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A systematic revision of Atlantic tonguefishes (Symphurus: cynoglossidae: pleuronectiformes) with a preliminary hypothesis of species group relationships

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The College of William and Mary, 1987

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A SYSTEMATIC REVISION OF ATLANTIC TONGUEFISHES (SYMPHURUS: CYNOGLOSSIDAE: PLEURONECTIFORMES) WITH A PRELIMINARY HYPOTHESIS OF SPECIES GROUP RELATIONSHIPS

A Dissertation

Presented To

The Faculty of the School of Marine Science

The College of William and Mary in Virginia

In Partial Fulfillment

Of the Requirements for the Degree of

Doctor of Philosophy

by

Thomas A. Munroe

1987

APPROVAL SHEET

This dissertation is submitted in partial fulfillment of

the requirements for the degree of

Doctor of Philosophy

Thomas Allan Munroe

Thomas Allan Munroe

Approved, December 1986

John A. Musick, Co-Chairman

John V. Merriner, Co-Chairman

Bruce B. Collette

Michael P. Weinstein

John D. Boon III

DEDICATION

This study is dedicated to Donna and David Munroe. Their encouragement and support during the course of this work helped me to maintain my sanity. Of all their contributions, the most important was that they sacrificed their time for me, and time can never be repaid.

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Their is no particular attempt to evaluate the contributions of various people because each contribution was important in its own way. For the most part, I have listed people and their contributions in a somewhat chronological order, at least as much as I can remember them. If I have overlooked the help of anyone, I regret the oversight.

In a perverse sort of way, I guess I owe the person who sabotaged my first dissertation project (clearly the work of the insidious Ratnose) my deepest appreciation. It was through this handiwork that I shifted interests from field ecology to systematics. C'est la vie.

I would like to thank the members of my committee, especially Drs. John Merriner, John Musick, Bruce Collette and Michael Weinstein for providing innumerable services as committee members. John Merriner, as committee chairman, was particularly understanding in my early, somewhat tumultuous, graduate student career. Through his patience, understanding and

consideration, he provided the most important contribution to this study in that he provided a setting in which I was allowed to develop and mature at my own rate. This policy was continued when Jack Musick became co-chairman of the committee. Jack Musick provided encouragement, financial assistance and criticism which greatly improved the study. His editorial comments were particularly helpful in improving the thesis. Since he was the ichthyologist near at hand, he quite often had to listen (at least I thought he was listening) to my seemingly daily anxiety attacks or setbacks and though he probably had good reason to, he was kind enough not to question my sanity, at least not in my presence. Bruce Collette offered much assistance regarding the methodology practiced by systematic ichthyologists His task was perhaps the most difficult and required considerable patience. I would like to thank Bruce for his encouragement, critical readings of the thesis and constructive criticism in improving the manuscript. Mike Weinstein was particularly helpful early on in this study in his encouragement and his discussions on developing an intellectual approach to scientific methodology. Mike always had time for his students and I was no exception. He seemed always to have time to answer questions or to discuss various research topics. Dr. John Boon, in his role as an outside committee member, was ideal in providing a proper balance of academia and pragmatism.

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ABSTRACT

Four of 29 previously described nominal species of *Symphurus* are junior synonyms; one sub-species (*S. p. plagusia*) is accorded full species status (*S. tessellatus*); two undescribed dwarf species are present in the eastern Atlantic; three new species were found among western Atlantic material; and several Atlantic forms are represented in the eastern Pacific by cognate species. Detailed and expanded descriptions, differential diagnoses, artificial keys and updated ecological information are provided for 29 species occurring in the Atlantic Ocean.

Preliminary evidence based upon osteological characters, including interdigitation patterns (ID) of dorsal pterygiophores with neural spines, urohyal shape, caudal skeleton, dentition and other morphological characters, indicates the existence of eight supra-specific lineages among the 66 nominal species of *Symphurus*. Species groupings are also supported by zoogeographical and ecological distributional patterns. Seven species groups are represented among the Atlantic *Symphurus*.

The most generalized species group is nearly worldwide in distribution (absent from the eastern Pacific), and is especially diverse in the Indo-Pacific region (22 nominal species). Most members occur in deep (>200 m) continental shelf and slope habitats. The group is characterized by high caudal ray counts (usually 14), 1-2-2 ID pattern, high meristic features, and usually, small to medium-sized, elongate bodies. Two species

representative of this group occur in the Atlantic Ocean (one each in eastern and western parts). A second species group is predominant in the Atlantic Ocean (only two species occur extra-limitally in the eastern Pacific). Seven species occur in the western Atlantic while another four are found in the eastern Atlantic. Members of this group inhabitat moderately deep continental shelf habitats (50-200 m). These species possess a 1-3-2 ID pattern, 12 caudal rays and full dentition on both jaws. A third species group is comprised of four species characterized by a 1-3-3 ID pattern and 10 or 12 caudal rays. Members of this group occur in shallow to moderate depths on the open shelf of the eastern Atlantic (one species), western South Atlantic (one species) and eastern Pacific (two species). A fourth species group, those possessing a 1-4-2 ID pattern, is comprised of four species that occur only in the western Atlantic (three north and one south of the equator). Three of the four species are found at moderate depths (20-80 m) on the open continental shelf while the fourth member inhabits shallow, sandy areas in seagrass beds in the Caribbean. A fifth species group is unique to the New World; seven species occur in the western Atlantic; eight in the eastern Pacific. Members of this group occupy shallow-water substrates from the shorezone to about 80 m. These species are characterized by 1-4-3 and 1-5-3 ID patterns, reduction or loss of dentition on eyed-side jaws and are the largest-sized species in the genus.

PROLOGUE

"When a young naturalist commences the study of a group of organisms quite unknown to him, he is at first much perplexed in determining what differences to consider as specific, and what as varietal; for he knows nothing of the amount and kind of variation to which the group is subject; and this shows, at least, how very generally there is some variation. But if he confine his attention to one class within one country, he will soon make up his mind how to rank most of the doubtful forms. His general tendency will be to make many species, for he will become impressed, just like the pigeon or poultry fancier before alluded to, with the amount of difference in the forms which he is continually studying; and he has little general knowledge of analogical variation in other groups and in other countries, by which to correct his first impressions. As he extends the range of his observations, he will meet with more cases of difficulty; for he will encounter a greater number of closely-allied forms. But if his observations be widely extended, he will in the end generally be able to make up his own mind; but he will succeed in this at the expense of admitting much variation,--and the truth of this admission will often be disputed by other naturalists. When he comes to study allied forms brought from other countries not now continuous, in which case he cannot hope to find intermediate links, he will be compelled to trust almost entirely to analogy, and his difficulties will rise to a climax."
From: "The Origin of Species" by Charles Darwin.

Well, the young naturalist is now much older and "the climax" is evident in the following pages.

A Systematic Revision of Atlantic Tonguefishes (*Symphurus*: Cynoglossidae: Pleuronectiformes) With A Preliminary Hypothesis of Species Group Relationships

CHAPTER 1

Introduction

Fishes of the Order Pleuronectiformes (flatfishes) are unique among living fishes. They are highly modified for living on or near the substrate and begin life bilaterally symmetrical, as other fishes, but undergo an unparalleled ontogenetic transformation resulting in both eyes occurring on the same side of the head. Eye migration is indeterminate in some taxa with almost equal numbers of right-sided (dextral) and left-sided (sinistral) individuals, whereas other groups have determinate eye migration with either the right or left eye migrating to the other side of the head. Associated with eye migration is a loss of bilateral symmetry and the fish lies on either the left side (dextral flatfishes) or the right side (sinistral flatfishes). This results in flatfishes having an eyed (ocular) and blind side. Other anatomical specializations occurring in various flatfishes include modifications of the cranium associated with eye migration, elongation of the dorsal fin forward onto the head (in all members except species of the family Psettodidae), the union of long dorsal and anal fins to the caudal fin, and asymmetries and reductions in the paired fins.

Among the seven families of pleuronectiform fishes (Hensley and Ahlstrom 1984) are the sinistral Cynoglossidae (tonguefishes), a curious group of flatfishes characterized by their small mouths, strongly curved and toothed jaws on the blind side, union of the caudal, dorsal and anal fins, absence of pectoral fins, and the loss of the right-side pelvic fin. The left pelvic fin is greatly shortened, being comprised of only four rays and is situated along the mid-line of the body and connected to the anal fin by a short, delicate membrane. Tonguefishes are small to medium-sized flatfishes generally of little or no commercial importance. Tonguefishes are the most divergent of flatfishes from the generalized fish form and the species share a rather conservative body plan featuring many structural reductions and losses. As presently conceived (Menon 1977), the Cynoglossidae consists of two subfamilies, the Cynoglossinae including the genera Cynoglossus (ca. 50 species) and Paraplagusia (4 species), and the Symphurinae with a single genus Symphurus (ca. 62 species).

Tonguefishes are present in all temperate and tropical oceans, but the three genera have different patterns of geographic distribution. Distributions for the three cynoglossid genera appear in Figure 1. Cynoglossus is the most widespread of the cynoglossine tonguefishes. Species of this genus occur throughout shallow coastal and estuarine waters of the Indo-West Pacific (see Menon 1977 for range maps of individual species). In the Atlantic Ocean, representative species of Cynoglossus occur only along the tropical coast of West Africa and at Saint Helena Island. One additional species has recently made its way into the eastern Mediterranean Sea via the Suez Canal (Menon 1977). Species of Paraplagusia are entirely Indo-West Pacific and much more restricted in distribution than Cynoglossus (Menon 1979). These species range principally from the coasts of China, Japan and Australia to the Malay Peninsula area. The westernmost extension of this genus is the coastal waters of Pakistan. Neither Cynoglossus nor Paraplagusia occur in the New World.

Symphurine tonguefishes are the most widely distributed tonguefishes. Species of Symphurus occur in all temperate and tropical oceans (Fig. 1). However, the greatest diversity of species occurs in bathyal depths of the Indo-West Pacific (approximately 26 nominal species) and in nearshore waters of the New World (approximately 30 nominal species have been recorded from both sides of the Americas). In the western Atlantic Ocean, tonguefishes have been collected as far north as Nova Scotia (45°N) and as far south as Argentina (35°S). In the Eastern Atlantic, Symphurus have been recorded from the Bay of Biscay (43°N) and Mediterranean Sea to Angola (15°S). In the Eastern Pacific, symphurine tonguefishes range from Oregon (44°N) to Peru (ca. 20°S).

Symphurine tonguefishes inhabit diverse bathymetric environments, ranging from shallow, estuarine waters to bathyal depths of the outer continental shelf and upper continental slope regions. They are among the deepest-dwelling flatfishes and have been recorded as deep as 1470 meters (McCulloch 1907).

The symphurine tonguefishes comprise a rather diverse assemblage of small to medium-sized flatfishes. Several Symphurus species are among the smallest of flatfishes, attaining adult lengths of only 35-60 mm SL. The majority of species reach maximum lengths between 80-180 mm SL, but the largest, S. jenynsi (from South America) may exceed 300 mm SL.

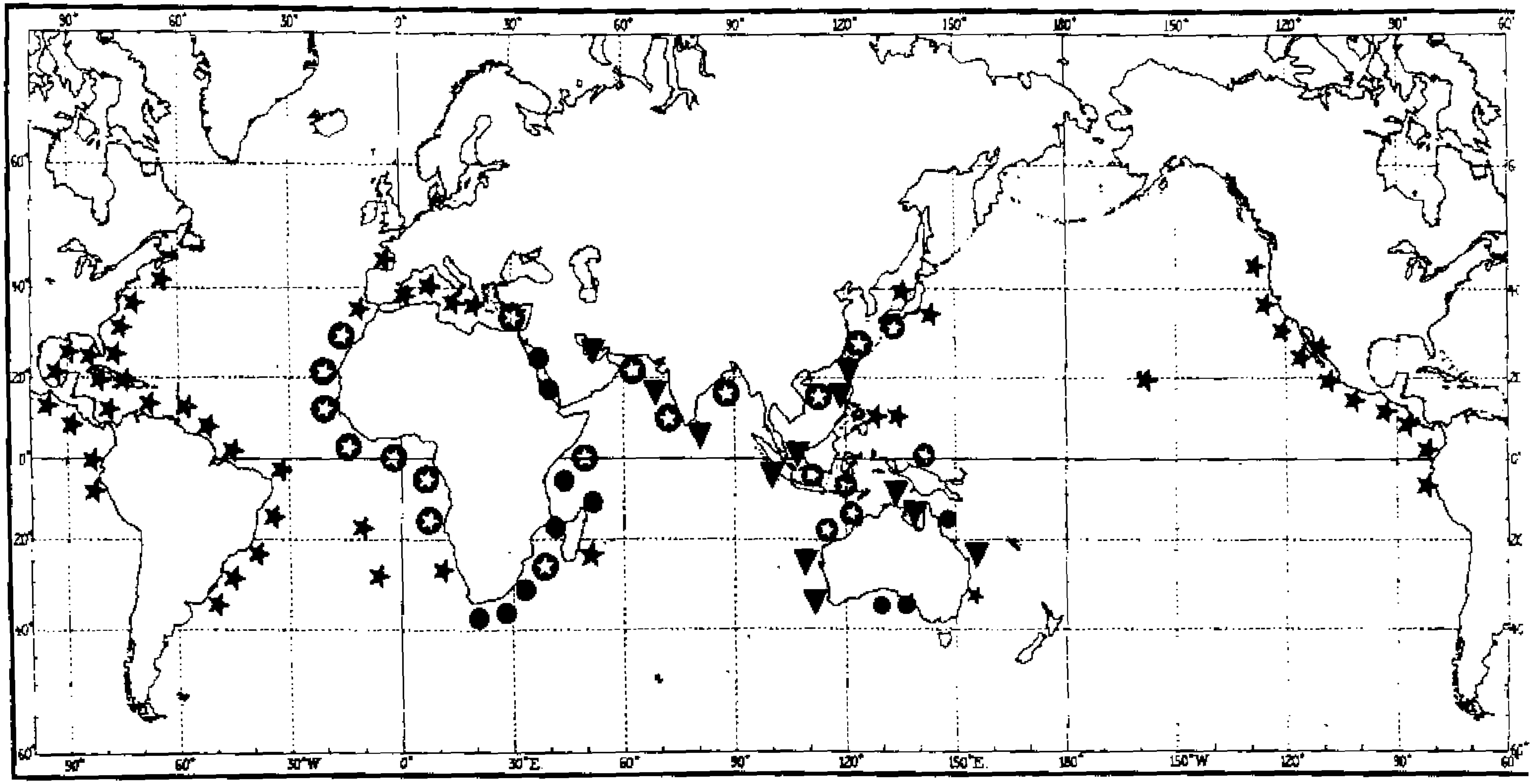
Figure 1. Geographic distribution of three genera of cynoglossid flatfishes.

Circles- Cynoglosssus

Stars- Symphurus

Encircled Stars- Overlapping Distributions of Cynoglossus and Symphurus

Triangles- Paraplagusia



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Objectives of this study were to revise the Atlantic tonguefish species by providing complete descriptions for the twenty nine nominal forms considered valid. Secondly, the genus was divided into species groups, based on a combination of morphological and osteological characters and patterns of zoogeographical and ecological distributions. Thirdly, ecological information with the collections was summarized and analyzed to compare life-history traits for the individual species. These ecological analyses, combined with hypotheses of species group relationships, allowed for an in-depth examination of patterns of geographical and ecological distributions between members of the various species groups and allowed for direct comparisons among closely related species. Analyses of this type were particularly instructive in the case of closely related species, which despite sharing a high degree of phenotypic similarity, were usually found to segregate along one or more resource dimensions.

CHAPTER 2

Historical Review

In the Atlantic Ocean, 33 nominal species of tonguefishes have previously been described (Table 1). Of these, 24 are presently considered valid, 9 represent synonymns. Another five species are described in the present work bringing to 29 the number of valid species inhabiting the Atlantic Ocean.

The earliest years of taxonomy involving tonguefishes was marked by the creation of a considerable number of synonyms. During this time, ichthyologists had little or no information concerning the usefulness or the variability of characters chosen in their descriptions of new species. Additionally, most of the earliest descriptions were based entirely upon single specimens, specimen skins (Linnaeus 1766) or even unpublished illustrations (DeKay 1842). Even the best species descriptions during this time period utilized only a small number of specimens. Comparisons with described species were seldom made further complicating the early nomenclature applied to these species.

The earliest description of a tonguefish is that of Linnaeus (1766), who provided a brief description of *Pleuronectes plagiusa* (=*S. plagiusa*), sent to him from South Carolina by Garden. In 1801, a second Atlantic species of tonguefish (*Pleuronectes plagusia*) was described from Jamaica by

Schneider, in Bloch and Schneider (from Browne 1756; 1789; non-binomial). This was followed by a brief, vague description of a tonguefish by Lacepede (1803). This specimen was donated to France by Holland and is thought to have come from the New World. The description is so brief and vague and together with the unknown collection site, considerable doubt remains regarding the identity of the Lacepede specimen.

In 1810, Rafinesque first applied the name Symphurus in his description of the Mediterranean species, S. nigrescens. His brief description, however, was extremely vague and of little value. Consequently, this description of the genus and species (S. nigrescens) was generally overlooked by both his contemporaries and subsequent workers. This also contributed to the nomenclatural confusion and proliferation of synonyms for poorly described taxa during the early 1800's.

From Rafinesque's description of S. nigrescens in 1810 until the beginning of deep-sea collecting in the 1880's and early 1900's, the literature on Atlantic species of Symphurus consisted primarily of nomenclatural rearrangements of taxa already described and very little was provided in the way of new information.

Other confounding factors in the nomenclatural history of this taxon were the descriptions of several new genera and species during this period based on symmetrical larval stages (Cocco 1844; Emery 1878; Raffaele 1888). Since nothing was known concerning larval stages and metamorphosis of pleuronectiforms in general, and tonguefishes in particular, these symmetrical larvae were not recognized as flatfish larvae either by the original describers or subsequent workers until the late 1800's. This lack of knowledge facilitated the proliferation of generic and specific names applied to Atlantic tonguefishes.

In the 1880's, the majority of tonguefish species inhabiting deep-sea areas of the Atlantic Ocean were described. At this time, deep-sea exploration began in earnest and collecting efforts of major expeditions provided many new taxa including several new tonguefishes. Five new species were added to the known list of Atlantic tonguefishes during this period. Goode and Bean's studies resulted in descriptions of: Aphoristia nebulosa (1883); A. diomedeana, A. pusilla (1885); and A. marginata and A. pigra (1886).

In 1889, Jordan and Goss revised the flounders and soles of Europe and the Americas. In this work, they evaluated the validity of the described species of tonguefishes. They proposed that Aphoristia nebulosa (=S. nebulosus) differed significantly enough from other tonguefishes to be placed into the separate genus or subgenus Acedia. It is evident from this study and that of Jordan and Evermann (1898) that these authors apparently had few useful characters upon which to distinguish the various species and had little appreciation for the meristic variation within this taxon. They considered that at least four (two western Atlantic, two eastern Pacific) of the then described species of tonguefishes probably represented only geographic variations of a single species.

Table 1. Chronology of specific, subspecific names and new combinations assigned to Atlantic species of *Symphurus*. Original authorship, generic placement and spelling are maintained in the table.

Author	Taxon	Present Status
1756 Browne	*Plagusia*	non-binomial
1766 Linneaeus	*Pleuronectes plagiusa*	*S. plagiusa*
1789 Browne	*Pleuronectes plagusia*	(rejected)
1801 Schneider, in Bloch & Schneider	*Pleuronectes plagusia* (after Browne)	*S. plagusia*
1803 Lacepede	*Achirus ornatus*	*nomen dubium*
1810 Rafinesque	*Symphurus nigrescens*	*S. nigrescens*
1817 Cuvier	*Plagusia ornata*	?*S. tessellatus*
1824 Quoy and Gaimard	*Plagusia tessellata*	*S. tessellatus*
1829 Agassiz	*Plagusia brasiliensis*	*S. tessellatus*
1832 Bonaparte	*Plagusia lactea*	*S. nigrescens*
1842 DeKay	*Plagusia fasciata*	*S. plagiusa*
1844 Cocco	*Bibronia ligulata*	*S. ligulatus*
1858 Kaup	*Aphoristia ornata*	?*S. tessellatus*
1861 Gill	*Glossichthys plagiusa*	*S. plagiusa*
1862 Costa	*Plagusia picta*	*S. nigrescens*
1862 Günther	*Ammopleurops lacteus*	*S. nigrescens*
1864 Gill	*Plagusia plagiusa*	*S. plagiusa*
1883 Goode and Bean	*Aphoristia nebulosa*	*S. nebulosus*
1885 Goode and Bean	*Aphoristia diomedeana*	*S. diomedeanus*

Table 1. (Continued).

1885 Goode and Bean	*Aphoristia pusilla*	*S. pusillus*
1886 Goode and Bean	*Aphoristia marginata*	*S. marginatus*
1886 Goode and Bean	*Aphoristia pigra*	*S. piger*
1886 Jordan and Goss	*Acedia nebulosa*	*S. nebulosus*
1895 Goode and Bean	*Aphoristia fasciata* (not DeKay)	*S. tessellatus*
1907 Evermann and Kendall	*Symphurus jenynsi*	*S. jenynsi*
1916 Thompson	*Symphurus bergi*	*S. jenynsi*
1948 Chabanaud	*Symphurus trewavasae*	*S. trewavasae*
1948 Chabanaud	*Symphurus sumptuosus*	*S. diomedeanus*
1950 Chabanaud	*Symphurus normani*	*S. normani*
1951 Ginsburg	*Symphurus minor*	*S. minor*
1951 Ginsburg	*Symphurus parvus*	*S. parvus*
1951 Ginsburg	*Symphurus pelicanus*	*S. pelicanus*
1951 Ginsburg	*Symphurus pterospilotus*	*S. diomedeanus*
1951 Ginsburg	*Symphurus civitatum*	*S. civitatium*
1951 Ginsburg	*Symphurus urospilus*	*S. urospilus*
1952 Chabanaud	*Symphurus vanmelleae*	*S. vanmelleae*
1961 Böhlke	*Symphurus ommaspilus*	*S. ommaspilus*
1961 Böhlke	*Symphurus rhytisma*	*S. rhytisma*
1965 Robins and Randall	*Symphurus arawak*	*S. arawak*
1976 Menezes and Benvegnu	*Symphurus kyaropterygium*	*S. kyaropterygium*
1976 Menezes and Benvegnu	*Symphurus ginsburgi*	*S. ginsburgi*
1977 Lema and Oliveira	*Symphurus meridionalis*	*S. jenynsi*

From 1900 until 1951, six nominal species were added to the Atlantic fauna. The principal contributor was Chabanaud, who in 1948 described S. trewavasae and S. sumptuosus (=S. diomedeanus) from the coasts of Brazil and Uruguay, respectively. Later, he described S. normani (1950) and S. vanmelleae (1952) from the tropical West African coast. During the course of his studies on Symphurus and other cynoglossids (1927; 1940a; 1947a; 1947b; 1947c; 1947d; 1949a; 1949b), Chabanaud attempted to stabilize nomenclature, delimit important characters for identifying tonguefish species and attempted to derive a standard system for measuring and comparing character states among the different species of tonguefishes.

The first comprehensive revison of western Atlantic tonguefishes was made by Ginsburg (1951) who described six new species and updated information on distributions and characters for identification of another nine species. Ginsburg's revision provided a diagnosis for the genus Symphurus and recognized important characters currently in use for diagnosing individual species of Symphurus. Despite these contributions, Ginsburg's study was limited in detail by insufficient material, particularly for deep-sea species.

The only major revision of western South Atlantic tonguefishes is that of Menezes and Benvegnu (1976). Menezes and Benvegnu revised the species of tonguefishes occurring primarily along the southern coast of Brazil but also included comparative material from other areas when possible. In this work they described two new species (S. kyaropterygium and S. ginsburgi) collected from moderate shelf depths. Their work complimented and expanded upon Ginsburg's earlier study. Menezes and Benvegnu, although successful in several areas, were also hindered by insufficient study material and were unable to provide conclusions regarding the taxonomic validity of several species. Another nominal species, S. meridionalis (=S. jenynsi), was added to the list of western South Atlantic species by Lema and Oliveira (1977).

Even less is known about the ecology of most Atlantic tonguefishes. In the Mediterranean Sea, tonguefishes occur only in relatively deep-water habitats. The earliest literature reported only isolated captures of tonguefishes and little ecological information beyond depth of capture was included in these earliest accounts. The first attempts to summarize ecological information on Mediterranean tonguefishes were those of Kyle (1913) on reproductive seasonality and the studies of Scordia (1925; 1927; 1929). Scordia summarized available information on the bathymetric and ecological distribution of S. nigrescens in the Mediterranean Sea.

In recent years, the increased emphasis in bathyal biology is reflected in the larger number of publications reporting on the general ecology of the two Mediterranean tonguefishes, S. nigrescens and S. ligulatus, (Tortonese and Queirolo 1971; Cau and Deiana 1979; Cau et al. 1980; Papaconstantinou and Tortonese 1980; Allue 1982; Allue 1985; MacPherson 1978; 1981; Matallanas 1984). These studies have examined geographical and bathymetric distributions, food habits and reproductive biology of the Mediterranean tonguefishes and provide a considerable ecological data base for these species.

The increase of deep-sea studies in the eastern Atlantic Ocean has also contributed significantly to our understanding of ecological relationships of tonguefishes in this area. An increasing number of studies have reported on various aspects of tonguefish biology (Blache 1962; Maurin 1962; 1968; Nielsen 1963; Aldebert 1970; Maul 1976; and Merrett and Marshall 1981).

In the western Atlantic, there are many more tonguefish species and the numbers of species inhabiting shallow-water and deep-water environments are similar. Despite the fact that there are many shallow-water species, little ecological information has been published for most of the species. Ginsburg (1951) first noted that western Atlantic tonguefishes had species-specific depth ranges. This finding was expanded upon by Topp and Hoff's study (1972) and Menezes and Benvegnu (1976). Topp and Hoff's study summarized ecological and geographical distributions for six shallow-water species occurring in the eastern Gulf of Mexico along the Florida shelf. Their study included information on geographical distribution, food and habit data, reproduction, relative sizes at maturity, relative abundance and commercial importance. Topp and Hoff also provided an interesting discussion of sediment relationships for individual species and noted strong interrelationships between substrate requirements and patterns of geographical and bathymetric distributions for particular species.

Very little ecological information, other than depth and location of capture, has been published on deep-water Symphurus from the western Atlantic. Only in the last three decades, with the increase in collecting efforts in the deep-sea, has sufficient material been collected to permit any detailed ecological analyses. Most of this material was collected but remained unidentified in museum holdings. Ecological analyses, where available, are provided in the individual species accounts listed below.

It is apparent from this historical summary that no comprehensive systematic or ecological account has been made either for Atlantic species or for the entire genus Symphurus. The reasons for this are: earlier studies were primarily regional in scope; earlier studies encountered difficulties in identifying suitable characters useful in distinguishing taxa; and lastly many deep-sea species were not previously collected in sufficient numbers or have only recently been collected in quantities to permit detailed descriptions and comparisons.

CHAPTER 3

Methods and Materials

Measurements and counts were modified from Ginsburg (1951), Mahadeva (1956) and Menezes and Benvegnu (1976). Measurements and counts are redefined below and examples outlining measurements are presented in Figures 2-3. All measurements were made on the ocular surface except where noted. Measurements over 150 mm were taken to the nearest millimeter with a steel ruler. Measurements less than 150 mm were made to the nearest 0.1 mm with dial calipers or ocular micrometer. Measurements are expressed as thousandths of standard length or head length, respectively. Abbreviations used in figures and text are listed in Table 2.

The present study placed a strong emphasis on meristics. Meristics, exclusive of scale counts, were made from radiographs. Fish were radiographed on a Picker Soft X-Ray Machine.

Diagnoses for Atlantic species are based upon examination of radiographs of 2074 specimens. Total numbers of specimens examined for each of the 29 species recognized in this study are listed in Table 3. An additional 170 specimens, representing 35 additional species occurring outside of the Atlantic Ocean, were radiographed for inclusion in the study of interdigitation patterns and species groups. These specimens are listed in Appendix A.

Table 2. List of abbreviations used in this study.

ABBREVIATION	DEFINITION
ABL	anal base length
BD	body depth
CD	chin depth
CFL	caudal fin length
DBL	dorsal base length
ED	eye diameter
HL	head length
HW	head width
ID	interdigitation pattern
LHL	lower head lobe width
m or M	meters
OPUL	upper opercular lobe width
OPLL	lower opercular lobe width
PA	pelvic to anal fin distance
PAL	preanal length
PDL	predorsal length
PFL	pelvic fin length
POL	postorbital length
SL	standard length
SNL	snout length
UHL	upper head lobe width
UJL	upper jaw length

Table 3. Number of specimens included in systematic revision of 29 Atlantic species of *Symphurus*.

Species	Number Examined	Species	Number Examined
arawak	42	*pelicanus*	19
civitatium	347	*plagusia*	33
diomedeanus	303	*piger*	174
ginsburgi	34	*pusillus*	20
jenynsi	96	*rhytisma*	7
ligulatus	38	*tessellatus*	432
marginatus	102	*trewavasae*	58
minor	79	*urospilus*	122
nebulosus	24	*vanmelleae*	47
nigrescens	158	undescribed A	2
normani	24	undescribed B	5
ommaspilus	28	undescribed C	84
parvus	74	undescribed D	67
kyaropterygium	14	undescribed E	94
plagiusa	379		

Synonymies in the taxonomic section are in short form (author, date, page number). Complete references are provided in the literature cited section. Additional references in synonymies are presented in chronological order.

Anatomical illustrations were prepared from dissected, cleared and stained material, or from radiographs. Specimens were drawn with the aid of a camera lucida. Clearing and staining protocol followed the method outlined in Dingerkus and Uhler (1977).

Study specimens were obtained mainly from museum collections. Institutional abbreviations occur in Table 4. Complete information for museums may be obtained in Leviton et al. (1985). Material for Atlantic Ocean species included in both the species group section and in the revisions of the individual species is listed under the material examined section for each individual species account. Frequency distributions, including counts for holotypes (whenever possible), appear in Tables 10-16 and are discussed in descriptive accounts for the individual species.

Statistical analyses were performed on the VIMS PRIMOS computer system using the SPSS and SPSSX statistical packages. All analyses of morphological data were conducted on log transformed data.

Ecological data accompanying the specimens were tabulated and analyzed. Depth of capture information (whether in feet or fathoms) were converted to the nearest meter. If the capture depth for specimens was reported as a range of depths, then a mean depth was calculated and used in analyses of ecological distributions.

MERISTIC CHARACTERS

1). INTERDIGITATION (ID) PATTERN. Patterns of interdigitation of proximal dorsal pterygiophores and neural spines were counted and recorded for the first five interneural spaces. The number of dorsal pterygiophores inserted into interneural spaces 1-3 was diagnostic for a species group or in one case, for a particular species (see species group section below). Interdigitation patterns are indicated by a pterygiophore formula such as 1-2-2; 1-3-2; 1-4-3, etc. (see Tables 5-9). Of 27 Atlantic species, only Symphurus vanmelleae had a unique ID pattern diagnostic for the species (when extended to include pterygiophores inserted into interneural spaces 4-5). This represents the first time that interdigitation patterns have been used in interpreting species relationships in the genus Symphurus and also represents the first time they have been used in identifying or diagnosing individual species of tonguefishes.

FIN RAYS

Fin rays represented only by the basal ossicle of the ray were counted as one ray and included in the total count. Fin rays separate at the bases but fused along their lengths were counted as two separate rays. Specimens missing fin rays as a result of obvious injuries or trawl damage were omitted from analyses.

2). CAUDAL FIN RAYS. Caudal fin ray count is extremely conservative for this genus (Table 10). Fidelity for a particular count is high, usually ranging from 90-98% for an individual species. Irregularities are not uncommon in the development of the caudal rays, so that particular care must be taken to accurately determine the total number of caudal rays. Ginsburg (1951) and Mahadeva (1956) noted the two common types of irregularities encountered: A) an incomplete ray in the form of an articulated cup (only the basal ossicle developed). In the absence of a radiograph, this condition is evident when the space between two rays is much greater than the spaces between any other caudal rays. B) Two adjacent rays merging and becoming one ray distally, though they are proximally free for a variable distance from their bases. Caudal fin rays are most easily counted from the blind side with transmitted light or from radiographs.

3). DORSAL FIN RAYS. All rays are simple, unbranched (Table 11). Care should be used to avoid missing the first few rays of the dorsal fin. These rays are very slender and considerably shorter than the rest.

4). ANAL FIN RAYS. All rays are simple, unbranched (Table 12). Includes all fin rays and is exclusive of the thick, muscular gonadal duct.

5). PELVIC FIN RAYS. All rays are simple, unbranched. The number of pelvic fin rays is invariably four and is among the most conservative characters for the genus.

VERTEBRAL COUNTS. Included are counts for abdominal, caudal and total vertebrae. The terminal centrum bearing the urostyle was counted as one vertebra. Vertebrae, especially the PU 1 and PU 2 vertebrae, often possessed more than one haemal or neural spine (two spines present in approximately 35% of the specimens examined). Whenever a centrum had an extra spine it was counted as two vertebrae. Specimens with obviously damaged vertebral skeletons, underlying support bones, or caudal fins were excluded from summaries and analyses.

6). ABDOMINAL VERTEBRAE. With the exception of S. vanmelleae all other Atlantic Symphurus have nine abdominal vertebrae (three without haemal arches, six with zygapophyses of variable lengths). Symphurus vanmelleae possesses either 10 or 11 abdominal vertebrae (three without haemal arches, seven or eight with elongate zygapophyses). With the singular exception of S. vanmelleae, differences in vertebral counts among Atlantic species result from interspecific variations in numbers of caudal vertebrae.

7). CAUDAL VERTEBRAE. Caudal vertebrae count begins with the first vertebra with a definite haemal spine and includes the vertebra possessing the urostyle.

8). TOTAL VERTEBRAE COUNT. Includes the sum of abdominal and caudal vertebrae counts. This count represents data presented in Table 13.

9). HYPURAL NUMBER. This count includes the total number of hypurals in the caudal skeleton. This count was invariable for most species, but for some there was intraspecific variation in this character. Most species have either four or five hypurals, however, three species have counts of either four or five hypurals.

SCALE COUNTS. Accurate, repeatable scale counts are difficult to make in such fishes as Symphurus, with their numerous thin and deciduous scales. Only for those specimens trawled or collected with SCUBA from shallow depths were somewhat reliable scale counts available. For all species, an approximate count was made based on either partial scale counts, from scale pockets, or a combination of the two. In some deeper-living species, scale counts were virtually impossible to make because of the extensive abrasion to the specimens incurred in the trawling process. For these, approximate scale counts are reported (see Tables 14-16) but were not relied on for diagnostic accounts.

10). LONGITUDINAL SCALE COUNT. This count includes the total number of complete diagonal rows of scales along the body, beginning above a hypothetical longitudinal line starting just above the opercular angle to the end of the hypural. The few rows of scales along the caudal fin base are not included in this count. The last scale included in this count must be at least half in front of the posterior margin of the hypural plate.

11). HEAD SCALES. The oblique, complete rows of scales on the ocular side of the head between the posterior margin of the lower eye and the point of emargination of the operculum into dorsal and ventral lobes. From the dorsal edge, the rows run downward and backward. Count does not include the small number of scales usually present on the distal dorsal and ventral lobes of the operculum beyond the point of the opercular emargination.

12). LATERAL SCALE ROWS. The count of scales in a transverse row starts from the base of the dorsal fin at a point directly above the dorsal edge of the posterior margin of the operculum and runs ventrally along a diagonal to the base of the anal fin. This count does not include scales along the dorsal and anal fins.

LIST OF MEASUREMENTS

1). STANDARD LENGTH. Distance from tip of fleshy snout to posterior end of hypural plate.

2). BODY DEPTH. Measured as greatest distance across body exclusive of fins. Made on blind side.

3). PREANAL LENGTH. Distance from tip of snout to origin of anal fin. Measured on blind side.

Figure 2. Graphic illustration of locations on the body for measurements outlined in text.

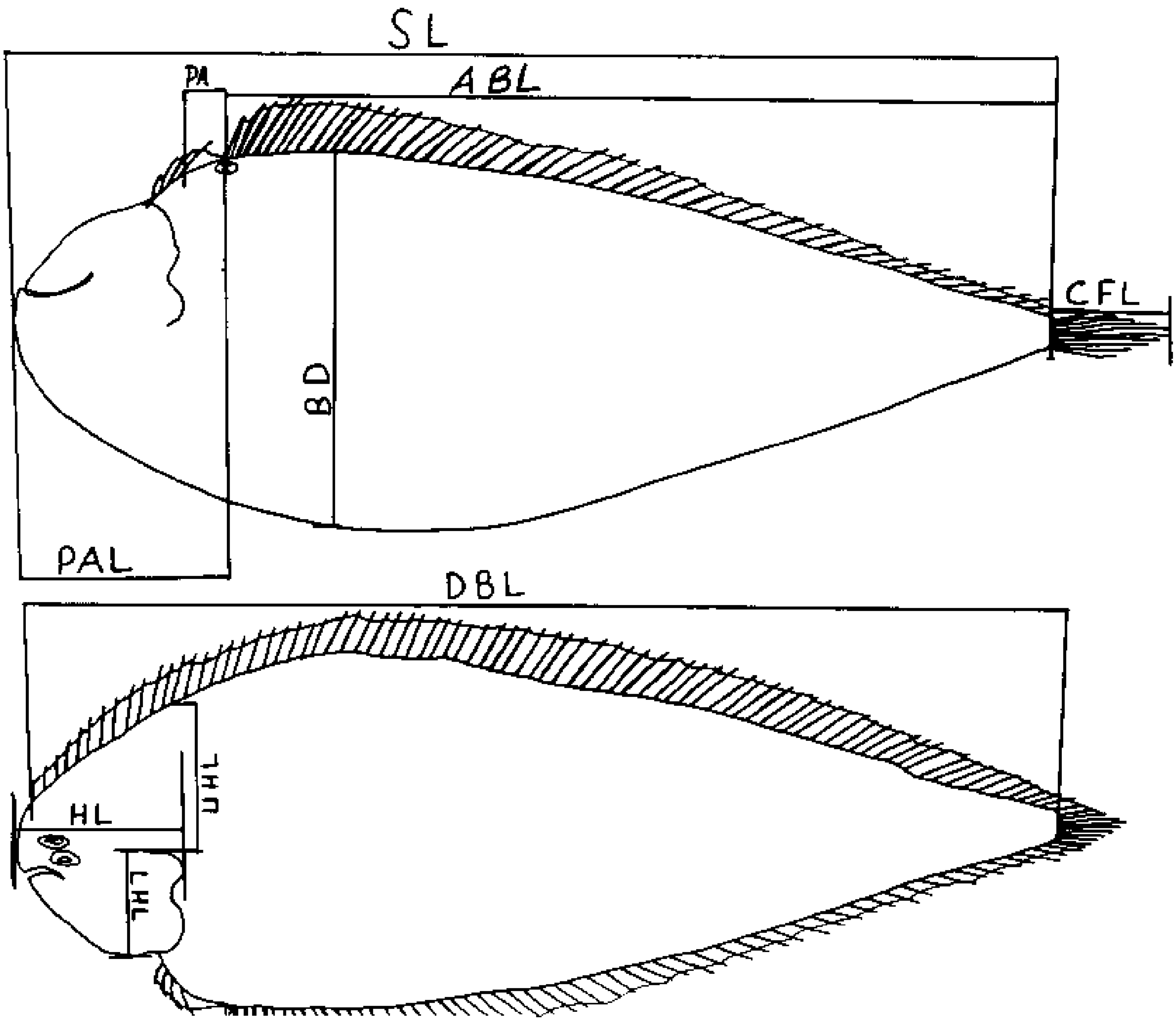
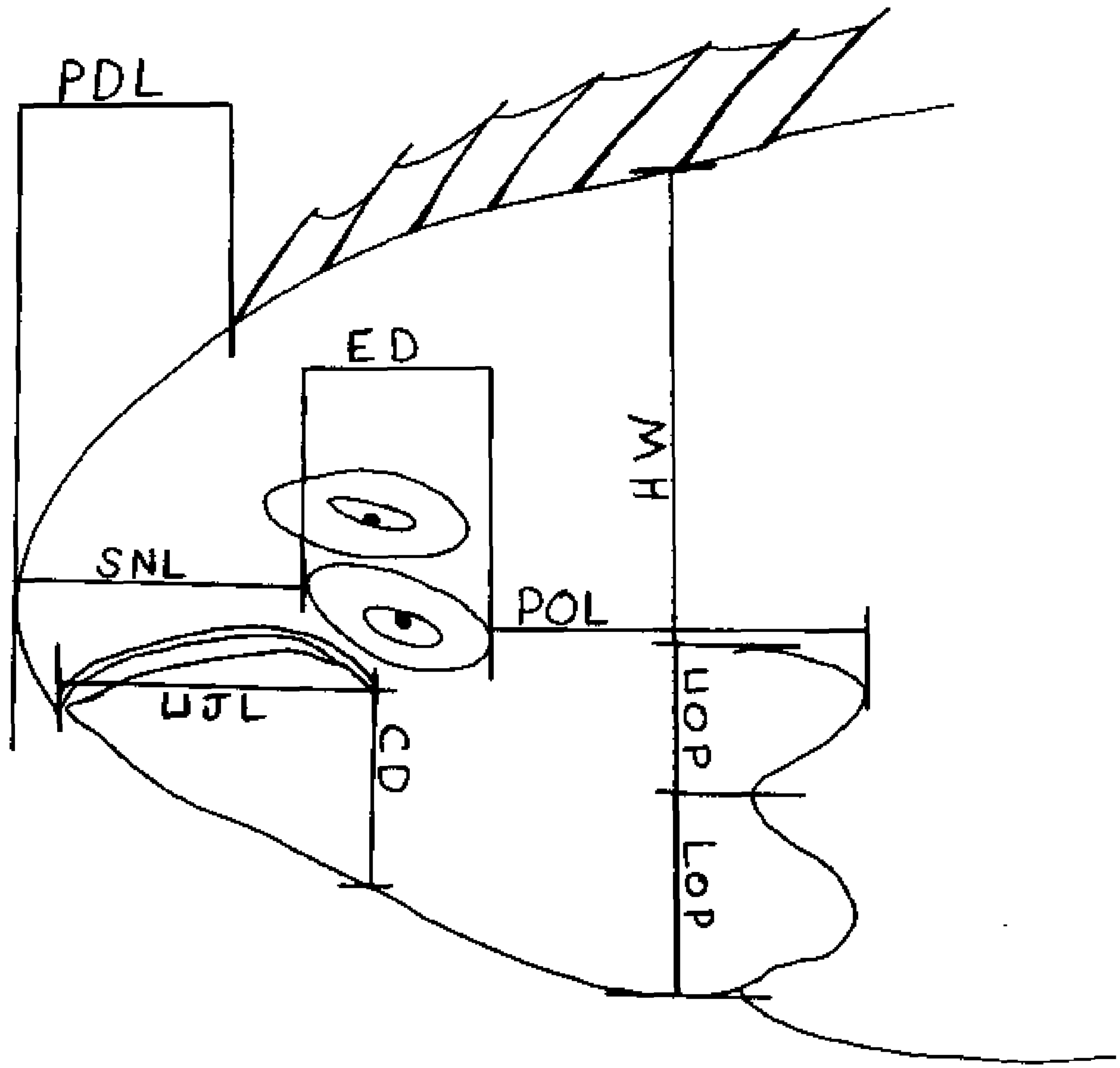

SL
PA
ABL
CFL
BD
PAL
DBL
HL
UHL
LHL

Figure 3. Graphic illustration of locations on the head for measurements outlined in text.


PDL
ED
SNL
POL
HW
UJL
CD
UOP
LOP

4). ANAL BASE LENGTH (ABL). Distance from origin of anal fin to posterior end of hypural plate. Measured on blind side.

5). DORSAL BASE LENGTH (DBL). Distance from origin of dorsal fin to posterior end of hypural plate.

6). PREDORSAL LENGTH (PDL). Distance from most anterior point of fleshy snout to origin of dorsal fin.

7). PELVIC FIN LENGTH (PL). Distance from base of fourth (posterior) pelvic ray (the longest) to distal tip of last fin ray.

8). CAUDAL FIN LENGTH (CFL). Distance from base of articular cups of middle caudal fin rays to tip of longest middle rays.

9). HEAD LENGTH (HL). Distance from most anterior point of fleshy snout to most posterior extension of upper fleshy lobe of operculum.

10). HEAD WIDTH (HW). Greatest distance across head at posterior portion of operculum.

11). POSTORBITAL HEAD LENGTH (POL). Distance from posterior margin of lower eye to posterior extent of upper fleshy lobe of operculum.

12). UPPER HEAD LOBE WIDTH (UHL). Distance at operculum from dorsal margin of body to dorsal origin of operculum.

13). LOWER HEAD LOBE WIDTH (LHL). Distance at operculum from dorsal origin of operculum to most ventral part of operculum.

14). UPPER OPERCULAR LOBE WIDTH (OPUL). Distance from dorsal origin of operculum to mid-point of emargination on posterior border of operculum.

15). LOWER OPERCULAR LOBE WIDTH (OPLL). Distance from mid-point of emargination of posterior border of operculum to the most ventral point of operculum.

17). SNOUT LENGTH (SNL). Distance from anterior rim of lower eye to tip of snout.

18). UPPER JAW LENGTH (UJL). Shortest distance from tip of premaxilla to angle of mouth.

19). EYE DIAMETER (ED). Greatest horizontal diameter of the cornea of lower eye. Does not include fleshy tissue surrounding eye.

20). CHIN DEPTH (CD). Vertical distance from angle of the mouth to most ventral point of chin.

21). PELVIC TO ANAL DISTANCE (PA). Shortest distance from base of most posterior pelvic ray to base of first anal ray.

QUALITATIVE CHARACTERS

The following characters are important in identifying Symphurus specimens when used in combination with other meristic and morphometric data.

1). BODY PIGMENTATION. Pigmentation is unique for some species. In others, pigmentation pattern is variable, but still of limited value in distinguishing the species. Frequently observed pigmentation patterns consist of uniform coloration or bold patterns of a variable number of crossbands. Some species have pigmented blind surfaces, but most usually have a uniformly cream-white or slightly yellowish blind side.

2). FIN PIGMENTATION. Pigment spots on the dorsal, anal and caudal fins are diagnostic for some species.

3). PERITONEUM COLOR. Diagnostic for placement within a species group, but not diagnostic for species identification when used alone.

4). OPERCULAR PIGMENTATION. Three areas were examined for pigmentation, the outer operculum, inner operculum and the isthmus. This character is useful in combination with other characters but is of generally little value when used alone.

5). PUPILLARY OPERCULUM. A pigmented, usually triangular or spherically-shaped structure on the top part of the cornea (see Fig. 3). The presumed function is to shade the retina from direct exposure to bright light. Ginsburg (1951) and Menezes and Benvegnu (1976) did not utilize this character in their studies on western Atlantic tonguefishes. Mahadeva (1956), however, found this character useful in diagnosing several Eastern Pacific species. Presence or absence of a pupillary operculum was also found to be important for differentiating several species of western Atlantic tonguefishes.

6). EYE POSITION. The relative position of the upper eye with respect to the lower eye is useful in identification but not diagnostic when used alone.

7). SNOUT SQUAMATION. The extent of squamation on the snout, although useful in identifying species-group placement, is not useful at the species level.

8). JAW POSITION. The relative position of the angle of the mouth with respect to the lower eye is useful in diagnosing some species.

9). DORSAL FIN ORIGIN. The relative position of the dorsal fin origin with respect to the upper eye is useful in identifying some species.

10). JAW PIGMENT. The degree of pigment development on the eyed-side lips is helpful in identifying some species.

11). SQUAMATION ON DORSAL AND ANAL FINS. The presence and number of scales on the dorsal and anal fins are useful characters for identifying some species.

12). DENTITION ON EYED SIDE JAWS. The extent of dentition developed on the eyed-side jaws is useful in identifying some species.

Table 4. Acronyms for museum material examined in the present study. Complete address and other pertinent information may be found in Leviton et al. (1985).

Code	Institution
ALA	University of Alabama, University.
AMNH	American Museum of Natural History, New York.
AMS	Australian Museum, Sydney.
ANSP	Academy of Natural Sciences, Philadelphia.
ARC	Atlantic Reference Centre, St. Andrews.
AUM	Auburn University Museum, Auburn.
BMNH	British Museum (Natural History), London.
BPBM	Bernice P. Bishop Museum, Honolulu.
CAS	California Academy of Sciences, San Francisco.
CAS-SU	California Academy of Sciences, San Francisco.
FDNR	Florida Department of Natural Resources, St. Petersburg.
FMNH	Field Museum of Natural History, Chicago.
FURG	Fundacao Universidade do Rio Grande, Rio Grande.
GCRL	Gulf Coast Research Laboratory, Ocean Springs.
GMBL	College of Charleston, Grice Marine Biological Laboratory, Charleston.
IMS	University of Texas at Austin, Austin.
IOAKE	Institute of Oceanographic & Fisheries Research, Athens.

Table 4. (Continued).

IOS	Institute of Oceanographic Sciences, Surrey.
IRSNB	Institut Royal des Sciences Naturales de Belgique, Brussels.
ISH	University of Hamburg, Institut fur Seefischerei, Hamburg.
LS	Linnean Society of London, London.
LSUMZ	Louisiana State University, Museum of Zoology, Baton Rouge.
MCN	Fundacao Zoobotanica do Rio Grande do Sul, Porto Alegre.
MCP	Pontificia Universidade Catolica do Rio Grande do Sul, Porto Alegre.
MCZ	Museum of Comparative Zoology, Cambridge.
MHNN	Musee d'Histoire Naturalle, Neuchatel.
MMF	Museu Municipal do Funchal, Funchal.
MNHN	Museum National d'Histoire Naturelle, Paris.
MZUSP	Universidae de Sao Paulo, Museu de Zoologia, Sao Paulo.
NMC	National Museums of Canada, Ottawa.
SHML	National Marine Fisheries Service, Sandy Hook Marine Laboratory, Highlands.
TCWC	Texas A&M University, College Station.
TU	Tulane University, New Orleans.
UF	University of Florida, Florida State Museum, Gainesville.
UF-FSU	University of Florida, Florida State Museum, Gainesville (Formerly Florida State University).

Table 4. (Continued).

UMML	University of Miami, Rosenstiel School of Marine and Atmospheric Sciences, Miami.
UMMZ	University of Michigan, Museum of Zoology, Ann Arbor.
UMO	University of Maine, Orono.
UNC	University of North Carolina, Morehead City.
UPRM	University of Puerto Rico at Mayaguez, Mayaguez.
USA	University of South Alabama, Mobile.
USNM	National Museum of Natural History, Smithsonian Institution, Washington.
UWF	University of West Florida, Pensacola.
VIMS	Virginia Institute of Marine Science, Gloucester Point.
YPM	Yale University, Peabody Museum, New Haven.
ZMA	Universiteit van Amsterdam, Zoologisch Museum, Amsterdam.
ZMUC	Kobenhavns Universitet, Zoologisk Museum, Copenhagen.

CHAPTER 4.0

Phylogenetic Position of the Cynoglossidae

As presently conceived, the sinistral Cynoglossidae and the dextral Soleidae (true soles) comprise the suborder Soleoidei of the Order Pleuronectiformes. The Soleoidei are distinguished by having a small mouth without a prominent lower jaw; blind side jaws strongly curved and toothed; eyed-side upper jaws with varying degrees of dentition; no preopercular margin; gill membranes fused with free branchiostegal rays; nasal organs symmetrical in position; postcleithrum absent and pleural ribs absent.

No generally accepted classification for the Soleoidei exists. Most previous studies have considered the Soleoidei as a distinct group within the pleuronectiforms, although there is little agreement regarding the interrelationships to other flatfishes (Regan 1910; Norman 1934; 1966; Hubbs 1945; Lauder and Leim 1983; Hensley and Ahlstrom 1984). Hensley and Ahlstrom (1984) indicated that there was strong evidence to support monophyly in the Cynoglossidae, but that relationships of this family are still obscure. Regarding the Soleidae, they stated that the subfamily Soleinae shares many characters with the Cynoglossidae, whereas the subfamily Achirinae is more primitive than originally thought. The character state proposed as uniting the Soleinae and Achirinae appears to be that all species are dextral. Hensley and Ahlstrom (1984) noted that the evolution of ocular asymmetry is not well understood, and making phylogenetic interpretations from states of ocular asymmetry without corroborative information from other characters may lead to circular reasoning and the establishment of polyphyletic groups. They noted that "In any cladistic analysis of pleuronectiform interrelationships, character states used to unite soleoids will need to be re-interpreted." Evidence used to support the grouping of the Soleidae and Cynoglossidae in the suborder Soleoidei are unconvincing, not sufficiently detailed or are untested by modern methods of phylogenetic reconstruction using outgroup comparisons (Hensley and Ahlstrom, 1984).

At present there is difficulty in diagnosing the Soleoidei based on synapomorphic characters. Hensley and Ahlstrom (1984) pointed out that some characters, such as dimorphic optic chiasmata and symmetrical nasal organs, used in previous studies as evidence that soleids and cynoglossids are most closely related, are actually plesiomorphic for the order and thus not useful in advancing that hypothesis. Some characters, such as the absence of all ribs in some groups (Nelson 1984; Lauder and Leim 1983), have been incorrectly interpreted. Although apparently absent in the Achirinae and Cynoglossidae, Chabanaud (1940b; 1941) and Hensley and Ahlstrom (1984) reported finding short epipleural ribs in some genera of the subfamily Soleinae.

Hensley and Ahlstrom (1984) suggested that possible synapomorphies for the suborder Soleoidei included the continuous skinfold covering from the chin across the dentary and interopercular bones and the absence of pleural ribs. These characters have not been examined in all species, however, and may prove to be inappropriate in defining the monophyly of the group. Other possible synapomorphies not discussed by these authors include the presence and degree of development of the epicranial bony system. Ochiai (1963) briefly discussed this character in his study of Japanese soleoids, but the importance of this character in a phylogenetic study has not been fully evaluated.

Monophyly of the Cynoglossidae has not been unequivocally demonstrated but there do seem to be several possible synapomorphies for the group. Most of the synapomorphies involve reductions or losses of structures including the absence of pectoral fins in the adult stage, loss of the blind side pelvic fin and reduction of the remaining pelvic fin to four rays. Additional characters may include modifications of the epicranial bony system.

The next sections (Chapter 4.1-4.3) provide diagnoses for the family Cynoglossidae, the two subfamilies of tonguefishes, the Cynoglossinae and Symphurinae. Chapter 4.4 is a generic synonymy for the genus Symphurus. This is followed (Chapter 4.5) with a detailed description for the genus Symphurus. Information provided in the diagnoses and descriptions was gathered from Ginsburg (1951), Mahadeva (1956), Ochiai (1968) and Menon (1977) and supplemented with findings derived from the present study.

CHAPTER 4.1

Family Cynoglossidae

Eyes sinistral, small. Optic chiasma dimorphic. Jaws strongly asymmetrical, upper jaw usually bent anteriorly, the fleshy snout curving over the lower jaw and forming a distinct hook (only weakly developed in Symphurus). Nares, two pairs, placed symmetrically; the anterior nares a well-developed tubule, the posterior nares with a raised edge only. Narial tube of eyed side always arising in front of fixed eye; posterior nares on ocular side usually placed on anterior part of interorbital space. Median axil rod of nasal laminae thickened and straight. Dorsal and anal fins confluent with caudal. Dorsal fin originates on head. The first dorsal ray usually inserted anterior to posterior margin of migrating eye. Dorsal and anal fins containing numerous rays, not fewer than 69 in the dorsal and 55 in the anal. All fin rays segmented and unbranched. Anal fin origin immediately posterior to anus. Anus and opening of oviduct are eccentrically placed onto blind side immediately anterior to anal fin origin.

Pectoral fins lost or represented only by a thin membrane in adult (present in symmetrical larva). Pelvic fin unpaired, inserted on midline of abdomen, with 4 rays. The single left pelvic fin assumes a median position (Kyle 1921; 1926). Pelvic of eyed side absent (except in rare individual cases where it is situated on the eyed side much above the mid-ventral line). Urogenital papilla long, midventrally placed anterior to but attached to first anal ray.

Scales generally strongly ctenoid on eyed side; secondarily cycloid in a few species. Scales of blind side ctenoid or cycloid, depending on the species. Secondary squamation on vertical fins present or absent.

No prominent dermal flaps or fringes on blind side of head. Epidermal sensory papillae present or absent. Epidermal hairs absent.

Lateral lines on ocular side of body entirely absent or 2 to 3 in number, if present. Lateral line entirely absent or 1 or 2 in number on blind side.

Abdominal cavity relatively broad. Intestine short, coiled in abdominal cavity. Digestive and urinary organs do not extend to the caudal region, only the ovaries and posturethral portion of the urinary bladder occupy the caudal region. Peritoneum clear or highly pigmented. Swimbladder absent in adult (present in symmetrical larva).

Vault of cranium absent due to huge fontanelle (Symphurinae) or completely ossified (Cynoglossinae). Otic capsules bulky and hemispherical or not prominent; prefrontal bones with or without a spinuous divergence posteriorly directed and attached to base of anterior pseudointerneural spine; supraoccipital cartilagenous or calcified. Rostral process of neurocranium absent or rudimentary, or well developed. Anterior pseudointerneural spine slender or robust, quadrangular or swordlike; the first complex dorsal pterygiophore (the erisme) short or elongate; archlike or falciform in shape and supporting numerous pterygiophores advanced onto cranium.

Tooth patches on upper pharyngeal bone 2 in number. Urohyal bone thin; posterior margin forked, emarginate or entire. Pectoral girdle comprised of a posttemporal, supracleithrum and cleithrum. Cleithrum smooth or with posteriorly directed spine at angle; weakly or subangularly arched.

Abdominal vertebrae usually 9, sometimes 10, 11, or rarely 12; the number of caudal vertebrae ranges from 33 to 66. Neural arch complete in all vertebrae, including the first abdominal vertebrae. Haemal arches complete as far forward as the fourth abdominal vertebrae; and an anal interhaemal spine is present, attached to the first caudal haemal spine near its extremity. Parapophyses long, the last one evidently shorter than half the length of first haemal spine.

First neural spine short, the tip extending anteriorly above rear of supraoccipital bone. In general, each neural and haemal spine posterior to the third neural and second haemal spines associated with two pterygiophores.

Caudal rays unbranched, variable in number (usually 9-14), but consistent within a particular species. Caudal skeleton much reduced. Usually four, occasionally five, hypurals present. A single epural and parhypural present.

Vegus lobe of medulla oblongata well enlarged.

CHAPTER 4.2

Subfamily Cynoglossinae

Type Genus: Cynoglossus Hamilton-Buchanan 1822 by monotypy.

Snout well-hooked, overhanging mouth. Mouth inferior. Jaws, on blind side only, armed with needle shaped teeth; teeth on dentary and premaxilla form wide short band. Scales generally ctenoid; head scales on blind side embedded; scales in midlateral line imbricate but with deep median cleft; in species with ctenoid scales, usually the lateral line scales with cteni on either side of pore of lateral line.

Lateral line well developed on ocular side; midlateral line, except in C. sinusarabici, accompanied by marginodorsal line and frequently by marginoventral line. Predorsolateral line nerve present, giving off one or a few branches; dorsolateral and ventrolateral line nerves usually well developed.

Left and only pelvic fin confluent with anal fin. Pectoral fins absent. Urogenital papilla long, attached to first anal ray.

Vault of cranium completely ossified; otic capsules not prominent; prefrontal bone without spinous divergence; supraoccipital calcified (Chabanaud 1940a). Diencephalon enlarged (Ochiai 1963:68).

Prefrontal bone on blind side without a spinous divergence, which is directed posteriorly and firmly attached to base of anterior pseudointerneural spines. Anterior pseudointerneural spine robust, quadrangular or swordlike; erisma elongate, falciform, directly supporting numerous interneural spines advanced onto cranium; rostral cartilage well developed.

Interneural spines associated with anterior three neural spines about 15 to 20 in number.

Vertebrae (9+10 or 11, rarely 12) + (33-66) = 42-76 or 77 or 78. Vertebral diapophyses absent or present only in the anterior part of caudal region; abdominal diapopyses begin with fourth abdominal vertebra and are shorter and more strongly oblique than those of caudal series; all abdominal and caudal vertebrae have neural spines.

Cleithrum rather robust, subangularly arched; at its base cuticular crest of coracoid segment is hypertrophied into an acute angled apophysis.

Larval development: Symmetrical larval stage known (Seshappa and Bhimachar 1955); with swimbladder.

Ecology: Marine, but a few species are known to occur in fresh waters; shallow-water burrowing forms.

Remarks

There has been considerable diversity of opinion regarding the number of valid genera to be recognized within the subfamily Cynoglossinae. For example, Chabanaud (1955a) and Menon (1977) validate only *Paraplagusia* and *Cynoglossus*. Ochiai (1963) considered *Arelia* Kaup 1858 to be valid also. Smith (1953) recognized the most genera and considered *Arelia*, *Areliscus*, *Cynoglossoides*, *Cynoglossus*, and *Trulla* to be valid genera.

CHAPTER 4.3

Subfamily Symphurinae

Type Genus Symphurus Rafinesque 1810 (by monotypy).

Eyes small, close together. Eyes even or migrating eye slightly to moderately in advance of fixed eye. Snout scarcely hooked. Mouth terminal; jaws slightly to moderately curved. Teeth on ocular side of premaxilla absent altogether, or present in a partial or complete single row of needle-like teeth. Dentary on eyed side possesses sharp, needle-like teeth in a singular row. Teeth on blind side jaws well developed; premaxillary and dentary teeth arranged in small number of longitudinal series, forming long narrow band.

Scales strongly ctenoid on eyed-side; less strongly on blind side. Head scales of blind side imbricate.

Lateral line absent on both sides. Free neuromasts evident along margins of body in short rows of five to ten papillae. Dorsolateral line nerve single; predorsolateral and ventrolateral line nerves absent.

Pelvic fin joined to anal fin.

Pectoral fin represented only by a rudimental membrane. Cleithrum smooth and weakly arched.

Urogenital papilla short, attached to first anal ray.

Vault of cranium absent due to huge fontanelle; otic capsules bulky and hemispherical; supraoccipital cartilaginous anteriorly (Chabanaud 1940a). Prefrontal bone on blind side with a spinous divergence dorsally and posteriorly directed, firmly attached to base of anterior pseudointerneural bone. Pseudointerneural spines slender; erisma short to moderately developed, straight to moderately curved to archlike in shape; rostral cartilage not developed. Pterygiophores associated with anterior three neural spines not numerous, ranging from 3-6.

Pharyngeal teeth villiform.

Vertebrae (9-10, only occasionally 11) + (30-54) = 39-63. All vertebrae bear diapophyses that are heavy in abdominal region and anterior half of caudal region, but become weaker posteriorly; abdominal haemapophyses begin with fourth abdominal vertebra, and are shorter and more strongly oblique than those of caudal series; abdominal haemapophyses gradually increase in length from fourth to ninth vertebrae and are also gradually inclined more and more posteriorly; all abdominal and caudal vertebrae have neural spines. Neural spines thicker and stronger and less inclined in anterior end of body; neural spine of first vertebra in direct contact with the posterior portion of the cranium; neural spine of second vertebra distinctly inclined forward but third neural spine inclined only slightly forward.

Brain diencephalon only slightly thickened, granular eminences on cerebellum very small (Ochiai 1963).

Larval development: Symmetrical larval stage with swimbladder (Kyle 1913; 1921; Olney and Grant 1976).

Ecology: Marine and estuarine but a single species (S. orientalis Bleeker) is reported from freshwater at Peiping. Majority of species are eurybathyal in the Indo-West Pacific and coastal in the New World.

Remarks

Only one study (Jordan and Goss 1889) has suggested that the genus Symphurus be divided. Jordan and Goss proposed that S. nebulosus was sufficiently distinct from all other western Atlantic species to warrant placement into a separate subgenus or genus. They suggested the name Acedia to accomodate this taxon.

CHAPTER 4.4

Genus *Symphurus* Rafinesque 1810

Type species: *Symphurus nigrescens* Rafinesque (by monotypy).

Symphurus

Rafinesque 1810: 52 (original description; type species *S. nigrescens*).

Jordan and Goss 1889: 321 and Jordan and Evermann 1898: 2704 (original description quoted in full; review of American and European species).

Meek and Hildebrand 1948: 1004 (synonymy; review of Panamanian species).

Ginsburg 1951: 185 (synonymy; review of western Atlantic species).

Mahadeva 1956: unpublished dissertation (review of Eastern Pacific species).

Menezes and Benvegnu 1976: 137 (review of western South Atlantic species).

Plagusia

Cuvier 1817: 224 (original description; based on *Pleuronectes plagusia* of Browne; preoccupied in Crustacea by *Plagusia* Latreille 1806).

Plagiusa

Bonaparte 1837: fasc. 120, not paged (substitute for *Plagusia*, preoccupied, type species: *Pleuronectes plagiusa* Linnaeus).

Bonaparte 1846: 51 (substitute for *Plagusia*, preoccupied, type species: *Plagiusa lactea* Bonaparte).

Bibronia

Cocco 1844: 15 (original description of symmetrical larva of *S. ligulatus*, type species *Bibronia ligulata* Cocco by monotypy).

Aphoristia Kaup 1858: 106 (type species *Achirus ornata* Lacepede by subsequent designation).

Glossichthys Gill 1861: 51 (type species *Pleuronectes plagiusa* Linnaeus by original designation).

Ammopleurops

Günther 1862: 490 (type species *Plagiusa lactea* Bonaparte (*lacteus* same as *nigrescens*) by original designation).

?*Bascanius* Schodte 1867: 269 (type species *Bascanius toedifer*, a larval form, by monotypy).

Acedia (subgenus)

Jordan, In Jordan and Goss 1889: 321 (type species *Aphoristia nebulosa* Goode and Bean by original designation).

CHAPTER 4.5

Genus SYMPHURUS

Description

Sinistral, strongly compressed; symmetrically shaped; greatest depth in anterior half of length; the depth nearly uniform for a considerable distance, then tapering both ways; anterior taper moderate; posterior taper differs in various species. The depth may decrease rapidly to caudal base or the taper may be quite convex.

Pigmentation on eyed-side generally brown, greyish brown, or yellowish brown. A variable number of crossbands in various stages of completeness present in some species. Blind side usually colorless or creamy white in life. Some species with pattern of pepper-dot pigment spots on blind side of body. The ctenoid scales on the eyed side generally have a characteristic dark center, thereby giving the appearance of faint streaks running longitudinally along the body. The inner lining of the peritoneal cavity may or may not be pigmented. This dark black pigmentation often shows through the thin translucent skin on either side of the body.

Eyes small, slightly smaller than short snout; the two eyes separated by a very narrow interorbital space; usually anterior margin of upper eye slightly in advance of that of lower, infrequently both about aligned on same vertical. Pupillary operculum present or absent. Anterior part of eyes in some species covered with small rows of scales.

Snout short and very blunt, the anterior profile forming a nearly continuous broad curve. Mouth very small, the posterior angle ranges from just under anterior margin of lower eye to a point just slightly posterior to posterior margin of lower eye. Mouth asymmetrical, moderately curved on eyed-side, notably curved on blind side.

Anterior nostril on eyed-side a well-developed tubule, placed at some distance in front of lower eye, whereas tubule short on the blind side; posterior nostril with a raised edge, placed directly in front of and between the eyes.

Dentition chiefly developed on blind side jaws, teeth on eyed-side jaws are better developed in some species than in others. The teeth are conical, small and subequal. The moderately curved outer teeth are somewhat larger than the inner ones. On the blind side, teeth moderately larger, in bands; band in upper jaw of nearly uniform and moderate width; band in lower jaw shorter and wider, shaped somewhat like the segment of a circle or moderately crescentic with a straight or slightly curved margin internally and a well-curved margin externally. The dentition on eyed side very moderately or poorly developed, the teeth small, few or moderate in number, eyed-side of upper jaw with a narrow band of teeth at symphysis in 2-3 irregular rows, tapering backward to one row, or one row throughout, or a small group of a few teeth near symphysis; eyed-side lower jaw with one row, or with very few teeth, or altogether toothless, depending on the species and intraspecific variability.

Teeth are also well developed on the pharyngeal bones (Clark 1936). The rounded and pad-like upper pharyngeals are armed with a rosette of sharp, long, curved, strong teeth. The lower pharyngeals are elongate and have one irregular row of strong teeth, similar to those on the upper pharyngeals, clearly discernible by use of a jet of air.

Opercle separated by a posterior emargination into two lobes, the dorsal lobe smaller. Branchiostegals six in number on either side; membranes united, their point of union at base of ventral fin. Isthmus free. Pseudobranchiae greatly reduced, consisting of only 2-4 small filaments. No slit behind fourth gill arch. Gill rakers nearly obsolete, indicated as slight, uneven variable protuberances on gill arch (not examined in all species).

Body and head with ctenoid scales; the strongly ctenoid scales are generally deciduous, especially so in the deep-water forms; those on anterior part of head becoming more or less embedded; scales on anterior regions of the head, around the snout, eyes and lower jaw are reduced to small, thin filmy structures that become more or less embedded in the skin; posteriorly, scales diminish in size toward the caudal fin. Scales extend onto the caudal fin. Caudal with scale rows present at its base, scales also in rows between the rays for some distance posteriorly, scaleless distally. Short rows of small scales present in some species along the proximal part of dorsal and anal fin rays.

Lateral line absent on both eyed and blind sides of fish.

Dorsal fin origin over eye; dorsal and anal continuous with caudal. Pelvic fin unpaired, placed at isthmus, normally having four rays. Delicate membrane (torn most times in trawl caught specimens) connects pelvic to base of anal fin. Pectoral fins absent. All fin rays segmented and unbranched.

Alimentary canal relatively simple. Stomach about half as long as intestine without the rectum. Pyloric caecae absent. Intestine fairly long with a single coil. Rectum a distinct thin-walled structure. Anus placed eccentrically on blind side, just in front of anal fin.

Kidney and its duct are developed only on the right side. Gonads open to exterior by means of a tough muscular tube located anterior to first anal ray and sheathed by a part of the anal fin.

The eggs (where known) 0.7 to 0.8 mm in diameter containing numerous oil globules. The eggs and larvae are pelagic. Larvae are externally symmetrical and possess a gas bladder. A variable number of the anteriormost rays of the dorsal fin prolonged into filamentous extensions which measure almost as long as the head. The pectoral fins are present as two thin protrusions of the skin. The larval alimentary canal is thrust outside of the body cavity into a thin-walled triangular sac on the ventral side. During metamorphosis, the pectoral fins, gas bladder, and filamentous extensions of the anterior dorsal rays are all lost; the viscera are pulled inside the body; and the eye on the right side migrates through the tissues of the head onto the left side and comes to be placed above the left eye (Kyle 1921; Olney and Grant 1976).

CHAPTER 5

Interdigitation Patterns and Species Groups within *Symphurus*

Introduction

Symphurine tonguefishes occur worldwide in all temperate and tropical oceans. Thus far, 62 nominal species have been described and another 7-10 undescribed species are known from unpublished studies. No comprehensive revisionary study has ever been made of the genus *Symphurus*, partly because many species inhabit deep-sea environments and consequently have only rarely been collected. In fact, several deep-sea species are known only from the holotype or a small type series (see Material Examined listed below). Additionally, previous investigators (Chabanaud 1949a; 1955b; 1955c; 1956; Ginsburg 1951; Mahadeva 1956; Ochiai 1963; Menezes and Benvegnu 1976) although providing comprehensive reviews of tonguefishes from selected regions have made little or no comparison with studies from other geographic regions. Consequently, our knowledge of both the number of species of *Symphurus* and their interrelationships is still very basic.

Another shortcoming of all previous reviews has been that authors have relied almost exclusively on external morphology (primarily fin ray counts and morphometrics) to diagnose species. Among species of *Symphurus*, there is considerable overlap in traditional meristics and morphometrics. Therefore, when these characters alone are used they are of limited value in delineating the individual species and secondly, they provide little information concerning species interrelationships within the genus.

Other difficulties hindering interpretation of species relationships in Symphurus are that as a whole the taxon exhibits considerable morphological conservatism with many structural reductions and losses. This high degree of phenotypic similarity is evidenced in Menon's remark in his revision (1977) of the confamilial genus Cynoglossus: "that all three cynoglossid genera are so homogeneous that to subdivide any of the genera into subgenera would appear only artificial."

During the course of this revision of Atlantic symphurine tonguefishes, I had the opportunity to examine types (in a few cases only radiographs of types) and representative series of specimens for 64 of 68 nominal species presently assigned to Symphurus. Comparisons of radiographs revealed that for each species there is a predominant pattern of interdigitation of dorsal pterygiophores and neural spines (hereafter referred to as the ID pattern). Additionally, not all species possess similar patterns. Since there was variation in these ID patterns, it became evident that they could be useful in diagnosing some species or groups of species. In fact, in some instances where species were found to overlap extensively in traditional meristics, they were found to possess quite different ID patterns confirming the value of interdigitation patterns as a useful taxonomic character in identifying species or groups of species within Symphurus. Additionally, it is proposed (see below) that ID patterns can be used to support a preliminary hypothesis of intrageneric relationships among the species.

The range of ID patterns observed in the species, their particular arrangements and the levels of within species variation form the basis of this portion of the study. Based largely on ID patterns reported herein, together with supporting osteological information from cleared and stained specimens, a preliminary hypothesis of species group relationships among the symphurine tonguefishes is presented. This hypothesis is supported also by patterns of zoogeographical and ecological distributions of species possessing particular pattern types.

Materials and Methods

A total of 2244 specimens, representing 62 of 68 nominal species of *Symphurus* were examined and radiographed (Table 5). Specimens and radiographs borrowed from museums are listed below by collection numbers only. Complete titles, information and addresses of these collections may be obtained from Leviton et al. (1986). Whenever possible, specimens representative of the entire size range and geographic distribution for the species were selected for study. Most specimens were radiographed on a Picker Soft X-Ray Machine. A smaller number of specimens were cleared and counter-stained (after Dingerkus and Uhler 1979).

For each specimen, the number of proximal dorsal pterygiophores inserting into the first three to five interneural spaces were observed from radiographs or from cleared and stained specimens (Fig. 4). The arrangement of pterygiophores inserting into the first three to five interneural spaces were recorded as the interdigitation (ID) pattern formula. Since the first neural spine abuts directly against the cranium, there is no obvious space

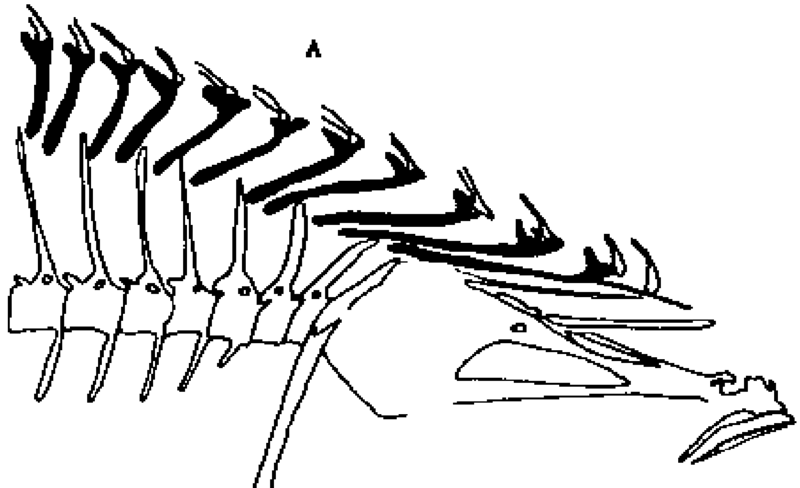
Figure 4. Illustrations of three different interdigitation (ID) patterns observed in species of *Symphurus*. Proximal pterygiophores are indicated in black. Note also the relative lengths and arching of the first modified pterygiophore.

Patterns and their representative species are:

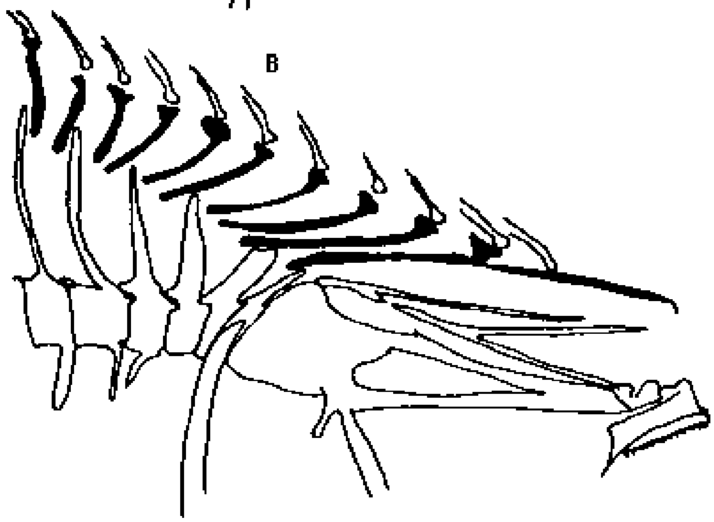
A) 1-2-2-1-2 ID pattern (*S. vanmelleae*).

B) 1-3-2 ID pattern (*S. marginatus*).

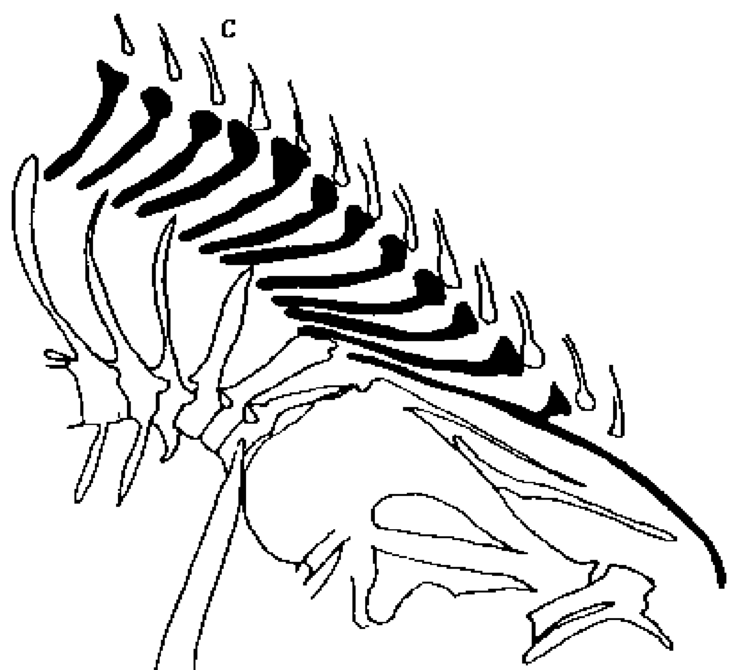
C) 1-4-3 ID pattern (*S. civitatium*).



1-2-2-1-2 ID PATTERN



1-3-2 ID PATTERN



1-4-3 ID PATTERN

between it and the cranium. Therefore, the pattern formulae reflect the numbers of pterygiophores inserting into each respective interneural space beginning with the first obvious interneural space (posterior to the first neural spine) and continuing with each successive interneural space to either interneural space three or five. Since only two pterygiophores per space were usually inserted into interneural spaces posterior to the third interneural space (with few exceptions, see below), counts usually were made and recorded of the pterygiophores inserting into the first three interneural spaces only. One group of species had a unique pattern where only one pterygiophore inserts into either the fourth or the fifth interneural space. For these species, the ID pattern is extended to five digits to reflect this variation.

The system of notation for ID pattern formulae follows a simple three or five digit formula such as 1-3-2 or 1-2-2-2-1. In the first example, the pattern would be interpreted as one pterygiophore inserting into interneural space one; three in interneural space two; and two in interneural space three. In the second example, the 1-2-2-2-1 formula is interpreted as one pterygiophore inserting into interneural space one; two in interneural space two; two in interneural space three; two in interneural space four; and one pterygiophore inserting into interneural space five.

It should be emphasized that the pterygiophore patterns recorded in this study relate only to the numbers of pterygiophores inserting into successive interneural spaces. These formulae are not analagous to formulae adopted by other authors (Smith and Bailey 1961, for example) to demonstrate relationships and correspondence between neural spines and predorsal bones.

Results

ID PATTERN GROUPS

Examination of radiographs revealed that each species of Symphurus has a predominant pattern of interdigitation of dorsal pterygiophores and neural spines and secondly not all species share identical patterns (Tables 5-9). The overall predominant ID pattern for 64 species is presented in Table 5. Three of the most commonly observed patterns are illustrated in Figure 4. A total of eight different predominant patterns were evident among the species examined. The most commonly observed patterns among the species were: 1-2-2-1-2; 1-2-2; 1-2-3; 1-3-2; 1-3-3; 1-4-2; 1-4-3 and 1-5-3. The patterns observed and the number of species possessing each pattern are listed in Table 6. From Table 6, it can be seen that the most speciose are the 1-2-2 pattern (18 species), the 1-3-2 pattern (13 species) and the 1-4-3 pattern (12 species).

Before discussing the different pattern types, there are several shared features of interdigitation patterns among the many species of Symphurus. First, within a species, ID patterns did not vary with respect to sex, ontogeny (at least not over the size range examined, 20-320 mm SL) or geographic origin. Secondly, all species have only one pterygiophore inserting into the first interneural space. Only in unusual cases (less than 1% of the specimens examined) were specimens found with more than one (usually two, less commonly three) pterygiophores in the first interneural space. Additionally, among Symphurus species, with a single exception (S. vanmelleae group), all species typically have two pterygiophores per interneural space posterior to the fourth neural spine. Therefore, observed variation in ID patterns between species results almost exclusively from differing numbers of pterygiophores inserting into interneural spaces two and three.

A single pterygiophore inserted in the first interneural space in *Symphurus* is unique among the Cynoglossidae and Soleidae (Table 5). This condition is therefore considered a synapomorphy for the subfamily Symphurinae with its monotypic genus *Symphurus*. Interdigitation patterns for a small number of representative species of Cynoglossinae and Soleidae are included in Table 5. In the *Cynoglossus*, *Paraplagusia* and soleid species examined thus far (Table 5), ID patterns are quite different. These taxa have a much larger number of pterygiophores preceding the second neural spine than was observed in any species of *Symphurus*. For example, in non-symphurine cynoglossids the number of pterygiophores in interneural space one ranged from seven (*Cynoglossus*) to 13 (*Paraplagusia*) while in soleids the numbers of pterygiophores inserted in neural space one is typically much higher, ranging from seven (*Aseraggodes*) to 23 (*Heteromycteris*).

Since ID patterns have not been studied previously in tonguefishes, it was necessary to determine the amount of intraspecific variation occurring in this character. Although each species has a particular prominent pattern (Tables 5-9) varying levels of intraspecific variation do occur in this character. The levels of intraspecific variation in ID patterns are contrasted in detail for 17 species representative of seven of the eight common pattern types observed (Table 7).

Table 5. *Symphurus* species grouped according to predominant ID pattern, caudal ray count and abdominal vertebrae count. Data for species marked with an asterisk (*) were obtained from original descriptions or revisionary works.

SPECIES	No. X-RAYED	ID PATTERN	CR	DR	AR	VERTEBRAE	HYPURALS
arabicus Chabanaud 1954	1	1-2-2-1	14	97	84	(3+7)+43=53	5
gilesii (Alcock 1889)	4	1-2-2-1	14	97-98	81-85	(3+7)+44-45=53-54	5
regani Weber & deBeaufort 1929	4	1-2-2-1	14	103-105	89-90	(3+7)+46-47=56-57	5
vanmelleae Chabanaud 1952	47	1-2-2-1	12	101-108	86-93	(3+7)+45-49=55-59	4-5
fuscus Brauer 1906	1	1-2-2-2-1	14	105	93	(3+6)+49=58	5
ligulatus (Cocco 1844)	37	1-2-2	14	102-113	90-102	(3+6)+47-52=56-61	4-5
macrophthalmus Norman 1939	2	1-2-2	14	89	73	(3+6)+48=57 CHECK	?
maldivensis Chabanaud 1955	1	1-2-2	6+	108	95	(3+6)+49=58	5
marmoratus Fowler 1934	1	1-2-2	14	119	106	(3+6)+54=63	5
nebulosus (Goode & Bean 1883)	25	1-2-2	14	105-113	91-99	(3+6)+48-51=57-60	4-5
ocellatus Van Bonde 1923	13	1-2-2	14	97-103	86-89	(3+6)+45-47=54-56	5
sayademalhensis Chabanaud 1955	1	1-2-2	14	100-101	87-88	(3+6)+45=54	5
unident. Sp. A.(microrhynchus?)	2	1-2-2-2-1	14	85-87	75	(3+6)+39-40=48-49	5
schultzi Chabanaud 1955	5	1-2-2;1-2-2-1	14	86-88	72-75	(3+6)+39-41=48-50	5
strictus Gilbert 1895	4	1-2-2	14	111-115	97-103	(3+6)+51-53=60-62	5
australis McCullock 1907	1	1-2-2	14	116	103	(3+6)+54=63	5
variegatus (Gilchrist 1903)	1	1-2-2	14	104	91	(3+6)+47=56	5
woodmasoni (Alcock 1889)	4	1-2-2	14	94-96	81-83	(3+6)+42-43=51-52	5
hondoensis Hubbs 1915	1	1-2-3	14	113	95	(3+7)+49=59	?
holothuriae Chabanaud 1948	1	1-2-3-2	12	84	70	(3+6)+37=46	4
undatus Gilbert 1905	21	1-2-3	14	99-102	88-89	(3+6)+45-48=54-57	5
*fallax Chabanaud 1957	0	No Xray	12	95	82	NA	NA
luzonensis Chabanaud 1955	1	1-2-2	12	99	85	(3+6)+42=52	4
*novemfasciatus Shen 1983	0	No Xray	12	100-101	88	NA	NA
orientalis (Bleeker 1879)	1	1-2-2	12	96	83	(3+6)+44=53	?
*septemstriatus (Alcock 1891)	0	No Xray	12	93-101	81-89	(3+6)+44=53	NA
*seychellensis Chabanaud 1955	0	No Xray	12	100	83	(3+6)+42=51	NA
trifasciatus (Alcock 1894)	1	1-2-2	12	88	75	(3+6)+39=48	NA
unident. sp. B. New Guinea	5	1-2-2	12	88-92	75-78	(3+6)+39-41=48-50	4
microrhynchus Weber 1913	1	1-2-2	?	87	73	(3+6)+39=48	?

TABLE 5. (Continued).

SPECIES	NO. X-RAYED	ID PATTERN	CR	DR	AR	VERTEBRAE	HYPURALS
arawak Robins & Randall 1965	40	1-3-2	12	70-75	55-61	(3+6)+30-33=39-42	4
rhytisma Bohlke 1961	6	1-3-2	12	83-86	68-71	(3+6)+37-39=46-48	4
undescribed species A	2	1-3-2	12	87-88	78	(3+6)+39-40=48-49	4
undescribed species B	5	1-3-2	12	88-89	74-75	(3+6)+39-40=48-49	4
ginsburgi Menezes & Benv.1976	33	1-3-2	12	87-94	75-81	(3+6)+41-43=50-52	4
gorgonae Chabanaud	13	1-3-2	12	82-88	69-73	(3+6)+37-40=46-49	4
marginatus Goode & Bean 1886	96	1-3-2	12	93-104	80-89	(3+6)+42-47=51-56	4-5
microlepis Garman 1897	2	1-3-2	12	106-109	92-94	(3+6)+48-49=57-58	5
nigrescens Rafinesque 1810	156	1-3-2	12	82-92	69-79	(3+6)+38-42=47-51	4
pelicanus Ginsburg 1951	19	1-3-2	12	77-85	64-69	(3+6)+35-37=44-46	4
piger Goode & Bean 1888	144	1-3-2	12	80-88	68-75	(3+6)+36-40=45-49	5
pusillus Goode & Bean 1885	19	1-3-2	12	83-88	71-75	(3+6)+38-40=47-49	4
undescribed species C	78	1-3-2	12	89-95	76-84	(3+6)+41-44=50-53	4
atramentatus Jord.&Boll.1889	14	1-3-3	12	92-96	77-81	(3+6)+41-43=50-52	4
normani Chabanaud 1950	23	1-3-3	12	87-92	73-77	(3+6)+39-41=48-50	4-5
trewavasae Chabanaud 1949	54	1-3-3	10	88-94	73-79	(3+6)+38-42=47-51	4
varius Garman 1897	6	1-3-3	12	94-96	79-81	(3+6)+42-43=51-52	5
kyaropterygium Men.&Benv.1976	14	1-4-2	10	83-87	67-72	(3+6)+38-40=47-49	4
minor Ginsburg 1951	78	1-4-2	10	69-77	55-63	(3+6)+32-35=41-44	4
ommaspilus Bohlke 1961	28	1-4-2	10	74-79	60-64	(3+6)+34-35=43-44	4
parvus Ginsburg 1951	66	1-4-2;1-5-2	10	75-86	60-70	(3+6)+34-38=43-47	4
diomedeanus (Goode & Bean 1886)	207	1-4-3	10	86-96	69-80	(3+6)+38-41=47-50	4
fasciolaris Gilbert 1891	4	1-4-3	10-12	92-94	76-78	(3+6)+40-41=49-50	4
jenynsi Evermann & Ken. 1907	93	1-4-3	10	107-115	91-99	(3+6)+48-51=57-60	4
plagiusa (Linnaeus 1766)	132	1-4-3	10	83-91	67-75	(3+6)+36-40=45-49	4
urospilus Ginsburg 1951	110	1-4-3	11	83-91	64-74	(3+6)+35-39=44-48	4
civitatium Ginsburg 1951	177	1-4-3	12	86-93	70-78	(3+6)+37-41=46-50	4
leei Jordan & Bollmann 1889	30	1-4-3	12	96-102	79-86	(3+6)+43-46=52-55	4
paitensis Hildebrand 1946	3	1-4-3	12	93-97	76-81	(3+6)+40-42=49-51	4
plagusia (Bl.in Schneid. 1789)	33	1-4-3	12	91-97	75-81	(3+6)+39-42=48-51	4
tessellatus (Quoy & Gaim. 1824)	234	1-4-3	12	91-104	77-88	(3+6)+40-45=50-54	4
undescribed species D	38	1-4-3	12	99-107	81-89	(3+6)+43-46=52-55	4
undescribed species E	85	1-4-3	12	89-96	74-80	(3+6)+39-42=48-51	4
atricaudus Jord.& Gilb. 1880	8	1-5-3	12	96-98	78-82	(3+6)+42-43=51-52	4
elongatus Gunther 1869	2	1-5-3	12	104-105	87-88	(3+6)+46=54	4
melanurus Clark 1936	2	1-5-3	12	97-99	79-82	(3+6)+41-42=50-51	4
sechurae Hildebrand 1946	3	1-5-3	12	99-101	83-85	(3+6)+43-44=52-53	4
williamsi Jord. & Culv. 1895	2	1-4-3; 1-5-3	12	92-94	76-77	(3+6)+40=49	4

TABLE 5. (Continued).

SPECIES	No. X-RAYED	ID PATTERN
CYNOGLOSSINES		
Cynoglossus	4	7-3-2
Paraplagusia	4	13-3-2
SOLEIDS		
Heteromycteris	1	23-3-2
Aseraggodes	1	7-2-2
Liachirus	1	9-2-2
Parachirus	1	11-3-3
Pardachirus	1	8-2-2

Table 6. Summary of interdigitation patterns and the number of Symphurus species observed with each pattern.

INTERDIGITATION PATTERN	SPECIES
1-2-2-1-2	6
1-2-2	18
1-2-3	3
1-3-2	13
1-3-3	4
1-4-2	4
1-4-3	12
1-5-3	5

Table 7. Variation in frequency distributions of interdigitation (ID) patterns of dorsal pterygiophores for 17 species of Symphurus. Species selected represent eight pattern types outlined in text. Following species names are the pattern group (in parentheses) followed by abbreviations for the geographic distributions of the species. Number of specimens examined is listed with the summary for each species. Numbers following pattern types represent frequency and per cent occurrence for respective ID patterns. Abbreviations are: EA Eastern Atlantic; EA-M Eastern Atlantic and Mediterranean; WNA Western North Atlantic; IP Indo-Pacific; HI Hawaii; CA Caribbean; WNA-SUR Western North Atlantic south to Surinam; EP Eastern Pacific; WSA Western South Atlantic.

S. vanmelleae (1) EA

ID PATTERN	N	%
1-2-2-1-2	23	49
1-2-2-2-1	13	28
1-2-1-2-2	5	11
1-2-1-2-2	2	4
1-2-2-1-1	2	4
1-2-2-1-2-1	1	2
1-3-1-2-2	1	2

	N=47	

S. ligulatus (2) EA

ID PATTERN	N	%
1-2-2-2	25	68
1-2-2-1	3	8
1-2-3-1	2	5
1-2-2-3	2	5
1-2-3-2	1	3
1-2-2-1	1	3
1-1-3-2	1	3
1-1-2-2	1	3
2-2-2-1	1	3

	N=37	

S. nebulosus (2) WNA

ID PATTERN	N	%
1-2-2-2	20	87
1-2-3-2	1	4
2-1-2-2	1	4
2-2-2-2	1	4

	N=23	

S. ocellatus (2) IP

ID PATTERN	N	%
1-2-2-2	11	85
1-2-2-1	2	15

	N=13	

S. undatus (3) HI

ID PATTERN	N	%
1-2-3-2	16	76
1-2-4-2	2	10
1-3-3-2	1	5
1-3-2-2	1	5
1-3-2-3	1	5

	N=21	

S. arawak (4) CAB

ID PATTERN	N	%
1-3-2	25	74
1-3-3	3	9
1-3-1	3	9
1-2-2	1	3
2-3-2	2	6

	N=34	

S. marginatus (4) WNA-SUR

ID PATTERN	N	%
1-3-2	73	79
1-3-3	11	12
1-2-3	6	6
1-2-2	2	6

	N=92	

S. nigrescens (4) EA-M

ID PATTERN	N	%
1-3-2-2	131	86
1-2-3-2	6	4
1-2-3-1	3	2
1-3-2-1	2	1
1-3-3-2	2	1
1-3-1-2	2	1
1-2-2-2	2	1
2-2-2-2	1	.7
2-2-2-3	1	.7

	N=152	

S. piger (4) CAB

ID PATTERN	N	%
1-3-2	136	97
1-3-3	1	1
1-2-3	1	1
1-2-2	2	1

	N=140	

Table 7. (Continued).

S. normani (5) EA

ID PATTERN	N	%
1-3-3-2	15	71
1-3-4-2	1	5
1-3-2-3	1	5
1-3-2-2	1	5
1-4-3-2	1	5
2-3-2-2	1	5

	N=21	

S. trewavasae (5) WSA

ID PATTERN	N	%
1-3-3	37	68
1-4-2	8	15
1-3-2	4	7
1-3-4	2	4
1-4-3	1	2
1-2-3	1	2
1-2-4	1	2

	N=54	

S. minor (6) WNA

ID PATTERN	N	%
1-4-2	73	95
1-3-2	3	4
1-4-3	1	1

	N=77	

S. parvus (6) WNA-SUR

ID PATTERN	N	%
1-4-2	26	36
1-5-2	30	40
1-4-3	5	8
1-5-1	4	6
1-3-2	1	2

	N=66	

S. plagiusa (7) WNA

ID PATTERN	N	%
1-4-3	80	61
1-4-2	24	18
1-3-3	22	17
1-5-2	3	2
1-4-4	1	.8
1-3-4	1	.8
1-5-3	1	.8

	N=132	

S. civitatium (7) WNA

ID PATTERN	N	%
1-4-3	129	76
1-4-2	19	11
1-5-2	7	4
1-5-3	3	2
1-3-3	8	5
1-3-4	6	4

	N=170	

S. diomedeanus (7) WNA-WSA

ID PATTERN	N	%
1-4-3	150	74
1-3-4	13	6
1-4-2	13	6
1-5-3	12	6
1-3-3	7	3
1-5-2	6	3
1-4-4	2	1
3-3-2	1	.5

	N=204	

S. leei (8) EP

ID PATTERN	N	%
1-4-3-2	14	47
1-4-4-2	6	20
1-4-3-3	3	10
1-3-4-2	2	7
1-5-3-2	2	7
1-4-4-3	1	3
2-3-3-2	1	3
2-4-3-2	1	3

	N=30	

Table 8. Summary of the frequency of predominant ID patterns for 22 representative species of Symphurus. For New World species (1-4-3 pattern, the frequency of the predominant ID pattern is listed in Column 3 and the frequency of occurrence for all patterns shared only by New World tonguefishes is listed in Column 4.

SPECIES	ID PATTERN	FREQUENCY	% OCCURRENCE	% OCCURRENCE ALL NEW WORLD ID PATTERNS
vanmelleae	1-2-2-1-2	46/47	98	
ligulatus	1-2-2	26/37	70	
nebulosus	1-2-2	20/23	87	
ocellatus	1-2-2	11/13	85	
undatus	1-2-3	16/21	76	
arawak	1-3-2	25/34	74	
ginsburgi	1-3-2	29/32	91	
marginatus	1-3-2	73/92	79	
nigrescens	1-3-2	133/152	88	
piger	1-3-2	136/140	97	
undescribed C	1-3-2	76/78	97	
atramentatus	1-3-3	13/15	87	
normani	1-3-3	15/21	71	
trewavasae	1-3-3	37/54	68	
minor	1-4-2	73/77	95	
ommaspilus	1-4-2	28/28	100	
civitatium	1-4-3	129/177	76	96
diomedeanus	1-4-3	150/204	74	94
jenynsi	1-4-3	61/85	72	89
plagiusa	1-4-3	80/132	57	83
urospilus	1-4-3	74/110	67	97
tessellatus	1-4-3	169/234	72	97

Examination of Table 7 reveals that the species vary in fidelity for a particular pattern. For example, at first observation it would appear that there is little evidence to characterize S. vanmelleae by a single ID pattern. In this species, only 49% (23/47) of the individuals shared the 1-2-2-1-2 pattern. However, all other patterns occurring in this species, with one exception (the 1-3-1-2-2 pattern), are similar patterns in that there is only a single pterygiophore inserting into interneural spaces 3, 4 or 5. Since no species (other than members of this species group, see Table 5) exhibit this particular arrangement, I consider all patterns, where only one pterygiophore inserts into any of interneural spaces 3, 4 or 5 and only two pterygiophores insert into the remaining spaces, to represent minor variations on a single pattern. With this modification then, the frequency of occurrence for ID patterns in S. vanmelleae (Table 8) where only one pterygiophore inserts into interneural spaces 3, 4 or 5 is approximately 98% (46/47).

Overall, the frequency of occurrence for a predominant ID pattern in most of the species was quite high ranging from a low value of 61% in S. plagiusa to a high value of 97% in S. piger (Table 7). For most species where adequate data was available, values for a predominant pattern usually ranged between 70% and 85%. Examination of the ID pattern frequencies in Table 7 also show that usually less than 10% of the individuals of a species possess ID patterns of another pattern group (referred to as crossover counts). The following is a discussion, on a group by group basis, of the intraspecific variation observed in species with representative ID patterns (refer to Table 7-8).

Species possessing 1-2-2-2-1 ID patterns are all deep-water residents and quite rare in collections. Only S. vanmelleae was available in sufficient sample sizes to permit discussion of intraspecific variation in pterygiophore patterns. Forty-seven S. vanmelleae were studied. Of these, 23 (49%) shared an identical pattern (1-2-2-1-2). Another 28% (13 individuals) shared a 1-2-2-2-1 pattern. In addition to having only a single pterygiophore inserted into interneural space 3, 4 or 5, these species also have a unique number of abdominal vertebrae (3+7 or 8 vs. 3+6 in all other species of the genus). These two characters support recognition of this group of species as a monophyletic assemblage in the genus.

Among the 1-2-2 and 1-2-3 species, other groups of mostly deep-water species, crossover counts with other pattern types was low. In S. ligulatus, only 4/37 (11%) were found with another pattern type (the 1-2-2-1-2 pattern) while in S. nebulosus, only 1/23 (4%) possessed a pattern (the 1-2-3 pattern) other than the 1-2-2 pattern. Data for species with 1-2-3 patterns were limited because of the rarity of these species in collections. For Symphurus undatus, over 80% of the individuals possess a 1-2-3 pattern. It should be noted that crossover counts did occur with other pattern types especially between the 1-2-2 and 1-2-3 groups and the 1-3-2 group. However, these crossover counts never amounted to more than 5% of the sample size.

Among species with the 1-3-2 pattern, predominance of a single pattern is among the highest observed in the study and, therefore, crossover counts usually were among the lowest encountered in the study. For example, in S. arawak, S. marginatus, S. nigrescens and S. piger crossover counts were never greater than 12%. Usually, however, crossover counts in this group were considerably lower. For example, specimens of these four 1-3-2 species with crossover counts of a 1-2-2 pattern occurred in only 3, 6, 1 and 1% of the specimens, respectively. Seldom were other pattern types, such as the 1-3-3 (11/92 S. marginatus with a 1-3-3 pattern) or 1-4-2 patterns, found in individuals of species normally possessing the 1-3-2 ID pattern.

The lowest fidelity observed in 1-3-2 species occurred in S. arawak. Only 74% (25/34) of the individuals possessed the 1-3-2 pattern. However, although crossover counts with other patterns did occur in this species, they were to be randomly distributed among other pattern types (Table 7).

Species with 1-3-3 patterns had relatively high fidelity for this pattern (71% in S. normani, 68% in S. trewavasae, data not available for two other species). Crossover counts among this group occurred not usually with 1-3-2 or 1-2-2 patterns, but more frequently with 1-4-2 or 1-4-3 patterns.

Three of the four species possessing a 1-4-2 ID pattern had little or no crossover counts with other species groups and overall the fidelity for a particular ID pattern (1-4-2) was among the highest observed in the study. In S. ommaspilus, 22/22 specimens had a 1-4-2 ID pattern while in S. kyaropterygium, 13/14 had a similar pattern. For S. minor, 73/77 (95%) had a 1-4-2 ID pattern. The most unusual arrangement of ID patterns of this species group was found in S. parvus. Two pattern types were found with almost equal frequency in this species (Table 6), the only one of all the species studied in which two patterns were found with equal frequencies. Twenty-six of 66 (36%) S. parvus had a 1-4-2 pattern, while 30/66 (40%) had a 1-5-2 pattern. No relationships between geographic, sexual or size differences were found to explain the observed bimodal distribution of pattern types in this species. Reasons for including this species in the 1-4-2 species group are that all four species possess a common ID pattern, membrane ostia (apparently unique to this group), 10 caudal rays, a well-developed pupillary operculum, similar meristics and three of the four species share similar pigmentation (large caudal blotch) patterns.

Species with ID patterns greater than 1-4-2 typically possess four or more pterygiophores in interneural space two and three to four pterygiophores in interneural space three. In these species a lower fidelity for a particular pattern was observed (Table 7). However, although there is generally a lower fidelity for a single ID pattern, there is not an increased level of crossover counts with species characterized by patterns less than 1-3-3. It should be emphasized that most intraspecific variation in ID patterns of >1-4-2 species occurs as overlap with patterns shared only by members of the same or closely related species groups. When the total range of ID patterns is recorded for species with patterns >1-4-2 (Table 7), it can readily be seen that there is no overlap with species posssessing a 1-2-2, 1-2-3 or 1-3-2 pattern. Also, there are only a small number of specimens of these species overlapping with the 1-3-3 pattern. There are two species groups with ID patterns >1-4-2 and the following section discusses the levels of intraspecific variation in ID patterns observed within species of each respective group.

Intraspecific variation within species characterized by ID patterns with 1-4-3 and 1-5-3 pterygiophore arrangements was generally higher than that observed in groups with patterns less than 1-4-2. As mentioned above, this variation resulted mostly from crossover counts with pattern types frequently observed usually only within these groups or the 1-4-2 group. In fact, when frequency counts of patterns shared only by other members of this pattern group are combined (Table 8) the overall frequency is increased to 80-95%. For example, specimens of S. plagiusa, S. civitatium and S. diomedeanus, each had the following range of pattern types: 1-4-3, 1-4-2, 1-3-3, 1-5-2 and 1-5-3. The overall range and frequencies of the various pattern types co-occurring in these species groups are listed in Tables 7-8. Unusual in this group was S. leei. This species (n=30), although the predominant pattern was 1-4-3, had the lowest fidelity (47%) for this pattern among all the species of this group. Since only 30 specimens were examined, further study is needed to determine if this is a normal condition or is due to small sample size.

Geographical Distribution of Specific ID Patterns

Geographical ranges for species of several ID pattern groups were plotted in an attempt to identify and uncover patterns of zoogeographical distributions or to identify areas of endemism for species with unique pattern types (Figures 5-6). When geographic ranges of species organized by specific ID patterns were plotted, several interesting zoogeographical distributions become apparent.

For example, the species with a 1-2-2 ID pattern are the most widespread in occurrence (Fig. 5A). Of 18 species possessing a 1-2-2 pattern, 16 occur in the Indo-West Pacific. One other species (S. undatus), a deep-water species, ranges onto the Pacific Plate at the Hawaiian Islands. Only two of the 18 species characterized by a 1-2-2 pattern occur beyond the Indo-Pacific region. Interestingly, both species inhabit bathyal depths on the outer continental shelf or slope. Symphurus ligulatus occurs in 300-800 m in the Mediterranean Sea and nearby Eastern Atlantic Ocean, while the closely related S. nebulosus occurs along the outer shelf and slope areas of the western Atlantic from Long Island to the Blake Plateau off Florida. Of particular interest is the notable absence of this pattern group from the Eastern Pacific region.

Data for species with 1-2-2-1-2 and 1-3-2 ID patterns are lacking because of the general rarity of these deep-sea fishes. However, three of the four species with a 1-2-2-1-2 pattern occur in the Indo-Pacific. The fourth member, S. vanmelleae, occurs along the continental slope and shelf of western Africa at depths of 300-1000 meters. Symphurus undatus of the 1-2-3 ID group occurs on the Pacific Plate in bathyal depths at Hawaii.

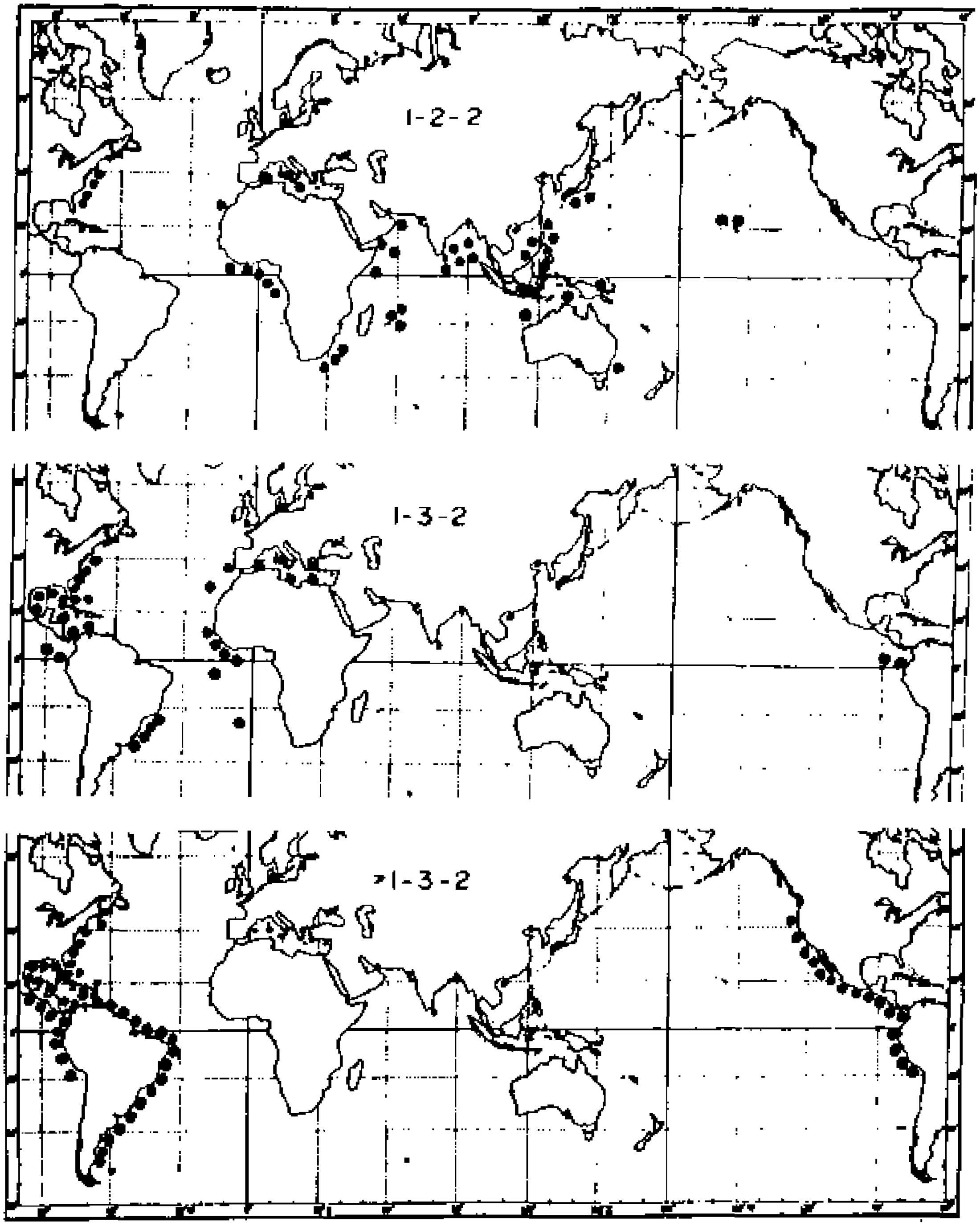
In Figure 5B the distribution of species possessing a 1-3-2 pattern is plotted. Species characterized by this pattern are not as widespread as the 1-2-2 species. Species with 1-3-2 patterns occur on both sides of the equator but only in the eastern and western Atlantic Ocean with an additional two species occurring in the eastern Pacific region along Central America and the Galapagos Islands. It is emphasized that species with

Figure 5. Geographic distribution of species possessing the three most commonly observed interdigitation (ID) patterns among species of *Symphurus*.

A

B

C

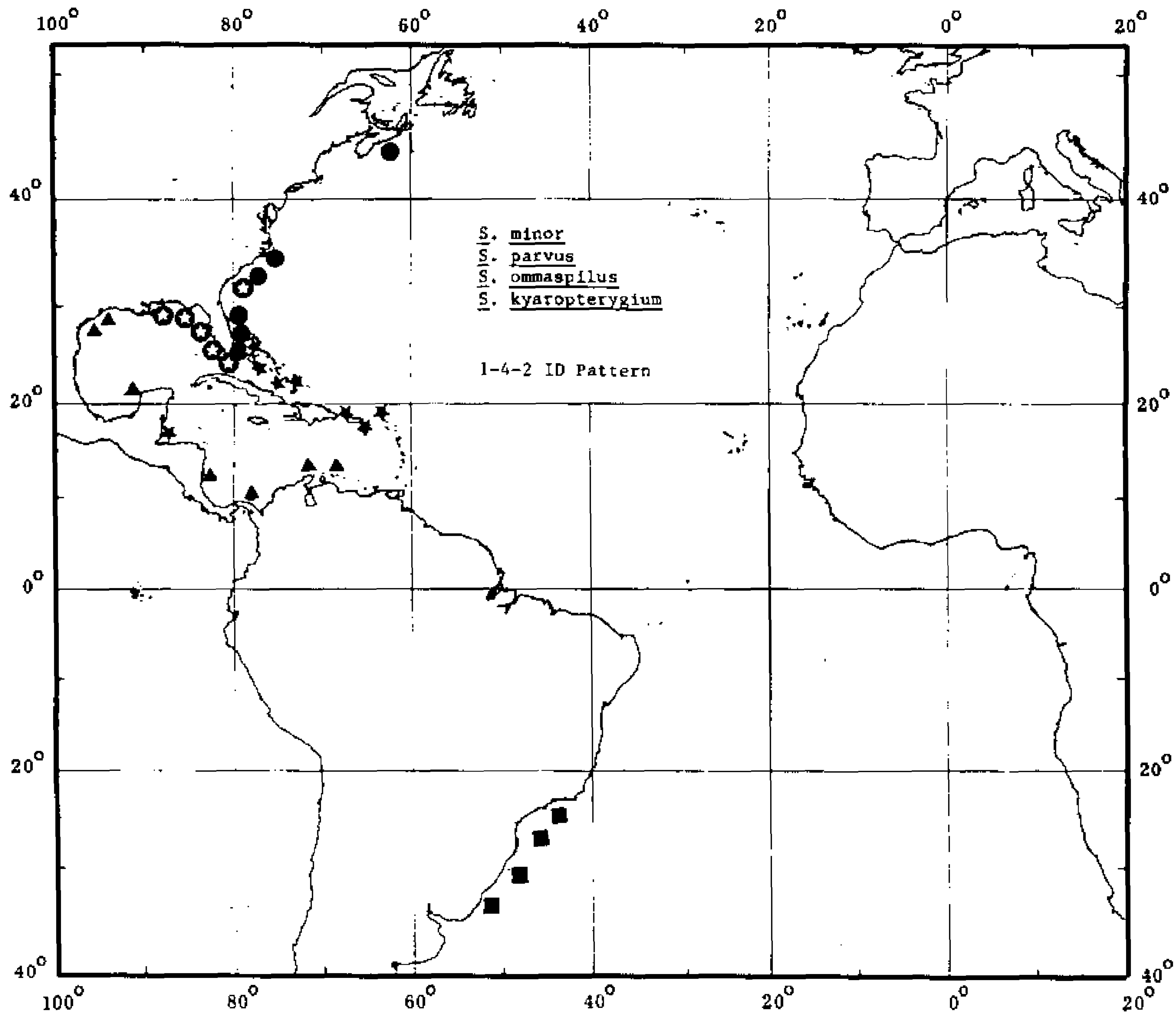


either 1-3-2 or >1-3-2 patterns (see below) have yet to be recorded from the Indo-Pacific region. Of the 13 species bearing this pattern, 11 occur in the Atlantic: three in the eastern Atlantic, and eight in the western Atlantic. Included among these species are two groups of closely related species, S. nigrescens and S. pusillus; Undescribed specis A and Undescribed species B and S. rhytisma (see individual species accounts for further information). The two eastern Pacific species (S. gorgonae and S. microlepis) are relatively deepwater species occurring at depths ranging from 50-100 m and 300-600 m, respectively. Of interest is that S. gorgonae forms an amphi-American species pair with S. pelicanus which occurs in the Atlantic from the Gulf of Mexico southward through the Caribbean Sea off northern South America (see account of S. pelicanus for further information).

Species with a 1-3-3 ID pattern occur on either side of the Atlantic Ocean (north and south of the equator) and in the eastern Pacific. Four species with a 1-3-3 ID pattern are S. atramentatus and S. varius from the eastern Pacific, S. trewavasae from the western South Atlantic and S. normani from the tropical eastern Atlantic. The geographic distribution of this species group is similar to that observed for 1-3-2 species where no representatives of this pattern type are found in the Indo-Pacific Ocean.

Species with a 1-4-2 ID pattern are entirely New World in distribution. They occur on both sides of the equator but only in the western Atlantic (Fig. 6). The four species with this particular pattern have been collected from the continental shelf off Nova Scotia (unusual strays of S. minor) southward into the South Atlantic to Rio Grande do Sul, Brazil. In the

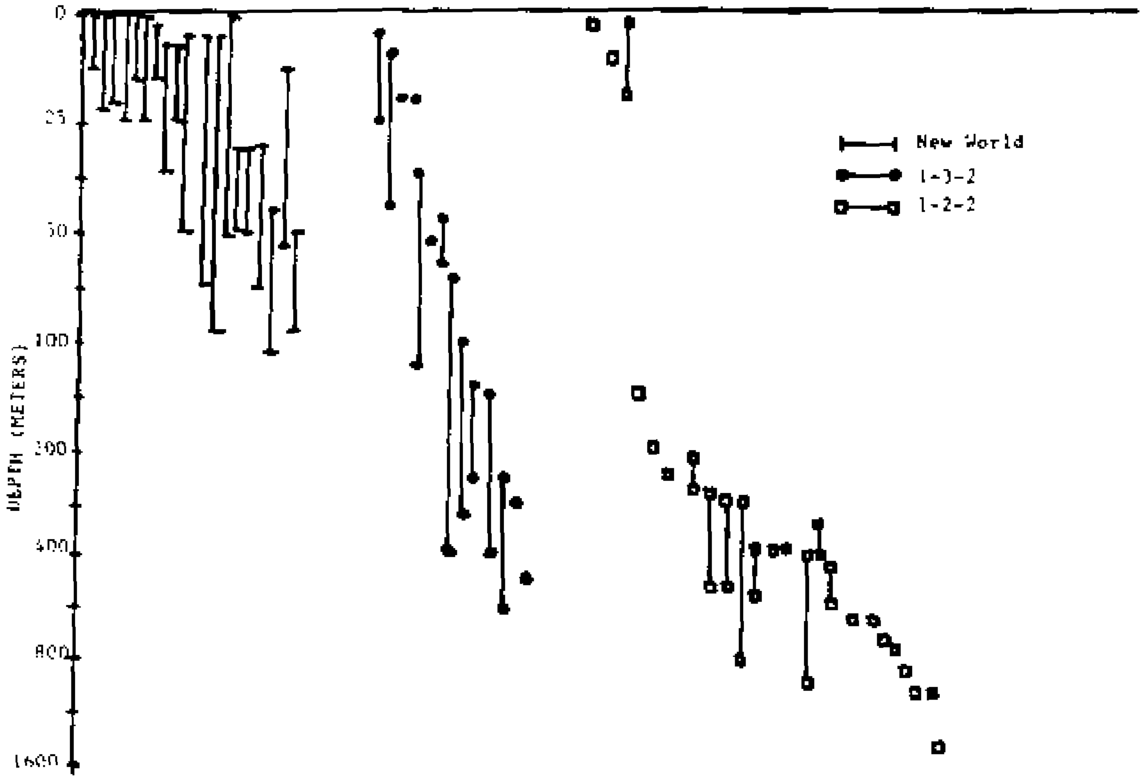
Figure 6. Geographic distribution of the four species of *Symphurus* characterized by a 1-4-2 interdigitation (ID) pattern.


100°
80°
60°
40°
20°
0°
20°
40°
S. minor
S. parvus
S. ommaspilus
S. kyaropterygium
1-4-2 ID Pattern

western North Atlantic, two species (*S. minor* and *S. parvus*) range from just south of Cape Hatteras, North Carolina, southward and coastally along eastern Florida. Both species range into the Gulf of Mexico along the west coast of Florida but *S. minor* extends into the Gulf of Mexico only as far (westward as the region of DeSoto Canyon. The range of *Symphurus parvus* is considerably more extensive and nearly encompasses the entire coastal seas of the Gulf of Mexico and Caribbean Sea. This species extends westward and southward throughout the Gulf of Mexico and Caribbean Sea along coastal Central America, extending coastally along northern South America to Trinidad. The third species of this group, *S. kyaropterygium*, is found in open shelf habitats. It is the only South Atlantic member of this group and ranges from Baia da Ilha Grande, Rio de Janeiro (23^{o}S) to Rio Grande do Sul (31^{o}S). The fourth member of this group, *S. ommaspilus*, is a widespread, insular Caribbean species. *Symphurus ommaspilus* occurs in shallow-water sand habitats adjacent to coral reefs from the Bahamas, Puerto Rico and Virgin Islands to Glovers Reef, Belize.

Species with 1-4-3 and 1-5-3 ID patterns occur entirely in coastal seas of the New World. Figure 5C shows that species with patterns >1-4-2 occur on either side of the Americas ranging from about 45^{o}N-35^{o}S in the Atlantic and from about 44^{o}N-20^{o}S in the eastern Pacific. Seventeen species possessing these patterns are distributed in the following manner: 11 species occur in the western Atlantic and nine species are resident in the eastern Pacific. Several geminate species pairs are included in this group. Further resolution of relationships among these species will have to await examination of additional material from the eastern Pacific.

Figure 7. Bathymetric ranges of Symphurus species representing the three most commonly observed interdigitation (ID) patterns.



New World
1-3-2
1-2-2
DEPTH (METERS)
0
25
50
100
200
400
800
1600

Ecological differences between the three groups are also apparent. A plot of bathymetric ranges (Fig. 7) is provided for representative species of Symphurus possessing different ID patterns. Data in this graph reveal that three species groups, each with quite distinct bathymetric ranges, can be recognized. Interestingly, these three ecological groups correspond to species groups defined above based on interdigitation patterns.

New World species (combined data for 1-4-2, 1-4-3 and 1-5-3 patterns) are primarily shallow water inhabitants. Most of these species are centered at depths shallower than 50 meters with several species occurring in estuarine and extremely shallow environments. The deepest record of common occurrence for any New World species is only about 110 m. It is of interest to note that only one of the 21 species in these groups possesses a black peritoneum- a character typically present in deep-water species of all other pattern groups.

Although not shown, the bathymetric distribution for species with a 1-3-3 ID pattern is different from the New World species. These species occupy substrates on the open continental shelf commonly occurring between 30-100 meters.

In contrast to New World species, with the exception of four dwarf species inhabiting relatively shallow sandy areas adjacent to coral reefs, the majority of 1-3-2 species are moderately deep water continental shelf species. Most occur between 30 and 200 m. Several species extend down to depths of about 500-600 m. It is of interest to note that the 1-3-2 species that occur in depths normally occupied by 1-2-2 species, do so only in geographic areas where species of the 1-2-2 group are absent. All species in this group with the exception of the four shallow-water dwarf species possess a black peritoneum.

The deepest-dwelling species in the genus are species with the 1-2-2, 1-2-3 and 1-2-2-1-2 patterns. Except for three shallow-water species, most are deep bathyal species occurring in outer continental shelf and slope waters. Most of these species have been taken at depths greater than 200 m. In fact, the deepest recorded capture for any member of the genus, approximately 1500 m, is for a species (S. australis) in this group. All species with a 1-2-2 pattern, except for the three shallow-water forms, possess a black peritoneum. Symphurus vanmelleae occurs along the West African continental slope at depths of 400-1000 m.

Complete osteological study of representatives for all interdigitation pattern groups is necessary to identify monophyletic assemblages within the genus. However, some preliminary data are available from observations made on cleared and stained specimens representative of three of the groups (1-2-2, 1-3-2 and 1-4-3 or New World group) outlined above. Differences between the groups were found in several characters including the development of a bony spur on the basipterygium, shape differences of the urohyal bones, development of dentition on eyed-side jaws, hypural numbers, caudal ray numbers, and modifications of the first pterygiophore (erisme).

Figure 8. Differences in shape and relative degree of development of a basipterygial spur (shaded in black) in six species of Symphurus representing different species groups as defined by interdigitation (ID) patterns.

A) S. undatus 1-2-3 ID pattern.

B) S. nebulosus 1-2-2 ID pattern.

C) S. pusillus 1-3-2 ID pattern.

D) S. diomedeanus 1-4-3 ID pattern.

E) S. civitatium 1-4-3 ID pattern.

F) S. plagiusa 1-4-3 ID pattern.

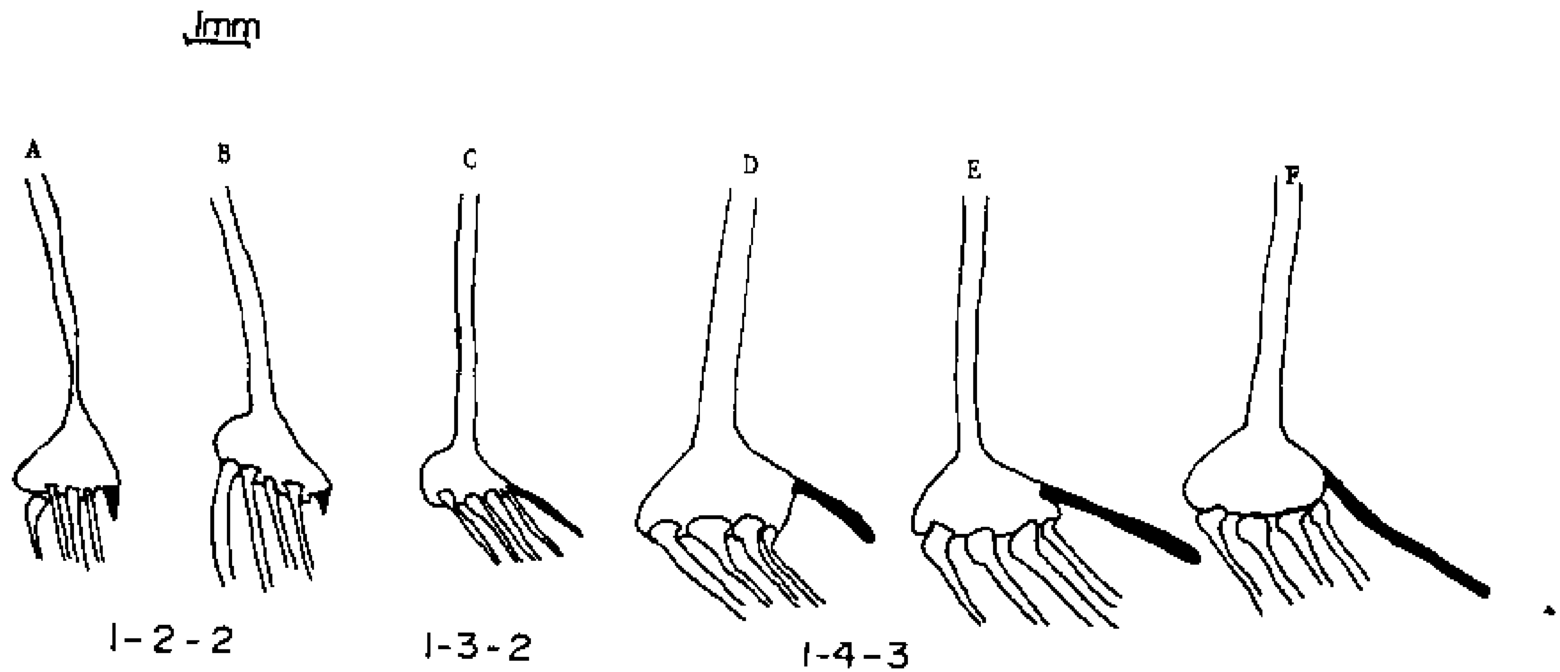

1mm
A
B
C
D
E
F
1-2-2
1-3-2
1-4-3

Figure 9. Variation in the shape of urohyal bones among species of _Symphurus_ representing different species groups as defined by interdigitation (ID) patterns.

A) _S. vanmelleae_ 1-2-2-1-2 Pattern

B) _S. nebulosus_ 1-2-2 Pattern

C) _S. marginatus_ 1-3-2 Pattern

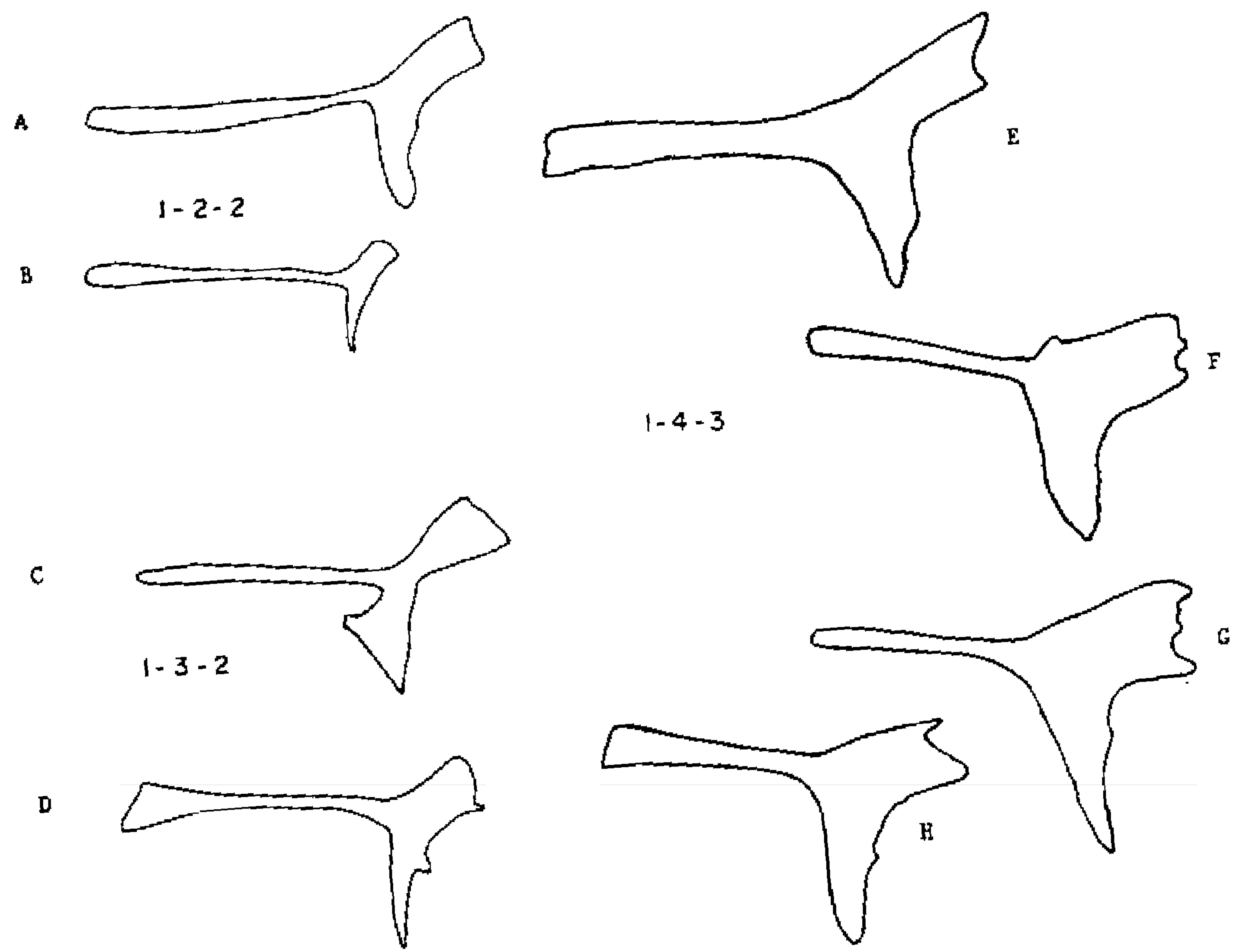
D) _S. pusillus_ 1-3-2 Pattern

E) _S. diomedeanus_ 1-4-3 Pattern

F) _S. plagiusa_ 1-4-3 Pattern

G) _S. civitatium_ 1-4-3 Pattern

H) _S. urospilus_ 1-4-3 Pattern


A
1-2-2
B
C
1-3-2
D
E
1-4-3
F
G
H

The basipterygial spur (Fig. 8) is either absent, nub-like or a blunt spike in the 1-2-2 species (also in 1-2-2-2-1 and 1-2-3 species). In contrast, in the 1-3-2 species examined thus far, this spur is moderately developed, equalling about one-third the length of the basipterygial shaft. In New World species, the basipterygial spur is even more elongate equalling or sometimes exceeding one-half the length of the basipterygial shaft.

The urohyal (Fig. 9) while basically similar in shape between the three species groups did show some variation with respect to the number and extent of posteriorly developed processes. In 1-2-2-1-2 and 1-2-2 species the bone is bi-lobed, with simple smooth margins. In 1-3-2 species the urohyal is more ornate with processes developed on either the dorsal or ventral flanges, or sometimes both flanges, of the posterior margin. In New World species, the urohyal is often tri-lobed with several processes developed on the posterior margin.

Differences were also noted between the three groups in the degree of development of the first highly modified pterygiophore (erisme). In 1-2-2-1-2 and 1-2-2 species the erisme is short, straight and usually does not reach the anteriormost extension of the anterior pseudointerneural spine (Fig. 4). In 1-3-2 species, the erisme is similarly shaped but of greater length, oftentimes equalling or slightly surpassing the anteriormost extension of the anterior pseudointerneural spine. In New World species (1-4-3 and 1-5-3 species), the erisme is strongly arched, extending anteriorly beyond the anteriormost extension of the pseudointerneural spine. In some species (S. civitatium, S. plagusia), it extends far enough anteriorly to form a bony support for the antero-dorsal margin of the snout.

Caudal ray count, an extremely conservative character at the species level (Table 10 below), will not definitively separate the species groups. However, there is a trend among the species groups with respect to caudal ray number and it should be noted that 1-2-2 species never have less than 12 caudal rays and are the only group to have greater than 12 caudal rays (14). The 1-3-2 species always have 12 caudal rays. Species with a 1-3-3 pattern have either 10 or 12 caudal rays. The four 1-4-2 species have only 10 caudal rays. Among the 1-4-3 and 1-5-3 species, there are species with 12, 11, or 10 caudal rays. Thirteen of 17 species have 12 caudal rays, three species have 10 and one species has 11 caudal rays.

Hypural number also varies between the three species groups, but similar to caudal ray counts, this character is not definitive for separating any of the species groups identified by ID pattern. All species in the 1-2-2 group that have 14 caudal rays were also found to have five hypurals. It is unknown at this time if any of the four species with 12 caudal rays and a 1-2-2 ID pattern also have five hypurals. Information is lacking for six of these species. For the remaining three species with 12 caudal rays and 1-2-2 ID pattern, there are only four hypurals in the caudal skeleton. Among other pattern groups, only two species, S. piger (all specimens) and S. marginatus (one-half of the specimens examined), in the 1-3-2 group possess five hypurals, all other species in this group have only four hypurals. Interestingly, in two of four species (S. varius all individuals and some individuals of S. normani) with a 1-3-3 ID pattern (both with 12 caudal rays) also have five hypurals. The other two species with this pattern have 10 or 12 caudal rays and four hypurals. Thus far, no species in any of the New World pattern groups have been found to have more than four hypurals.

The species groups differ in the degree of development of dentition on the eyed-side jaws. In all species groups, except the 1-4-2, 1-4-3 and 1-5-3 species, the dentition is strongly developed on all jaws. In New World species, dentition on eyed-side jaws is reduced or absent.

The combined results from osteological and ecological characters indicate that species with 1-2-2, 1-2-3 and 1-2-2-1-2 ID patterns are the most different from species with 1-4-3 and 1-5-3 patterns. It is interesting to note that Jordan and Evermann (1898: 2704) suggested dividing Symphurus into two subgenera, Symphurus and Acedia, based strictly on external differences in meristic characters, such as scale shape and number, and numbers of dorsal and anal fin rays. In subdividing Symphurus, Jordan and Evermann defined the subgenus Symphurus by the following combination of characters: scales rather large, 65-105 in a longitudinal series; snout and jaws with scales; dorsal rays 86-100; and with a range in anal fin rays from 70-87. This subgenus included all except one species in the genus. In constrast, the monotypic subgenus Acedia was characterized by having numerous (>120) small, keeled scales, each with a median dark line; scaleless snout and jaws; and numerous rays in the dorsal and anal fins. The single member of this subgenus, S. nebulosus, is a bathyal species of the western North Atlantic with a 1-2-2 ID pattern.

Recognition of subgeneric groups within Symphurus is not done in the present study because the information is still too preliminary. However, Jordan and Evermann's proposal placing S. nebulosus in a separate subgenus based on meristic differences is unfounded. As can be seen from Table 5, there is little basis for sub-dividing the genus based on meristic differences in the species. High meristics are features of species in several species groups defined by interdigitation patterns and other osteological data. Therefore, no formal subdivisions are recognized in the present study. Any acceptance of subdivisional groups within the genus will have to await completion of a more detailed osteological study using outgroup comparisons.

Summary

Eight ID pattern groups were identified among species of the genus *Symphurus*. Although a more thorough osteological study based on shared derived characters is needed to identify and define monophyletic assemblages within the genus, the preliminary grouping of species by interdigitation pattern is partially supported by a combination of other osteological characters. However, the strength of this preliminary hypothesis thus far lies in the patterns of interdigitation of dorsal pterygiophores and their respective distribution among the species. Other osteological characters such as caudal ray counts, hypural number, urohyal shape, modifications of the erisme and development of dentition on eyed-side jaws tended to support the proposed grouping of species by ID pattern and warrant further study. Zoogeographical distributions of species possessing identical patterns revealed interesting and potentially fruitful areas for interpreting questions about the historical biogeography of these flatfishes. In general, the distributional patterns of species possessing similar ID patterns also support group placement based on ID pattern. Additional information such as bathymetric distributions reflect ecological similarities among species assigned to ID pattern groups and are supportive to the proposed groupings of the species.

Although more work is necessary to provide an accurate definition of the species groups, this preliminary information provides a framework for future testing of the hypothesis that eight naturally occurring species groups, identifiable by ID pattern, exist within the genus *Symphurus*.

CHAPTER 6

Systematic Revision of Atlantic *Symphurus*

Atlantic symphurine tonguefishes share a relatively conservative body plan lacking marked external morphological distinctions. Instead, morphological diversification in this taxon appears more as subtle variations in morphometrics, meristics and pigmentation. Among the 29 species studied, there is a high degree of overlap in most of the characters considered. Seldom is it possible to identify an individual specimen based entirely on a single character, more often it requires a combination of characters including accurate counts of caudal rays and the numerous dorsal and anal rays. Internal characters which demonstrate the greatest differences between Atlantic species of symphurine tonguefishes include osteological characters such as ID patterns of dorsal pterygiophores, pigmentation of the peritoneum, number of hypurals and the number of caudal and abdominal vertebrae. Among external features, meristics, especially caudal fin ray counts, are extremely conservative and valuable in identifying the individual species. Other pertinent characters include dorsal and anal fin ray counts, degree of development of dentition on eyed-side jaws, presence or absence of a pupillary operculum, presence and degree of development of scales on blind-side dorsal and anal fins and variations in body pigmentation (both sides) and pigmentation patterns in the fins.

The following chapters comprise the revison of Atlantic Symphurus. The individual species are arranged by species groups based on shared interdigitation patterns as defined in Chapter 5. The order of presentation (groups listed by predominant ID pattern) is 1-2-2-2-1 and 1-2-2 species (Chapter 6.1), dwarf 1-3-2 species with peritoneum unpigmented (Chapter 6.2), 1-3-2 species with a black peritoneum (Chapter 6.3), 1-3-3 species (Chapter 6.4), 1-4-2 species (Chapter 6.5), 1-4-3 species with 10 and 11 caudal rays (Chapter 6.6) and 1-4-3 species with 12 caudal rays (Chapter 6.7).

Meristic characters were relied on heavily in diagnosing the species and tabular summaries of these characters for 29 species of Atlantic tonguefishes are presented in Tables 9-16.

Table 9. Summary of Predominant Interdigitation Patterns Observed in 29 Atlantic Species of *Symphurus*.

Species	N	1-2-2-1*	1-2-2	1-3-2	1-3-3	1-4-2	1-4-3	1-5-2	1-5-3
vanmelleae	47	46	-	-	-	-	-	-	-
ligulatus	37	4	27	-	-	-	-	-	-
nebulosus	23	-	20	-	-	-	-	-	-
arawak	34	-	1	25	3	-	-	-	-
rhytisma	6	-	-	6	-	-	-	-	-
undescribed A	2	-	-	2	-	-	-	-	-
undescribed B	5	-	-	5	-	-	-	-	-
ginsburgi	33	-	-	29	1	1	-	-	-
nigrescens	152	-	2	131	2	-	-	-	-
pelicanus	19	-	-	16	-	-	-	-	-
pusillus	19	-	-	16	1	-	-	-	-
undescribed C	78	-	-	76	1	1	-	-	-
marginatus	96	-	2	73	11	-	-	-	-
piger	144	-	2	136	1	-	-	-	-
normani	20	-	-	1	15	-	1	-	-
trewavasae	54	-	-	4	37	8	1	-	-
kyaropterygium	14	-	-	-	1	13	-	-	-
minor	78	-	-	3	-	73	1	-	-
ommaspilus	28	-	-	-	-	28	-	-	-
parvus	66	-	-	1	-	30	5	26	-
diomedeanus	207	-	-	-	7	13	150	6	12
jenynsi	93	-	-	-	4	2	61	2	6
plagiusa	132	-	-	-	22	24	80	3	1
urospilus	110	-	-	-	4	9	74	17	4
civitatium	177	-	-	-	8	19	127	7	3
plagusia	33	-	-	-	4	2	24	-	1
tessellatus	234	-	-	-	8	10	169	3	14
undescribed D	38	-	-	-	-	1	32	-	-
undescribed E	85	-	-	-	8	-	67	-	-

* Includes specimens with the following patterns: 1-2-1-2-2 (n=2); and 1-2-2-2-1 (n=13).

Table 10. Frequency Distributions of the Numbers of Caudal Rays for 29 Atlantic Species of *Symphurus*.

		CAUDAL RAY COUNT								
Species	N	8	9	10	11	12	13	14	15	16
vanmelleae	45	-	-	-	2	40	3	-	-	-
ligulatus	38	-	-	-	-	1	4	33	-	-
nebulosus	24	-	-	-	-	-	2	21	-	1
arawak	37	-	-	-	1	34	1	1	-	-
rhytisma	6	-	-	-	-	6	-	-	-	-
undescribed A	2	-	-	-	-	2	-	-	-	-
undescribed B	4	-	-	-	-	4	-	-	-	-
ginsburgi	30	-	1	-	1	27	1	-	-	-
nigrescens	154	-	-	-	6	147	1	-	-	-
pelicanus	18	-	-	-	2	15	1	-	-	-
pusillus	19	-	-	-	-	19	-	-	-	-
marginatus	98	-	-	-	3	94	1	-	-	-
piger	138	-	-	2	2	134	-	-	-	-
undescribed C	78	-	-	-	4	74	-	-	-	-
normani	23	-	-	-	-	23	-	-	-	-
trewavasae	57	-	-	57	-	-	-	-	-	-
kyaropterygium	13	-	-	12	1	-	-	-	-	-
minor	78	1	1	73	3	-	-	-	-	-
ommaspilus	25	-	-	25	-	-	-	-	-	-
parvus	68	-	2	65	1	-	-	-	-	-
diomedeanus	196	-	8	182	5	1	-	-	-	-
jenynsi	81	-	3	78	-	-	-	-	-	-
plagiusa	130	-	4	125	1	-	-	-	-	-
urospilus	110	-	1	4	105	-	-	-	-	-
civitatium	171	-			8	163	-	-	-	-
plagusia	33	-	-	-	1	31	1	-	-	-
tessellatus	223	-	-	4	11	206	2	-	-	-
undescribed D	53	-	-	-	4	49	-	-	-	-
undescribed E	82	-	-	1	2	78	1	-	-	-

Table 11. Frequency distributions of dorsal rays for 29 Atlantic species of *Symphurus*.

Dorsal Ray Number

Species	N	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92
vanmelleae	45																								
ligulatus	38																								
nebulosus	24																								
arawak	40		2	3	6	11	11	5																	
ginsburgi	34																			1	1	-	2	8	6
undescribed A	2																			1	1				
undescribed B	4																				2	2			
marginatus	97																								
nigrescens	158														1	2	3	7	21	28	33	38	18	5	2
pelicanus	19										3	2	3	5	2	3	-	1							
piger	140												1	1	1	8	15	40	46	24	4				
pusillus	19															1	1	2	7	4	4				
rhytisma	6															2	2	2							
undescribed C	78																					1	1	9	19
normani	20																			1	4	5	5	4	1
trewavasae	54																				2	8	13	18	10
kyaropterygium	13															1	6	2	3	1					
minor	78	1	-	1	15	18	21	9	7	3	-	2	-	1											
ommaspilus	25						1	4	5	8	6	1													
parvus	65							1	2	5	7	5	9	16	6	10	2	1	1						
civitatium	171																		2	3	14	33	49	46	23
diomedeanus	206																		1	3	10	25	43	56	39
jenynsi	88																								
plagiusa	128															2	9	9	11	25	30	34	7	1	
plagusia	54																					1	-	3	7
tessellatus	231																							1	1
urospilus	112															2	5	17	28	23	21	10	5	1	
undescribed D	54																								
undescribed E	82																					1	-	1	13

Species	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115
vanmelleae									1	4	4	7	15	7	6	1							
ligulatus										1	-	2	1	1	2	3	9	8	5	3	1		
nebulosus													1	-	2	7	7	5	1	-	1		
arawak																							
ginsburgi	12	4																					
undescribed A																							
undescribed B																							
marginatus	2	2	6	9	19	17	18	15	6	1	1	1											
nigrescens																							
pelicanus																							
piger																							
pusillus																							
rhytisma																							
undescribed C	28	17	3																				
normani																							
trewavasae	1	2																					
kyaropterygium																							
minor																							
ommaspilus																							
parvus																							
civitatium	1																						
diomedeanus	24	1	1	1																			
jenynsi															1	5	9	20	15	19	9	7	3
plagiusa																							
plagusia	21	10	4	6	2																		
tessellatus	6	16	37	29	50	36	28	17	9	1													
urospilus																							
undescribed D							4	14	17	9	5	2	-	1	2								
undescribed E	29	24	9	5																			

Table 12. Frequency Distribution of Anal Rays for 29 Atlantic Species of *Symphurus*.

Anal Ray Number

Species		55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102
vanmelleae	45																																1	4	4	10	13	6	3	4									
ligulatus	17																																				2	2	–	6	5	8	11	2	–	–	–	–	1
nebulosus	24																																					1	–	7	4	4	6	4	7	1			
arawak	39	1	3	2	8	10	11	3																																									
ginsburgi	34																					1	2	7	8	9	5	2																					
undescribed A	2																				2																												
undescribed B	4																				2	2																											
marginatus	97																										5	6	8	21	24	17	10	2	2	2													
nigrescens	158															2	1	3	20	30	42	27	21	9	2	1																							
pelicanus	19										4	3	2	5	3	2																																	
piger	140														3	6	18	48	38	19	7	1																											
pusillus	19																	1	4	10	2	2																											
rhytisma	6														1	2	1	2																															
undescribed C	78																						3	8	18	21	20	7	3	1	1																		
normani	20																			2	6	8	2	2																									
trewavasae	54																			2	8	15	17	7	5																								
kyaropterygium	13													1	1	2	5	3	1																														
minor	78	1	3	6	23	22	11	4	3	2	3																																						
ommaspilus	25						2	6	13	2	2																																						
parvus	65						1	1	4	6	14	10	16	7	3	2	1																																
civitatium	173																1	2	6	34	49	57	20	3	1																								
diomedeanus	206															1	1	2	6	28	51	58	40	15	3	–	1																						
jenynsi	88																																					2	3	11	25	14	20	8	3	2			
plagiusa	137													4	6	10	12	24	29	32	12	3																											
plagusia	33																					3	6	12	4	6	1	1																					
tessellatus	231																							4	24	33	42	45	36	26	18	2	1																
urospilus	113										2	–	1	3	21	24	27	24	8	2	1																												
undescribed D	55																											1	2	5	12	17	5	5	1	2													
undescribed E	81																				1	3	6	24	38	6	3																						

Table 13. Frequency Distributions of the Numbers of Vertebrae for 29 Atlantic Species of *Symphurus*.

Species	N	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61
										VERTEBRAE NUMBER														
vanmelleae	44																	1	13	19	10	1	-	-
ligulatus	38																	-	1	1	4	19	10	3
nebulosus	23																	-	-	1	9	11	2	-
arawak	38	1	13	18	6	-	-	-	-	-	-	-												
chrtisma	6	-	-	-	-	-	-	-	1	4	1	-												
undescribed A	2	-	-	-	-	-	-	-	-	-	1	1												
undescribed B	4	-	-	-	-	-	-	-	-	-	1	3												
ginsburgi	33	-	-	-	-	-	-	-	-	-	-	-	3	19	11	-	-	-	-					
nigrescens	157	-	-	-	-	-	-	-	-	2	42	78	31	4	-	-	-	-	-					
pelicanus	18	-	-	-	-	-	4	6	8	-	-	-	-	-	-	-	-	-	-					
pusillus	19	-	-	-	-	-	-	-	-	1	10	8	-	-	-	-	-	-	-					
marginatus	95	-	-	-	-	-	-	-	-	-	-	-	-	1	17	36	37	2	2					
piger	142	-	-	-	-	-	-	1	3	49	79	10	-	-	-	-	-	-	-					
undescribed C	78	-	-	-	-	-	-	-	-	-	-	-	8	40	29	1	-	-	-					
normani	21	-	-	-	-	-	-	-	-	-	5	13	3	-										
trewavasae	51	-	-	-	-	-	-	-	-	4	19	22	4	2										
kyaropterygium	13	-	-	-	-	-	-	-	-	9	3	1												
minor	78	-	-	11	45	18	4	-	-	-	-	-												
ommaspilus	22	-	-	-	-	10	12	-	-	-	-	-												
parvus	65	-	-	-	-	1	12	21	28	3	-	-												
diomedeanus	206	-	-	-	-	-	-	-	-	4	45	126	31	-	-	-	-	-	-	-	-	-	-	
jenynsi	87	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	36	36	11	
plagiusa	133	-	-	-	-	-	-	16	29	66	21	1	-	-	-	-	-	-	-	-	-	-	-	
urospilus	112	-	-	-	-	-	3	54	47	7	1	-	-	-	-	-	-	-	-	-	-	-	-	
civitatium	174	-	-	-	-	-	-	-	2	34	108	28	2	-	-	-	-	-	-	-	-	-	-	
plagusia	33	-	-	-	-	-	-	-	-	-	3	14	11	5	-	-	-	-	-	-	-	-	-	
tessellatus	232	-	-	-	-	-	-	-	-	-	-	3	46	80	70	31	2	-	-	-	-	-	-	
undescribed D	37	-	-	-	-	-	-	-	-	-	-	-	-	-	2	23	11	1	-	-	-	-	-	
undescribed E	79	-	-	-	-	-	-	-	-	-	1	43	32	3	-	-	-	-	-	-	-	-	-	

Table 14. Frequencies of longitudinal scale rows for 29 Atlantic species of *Symphurus*.

Species	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
arawak	1	-	1	3	4	6	3	7	7	3	1										
minor	2	1	3	3	6	9	8	8	6	3	1	1	2								
nigrescens	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	1
pelicanus	-	-	-	-	-	-	-	1	1	1	2	1	1	2	1	1					
piger	-	-	-	-	-	-	-	1	-	3	1	9	9	10	13	13	9	10	6	1	1
trewavasae	-	-	-	-	-	-	-	-	-	-	-	-	1	1	1	2	4	3	5	12	1
ommaspilus	-	-	-	4	1	2	1	8	4	2											
parvus	-	-	-	-	2	2	3	1	5	4	4	5	2	1	2	3	2	-	1	4	1
kyaropteryg.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	1
urospilus	-	-	-	-	-	-	-	-	-	-	-	-	1	2	2	3	5	6	3	5	5
civitatium	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	2	-	-	1	4	8

Species	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96
rhytisma	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	1	-	1	1
new specis B	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
ginsburgi	-	-	-	-	-	-	-	-	-	-	-	2	2	-	2	1	-	2	2		
marginatus	-	-	-	-	-	-	-	-	-	-	3	3	5	5	6	6	8	5	6	5	3
nigrescens	-	2	2	1	5	2	7	6	6	4	8	11	6	5	3	2					
pusillus	-	1	1	-	1	-	-	3	1	-	-	1									
new species C	-	-	-	-	1	-	-	-	-	3	-	-	4	1	1	-	4	1	2	-	-
trewavasse	5	3																			
parvus	-	-	1																		
kyaroptery.	1	3	-	-	-	1															
diomedeanus	-	-	-	1	-	-	1	1	4	5	7	11	12	13	11	8	13	9	3	1	1
plagiusa	1	2	1	4	2	6	4	2	7	-	1										
urospilus	11		4	5	4	2	1														
civitatium	11	5	14	8	7	3	3	1													
plagusia	-	-	-	1	3	2	3	2	2	1	3	-	-	2							
tessellatus	-	-	-	-	-	2	2	8	10	10	11	21	31	21	20	14	5	4	2	-	1
new species D	-	-	-	-	-	-	-	-	-	1	3	1	7	5	2	6	4	2	-	1	-
new species E	-	-	3	-	4	11	4	3	6	2	2	1	1	3							

Table 14. (Continued)

Count

	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	
vanmelleae	-	-	-	-	-	-	-	-	-	-	2	2	2	4	3	2	
rhytisma	1																
new sp. A	1	-	1														
new species B	-	-	-	-	1	-	1	-	-	1	-	-	1				
new species C	-	2	1	2													
marginatus	1	1	2														
normani	-	-	2	1	-	2	2	1	-	-	1	3	1				
jenynsi	-	-	-	-	-	1	-	3	2	3	3	1	2	1	3	3	2
new species D	-	1															

	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128
vanmelleae	2	3	3	2	2	2	-	-	-	1	1	1				
ligulatus	-	-	1	-	1	-	-	1	-	1	1	2	-	-	1	4
nebulosus	-	-	-	-	-	-	-	1	-	-	1	1	2	2	-	4
jenynsi	2	5	2	1	-	1										

	129	130	131	132	133	134	135
ligulatus	1	-	1	1	-	-	1
nebulosus	1	4	-	1	-	1	1

Table 15. Frequencies of the numbers of scale rows on the posterior portion of the head for 29 Atlantic species of *Symphurus*.

Species	Count																
	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
vanmelleae	-	-	-	-	-	-	-	-	1	3	3	13	6	3	6	-	1
ligulatus	-	-	-	-	-	-	-	3	4	6	-	1	-	-	-	-	-
nebulosus	-	-	-	-	-	-	-	1	2	4	8	3	1	-	-	-	-
arawak	2	6	14	16	-	-	-	-	-	-	-	-	-	-	-	-	-
rhytisma	-	-	-	-	-	-	4	1	1	-	-	-	-	-	-	-	-
new species A	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-
new species B	-	-	-	-	-	-	2	1	1	1	-	-	-	-	-	-	-
ginsburgi	-	-	-	1	2	2	4	5	3	-	-	-	-	-	-	-	-
nigrescens	-	-	-	-	4	10	18	13	14	4	1	-	-	-	-	-	-
pelicanus	-	-	4	2	1	1	-	-	-	-	-	-	-	-	-	-	-
pusillus	-	-	-	-	-	4	3	2	-	-	-	-	-	-	-	-	-
piger	-	-	-	-	3	28	26	13	1	1	-	-	-	-	-	-	-
marginatus	-	-	-	-	6	32	25	5	-	-	-	-	-	-	-	-	-
new species C	-	-	-	-	1	2	3	7	6	3	1	-	-	-	-	-	-
normani	-	-	-	-	-	-	-	-	-	-	2	3	3	3	-	-	-
trewavasae	-	-	-	4	23	10	3	-	1	-	-	-	-	-	-	-	-
minor	2	13	23	12	-	-	-	-	-	-	-	-	-	-	-	-	-
ommaspilus	-	-	5	9	6	3	-	-	-	-	-	-	-	-	-	-	-
parvus	-	1	5	20	8	4	1	-	-	-	-	-	-	-	-	-	-
kyaropterygium	-	-	-	-	4	5	1	-	-	-	-	-	-	-	-	-	-
diomedeanus	-	-	-	-	11	25	32	29	3	2	-	-	-	-	-	-	-
jenynsi	-	-	-	-	-	-	-	-	-	2	15	12	5	1	-	-	-
plagiusa	-	-	-	1	2	17	8	3	-	-	-	-	-	-	-	-	-
urospilus	-	2	11	25	26	3	-	-	-	-	-	-	-	-	-	-	-
civitatium	-	-	-	-	3	18	32	16	3	-	-	-	-	-	-	-	-
plagusia	-	-	-	-	-	-	8	4	8	2	1	-	-	-	-	-	-
tessellatus	-	-	-	-	-	-	1	-	8	8	4	1	-	-	-	-	-
new species D	-	-	-	-	-	-	-	3	8	1	1	2	-	-	-	-	-
new species E	-	-	-	-	-	1	1	9	16	8	3	-	-	-	-	-	-

Table 16. Number of lateral scale rows for 29 Atlantic species of *Symphurus*.

SPECIES	COUNT 24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42
vanmelleae	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	4	1	1
ligulatus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
arawak	-	-	-	1	-	1	-	1	9	9	5	4	8	-	-	-	-	-	-
undescribed B	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
ginsburgi	-	-	-	-	-	-	-	-	1	-	-	1	-	2	1	2	1	4	1
nigrescens	-	-	-	-	-	-	1	-	1	1	2	2	4	1	2	4	2	3	2
pelicanus	2	1	5	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-
marginatus	-	-	-	-	-	-	3	1	1	-	2	3	-	1	-	-	-	-	-
piger	-	-	-	-	-	-	-	-	1	2	2	5	3	2	2	-	-	-	-
pusillus	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-
undescribed C	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	1	-
normani	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-
trewavasae	-	-	-	-	-	-	-	1	2	8	11	9	-	2	-	-	-	-	-
kyaropterygium	-	-	-	-	-	-	-	-	-	-	-	-	4	3	-	2	-	-	-
minor	1	2	2	1	3	6	7	7	-	-	-	-	-	-	-	-	-	-	-
ommaspilus	-	-	-	1	-	6	5	5	2	1	-	-	-	-	-	-	-	-	-
parvus	-	-	2	-	1	2	5	4	5	2	2	1	-	-	-	-	-	-	-
diomedeanus	-	-	-	-	-	-	-	-	-	-	2	2	3	4	12	15	16	7	3
jenynsi	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1
plagiusa	-	-	-	-	-	-	1	-	-	2	2	5	4	6	6	4	-	-	-
urospilus	-	-	-	1	-	1	2	8	15	11	13	3	3	1	8	7	8	-	-
civitatium	-	-	2	1	2	-	2	5	4	6	2	11	5	6	6	1	-	-	-
plagusia	-	-	-	-	-	-	-	-	-	-	-	1	-	-	2	3	7	3	3
tessellatus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	2	4	5	2
undescribed D	-	-	-	-	-	-	-	-	-	-	-	-	1	1	6	2	2	1	1
undescribed E	-	-	-	-	-	-	-	-	-	-	-	-	2	3	6	10	3	6	2

Table 16. (Continued).

	43	44	45	46	47	48	49	50	51	52	53	54	55	56
ligulatus	-	-	1	2	-	-	-	-	-	-	-	-	-	-
nebulosus	1	1	1	1	1	-	3	1	-	-	-	-	-	-
rhytisma	2	2	1	-	-	-	-	-	-	-	-	-	-	-
undescribed A	1	-	-	-	-	1	-	-	-	-	-	-	-	-
undescribed B	1	-	-	-	-	-	-	-	-	-	-	-	-	-
ginsburgi	-	1	-	-	-	-	-	-	-	-	-	-	-	-
undescribed C	-	-	1	1	-	-	1	-	-	-	-	-	-	-
normani	-	1	4	-	1	-	-	-	-	-	-	-	-	-
diomedeanus	4	4	1	1	1	-	-	-	-	-	-	-	-	-
jenynsi	1	3	6	6	7	5	2	-	1	-	-	-	-	-
plagusia	1	-	-	-	-	-	-	-	-	-	-	-	-	-
tessellatus	1	3	2	-	-	-	-	-	-	-	-	-	-	-
undescribed E	1	1	-	-	-	-	-	-	-	-	-	-	-	-

CHAPTER 6.1

1-2-2-1-2 and 1-2-2 ID Pattern Species

Symphurus vanmelleae Chabanaud 1952

(Fig. 39A)

S. vanmelleae

Chabanaud 1952: 3; Original description; West Africa 6°25'S-11°53'S;

. Holotype IRSB 16808-439.

Nielsen 1963: 27; Figured; West Africa; Doubtful synonymy with *S. ligulatus*.

Maurin 1968: 56; Mentioned, West Africa.

Aldebert 1970: 216; Suggested synonymy with *S. ligulatus* (Cocco 1840).

Allue 1982: 306. Mentioned.

Matallanas 1984: 198; Doubtful synonymy with *S. ligulatus*.

S. vanmellae

Blache et al. 1970: 79; Listed Gulf Guinea and Angola.

Torchio 1971: 262; Synonymized with *S. ligulatus*.

Torchio 1973: 636; Questionable synonymy with *S. ligulatus*.

Maul 1976: 64; Counts, comparison and clarification with *S. ligulatus*.

Study Material: 47 specimens, 68.0-118 mm SL. 47 x-rayed; 42 measured.

Remarks

Prior to discovery of adult S. ligulatus (Torchio 1963) there was considerable confusion in the literature between S. vanmelleae and this species. Both have similar counts and body shape and both species are deep-sea inhabitants that have not been collected in sufficient numbers for comparative study until only recently. Furthermore, early descriptions of S. ligulatus (Cocco 1844; Kyle 1913; Padoa 1942) were based entirely upon larval stages. Although many symmetrical, pre-metamorphic larvae of S. ligulatus were known from the Mediterranean Sea and Canary Islands region (Cocco 1844; Kyle 1913; Padoa 1941), adults of this species were completely unknown until Torchio described two specimens in 1963. Adding to the confusion was Chabanaud's statement (1952) in the original description of S. vanmelleae tentatively suggesting that S. vanmelleae was possibly the adult form of S. ligulatus. Nielsen (1963) also tentatively proposed that S. vanmelleae and S. ligulatus were the same species, but his study was conducted prior to Torchio's (1963) published account on adult specimens of S. ligulatus.

Even following the discovery and description of adult specimens of S. ligulatus, the status of S. vanmelleae remained uncertain (Aldebert 1970; Torchio 1971; 1973; Golovan 1978; Matallanas 1984). Diagnostic differences between this species and S. ligulatus were still unclear. For example, morphological similarities between the two species prompted Torchio (1971) to conclude, even after directly examining adults of both species, that only one species was represented among material he examined. It was not until sufficient specimens of S. ligulatus became available that Maul (1976) properly diagnosed these two species (based on caudal rays and other meristic differences) and clearly established the validity of both S. vanmelleae and S. ligulatus.

Diagnosis

Symphurus vanmelleae is the only Atlantic species with the combination of 10-11 abdominal vertebrae, the unique ID pattern of 1-2-2-1 or 1-2-2-2-1, 12 caudal rays and 56-58 vertebrae. It has a narrow body similar in shape to the eastern Atlantic species, S. ligulatus, and to the western Atlantic species, S. nebulosus and S. marginatus. It differs from the first two species in its ID pattern (1-2-2-1 vs. 1-2-2) and generally lower counts, especially caudal ray number (12 vs. 14). From S. marginatus it differs in ID pattern (1-2-2-1 vs. 1-3-2), vertebral number (56-58 vs. 52-54) and pigmentation (plain brown-gray vs. brown-gray with well-developed, dark brown caudal blotch in S. marginatus).

Symphurus vanmelleae is of considerable interest in that this species possesses 10 (3+7) or rarely 11 (3+8) abdominal vertebrae. This particular arrangement of abdominal vertebrae is unusual for members in the genus. Usually, Symphurus species possess 9 (3+6) abdominal vertebrae (present in all other Atlantic species and all but three species in the genus). The three species with 10 (3+7) abdominal vertebrae are known only from the Indo-West Pacific. These are S. regani, S. gilesi and S. arabicus. All three may readily be distinguished from S. vanmelleae by caudal ray count

(12 vs. 14). Symphurus arabicus is known only from the holotype. It differs from S. vanmelleae in several additional meristic characters, most notably in lower dorsal (97 vs. 101-108), anal (84 vs. 86-93) and vertebral counts (53 vs. 56-58). Symphurus vanmelleae differs from S. gilesii by having a greater number of dorsal (101-108 vs. 97-98) and anal rays (86-93 vs. 83-85). Symphurus vanmelleae generally overlaps S. regani in all meristics except caudal ray number (12 vs. 14).

Description

A medium-sized tonguefish attaining maximum adult lengths of approximately 118 mm SL. ID pattern 1-2-2-1 or 1-2-2-2-1 (Table 9). Caudal rays 12, less frequently otherwise (Table 10). Dorsal rays 101-108 (Table 11). Anal rays 86-93 (Table 12). Vertebrae: abdominal 3+7-8; total usually 56-58 (Table 13). Hypural number usually 5 (34/46), less frequently 4 (12/46). Scales in longitudinal series 107-124 (usally 110-118) (Table 14). Scale rows on head posterior to lower orbit 20-26, usually 23-26 (Table 15). Lateral scale rows 38-42 (Table 16). Proportional measurements appear in Tables 17-18.

Body narrow (depth 21.0-27.0% SL) with gradual taper. Head relatively short (13.0-23.4% SL); head length nearly equal to width. Snout moderately long (15.7-28.6% HL), covered with small ctenoid scales. Anterior nostril on eyed side much closer to rostral extremity of premaxilla than to fixed eye; not passing midpoint of distance between nostril base and fixed eye when depressed backwards. Posterior extension of maxilla usually reaches only to anterior margin of pupil of lower eye; sometimes extending a small

Table 17. Summary of morphometrics for Symphurus vanmelleae. Measurements, except SL (in mm), expressed as thousandths of Standard Length.

Character	N	Range	Mean	Standard Deviation
SL	42	68.0-118.4	100.0	11.28
BD	42	210-270	242.2	14.91
PDL	42	38-63	51.6	5.69
PAL	42	163-285	232.0	22.27
DBL	42	875-976	948.5	15.64
ABL	42	693-772	746.9	18.89
PL	40	44-76	60.7	6.25
PA	42	43-83	60.5	8.48
CFL	38	72-109	93.4	7.22
HL	42	130-234	192.7	14.63
HW	42	117-241	193.1	18.94
POL	42	111-161	126.5	8.77
SNL	42	29-47	38.6	4.10
UJL	42	33-46	38.3	3.28
ED	42	21-29	25.4	1.82
CD	42	11-41	30.1	4.72
UHL	42	81-130	105.0	11.43
LHL	42	66-120	100.2	12.72

Table 18. Summary of morphometrics for *Symphurus vanmelleae*. Measurements, except SL (in mm), expressed as thousandths of Standard Length.

Character	N	Range	Mean	Standard Deviation
HW	42	625-1094	1002.8	79.53
POL	42	601-920	658.1	48.27
SNL	42	157-286	201.3	23.87
UJL	42	169-268	199.7	19.02
ED	42	111-196	132.7	14.45
CD	42	61-232	156.0	27.81
OPLL	40	199-366	273.8	40.92
OPUL	40	138-446	243.2	56.94
UHL	42	432-732	543.4	68.34
LHL	42	364-875	521.8	82.81

distance posterior to front edge of pupil. Eyes moderate (11.1-19.6% HL); equal in position. Eyes usually with from 3-6 scales in narrow interorbital space. Pupillary operculum absent. Dorsal fin origin at a vertical equal to midpoint of upper eye; rarely anterior to mid-point. Opercular lobes of eyed side equal. Scales absent from blind side dorsal and anal fins.

Teeth well developed on all jaws. Dentary on ocular side with a single row of strong teeth; premaxilla on ocular side usually with a complete or nearly complete single row of teeth.

Pigmentation (Based mostly on recently preserved (1983) material from IOS 10873)

Eyed surface usually dark brown to grayish-blue with no obvious pigment patterns. Scales with underlying pigment forming longitudinal streaks along body from just above eyes to caudal extremity. Snout region clear. Blackened longitudinal line at mid-body more or less evident in area of myomere separation. Pterygiophore regions of anal and dorsal fins demarcated from main trunk myomeres by obvious longitudinal black line. Pterygiophore region darker in color than trunk; dark brown or bluish-gray pigment continues from pterygiophore region onto basal half of dorsal and anal rays giving them a dark color for the first half of their length. Operculum with dusky-brown to bluish pigment slightly darker in color than general background color. Inner lining of both sides of operculum, isthmus and mouth cavity with black pigment. Tongue unpigmented. An obvious moustache present on upper lip of eyed side. Blind side mostly clear, occasionally some diffuse yellowish-brown markings. Peritoneum black, clearly visible through abdominal wall on both sides.

Dorsal and anal fins with dark brown or grayish-blue pigment along proximal half of rays. Distal half of rays unpigmented. Caudal fin rays dusky, without obvious pigment pattern.

Geographic and Bathymetric Distribution (Fig. 10)

Symphurus vanmelleae is a bathyal species inhabiting mud bottoms along equatorial West Africa. Thus far, this species has been collected from a relatively restricted region extending from approximately 14°N to 11°S . Symphurus vanmelleae has been trawled entirely from deep-water stations on the outer continental shelf and upper slope region (depths of 400-925 m). The shallowest depth of capture is for a single specimen at 361 m, but the majority of specimens (30) were taken in a single haul from 925 m which is also the deepest recorded depth for this species.

Ecology

This species has rarely been captured and is poorly represented in collections. Six of 10 lots examined were collections of solitary specimens. Only four lots contained two or more specimens. The largest single collection (IOS 10873), taken off the northwest coast of Africa (14°49'N; 17°43'E) at 925M, contained 30 specimens.

Due to the infrequency of capture of S. vanmelleae, virtually nothing is known concerning life history aspects. Specimens examined in this study ranged in size from 68.0-118 mm SL. Eighteen males and 26 females were represented in the material examined (information unavailable for three specimens). Analysis of 44 specimens for which information was available, indicated that females attain slightly larger sizes than males. The three largest fish were females measuring 118, 115 and 113 mm SL, respectively. By comparison, the two largest males measured only 110 mm SL.

Based on reproductive stages of females, it is apparent that this species matures at sizes slightly larger than 90 mm SL. The five smallest females (77.2-86.0 mm SL) were undergoing gonad elongation or had elongate ovaries without ripe ova. Two females, 94.2 and 99.2 mm SL, had fully elongate ovaries without visible signs of ripened ova (spent ?). Sixteen females ranging in size from 96.7-118 mm SL had fully extended ovaries containing ripe ova.

Material Examined

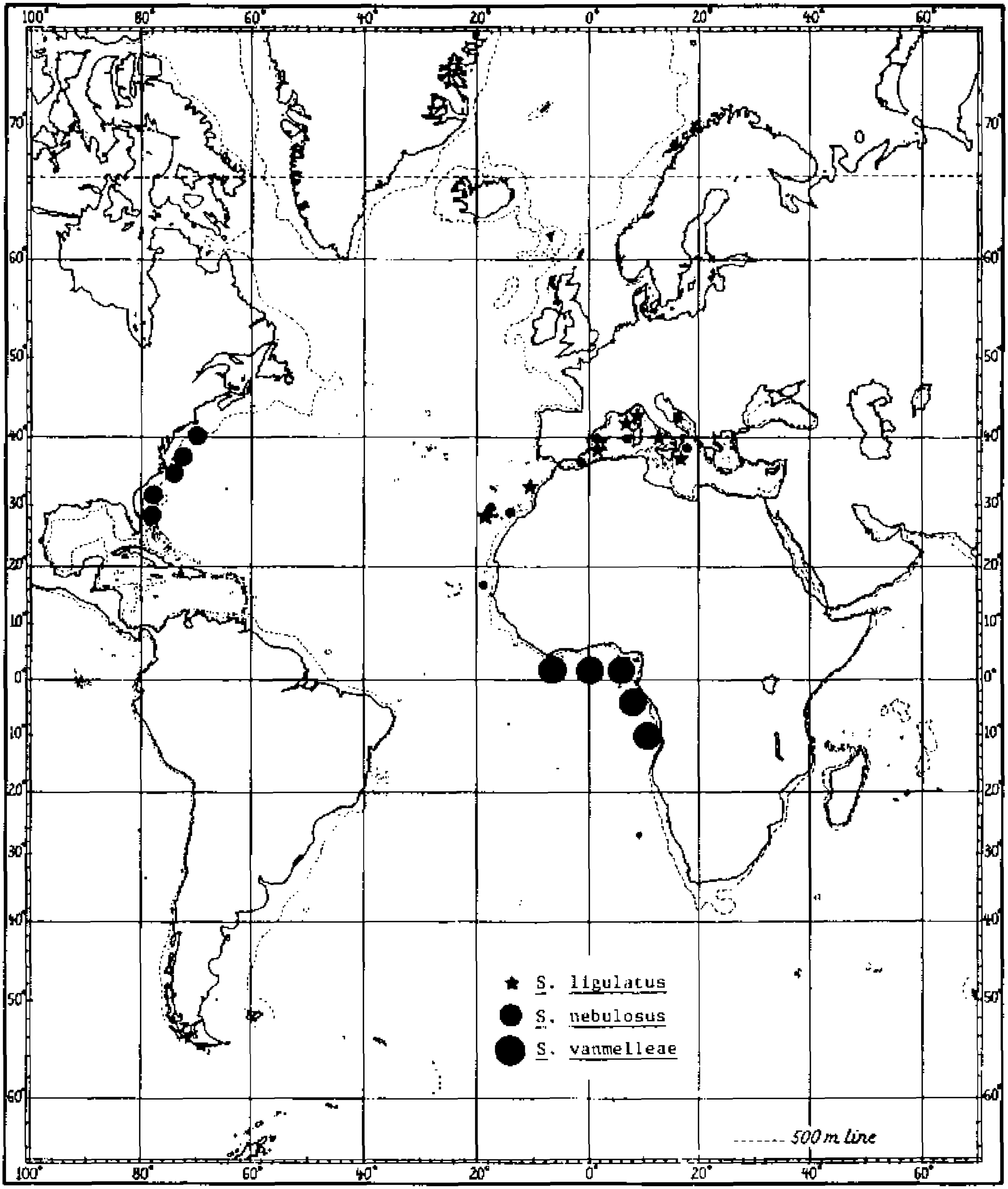
Measured and Counted 41 Specimens, 8 Lots.

IRSNB 16808-439; Holotype (104.8); 11°53'S 13°20'E; 500M; 18 XII 48. IRSNB 16808-440; Paratype (96.9); 07°16'S 12°02'E; 440M; 01 X 48. UF 33891; 4(77.2-107); 02°00'S 08°46'E; 536M; 04 IX 63. UMML UNCAT; 2(68.0-83.7); 02°30'S 08°52'E; 494M; 05 IX 64. ZMUC 86226; (97.1); 02°09'N 09°27'E; 455M; 1 III 46. ZMUC 86227; (113); 07°55'S 12°38'E; 400M; 1 III 46. UMML UNCAT; (80.5); 03°02'S 09°16'E; 400M; 6 IX 63. IOS DISC ST 10873; 30(82.6-118.4); 14°49.40'N 17°43.69'W; 925M; 07 VIII 83.

Counted 5 Specimens, 5 Lots.

BMNH 1962.6.18:138; (97.3); 07°55'S 12°38'W; 400M; 01 III 46. BMNH 1962.6.18:139; (102); 07°55'S 12°38'W; 400M; 01 III 46. UMML UNCAT TABL 68-287; (97.4); 10°36'S 13°12'E; 361M; 12 IV 68. ZMUC 86230; (105); 07°55'S 12°38'E; 400M; 17 III 46. ZMUC 86233; (94.0mm); 07°55'S 18°38'E; 400M; 17 III 46.

Figure 10. Geographic distributions of *Symphurus vanmelleae*, *S. ligulatus* and *S. nebulosus*.



Atlantic 1-2-2 and 1-2-2-1-2 Species.

Symphurus ligulatus (Cocco 1844)

(Fig. 39B)

Bibronia ligulata

Cocco 1844: 25; Original description based on symmetrical larvae; Mediterranean, Messina.

Facciola 1885: 264; Larvae; Mediterranean, Messina.

Jordan and Goss 1889: 330; Discussion of larval forms and possible synonymy with *S. nigrescens*.

Peloria ruppeli (nec *Peloria ruppellii* Cocco 1844 = *Arnoglossus*)

Emery 1883: 403; Larvae; Mediterranean, Messina and Naples.

Raffaele 1888: 53; Larvae; Mediterranean, Naples; (*Peloria ruppeli* Emery not *Peloria ruppeli* Cocco).

Ammopleurops sp.

Lo Bianco 1909: 513; Larvae; Mediterranean, Naples; *Bibronia* = *Ammopleurops*.

Symphurus ligulata

Kyle 1913:138; Description of symmetrical larvae; Counts, figure (Plate IV; Figs. 45-46), synonymy, distinguished from *S. nigrescens*; Mediterranean, Ionian Sea and Atlantic, S of Canary Islands.

Symphurus ligulatus

Chabanaud 1931: 33; Listed, Mediterranean; synonymy.

Chabanaud 1939: 26; Listed, Mediterranean; Atlantic; Canary Islands.

Padoa 1939: 105; Mediterranean, Messina; description of post-larvae; counts; measurements.

Padoa 1942: 105; Description of metamorphosed juveniles; meristics; comparison with S. nigrescens.

Chabanaud 1952: 5; Comparison with S. vanmelleae; Suggested S. vanmelleae possibly metamorphosed form of S. ligulatus.

Padoa 1956: 875; Postlarval description; Literature summary of larval forms.

Lozano Rey 1960: 613; = S. nigrescens.

Nielsen 1963: 28; Suggested that S. vanmelleae might be metamorphosed form of S. ligulatus.

Torchio 1963: 273; First report of adults (two specimens), Mediterranean, Italy; Description, meristics, measurements; Comparison with S. nigrescens.

Bini 1968: 87; Summary of available life history information.

Maurin 1968: 44; West Africa: Cape Juby-Medano de Aaium, near Rio de Oro; depth 420-695 meters..

?Aldebert 1970: 216; West Africa: Cape Juby; Specimen either S. ligulatus or S. vanmelleae (Specimen not examined).

Arena and Bombace 1970: 145; Mediterranean, Gulf of Patti.

Maurin et al. 1970: 20; Listed, West Africa; Cape Juby (420-695 m), Nouakchott (205-282 m).

Torchio 1971: 259; Neotype designation; Color and black and white photographs; Comparison with S. nigrescens; S. vanmelleae = S. ligulatus; Comments on ecology and bathymetric distribution.

Tortonese and Casanova Queirolo 1970: 43; One specimen, Mediterranean, Ligurian Sea; Comparison with S. nigrescens; Geographical distribution.

Relini Orsi and Relini 1972: 15; Mediterranean: Ligurian Sea, one specimen, counts and measurements.

Bombace and Froglia 1973: 160; Mediterranean: Adriatic, 300-700 m.

Torchio 1973: 636; Synonymy and summarized life history information; S. vanmelleae = S. ligulatus.

Aldebert and Pichot 1973: 57; Mediterranean, Libya.

Maul 1976: 64; 112 specimens, West Africa, Morocco; Meristics, measurements, figure, diagnosed from S. vanmelleae.

Cau 1977: 393; Mediterranean, Sardinian Sea, Sicily.

Golovan 1978: 231; Listed, West Africa; S. vanmelleae = S. ligulatus after Torchio 1973).

Cau and Deiana 1979: 247; Life history study 2000 adults; Mediterranean: Cagliari, Sicily Bay.

Quero et al. 1979: 37; Included in key.

Cau et al. 1980: 15; Sexual dimorphism; 2000 adults; Mediterranean: Cagliari,Sicily Bay.

Allue 1982: 305; 3 specimens (74-104 mm SL); Mediterranean, Spain; 651-1024 m; counts, measurements, description of otolith. Comparison with S. nigrescens.

Cerro and Portas 1984: 17; Listed, Mediterranean, Spain (500-700 m). Lloris et al 1984: 182; Listed, Mediterranean, Catalan Coast, Spain. Matallanas 1984: 198; Listed, Mediterranean, Catalan Coast, Spain; one specimen (82 mm SL, 600-750 m).

Remarks

Symphurus ligulatus is a relatively small, deep-sea (up to 1000 m) species that has been infrequently collected until only recently (Cau and Deiana 1979). The great depth of occurrence of adults, relatively small adult sizes and infrequency of successful sampling in deep-sea areas, undoubtedly have contributed to the rarity of this species in museum collections.

The first published description (Cocco 1844) of *Symphurus ligulatus* (=*Bibronia ligulata*) was based on a symmetrical larva. Adult specimens were not described for another 119 years (Torchio 1963). This long interval between Cocco's original description based on the symmetrical larva and the capture of adults caused considerable confusion regarding the taxonomic status of this species. In the literature of the 1800's, the confusion centered on this species and *S. nigrescens*. After 1952, when Chabanaud described another deep-sea tonguefish (*S. vanmelleae*) from the West Coast of Africa, a second period of confusion involving *S. ligulatus* and this second species occurred.

The earliest literature accounts concerning *S. ligulatus* were larval descriptions for which a variety of generic and specific names were applied. Larval pleuronectiforms were not particularly rare to earlier investigators.

For example, Emery (1883), using the name Pelloria ruppelli, also described the larval stage of this species. (See Raffaele 1888 for nomenclatural corrections). Once these larvae were recognized as larval flatfishes, the next task was to determine the proper taxon to which these larvae belonged. It was Kyle (1913) that determined that Cocco's Bibronia ligulata belonged to a species of Symphurus. In 1913 Kyle published an expanded description of S. ligulatus based on two larvae (one each from the Mediterranean and Canary Islands, respectively). Kyle clearly demonstrated salient differences between the larval stages of S. ligulatus and larvae of the cosmopolitan Mediterranean and northeast Atlantic species, S. nigrescens. Kyle also deduced (quite correctly, as would be shown by later studies), based on the relative size and high meristic features of the S. ligulatus larvae, that adults of this species were deep-sea inhabitants.

From Kyle's study in 1913 until the capture of adult specimens in 1963, the validity of S. ligulatus still remained doubtful. Padoa (1942), based on larval material, believed that two species of Symphurus inhabited the Mediterranean, but other authors (Chabanaud 1931; Lozano Rey 1960), remained skeptical of the validity of S. ligulatus.

Adult S. ligulatus were finally described in 1963, when Torchio reported on two specimens collected from the Ligurian Sea in the North Central Mediterranean. This discovery confirmed the existence of a second Symphurus species (other than S. nigrescens) in the Mediterranean and provided a basis for identifying the two species based on body shape and meristic features. Interestingly, these specimens were collected between 500-600 m, corroborating what Kyle had earlier (1913) proposed, based strictly on larval characteristics, that adult S. ligulatus would be found to be deep-sea inhabitants.

Chabanaud's description of S. vanmelleae (1952) caused a second period of confusion regarding the identity of this species and S. ligulatus. Symphurus vanmelleae is a rarely collected, deep-sea tonguefish that occurs off the outer continental shelf and upper slope region of equatorial west Africa. It partially overlaps S. ligulatus in meristics and has a similar elongate body shape. Since adult S. ligulatus were unknown at this time, similarities in meristic features between the two species prompted Chabanaud (1952) to tentatively suggest that S. vanmelleae might be the adult form of S. ligulatus. Several subsequent authors followed Chabanaud including Nielsen (1963) and Torchio (1971; 1973). The validity of both S. ligulatus and S. vanmelleae was finally stabilized when Maul (1976), based on a collection of 112 S. ligulatus collected off the coast of Morocco, clearly demonstrated the salient differences between these two species.

Historically, comparisons of this species with western Atlantic species have not been made. Only Chabanaud (in a footnote, 1955b) briefly mentioned the similarities in meristics between this species and the western Atlantic, S. nebulosus (Goode and Bean 1883). Results of direct comparisons of these two species reveal that S. ligulatus and S. nebulosus comprise a closely related amphi-Atlantic species pair. The two species are different but demonstrate only subtle morphological and meristic variations in most of the characters studied. Principal meristic differences between the species occur in modal counts for vertebrae. The species also differ in morphological characteristics, especially width of the lower head lobe, postorbital head length and body depth (S. ligulatus is more elongate).

Study Material: 38 specimens, 47.5-84.5mm SL. 38 x-rayed, 24 measured.

Type Material: Neotype CSI 2507; 83 mm TL, 78 mm SL; 400-550 m; Golfo di Patti; 01 VII 1970. (not examined).

Diagnosis

The combination of an elongate body with relatively uniform depth, 1-2-2 ID pattern, 14 caudal rays and high meristics distinguish this from all other Atlantic species except S. nebulosus. It is very similar in body shape and meristic features to S. nebulosus but may be distinguished by its higher vertebral count (59-60 vs. 58-59) and by differences in body depth (S. ligulatus is more elongate) and head morphology (S. ligulatus has a narrower lower opercular lobe and shorter POL when compared to S. nebulosus). Results of multivariate analysis (p=.009) of 14 morphometric varibles comparing these species are presented in Table 19.

It is readily distinguished from S. vanmelleae by caudal ray count (14 vs. 12), vertebral counts (abdominal vertebrae 3+6, total vertebrae 59-60 vs. 3+7-8 abdominal vertebrae and 56-58 total vertebrae), modally higher fin ray counts (dorsal rays 102-113 vs. 101-108; anal rays 90-102 vs. 86-93 in S. vanmelleae) and ID pattern (1-2-2 vs. 1-2-2-1 or 1-2-2-2-1).

Table 19. Summary of MANOVA analysis of 14 morphometric variables comparing body shapes of _S. ligulatus_ and _S. nebulosus_.

	S. ligulatus		_S. nebulosus_		F	Significance of F
	Range	$\bar{X}$	Range	$\bar{X}$		
Morphometric						
BD	194-238	213.1	165-282	233.5	10.83	P=.002
PDL	35-62	50.0	33-69	50.3	1.84	P=.181
PAL	205-247	225.2	163-246	223.2	2.91	P=.095
DBL	938-965	950.0	931-967	949.7	2.56	P=.117
ABL	677-790	756.2	708-790	757.0	4.19	P=.046
HL	157-201	181.9	159-208	186.7	8.93	P=.005
HW	169-216	192.8	186-239	216.3	18.02	P>.000
POL	110-128	118.7	110-133	124.0	11.64	P>.001
SNL	31-49	39.0	29-47	39.0	2.98	P=.091
UJL	32-46	39.4	31-47	38.5	2.13	P=.151
ED	18-26	21.9	16-26	21.3	1.79	P=.187
CD	26-48	37.6	26-52	39.1	3.41	P=.071
UHL	101-137	118.3	64-144	122.4	4.92	P>.032
LHL	71-100	86.2	82-129	103.6	24.46	P>.000

Symphurus ligulatus differs from other 1-2-2 species by combined meristic and morphometric differences. Among 1-2-2 species, other than *S. nebulosus*, it is most similar to the South African species *S. variegatus* but may be distinguished by its greater number of vertebrae (59-60 vs. 56).

Description

Symphurus ligulatus is a rather small species attaining adult maximum sizes of 84-104 mm SL (Allue 1982). ID pattern 1-2-2 (Table 9). Caudal rays normally 14 (Table 10). Dorsal rays 102-113 (Table 11). Anal rays 90-102 (Table 12). Vertebrae 56-61, usually 59-60 (Table 13). Hypurals normally 5 (21/31) or less often 4 (10/31). Longitudinal scale rows 115-135 (Table 14). Scale rows on head posterior to lower orbit 19-23, usually 19-21 (Table 15). Lateral scale rows 42-46 (Table 16). Morphometrics appear in Tables 20-21.

Body notably slender (depth 19.4-23.8, usually 21.0-22.0% SL); of nearly uniform width for most of length. Snout short (18.0-25% HL); with scaleless area on dorsal portion. Blind side snout and chin with well developed dermal papillae; papillae not extending to dorsal origin. Head narrow (0.86-1.16 in HL); upper head lobe notably small; lower lobe large (23.2-54.5% HL) and usually projecting beyond upper. Mouth small, slightly arched; posterior extension of maxilla reaches to or slightly beyond forward margin of lower eye. Dorsal fin origin at anterior edge of pupil of upper eye; only rarely at anterior margin of upper eye. First rays shorter and separated more than others. Ventral fin with membranous connection to body

Table 20. Summary of morphometrics for Symphurus ligulatus. Measurements, except Standard Length (mm), expressed in thousandths of Standard Length.

Character	N	Range	MEAN	SD
SL	24	50.0-84.5	67.2	7.37
BD	24	194-238	213.1	12.72
PDL	24	35-62	50.0	6.82
PAL	24	205-247	225.2	11.50
DBL	24	938-965	950.0	6.82
ABL	24	677-790	756.2	21.80
PL	18	52-76	63.3	7.18
PA	19	40-64	52.9	7.06
CFL	7	86-107	95.6	6.40
HL	24	157-201	181.9	9.96
HW	23	169-216	192.8	13.44
POL	24	110-128	118.7	4.95
SNL	24	31-49	39.0	4.78
UJL	24	32-46	39.4	3.33
ED	24	18-26	21.9	2.23
CD	23	26-48	37.6	6.17
UHL	22	101-137	118.3	9.74
LHL	21	71-100	86.2	8.28

Table 21. Summary of morphometrics expressed as thousandths of Head Length (except HW/HL) for *Symphurus ligulatus*.

Character	N	RANGE	MEAN	SD
HW/HL	23	0.86-1.16	1.1	0.08
POL	24	594-701	653.5	27.06
SNL	24	180-250	214.0	21.31
UJL	24	180-252	216.3	18.24
ED	24	98-141	120.4	12.25
CD	23	136-254	205.6	32.05
OPLL	20	220-360	292.6	45.52
OPUL	20	108-240	177.0	35.50
UHL	22	545-766	645.1	57.80
LHL	22	232-545	460.6	65.68

near origin of anal base (most often this delicate membrane is torn during capture). Anterior nostril not reaching eye. Eyes moderate, sub-elliptical; 9.8-14.1% HL); usually equal in position or upper eye only slightly in advance of lower. Eyes not covered with scales; usually with only 1-2 small scales in narrow interorbital space. Pupillary operculum absent.

Teeth well-developed on all jaws. Both jaws on ocular side usually with a complete row of slender teeth; occasionally with tooth row present only on anterior two-thirds of upper jaw.

Scales small, numerous, strongly ctenoid on both sides. No scales on blind side dorsal or anal fins.

Pigmentation

Ocular side without distinctive markings. Almost uniformly light brown or yellowish brown, sometimes with an overlying speckled pattern of light brown dots. Area immediately posterior to opercular opening sometimes darker brown. Operculum not pigmented other than general background color; inner lining of operculum and isthmus not pigmented. Moustache usually prominent on both ocular side lips. Blind side off-white. Anal sphincter usually with a circular ring of black pigment. Peritoneum black, clearly evident through both sides of abdominal wall.

Fins lacking obvious pigmentation. Dorsal and anal fin rays with light brown pigment along their entire lengths; little if any pigment on fin membranes. Proximal third of caudal fin with diffuse brown pigment. Distal two-thirds of caudal fin usually unpigmented or only faintly pigmented.

Geographic Distribution (Fig. 10)

Symphurus ligulatus is known only from the Mediterranean Sea and nearby Atlantic Ocean to about $18^{o}N$ latitude. Until only recently this species was seldom captured, but with increased collecting in bathyal regions of the Mediterranean Sea and nearby Atlantic Ocean, a greater number of specimens have now become available for study. Within the Mediterranean it has been taken on soft mud bottoms in the following regions: Ligurian Sea, Bay of Sicily, Adriatic and the Mediterranean coast of Spain. The largest collections of this species have been taken in the Sea of Cagliari and Sicily Bay (Cau and Deiana 1979). It is unknown from the far western regions of the Mediterranean. Aldebert and Pichot (1973) reported this species from the Mediterranean off Libya. It has only once been taken in the Adriatic (Bombace and Froglia (1973). More recently, this species has been captured in the eastern Mediterranean probably reflecting the growing research interest in deep sea communities along the continental slope region in this area (Allue 1982; Cerro and Portas 1984; Lloris 1984; Matallanas 1984).

In the open eastern Atlantic, it has been taken at the Canary Islands (larvae, Kyle 1913) and Cape Juby near Rio de Oro, West Africa ($18^{o}N$) (Maurin 1968). Maul (1976) reported on the capture of 112 specimens collected off Morocco, West Africa.

Bathymetric Distribution

Symphurus ligulatus is a resident species on the outer continental shelf and upper continental slope regions in the Mediterranean and nearby eastern Atlantic. This is a deep-dwelling species usually taken at depths greater than 300 m. The bathymetric distribution for specimens examined in this study ranged from 400-600 meters but the species occurs much deeper as Cau and Deiana (1979) reported capturing specimens from depths of 800 m in the Gulf of Cagliari and Matallanas (1984) reported a specimen from 700 m. Allue (1982) reported a capture depth of 1,000 meters for this species from the Spanish Mediterranean. Although S. ligulatus is sympatric with S. nigrescens throughout its geographic range, it is largely if not completely allotopic with respect to bathymetric distribution (S. nigrescens occurs much shallower from 70-350 meters).

The infrequency of capture, except in certain locations of the Mediterranean (Cau and Deiana 1979) and eastern Atlantic (Maul 1976) where this species is exceptionally abundant, indicates that this species may have a reasonably strong preference for specific substrates. However, data presently available with specimens are insufficient to permit any type of detailed analysis of substrate composition and frequency of occurrence.

Size and Sexual Maturation

Cau and Deiana (1979) reported on the size and sexual development of S. ligulatus collected in Gulf of Cagliari, Mediterranean. They examined over 2,000 adult fishes and fiound that males and females reach similar sizes (90-92 mm SL). Females began to mature at small sizes (52-54 mm SL), however, 100% maturity did not occur until females were 58-60mm SL. Males matured at smaller sizes (42-44 mm SL). Cau and Deiana (1979) also provided additional information on seasonality of spawning and age and growth.

Ecology

According to Cau and Deiana (1979) *S. ligulatus* consumes a wide variety of benthic invertebrates. Diets of 200 specimens were dominated by isopods, euphausids and small decapods, polychaetes, bivalves and gastropods, small echinoids and Foraminifera.

Material Examined 37 Specimens, 4 Lots.

ANSP 123249; (84.5); Mediterranean: Gulf of Patti, Messina; 450M; 1970. MSNG 45458; 4(65.1-76.6); Mediterranean: E Ligurian Sea; 590M; 1973. ISNB 20,810; 3(65.7-72.7); Mediterranean: Gulf of Cagliari; 550M; 28 II 67. MMF 22492; 30(47.5-74.5); E ATL 33°12.6'N 09°15.2'W; 500M; 30 I 67.

Symphurus nebulosus (Goode and Bean 1883)

(Fig. 39C)

Freckled Tonguefish

Aphoristia nebulosa

Goode and Bean 1883: 192; Original description; Holotype MCZ 27966; 32°07'N 78°37'30"W.

Günther 1887: 167; Listed, Based on Goode and Bean 1883.

Goode and Bean 1895: 458; Description with figure of holotype.

Aphoristia marginata

Goode and Bean (in part), 1886: 154; Specimen from Fish Hawk Station 1154 belongs to S. nebulosus.

Symphurus nebulosus

Ginsburg 1951: 200; Counts, measurements, distribution.

Chabanaud 1939: 26; Listed, Atlantic coast of the Carolinas.

Study Material: 24 Specimens, 45.0-86.2 mm SL. 23 x-rayed and measured.

Diagnosis

The combination of an elongate body with relatively uniform and narrow depth (16.5-28.2% of SL), 1-2-2 ID pattern, 14 caudal rays and high vertebrae (57-60) and fin ray counts (dorsal rays 105-113; anal rays 91-99) very similar in body shape and meristic features to S. ligulatus but may be distinguished by its lower vertebral counts (58-59 vs. 59-60) and by differences in morphometrics such as greater body depth (16.5-28.2% SL vs. 19.4-23.8, but usually 21-22% SL), longer head length, wider lower head lobe and other shape differences (see Table 19 and Figs. 39B and 39C). There are some slight differences in pigmentation between these two species. Specimens of S. ligulatus generally had a well-developed moustache on both ocular side lips. In contrast, S. nebulosus despite having a darker pigmented body in general, has only a slight moustache, if any at all, on the eyed-side upper lip.

Symphurus nebulosus is readily distinguished from S. vanmelleae by caudal ray count (14 vs. 12), vertebral counts (3+6, 58-59 vs. 3+7-8, 56-58), usually higher meristic counts (DR 105-113 vs. 101-108; AR 91-99 vs. 86-93, and in its ID pattern (1-2-2 vs. 1-2-2-1 or 1-2-2-2-1).

Symphurus nebulosus overlaps S. jenynsi in most meristic features but can easily be distinguished by its higher caudal ray count (14 vs. 10), ID pattern (1-2-2 vs. 1-4-3), black peritoneum (unpigmented in S. jenynsi), and much narrower and smaller body.

In its notably slender body, it approximates body depths observed in small to medium-sized S. marginatus. It differs from S. marginatus in several features including caudal ray count (14 vs. 12), ID pattern (1-2-2 vs. 1-3-2), and much higher meristics (vertebrae 58-59 vs. 52-56; dorsal rays 105-113 vs. 93-104; and anal rays 91-99 vs. 93-104) and by differences in body pigmentation (no caudal blotch in S. nebulosus vs. large caudal blotch in S. marginatus).

Among 1-2-2 species occurring outside the Atlantic Ocean, it most closely resembles S. variegatus, but possesses a greater number of vertebrae (58-59 vs. 56).

Description

Symphurus nebulosus is a relatively small species (maximum sizes not exceeding 87 mm SL). ID pattern 1-2-2 (Table 9). Caudal rays normally 14 (Table 10). Dorsal rays 105-113 (Table 11). Anal rays 91-99, usually 93-98 (Table 12). Vertebrae usually 58-59 (Table 13). Hypurals normally 5 (19/20 individuals), rarely 4 (1/20). Longitudinal scale rows 120-135, usually 125-130 (Table 14). Scale rows on head posterior to lower orbit 19-24, usually 21-22 (Table 15). Lateral scale rows 43-50 (Table 16). Morphometrics appear in Tables 22-23.

Body notably slender (depth 16.5-28.2, usually 22.5-24.0% SL); of nearly uniform width for most of length. Snout moderately long (16.0-24.8% HL); with scaleless area on dorsal portion. Blind side snout and chin with well-developed dermal papillae; papillae not extending to dorsal fin origin. Head narrow (18.6-23.9% SL); upper head lobe notably small; lower lobe large and usually projecting beyond upper. Mouth small, slightly arched; posterior extension of maxilla usually reaches to front edge of pupil; less frequently to almost mid-eye or only to front margin of lower eye. Dorsal fin origin usually equal to about the middle of the upper eye; less frequently reaching anterior margin of the pupil or reaching only to the posterior edge of the eye. First dorsal rays shorter and separated more

Table 22. Summary of morphometrics, expressed as thousandths of Standard Length except SL in (mm), for *Symphurus nebulosus*.

Character	N	RANGE	MEAN	SD
SL	23	45.0-86.2	72.6	10.18
BD	23	165-282	233.5	23.92
PDL	23	33-69	50.3	9.41
PAL	23	163-246	223.2	17.73
DBL	23	931-967	949.7	9.41
ABL	23	708-790	757.0	19.44
PL	20	46-81	65.4	8.30
PA	21	37-67	49.3	9.06
CFL	21	80-116	102.4	10.42
HL	23	159-208	186.7	12.40
HW	23	186-239	216.4	13.45
POL	23	110-133	124.0	6.44
SNL	23	29-47	39.0	5.43
UJL	22	31-47	38.5	4.51
ED	23	16-26	21.3	2.69
CD	23	26-52	39.1	6.78
UHL	23	64-144	122.4	16.20
LHL	23	82-129	103.6	10.85

Table 23. Summary of morphometrics expressed as thousandths of Head Length (except for HW/HL) for *Symphurus nebulosus*.

Character	N	RANGE	MEAN	SD
HW/HL	23	0.98-1.28	1.2	0.08
POL	23	620-711	665.6	26.87
SNL	23	160-248	208.7	22.91
UJL	22	169-248	206.9	20.23
ED	23	94-133	114.2	11.50
CD	23	141-308	210.0	38.56
OPLL	23	233-479	358.4	49.47
OPUL	23	126-253	188.7	35.64
UHL	23	315-786	658.6	98.81
LHL	23	411-671	557.4	61.22

than others. Ventral fin with membranous connection to body near origin of anal base (most often this membrane is torn). Anterior nostril not reaching eye. Eyes moderately large, sub-elliptical; 9.4-13.3% HL; usually equal in position or upper eye hardly noticeably in advance of lower eye. Eyes usually without scales; usually with only 1-3 small scales in narrow interorbital space. Pupillary operculum absent.

Teeth well-developed on all jaws. Both jaws on ocular side usually with a complete row of slender teeth; sometimes row on upper jaw present only on anterior two-thirds of premaxilla.

Scales small, numerous, strongly ctenoid on both sides. No scales on blind side dorsal and anal fins.

Pigmentation

Ocular side almost uniformly colored light to dark brown, sometimes with an overlying pattern of dark brown cloudy areas on the body but otherwise with no distinctive markings. Area immediately posterior to opercular opening sometimes with darker brown shading than general body color. Scales on ocular side with a longitudinal streak; forming about 40-60 streaks across body. Fins lack any obvious pigment patterns. Dorsal and anal fin rays with light brown pigment along their lengths; little if any pigment on fin membranes. Proximal third of caudal fin with diffuse brown pigment not unlike that of body. Blind side off-white, usually with a median line of black pigment spots from deeper muscle bands along the vertebral column showing through skin. Operculum not pigmented other than general background color; inner lining of operculum and isthmus not pigmented. Peritoneum black, clearly evident through both sides of abdominal wall. Occasionally a slight moustache on ocular side upper lip, but not present in most specimens examined. Goode and Bean (1883) described the holotype as being grayish, everywhere mottled with brown. Ginsburg (1951) described three specimens he examined as being partly faded with almost uniform reddish or yellowish brown coloration.

Geographic Distribution (Fig. 10)

Symphurus nebulosus occurs only in the western North Atlantic from just south of Long Island, New York (40°48'N) to more southerly waters of the Blake Plateau off Fort Lauderdale, Florida (26°28'N). This species is only rarely captured undoubtedly due to its small size and the difficulties in collecting small fishes at the great depths that it frequents. Only 24 specimens were available for this study. Consequently, little is known concerning most aspects of the biology of this species.

Whether this species is rare in nature or the small numbers available for study reflect the unsuccessful trawling in the species preferred habitat is unknown. Most (8/12) captures have been of single specimens. The largest single collection (UNC 4951; depth 495 m) in which 10 specimens were taken was made due east of Cape Fear, North Carolina.

This is a deepwater tonguefish. The overall depth range is 239-810 m but the majority of specimens have been taken between 400-600 m.

Based on the material at hand, the species attains a maximum size of approximately 87 mm SL.

Material Examined 24 Specimens, 12 Lots.

MCZ 27966; Holotype (76.6); 32°07'N 78°37'30"W; 421M. MCZ 39480; (67.0); 30°58'N 79°34'W; 511M; 24 II 40. UMML 20746; 2(67.9-68.1); 28°09-10'N 79°02-00'W; 810M; 18 VII 65. UMML 27439; (54.9); 26°28-27'N 78°40-43'W; 658M; 21 VII 65. UMO 311.8; (76.7); 40°48'N 66°36-38'W; 524M; 19 VI 74. UNC 4951; 10(67.7-86.2); 33°48-52'N 76°12-06'W; 495M; 29 VII 70. USNM 152842; (45.0); 39°55'31"N 70°39'W; 355M; 04 X 1882. USNM 265179; (63.8); 29°29'N 79°53'W; 686M; 19 XI 65. USNM UNCAT ORII 11715; (67.7); 30°54'N 79°40'W; 488M; 21 I 72. USNM UNCAT ORII 11720; 2(69.5-69.6); 31°43'N 79°21'W; 239M; 21 I 72. VIMS 5577; 2(64.3-66.5); 36°00.5'N 74°45'W; 400M; 12 XI 74. VIMS UNCAT CI8077; (77.7); 29°08-12'N 78°56.00-07'W; 800M; 22 IX 80.

CHAPTER 6.2

Dwarf Species with 1-3-2 ID pattern and Unpigmented Peritoneum

Symphurus arawak Robins and Randall 1965

(Fig. 40A)

Caribbean Tonguefish

Symphurus arawak

Robins and Randall 1965: 331; Original description with photograph; Curacao.

Böhlke and Chaplin 1968: 223; Bahamas; Diagnosis, counts, figure, distribution.

Randall 1968: 166; Caribbean distribution.

Starck 1968: 31; Listed, Alligator Reef, FL.

Garzon F. and Acero P. 1983: 106; Listed, Colombia; Counts, measurements and photograph.

Holotype ANSP 101985 Female 33.7 mm SL. Curacao, Lagoen. 14M. 25 XI 62.

Remarks

Robins and Randall (1965) tentatively proposed that *S. arawak* and *S. minor* represented a north-south species pair which may have differentiated because of repeated latitudinal fluctuations in the fish fauna during glacial and interglacial periods. While this hypothesis is attractive and may even be substantiated within other groups of *Symphurus*, it does not apply to these two species. Based on evidence presented earlier in the analysis of species groups, it was shown that *S. arawak* belongs to the 1-3-2 ID pattern species group, whereas, *S. minor* belongs to a small group of quite different species characterized by a 1-4-2 ID pattern, well-developed pupillary operculum and membrane ostia. The only similarities between these species are low meristics and small body size.

Study Material: 42 Specimens, 11.7-49.3 mm SL. 42 radiographed, 40 measured.

Diagnosis

A readily distinctive species characterized by the lowest meristic features of any species in the genus. It is easily recognized by the following combination of characters: small body size (usually less than 50 mm SL), 1-3-2 ID pattern, unpigmented peritoneum and the following combination of meristics: caudal rays 12, dorsal rays 70-75, anal rays 55-61, and vertebrae 39-42. Of all the species in the genus, only *S. minor* approaches the meristics and small body size observed in *S. arawak*. However, this species differs significantly from *S. arawak* in many features including ID pattern (1-4-2 vs. 1-3-2), caudal ray count (10 vs. 12), possession of a well-developed pupillary operculum and membrane ostia along the bases of dorsal and anal fins (both absent in *S. arawak*), and *S. minor* generally has a higher vertebral count (41-43 vs. 40-42).

Symphurus arawak shares with three other Atlantic dwarf species (S. rhytisma, undescribed species A and undescribed species B) the following characters: small body size, 12 caudal rays, unpigmented peritoneum and 1-3-2 ID pattern. Symphurus arawak is not easily confused with these species because of its considerably lower meristics (vertebrae 39-42 vs. 46-49; dorsal rays 70-75 vs. 82-89; anal rays 55-61 vs. 68-75) and pigmentation pattern. Symphurus arawak has a banded pattern on the eyed surface or the eyed surface is covered with irregularly-shaped blotches. In about one-half of the individuals examined, the blind side is sprinkled with dark brown or black melanophores. In contrast, none of the other species have such a combination of pigmentation. The eyed surface of Symphurus rhytisma is also banded but usually the last two bands on the trunk coalesce to form a heavily pigmented caudal patch and the blind side of the body of S. rhytisma is unpigmented. Undescribed species A has a cream-colored eyed-surface with several mostly incomplete crossbands and no pigment on the blind side. Undescribed species B has a dark, chocolate brown coloration with alternating X and Y-shaped markings on the ocular surface of the body and the blind side is unpigmented. Also, the dorsal and anal fins in this species have an alternating series of blotches and clear areas (uniform in S. arawak).

Description

Symphurus arawak is a dwarf species reaching adult lengths of approximately 50 mm SL. ID pattern 1-3-2 (Table 9). Caudal rays normally 12, rarely otherwise (Table 10). Dorsal rays 70-75 (Table 11). Anal rays

55-61 (Table 12). Vertebrae 39-42, usually 40-41 (Table 13). Longitudinal scale rows 55-65, usually 58-64 (Table 14). Scale rows on head posterior to lower orbit 12-15 (usually 14-15) (Table 15). Lateral scale rows 27-36, usually 32-36 (Table 16). Proportional measurements appear in Tables 24-25.

Body deep (25.4-37.7% SL), of stocky build (greatest body depth occurring in anterior one third of body. Head relatively wide (22.5-31.6% SL); with relatively long pointed snout. Snout length 16.3-30.7% HL. Snout covered to tip with small ctenoid scales; scales not embedded but rather deciduous. Posterior extension of maxilla somewhat variable in location; usually reaches to about the middle of lower eye, sometimes only to anterior margin of pupil of lower orbit, or rarely only to front margin of eye. Eyes relatively large, 9.7-20.0% HL; usually equal in position. Eyes not covered with scales; usually with 1-2, occasionally 3 small scales in narrow interorbital space. Pupillary operculum absent. Anterior nostril almost reaching anterior margin of lower eye. Dorsal fin origin usually at a vertical equal to front margin or mid-point of upper eye. No scales on dorsal and anal fins. Pelvic fin with membranous connection to body at base of anal fin.

Teeth well-developed on all jaws. Dentary of ocular side usually with a complete row of slender teeth; less frequently row of teeth present only on anterior three-fourths of dentary. Row of teeth present only on anterior three-fourths of ocular side premaxilla.

Scales relatively large, strongly ctenoid on both sides of fish.

Table 24. Summary of morphometrics, expressed as thousandths of Standard Length except for SL (in mm), for *Symphurus arawak*.

Character	N	RANGE	MEAN	SD
SL	40	11.7-49.3	28.2	8.18
BD	40	254-377	317.2	24.98
PDL	39	49-145	93.1	15.12
PAL	40	188-350	300.2	30.96
DBL	40	649-941	903.3	44.33
ABL	40	495-776	687.0	39.75
PL	36	60-100	83.6	9.88
PA	40	43-99	66.4	10.53
CFL	34	120-204	169.6	17.99
HL	40	182-299	265.8	20.58
HW	40	225-316	282.0	17.04
POL	40	114-188	156.6	15.96
SNL	40	43-74	59.4	8.57
UJL	40	54-77	62.3	5.86
ED	40	25-49	38.1	4.33
CD	40	30-68	54.0	7.11
UHL	40	109-192	153.3	15.23
LHL	40	110-174	140.0	14.727

Table 25. Summary of morphometrics expressed as thousandths of Head Length (except HW/HL) for *Symphurus arawak*.

Character	N	RANGE	MEAN	SD
HW/HL	40	0.92-1.28	1.1	0.07
POL	40	500-660	588.7	34.46
SNL	40	163-307	224.2	32.90
UJL	40	200-333	235.6	23.42
ED	40	97-200	144.1	19.71
CD	40	132-347	204.8	36.14
OPLL	39	229-379	288.5	34.64
OPUL	39	159-303	230.8	30.17
UHL	40	480-738	576.7	63.58
LHL	40	415-680	531.0	56.72

Pigmentation

Eyed surface conspicuously marked with 2-7, usually 4-5, complete bands in about one-half of the individuals examined. Otherwise, individuals with bands incomplete and recognizable only as 6-10 large and variably positioned dark blotches. Bands are brown against a usually off-white or pale yellowish background. The first band situated at opercular opening. Second band usually at or near origin of anal fin. Last band near the posterior extent of dorsal and anal fins. Specimens lacking complete bands characteristically with 3 or 4 blotches (rarely large round spots) along dorsal and ventral thirds of eyed side. The posteriormost pair of bands usually forming a dark V or Y at about the one-third point between caudal-fin base and gill opening. A narrow dark vertical bar extends from upper eye to dorsal profile. A small dark spot always present at upper end of gill opening. Outer operculum not pigmented other than general background color. Inner operculum and isthmus not pigmented. Moustache of variable intensity present on ocular side upper lip. Dark spot usually present at angle of jaws on ocular surface. Each scale on the head and body marked by numerous small melanophores but ground color pale in contrast to the dark blotches on the body. Melanophore concentrations heaviest in caudal one-third of body. Blind side in about half the specimens with small pepper-dots extending variable distances along trunk. Pepper-dots heaviest usually in region overlying pterygiophores of dorsal and anal fins and in caudal one-third of body. Peritoneum unpigmented.

Dorsal and anal fins without obvious spotted pattern. Dorsal and anal fin rays with brown melanophores along each ray. Melanophores increase in density in region of body blotches and bands and become extremely dense in caudal one-third of body so that fins become darker posteriorly. Caudal fin and neighboring parts of dorsal and anal fins dark brown or black.

Distribution (Fig. 11)

Symphurus arawak is widespread throughout the Caribbean Sea. It has been taken once extralimitally at Alligator Reef, Florida (Starck 1968). However, the majority of specimens have been collected in the Bahamas and islands of the Caribbean. Material examined includes specimens captured from the following locations: Bahamas (several locations), Curacao, Dominica, Haiti, Jamaica, Puerto Rico, Providencia Island and Cayman Islands. Robins and Randall (1965) reported this species also at St. John, Virgin Islands. In addition to the Alligator Reef capture, several additional specimens have also been taken along continental reef areas at Belize (FMNH 94817) and at Cabo de la Aguja (one specimen) and Baha de Guyraca (three specimens), Colombia (Garzon F. and Acero P. 1983).

Size and Sexual Maturity

Symphurus arawak is a dwarf species of *Symphurus* and is among the smallest of flatfishes (Fig. 12). The largest specimen examined was a female (49.3 mm SL). The largest male was 34.7 mm SL. Most females had evidence of gonadal elongation with initiation of ripening at sizes of 24-30 mm SL. Sexual maturity in females apparently occurs somewhere around 30 mm

SL. The two smallest mature females were 30.3 and 30.7 mm SL. Small size is also reflected in the ontogeny of this species, as juveniles of 11.7, 13.2 and 13.9 mm SL had already metamorphosed and assumed a benthic existence.

Ecology

The majority of specimens have been captured in clear waters on sand bottoms adjacent to coral reefs. The known depth range is 5-40 m, with most captures occurring between 5-20 m (Fig. 13)

Little else is known concerning life history aspects of this species.

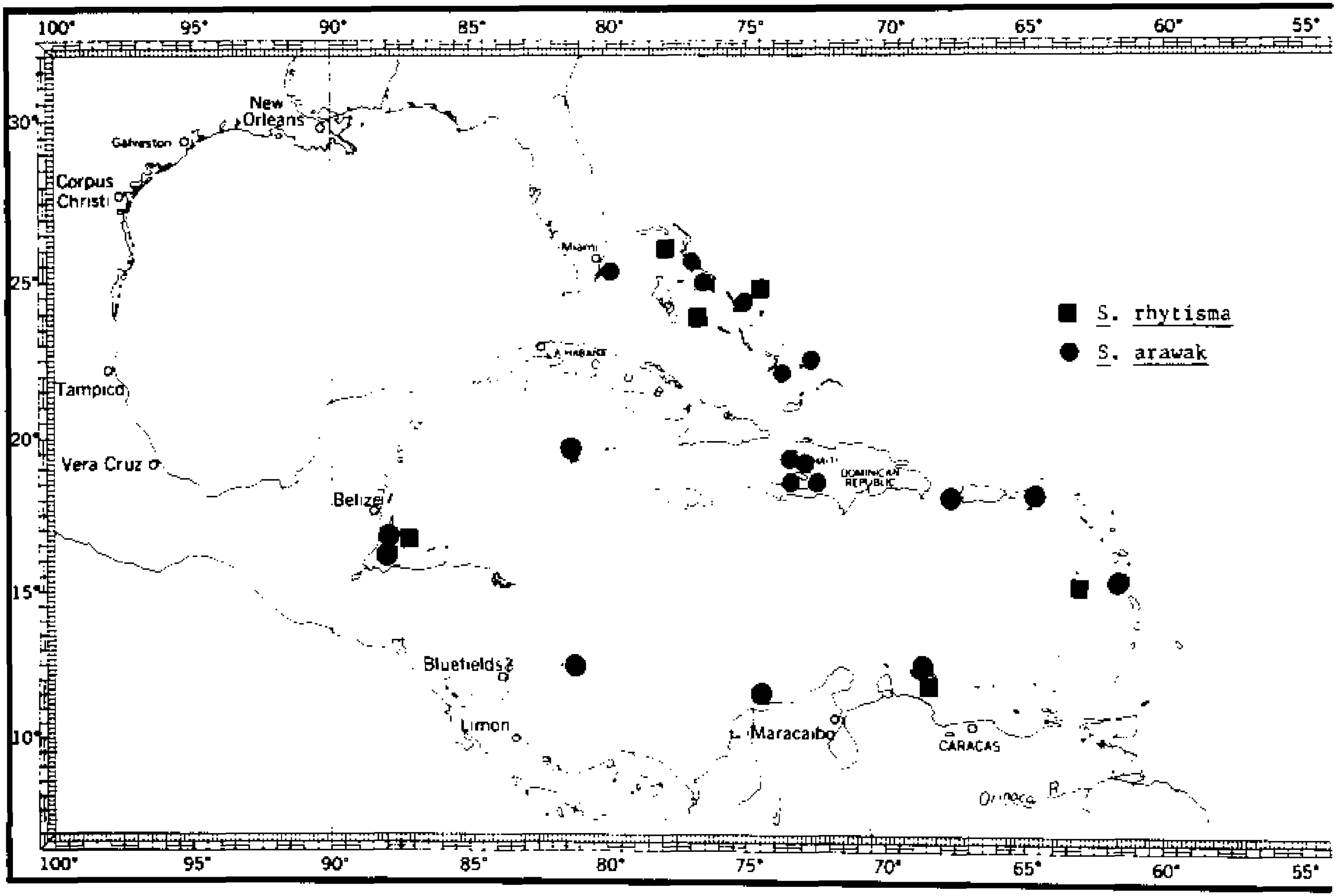
Material Examined

Measured and Counted 42 Specimens, 14 Lots.

ANSP 101985; Holotype (33.1); Curacao; 14M; 25 XI 62. UMML 15491; Paratypes; 2(26.3-36.3); Curacao; 14M; 25 XI 62. UMML 15492; Paratypes; 2(28.8-38.3); St. Marc's Bay, Haiti; 6M; 22 XII 59. UF 12269; Paratype (29.8); Grand Cayman Island; 15M; 22 X 64. USNM 198200; (2); Curacao; 14M; 25 XI 62. AMNH 27327; (18.0mm); Mayaguana Island, Bahamas; 9M; 19 III 66. AMNH 27706; (24.4); Acklins Island, Bahamas; 20M; 09 III 66. AMNH 29214; (35.4); Mayaguana Island, Bahamas; 15M; 19 III 66. AMNH 34603; (25.2); Eleuthera Island, Bahamas; 11M; 02 II 68. AMNH 33161; (13.9); Little Inagua, Bahamas; 25M; 21 I 68. ANSP 111378; (26.6); St. Marc Bay, Haiti; 39M; 16 IX 67. ANSP 111924; 3(23.1-27.1); Eleuthera Island, Bahamas; 11M; 02 II 68. ANSP 119056; (27.7); Haiti; 29M. ANSP 119057; (41.3); Port Au Prince Bay, Haiti; 22M; 12 IX 67). ANSP 144354; 2(13.2-24.3); 6 mi. S La

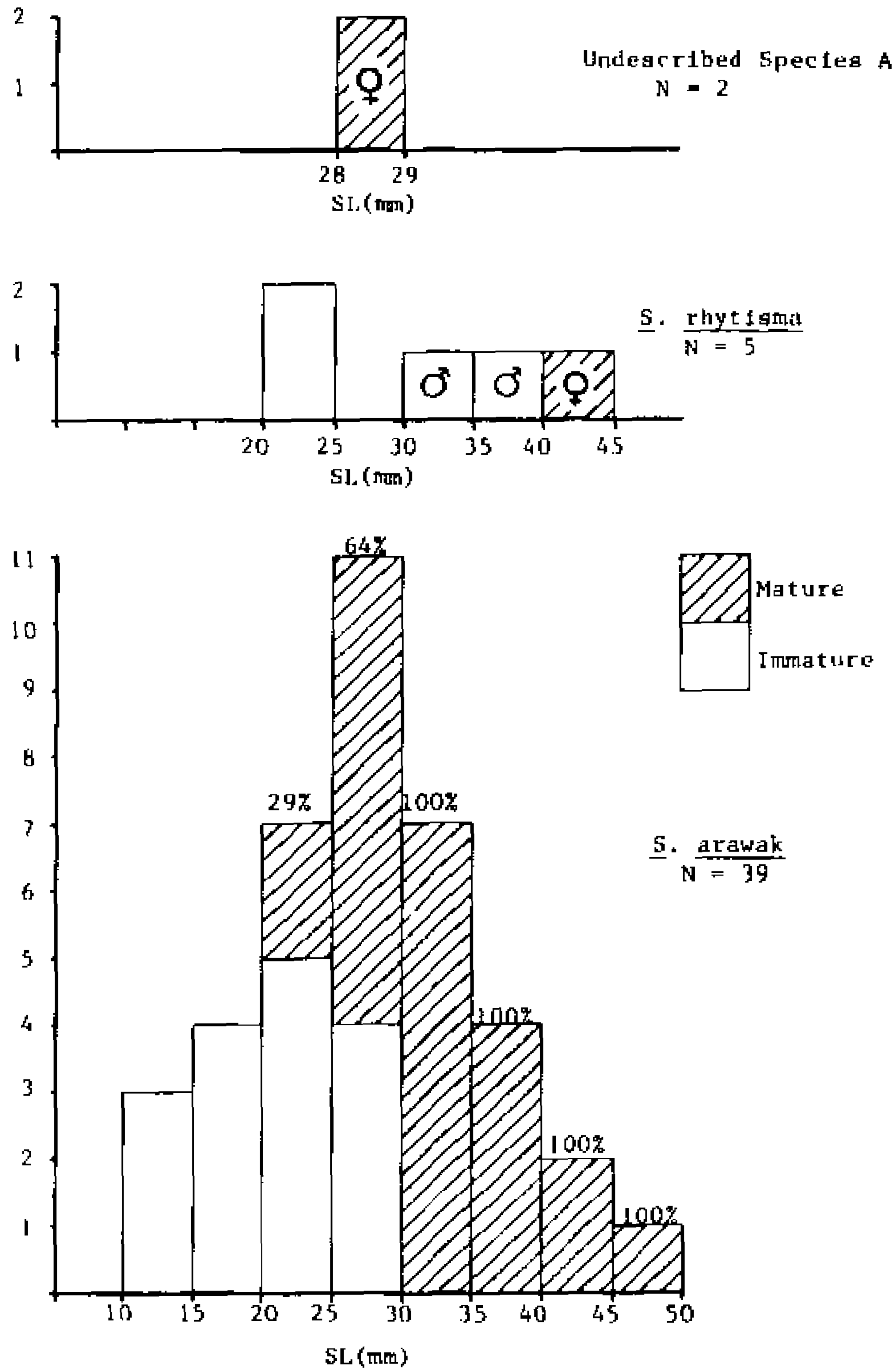
Parguara, Puerto Rico; 9M; 12 XI 76. ANSP 147929; (17.8); Cat Island, Bahamas; 28M; 31 I 68. FMNH 94817; (32.5); Glovers Reef, Belize; 25M; 28 VI 79. UF 13380; (11.7); Little San Salvador, Bahamas; 31M; 09 IX 66. UF 13455; 2(29.2-34.7); Green Cay, Bahamas; 20M; 21 VIII 66. UF 17054; (31.6mm); Green Cay, Bahamas; 18M; 22 VIII 66. UF 25721; (30.3); Providencia Island; 34M; 14 VIII 69. UF 25876; (22.0); Providencia Island; 18M; 11 VIII 69. UMML 19274; (28.0); Alligator Reef, FL; 15M; 16 VII 65. UMML 21421; (27.3); St. Marc Bay, Haiti; 6M; 22 XII 59. UMML 31430; (30.6); Discovery Bay, Jamaica; 25M; 24 VI 72. UMML UNCAT PLC-B-18; 2(38.5-49.3); 11M; 17 VI 70. UMML UNCAT; (37.7); Jamaica; Summer, 1972. UMML UNCAT; (1); No Data. USNM 265177; 2(26.7-41.0); Dominica, BWI; 8M; 10 XI 64. USNM 265178; (20.4); Dominica, BWI; 8M; 14 XI 64. USNM 265182; 2(18.6-20.8); Dominica, BWI; 15 XI 64. USNM 267784; (29.3); Belize (16°48'N; 88°04'W); 24M; 02 IV 83.

Figure 11. Geographic distributions for *Symphurus arawak* and *S. rhytisma*.



Western Atlantic 12 Caudal-Rayed Dwarf Species

Figure 12. Frequency histogram of size and sexual maturity for three dwarf species of *Symphurus* possessing 1-3-2 ID patterns.



Undescribed Species A
N = 2
28
29
SL (mm)
S. rhytisma
N = 5
20
25
30
35
40
45
SL (mm)
64%
29%
100%
100%
100%
100%
Mature
Immature
S. arawak
N = 39
10
15
20
25
30
35
40
45
50
SL(mm)

Symphurus rhytisma Böhlke 1961

(Fig. 40B)

Patchtail Tonguefish

S. rhytisma

Böhlke 1961: 3; Original description with photograph; Bahamas.

Robins and Randall 1965: 334; Curacao, Lagoen; Supplementary counts and measurements.

Böhlke and Chaplin 1968: 224; Distribution, counts, description, figure.

Holotype ANSP 93812. 26.3 mm SL. Bahamas W of Wood Cay, off Grand Bahama Island, Little Bahama Bank (ca.26°44'15"N; 79°02'37"W. Depth. 19 VII 59.

Study Material: 7 specimens, 21.7-45.1 mm SL. 6 x-rayed, 6 measured.

Diagnosis

Symphurus rhytisma is only one of four dwarf species with a combination of a 1-3-2 ID pattern, 12 caudal rays and an unpigmented peritoneum. It most closely resembles two undescribed species (undescribed species A and B) known only from islands in the eastern Atlantic. It may be distinguished from both these species on the basis of its lower meristics (dorsal rays 83-85 vs. 87-89; anal rays 68-71 vs. 74-75; vertebrae 46-48 vs. 48-49; and somewhat larger scales, 91-97 scale rows vs. 101-109 in the other two species) and differences in pigmentation. All but the largest specimens of _S_. _rhytisma_ have a dark blotch across the posterior third of the body (absent in the two eastern Atlantic species), the eyed surface generally has a series of incomplete, dark brown crossbands against a pallid body color and the fins are uniformly and lightly pigmented. In contrast, undescribed species B has a dark chocolate brown body with X and Y markings and a series of alternating blotches and clear areas in the dorsal and anal fins.

In the Caribbean region, only _S_. _arawak_ possesses the 1-3-2 ID pattern, 12 caudal rays and unpigmented peritoneum. This species is readily diagnosed from _S_. _rhytisma_ by its much lower meristic features (dorsal rays 70-75 vs. 83-85; anal rays 55-61 vs. 68-71; and vertebrae 39-42 vs. 46-48). _Symphurus_ _rhytisma_ also has considerably finer scales and this is reflected in its much higher number of scale rows (91-97 vs. 55-65 in _S_. _arawak_).

Description

Symphurus _rhytisma_ is a dwarf species of tonguefish, adults attain maximum sizes of only approximately 45 mm SL. ID pattern 1-3-2 (Table 9). Caudal rays 12 (Table 10). Dorsal rays 83-85 (Table 11). Anal rays 68-71 (Table 12). Vertebrae 46-48, usually 47 (Table 13). Hypurals 4. Longitudinal scale rows 91-97 (Table 14). Scale rows on head posterior to lower orbit 18-20, usually 18 (Table 15). Lateral scale rows 43-45 (Table 16). Proportional measurements are presented in Tables 26-27.

Table 26. Summary of morphometrics, expressed as thousandths of Standard Length (except SL) for *Symphurus rhytisma*.

Character	N	RANGE	MEAN	SD
SL	5	21.7-45.1	32.7	9.26
BD	5	295-330	306.4	15.36
PDL	5	69-78	72.0	3.74
PAL	5	262-295	273.6	14.78
DBL	5	929-960	938.8	12.40
ABL	5	719-767	735.0	19.71
PL	5	70-83	77.2	4.66
PA	5	46-66	57.2	9.12
CFL	5	104-143	118.4	14.88
HL	5	203-262	233.0	23.70
HW	5	242-264	258.6	9.32
POL	5	126-160	148.0	13.32
SNL	5	44-59	52.6	5.86
UJL	5	38-59	49.8	8.17
ED	5	26-35	31.4	3.36
CD	5	46-67	56.0	8.40
UHL	5	134-166	154.0	12.31
LHL	5	108-131	118.2	9.52

Table 27. Summary of morphometrics expressed as thousandths of Head Length (except HW/HL) for *Symphurus rhytisma*.

Character	N	RANGE	MEAN	SD
HW/HL	5	1.00-1.30	1.1	0.14
POL	5	588-773	638.8	75.72
SNL	5	206-250	226.6	17.02
UJL	5	175-250	213.8	30.29
ED	5	108-165	137.2	24.68
CD	5	213-277	240.6	24.06
OPLL	5	258-325	289.0	31.12
OPUL	5	159-268	203.2	39.82
UHL	5	554-818	669.8	108.39
LHL	5	446-608	511.2	70.58

Body moderately deep (25.7-33.3% SL), greatest width occurring in anterior third of body; with moderate taper. Head relatively narrow, length only slightly smaller than head width. Snout moderate (20.6-23.8% HL); snout on both sides of fish covered by dense network of large, obvious dermal papillae. Snout scales deciduous, mostly absent; those present found only in areas where dermal papillae absent. Posterior extension of maxilla usually reaches to front of pupil of lower eye; occasionally reaches to mid-point of eye. Eyes relatively large (10.8-16.5% HL); usually equal in position, or upper eye scarcely forward of lower eye. Eyes without scales, with 0-4 scales in narrow interorbital space. Pupillary operculum absent. Dorsal fin origin usually at vertical equal to mid-point of upper eye. No scales on dorsal or anal fins.

Teeth well developed on all jaws. Blind side jaws with small band of teeth on both upper and lower jaws. Eyed side jaws usually with single complete row of teeth; occasionally with teeth present only on anterior three-fourths of bone.

Pigmentation

Eyed surface usually with evidence of from 2-8 (usually 8) incomplete, brown bands against a pallid ground color. The first band, when present, crosses head at about the fifth dorsal ray. The third band, situated at or slightly behind anal fin origin, most often complete and usually the darkest of the forward bands. Band number variable on trunk. Usually posteriormost two bands on trunk coalesce to form caudal patch. Of the very irregular eight narrow dark bands on body, the fifth, sixth and eighth terminate both dorsally and ventrally in elongate dark markings on the vertical fins. Posterior one-third of body notably darkened (this is the most conspicuous feature of the color pattern) in smaller individuals. Caudal blotch more diffuse in larger specimens. In larger individuals the darker posterior portion of the body less extensive and less well-defined anteriorly, suggesting this feature may characterize juveniles only.

Dorsal and anal fins unpigmented except in last half of body. In posterior half of body, wherever bands are present the pigment extends onto the rays of the vertical fins. In caudal blotch region, the rays and membranes on both sides of the vertical fins are heavily pigmented. In last few dorsal and anal rays, pigment concentrated on proximal half of ray forming a diffuse dark spot.

Blind side uniformly pale, off-white. Black internal markings along mid-axis of body evident in some specimens.

Distribution (Fig. 11)

Symphurus rhytisma is known only from the Caribbean region of the western North Atlantic. It has not been collected very frequently (only seven specimens could be located for this study). Of the six collections of this species, three have occurred in different regions of the Bahamas while additional collections have occurred at Glovers Reef, Belize and Curacao. It has most often been collected at rotenone stations on sandy substrates adjacent to coral reefs. One specimen (UMML UNCAT GS-53) was trawled at a shallow-water station due west of Dominica (15°42'N 63°38'W).

Thus far, this species has been collected at depths ranging from 1-25 meters (Fig. 13).

Among the study material was a single mature female measuring 45.1 mm SL (Fig. 12). Sexual maturity at such a small size indicates that S. rhytisma is a dwarf species of tonguefish.

Material Examined 7 Specimens, 6 Lots.

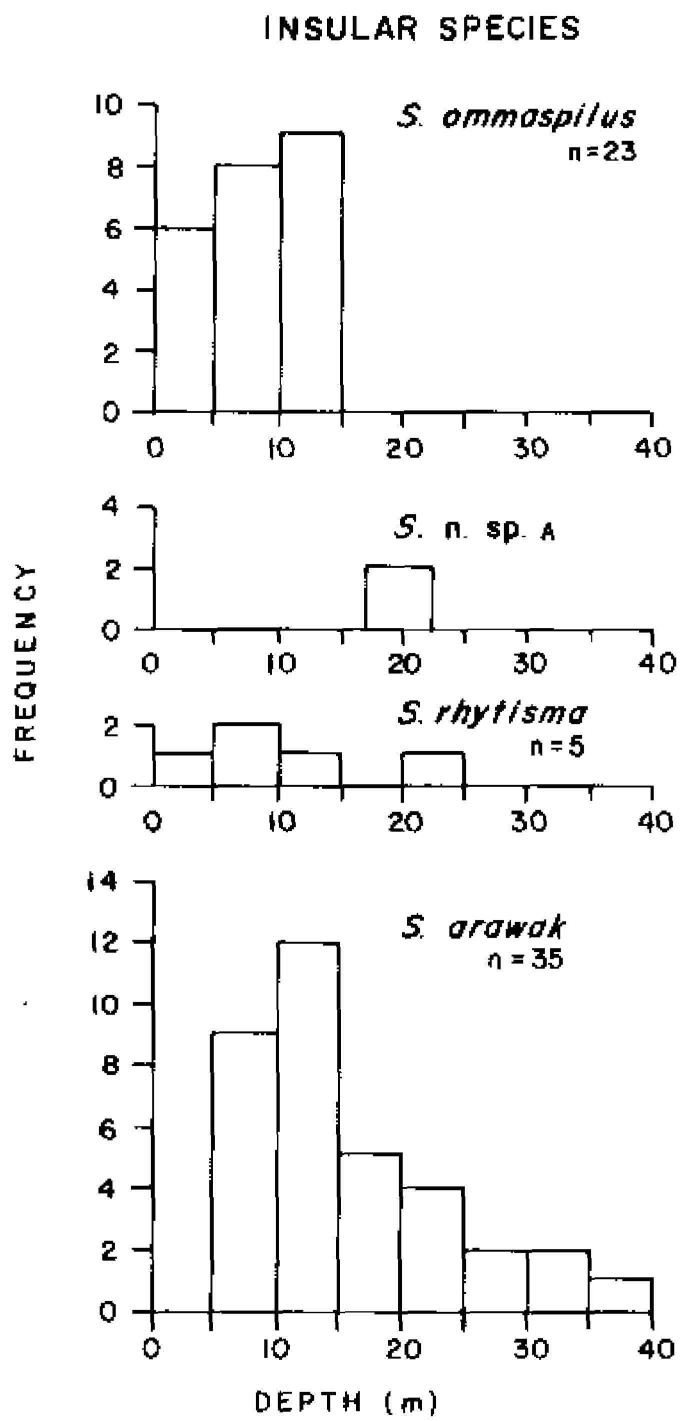
Measured and Counted

ANSP 93812; Holotype (25.6); W Wood Cay, Bahamas; 15M; 19 VII 59. ANSP 124854; 2(36.6-45.1); S Amana Cay, Bahamas; 6M. FMNH 94821; (21.7); Glovers Reef, Belize; 25M; July, 1979. UF 1345; (34.3); High Cay, Bahamas; 3M; 19 VIII 66. UMML UNCAT GS-53; (25.7); 15°42'N; 63°38'W; 12 VIII 72.

Counted

UMML 14379; Curacao; 14M; 25 XI 62.

Figure 13. Frequency histogram of capture depths for four species of dwarf tonguefishes.



INSULAR SPECIES
S. ommaspilus
n=23
S. n. sp. A
S. rhytisma
n=5
S. arawak
n=35
FREQUENCY
DEPTH (m)

Symphurus Undescribed Species A

(Fig. 41A)

Symphurus sp.

Lubbock 1980: 297; Listed, Ascension Island; counts, measurements.

Remarks

In his account on the shore fishes of Ascension Island, Lubbuck (1980) provided a brief description and comparison of these tonguefishes with described species of Symphurus from the eastern Atlantic. Although Lubbock recognized that his specimens represented an undescribed species, he did not formally name or describe the species because he lacked adequate comparative material to provide a proper diagnosis.

In recognition of Lubbock's keen interest and contribution to the knowledge of Ascension Island fishes, cut short by his untimely death, I propose to name this species in his honor.

Study Material: 2 Specimens, 28.0-28.3 mm SL.

BMNH 1979.1.5:237; Holotype (28.0); Ascension Island; 20M.

BMNH 1979.1.5:238; Paratype (28.3); Ascension Island; 20M.

Diagnosis

A dwarf species which can be readily distinguished from all other Symphurus species by the combination of a 1-3-2 ID pattern; 12 caudal rays; unique pigmentation pattern; numerous, fine scales; and an unpigmented peritoneum. Most similar to Symphurus n. sp. B and S. rhytisma which share the 1-3-2 ID pattern, clear peritoneum, unusual ornate pigmentation (for a tonguefish) and the possession of numerous, fine scales along the body. It differs from new species B in the following: pigmentation of eyed surface (cream-colored with several mostly incomplete crossbands and no pigment on fins vs. dark, chocolate brown coloration with alternating X and Y-shaped markings and fin blotches). The species also differ in the following morphometric measurements: shorter dorsal fin base (91.8-91.9 vs. 93.7-96.2% SL) and longer head length (23.0-24.3 vs. 20.7-22.6); longer predorsal distance (30.9-33.8 vs. 18.3-30.3% HL), longer snout (23.1-23.5 vs. 18.2-22.1% HL), longer upper jaw length (21.5-22.1 vs. 19.7-22.0% HL), deeper cheek depth (21.5-22.1 vs. 12.1-20.8% HL) and smaller upper head lobe (60.0-61.8 vs. 65.7-82.6).

The new species differs from S. rhytisma in pigmentation pattern (S. rhytisma at this size usually has a dark caudal blotch) and its greater number of dorsal (87-88 vs. 83-85) and anal rays (74 vs. 68-71), and vertebrae (48-49 vs. 46-48, usually 47). The new species also has smaller scales, as indicated by the greater number of longitudinal scale rows (107-109 vs. 91-97).

The new species is similar to two other 1-3-2 species (S. nigrescens and S. pusillus) in some meristic features. It differs from both of these in having an unpigmented peritoneum (black in the other two species), and having much finer scales (107-109 vs. 95 or less).

The new species also partially overlaps the range of some meristic features for Symphurus normani (a species with a 1-3-3 ID pattern). It differs from this species, however, in body size (S. normani is a much larger species), pigmentation pattern (uniform light brown in S. normani), and the new species does not have scales on the blind side dorsal and anal fins (well-developed in S. normani).

Description

Symphurus n. sp. A is a dwarf species of tonguefish. The two known specimens measure 28.0 and 28.3 mm SL and are females with at least partially elongate ovaries. ID pattern 1-3-2 (Table 9). Caudal rays 12 (Table 10). Dorsal rays 87-88 (Table 11). Anal rays 74-75 (Table 12). Vertebrae 48-49 (Table 13). Hypurals 4. Longitudinal scale rows 107-109 (Table 14). Scale rows posterior to lower orbit 19-20 (Table 15). Lateral scale rows 45-48 (Table 16). Proportional measurements are provided in Tables 28-29.

Body moderately deep (25.8-29.3% SL); with greatest depth in anterior half of body. Head relatively narrow, (22.6-25.7% SL); with long snout (23.1-23.5% HL). No scales evident on snout. Posterior extension of maxilla reaches anterior margin of pupil of lower eye. Eyes relatively large (13.2-15.4% HL); equal in position. Eyes not covered with scales. No scales evident in narrow interorbital region. Pupillary operculum absent. Dermal papillae evident on blind side snout but not pronounced. Dorsal fin origin at vertical equal to mid-point of upper eye. No scales on dorsal and anal fins.

Teeth present on all jaws. Blind side jaws with teeth well developed. Ocular side dentary with incomplete row (holotype) or complete row (paratype) of rather large teeth. Ocular side premaxilla with single, incomplete row of teeth covering anterior three-fourths (holotype); second specimen with teeth on entire length of premaxilla.

Pigmentation

Eyed surface with cream-colored background. Pigment forming a series of variable, mostly incomplete crossbands along body. On head region, line of small brown pigment spots first appears on the dorsal surface about the mid-point between eyes and opercular opening. These pigment spots extend ventrally to about the level of the eyes. Along posterior head and forward part of trunk, pigment forms small blotches or partial crossbands, most oriented dorso-ventrally (some anterior-posterior). In caudal fifth of body in both specimens, there are two complete crossbands. The posteriormost band located a short distance from caudal fin origin. A narrow stripe of dark brown pigment evident on body at caudal fin base. Operculum not pigmented other than general background color. Inner lining of operculum and isthmus not pigmented. No evidence of moustache on ocular side upper lip. Blind side cream-colored to off-white. In holotype, dark black internal pigment evident on both sides in midbody region along body axis. In paratype, pigment spots less numerous and only evident on blind side along axis of body. Peritoneum unpigmented.

Fins with no obvious pattern of spots or blotches. Vertical fin rays with pigment along entire length of ray. Pigment heaviest in regions adjacent to banding on body. Caudal fin with narrow pigment stripe at base of fin, otherwise generally without pigment. No pigment on pelvic fin base or rays.

Distribution and Ecology (Fig. 14)

The only two known specimens of this species were collected at a rotenone station in 20 meters of water at Ascension Island. The advanced state of development of the ovaries at such small sizes (28.0, 28.3 mm SL) indicates that these specimens represent ripening females of a dwarf species (see Fig. 12 for comparison with other dwarf species).

Table 28. Body proportions for *Symphurus* n. sp. A and n.sp. B. Measurements, except SL (in mm), expressed as thousandths of Standard Length.

Species A.

	SL	BD	PAL	DBL	ABL	DRL	ARL	PL	PA	HL	HW	POL	UHL	LHL	CFL
HOLOT.	28.0	293	250	918	725	114	111	71	36	243	257	146	150	114	118
PT.	28.3	258	272	919	738	106	99	78	50	230	226	131	138	64	127

SPECIES B.

	SL	BD	PAL	DBL	ABL	DRL	ARL	PL	PA	HL	HW	POL	UHL	LHL	CFL
HOLOT.	59.2	328	240	946	790	103	90	78	47	223	260	128	184	117	115
PT. 1	59.9	329	244	950	738	105	90	78	63	217	239	135	150	108	110
PT. 2	31.6	288	244	937	718	142	142	82	48	209	225	133	139	98	146
PT. 3	31.0	271	261	942	748	132	132	81	55	226	239	136	148	103	142
MADEIRA	50.3	286	233	962	754	91	90	70	64	207	242	129	155	101	95

Table 29. Body proportions for *Symphurus* n.sp. A and n.sp. B. Measurements, except SL and HL (in mm), expressed as thousandths of Head Length.

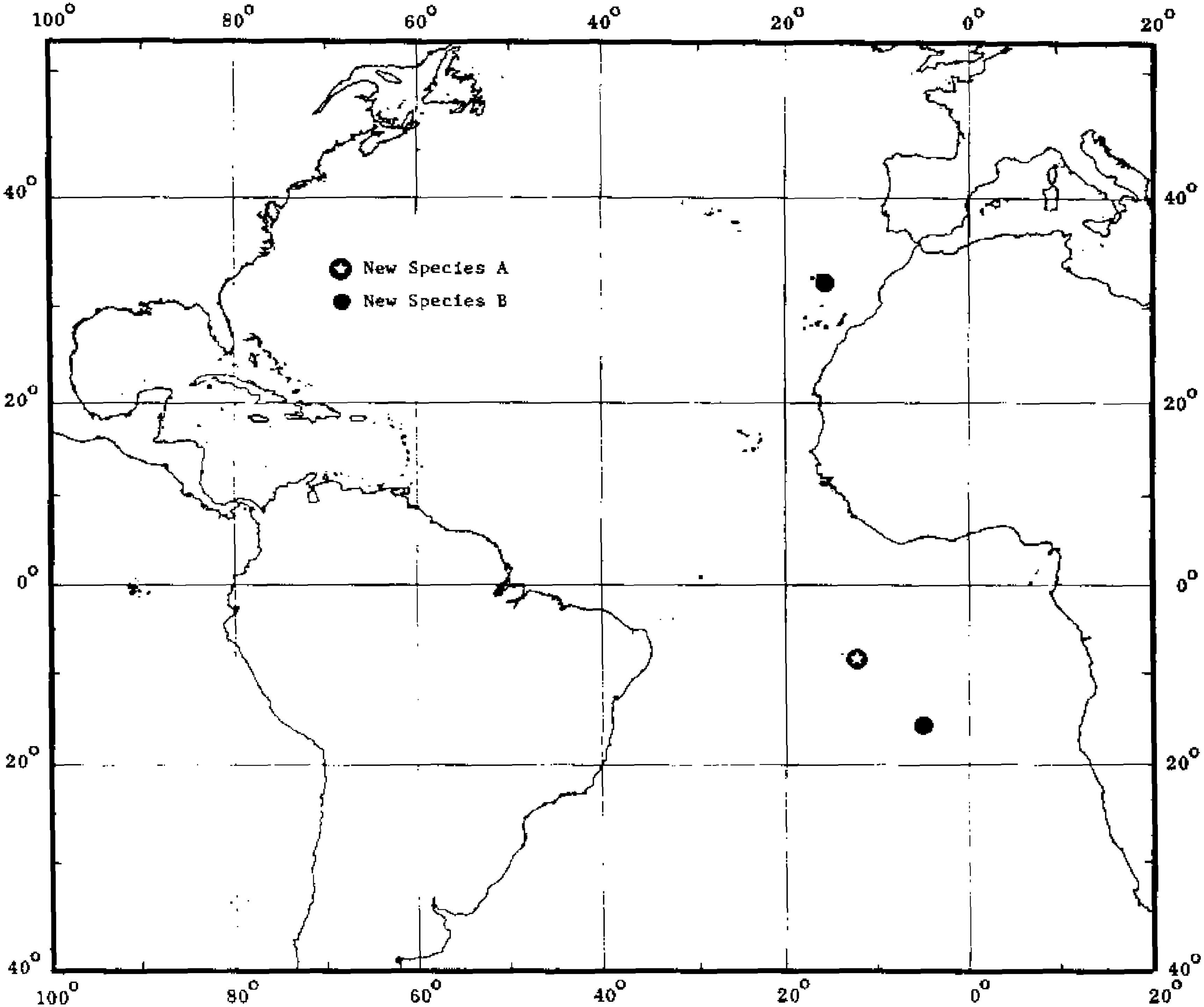
SPECIES A.

Specimen	SL	HL	HW	POL	PDL	SNL	UJL	ED	CD	UHL	LHL	OPUL	OPLL
HOLOTYPE	28.0	6.8	1059	603	309	235	221	132	221	618	471	191	324
PARATYPE	28.3	6.5	985	569	338	231	215	154	215	600	277	200	231

SPECIES B.

SPECIMEN	SL	HL	HW	POL	PDL	SNL	UJL	ED	CD	UHL	LHL	OPUL	OPLL
HOLOTYPE	59.2	13.2	1167	576	208	220	220	189	182	826	523	212	265
PT. 1	59.9	13.0	1100	623	231	192	208	138	208	692	500	215	292
PT. 2	31.6	6.6	1076	636	303	182	197	167	121	667	470	167	273
PT. 3	31.0	7.0	1057	600	271	186	200	129	157	657	457	171	286
MADEIRA	50.3	10.4	1173	625	183	221	212	135	192	750	490	240	240

Figure 14. Geographic distribution of undescribed species A and undescribed species B.



Eastern Atlantic 12 Caudal-Rayed Dwarf Species.

Symphurus Undescribed Species B

(Fig. 41B)

Symphurus nigrescens

Nielsen 1963: 25; (in part); St. Helena.

Cadenat and Marchal 1963: 1311; (in part); St. Helena.

Maul 1976: 63; (in part); Madeira Island.

Previous investigators have not recognized this species in collections. Most have identified their specimens of the new species as *S. nigrescens*, a similar-sized species that is closely related to the new species. Differences between these two species are provided in the diagnosis.

Study Material: 5 specimens, 31.0-59.9 mm SL. Five x-rayed and measured.

Diagnosis

A dwarf species of *Symphurus* characterized by a 1-3-2 ID pattern, 12 caudal rays, unique pigmentation pattern, high scale counts, and unpigmented peritoneum. It most closely resembles other dwarf species, especially the eastern Atlantic *Symphurus* new species A and western Atlantic *S. rhytisma*. It differs from new species A in its pigmentation (dark, chocolate brown body color with series of alternating X and Y-shaped marks along head and anterior region of trunk, and bases of vertical fin rays heavily pigmented vs. general cream-colored body with chain-like reticulations and fins generally devoid of pigment in new species A). Species B also differs from Species A in the following morphometric features: longer dorsal fin base (93.7-96.2 vs. 91.8-91.9% SL) and shorter head length (20.7-22.6 vs. 23.0-24.3); shorter predorsal distance (18.3-30.3 vs. 30.9-33.8% HL), shorter snout (18.2-22.1 vs. 23.1-23.5% HL), shorter upper jaw (19.7-22.0 vs. 21.5-22.1% HL), narrower cheek depth (12.1-20.8 vs. 21.5-22.1% HL) and larger upper head lobe (65.7-82.6 vs. 60.0-61.8).

The new species may be distinguished from S. rhytisma in its higher meristics (dorsal rays 88-89 vs. 83-85; anal rays 74-75 vs. 68-71; vertebrae 48-49, usually 49 vs. 46-48, usually 47; and especially scale row number 101-109 vs. 91-97). These two species also have different pigmentation patterns (S. rhytisma has a generally light, cream colored background with a caudal blotch developed in most of the smaller specimens; the new species shows no indication of a caudal blotch at any size and has a dark, chocolate brown background color).

The new species is similar to two other 1-3-2 species (S. nigrescens and S. pusillus) in some meristic features. It differs from both of these species in pigmentation pattern, especially in pigmentation of the peritoneum (unpigmented in the new species vs. black in the other species). The new species also has much smaller scales, 101-109 vs. 95 or less in the other species.

In certain meristic features, the new species overlaps S. normani (a species with a 1-3-3 ID pattern). It differs from this species primarily in pigment pattern (dark, chocolate brown with alternating X and Y-shaped marks vs. uniform light brown color) and absence of scales on dorsal and anal fins (well-developed in S. normani).

Description

A dwarf Symphurus attaining maximum adult size around 60 mm SL. ID pattern 1-3-2 (Table 9). Caudal rays 12 (Table 10). Dorsal rays 88-89 (Table 11). Anal rays 74-75 (Table 12). Vertebrae 48-49 (Table 13). Longitudinal scale rows 101-109 (Table 14). Scale rows on head posterior to lower orbit 18-21 (Table 15). Lateral scale rows 41, 43 and 53 (Table 15). Proportional measurements are presented in Tables 28-29.

Body relatively deep (27.1-32.9% SL); with greatest depth in anterior third of body. Head usually wider than long (HL into HW = 1.06-1.17). Snout relatively short (18.2-22.1% HL); with small ctenoid scales present in most specimens. Posterior extension of maxilla reaching to mid-point of lower eye in smaller specimens; only to anterior margin of pupil of lower eye in larger specimens. Eyes relatively large (12.9-18.9% HL); usually equal in position, occasionally upper eye slightly anterior to lower eye. Small scales partially covering anterior portion of eye; usually with 3-6 ctenoid scales in narrow interorbital space. Pupillary operculum absent. Dermal papillae well-developed on blind side snout and chin; occasionally extending onto anterior margin of snout and ventral margin of chin on eyed side. Dermal papillae not as well-developed in smaller specimens. Dorsal fin origin at vertical equal to mid-point of upper eye; occasionally reaching anterior margin of upper eye. No scales on dorsal and anal fins.

Teeth well developed on blind side jaws. Eyed side dentary usually with a single, complete row of slender teeth. Ocular side premaxilla with dentition developed to variable degree. Some specimens (both large and small) with single row of slender teeth covering only anterior half or three-fourths of premaxilla; one other specimen (50.3 mm SL) has a complete row of teeth on the premaxilla; while in the smallest specimen (31.0 mm SL) there are only a few teeth evident on the ocular side premaxilla, just anterior to the anterior nostril.

Pigmentation

(Based on the holotype): Eyed surface with a general dark chocolate brown color. Body with eight yellowish to olive-colored cross bands. First four bands interconnect and form a series of alternating X and Y shaped marks which cross the entire body. The first band situated on the head immediately posterior to eyes. The second band located just posterior to opercular opening, conjoined with two other bands on trunk. The next four bands on the trunk completely separate. The posteriormost band crosses the body at origin of caudal fin. Outer operculum with mottled areas but pigment pattern not outstanding against general body color. Inner lining of operculum and isthmus without pigment. Pelvic fin with pigment on both rays and membrane. Blind side yellowish-green with no melanophores evident along mid-line of body.

Vertical fins with series of alternating dark, brown blotches and clear areas. Dorsal and anal fin blotches number about eight. Blotches begin about dorsal ray number eight and anal ray number one. Blotches involve approximately from 5-10 rays (alternating with about 4-8 clear rays). Darkest pigment on fin rays associated with cross bands on body. Fin rays with brown pigment blotches only on basal half of rays. Distal half of rays unpigmented. Caudal fin with dark brown line of pigment on origin of fin, but remainder of fin entirely clear. Moustache evident on ocular side upper lip, with heaviest pigment noticeable in angle of jaws.

In specimens collected by Mortenson (ZMUC lots), body mostly faded, or pigmentation present only where scales still remain. Banding pattern only slightly evident in one specimen. In these mostly faded specimens, the most noticeable color patterns still evident are the blotches on the vertical fins. As in the holotype, these blotches number from 5-7 in each fin and alternate with clear areas. Pigment is heaviest only on basal half of the fin rays (in one specimen ZMUC 82222, the blotches extend for about seven-eighths of the length of the fin rays). The moustache on the ocular side upper lip is also still evident in all three specimens. Noticeable in these specimens but not evident in the holotype, are a series of dark internal pigment spots along the axial skeleton on the blind side. In one specimen, the internal pigment is evident on both sides. The axial pigment is evident for almost the entire length of the body. In the specimen collected at Madeira, the axial pigment is also evident on about three-quarters of the body.

Distribution and Ecology (Fig. 14)

Four of the five known specimens of this species have been collected at various sites at St. Helena Island in the South Atlantic. The fifth specimen was collected from a seaside swimming pool at Madeira Island in the North Atlantic (Maul 1976). The St. Helena specimens were collected at various depths between 5-45 meters over bottom types consisting of shells, stones, and gravel.

This colorful species apparently is a dwarf species, not exceeding 60 mm SL. The largest specimen (59.9 mm SL) collected is the only known female. The ovaries of this specimen are elongate with a number of developing ova evident. The largest male (59.2 mm SL) is the holotype. The specimen collected from Madeira measures 50.3 mm SL and is also a male. The other two specimens collected at St. Helena are small males (31.0 and 31.6 mm SL). Little else is known concerning the life history of this species.

Material Examined

BMNH 1984.7.16:246; Holotype (59.2); St. James Bay, St. Helena; 5-10M.

ZMUC 86220; Paratype (31.0); James Bay, St. Helena; 35M.

ZMUC 86222; Paratype (59.9); off Old Woman Valley, St. Helena; 20M.

ZMUC 86223; Paratype (31.6); off Lemon Valley, St. Helena; 45M.

MMF 22999; (50.3); Madeira Island; 1M.

CHAPTER 6.3

Species with a 1-3-2 ID Pattern and a Black Peritoneum

Symphurus ginsburgi Menezes and Benvegnu, 1976

(Fig. 42B)

Symphurus pterospilotus (not of Ginsburg 1951: 194)

Roux 1973: 175; Continental shelf, Brazil.

Symphurus ginsburgi

Menezes and Benvegnu 1976: 146; Original description, southern Brazil.

Symphurus civitatum

Lazzaro 1977: 69; Continental shelf of Uruguay.

Holotype: MZUSP 12339, male; Rio Grande do Sul; 31°31'S 49°52'W; 200 m; April 11, 1972.

Study Material: 34 specimens, 30.9-90.4 mm SL. 34 x-rayed, 30 measured.

Diagnosis

This is a relatively deep-water, small-sized species, reaching adult lengths of only 90 mm SL. The combination of 1-3-2 ID pattern (the only known western South Atlantic species with this pattern), black peritoneum, 12 caudal rays, four hypurals, and the following meristics: vertebrae usually 51-52, dorsal rays 87-95 and anal rays 75-81 (73-81 reported by Menezes and Benvegnu 1976), distinguish S. ginsburgi from all other tonguefishes except the western north Atlantic undescribed species C.

Meristics of S. ginsburgi overlap completely those of the western North Atlantic undescribed species C. Differences between these two species include distinct but subtle differences in morphometrics (Table 30) and body size. The most distinctive morphometric differences include the following: S. ginsburgi has a relatively smaller body depth; a much longer snout, head and upper jaw; and the eye is larger when compared to undescribed species C. Symphurus ginsburgi is also somewhat smaller and reaches maturity at smaller sizes when compared to undescribed species C. Maximum size observed in S. ginsburgi is 90 mm SL and gravid females as small as 51-53 mm SL have been reported. In contrast, undescribed species C attains larger sizes (to 127 mm SL) and all females smaller than 80 mm SL were immature. The smallest sexually mature females observed in undescribed species C (80.9, 83.9 mm SL) were considerably larger than those of S. ginsburgi.

Among other 1-3-2 species, S. ginsburgi overlaps partially meristics of the eastern Atlantic S. nigrescens and the western Atlantic S. marginatus. It can easily be distinguished from S. nigrescens by modal differences in counts (vertebrae 50-52, usually 51-52 vs. 47-51, usually 48-50; dorsal rays 87-95 vs. 82-92, usually 84-91; and anal rays 75-81 vs. 69-79). From S. marginatus, it can be distinguished by its stockier and deeper body (greatest depth in anterior third of body) vs. a more elongate body (body depth more uniform, at mid-point of body), lower meristics (vertebrae 51-52 vs. 52-54; dorsal rays 87-95 vs. 93-104; anal rays 75-81 vs. 80-89, four hypurals vs. 4-5) and S. ginsburgi lacks the dark brown caudal blotch that characterizes S. marginatus.

Some meristic features of S. ginsburgi overlap those of the western South Atlantic species, S. trewavasae. Similarities between these species, however, are only superficial. Symphurus ginsburgi can readily be distinguished from this species by differences in ID pattern (1-3-2 vs. 1-3-3), caudal ray count (12 vs. 10) and by modal distributions in vertebral counts (50-52 vs. 47-51, usually 48-50).

The meristics of S. ginsburgi also overlap those of several western Atlantic species including S. civitatium, S. diomedeanus, S. plagusia, S. tessellatus and undescribed species E. Since all of these are relatively shallow water species (usually occurring in depths <70 m), there is little liklihood of collecting them with the much deeper occurring S. ginsburgi (depths ranging from 100-200 m). Additionally, partial overlaps in fin ray or vertebrae counts with these species are the only similarities between these otherwise divergent species. For example, differences occur in ID pattern (1-3-2 in _S. ginsburgi_ vs. 1-4-3 in all the others), peritoneum color (black vs. unpigmented) and vertebrae counts (see Table 13). There are also differences in caudal rays between _S. ginsburgi_ (12) and _S. diomedeanus_ (10) and _S. urospilus_ (11). Furthermore, the eyed-side jaws of _S. ginsburgi_ have a complete row of teeth, whereas in all of 1-4-3 species, dentition is either absent altogether or only poorly developed.

Description

Symphurus ginsburgi is a small-sized tonguefish attaining maximum lengths of approximately 90 mm SL. ID pattern 1-3-2 (Table 9). Caudal rays normally 12 (Table 10). Dorsal rays 87-94 (Table 11). Anal rays 75-81 (Table 12). Vertebrae 50-52, usually 51-52 (Table 13). Hypurals 4. Longitudinal scale rows 87-94 (Table 14). Scale rows on head posterior to lower orbit 15-20 (Table 15). Lateral scale rows 32-44 (Table 16). Proportional measurements appear in Tables 31-32.

Body relatively deep (depth 20.5-32.4% SL) with rapid taper; maximum depth in anterior third of body. Head relatively narrow (0.96-1.24 in HW); with moderately long, pointed snout (16.6-28.4% HL). Snout covered with small scales. Dermal papillae present but not well-developed on blind side snout. Posterior extension of maxilla short, reaching only to front margin of lower eye or to front edge of pupil of lower eye. Eyes relatively large (11.6-15.8% HL); usually equal in position or with upper eye slightly anterior of lower. Eyes covered with small scales on upper surfaces and in interorbital region; 4-8 small ctenoid scales in narrow interorbital region.

Table 30. Summary of MANOVA Analysis, based on 14 morphometric variables, comparing body shapes of S. ginsburgi and the western North Atlantic undescribed species C.

	S. ginsburgi		Undescribed C		F	Significance of F
	Range	X	Range	X		
Morphometric						
BD	205-324	285.8	251-328	294.2	23.31	P>.000
PDL	33-79	59.9	35-58	48.3	8.98	P=.004
PAL	201-271	240.2	200-249	224.7	22.19	P>.000
DBL	921-971	939.4	942-965	951.7	31.13	P>.000
ABL	693-795	742.3	736-815	767.7	31.69	P>.000
HL	198-257	225.5	183-225	205.9	21.46	P>.000
HW	220-272	244.0	207-270	234.3	19.98	P>.000
POL	133-159	144.7	120-174	136.5	22.26	P>.000
SNL	34-64	48.2	33-50	40.9	9.99	P=.002
UJL	40-58	48.4	33-47	40.9	10.76	P=.002
ED	25-36	30.4	21-32	25.0	5.68	P=.020
CD	31-63	51.0	33-56	45.6	12.74	P=.001
UHL	116-181	150.2	113-174	154.9	26.02	P>.000
LHL	96-138	113.1	93-128	107.3	18.16	P>.000

Pupillary operculum absent. Dorsal fin origin usually at a vertical equal to front margin of pupil of upper eye; occasionally dorsal fin placed anteriorly to front margin of upper eye or in a smaller number of specimens, dorsal fin origin at a point equal only to mid-point of pupil of upper eye. Scales absent from blind side dorsal and anal fins. Body scales small, strongly ctenoid on eyed-side, less so on blind side.

Teeth well developed on blind side jaws. Lower jaw on ocular side with complete row of teeth. Ocular side premaxilla with a row of slender teeth usually only on anterior three-fourths of surface.

Pigmentation

Eyed surface usually light brown with 2-5 (usually 4) irregular, dark brown crossbands. Bands not continued onto dorsal and anal fins. Traces of first band usually evident on head region at the operculum. Crossbands, except for the second which crosses the body immediately behind the operculum and which is almost always continuous and more uniformly colored than the rest, are darker in dorsal and ventral regions of the body and somewhat blurred in the mid section. Small dark melanophores are scattered throughout the body surface. Outer operculum not pigmented other than general background color. Inner lining of operculum and isthmus not pigmented. Moustache on ocular side lips usually not pronounced, or if present on upper lip, appearing only as a small speckling of pigment spots. Blind side unpigmented, except in faded specimens which have lost all of their scales. In these specimens, there is a series of deep, internal melanophores along the body midline (noticeable on both sides). Peritoneum black, showing through abdominal wall on both sides of body.

A small, non-ocellated dark-brown pigment spot present at scale-covered base of caudal fin. Distal two-thirds of caudal fin unpigmented. Dorsal and anal fins pale anteriorly, but from level of first crossband posteriorly, their bases become darker, forming, in some specimens, a continuous narrow dark stripe; others with dark stripe inconspicuous and with only a concentration of pigment in regions of body crossbands.

Geographic Distribution (Fig. 15)

Symphurus ginsburgi occurs on the open continental shelf of the western South Atlantic from about Cabo Frio ($23^{o}15'S$) to Maldonado, Uruguay ($35^{o}18'S$) (Menezes and Benvegnu 1976).

Bathymetric Distribution

Symphurus ginsburgi, like other members of the 1-3-2 ID pattern species group and black peritoneum, occurs at moderate depths (103-200 m) on the continental shelf. The majority of specimens (71/91, 78%) were collected between 151-200 meters while an additional 20 specimens were taken between 103 (3 fish) and 150 meters (Menezes and Benvegnu 1976). Depths inhabited by *S. ginsburgi* are somewhat shallower than that recorded for the closely related undescribed species C (usually collected at 201-376 m).

Table 31. Summary of morphometrics expressed as thousandths of Standard Length, except SL (in mm), for *Symphurus ginsburgi*.

Character	N	RANGE	MEAN	SD
SL	30	30.9-90.4	54.9	17.78
BD	30	205-324	285.8	25.67
PDL	30	33-79	59.9	9.97
PAL	30	201-271	240.2	17.18
DBL	30	921-971	939.4	10.17
ABL	30	693-795	742.3	22.86
PL	27	54-89	67.8	8.22
PA	30	46-94	62.5	8.69
CFL	26	104-148	123.3	8.76
HL	30	198-257	225.5	15.28
HW	30	220-272	244.0	14.28
POL	30	133-159	144.7	7.10
SNL	30	34-64	48.2	6.89
UJL	30	40-58	48.4	5.39
ED	30	25-36	31.0	2.96
CD	30	31-63	51.0	6.54
UHL	28	116-181	150.2	16.36
LHL	30	96-138	113.1	9.80

Table 32. Summary of morphometrics expressed as thousandths of Head Length (except HW/HL) for *Symphurus ginsburgi*.

Character	N	RANGE	MEAN	SD
HW/HL	30	0.96-1.25	1.1	0.07
POL	30	588-746	643.0	32.98
SNL	30	166-284	213.6	21.68
UJL	30	182-247	215.1	18.68
ED	30	116-158	136.9	11.35
CD	30	152-271	226.5	27.73
OPLL	30	214-364	287.0	36.28
OPUL	30	160-312	220.1	39.03
UHL	28	500-808	668.0	48.52

Size and Sexual Maturity

Symphurus ginsburgi is a small-sized species attaining maximum lengths of only 90 mm SL. The largest fish examined, a male (81.0 mm SL) was only slightly larger than the largest female (78.9 mm SL). Ten males ranged in size from 34.9-81.0 mm SL, 15 females were 31.6-78.9 and six immature fish (sex could not be determined) measured 30.9-36.3 mm SL.

Based on reproductive stages of females, it is evident that this species attains sexual maturity at relatively small sizes. Of 15 females, eight (ranging in size from 51.6-78.9 mm SL) were gravid. Four of these were smaller than 60 mm SL (51.6, 52.7, 53.1 and 57.5 mm SL). Menezes and Benvegnu (1976) also noted the small size at sexual maturity in this species and reported finding gravid females ranging in size from 58-79 mm SL. Immature females, with gonads undergoing posterior elongation, ranged from 39.8-60.7 mm SL. Ovaries of the smallest (31.6, 33.2 and 34.3 mm SL) immature females had not yet started maturing.

Ecology

Other than depth of capture and the brief observations on sexual maturation, little else is known concerning the ecological requirements of this species.

<u>Material Examined</u>

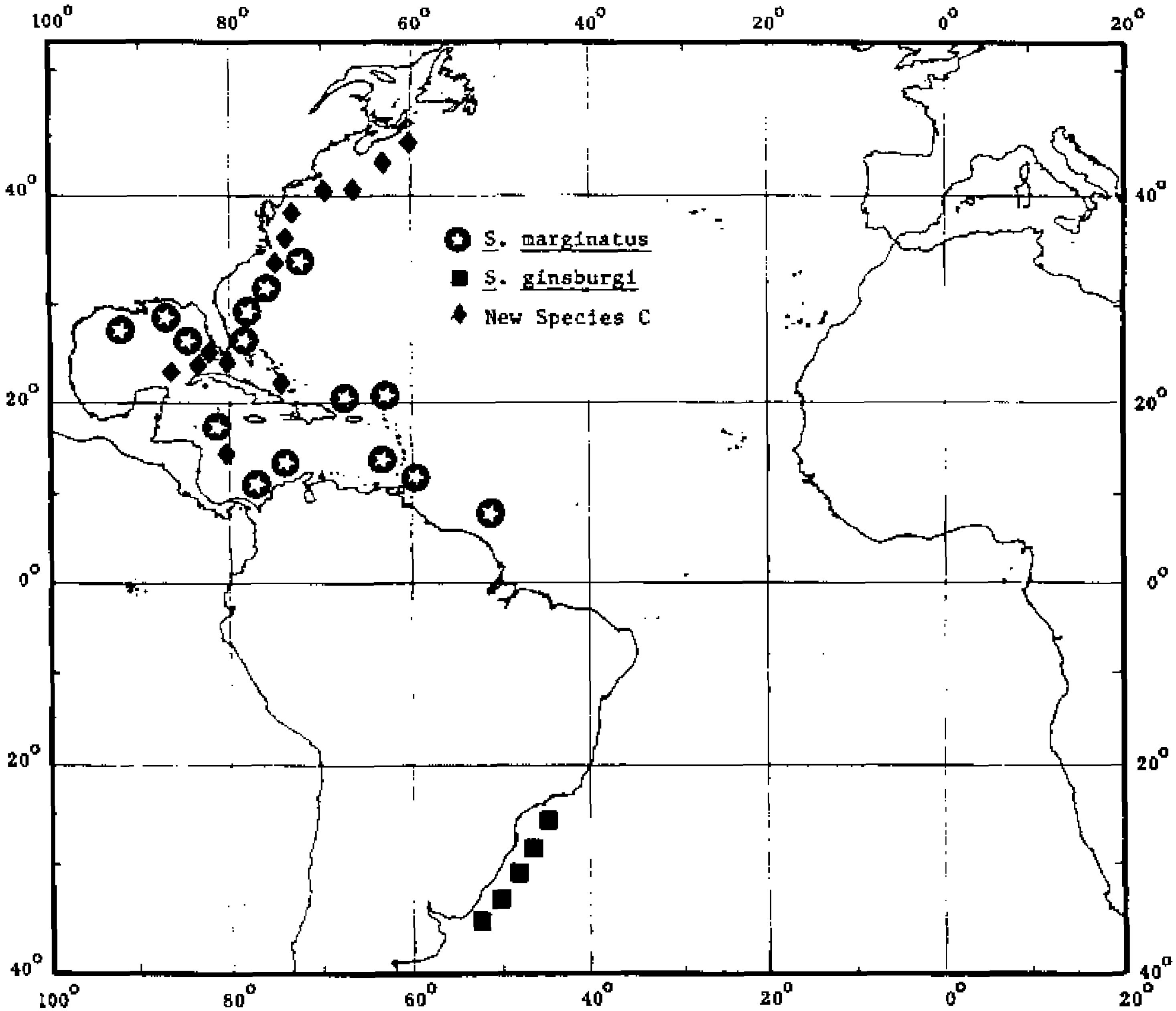
<u>Measured and Counted</u> 30 Specimens, 28 Lots.

MZUSP 12339; Holotype (61.5); 31°31'S 49°52'W; 200M; 11 IV 72. MNHN 1975-270; Paratypes 3(87.2-90.4); 23°08'S 42°30'W; 103M; 02 XII 61. MZUSP 12314-15; Paratypes 2(59.3-60.2); 23°15'S 42°24'W; 111M; 08 VIII 70. MZUSP 12320; Paratype (54.0); 32°46'S 50°25'W; 200M; 21 I 72. MZUSP 12335; Paratype (43.9); 31°02'S 49°52'W; 135M; 04 X 72. MZUSP 12340-48; Paratypes 9(31.6-60.7); 31°31'S 49°52'W; 200M; 11 IV 72. MZUSP 12377-84; Paratypes 8(33.2-78.9); 34°45'S 52°05'W; 179M; 15 VIII 72. MZUSP 12391-93; Paratypes 3(31.8-60.2); 32°21'S 50°13'W; 180M; 21 VIII 72. MZUSP 12902-03; 2(30.9-31.1); No data.

<u>Counted</u> 4 Specimens, 4 Lots.

MZUSP 12336-38; Paratypes 3(34.6-42.8); 31°31'S 49°52'W; 200M; 11 IV 72. MZUSP 12370; Paratype (35.3); 29°53'S 48°19'W; 194M; 03 VIII 72.

Figure 15. Geographic distribution of *Symphurus ginsburgi*, *S. marginatus* and *Symphurus* undescribed species C.



Western Atlantic 1-3-2 Species.
(Black Peritoneum)

Symphurus Undescribed Species C

(Fig. 42C)

Study Material: 84 specimens, 51.8-127 mm SL, 78 x-rayed, 33 measured.

Diagnosis

This is a relatively deep-water, medium-sized species, reaching adult lengths of 127 mm SL. The combination of 1-3-2 ID pattern, black peritoneum, 12 caudal rays, four hypurals, and the following meristics: vertebrae usually 51-52, dorsal rays 89-95, and anal rays 76-84 distinguish undescribed species C from all other tonguefishes except the western south Atlantic *S. ginsburgi*. Meristics of undescribed species C completely overlap those of *S. ginsburgi*. Differences between these two species include distinct but subtle differences in morphometrics (Table 30) and body size. The most distinctive morphometric differences include the following: undescribed species C has a deeper body than *S. ginsburgi*; a much shorter snout, head and upper jaw length; and the eye is smaller when compared to *S. ginsburgi*. *Symphurus ginsburgi* is also somewhat smaller and reaches maturity at smaller sizes when compared to undescribed species C. Maximum size observed in *S. ginsburgi* is 90 mm SL and gravid females as small as 51-53 mm SL have been reported. In contrast, undescribed species C attains larger sizes (to 127 mm SL) and all females smaller than 80 mm SL were immature. The smallest sexually mature females observed in undescribed species C (80.9, 83.9 mm SL) were considerably larger than those of S. ginsburgi.

Among other 1-3-2 species, undescribed species C overlaps partially meristics of the eastern Atlantic S. nigrescens and the western Atlantic S. marginatus. It can easily be distinguished from S. nigrescens by modal differences in counts (vertebrae 50-52, usually 51-52 vs. 47-51, usually 48-50; dorsal rays 89-95 vs. 82-92, usually 84-91; and anal rays 76-84 vs. 69-79). From S. marginatus, it can be distinguished by its relatively stockier and deeper body (greatest depth in anterior third of body) vs. a more elongate body (body depth more uniform, at mid-point of body), lower meristics (vertebrae 51-52 vs. 52-56, usually 52-54; dorsal rays 89-95 vs. 93-104; anal rays 76-84 vs. 80-89, four hypurals vs. 4-5 and undescribed species C has highly pigmented fins (uniformly pigmented in S. marginatus) and lacks the dark brown caudal blotch that characterizes S. marginatus.

Some meristics of undescribed species C overlap those for the western South Atlantic species, S. trewavasae. Similarities between these species, however, are only superficial. The new species can be distinguished from this species by differences in ID pattern (1-3-2 vs. 1-3-3), caudal ray count (12 vs. 10) and by modal distributions in vertebral counts (51-52 vs. 47-51, usually 48-50).

The meristics of undescribed species C also overlap those of several western Atlantic species including S. civitatium, S. diomedeanus, S. plagusia, S. tessellatus and undescribed species E. Since all of these are relatively shallow water species (usually occurring in depths <70 m), there is little liklihood of collecting them with the much deeper occurring undescribed species C (depths ranging from 180-400 m). Additionally, partial overlaps in fin ray or vertebrae counts with these species are the only similarities between these otherwise divergent species. For example, differences occur in ID pattern (1-3-2 in undescribed species C vs. 1-4-3 in all the others), peritoneum color (black vs. unpigmented in all the others) and vertebrae counts (see Table 13). There are also differences in caudal rays between undescribed species C (12) and S. diomedeanus (10) and S. urospilus (11). Furthermore, the eyed-side jaws of undescribed species C have a complete row of teeth, whereas in all of the 1-4-3 species, the dentition is either absent altogether or only present in incomplete rows.

Description

A medium-sized tonguefish attaining maximum adult lengths of approximately 127 mm SL. ID pattern 1-3-2 (Table 9). Caudal rays 12 (Table 10). Dorsal rays 89-95, usually 91-95 (Table 11). Anal rays 76-84, usually 77-81 (Table 12). Vertebrae 50-53, usually 51-52 (Table 13). Hypurals 4. Scales frequently missing due to trawl damage. Longitudinal scales 85-99, usually 85-94 (Table 14). Scale rows on head posterior to lower orbit 16-21, usually 18-20 (Table 15). Lateral scale rows 38-49 (Table 16). Proportional measurements appear in Tables 33-34.

Body relatively deep, 25.1-32.8% SL; with relatively wide head (20.7-27.0% SL). Snout relatively short, 16.6-23.3% HL; covered with small ctenoid scales. Dermal papillae well-developed on blind side snout; often evident on ocular-side snout as well. Posterior extension of maxilla reaches to about front margin of pupil of lower eye. Eyes relatively large, 10.2-14.7% HL; usually equal in position. Anterior and upper surfaces of eyes partially covered with 3-5 scale rows; 1-2 scales in narrow interorbital region. Pupillary operculum absent. Dorsal fin origin reaches a vertical equal to mid-point of upper eye; occasionally reaching anterior margin of pupil of upper eye. No scales on blind side dorsal and anal fins.

Teeth well-developed on blind side jaws. Teeth on ocular-side covering entire dentary. Teeth on ocular-side premaxilla slender, in complete row or occasionally only covering anterior three-fourths of bone.

Pigmentation

Most specimens were missing scales and were generally faded with little or no evidence of a particular pigmentation pattern. In specimens retaining scales, body color variable, light to dark brown, or yellowish. Most specimens collected from northern portions of range with 5-8 darker crossbands, of variable intensity; or sometimes with bands so light that they are inconspicuous relative to background color. Bands become incomplete and rather diffuse in region of body midline. In some specimens, there are only dark blotches along the body at bases of dorsal and anal fins (remnants of bands?). Bands often continued onto dorsal and anal fins in form of dark blotches. Specimens collected off Cuba and Straits of Yucatan generally yellowish with brown mottling but without blotches or banding on body. Outer operculum with no pigmentation other than general background color. Inner lining of operculum and isthmus generally without pigment. In most individuals, ocular side upper lip lightly spotted but without well-

Table 33. Summary of morphometrics expressed as thousandths of Standard Length, except SL (in mm), for *Symphurus* undescribed species C.

Character	N	RANGE	MEAN	SD
SL	36	51.8-126.7	79.6	18.62
BD	36	251-328	294.2	18.56
PDL	36	35-58	48.3	5.56
PAL	36	200-249	224.7	13.14
DBL	36	942-965	951.7	5.56
ABL	36	736-815	767.7	16.58
PL	32	45-84	64.3	8.74
PA	35	34-88	54.8	11.70
CFL	35	100-147	121.2	8.98
HL	36	183-225	205.9	10.85
HW	36	207-270	234.3	16.39
POL	36	120-174	136.5	9.85
SNL	36	33-50	40.9	4.59
UJL	36	33-47	40.9	3.72
ED	36	21-32	25.0	3.14
CD	36	33-56	45.6	5.21
UHL	36	113-174	154.9	12.49
LHL	35	93-128	107.3	9.21

Table 34. Summary of morphometrics expressed as thousandths of Head Length (except HW/HL) for *Symphurus* undescribed species C.

Character	N	RANGE	MEAN	SD
HW/HL	36	0.99-1.41	1.1	0.09
POL	36	589-804	658.8	35.88
SNL	36	166-233	198.9	18.07
UJL	36	142-234	197.7	19.40
ED	36	102-147	121.2	12.40
CD	36	166-289	222.2	26.60
OPLL	36	232-352	298.4	31.88
OPUL	36	164-315	219.5	33.85
UHL	36	566-909	753.7	69.04
LHL	36	232-600	514.6	63.81

defined moustache. Less frequently, individuals with dark moustache on ocular side upper lip and spotting on lower lip. In specimens missing scales, ocular side region of head, dorsal and forward of eyes with black melanophores forming a V-shaped pigment mark. Peritoneum black, showing externally on both sides. Blind side off-white.

Dorsal and anal fins of all specimens with a series of alternating blotches and unpigmented areas of approximately similar size. Blotches irregularly shaped, covering approximately 5-10 rays. Blotches intensify in regions corresponding to crossbanding on body. In some specimens, a dark streak of pigment, covering both fin rays and intervening membranes, occurs along basal one-third of dorsal and anal fins; inconspicuous in others. Caudal fin generally devoid of pigment for most of length. Some specimens have a concentration of dark pigment at the caudal fin base forming an irregularly-shaped, diffuse spot. In specimens missing scales, there is a series of deep, dark black, dermal pigments along the bases of the most anterior dorsal rays.

Geographic Distribution (Fig. 15).

This species has one of the broadest geographic ranges of western North Atlantic tonguefishes. This species occurs in relatively deep waters on the continental shelf from as far north as the continental shelf off Nova Scotia (approximately 43°N) to as far south as the Straits of Yucatan (21°N) and the continental shelf off Nicaragua (14°14'N 80°28.5'W). It has been taken on several occasions off the Nova Scotian shelf (see Material Examined) and may be the only species of *Symphurus* occurring with any regularity in the northern Atlantic north of Long Island, New York. The majority of specimens have been collected in the mid-Atlantic Bight and off the eastern coast of Florida and whether this distribution reflects the geographic center of occurrence for this species or the relative trawling activity at appropriate depths within these locales can not be estimated.

Although this species ranges into the eastern Gulf of Mexico along the southern tip of Florida, it is doubtful that it is a regular component of the ichthyofauna of the Gulf of Mexico or Caribbean Sea. No specimens have been taken in the central or western Gulf areas along the Louisiana or Texas continental shelf. Of the eight specimens recorded from locations west or south of Florida, two (USNM 158310; UMML 16314) have been taken on the southwestern Florida shelf just inside the Gulf region, five (FMNH 88819; UMML UNCAT G-893 and G-898) have been collected on the continental shelf off Yucatan and three other specimens (UMML UNCAT OR 4834) were taken in a single collection off Nicaragua. A single specimen (MCZ 27968) was collected off Dominica. It is possible that this species is replaced in the Gulf of Mexico and Caribbean Sea by either *S. piger* or *S. marginatus*, two common, similarly-sized species that have been collected in relatively large numbers in the Gulf of Mexico and Caribbean Sea and which occupy similar depths as those inhabited by undescribed species C.

Bathymetric Distribution

Undescribed species C occurs primarily in moderate depths of the outer continental shelf region. Its bathymetric center of abundance occurs between 201-376 meters. Over 96% (81 of 84) of the specimens were collected at these depths. Only one specimen was collected deeper (at 668 m), while six others were collected at shallower depths (117-200 m). The shallowest recorded depth of capture is for a single specimen collected off the coast of Virginia at 117 meters.

Size and Sexual Maturation

Symphurus undescribed species C is a medium-sized tonguefish. The largest fish measured, a female, was 127 mm SL. The largest male was only slightly smaller (112 mm SL). Most specimens examined ranged in size between 65-95 mm SL. There were 22 females (54.5-127 mm SL) and 27 males (51.8-112 mm SL) among the 49 specimens for which sex was determined.

Based on the reproductive stages of females, sexual maturity occurs at a relatively large size in this species. Of the 22 females, 16 ranging in size from 80.9-127 mm SL were mature with elongate, gravid ovaries. The four smallest of these measured 80.9, 83.9, 83.9 and 87.4 mm SL. Six females (54.5-66.1 mm SL) had ovaries which were just undergoing posterior elongation.

Ecology

As for most other deep-sea tonguefishes little else is known concerning the ecology of this species.

<u>Material Examined</u>

<u>Measured and counted</u> 36 Specimens, 18 Lots.

NMC 82-0332; (95.5); 43°26'N 60°29'W; 183M; 20 XI 78. UMML 13917; (66.8); 24°32-29'N 80°54-53'W; 192M; 21 VI 63. UMML 15642; 5(55.0-89.5); 24°40-42'N 80°23-20'W; 258M; 23 VI 63. UMML UNCAT GERDA 898; 3(95.2-127); 21°04'N 86°19'W; 352M; 10 IX 67. USNM 158310; (80.6); 24°20'N 83°20'W; 348M; 13 IV 54. VIMS 1905; (51.8); 40°00'N 69°11'W; 231M; 25 X 70. VIMS 3070; 2(68.4-97.1); 36°35'N 74°42'W; 317M; 08 VI 73. VIMS 3073; (105.6); 37°00.7'N 74°36'W; 292M; 12 VI 73. VIMS 5564; 2(62.8-77.1); 37°01'N 74°37'W; 12 VI 73. VIMS 5572; 6(59.7-112); 36°39'N 74°40.6'W; 275M; 17 IX 75. VIMS 5574; (70.0); 37°04'N 74°36'W; 238M; 30 I 76. VIMS 5581; (59.8); 37°04'N 74°38'W; 252M; 12 VI 73. VIMS UNCAT ALB IV 73-8 ST 44; 3(65.1-83.9); 36°08'N 74°43'W; 320M; 11 X 73. VIMS UNCAT ALB IV 83-8 ST 166; 2(66.1-101); 39°04'N 72°44'W; 186M; 28 IX 83. VIMS UNCAT ALBIV 84-2 ST 21; (62.6); 34°46'N 75°27'W; 352M; 04 III 84. VIMS UNCAT DEL 76-5; (74.6); 08 III 76. VIMS UNCAT GI 74-04 ST 91; 3(63.4-94.4); 36°44'N 74°38'W; 376M; 20 XI 74. VIMS UNCAT GI 76-01 ST 63; (106); 37°00'N 74°37'W; 340M; 30 I 76.

<u>Counted</u> 42 Specimens, 23 Lots.

AMNH 40834; (80.9); 39°13'N 72°26'W; 297M; 26 IX 74. FMNH 88819; 1; 23°51'N 87°49'W; 183M; 09 XII 63. MCZ 27968; 1; Off Dominica; 329M. MCZ 39205; 2; 26°08'N 79°02'W; 284M; 03 II 38. SHML DEL 75-15 ST76-3-6; (83.9); 38°50'N 72°55'W; 264M; 20 V 75. UMML 16314; 1; 24°17'N 82°15'W; 373M; 28 XI 64. UMML UNCAT GERDA 893; (54.5); 21°10'N 86°21'W; 281M; 10 IX 67. UMML UNCAT OR4834; 1; 14°14.2'N 80°28.5'W; 274M; 05 XII 64. VIMS 1600; 3;

38°25'N 73°24'W; 247M; 10 VIII 69. VIMS 1601; 1; 38°20'N 73°40'W; 117M; 10 VIII 69. VIMS 1900; 5; 40°02'N 70°19'W; 222M; 24 VII 69. VIMS 1905; 3; 40°00'N 69°11'W; 231M; 25 X 70. VIMS 3071; (77.8); 36°35'N 74°42'W; 317M; 08 VI 73. VIMS 5511; 3; 36°44'N 78°38'W; 304M; 17 IX 75. VIMS 5570; 3; 36°32'N 74°42'W; 330M; 20 IX 75. VIMS 5575; 36°37'N 74°42'W; 316M; 09 VI 73. VIMS 5579; 2; 36°38'N 74°41'W; 255M; 08 VI 73. VIMS UNCAT; (108); 35°57'N 74°49'W; 245M; 11 III 82. VIMS UNCAT GI -04 ST 68; 6; 36 43'N 74°38'W; 269M; 16 XI 74. VIMS UNCAT GI 74-04 ST 69; 1; 36°43'N 74°37'W; 668M; 16 XI 74. VIMS UNCAT GI 74-04 ST 79; (82.7); 36°43'N 74°38'W; 260M; 18 XI 74. VIMS UNCAT GI 76-01 ST 63; (67.8); 37°00'N 74°37'W; 340M; 30 I 76. UF UNCAT TURSIOPS; 1; Govt Cut, 7mi E; 201M; 29 III 65.

<u>OTHER MATERIAL</u>. 6 Specimens, 5 Lots.
ARC 8600284; 1; 42°46'N 63°59'W; 264M; 23 II 82. SHML UNCAT DEL-70-21; 1; 20 VIII 70. UMML UNCAT SB2479; 1; 25°29'N 79°19'W; 366M; 09 XI 60. VIMS 3072; 1; 36°37.6'N 74°41.2'W; 256M; 08 VI 73. VIMS 5569; 2; 36°37.5'N 74°43'W; 301M; 09 VI 73.

Symphurus nigrescens Rafinesque 1810

(Fig. 42C.)

Symphurus nigrescens

Rafinesque 1810: 52; Original description.

Jordan and Goss 1889: 321; synonymized Ammopleurops lacteus; in key.

Collett 1896: 103; Listed, eastern Atlantic.

Roule and Angel 1930: 113. Description of larval stages.

Chaine 1936: 241; Description of otolith.

Fowler 1936: 523; Listed, West Africa.

Chabanaud 1939: 26; Listed, Mediterranean and eastern Atlantic, Gulf of Gascogne to Angola.

Chabanaud 1949a: 88; Counts, measurements, distribution.

Chabanaud 1950: 624; Redescription, counts, measurements.

Ben-Tuvia 1953: 13; Listed, rare; Israel, Mediterranean.

Albuquerque 1954-56: 1001; Listed, Portugal.

Dieuziede et al. 1955: 335; Listed, Algeria.

Bauza-Rullan 1956: 132; Description of otolith.

Tirelli 1958: 85; Description of sensory papillae.

Cadenat and Marchal 1963: 1311 (in part); Listed, West Africa; specimens from St. Helena are undescribed species B.

Nielsen 1963: 25 (in part); Specimens from St. Helena are actually undescribed species B.

Torchio 1963: 273; Comparison with S. ligulatus.

Bini 1968: 85; Description, counts, ecology.

Tortonese and Casanova Queirolo 1970: 43; Listed Ligurian Sea, Mediterranean.

Ben-Tuvia 1971: 34; Listed, rare; Israel, Mediterranean.

Torchio: 1971: 259; Comparison with S. nebulosus.

Bombace and Froglia 1973: 160; Listed, Adriatic, Mediterranean.

Galloti 1973: 125; Listed, Gulf of Taranto, Mediterranean; 95-390 m.

Torchio 1973: 635; Synopsis of species, literature, distribution.

Economides and Bauchot 1976: 895; Listed, Aegean Sea.

Maul 1976: 63 (in part); Specimen from Madeira is undescribed species B.

Cau 1977: 393; First report Sardinian Sea, Mediterranean.

Golovan 1978: 230; Listed, West Africa.

MacPherson 1978: Feeding ecology of species in eastern Mediterranean.

Matallanas 1979: 140; Listed, Spanish Mediterranean.

Matallanas and Rubio 1979: 563; Listed, Catalan Sea.

Tsimenidis et al. 1979: 69; Saronikos Gulf, Aegean Sea, 200-420 m.

Papaconstantinou and Tortonese 1980: 38; Aegean Sea; shallow-400 m.

MacPherson 1981: 183; Trophic ecology and resource partitioning.

Matallanas et al. 1981: 127; Listed, Spanish Mediterranean.

Merrett and Marshall 1981: 226; Listed, northwest Africa.

Cerro and Portas 1984: 17; Listed, Spanish Mediterranean; 300-700 m.

Lloris et al. 1984: 182; Listed, Catalan Sea, Mediterranean.

Allue 1985: 79; Listed, 234 specimens Barcelona fishing grounds, eastern Mediterranean Sea; feeding ecology.

Merrett and Domanski 1985: 384; Listed, 174 specimens, northwest Africa; 279-482 m.

<u>Plagusia lactea</u>

Bonaparte 1833: 27; Original description, Tyrrhenian Sea.

Costa 1850: 60; Listed, Mediterranean Sea.

Canestrini 1861; Listed, Gulf of Genova.

Canestrini 1871; Listed, Italian Mediterranean.

Scordia 1925; Ecology in central Mediterranean.

Scordia 1927: 289; Ecology in central Mediterranean.

Scordia 1929: 348; Ecology in central Mediterranean.

<u>Plagusia picta</u>

Costa 1862: 49; Original description, Mediterranean.

<u>Ammopleurops lacteus</u>

Günther 1862: 490; Mediterranean Sea.

Vaillant 1888: 192; Gulf of Gascogne, Spain and Banc d'Arguin.

Roule 1919: 135; Listed, eastern Atlantic.

Soljan 1948: 11; Listed, Adriatic.

Padoa 1956: 871; Description of larval stages; Mediterranean.

<u>Symphurus lactea</u>

Kyle 1913: 130; Description of larval stages with figures; western Mediterranean and Gulf of Taranto.

<u>Symphurus lacteus</u>

Chabanaud 1931: 32; Listed, Mediterranean.

Symphurus normani (not of Chabanaud 1950)

Merrett and Marshall 1981: 226; Northwest Africa; all specimens were S. nigrescens.

Misidentifications

Norman 1930: 363; Specimens form type series of S. normani.

Norman 1935: 34; after Norman 1930.

Remarks

There have been several specific and generic names applied to this species. Most of the nomenclatorial rearrangements were a direct result of the inadequate original description and lack of type material for Symphurus nigrescens Rafinesque. In the original description, Rafinesque (1810: 52) clearly indicated that the specimen forming the basis of his new species was a tonguefish characterized by a having united caudal, dorsal and anal fins. Beyond this brief description, little else in the way of diagnostic information was provided. Rafinesque failed to provide any counts or measurements and additionally, he described the specimen as having a single lateral line.

The original description of S. nigrescens was either overlooked by subsequent authors or because of the reference to a lateral line was discounted as representing a species of symphurine tonguefish. During the mid 1800's, two additional nominal species of tonguefish were described from Mediterranean waters near Italy. These were Plagusia lactea Bonaparte 1833 and *Plagusia picta* Costa 1862. Apparently Bonaparte was unaware of the earlier description of *S. nigrescens* by Rafinesque when he described this nominal species. His name historically has had considerable application but since Jordan and Goss (1889) and continued into the present study his species is considered a junior synonym of *S. nigrescens*. The history and status of *Plagusia picta* Costa is discussed below.

Günther (1862) who apparently was unaware of the earlier description of *Symphurus* by Rafinesque reassigned *Plagusia lactea* Bonaparte into his new monotypic genus *Ammopleurops*. Günther distinguished *Ammopleurops* from other tonguefish genera (*Aphoristia* Kaup, *Plagusia* Cuvier and *Cynoglossus* Hamilton-Buchanan, a cynoglossine genus) by the following combination of characters: sinistral wirh confluent vertical fins; ctenoid scales; no pectoral fins; short snout not produced into a hook; mouth unsymmetrical, rather narrow; and minute teeth on jaws of both sides of head. He listed the distribution of this genus as the Mediterranean. *Ammopleurops* differed from the other symphurine genus *Aphoristia* basically in two characters; *Aphoristia* had no lateral lines and had minute teeth only on the eyed side jaws. Also, *Aphoristia* was distributed only on the Atlantic Coast of America. The only major distinction between *Aphoristia* and *Ammopleurops* was the supposed presence of a lateral line in *Ammopleurops* and its absence in *Aphoristia*.

It was Jordan and Goss (1889) who recognized that the single lateral line referred to by both Rafinesque for *Symphurus* and Günther for *Ammopleurops* was not an actual lateral line but rather a median depression in the body where the junction of the myomeres occurs. Since the major distinction between *Symphurus*, *Aphoristia* and *Ammopleurops* was the presence or absence of a lateral line, and lateral lines were shown to be absent in all three nominal genera, the three were placed into synonymy by Jordan and Goss (1889) with *Symphurus* Rafinesque as the senior synonym.

In this same work, Jordan and Goss (1889) considered *Symphurus* (=*Plagusia*) *pictus* (Costa 1862) as a junior synonym of *S*. *nigrescens* differing from this species only in color pattern.

Subsequent authors did not follow Jordan and Goss's useage of *S*. *nigrescens* for the 12 caudal-rayed eastern Atlantic *Symphurus*. Kyle (1913) described the larvae of this species and in reviewing the nomenclature of the species expressed doubt regarding the validity of *S*. *nigrescens* Rafinesque. Instead, he recommended that the species (*Symphurus* =*Plagusia lactea*) described by Bonaparte and accompanied by a more complete description should be used instead of *S*. *nigrescens* Rafinesque.

Other authors have followed Kyle's recommendation. For example, Scordia (1925; 1927; 1929) used the name *Plagusia lactea* in his papers on the ecology of this species in the central Mediterranean. Useage of Bonaparte's name (emended to *lacteus* to agree in gender with a masculine genus) was employed by several other authors usually in combination with Günther's genus *Ammopleurops* (Vaillant 1888; Roule 1919; Soljan 1948; Padoa 1956).

Consistent useage of the name *S*. *nigrescens* for this species began in the 1930's and has prevailed in most of the important taxonomic (Chabanaud 1950) and ecological literature (see synonymy) and is considered the oldest available name for this species in the present study.

Study Material: 158 Specimens, 40.3-117 mm SL, 156 x-rayed, 32 measured.

Diagnosis

Symphurus nigrescens is a medium-sized (to 117 mm SL), relatively deepwater tonguefish with a 1-3-2 ID pattern, 12 caudal rays and a black peritoneum. It is the only species of eastern Atlantic Symphurus with a 1-3-2 ID pattern and a black peritoneum. It is structurally most similar to other deepwater members of the 1-3-2 species group including S. pusillus, S. piger, S. pelicanus, S. gorgonae, S. ginsburgi and undescribed species C. It also overlaps in counts and is similar to three shallow-water dwarf species possessing a 1-3-2 ID pattern. It overlaps partially meristics of S. normani and has been confused with this species in the literature.

Symphurus nigrescens is morphologically similar to and overlaps completely the meristics of the western Atlantic S. pusillus. It can, however, be distinguished from this species by differences in caudal fin lengths, pigmentation differences, relative body size and size at sexual maturity. The caudal fin of S. nigrescens is distinctly shorter than that of S. pusillus (7.6-12.2 vs. 11.5-15.4% SL in S. pusillus). With respect to pigmentation, S. nigrescens usually is dark brown in color with a variable number (as many as 5-7) of dark brown crossbands and the dorsal and anal fins are highly pigmented with either alternating series of oblong blotches throughout the length of the fins, or alternating fin rays are streaked over half of their length with dark pigment. In S. pusillus, the body is yellowish with several dark crossbands (usually only 3-4 clearly evident) and the dorsal and anal fins although the fins have pigment along their basal margins, they lack any other obvious pattern such as blotches or streaking along the fin rays. It could be that S. nigrescens has modally higher counts than S. pusillus but this is not known for certain because data for S. pusillus are limited by small sample size. Meristics for the two species are (those for S. nigrescens listed first); vertebrae 47-51, usually 48-50 vs. 47-49, usually 48-49; dorsal rays 82-92, usually 85-91 vs. 83-88; and anal rays 69-79, usually 72-77 vs. 71-75. Symphurus nigrescens attains adult sizes of approximately 117 mm SL and matures around 70 mm SL. In contrast, S. pusillus is a dwarf species, reaching maximum size of only 65 mm SL and maturing at sizes as small as 45 mm SL.

Symphurus nigrescens overlaps ranges of meristics for the western Atlantic S. piger but is easily distinguished from this species by scale counts. Symphurus nigrescens has smaller scales (72-91 rows along the body vs. 62-75 rows in S. piger). Symphurus nigrescens has 4 hypurals in the caudal skeleton (5 in S. piger). Additionally, the two species also have distinct body shapes (S. piger has a much deeper body and wider head, compare Figs. 42B and 42C)..

Although S. nigrescens overlaps meristics of the amphi-American species pair comprised of the western Atlantic S. pelicanus and the eastern Pacific S. gorgonae, there are considerable differences between these species. The most apparent difference is the blind side pigmentation (whitish or cream-colored in S. nigrescens vs. a pepper-dot pattern of black melanophores in the other species). Symphurus nigrescens also has higher counts than S. pelicanus, especially in the number of vertebrae (47-51, usually 48-50 vs.

44-46 in *S. pelicanus*). *Symphurus nigrescens* is also a much larger fish (maximum size 117 mm vs. 70 mm SL in the other species).

Meristics of *S. nigrescens* and the western South Atlantic *S. ginsburgi* and the western North Atlantic undescribed species C overlap partially, but they are higher in *S. ginsburgi* and undescribed C (vertebrae 50-52, usually 51-52; dorsal rays 87-94, usually 90-94; and anal rays 75-81).

Symphurus nigrescens also overlaps meristics of three dwarf *Symphurus*, *S. rhytisma* from the Caribbean Atlantic, and two undescribed eastern Atlantic species (A and B). It differs from these shallow-water species principally in peritoneum color (black vs. unpigmented), larger scales (72-91 vs. 97-110) and much larger size (117 mm vs. 45-60 mm SL). It differs further from *S. rhytisma* in its modally greater number of vertebrae (47-51, vs. 46-48, usually 47 in *S. rhytisma*).

Historically, there has been some confusion between *S. nigrescens* and the tropical eastern Atlantic *S. normani* but the differences between these species are quite distinctive. *Symphurus normani* differs from *S. nigrescens* in ID pattern (1-3-3 vs. 1-3-2), a much smaller eye (7-9 vs. 12-15% HL), smaller scales (95-105 vs. 80-90), smaller size (80 mm vs. 117 mm SL) and *S. normani* has numerous scales on the blind side dorsal and anal fin rays (absent in *S. nigrescens*). Further differences between these species are listed in the account of *S. normani*.

Symphurus nigrescens overlaps almost entirely in meristics with the South Atlantic *S. trewavasae*. However, these species are only superficially similar. They differ in ID pattern (1-3-2 vs. 1-3-3), caudal ray count (12 vs. 10) and *S. trewavasae* is a larger species (139 vs. 117 mm SL).

Description

Symphurus nigrescens is a medium-sized tonguefish attaining maximum sizes of approximately 117 mm SL. The usual ID pattern is 1-3-2 (Table 9). Caudal rays 12 (Table 10). Dorsal rays 82-92, usually 85-91 (Table 11). Anal rays 69-79, usually 72-77 (Table 12). Vertebrae 47-51, usually 48-50 (Table 13). Hypurals 4. Longitudinal scale rows 72-91 (Table 14). Lateral scale rows 30-42 (Table 15). Scale rows on head posterior to lower orbit 16-22, usually 17-20 (Table 16). Proportional measurements appear in Tables 35-36.

Body moderately deep (25.8-30.5% SL); maximum depth in anterior third of body. Body with moderate posterior taper. Head only moderately wide (21.8-25.7% SL); with relatively short, somewhat pointed snout (16.9-23.8% HL). Snout covered with small ctenoid scales. Dermal papillae well developed on blind side snout, chin and dorsal region of head at base of dorsal fin; in some specimens, dermal papillae extend onto ocular side of snout. Posterior extension of maxilla reaches to front margin of pupil or front margin of lower eye. Eyes moderate to relatively large (9.1-15.3% HL); usually equal in position, although occasionally upper eye slightly in advance of lower eye. Eyes without heavy covering of scales; with 1-3 scales in narrow interorbital space. Pupillary operculum absent. Dorsal fin origin usually at a vertical equal to middle or front margin of upper eye. No scales present on blind side dorsal and anal fins. Body scales large, strongly ctenoid.

Table 35. Summary of morphometrics expressed in thousandths of Standard Length, except Standard Length (in mm), for *Symphurus nigrescens*.

Character	N	RANGE	MEAN	SD
SL	28	46.2-117.2	86.2	15.78
BD	28	258-305	280.9	14.34
PDL	28	42-66	54.1	6.28
PAL	28	197-284	250.8	20.53
DBL	28	891-976	946.9	14.56
ABL	28	716-797	748.7	21.95
PL	23	46-78	65.5	6.99
PA	28	31-91	65.5	12.96
CFL	19	76-122	104.8	10.88
HL	27	197-240	217.9	9.45
HW	27	218-257	239.4	12.23
POL	27	128-157	143.5	8.72
SNL	28	34-53	43.2	3.98
UJL	28	37-50	44.4	3.76
ED	28	19-37	26.0	3.74
CD	24	31-59	44.6	6.78
UHL	28	121-172	142.8	12.56
LHL	28	88-142	113.1	14.36

Table 36. Summary of morphometrics expressed in thousandths of Head Length (except HW/HL) for *Symphurus nigrescens*.

Character	N	RANGE	MEAN	SD
HW/HL	27	1.01-1.24	1.1	0.05
POL	27	604-740	659.2	28.52
SNL	27	169-238	199.8	14.86
UJL	27	177-232	205.2	15.93
ED	27	91-153	119.5	13.36
CD	23	142-267	206.8	30.17
OPLL	24	209-332	280.7	32.52
OPUL	24	124-354	252.0	54.60
UHL	27	566-791	657.7	54.98
LHL	27	403-646	523.8	61.18

Teeth well-developed on blind side jaws. Lower jaw on ocular side with a row of teeth; upper jaw on ocular side usually with a row of teeth covering anterior three-fourths of premaxilla or occasionally entire premaxilla bears teeth.

Pigmentation

Eyed surface variably darkly pigmented not usually banded. The majority of specimens of uniform color with irregular blotches of darker pigmentation. Only a few of the specimens examined had 4-6 dark brown, sharply contrasting crossbands. Crossbands, when present, not continued onto dorsal and anal fins. Outer operculum not pigmented other than general background color. Inner operculum not usually pigmented, occasionally specimens with light speckling of melanophores on the eyed-side inner lining of the operculum. Ocular side upper and lower lips usually speckled with pigment but only small number of individuals with definite moustache. Blind side usually unpigmented but some individuals with dark pigment blotch in caudal region. Peritoneum black.

In specimens that have lost all their scales, the body is mostly faded or light brown. The only visible pigmentation is a V-shaped pattern of melanophores on the forward part of the snout dorsal to the upper eye and an additional series of dark black, dermal pigment spots along the bases of the dorsal fin rays.

Dorsal and anal fins with well-developed pigmentation in the form of an alternating series of small blotches (2-5 fin rays wide) and unpigmented areas or with dorsal and anal fin rays individually streaked with dark brown pigment. In some specimens, the basal third of the dorsal and anal fins and intervening membrane are pigmented dark brown and the distal two-thirds of the fins are colorless. Caudal fin usually not heavily pigmented except for the proximal portion covered with scales. Just anterior to the caudal fin base in some specimens there is a concentration of pigment which forms a diffuse, roughly circular spot of variable intensity.

Geographic Distribution (Fig. 16)

Symphurus nigrescens is the most common and widespread species of eastern Atlantic *Symphurus*. This species inhabits moderate depths on the continental shelf in the Mediterranean Sea and eastern Atlantic at least as far south as Angola (20°S) (Chabanaud 1950; Nielsen 1963). In the Mediterranean it has been collected at numerous locations ranging from eastern regions of the Adriatic (Soljan 1948; Bombace and Froglia 1973) and Aegean Sea (Economides and Bauchot 1976) including the Thermaikos Gulf (Papaconstantinou and Tortonese 1980) and Saronikos Gulf (Tsimenidis and Papaconstantinou 1979) to areas in the southeastern Mediterranean off the coast of Israel (Ben-Tuvia 1971). It has been frequently collected from many locations in the Central Mediterranean (Kyle 1913, Scordia 1927; 1929; Padoa 1956) including the Ligurian Sea (Tortonese and Casanova Queirolo 1970), Gulf of Taranto (Galloti 1973), Sardinian Sea (Cau 1977), and off the coast of Algeria (Chabanaud 1950; Dieuziede et al. 1955). In the western Mediterranean this species almost universally appears on every checklist of deep-sea fishes. Some of the studies reporting this species from the western Mediterranean (mostly off the Spanish coast) include Vaillant

(1888); MacPherson (1978; 1981), Matallanas (1979), Matallanas and Rubio (1979), Matallanas et al. (1981), Cerro and Portas (1984) and Allue (1985).

In the open Atlantic, S. nigrescens ranges as far north as the Bay of Gascogne (Vaillant 1888) and the coast of Portugal (Albuquerque 1954-56). Many specimens have been taken in studies of deep-sea communities off the north African coast (Blache 1962; Maurin 1962; 1968; Merrett and Marshall 1981; Merrett and Domanski 1985). It has also been taken at the Azores (Collett 1896; Kyle 1913; Chabanaud 1950) and at the seamounts (Maul 1976) in the open Eastern Atlantic. Along the coast of Africa, it was collected by Cadenat and Marchal (1963) and Nielsen (1963) and listed by Fowler (1936).

Bathymetric Distribution

Symphurus nigrescens typically occurs at moderate depths on the open shelf (Table 38). Although the vertical range over which this species has been collected is extensive (47-1000 m), the center of abundance, based on the frequency of capture and the numbers of individuals taken, occurs between 90-350 meters. Depth of capture was summarized for 114 specimens examined in the present study. The majority (108/114, 95%) of these were collected between 90-336 meters. The shallowest depth for specimens in the present study was 47 m where a single specimen was collected. The deepest collections were captures of single individuals at the following depths: 500, 550 and 615 meters, respectively. Most of the studies listed above have collected specimens between 100-400 meters.

Table 37. Summary of bathymetric distributions for Symphurus nigrescens examined in the present study.

Depth (m)	47-50	51-100	101-150	201-300	301-400	401-500	501-600	615
Frequency	1	40	3	34	33	1	1	1

Size and Sexual Maturation

Symphurus nigrescens is a medium-sized tonguefish. The largest specimen, a female, measured 112 mm SL, and was only slightly larger than the largest male (105 mm SL). Most individuals in the study ranged between 60-95 mm SL. These sizes are slightly larger than those reported by Chabanaud (maximum size observed for females and males were 89 and 80 mmSL, respectively).

Among the 145 fish for which sex could be determined, 63 were males (size range 42.3-105 mm SL) and 82 were females (size range 40.3-112 mm SL). Based on the reproductive stage of females, sexual maturity is achieved at a relatively small size in this secies. Of the 82 females, 74, ranging in size from 46.2-112 mm SL were mature. Most mature females were larger than 60 mm SL, however, and ranged in size from 75-100 mm SL. There were only four mature females smaller than 60 mm SL. These measured 46.2, 54.2, 55.8 and 59.6 mm SL. In the 40.3 mm SL female, the ovaries had just started their posterior elongation. In all other immature females the ovaries had already initiated elongation.

Ecology

Considerable ecological information is available concerning this species. Most of the important references dealing with the ecology of this species were listed in the synonymy section and the reader is referred to that section for papers on the ecological requirements of *S. nigrescens*.

Material Examined

Measured and Counted 32 Specimens, 10 Lots.

Eastern Mediterranean

MNHN 1975-412; 2(73.3-93.7); Greece, off Thassos; No Depth; 26 II 74. VIMS UNCAT; 11(81.7-114); Thermaikos Gulf, Greece; Apr.-June, 1976.

Central Mediterranean

MNHN 59-608; 4(70.8-79.8); Bou Haroum, Algeria; No Depth. MNHN 58-157; 2(67.9-82.4); Tunisia; No Depth. MSNG 41890; 5(61.5-88.5); East Ligurian Sea, Mediterranean; 325M. MSNG 47614; (86.1); East Ligurian Sea, Mediterranean; 615M.

Western Mediterranean

MNHN 59-183; 3(106-117); Banyuls-Frontier, France; No Depth.

Eastern Atlantic

BMNH 1890.6.16:46; (72.8); Eastern Atlantic. IOS 7810; 2(60.5-101); 18°05.2'N 16°32'W; 307M; 27 II 72.

Central Eastern Atlantic

ZMUC 86219; (46.2); 07°19'S 12°40'E; 47M.

Counted

Central Mediterranean

IRSNB 23724-16576; 1; G of Cagliari, Sardinia; 550M; 28 II 67. MCZ 26397; 1; Bay of Naples, Italy; No Depth. USNM 10092; 2; Mediterranean; No Depth. USNM 48292; 2; Bay of Naples, Italy; No Depth; April, 1897. USNM 49333; 1; Bay of Naples, Italy; No Depth.

WESTERN MEDITERRANEAN

MATALLANAS; (112); Catalan Sea, Spain; 500M; 30 XI 84. MATALLLANAS; 4(52.2-69.7); Catalan Sea, Spain; 100M; 14 II 1974. VIMS UNCAT; 32(59.6-94.7); Mediterranean, Spain; 90M; 11 IV 84.

Eastern Atlantic

ISH 194177; 14(46.5-79.9); 21°30'N 17°08'W; June 1968. IOS 7810; 7 of 9(48.4-97.0); 18°05.2'N 16°32'W; 307M; 27 II 72. IOS 8020; 28(46.2-105); 20°45.1'N 17°39.3'W; 279M; 27 VII 72. MCZ 58645; 18(51.4-80.6); 21°43'N 17°27'W; 336M; 24 V 74. MCZ 58646; (40.3); 21°08'N 17°31'W; 149M; 22 V 74. MCZ 58647; (83.8); 21°08'N 17°31'W; 97M; 22 V 74. MCZ 58648; (89.6); 21°21'N 17°37'W; 400M; 23 V 74. MCZ 58649; (42.3); 21°00'N 17°22'W; 64M; 22 V 74. MCZ 58650; 2(42.3-43.8); 21°08'N 17°31'W; 149M; 22 V 74. MNHN 1967-539; (75.0); 10°49'N 17°00'W; 100M; 08 XII 63.

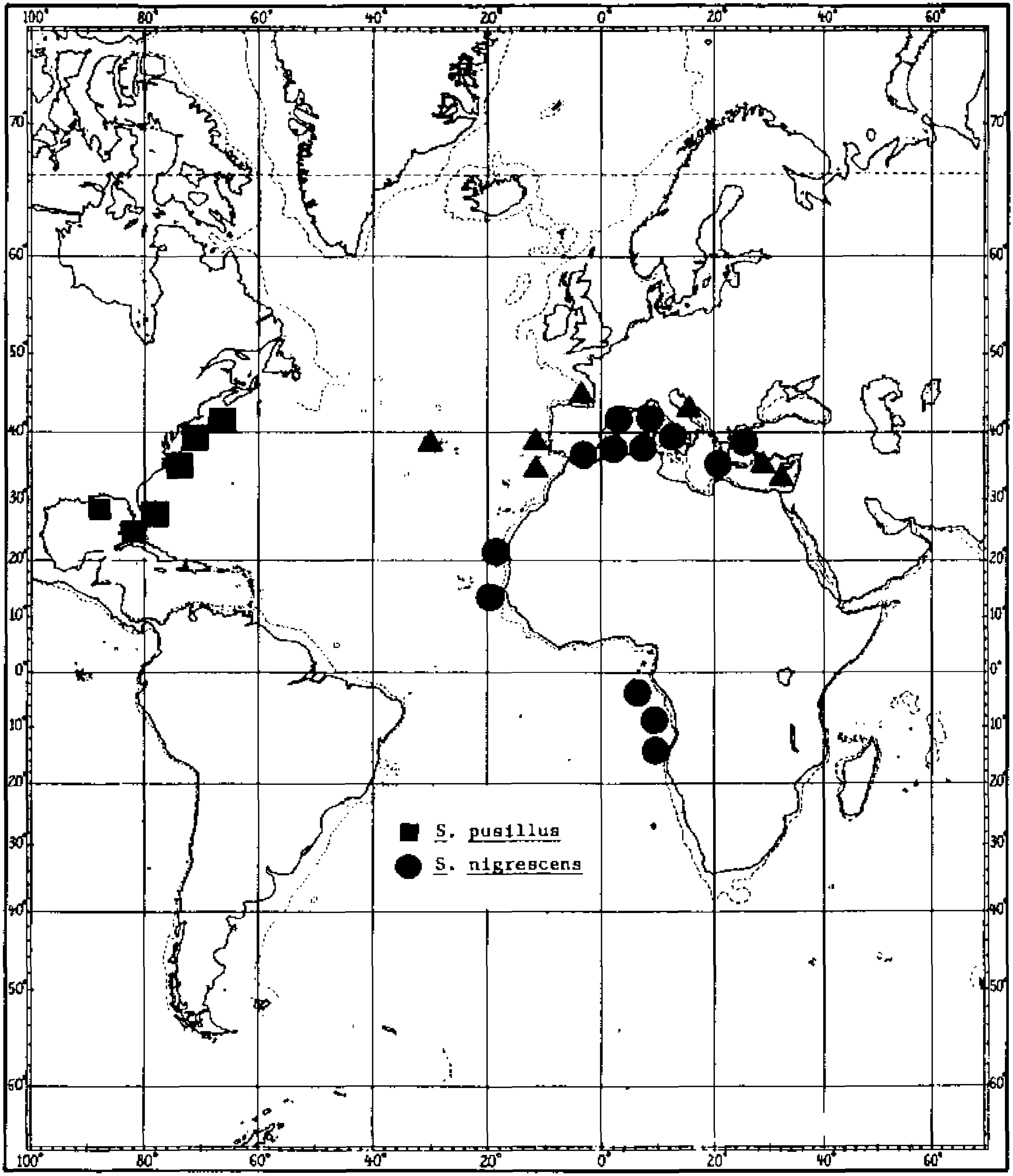
Central Eastern Atlantic

IRSNB 16808-14787; (68.9); 06°29'S 11°35'E; 230M; 07 VIII 48. UF 33890; (84.3); 02°00'S 08°55'E; 100M; 4 IX 63. UMML UNCAT; 5(86.9-92.5); 02°31'S 08°51'E; 300M; 30 IX 62.

Other Material

MNHN 59-606; 1; Bay of Naples.

Figure 16. Geographic distribution of Symphurus nigrescens and S. pusillus.



Atlantic 1-3-2 Species.
(Black Peritoneum)

Symphurus pusillus (Goode and Bean 1885)

(Fig. 43B)

Northern Tonguefish

Aphoristia pusilla

Goode and Bean 1885a: 590; Original description; Long Island, NY.

Goode and Bean 1895: 461; Based on preceding specimens; Description and figure (Fig. 379).

Symphurus pusillus

Jordan and Goss 1889: 325; Suggest synonymy with S. plagiusa.

Jordan and Evermann 1898: 2710; Description, counts (after Goode and Bean).

Chabanaud 1939: 26; Listed, western Atlantic, Gulf Stream.

Ginsburg 1951:197. Description and comparison of original type series.

Misidentifications

Baughman 1950: 138; Near Corpus Christi, Texas; (specimen actually S. plagiusa).

Longley and Hildebrand 1941: 50; Listed, Tortugas, Forida; (specimen actually S. piger).

Kyle 1913: 145; Symmetrical larval form with figure; Incorrect identification, more probably S. ommaspilus, S. minor or S. parvus.

Material Examined: 20 specimens, 38.5-62.7 mm SL. 20 x-rayed, 18 measured.

Diagnosis

The combination of a 1-3-2 ID pattern, 12 caudal rays, 47-49 vertebrae, four hypurals in the caudal skeleton, 83-88 dorsal rays, 71-75 anal rays, black peritoneum and diminutive size distinguishes this species from all other members of the genus. In meristic features, S. pusillus closely resembles the western Atlantic S. piger and the eastern Atlantic S. nigrescens. It is more distantly related to the western Atlantic S. pelicanus and S. rhytisma.

Symphurus pusillus overlaps almost completely the meristics for S. piger. However, it differs in the number of hypurals (4 in S. pusillus vs. 5 in S. piger), in scale size (S. pusillus has smaller scales ranging between 77-87 scale rows while in S. piger, the scales are much larger ranging between 62-74 scale rows) and the two species differ in relative body sizes. Symphurus pusillus is a diminutive species attaining maximum lengths of only about 65 mm SL, whereas, S. piger is much larger reaching lengths of approximately 130 mmSL.

Symphurus pusillus comprises an amphi-Atlantic species pair with S. nigrescens. There are no differences in meristics between S. pusillus and the Eastern Atlantic S. nigrescens. However, the two species differ in the relative length of the caudal fin, pigmentation differences and relative body size and size at sexual maturity. In S. pusillus the caudal fin is longer (11.5-15.4% SL vs. 7.6-12.2% SL in S. nigrescens). With respect to pigmentation, S. pusillus has dorsal and anal fins with pigment along the basal margins of the fin rays but there are no blotches or streaks of pigment in the distal half of the fins. In contrast, in S. nigrescens, the dorsal and anal fins are quite colorful and are usually pigmented with a series of alternating blotches and unpigmented areas throughout their lengths or the fin rays are streaked with dark pigment throughout the dorsal and anal fins. *Symphurus pusillus* reaches maximum sizes of 65 mm SL and matures at sizes as small as 45 mm SL. *Symphurus nigrescens* is much larger (maximum sizes to 117 mm SL, sexual maturity at sizes of 70 mm SL).

Although dorsal ray counts for *S. pusillus* partially overlap counts observed for *S. pelicanus*, the two species differ in number of vertebrae (48-49 vs. 44-46), anal ray count (71-75 vs. 64-69) and blind side pigmentation (unpigmented vs. spotted in *S. pelicanus*). *Symphurus pusillus* is readily separated from *S. rhytisma* by peritoneum color (black vs. unpigmented).

Symphurus pusillus is similar in coloration and co-occurs throughout its range (but is not syntopic with respect to depth of occurrence) with undescribed species C. It differs from this species in its generally lower meristics (vertebrae 47-49 vs. 50-52; dorsal rays 83-88 vs. 89-95, and anal rays 71-75 vs. 76-84), and much smaller body size (species C attains lengths of 127 mm SL).

Description

Symphurus pusillus is a diminutive species attaining maximum adult lengths of only about 65 mm SL. ID pattern 1-3-2 (Table 9). Caudal rays 12 (Table 10). Dorsal rays 83-88 (Table 11). Anal rays 71-75 (Table 12). Vertebrae 47-49, usually 48-49 (Table 13). Hypurals 4. Most specimens were missing scales completely and scale pockets had often been damaged during capture. Therefore, scale counts, with the exception of head scale rows, are only approximate for this species. Longitudinal scale rows 77-87 (Table 14). Scale rows on head posterior to lower orbit 17-19 (Table 15). Lateral scale rows 33-34 (countable on only two of 19 specimens). Proportional measurements are listed in Tables 38-39.

Body moderately deep (25.7-31.7% SL); with relatively narrow head (21.3-26.2% SL). Snout covered with small ctenoid scales. Posterior extension of maxilla reaches to about mid-point of upper eye or extends to front margin of pupil of upper eye. Eyes large 10.9-15.6% HL; usually equal in position. Eyes partially covered with numerous small scales. Scales form a small wedge in anterior region of eye, partially covering anterior margin of both eyes; 1-3 small scales in narrow interorbital region. Pupillary operculum absent. Dorsal fin origin usually at a vertical equal to the mid-point or front margin of upper eye. No scales on dorsal and anal fins.

Dentition well-developed on blind side jaws. Teeth on eyed-side lower jaw in single row over full length of dentary. Teeth usually present only on anterior three-fourths of eyed-side premaxilla; occasionally extending over full length.

Table 38. Summary of morphometrics expressed in thousandths of Standard Length, except SL (in mm), for *Symphurus pusillus*.

Character	N	RANGE	MEAN	SD
SL	17	35.2-62.7	49.2	8.03
BD	17	257-317	280.0	15.12
PDL	17	47-86	58.6	10.56
PAL	17	212-278	240.1	16.90
DBL	17	914-953	941.4	10.56
ABL	17	707-778	741.8	19.29
PL	11	55-79	70.2	6.68
PA	17	44-93	65.9	14.58
CFL	11	115-154	129.4	11.36
HL	17	206-254	221.3	13.10
HW	17	213-262	232.6	15.71
POL	17	128-158	143.4	7.89
SNL	17	34-58	44.9	6.08
UJL	17	40-60	49.4	4.92
ED	17	24-36	29.2	3.63
CD	17	37-57	47.1	6.88
UHL	17	110-171	144.6	17.29
LHL	17	77-144	104.8	17.11

Table 39. Summary of morphometrics expressed in thousandths of Head Length (except HW/HL) for *Symphurus pusillus*.

Character	N	RANGE	MEAN	SD
HW/HL	17	0.98-1.19	1.0	0.05
POL	17	604-696	648.2	25.24
SNL	17	156-238	202.3	22.37
UJL	17	189-244	222.1	14.11
ED	17	109-156	131.9	15.01
CD	17	168-273	212.8	31.55
OPLL	17	234-375	275.3	36.68
OPUL	17	153-268	201.5	34.65
UHL	17	473-787	655.4	85.31
LHL	17	363-594	472.2	64.15

Pigmentation

Most specimens examined were faded with little evidence of any pigmentation pattern. Ginsburg (1951) described the coloration of the three syntypes as follows: "The three specimens examined mostly faded, rather light brownish, with traces of cross bands in two specimens, fins yellowish." The following color description is based primarily on the three most recently collected specimens, but is augmented whenever possible with observations from other specimens.

Eyed surface yellowish, with 2-6 light brown crossbands, usually only 3-4 clearly evident. The most anterior band occurs across opercular opening; the second crosses along the posterior margin of the body cavity. The third band is located at the body midpoint, while the fourth, fifth and sixth bands cross the caudal region of the body. Head region dorsal and anteriad to eyes with melanophores arranged in obvious V-shaped mark extending from the body margin to about the level of the upper eye. Operculum with no obvious pigmentation other than general body color. Inner lining of operculum and isthmus unpigmented. No well-developed moustache on eyed-side upper lip; pigment when present on lips restricted to light spotting. One specimen (VIMS 5571) with a slight moustache on both ocular-side lips. Blind side unpigmented, except in specimens that have completely lost their scales and are faded. These specimens have a series of dark black internal melanophores evident along anterior two-thirds of body midline (noticeable on both sides). Peritoneum black, visible through abdominal walls on both sides of body. Blind side off-white.

Dorsal and anal fins with pigment along basal portions of rays but usually with no other obvious pattern of pigmentation. Specimens with well-developed crossbands usually have small blotches of pigment in the dorsal and anal fins corresponding to regions of body crossbands. There is a small darkly pigmented area at the base of the caudal fin in four specimens (UF 29778, USAL 4822, VIMS 5573).

In specimens completely missing scales, there is a series of dark melanophores located deep within the dermis along the dorsal surface of the body at the bases of the first 10-20 dorsal rays.

Geographic Distribution (Fig. 16).

Symphurus pusillus occurs in the western North Atlantic along the eastern continental shelf of the United States from off Long Island in the north (40^{o}N) as far south as DeSoto Canyon region in the eastern Gulf of Mexico (29^{o}N; 87^{o}W). This species has not been collected with any frequency and most collections have been of single individuals undoubtedly due to the small size and great depths inhabited by this species. Most specimens have been collected from Long Island to Virginia. Baughman (1950: 138) recorded this species from the western Gulf of Mexico near Corpus Christi, Texas. However these two specimens (Lot number USNM 93584 and not USNM 93854 as listed in Baughman's publication) were incorrectly identified and are actually *S. plagiusa*.

Throughout its range, this species is sympatric (but not syntopic) with undescribed species C. Only one collection (VIMS UNCAT; 40^{o}N, 231 meters), the deepest capture of *S. pusillus*, contained both species.

Bathymetric Distribution

Symphurus pusillus inhabits moderate depths (73-231 m) on the middle continental shelf. Depth of occurrence for 18 specimens were summarized. Most specimens were collected at depths between 150-223 m. Only one specimen occurred shallower than 100 m (73 m) while the deepest occurrence was 231 m.

Ecology

This diminutive species is poorly represented in collections. The largest specimen examined was a male 62.7 mm SL. The largest female was just slightly smaller (62.1 mm SL) and was fully gravid. Based upon the reproductive state of females in the samples, sexual maturity occurs at a relatively small size. Females as small as 40.0, 54.2 and 54.5 mm SL, respectively, were gravid. Other females ranging from 41.6-58.4 mm SL, although not gravid, showed signs of ovarian ripening.

Material Examined

Measured and Counted 18 Specimens, 13 Lots.

USNM 28730; Syntype (53.5); 40°07'48"N 70°13'54"W; 123M; 04 VIII 1881. USNM 28778; Syntypes 2(54.5-58.4); 40°01'N 69°56'W; 139M; 04 VIII 1881. UF/FSU 22139; (35.2); 29°17'N 87°55'W; 11 X 70. UF/FSU 32430; (50.2); 24°24'30"N 81°55'54"W; 104M. UMML 17387; (62.1); 24°39'N 80°47'W; 134M; 23 I 65. UMML UNCAT GERDA 1083; 2(41.6-52.1); 24°18'N 82°20'W; 167M; 26 IV 69. UNC 12180; (40.0); 32°49'N 77°56'W; 229M; 19 IV 57. USA 4822; (38.5); 26°25'N 84°15'W;

32°49'N 77°56'W; 229M; 19 IV 57. USNM 153089; 1; Atlantic, Palm Beach, FL; February, 1950. VIMS 1129; 2(50.5-62.7); 34°37'N 75°41'W; 230M; 18 IV 71. VIMS 5571; 2(45.6-54.2); 36°37'N 74°02'W; 200M; 17 IX 75. VIMS 5573; 2(46.1-48.2); 37°02'N 74°39'W; 183M; 01 VIII 75. VIMS UNCAT; (43.0); 40°00'N 69°11'W; 231M; 25 X 70.

<u>Counted</u>

AMNH 19426; 1; Atlantic, S Florida.

Symphurus pelicanus Ginsburg 1951

(Fig. 42A)

Longtail Tonguefish

Aphoristia diomedeana

Goode and Bean 1895: 460 (in part); Specimen of S. pelicanus included in account of A. diomedeana.

Symphurus pelicanus

Ginsburg 1951: 193; Original description with photograph.

Study Material: 19 Specimens, 27.2-69.2 mm SL. 19 x-rayed and measured.

Diagnosis

A diminutive species with a 1-3-2 ID pattern, 12 caudal rays, a spotted blind surface, black peritoneum, and the lowest meristics among Atlantic species with a 1-3-2 ID pattern and a black peritoneum. Among other species with a 1-3-2 ID pattern and black peritoneum, S. pelicanus is most closely related to the Eastern Pacific S. gorgonae. It differs from this species primarily in its lower counts (vertebrae 44-46 vs. 47-49; dorsal rays 78-85 vs. 87-88; and anal rays 64-69 vs. 71-73). Among other 1-3-2 species, S. pelicanus is similar in meristic features to the western Atlantic S. piger and the eastern Atlantic S. nigrescens. Compared with S. piger, S. pelicanus has lower meristics (vertebrae 44-46 vs. 45-49, usually 47-49;

smaller body size (70 vs. 140 mm SL); one less hypural (4 vs. 5 in S. piger); and the two species differ in blind side coloration. In S. pelicanus, the blind side is sprinkled with black pigment spots (absent in S. piger). There is partial overlap in meristics of S. pelicanus and the eastern Atlantic S. nigrescens. However, differences between these two species are substantial. Symphurus pelicanus has a pigmented blind side (vs. unpigmented) and lower meristics (vertebrae 44-46 vs. 47-51; dorsal rays 78-85 vs. 82-92; and anal rays 64-69 vs. 69-79).

This species overlaps completely in meristics, general body size, and depth of occurrence with S. parvus. However, it is readily distinguished from this species in a considerable number of characters, in particular, S. pelicanus has 12 caudal rays (vs. 10), black peritoneum (vs. unpigmented), ID pattern (1-3-2 vs. 1-4-2 or 1-5-2 in S. parvus), and S. pelicans lacks membrane ostia and a pupillary operculum (both well-developed in S. parvus). The two species differ somewhat in body shape, including body depth and caudal fin length (S. pelicanus having the longer caudal and slenderer body). There are also pigmentation differences between these two species, the most obvious are the lack of spotting on the blind surface of S. parvus (present in S. pelicanus) and the absence of a caudal blotch in S. pelicanus (well-developed in S. parvus).

Description

Symphurus pelicanus is a diminutive species attaining maximum lengths of approximately 70 mm SL. ID pattern 1-3-2 (Table 9). Caudal rays 12 (Table 10). Dorsal rays 78-85, usually 78-83 (Table 11). Anal rays 64-69

(Table 12). Vertebrae 44-46 (Table 13). Hypurals 4. Scales somewhat deciduous, most specimens usually missing most or all scales due to trawl damage. Scales relatively large. Longitudinal scale rows 62-70 (Table 14). Scale rows on head posterior to lower orbit 14-17 (Table 15). Lateral scale rows 24-34 (Table 16). Proportional measurements appear in Tables 40-41.

Body relatively narrow 23.5-31.5% SL; greatest depth almost at mid-point of standard length; occasionally forward of mid-point in anterior third of body. Head moderately long, 21.1-25.4% of SL; with moderately long, pointed snout (13.6-22.6% HL). Snout covered with small ctenoid scales. Dermal papillae well-developed but not dense on blind side snout. Posterior extension of maxilla reaches to mid-point of lower eye. Eyes relatively large (9.3-15.8% HL). Small ctenoid scales covering anterior margin and upper surfaces of eyes, with 1-3 small ctenoid scales in narrow interorbital space. Pupillary operculum absent. Predorsal length relatively large, 17.2-32.5% HL. Dorsal fin origin more posterior when compared with other 1-3-2 ID pattern species, reaching only rear margin or a point immediately posterior to rear margin of upper eye. Scales absent on dorsal and anal fins.

Teeth well-developed on blind side jaws. Teeth on eyed side jaws very small. In lower jaw, teeth extend for nearly entire length; upper jaw teeth usually cover only anterior three-fourths of jaw or occasionally with a complete row of slender teeth in upper jaw.

Table 40. Summary of proportional measurements for *Symphurus pelicanus*. Measurements, except Standard Length (mm), expressed in thousandths of standard length.

Character	N	Range	Mean	SD
SL	19	27.2-69.2	53.4	10.62
BD	19	235-315	290.6	19.56
PAL	19	219-267	246.0	11.95
DBL	19	917-945	932.3	7.59
ABL	19	518-812	742.7	58.52
PL	17	45-78	65.6	8.60
PA	19	40-72	51.1	9.29
CFL	17	128-185	151.4	17.03
HL	19	211-254	230.6	10.99
HW	19	210-259	233.7	13.16
POL	19	144-170	155.7	7.24
SNL	19	30-53	40.9	5.74
UJL	19	45-62	50.7	4.85
ED	19	20-40	29.0	4.03
CD	19	36-56	45.3	5.87
UHL	19	109-156	134.3	15.17
LHL	19	100-136	119.6	9.16

Table 41. Summary of proportional measurements for Symphurus pelicanus. Measurements, except Head length (mm), expressed as thousandths of Head length.

Character	N	Range	Mean	SD
HL	19	6.8-15.9	12.3	2.30
HW	19	838-1153	1014.4	67.73
POL	19	632-714	675.2	18.00
PDL	19	172-325	227.9	44.90
SNL	19	136-226	177.1	21.35
UJL	19	193-250	219.6	16.67
ED	19	93-158	125.2	13.70
CD	19	167-244	196.0	21.81
UHL	19	440-676	583.8	72.32
LHL	19	463-597	518.3	40.60
UOL	19	214-299	250.6	22.84
LOL	19	191-344	269.6	33.95

Pigmentation

Eyed surface usually uniformly light brown to yellowish without banding and with irregular, very lightly shaded areas. Older specimens mostly faded, almost immaculate with fins light yellowish. Outer operculum usually not pigmented other than general body color; occasionally specimens with a concentration of darker pigment around opercular opening and on ventral edge and adjacent area of eyed-side operculum. Inner lining of operculum and isthmus with speckling on both sides in some specimens; others without pigment. Lips on eyed-side usually speckled, but with no well-developed moustache. Blind side thickly sprinkled with very small speckles covering entire blind surface from angle of jaws to caudal region in some specimens; in others, speckling more sparsely distributed and finer, often difficult to discern. Speckling usually heaviest in regions overlying dorsal and anal pterygiophores. Peritoneum black, showing externally on both sides of body.

Dorsal, anal and caudal fins without obvious pigment patterns. Basal one-third of fin rays light brown or yellowish, not different from general body coloration. In some specimens there is a concentration of melanophores at base of caudal fin, forming an irregular, poorly defined spot. In most specimens, caudal fin clear, yellowish. In specimens lacking scales, there is a series of deep, dark black, dermal pigment spots along bases of anterior 10-20 dorsal rays.

Geographic Distribution (Fig. 17)

Symphurus pelicanus occurs primarily in waters of the open continental shelf of the central and western Gulf of Mexico and Caribbean Sea. Thus far, this species has not been collected in the Antilles or other coral-reef islands of the Caribbean. Instead, the distribution of S. pelicanus parallels closely the contours of the coastline from approximately the Mississippi Delta region in the north and east and continuing westward and southward to Trinidad. Specimens were taken at numerous points along the coast and collection localities include Texas and northern Mexico (not Yucatan Peninsula), Nicaragua, Panama and Colombia. The occurrence of this species does not coincide with live bottom areas, but rather, the known distribution of this species coincides with mud bottom habitats from the central Gulf of Mexico to the inner shelf area off eastern Venezuela.

Bathymetric Distribution

Symphurus pelicanus inhabits moderate depths (24-133 m) on the inner continental shelf. Eleven of 18 specimens were collected between 52-82 meters. Only one specimen (54.9 mm SL taken at 24 m) occurred shallower than 40 meters. The deepest collections were of single specimens, both immature, at 110 m (43.8 mm SL) and 111 m (44.8 mm SL) and three mature specimens (64-69 mm SL) trawled from 133 meters. Overall, the species appears to have a fairly restricted depth range from approximately 40-140 meters.

The depth range of S. pelicanus encompasses those of S. parvus and S. diomedeanus and it is to be expected in collections with either of these two species. Its bathymetric range generally does not overlap that of the deeper-dwelling S. piger. However, two lots contained representatives of both species. One lot (UMML 30081) contained two specimens each of S. piger and S. pelicanus (collected from 60M at 08°N). A second lot (UMML 30181) taken at 133 meters at 11°N contained six specimens, evenly divided between the two species.

Size and Sexual Maturity

Symphurus pelicanus is a diminutive species attaining maximum lengths of only about 70 mm SL. It is poorly represented in collections, undoubtedly due to its small size and depth of occurrence. There are no apparent size differences between the sexes. The largest specimen examined was a male 69.2 mm SL; the largest female measured 65.4 mm SL. Based on the reproductive state of females, sexual maturity occurs at sizes between 52-58 mm SL. Females of 44.1 and 51.6 mm SL had ovaries just undergoing elongation. Eight females 54.9 mm SL and larger had ovaries which contained either ripe or ripening ova. Fishes under 50 mm SL were either males or immature females. The smallest specimens in this study (both immature, sex undetermined) were taken in the same trawl collection and measured 27.2 and 42.1 mm SL, respectively.

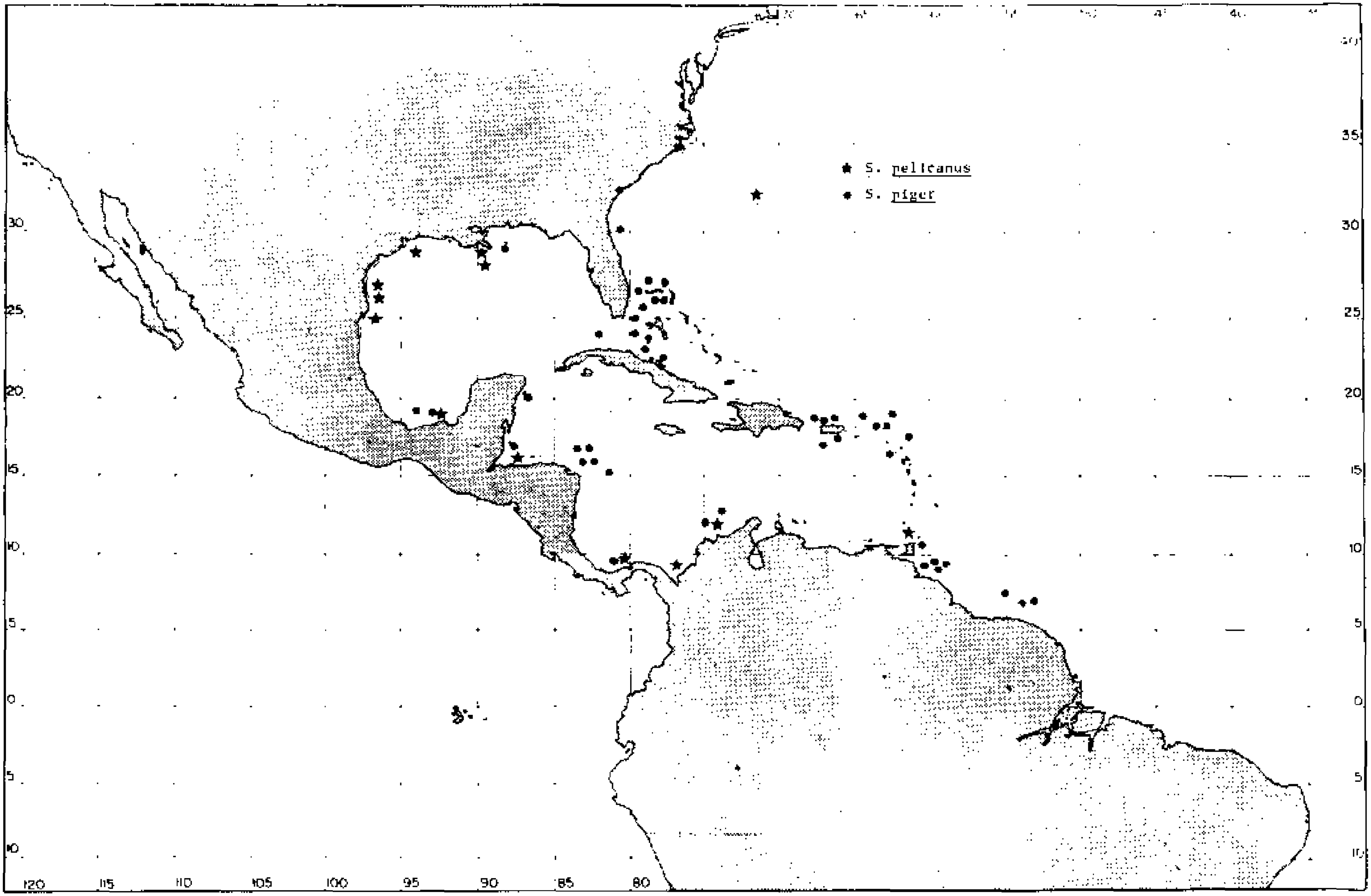
Little else is known about the ecology of this diminutive flatfish.

Material Examined 19 Specimens, 14 Lots.

USNM 155234; Holotype (50.2); 26°43'N 96°32'W; 46M; 04 II 39. USNM 74331; Paratype (60.7); 10°37'N 61°42'W; 57M; 03 II 1884. USNM 155235; Paratype (58.8); 26°34'N 96°32'W; 82M; 05 II 39. USNM 113252; (54.4); 10°37'N 61°42'W; 57M; 03 II 1884. FMNH 45980; (62.1); 28°55'N 89°15'W; 60M; 23 X 53. FMNH 46372; (43.0); 19°16'N 92°14'W; 40M; 23 VIII 51. FMNH 88821;

(43.8); 28°40'N 89°42'W; 110M; 28 III 62. FMNH 94460; (57.3); 38°52'N 89°42'W; 64M; 28 III 62. UF 15662; (44.8); 15°46'N 88°10'W; 111M. UMML 1328; (44.1); 29°55'W 70°20'W; Surface; 25 X 56. UMML 26664; (54.9); 09°18'N 80°03'W; 24M; 20 VII 66. UMML 30081; 2(27.2-42.1); 08°58'N 76°31'W; 60M; 12 VII 66. UMML 30181; 3(65.4-69.2); 11°08-07.6'N 74°18.1-19.3'W; 133M; 31 VII 68. TCWC 6248.2; 3(51.6-59.2); 25°09'N 97°03'W; 52M; 18 XI 75.

Figure 17. Geographic distribution of *Symphurus pelicanus* and *S. piger*.


S. pelicanus
S. niger

Symphurus _marginatus_ (Goode and Bean 1886)

(Fig. 44A)

Aphoristia _marginata_

Goode and Bean 1886: 154 (in part); Original description; Gulf of Mexico, off Mississippi.

Goode and Bean 1895: 459 (in part); Description with figure (Fig. 376); (based on preceding specimens).

Symphurus _marginatus_

Jordan and Goss 1889: 323; After Goode and Bean.

Jordan and Evermann 1898: 2706; After Goode and Bean.

Chabanaud 1939: 26; Listed, American Atlantic.

Ginsburg 1951: 198; Counts, measurements, distribution, in key.

Bright 1968: 58; Four specimens, Central Gulf of Mexico; 585-732 meters.

Symphurus _diomedianus_ (not Goode and Bean)

Longley and Hildebrand 1941: 49; Tortugas, FL.

Misidentification

Metzelaar 1919: 134. Misidentification based on specimen of _S_. _ommaspilus_.

Study Material: 102 specimens, 56.9-146 mm SL. 97 x-rayed, 30 measured.

Diagnosis

The combination of a slender body, a 1-3-2 ID pattern, 12 caudal rays, 51-56 vertebrae, 93-104 dorsal rays, 80-89 anal rays, a dark brown caudal blotch and black peritoneum distinguish S. marginatus from all other species in the genus. In its slender body it is similar to other slender-bodied Atlantic species including S. nebulosus, S. ligulatus and S. vanmelleae. It is readily distinguished from S. ligulatus and S. nebulosus by its lower caudal ray count (12 vs. 14), ID pattern (1-3-2 vs. 1-2-2), generally lower meristics (see Tables 10-16), and pigmentation (S. marginatus has a dark brown caudal blotch which is absent in these other species). From the Eastern Atlantic S. vanmelleae, it differs in ID pattern (1-3-2 vs. 1-2-2-1), lower total vertebrae (usually 52-54 vs. 56-58) and lower abdominal vertebrae count (9 vs. 10). Additionally, these species differ in coloration (S. marginatus has a dark brown caudal blotch which is not present in S. vanmelleae).

Symphurus marginatus is similar in meristics to the shallow-water, western Atlantic S. tessellatus and undescribed species D but is easily recognized by its black peritoneum (unpigmented in these other species), well developed dentition on eyed side jaws (vs. absent or reduced), interdigitation pattern (1-3-2 vs. 1-4-3 or 1-5-3), and pigmentation patterns; S. marginatus characteristically has a uniform body color with only a single dark brown caudal blotch and no spot on the operculum. In contrast, in S. tessellatus and undescribed species D, the body has well developed crossbands, both species have a dark spot on the the operculum and both species lack a dark brown blotch on the caudal region of the body.

Description

Symphurus marginatus is a medium-sized tonguefish attaining maximum lengths of approximately 150 mm SL. ID pattern 1-3-2 (Table 9). Caudal rays 12 (Table 10). Dorsal rays 93-104, usually 95-101 (Table 11). Anal rays 80-89 (Table 12). Vertebrae 51-56, usually 52-54 (Table 13). Hypurals 4-5. Longitudinal scale rows 86-99, usually 88-96 (Table 14). Scale rows on head posterior to lower orbit 16-19, usually 17-19 (Table 15). Lateral scale rows 30-37 (Table 16). Proportional measurements are presented in Tables 42-43.

Body relatively narrow; depth 20.0-31.5% SL; body taper gradual. Depth increasing with size, large adults with depth ranging from 28.0-31.5% SL; juveniles with a much narrower body, depths usually comprising less than 28.0% SL. Head nearly as long as wide; head length 12.7-22.1% SL; head width 14.7-22.7% HL. Snout moderately long, 16.8-33.1 HL; somewhat pointed; covered with small ctenoid scales. Posterior extension of maxilla reaches to front margin of lower eye. Eyes relatively large, 12.5-24.8% HL; usually equal in position. Eyes with large and obvious lens. Eyes with 4-6 small ctenoid scales on dorsal surface and usually with 4-6 small ctenoid scales in narrow interorbital space. Pupillary operculum absent. Dorsal fin origin usually at a vertical equal to mid-point of upper eye; occasionally only reaching posterior margin of upper eye. No scales on blind side dorsal and anal fins.

Teeth well-developed on both blind side jaws. Lower jaw on ocular side with complete row of teeth; upper jaw on ocular side usually with single row of teeth present on anterior four-fifths or occasionally premaxilla with complete row of teeth.

Pigmentation

Eyed surface usually uniformly dark brown, sometimes with yellowish tint, without cross banding. The most consistent and obvious pigmentations are the presence of two longitudinal black streaks at the base of the dorsal and anal fins and a dark brown caudal blotch, roughly circular in outline and usually covering the entire caudal region of the body. This caudal blotch extends over approximately 10 scale rows and 13-14 rays of the dorsal and anal fins, and sometimes extends onto base of caudal fin. Outer operculum not pigmented other than general background color. Inner lining of operculum and isthmus not usually pigmented. A moustache of variable intensity usually evident on ocular side upper lip. Occasionally, with small pigment patch, of variable intensity, at base of anterior nostril. Blind side unpigmented. Peritonum black, usually showing through abdominal wall on both sides of body. Anal sphincter white.

Dorsal and anal rays, in region of caudal blotch, heavily pigmented over entire length; in other parts of fins, rays heavily pigmented with dark brown or black pigment only on proximal halves. Caudal fin usually heavily pigmented along proximal half of fin; distal half with pigment similar to body in general or occasionally without pigment.

Table 42. Summary of measurements for *Symphurus marginatus*. Measurements, except SL (in mm), expressed as thousandths of standard length.

Character	N	Range	Mean	SD
SL	30	56.9-146.1	106.5	18.08
BD	30	200-315	250.3	27.14
PDL	30	44-81	56.0	7.33
PAL	30	182-256	219.1	17.40
DBL	30	919-956	944.0	7.34
ABL	30	616-846	768.2	34.22
PL	24	42-74	58.0	8.24
PA	30	27-74	52.9	11.50
CFL	25	80-125	105.9	11.46
HL	30	127-221	182.1	15.56
HW	30	147-227	191.2	16.74
POL	30	99-144	112.0	8.88
SNL	30	30-46	37.4	4.34
UJL	30	32-45	38.5	3.43
ED	30	22-35	26.8	3.34
CD	30	28-45	35.8	4.90
UHL	30	90-133	110.3	11.86
LHL	30	84-129	97.1	11.08

Table 43. Summary of proportional measurements for Symphurus marginatus. Measurements, except HL (in mm), expressed as thousandths of head length.

Character	N	Range	Mean	SD
HL	30	11.5-24.8	19.3	3.05
HW	30	845-1250	1053.9	93.26
POL	30	571-802	617.0	41.52
PDL	30	251-454	308.4	40.26
SNL	30	168-331	207.2	31.91
UJL	30	180-331	213.6	25.77
ED	30	125-248	148.6	22.98
CD	30	144-256	197.4	30.83
LOL	30	208-372	290.4	36.30
UOL	30	144-331	218.9	38.03
LHL	30	426-736	536.1	67.76
UHL	30	468-818	609.5	85.46

Geographic Distribution (Fig. 15.)

Symphurus marginatus occurs primarily in deep-water habitats of the southeastern coast of the United States, throughout the Gulf of Mexico and Caribbean Sea. It has been collected along the Northwest Atlantic continental shelf as far north as Virginia (36°N) and off southern New Jersey (39°N), but the majority of specimens have been taken in more southern waters. The southernmost records for this species are for specimens collected off the coast of northern South America (7°N).

Bathymetric Distribution

This species inhabits deep outer continental shelf and upper continental slope waters. It has been collected at depths ranging from 37-750 m (Table 44). However, its center of abundance occurs primarily between 301-600 m. The majority of specimens (73/99 or 74%) were collected between 300-500 m. Of 99 specimens with available depth information, only ten were collected at depths shallower than 300 m. Single specimens were collected at each of the following depths: 37, 66, and 72 m; while three additional specimens collected at 10-11°N and off Florida were taken at 45 m. Of the remaining four specimens collected shallower than 300 m, a single specimen was collected at 274 meters and three were collected at depths of 289 and 293 meters.

Table 44. Summary of bathymetric distribution (in meters) for 99 specimens of _S_. _marginatus_.

Depth	≤37-72	274-293	301-400	401-500	501-600	668	750
N	6	4	52	21	17	2	1

Size and Sexual Maturity

Symphurus _marginatus_ is a medium-sized tonguefish attaining maximum lengths of about 150 mm SL. The largest specimen examined in this study was a gravid female measuring 146.1 mm SL. The largest male was somewhat smaller, measuring just over 130 mm SL.

Of the specimens examined, 42 were males, 46 females and 14 were juveniles (sex undetermined). Based on reproductive development of females, sexual maturity occurs at a relatively large size in _S_. _marginatus_. The smallest female with elongate ovaries was 78.6 mm SL. Most females between 85-105 mm SL, although having elongate ovaries, showed little evidence of ripened ova. The smallest gravid female was 87.5 mm SL, but this is apparently unusual as most females smaller than 105 mm SL were not gravid. Females larger than 105 mm SL were either gravid, or had ripening ova clearly evident.

Little is known concerning life history aspects for this species.

Material Examined

Measured and Counted 30 Specimens, 24 Lots.

FMNH 47908; (95.2); Gulf of Mexico, unspecified location; 750M; 1952. FMNH 86396; (135); 07°10'N 53°10'W; 366M; 09 XI 51. FMNH 88815; 2(91.0-99.0); 29°10'N 87°56'W; 668M; 26 VII 62. FMNH 88817; (114); 29°10'N 88°10'W; 366M; 07 VIII 62. FMNH 88818; (104); 29°14'N 87°46'W; 406M; 28 X 62. FMNH 90539; (146); 07°34'N 54°50'W; 366M; 06 XI 57. MCZ 27967; Syntype; (90.1); 28°42'N 88°40'W; 587M. UF/FSU 22224; (56.9); 29°27'N 87°21'W. UMML 10519; (84.9); 29°44'N 80°11'W; 329M; 19 VI 58. UMML 10590; 2(78.6-80.5); 29°30'N 80°09'W; 348M; 18 VIII 57. UMML 23248; (97.6); 09°28'N 76°27'W; 531M; 16 VII 66. UMML UNCAT OR4860; (99.5); 11°09'N 74°26'W; 289M; 19 V 65. UMML UNCAT OR 5028; (123.8); 11°30'N 60°46'W; 403M. UMML UNCAT OR5101; 2(112-113); 29°14'N 80°05'W; 375M; 15 XI 64. UMML UNCAT OR5105; (114); 29°20'N 80°07'W; 379M; 16 XI 64. UMML UNCAT OR5106; 2(110-111); 29°16'N 80°06'W; 390M; 16 XI 64. UMML UNCAT SB3711; (105); 28°21'N 79°51'W; 329M; 26 I 62. USA 4665; (96.8); 24°17.5'N 82°57.5'W; 458M; 22 IV 74. USNM 159236; (108); 07°12'N 53°11'W; 329M; 09 XI 57. USNM 186042; 2(116-119); 29°05'N 88°22'W; 458M; 12 VI 59. USNM UNCAT OR5240; 2(112-113); 29°39'N 80°11'W; 348M. USNM UNCAT OR5690; (114); 12°30'N 72°08'W; 470M; 10 X 65. VIMS 4302; (131); 36°40.4'N 74°40'W; 335M; 08 VI 73. VIMS 5510; (123); 36°37.5'N 74°42.7'W; 301M; 09 VI 73.

Counted 71 Specimens, 51 Lots.

AMNH 40249; (1); Western Atlantic, unspecified. FDNR 6751; (80.5); 28°14'N 85°49'W; 476M. FMNH 86366; (107); 24°26'N 83°24'W; 388M; 14 X 59. FMNH

88820; (114); 29°00'N 88°35'W; 403M; 24 VIII 62. FMNH 88847; (97.8); 11°31'N 60°51'W; 448M; 22 IX 64. FMNH 94462; (102); 16°43'N 82°44'W; 470M; 16 IX 57. FMNH 94468; 6(77.4-95.1); 16°42'N 82°40'W; 549M; 16 IX 57. FMNH 94486; (103); 29°11'N 88°05'W; 476M; 26 VIII 62. FMNH 90533; (92.8); 16°42'N 82°30'W; 549M; 19 IX 57. FMNH 90534; (90.6); 16°42'N 82°36'W; 549M; 16 IX 46. MCZ 51900; (95.9); 27°45'N 91°18'30"W; 549M. MCZ 58657; (91.0); 11°36'N 62°40'W; 72M; 19 IV 60. SHML DEL 74-8; (126); 39°11'N 72°27'W; 19 VIII 74. TCWC 3956.1; 2(87.5-95.7); 29°27'N 86°45'W; 384M; 04 VIII 68. TCWC 6187.7; (118); 29°07'N 88°18'W; 476M; 15 X 69. TCWC 6187.8; (1); 29°07'N 88°18'W; 476M; 15 X 69. TU 11024; (97.2); 24°19'N 83°20'W; 329M; 14 IV 54. UF 33889; 2(91.1-93.6); 28°23'N 79°49'W; 342M; 13 VI 61. UF 33894; (92.7); 11°26'N 73°41'W; 403M. UF 41164; (127); 29°20'N 80°05.9'W; 320M; 30 V 84. UF 44377; 2(121-133); 29°09.20'N 88°09.80'W; 467M; 13 XI 84. UF 44394; (117); 29°19.39'N 80°29.71'W; 549M; 26 III 85. UMML 10565; (1); 27°29'N 78°58'W; 366M; 02 II 57. UMML 10569; (97.1); 29°15'N 80°05'W; 384M; 31 V 57. UMML 10587; (72.1); 28°36'N 79°54'W; 403M; 30 VII 57. UMML 10589; (101); 29°48'N 80°12'W; 384M; 14 VIII 57. UMML 17440; (104); 24°50'N 80°37'W; 37M; 14 IV 65. UMML 20536; (58.7); 27°02'N 79°49'W; 501M; 16 VII 65. UMML 20569; (80.1); 27°18'N 79°49'W; 324M; 16 VII 65. UMML 30106; (3); 10°32'N 75°35'W; 45M; 01 VIII 68. UMML UNCAT OR3653; (109); 29°12'N 87°52'W; 531M; 25 VII 62. UMML UNCAT OR4860; (108); 11°09'N 74°26'W; 289M; 19 V 65. UMML UNCAT OR5030; (117); 11°09'N 60°55'W; 66M; 22 IX 64. UMML UNCAT OR5092; (109); 29°31'N 80°09'W; 348M; 14 XI 64. UMML UNCAT OR5093; (2); 29°31'N 80°09'W; 384M; 14 XI 64. UMML UNCAT OR5097; (113); 29°21'N 80°06'W; 379M. UMML UNCAT OR5113; 6(106-116); 29°21'N

80°06'W; 390M; 17 XI 64. UMML UNCAT SB1611; (96.4); 29°06'N 80°00'W; 360M; 26 I 60. UMML UNCAT SB3711; 4(92.7-102); 28°21'N 79°51'W; 329M; 26 I 62. UMML UNCAT SB3752; (90.7); 29°57'N 80°10'W; 293M; 22 II 62. UMML UNCAT SB4225; (106); 29°17'N 80°04'W; 403M; 24 VIII 62. UNC 12175; (120); 31°58'N 79°08'W; 366M. UNC 12179; (126); 28°02'N 79°50'W; 329M; 31 I 57. USNM 108416; (71.5); 18°32'N 66°21'W; 476M. USNM 131634; Syntype; (105); 29°03'15"N 88°16W; 593M. USNM 159607; (123); 07°36'N 54°42'W; 412M; 07 XI 57. USNM 159891; (1); 29°06'N 88°19'W; 476M. USNM 236603; (107); 29°14'N 80°05'W; 357M; 29 XI 65. USNM 236609; 2(107-115); 29°39'N 80°11'W; 348M; 10 II 65. USNM UNCAT OR5241; (100); 29°03'N 80°00'W; 348M. USNM UNCAT OR5782; (2); 24°27'N 83°32'W; 512M.

Symphurus piger (Goode and Bean 1886)

(Fig. 44B)

Deepwater Tonguefish

Aphoristia pigra

Goode and Bean 1886: 154; (Original description, in part; specimens of more than one species in original account).

Goode and Bean 1895: 460 (in part); Description and figure, based on specimens in previous citation.

Cockerell 1912: 172; Brief discussion and figure (48) of scale type.

Symphurus piger

Jordan and Goss 1889: 326; (after Goode and Bean).

Jordan and Evermann 1898: 2705. (after Goode and Bean).

Chabanaud 1939: 26; Caribbean Sea, listed 457 m.

Ginsburg 1951: 197 (in part, specimens of more than one species in redescription); Redescription, designation of lectotype (MCZ 27965).

Symphurus pusillus (not Goode and Bean)

Longley and Hildebrand 1941: 50; Listed, Tortugas, FL.

Holotype MCZ 27965; (84.6mm); St. Kitts, WI; 458M.

Study Material: 174 specimens, 27.3-127 mm SL. 144 x-rayed, 33 measured.

Remarks

Among the seven specimens (holotype and six paratypes) included in the type series of *Aphoristia pigra* Goode and Bean 1886 are specimens of at least two species (*Symphurus parvus* and *S. piger*). Additionally, among non-type material listed in the original description, Goode and Bean included specimens of a third species, *S. minor*. The present status and even the existence of this material other than the holotype is somewhat confusing. The discussion below attempts to explain the history and present status of the seven specimens forming the original type series of *A. pigra* and the additional non-type material listed in the original description.

In Ginsburg's 1951 revision of western Atlantic tonguefishes, he stated that he was unsure from the original description of *A. pigra* which, if any, of the specimens from the original description was the holotype. Ginsburg (1951: 197) designated the specimen from *Blake* Station XXIII (now MCZ 27965) as the lectotype. This designation was unnecessary, however, because Goode and Bean (p. 154) clearly designated the specimen from *Blake* Station XXIII as the primary type and listed the other specimens (from *Albatross* Station 2318 and 2405) as paratypes. It is important to point this out because study of all presently available specimens believed to form the basis of the original description reveals that the only actual specimen of *S. piger* is the holotype collected at *Blake* Station XXIII. All other remaining specimens are either *S. parvus* or *S. minor*.

Both Ginsburg (1951) and I have been unable to locate all of the specimens included in the original description of *A. pigra*. The difficulty with tracing the whereabouts of this material is caused by two factors.

First, Goode and Bean did not list museum numbers for any specimens comprising the original description, but rather, they listed specimens only by Station Number (the Albatross or the Blake). Although some tonguefishes from these stations can presently be located, one can not be completely certain that these are the actual specimens used in Goode and Bean's original description. The inability to identify individual specimens, other than the holotype, included in the original description of A. pigra has caused confusion regarding the fate and whereabouts of all original material. The second difficulty with locating specimens comprising the original account of A. pigra is that Goode and Bean did not provide the actual number of specimens that were examined from each station. There is now some confusion regarding the number of specimens collected at Albatross Station 2318 (discussed in greater detail below).

In his 1951 revision, Ginsburg was unsure that specimens from Albatross Station 2318 that he examined were the actual ones studied by Goode and Bean in the original treatment of A. pigra. Under the material examined section for S. piger, Ginsburg stated that he was able to locate six specimens from Albatross Station 2318 but was unable to locate any specimens from Albatross Stations 2405 (two specimens) and 2425 (unknown number of specimens). Regarding specimens from Albatross Station 2318, it is interesting to note that Ginsburg listed not four specimens as was done by Goode and Bean in the original description, but instead listed six specimens from this station. Apparently Ginsburg was unaware of differences in specimen number between his account and that of Goode and Bean's description, as he failed to address this in his study.

I have attempted to locate all six paratypes of A. pigra and also to find out why there is a discrepancy in the number of specimens reported from Albatross 2318 between Goode and Bean's work and Ginsburg's study. A check of all available field data now included with the six specimens from Station 2318 (all housed at the USNM) reveals that all jar labels and museum registers list data only for Albatross Station 2318. It is possible that station data presently listed with all six specimens is correct. This would indicate that Goode and Bean either erred in listing only four (instead of six) specimens from this station (not likely), or that there were two additional specimens collected at this station that were not included in the original description (possible). However, if the number of specimens (4) reported from Albatross Station 2318 in Goode and Bean's account is correct and these authors used all available material, then it would appear that information regarding station data for two of the six specimens presently listed from Albatross Station 2318 has been lost or transposed sometime in their history prior to examination by Ginsburg. In an effort to retrace the history of these specimens prior to their inclusion into the holdings of the USNM, I have checked both the museum registers and the catalogue of the Bureau of Commercial Fisheries at the USNM for additional collection data. This effort uncovered no additional information. Secondly, I sought information regarding transfer of these specimens from the Bureau of Commercial Fisheries to the USNM through accession files of the USNM. This effort was also unsuccessful primarily because no accession number(s) were listed for any of the six specimens. Additional searches through accession lists of other Albatross material transferred from the Bureau of Commercial

Fisheries to the USNM provided no information concerning transfer of these particular specimens. Therefore, I am unable to unequivocally demonstrate that the discussion presented below regarding the history of the paratype material for A. pigra is actually correct. However, one possible explanation is offered to identify the status of all original types of A. pigra and also an explanation is provided for the discrepancy in the number of specimens reported from Albatross Station 2318 between the original account of Goode and Bean and the later revision by Ginsburg.

The present fate and status of all material used in the original description of A. pigra is as follows: one specimen from Blake Station XXIII, now catalogued as MCZ 27965, is the holotype of A. pigra; four specimens from Albatross Station 2318 (originally paratypes of A. pigra and now included as paratypes of S. parvus) are now catalogued as USNM 74330, 84991 and 152733 (but see below); two specimens from Albatross 2405 (paratypes of A. pigra) of unsure location and museum number (see below); additional material from Albatross Stations 2374 (now assigned as USNM 131293; non-type status for A. pigra but included in Ginsburg's paratype material for S. minor) and Albatross 2425 (of unsure identity, whereabouts or museum number, but of non-type status for A. pigra).

The six specimens listed by Ginsburg and supposedly collected from Albatross Station 2318 are now assigned the following museum numbers: four are assigned USNM 74330 (three of which Ginsburg designated as paratypes of S. parvus, the fourth was out on loan at the time to P. Chabanaud of the Paris Museum and was not listed as a paratype of S. parvus); the remaining two specimens also comprise part of the type series of S. parvus. These two, now assigned USNM 84491 (the holotype of S. parvus) and USNM 152733 (a paratype of S. parvus), were originally contained in the same jar (indicated in both museum cataloguing records and on jar labels). I believe these last two specimens (USNM 84491 and 152733) are actually the two specimens from Albatross Station 2405 listed in Goode and Bean's account. If this is correct, then together with the other four specimens listed above (USNM 74330) would account for the six original paratypes of A. pigra.

If USNM 84491 (the holotype of S. parvus) and USNM 152733 (a paratype of S. parvus) are indeed the actual specimens from Albatross Station 2405 included in Goode and Bean's A. pigra, then the type locality and collection information of S. parvus changes from Albatross Station 2318 (24°25'45" 81°46'W; 45 fms; 15 I 1885) to Albatross Station 2405 (28°45'N 85°02'W; 30fms; 15 III 1885).

The fate and status of the remaining material listed in the original description of A. pigra is as follows. Specimens from Albatross Station 2374 (not designated type status by Goode and Bean) are now paratypes of S. minor Ginsburg (1951) and are assigned USNM 131590. The whereabouts of specimens from Albatross Station 2425 are unknown. Both Ginsburg and I tried unsuccessfully to locate these specimens. This lot (unknown number of specimens), although included in the original description of A. pigra, did not comprise part of the type series.

In the redescription of S. piger in his revision of western Atlantic tonguefishes, Ginsburg (1951) included specimens of two species in his counts and measurements. He included three lots of S. piger, MCZ 27965 (the holotype), USNM 117186 (one specimen) and USNM 17287 (two specimens) of S.

piger. However, among the other material he listed are two USNM lots (153099 off Sombrero Light, FL and 153089 off Palm Beach, FL) both of which are *S*. *pusillus*.

The report of *S*. *piger* from Freemont, Texas by Baughman (1950) is based on a misidentification. This specimen (CAS-SU 40556) is actually *S*. *civitatium*.

Diagnosis

A medium-sized, deep-water tonguefish with a 1-3-2 ID pattern, 12 caudal rays, 5 hypurals, black peritoneum and relatively wide body. This species is only one of three species (the western Atlantic *S*. *marginatus* and the eastern Pacific *S*. *microlepis* are the others) in the genus with a 1-3-2 ID pattern, 12 caudal rays and five hypurals. *Symphurus piger* is readily distinguished from *S*. *marginatus* and *S*. *microlepis* by its much lower and non-overlapping meristics. Compared with *S*. *marginatus*, the meristics for *S*. *piger* are lower (vertebrae 47-49 vs. 51-54 in *S*. *marginatus*; dorsal rays 80-88 vs. 93-104; anal rays 67-75 vs. 80-89). Additionally, these species differ in body shape (*S*. *marginatus* has a more elongate body with a relatively narrow head vs. a wide body and wide head in *S*. *piger*). The species also differ in pigmentation (*S*. *piger* lacks the caudal blotch characteristic of *S*. *marginatus*). *Symphurus microlepis* is even more distinctive and differs in its much higher meristics (vertebrae 57-58; dorsal rays 106-109; anal rays 92-94) when compared to *S*. *piger*.

When compared to other Atlantic species with a 1-3-2 ID pattern, *S*. *piger* is similar in meristics to *S*. *pusillus*, *S*. *nigrescens*, and overlaps counts for S. rhytisma as well. It is readily distinguished from S. nigrescens and S. pusillus by hypural count (5 vs. 4) and by its much larger scales (62-75 rows vs. 72-91 in these other species). Its similarities with S. rhytisma are only superficial. It differs from this species in many charactes among the most obvious are peritoneum color (black vs. unpigmented in S. rhytisma), scale counts (62-75 vs. 91-97) and body size (130 vs. 45 mm SL).

Symphurus piger overlaps meristic counts of the South Atlantic S. trewavasae but is readily separated from this species by differences in ID pattern (1-3-2 vs. 1-3-3), caudal ray count (12 vs. 10) and peritoneum color (black vs. unpigmented).

Meristics of S. piger overlap those for four species possessing the 1-4-3 ID pattern (S. civitatium, S. diomedeanus, S. plagiusa and S. urospilus). It differs from all of these species in ID pattern (1-3-2 vs. 1-4-3) and peritoneum color (black vs. unpigmented). It can further be distinguished from all of these species except S. civitatium by caudal ray count (12 vs. 11 in S. urospilus and 10 in S. diomedeanus and S. plagiusa). It also differs from all of these species in modal counts of scales (lower in S. piger).

Description

A medium-sized Symphurus attaining maximum adult lengths of approximately 130 mm SL. ID pattern 1-3-2 (Table 9). Caudal rays 12 (Table 10). Dorsal rays 80-88, usually 83-88 (Table 11). Anal rays 68-75 (Table 12). Vertebrae 45-49, usually 47-49 (Table 13). Hypurals 5. Longitudinal scale rows 62-75, usually 66-73 (Table 14). Scale rows on head posterior to lower orbit 16-21, usually 17-19 (Table 15). Lateral scale rows 32-38 (Table 16). Proportional measurements appear in Tables 45-46.

Body relatively deep, depth 24-35% SL; with relatively wide head 24-31% SL; and short snout 17-28% HL. Snout covered with small ctenoid scales. Posterior extension of maxilla usually reaches to about mid-point of lower eye; less frequently only reaching rear margin of pupil of lower eye. Eyes relatively large, 10.1-16.7% HL; usually equal in position. Eyes usually covered with 4-5 short rows of small ctenoid scales. Pupillary operculum absent. Dorsal fin origin usually at a vertical equal to posterior margin of pupil of upper eye, occasionally reaching forward margin of upper eye. No scales on dorsal and anal fins.

Teeth well developed on blind side jaws. Teeth covering entire ocular side dentary. Teeth usually extending over anterior three-fourths of ocular-side premaxilla; occasionally covering entire surface.

Pigmentation

Eyed surface pigmentation usually dark brown with 3-10 (usually 5-8) well-developed, darker brown, sharply contrasting, rather narrow crossbands. Bands continued onto fins as darker speckling or small elongate or irregular blotches. Individuals from several locations (presumably sandy substrates) more yellowish, with faint, almost imperceptible crossbands. Older museum specimens generally mostly faded. In banded individuals, the first band crosses the body immediately behind the operculum and the second crosses

Table 45. Summary of morphometrics expressed in thousandths of Standard Length, except SL (in mm), for *Symphurus piger*.

Character	N	RANGE	MEAN	SD
SL	33	58.6-120.5	85.0	14.71
BD	33	244-350	322.5	23.09
PD	33	46-90	58.4	7.98
PA	33	176-327	255.4	26.40
DBL	33	910-954	941.6	7.98
ABL	33	730-778	748.5	12.65
PL	33	58-86	73.3	7.13
PA	33	28-67	46.1	9.09
CFL	33	103-168	147.9	13.92
HL	33	182-256	236.8	12.58
HW	33	242-313	276.8	13.63
POL	33	149-226	160.6	13.22
SNL	33	40-68	48.3	5.19
UJL	33	45-81	54.0	7.07
ED	33	23-40	27.8	3.32
CHD	33	45-66	54.8	5.34
UHL	33	124-198	171.3	13.08
LHL	33	103-142	126.5	9.76

Table 46. Summary of morphometrics for *Symphurus piger*. Measurements (except HW/HL) are expressed in thousandths of Head Length.

Character	N	RANGE	MEAN	SD
HW/HL	33	1.03-1.44	1.2	.08
POL	33	633-910	680.0	61.58
SNL	33	172-282	203.7	19.10
UJL	33	188-338	228.2	29.60
ED	32	101-167	118.1	13.84
CD	33	190-317	232.5	26.91
OPLL	33	269-401	321.8	29.94
OPUL	33	170-375	226.9	37.52
UHL	33	626-916	729.2	61.74
LHL	33	438-690	539.0	48.40

almost at the body mid-point. Usually the darkest bands are the second and third which are placed on the body just posterior to the operculum. Bands variable in number and degree of completeness in posterior part of body. The last band situated a short distance from caudal region. Occasionally bands scarcely evident against general dark background color. Operculum not pigmented other than general background color. Inner isthmus and operculum not heavily pigmented. Moustache variable in development; present in some specimens and very dark on both ocular side lips; in other specimens moustache lacking. Blind side uniformly yellowish-white. Peritoneum black, visible through both sides of body.

Fins without definite spots, generally light-colored anteriorly, usually with increasing darker-brown, but not black, pigmentation posteriorly. In regions of body crossbands, fins more heavily sprinkled with melanophores, or with irregular elongate blotches. There is no pigment spot at caudal fin base.

Size and Sexual Maturation

Symphurus piger attains a maximum size of approximately 130 mm SL, however, most specimens examined were much smaller, ranging in size from 80-105 mm SL. The largest *S. piger* examined was a female measuring 127 mm SL; the largest male was only slightly smaller (118 mm SL).

A total of 86 males, 85 females and three (sex unknown) immature fish were studied. Based on the reproductive stages of females, it appears that this species matures sexually at a relatively large size (approximately 68 mm SL). All females larger than 73 mm SL had fully elongate ovaries; four females ranging from 57.9-66.6 mm SL had ovaries which were just undergoing elongation. The smallest gravid female examined was 69.1 mm SL.

Geographic Distribution (Fig. 17).

Symphurus piger is primarily a tropical species with widespread occurrence in the Caribbean Sea. Its range extends also along the continental shelf of the eastern United States to at least as far north as 30°N (off St. Augustine, FL). From this point, the species extends southward southward through the Caribbean Sea along the coast of northern South America to a southern limit about off the Surinam coast (07°N; 53°W). *Symphurus piger* has only infrequently been reported from within the Gulf of Mexico and it is questionable whether this species forms part of the deep-sea fauna there. Only three collections of this species from the Gulf of Mexico were located during the course of this study. Only one of these lots (UF 44356, containing a single large (127 mm SL) adult) records this species from the eastern Gulf of Mexico (off the Mississippi Delta of Louisiana, 29°12'N; 88°25'W). Three other lots (TCWC 4468.11; 6097.14; and 6207.17), totalling 21 specimens, record this species from the western Gulf of Mexico off the Yucatan shelf (18.5-20.3°N).

Bathymetric Distribution

Symphurus piger is a relatively deep-water species. Depth of capture information was available for all 170 specimens examined and is summarized in Table 47. Overall, the species has been taken from a wide depth range (92-458 m), however, the center of abundance occurs between 100-300 m where

153/170 (90%) of the individuals have been captured. Only 3/170 (2%) _S. piger_ have been collected at depths shallower than 105 meters, while 14/170 (8%) have been taken deeper than 300 meters.

Table 47. Summary of depth distribution for 170 specimens of _S. piger_.

DEPTH (m)	92-100	101-200	201-300	301-400	401-458
N	3	76	77	9	5

Material Examined

Measured and Counted

MCZ 27965; HOLOTYPE (84.6mm); St. Kitts, WI; 458M. ANSP 144936; (78.2); 22°55'N 78°36'W; 274M; 07 XI 61. FMNH 86414; (92.1); 09°36'N 59°44'W; 146M; 04 XI 57. FMNH 90536; (112.4); 18°26'N 67°11'W; 229M; 06 X 59. FMNH 90538; 2(72.6-94.1); 17°38.5'N 63°27'W; 348M; 30 IX 59. FMNH 91116; 10(84.7-120); 18°26'N 67°10.5'W; 274M; 06 X 59. FMNH 94463; (92.7); 18°37.5'N 64°57'W; 403M; 26 IX 59. FMNH 94469; (76.5mm); 15°15'N 81°19'W; 265M; 25 VIII 57. UF 15637; 3(71.4-82.0); 22°55'N 78°36'W; 274M; 07 XI 61. UMML 17635; 7(58.6-90.1); 25°49-51'N 79°19'W; 225M; 29 VI 65. UMML 30166; 5(67.0-95.5); 11°20-22'N 73°48.51-44'W; 158M; 21 VII 68.

<u>COUNTED</u>

FDNR 12566; 2(103.7-106.9); 24°20.5'N 82°41.6'W; 105M; 22 VIII 81. FMNH 86398; 4(79.1-91.4); 18°12'N 67°18'W; 06 X 59. FMNH 90540; (104.0); 18°13'N 67°14.5'W; 229M; 06 X 59. FMNH 94461; 5(96.1-114.6); 07°30'N 55°00'W; 183M; 24 III 63. FMNH 94465; (79.1); 16°38'N 82°34'W; 384M; 21 VIII 57. GCRL V69.3817; (112.5); 07°27'N 54°30'W; 201M; 16 V 69. TCWC 4468.11; 9(87.6-122); 18°50.8'N 93°38'W; 146M; 12 XI 75. TCWC 6097.14; 11(57.9-123); 18°50'N 93°39'W; 166M; 12 XI 75. TCWC 6207.17; (92.9); 20°26.3-51.5'N 87°14.7-19.0'W; 265M; 11 IV 76. UF 33888; 11(30.5-85.9); 23°34'N 79°05'W; 274M; 11 VI 60. UMML 11175; (97.3); 09°39'N 59°47'W; 183M; 04 XI 57. UMML 14146; (51.2mm); 27°25'N 78°41-37.5'W; 302M; 05 II 64. UMML 17958; (87.5); 25°28'N 78°07'W; 458M; 24 IV 65. UMML UNCAT; 3(94.1-104.0); 11°08.51-07.6'N 74°18.1-19.3'W; 133M; 31 VII 68. UMML UNCAT G1329; 2(51.6-64.4mm); 25°50'N 78°22'W; 251M; 11 XII 71. UMML OR2633; 3(73.6-87.4); 17°34'N 63°30'W; 92M; 30 IX 59. UMML OR3587; (78.1mm); 09°18'N 80°25'W; 137M; 29 V 62. UMML OR3636; 7(82.7-104.7); 17°17'N 87°59'W; 229M; 10 VI 62. UMML OR5021; (75.9mm); 11°21.2'N 60°38.7'W; 174M; 20 IX 64. UMML SB3752; 2(100.5-103.1); 29°57'N 80°10'W; 293M; 22 II 62. USNM 159211; 23(89.3-122); 07°18'N 53°32'W; 183M; 08 XI 57. USNM 159605; 2(94.7-98.2); 09°36'N 59°44'W; 146M; 11 IV 57. USNM 159609; 7(83.4-106.1); 09°39'N 59°47'W; 183M; 11 IV 57. USNM 285198; 3(83.0-99.7); 18°12'N 64°18'W; 274M; 06 X 59. USNM 285195; 3(93.0-98.6); 18°11'N 63°15'W; 296M. 25 II 66. USNM 285197; 6(68.9-75.1); 23°34'N 79°05'W; 274M; 06 XI 60.

OTHER MATERIAL

FMNH 86416; 2(85.4-91.7); 16°39'N 81°43'W; 229M; 22 VIII 57. FMNH 94458; 2(61.3-75.3); 24°25'N 79°13'W; 229M; 07 XI 60. FMNH 94459; (71.1); 24°40'N 79°16'W; 366M; 07 XI 60. FMNH 94466; (66.5); 16°38'N 82°43'W; 256M; 21 VIII 57. MCZ 39395; (27.3); 22°34'N 78°15'W; 329M; 28 IV 39. UF 44356; (127); 29°12.30'N 88°25.10'W; 165M; 03 IV 85. UMML 7124; 4(83.6-117.8); 18°18'N 67°18.5'W; 549M; 06 10 59. UMML 27458; (75.6); 24°00'N 79°47'W; 300M. UMML SB2468; 2(79.5-81.4); 23°52'N 79°11'W; 375M; 06 XI 60. UMML SB2470; 5(72.7-75.9); 24°25'N 79°13'W; 229M; 07 XI 60. UMML SB2477; (66.6); 25°13'N 79°13'W; 366M; 08 XI 60. UMML SB3512; 2(69.9-79.4); 23°05'N 78°49'W; 434M; 07 XI 61. UMML SB3474; (85.7); 27°08'N 77°52'W; 289M; 25 X 61. USNM 117176; (103.4); FL, Tortugas. USNM 117287; 3(101.8-113.2); FL, Tortugas. USNM 285196; (77.2); 16°35.4'N 80°47.2'W; 259M; 11 III 60.

CHAPTER 6.4

1-3-3 ID Pattern Species

Symphurus normani Chabanaud 1950

(Fig. 45A)

Symphurus nigrescens

Norman 1930: 363; St. Paul di Loanda, Angola and Cape Lopez, French Congo.

Norman 1935: 34; after Norman 1930.

Symphurus normani

Chabanaud 1950: 625; Original description; Cape Lopez, French Congo; Holotype BMNH 1930.5.6:51; 81 mm SL.

Blache 1962: 791; Listed, Gulf of Guinea and Angola.

Nielsen 1963: 26; Listed, Portuguese Guinea.

Blache et al. 1970: 439; In key; West Africa.

Misidentification

Merrett and Marshall 1981: 244; Northwest Africa; Specimens were *S. nigrescens*.

Study Material: 24 specimens, 38.6-81.7 mm SL. 21 x-rayed, 14 measured.

Diagnosis

A distinctive species and the only one in the genus with the following combination of characters: a 1-3-3 ID pattern, 12 caudal rays, unpigmented peritoneum, well-developed ctenoid scales on the blind side dorsal and anal fins and spotted coloration on the blind side of the body.

Among the other species with a 1-3-3 ID pattern, S. normani is most similar in meristics to the western South Atlantic species, S. trewavasae. It differs from this species, however, in caudal ray count (12 vs. 10 in S. trewavasae) and the presence of scales on the blind side dorsal and anal fins (absent in S. trewavasae). It differs from the Eastern Pacific S. varius principally in color of the peritoneum (unpigmented vs. black in S. varius). It differs from the Eastern Pacific S. atramentatus in having lower counts (dorsal rays 87-92 vs. 92-96; anal rays 72-77 vs. 77-81; vertebrae 48-50 vs. 50-52) and smaller body size (ca. 80 vs. 134 mm SL (according to Mahadeva 1956)).

Symphurus normani differs from S. nigrescens, which co-occurs along the West African shelf region, in the following characters: ID pattern 1-3-3 vs. 1-3-2; scales on blind side dorsal and anal fins (present in S. normani vs. absent in S. nigrescens); much smaller eyes (7-9 compared to 12-15% HL); larger mouth which reaches a vertical from the posterior border of the lower eye vs. mouth not reaching beyond front of pupil or front margin of eye; much smaller and more numerous scales (95-105 compared to 72-91). The two species are also different in several features of the body pigmentation. In

_S_. _normani_, the peritoneum is unpigmented (vs. black in _S_. _nigrescens_); and in _S_. _nigrescens_, when crossbands exist, they are widely separated, mostly incomplete, and reduced to a series of irregular blotches while in _S_. _normani_ the body is uniformly light brown or if transverse bands are present, they extend without interruption across the body to the bases of the dorsal and anal fins. One other difference in coloration between these species occurs in the blind side pigmentation. _Symphurus_ _normani_ has a pepper-dot pattern of small pigment spots, whereas _S_. _nigrescens_ usually has a whitish blind-side without spotting.

Description

A medium-sized tonguefish attaining maximum adult lengths of just over 80 mm SL. ID pattern usually 1-3-3, rarely 1-3-2 (Table 9). Caudal rays 12 (Table 10). Dorsal rays 87-92 (Table 11). Anal rays 72-77 (Table 12). Vertebrae 48-50, usually 48-49 (Table 13). Hypurals 4, occasionally 5. Longitudinal scales 99-109, usually greater than 100 (Table 14). (Chabanaud (1950) reported 95-105 (108?) scale rows.) Scale rows on head posterior to lower orbit 22-25 (Table 15). Lateral scale rows 40-47 (Table 16). Proportional measurements are listed in Tables 48-49.

Body moderately deep, depth 25.0-28.7% SL; greatest depth usually in anterior third of body in region of anal rays 5-18. Head relatively narrow, width 20.8-23.9% SL; with short snout (14.8-22.0% HL). Snout covered with small ctenoid scales. Dermal papillae present on blind side snout only. Posterior extension of maxilla reaches to rear edge of pupil of lower eye or sometimes extends to rear margin of lower eye. Eyes small, 7.6-10.9% HL;

Table 48. Summary of morphometrics expressed in thousandths of Standard Length, except Standard Length (in mm), for *Symphurus normani*.

Character	N	RANGE	MEAN	SD
SL	14	38.6-81.7	65.7	11.16
BD	14	250-287	268.6	10.78
PDL	14	39-65	54.0	7.28
PAL	14	215-282	249.3	18.76
DBL	14	935-961	945.3	6.70
ABL	14	724-784	750.3	17.38
PL	14	58-77	69.4	5.27
PA	13	49-78	58.1	7.63
CFL	14	107-127	118.1	5.64
HL	14	206-238	216.2	9.13
HW	14	208-239	222.8	10.45
POL	14	142-163	153.6	6.36
SNL	14	31-49	38.6	5.30
UJL	14	40-56	48.0	4.13
ED	14	17-23	19.3	1.68
CD	14	37-57	45.3	5.90
UHL	14	121-150	136.1	8.69
LHL	14	86-123	105.7	9.41

Table 49. Summary of morphometrics expressed in thousandths of Head Length (except HW/HL) for *Symphurus normani*.

Character	N	RANGE	MEAN	SD
HW/HL	14	0.96-1.15	1.0	0.05
POL	14	669-758	711.0	26.09
SNL	14	148-220	178.6	19.79
UJL	14	189-245	222.2	16.60
ED	14	76-109	89.1	7.68
CD	14	175-256	209.6	24.91
OPLL	13	231-298	270.9	20.73
OPUL	13	170-301	235.2	40.65
UHL	14	532-704	630.8	46.67
LHL	14	404-562	489.6	45.72

usually equal in position, occasionally slightly subequal with upper eye in advance of lower; With 1-6 small ctenoid scales covering anterior and dorsal surface of eyes; 1-4 scales extending into narrow interorbital space. Pupillary operculum absent. Dorsal fin origin more posterior; reaching a vertical equal only to rear edge of pupil of upper eye or reaching only to rear margin of upper eye. Dorsal and anal fins with from 3-9, usually 4-8, small ctenoid scales on both the blind and ocular surfaces.

Teeth well developed on all jaws. Ocular side jaws with a single row of slender teeth extending over entire surfaces of premaxilla and dentary.

Pigmentation

Eyed surface uniformly light brown usually without strongly contrasting cross banding. Bands if present, not readily evident but extending to bases of dorsal and anal fins. Operculum usually not pigmented other than general body color. One specimen had a dark shading across outer operculum (banding ?). Inner lining of operculum and the isthmus on olar side lightly pigmented in about half of the specimens examined. Eyed-side lips variously pigmented but without well-developed moustache. Some specimens lack pigmentation on the lips completely; others have light spotting on the upper lip or less frequently have spotting on both lips. Blind side mostly whitish or cream colored, sprinkled with finely pigmented spots. Spots more dense in regions overlying the dorsal and anal pterygiophores. These spots are not evident in some of the older faded specimens. Peritoneum generally light in color, although some specimens have a small amount of spotting on the dorsal side of the peritoneum. In some specimens missing scales, there is a row of deep internal pigment spots evident on the blind side along the body midline.

Dorsal and anal fin rays without obvious pigment spots. Pigmentation on fins restricted to faint coloration along basal half of fin rays. Pigmentation intensifies in areas corresponding to banding on body. In specimens missing scales, a series of dark black, dermal melanophores evident along bases of dorsal rays. In some specimens, these melanophores are evident for a considerable distance along the dorsal fin.

This color description differs slightly from Chabanaud's (1950) account. He described the color in alcohol as follows: the eyed surface is reddish brown or greyish, sometimes uniform, sometimes variegated with dark shaded areas which appear to form, more or less, four to five large transverse bands. These bands are not interrupted across the vertebrae. The most anterior of these is placed at the level of the greatest body depth (this is a short distance before the middle of the standard length), and the last is placed about a third or fourth of the standard length from the caudal base. The opercular region is sometimes darkened by the outline of one cephalic band and one ordinarily can determine traces of a fifth band situated at the base of the caudal fin. The transverse bands do not continue onto the fins, which are uncolored but frequently decorated by blackish marks, placed on the proximal half of the rays. The blind side is uncolored or uniformly white.

Geographic Distribution

Symphurus normani occurs in the eastern Atlantic in equatorial waters off the west coast of Africa. Collections of *S. normani* extend from approximately 12°N to Saint Paul de Loanda (8°40'S). Based on the small number of specimens available, this species appears to have a comparatively narrow geographic range along the open continental shelf of West Africa.

Bathymetric Distribution

This species is confined to a relatively narrow depth range (40-75 m) along the open inner continental shelf. All but one of the 23 specimens were taken between 40 and 75 m. Thirteen were collected between 60-75 m, seven were taken at 40-50 m and a single specimen was collected at 25 m.

Size and Sexual Maturation

Symphurus normani is a medium sized species, attaining maximum lengths of approximately 82.0 mm SL. The two largest specimens examined were females measuring 81.7 and 81.4 mm SL. The second largest female is the holotype (Chabanaud incorrectly reported the sex of this specimen as a male by Chabanaud). The largest males were only slightly smaller and measured 74 and 69 mm SL, respectively.

Based on reproductive states of females, it appears that *S. normani* attains sexual maturity around 65 mm SL. Females longer than 64 mm SL all had elongate ovaries. Two females, measuring 53.9 and 57.0 mm SL were immature with little gonad elongation. Females measuring 64.6, 70.3 and 81.7 mm SL were gravid.

Little else is known concerning life history aspects of this species. It is poorly represented in collections and whether this reflects the species actual abundance in nature or results from inadequate sampling at appropriate depths and over suitable substrates is unknown at this time.

Material Examined

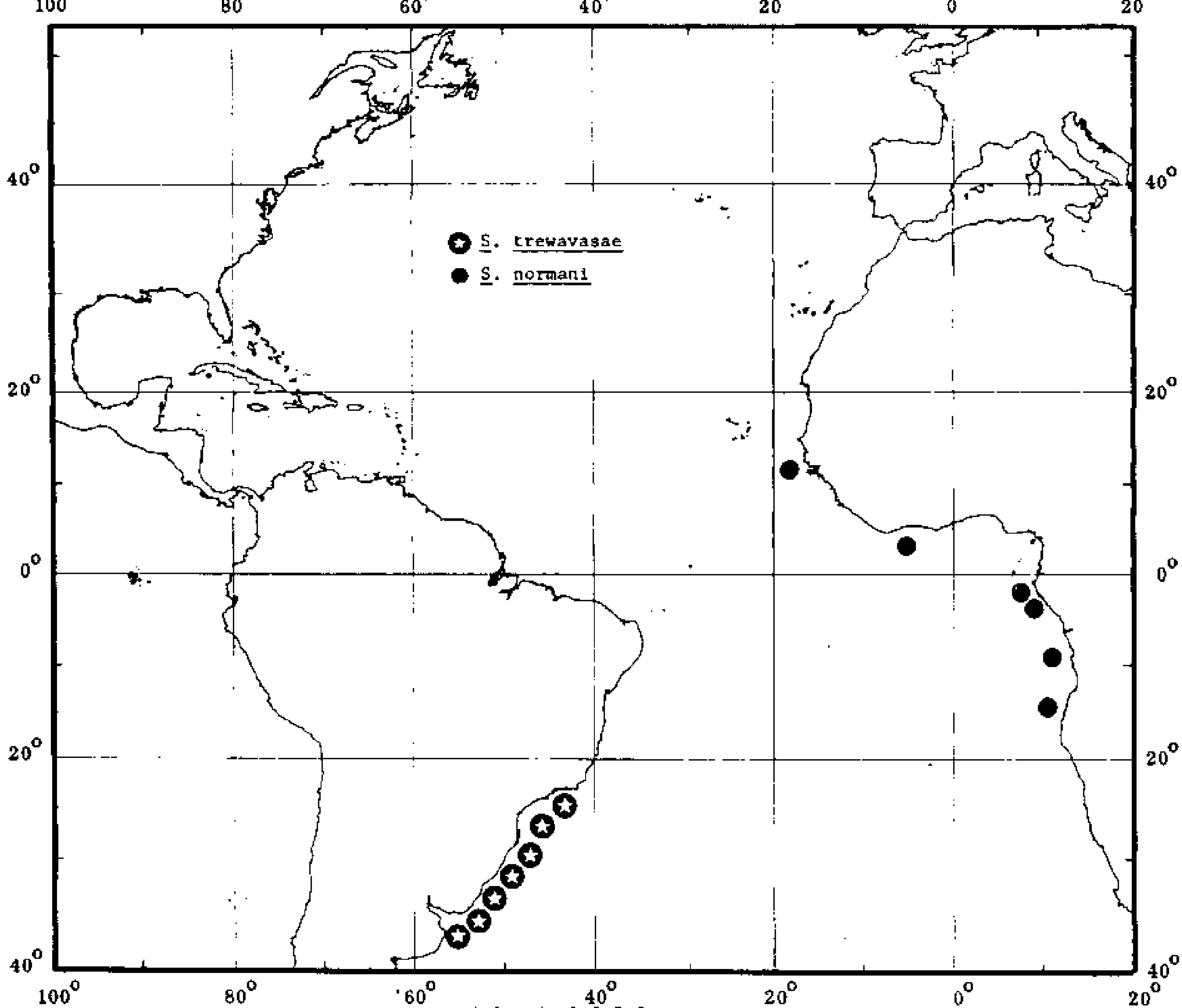
Measured and Counted 14 Specimens, 11 Lots.

BMNH 1930.5.6:51; Holotype (81.4); from 8.5 mi. N 71° E to 15 mi. N 24°E, off Cape Lopez Light, Cape Lopez, French Congo; 62M; 10 VIII 27. IRSNB 16808-404; Paratype (53.9); 05°54'S 11°58'30"E; 50M; 25 VIII 48. IRSNB 16808-405; Paratype (71.7); 05°55'S 12°01'E; 25M; 08 IX 48. IRSNB 16808-406; Paratype (57.0); 05°56'S 11°55'E; 50M; 27 X 48. IRSNB 16808-14788 #105; (70.3); 04°48'S 11°30'E; 49M; 31 III-1 IV 49. IRSNB 16808-14788 #106; (61.6); 04°48'S 11°30'E; 49M; 31 III-1 IV 49. MNHN 1967-540; (81.7); 12°09'30"N 17°12'W; 40M; 11 XII 63. UMML 16759; 3(64.3-69.1); 05°40'N 00°17-30'E; 46M; 26 V 64. UMML UNCAT. 2(38.6-74.2); 05°00'N 05°00'W; 75M; 31 V 64. ZMUC 86224; (67.6); 11°54'N 17°14'W; 67M; 17 IV 46. ZMUC 86225; (63.8); 11°54'N 17°14'W; 67M; 17 IV 46.

COUNTED 10 Specimens, 6 Lots.

BMNH 1930.5.6:46-50; Paratypes; 5(22-67.7); 08°40'15"-08°38'15"S 13°13'45"-13°13'00"E; 64M; 04 VIII 27. BMNH 1930.5.6:52-54; Paratypes; (55.6-68.3); Cape Lopez, French Congo; 63M; 10 VIII 27. BMNH 1935.5.11:230; Paratype; (39.0); ANGOLA. 64M. 04 VIII 27. IRSNB 16808-407; Paratype (66.3); 05°56'S 12°00'E; 60M; 14 XI 48.

Figure 18. Geographic distribution of *Symphurus normani* and *S. trewavasae*.



Atlantic 1-3-3 Species

Symphurus trewavasae Chabanaud

(Fig. 45B)

Symphurus plagiusa

Regan 1914: 23. Specimens formed in part the basis of *S. trewavasae*.

Lazzaro 1973: 245; Argentina; Misidentification.

Roux 1973: 176. Southern Brazil.

S. trewavasae

Chabanaud 1948a: 508. Original description; Cabo Frio, Brazil.

Ginsburg 1951: 185. Briefly mentioned in comparison with *S. plagiusa*.

Menezes and Benvegnu 1976: 144; Redescription, photograph, diagnosed from *S. plagiusa*, ecological notes.

Study Material: 58 Specimens, 52.5-131 mm SL. 54 x-rayed, 20 measured.

Remarks

Symphurus trewavasae was described by Chabanaud (1948: 508) from Cabo Frio, Brazil. In his revision of western Atlantic species, Ginsburg (1951: 185) briefly compared this species with *S. plagiusa* and suggested that possibly *S. trewavasae* was not distinct from *S. plagiusa*. He noted that differences in eye sizes between these species, considered diagnostic by Chabanaud (1948), were not always successful in separating the two species.

Ginsburg noted that the species, although overlapping somewhat in meristics, had modal differences in counts, however, Ginsburg did not directly examine any S. trewavasae and suggested that the two species should be directly compared in greater detail.

Menezes and Benvegnu (1976: 145) studied the two nominal species and concluded that two distinct species were represented. They pointed out several differences between the species noting that S. trewavasae had more dorsal and anal rays, more rows of scales, a shorter gape and a larger eye. They noted that the most significant differences occurred in pigmentation patterns and depth ranges. Symphurus plagiusa has a characteristic large black spot on the upper part of the opercle which is never present in S. trewavasae. Menezes and Benvegnu pointed out that there were also differences in maximum sizes attained by both species. Symphurus plagiusa reaches sizes of 109-166 mm and these sizes exceed that for S. trewavasae (largest size reported 139 mm). Size differences between the two species are also reflected in relative sizes at first maturity. Symphurus trewavasae matures at approximately 80 mm SL (see below); S. plagiusa matures at approximately 110 mm SL (see descriptive account for this species).

There are further differences in the ecology of the two species. Symphurus plagiusa is a shallow water tonguefish commonly found in inshore, estuarine areas and shallow coastal waters at depths between 1 and 28 meters. According to Topp and Hoff (1972) the usual bathymetric limit for the species is about 6 meters. The smallest (<25 mm SL) S. plagiusa are commonly taken in extremely shallow tidal creeks (Wyanski, pers. commun.).

In comparison, _S. trewavasae_ occurs in deeper waters on the inner continental shelf at depths between 12 and 190 meters with a center of abundance concentrated mostly between 40 and 110 meters (Menezes and Benvegnu 1976). Menezes and Benvegnu noted that even the smallest specimens of _S. trewavasae_ are found in relatively deep waters (12 to 38 meters). Also, both young and adult specimens occur sporadically in deeper waters (120-190 meters). It is clear from the above information that _S. plagiusa_ and _S. trewavasae_ are distinct species that are quite different in meristics, morphometrics and ecology.

Menezes and Benvegnu were convinced that _S. plagiusa_ does not occur along the Brazilian coast and that all the references to this species in this area or even further south were probably based on specimens of _S. trewavasae_. Therefore, reports of _S. plagiusa_ by Roux (1973: 176) from southern Brazil and by Lazzaro (1973) from Argentina are, in all probability, referrable to _S. trewavasae_.

Diagnosis

A medium-sized tonguefish with the unique combination of a 1-3-3 ID pattern, 10 caudal rays, unpigmented peritoneum, and without a pupillary operculum. It is one of two Atlantic species (_S. normani_ is the other) characterized by a 1-3-3 ID pattern. Among other species with a 1-3-3 ID pattern, _S. trewavasae_ is similar in meristics to the eastern Atlantic _S. normani_ and the eastern Pacific _S. atramentatus_. It is readily distinguished from _S. normani_ by caudal ray count (10 vs. 12), and the absence of scales on the blind side dorsal and anal fins (present in _S._

normani), and pigmentation patterns (sharply-contrasting crossbanding in S. trewavasae vs. little or faint crossbanding in S. normani). Symphurus trewavasae may be distinguished from S. atramentatus by caudal ray count (10 vs. 12) and lower counts (dorsal rays 87-94 vs. 92-96; anal rays 73-78 vs. 77-81), especially vertebrae number (48-49 vs. 50-52).

Among Atlantic tonguefishes not possessing a 1-3-3 ID pattern, S. trewavasae overlaps in meristics several 1-3-2 ID pattern species, including S. nigrescens, S. piger, S. pusillus, S. ginsburgi, and undescribed species C. It is readily distinguished from all of these by caudal ray count (10 vs. 12), ID pattern (1-3-3 vs. 1-3-2), and peritoneum pigmentation (unpigmented vs. black).

Among 1-4-2 ID pattern species, S. trewavasae partially overlaps S. kyaropterygium in some meristics (caudal rays, vertebrae), but may easily be distinguished from this species in several characters, including ID pattern (1-3-3 vs. 1-4-2 in S. kyaropterygium); pupillary operculum and membrane ostia (both well-developed in S. kyaropterygium and absent in S. trewavasae); pigmentation pattern (S. trewavasae is banded without a dark brown caudal blotch while in S. kyaropterygium bands are not usually present and there is a well-developed caudal blotch); and finally, S. trewavasae has higher numbers of dorsal (88-94 vs. 83-87) and anal rays (73-78 vs. 67-72).

Symphurus trewavasae also overlaps meristics of several 1-4-3 species including S. civitatium, S. diomedeanus, S. plagiusa and S. plagusia. It differs from all of these species in ID pattern (1-3-3 vs. usually 1-4-3) and has fewer caudal rays (10) than S. civitatium and S. plagusia (caudal rays 12). Symphurus trewavasae differs also from these two species and S.

diomedeanus in possessing more extensive dentition (S. trewavasae has well-developed teeth on the ocular side lower jaw and teeth present over half of the ocular side upper jaw vs. teeth usually absent or few on both ocular side jaws in S. civitatium, S. plagusia and S. diomedeanus). Symphurus trewavasae may be further distinguished from S. diomedeanus in that this species lacks a pupillary operculum (vs. well-developed in S. diomedeanus) and S. trewavasae lacks spotting on the dorsal and anal fins (usually well-developed in S. diomedeanus).

As mentioned above, Symphurus trewavasae is similar in body size and some meristics to the North Atlantic S. plagiusa. It differs from this species in having higher meristics (dorsal rays 88-94 vs. 83-91; anal rays 73-78 vs. 67-75; vertebrae 47-51, usually 48-49 vs. 45-49, usually 45-48); S. trewavasae also lacks scales on the blind side dorsal and anal fins (present in S. plagiusa). The two species have quite distinct pigmentation patterns (crossbanding without opercular spot in S. trewavasae vs. uniform coloration or occasional banding with well developed black pigment spot on the operculum in S. plagiusa).

Description

A medium-sized tonguefish attaining maximum sizes of about 139 mm SL. ID pattern usually 1-3-3, less frequently 1-4-2 (Table 9). Caudal rays 10 (Table 10). Dorsal rays 87-94 (Table 11). Anal rays 73-78 (Table 12). Vertebrae 46-51, usually 48-49 (Table 13). Hypurals 4. Longitudinal scale rows 67-80, usually 73-80 (Table 14). Lateral scale rows 31-37, usually 32-35 (Table 15). Scale rows on head posterior to lower orbit 15-20, usually 15-18 (Table 16). Proportional measurements appear in Tables 50-51.

Body moderately deep (depth 26.7-41.9% SL); maximum depth occurs from region of anal ray 10 to the mid-point of the body. Head moderately wide (20.6-26.0% SL); snout relatively short, rounded (18.1-26.3% HL), covered with small ctenoid scales. Dermal papillae evident but not highly developed on blind side snout. Posterior extension of maxilla reaches to about the forward edge of the pupil of the lower eye. Eyes relatively large 11.4-16.2% HL; usually equal in position or occasionally with upper eye slightly in advance of lower. Anterior surfaces of eyes and narrow interorbital space covered with 4-6 small ctenoid scales. Pupillary operculum absent. Dorsal fin origin usually at a vertical equal to front margin of upper eye, occasionally slightly anterior to upper eye. Scales absent on dorsal and anal fins.

Teeth well-developed on blind side jaws. Lower jaw on ocular side with slender teeth covering entire margin of dentary; upper jaw on blind side with small number or slender teeth on anterior one-half to one-third of premaxilla.

Table 50. Summary of morphometrics expressed in thousandths of Standard Length, except Standard Length (in mm), for *Symphurus trewavasae*.

Character	N	RANGE	MEAN	SD
SL	20	69.1-131.0	107.3	17.17
BD	19	267-419	307.9	31.01
PDL	20	36-50	41.4	4.25
PAL	20	184-243	217.1	15.05
DBL	20	952-969	959.6	4.35
ABL	20	757-812	783.1	15.56
PL	18	57-80	68.8	6.29
PA	20	37-83	60.8	12.76
CFL	19	83-129	114.2	13.70
HL	20	154-197	182.0	10.62
HW	20	206-260	227.2	15.92
POL	20	106-132	118.7	8.41
SNL	20	28-48	37.6	4.95
UJL	20	34-45	39.8	3.08
ED	20	20-28	23.8	2.13
CD	19	31-47	41.0	4.45
UHL	19	122-199	151.3	20.28
LHL	19	73-123	100.8	13.89

Table 51. Summary of morphometrics expressed as thousandths of Head Length (except HW/HL) for *Symphurus trewavasae*.

Character	N	RANGE	MEAN	SD
HW/HL	20	1.04-1.49	1.2	0.10
POL	20	613-696	651.7	25.95
SNL	20	181-263	206.0	22.84
UJL	20	186-250	218.8	17.72
ED	20	114-162	130.6	12.67
CD	20	159-264	227.2	26.08
OPLL	19	216-419	293.6	46.52
OPUL	19	159-297	227.3	38.54
UHL	19	682-960	817.7	80.69
LHL	19	363-736	548.1	87.74

Pigmentation

Eyed surface usually light brown with 3-7 (usually 3-5) complete, sharply-contrasting, dark brown crossbands. Bands not continued onto dorsal and anal fins. Crossbands on head and posteriormost body usually faint and sometimes incomplete but usually visible. The first conspicuous band crosses the body at the level of the operculum. In most specimens body usually with three conspicuous crossbands situated between the posterior part of the head and the caudal region. Outer operculum with small cluster of brown speckles near ventral margin (remnants of incomplete band?). Inner operculum of both sides occasionally lightly pigmented. Isthmus unpigmented. Slight moustache on ocular side upper lip; lower lip usually lightly spotted, but without definite moustache. Blind side a uniform creamy white. Peritoneum unpigmented.

Dorsal and anal fin rays faintly pigmented with light brown pigment, heaviest on proximal half of rays. Caudal fin usually pale, occasionally scales covering caudal base darker brown in color than distal portion of caudal fin rays.

Geographic Distribution (Fig. 18).

Symphurus trewavasae occurs in the western South Atlantic from southeastern Brazil to Argentina (Menezes and Benvegnu 1976). The northernmost record for this species ($22^{\circ}53'$S) roughly corresponds to Cabo Frio, Rio de Janeiro. The specimen described by Lazzaro (1973) from Argentina is also referrable to this species.

Bathymetric Distribution

Symphurus trewavasae occurs at moderate depths (40-110 m) on the open continental shelf (Menezes and Benvegnu 1976). Since all size classes are found at these depths, it is not likely that the species utilizes shallow inshore habitats as nursery grounds. Summarized depth of capture information from Menezes and Benvegnu (1976) reveals that 44/52 (85%) of the specimens they examined were taken at depths between 50-100 m. The deepest capture reported was for a single specimen collected at 179 m. Only three specimens were taken shallower than 40 m.

Size and Sexual Maturation

Symphurus trewavasae is a medium-sized tonguefish. Menezes and Benvegnu (1976) reported a maximum size of 139 mm SL. The largest specimens examined in this study were males measuring 124, 125 and 131 mm SL and a female at 123 mm SL. Males in the present study ranged in size from 52.5-131 mm SL; measured females were only slightly smaller, ranging from 63.7-123 mm SL.

Based on the reproductive stages of females, this species attains sexual maturity at approximately 80 mm SL. Females examined in this study ranged in size from 63.7-123 mm SL. The smallest gravid female was 78.3 mm SL. All females over 80 mm SL had fully elongate gonads and were either gravid or spent. Females ranging in size from 63.7-74.7 mm SL were ripening. Two females, 69.0 and 78.0 mm SL, were immature.

Little else is known of the biology of this species.

Material Examined 51 Specimens, 10 Lots.

BMNH 1913.12.4:264; Holotype; (117); Brazil; 73M. BMNH 1913.12.4:265-273; Paratypes; 9(59.5-112); 73M. MNHN 50-69; Paratype; (106); Brazil; 73M. MNHN 1975-272; 4(102-124); Brazil; 69M. MNHN 1975-271; 6(78.3-131); Brazil; 66M. MZUSP 12457-468; 12(52.5-119); 34°11'S 52°19'W; 58M; 16 I 72. MZUSP 12476-77; 2(124-125); 29°33'S 48°57'W; 96M; 06 IV 72. MZUSP 12485-89; 5(66.7-113); 33°50'S 51°51'W';65M; 19 IV 72. MZUSP 12498-500; 3(114-125); 35°11'S 52°47'W; 97M; 30 X 72. MZUSP 12829; 8(54.8-119); Brazil. FURG UNCAT; 2; 32°09'S 51°55'W; 14M; 01 IX 82.

CHAPTER 6.5

Species with a 1-4-2 ID Pattern

Symphurus kyaropterygium Menezes and Benvegnu 1976

(Fig. 46A)

S. parvus

Roux 1973: 175; (Not of Ginsburg, 1951: 192).

S. kyaropterygium

Menezes and Benvegnu 1976: 140; Original description with photograph; Brazil; 26°34'S 48°10'W; 52M; 14 V 75; Holotype MZUSP 12425; (119 mm SL).

Remarks

Menezes and Benvegnu (1976) regarded the presence of membrane ostia as a unique character separating *S. kyaropterygium* from all species in the genus. Three other species (*S. minor*, *S. parvus* and *S. ommaspilus*) have also been found to possess membrane ostia. Interestingly, all four species share a common ID pattern (1-4-2). The possession of these two synapomorhies indicate that these four species comprise a distinct assemblage within the genus. In addition to the two characters mentioned above, these species share other characters in common including caudal ray count (10), similar, low meristics and all have a well-developed pupillary operculum. Three of the four (not S. ommaspilus) share a similar pigment pattern with a prominent, dark brown blotch on the caudal region of the body. The caudal blotch is lacking in S. ommaspilus, instead this species has a single ocellated spot on the dorsal and anal fins.

Study Material: 14 specimens, 31.9-120 mm SL. 14 x-rayed, 12 measured.

Diagnosis

The presence of a 1-4-2 ID pattern, membrane ostia, 10 caudal rays and a pupillary operculum separates S. kyaropterygium from all other species in the genus except the other three members of this species group. With respect to fin ray and vertebrae counts and the presence of a pigment blotch near the caudal fin base, S. kyaropterygium is more closely related to the north Atlantic S. parvus than to the other two species. Symphurus kyaropterygium can be distinguished from S. parvus, however, by differences in modal distributions of meristic characters (see Figs. 19-21 for frequency histograms of meristics for 1-4-2 ID pattern species). Symphurus kyaropterygium has higher counts including higher dorsal and anal fin ray counts (dorsal rays 83-87 vs. 75-86; anal rays 67-72 vs. 60-70) and a higher number of scale rows (73-81 vs. 59-78, but usually 59-74 in S. parvus). There are also differences in maximum sizes attained by both species. Symphurus parvus is a smaller species reaching a maximum size of about 88 mm SL and individuals as small as 35-50 mm SL are sexually mature (Fig. 23). This contrasts with S. kyaropterygium where comparatively larger sizes (85 mm SL or larger) are necessary before maturity is reached.

Meristic differences between S. *kyaropterygium* and the Caribbean S. *ommaspilus* and North Atlantic S. *minor* are even more distinct (see Figs. 19-21) and additionally, S. *kyaropterygium* is a much larger than these two diminutive flatfishes. *Symphurus kyaropterygium* reaches lengths of 120 mm SL while the other two species are considerably smaller (60 mm SL, S. *ommmaspilus* and 71 mm SL, S. *minor*).

Description

A medium-sized tonguefish attaining a maximum length of approximately 120 mm SL. ID pattern 1-4-2 (Table 9). Caudal rays 10 (Table 10). Dorsal rays 83-87 (Table 11). Anal rays 67-72 (Table 12). Vertebrae 47-49, usually 47-48 (Table 13). Hypurals 4. Longitudinal scale rows 73-81 (Table 14). Scale rows on head posterior to lower orbit 16-18, usually 16-17 (Table 15). Lateral scale rows 36-39 (Table 16). Proportional measurements appear in Tables 52-53.

Body relatively deep (depth 24.4-31.9% SL); maximum depth in anterior third of body. Head relatively wide (20.8-25.3% SL); snout relatively short, somewhat rounded (14.9-19.5% HL), covered with small ctenoid scales. Dermal papillae well developed in larger specimens but poorly developed in smaller individuals. Dermal papillae present on blind side snout, chin and dorsal region of the head preceding dorsal fin. On the ocular side, dermal papillae extend onto the snout, almost to the level of the eyes. Mouth small, the gape very short, equal to the length of the snout; posterior extension of the maxilla extends to, but not usually beyond, the region of the anterior border and the anterior margin of the pupil of the lower eye.

Table 52. Summary of morphometrics expressed in thousandths of Standard Length, except Standard Length (in mm), for *Symphurus kyaropterygium*.

Character	N	RANGE	MEAN	SD
SL	12	31.9-119.6	93.4	23.46
BD	12	244-319	298.7	18.87
PDL	12	28-46	35.5	5.49
PAL	12	174-232	209.8	14.50
DBL	12	954-978	964.2	6.77
ABL	12	751-809	783.4	19.05
PL	10	59-85	70.8	7.05
PA	11	45-78	58.4	12.22
CFL	11	92-119	107.3	7.63
HL	12	156-210	192.3	15.23
HW	12	208-253	235.2	12.86
POL	12	105-142	127.4	10.54
SNL	12	26-40	32.8	4.45
UJL	12	29-47	37.2	4.75
ED	12	22-34	27.2	3.13
CD	12	29-49	40.6	5.92
UHL	12	130-175	151.8	14.30
LHL	12	82-115	100.8	9.81

Table 53. Summary of morphometrics expressed in thousandths of Head Length (except HL/HW) for *Symphurus kyaropterygium*.

Character	N	RANGE	MEAN	SD
HW/HL	12	1.04-1.35	1.2	0.09
POL	12	624-706	663.2	24.24
SNL	12	149-195	170.5	17.28
UJL	12	151-227	192.1	17.55
ED	12	117-164	139.8	14.29
CD	12	165-260	211.7	29.66
OPLL	12	179-370	298.4	46.78
OPUL	12	166-294	213.0	35.71
UHL	12	672-890	791.6	67.61
LHL	12	388-642	527.6	67.20

Eyes relatively large (11.7-16.4% HL), about equal to the length of the short snout, usually equal in position, although occasionally upper eye situated slightly more anterior than lower. Eyes with 4-8 small ctenoid scales on the upper surfaces; with 1-3 scales in narrow interorbital space. Pupillary operculum well-developed. Dorsal fin origin usually at a vertical equal to anterior margin of upper eye; occasionally extending slightly anterior of forward margin of upper eye. Dorsal fin membrane, from about the seventh ray backward, with a series of orifices in its basal part. Anal fin membrane along basal part also with perforations extending for the entire length of the fin.

Scales moderate in size; ctenoid; with cteni about equally developed on both sides of fish.

Teeth well developed on blind side jaws. Lower jaw on ocular side usually with a single row of small teeth extending over anterior three-fourths or occasionally covering entire dentary. Eyed side upper jaw with teeth arranged in a single row usually extending to the midpoint of the premaxilla or occasionally reaching slightly posterior to the midpoint of the premaxilla.

Pigmentation

Eyed surface generally light brown, often mottled with diffuse areas of darker brown pigment. Scale margins highlighted with darker brown pigment. The most conspicuous pigmentation on the body is a large and vertically elongated dark brown spot, approximately 5-7 scale rows in length and 7-9 scale rows wide, situated 3-5 scale rows in front of the caudal fin base.

Operculum not pigmented other than general body color. Inner operculum and isthmus not pigmented. Slight moustache on the ocular side upper lip; lower lip infrequently spotted. Blind side white. Peritoneum unpigmented.

No defined pigmentation patterns in the vertical fins, but with rays variously pigmented, becoming darker in posterior third of body. Caudal fin generally pale; the basal portion with scales more darkly pigmented than the distal, scaleless half of fin.

Size and Sexual Maturation

Symphurus kyaropterygium is a medium-sized tonguefish attaining maximum lengths of about 120 mm SL. It is infrequently collected and thus little is known regarding aspects of its life history. Of 12 specimens examined in this study, the largest three (120, 110 and 106 mm SL) were males. The largest female measured 106 mm SL and appeared to be gravid. Two smaller females, 74.1 and 85.9 mm SL, had elongate ovaries that contained only unripened ova. From these brief observations, it would appear that this species attains sexual maturity at a size of approximately 90 mm SL.

Geographic and Bathymetric Distributions (Fig. 22).

Symphurus kyaropterygium inhabits inner continental shelf waters along the coast of southern Brazil (Menezes and Benvegnu 1976). It has been collected only in the western South Atlantic from Baia da Ilha Grande, Rio de Janeiro (about 23°S, 44°30'W) to Rio Grande do Sul (31°24'S; 50°36'W).

Based upon the limited number of specimens collected thus far, it appears that this species inhabits open shelf waters between 36-69 meters. In the South Atlantic, the depth range inhabited by S. kyaropterygium partially overlaps that of S. trewavasae (see bathymetric distribution under account of S. trewavasae) but since so few S. kyaropterygium are available for analysis, it is difficult to estimate the degree of overlap between these two species. Symphurus trewavasae ranges into deeper water.

Material Examined

Counted and Measured 12 Specimens, 9 Lots.

MZUSP 12425; Holotype (119); 26°34'S 48°10'W; 52M; 14 V 75. MZUSP 12783; Paratype; (31.9); Baia de Ilha Grande, Brazil; May, 1966. MZUSP 12784; Paratype; (85.9); Ilha de Sao Sebastiao, Brazil; Oct. 1925. MZUSP 12913; Paratype; (92.7); 24°57'S 45°32'W; 61M; 26 II 75. MZUSP 12914-915; Paratypes; (86.3-94.7); 25°33'S 46°42'W; 55M; 17 V 75. MNHN 1975-264; 2(74.1-106); 23°26'S 44°36'W; 36M; 09 XII 61. MNHN 1975-266; Paratype; (96.5); 24°34'S 46°31'W; 45M; 14 XII 61. MNHN 1975-267; Paratype; (117); 31°24'S 50°36'W; 66M; 17 XII 61. MNHN 1975-268; 2(106-110); 31°24'S 50°36'W; 69M; 29 XII 61. Counted : MNHN 1975-265; Paratypes; 2(96.0-116); 24°18'S 45°22'W; 66M; 11 XII 61.

Figure 19. Frequency histogram for the number of dorsal rays occurring in four species with a 1-4-2 ID pattern.

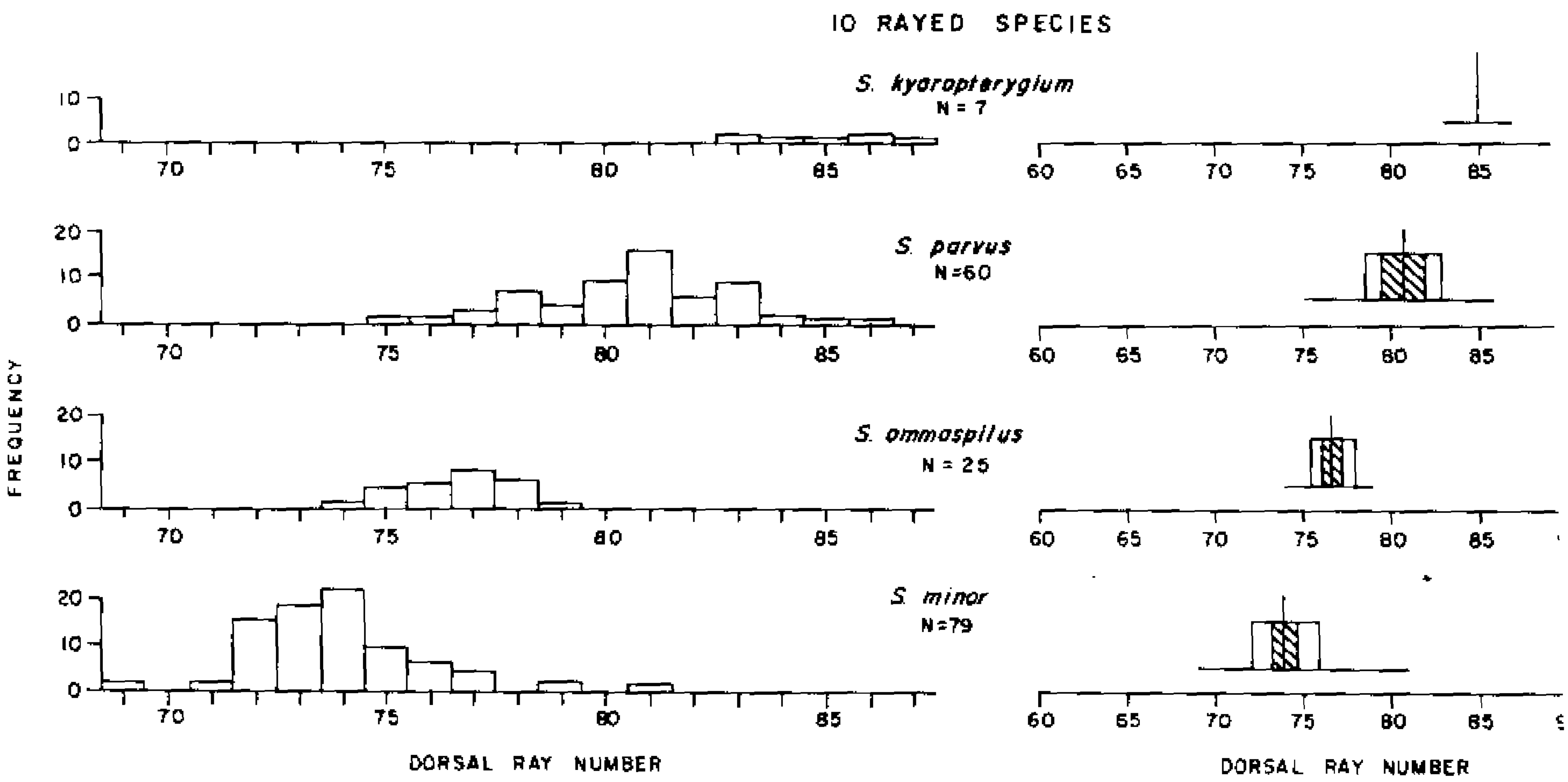

10 RAYED SPECIES
S. kyaropterygium
N = 7
S. parvus
N=60
S. ommaspilus
N = 25
S. minor
N=79
FREQUENCY
DORSAL RAY NUMBER
DORSAL RAY NUMBER

Figure 20. Frequency histogram for the number of anal rays occurring in four species with a 1-4-2 ID pattern.

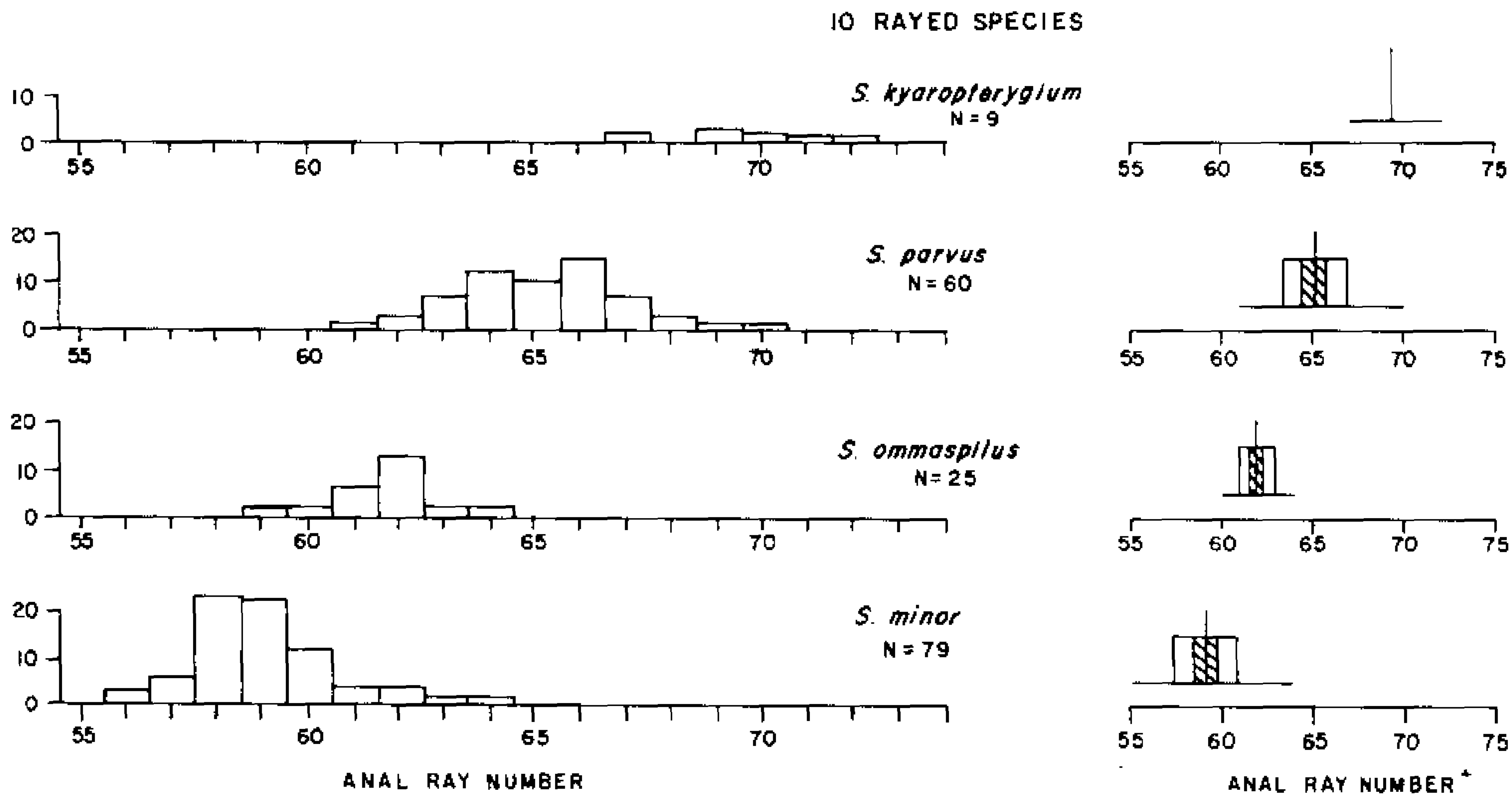
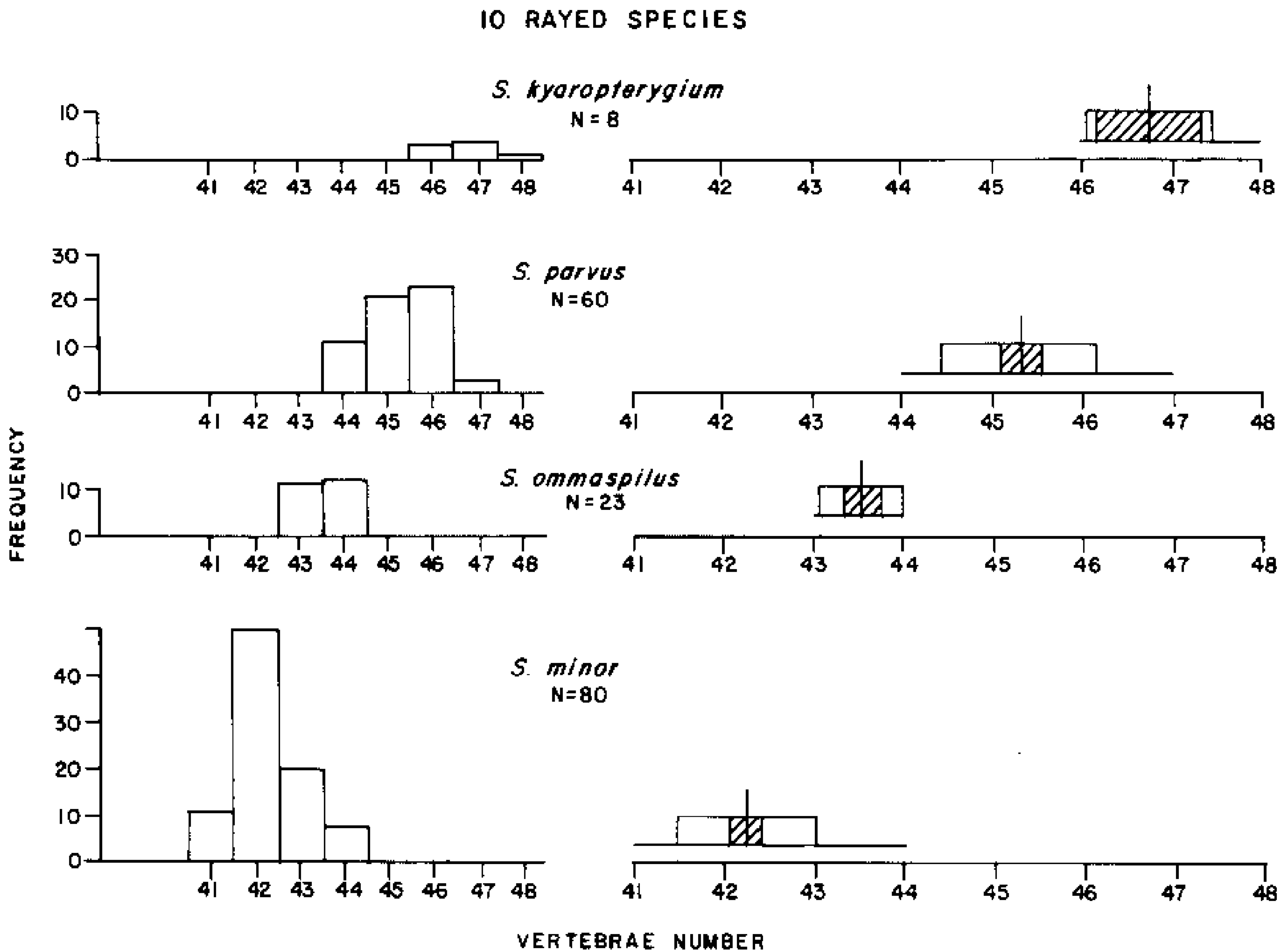

10 RAYED SPECIES
S. kyaropterygium
N = 9
S. parvus
N = 60
S. ommaspilus
N = 25
S. minor
N = 79
0
10
20
55
60
65
70
75
ANAL RAY NUMBER
ANAL RAY NUMBER +

Figure 21. Frequency histogram for the number of vertebrae occurring in four species with a 1-4-2 ID pattern.



10 RAYED SPECIES
S. kyaropterygium
N = 8
S. parvus
N=60
S. ommaspilus
N=23
S. minor
N=80
FREQUENCY
VERTEBRAE NUMBER

Symphurus minor Ginsburg 1951

(Fig. 46B)

Largescale Tonguefish

Aphoristia pigra

Goode and Bean 1886: 154 (in part); Specimens from *Albatross* Station 2374 might be the same specimens included in the original description of *A. pigra*.

?*Symphurus pusillus*

Kyle 1913: 145; Description and figure of symmetrical larva possibly of this species.

Symphurus minor

Ginsburg 1951: 192; Original description with photograph.

Briggs 1958: 298; Distribution listed for Florida.

Topp and Hoff 1972: 83; Distribution and ecological information; west Florida shelf.

Markle et al. 1980: 59; Capture of single larva on Nova Scotian shelf.

Miller and Jorgenson 1973: 305; Meristics for two specimens (included vertebrae counts).

Remarks

The specimens from Albatross Station 2374 (USNM 131590-91) might be the same as were included in the original account of S. piger as noted above under that species. In the original description, Ginsburg referred to the paratype from Albatross Station 2372 as USNM 131593. The actual catalog number is USNM 131293 (USNM 131593 is assigned to a lot containing Jenkinsia lamprotaenia).

The larval specimen described by Kyle (1913) could possibly be a specimen of S. minor but since little is known about the larval stages of this species the specific identity of this specimen can not be determined with accuracy at this time.

Study Material: 79 specimens, 22.6-70.6 mm SL. 78 x-rayed, 31 measured.

Diagnosis

This species differs from all others in the genus in its combination of 10 caudal rays, 1-4-2 ID pattern, presence of a well-developed pupillary operculum, possession of membrane ostia, and low meristics. It overlaps and intergrades widely with S. arawak, S. ommaspilus and S. parvus in meristic characters. It is closely related to S. parvus and S. ommaspilus, agreeing with them in possessing 10 caudal rays, membrane ostia, well developed pupillary operculum and a 1-4-2 ID pattern.

Symphurus minor overlaps both *S. parvus* and *S. ommaspilus* in most meristics. Frequency histograms of meristics for the four species with a 1-4-2 ID pattern are presented in Figures 19-21. Based on overall similarity, including meristics, ecology and pigmentation, *S. minor* is most similar to *S. parvus* but may be distinguished by its modally lower counts (vertebrae 41-43 vs. 44-46; dorsal rays 69-81 vs. 75-86; and anal rays 56-64 vs. 60-70). Also, its size averages somewhat smaller than *S. parvus* (see Fig. 23 for a comparison of sizes and maturity schedules for the 1-4-2 species) and *S. minor* generally occurs at shallower depths than *S. parvus* (see below).

The most notable differences between *S. ommaspilus* and *S. minor* are the pigmentation patterns for each species; *S. minor* lacks the single ocellated spots on the dorsal and anal fins which are present and quite conspicuous in *S. ommaspilus*. Additionally, *S. minor* has a large, irregularly-shaped dark brown blotch on the caudal portion of the body which is absent in *S. ommaspilus*.

This species is superficially similar to *S. arawak* in meristics but differs in many characters including caudal ray count (*S. minor* has 10 vs. 12 in *S. arawak*); ID pattern (1-4-2 vs. 1-3-2), pupillary operculum (present vs. absent); membrane ostia (present vs. absent); and body size. *Symphurus minor* is the larger of the two reaching lengths of approximately 71 mm SL while the largest *S. arawak* is only 49 mm SL.

Description

A diminutive species of tonguefish attaining maximum adult lengths of approximately 71 mm SL. ID pattern 1-4-2 (Table 9). Caudal rays 10 (Table 10). Dorsal rays 69-81, usually 72-77 (Table 11). Anal rays 55-64 (Table 12). Vertebrae 41-44, usually 41-43 (Table 13). Hypurals 4. Longitudinal scale rows 55-67 (usually 57-64) (Table 14). Scale rows on head posterior to lower orbit 12-15, usually 13-15 (Table 15). Lateral scale rows 24-31, usually 28-31 (Table 16). Proportional measurements appear in Tables 54-55.

Body deep (depth 20.7-32.4% SL); greatest depth in anterior third of body. Head relatively wide (19.8-25.6% SL); with relatively short snout (14.6-22.2% HL). Snout covered with small ctenoid scales. Posterior extension of maxilla reaches to front margin of pupil of lower eye; or occasionally to middle of lower eye. Eyes large 11.8-18.2% HL; usually equal in position. Eyes usually without scales; usually 2-3 small ctenoid scales in narrow interorbital space. Pupillary operculum well-developed. Dorsal fin origin usually at a vertical equal to mid-point of the upper eye or to forward margin of pupil of upper eye. No scales on blind side dorsal and anal fins. Dorsal and anal fins with membrane ostia present at proximal bases of fin membrane between fin ray bases.

Teeth well developed on blind side jaws. Teeth on eyed side lower jaw usually covering entire dentary, occasionally developed only over anterior three-fourths of dentary. A single row of slender teeth developed on anterior one-half to three-fourths (usually to the level of the anterior nostril) of ocular side premaxilla.

Table 54. Summary of morphometrics expressed in thousandths of Standard Length, except Standard Length (in mm), for *Symphurus minor*.

Character	N	RANGE	MEAN	SD
SL	31	22.6-70.6	48.1	14.79
BD	31	207-324	280.2	23.48
PDL	31	46-80	60.2	9.70
PAL	31	209-292	250.5	17.12
DBL	31	672-975	929.9	51.73
ABL	31	532-775	738.8	42.01
PL	28	51-88	74.4	7.68
PA	31	30-77	58.7	12.06
CFL	28	108-152	131.9	10.65
HL	31	200-247	222.6	10.73
HW	31	198-256	240.4	12.99
POL	31	120-154	142.6	8.61
SNL	31	33-50	42.8	4.11
UJL	31	40.56	44.8	4.62
ED	31	25-42	33.2	3.90
CD	31	32-56	43.2	6.65
UHL	31	136-166	152.0	9.10
LHL	31	66-131	105.8	13.88

Table 55. Summary of morphometrics expressed in thousandths of Head Length (except HL/HW) for *Symphurus minor*.

Character	N	RANGE	MEAN	SD
HW/HL	31	0.91-1.25	1.1	0.08
POL	31	580-704	641.5	29.66
SNL	31	146-222	193.1	18.60
UJL	31	172-247	214.9	17.46
ED	31	118-182	148.6	14.46
CD	31	145-263	194.6	30.40
OPLL	31	200-370	277.2	44.47
OPUL	31	132-265	206.1	29.60
UHL	31	569-810	684.8	57.95
LHL	31	313-586	476.5	65.85

Pigmentation

Eyed surface usually light brown with a variable number and arrangement of irregular dusky markings; sometimes body rather faintly cross-banded with dark brown bands. The bands diffuse, irregular, incomplete, often widely interrupted. Most often bands appear as two short bars placed on same vertical at dorsal and anal profile. One band at a moderate distance from caudal base often somewhat better developed than others. A well-developed dark brown blotch present a short distance before caudal fin base. This blotch usually 4-6 scales in length and 6-9 scales wide (usually reaching across entire body). Caudal blotch separated from caudal fin base by 3-4 lightly pigmented scales. Operculum not pigmented other than general body color. Inner lining of operculum and isthmus unpigmented. A small brown spot of variable intensity usually present in the angle of the opercle. A dark brown moustache usually well-developed on ocular side upper lip; moustache extends to angle of the maxilla; lower lip only infrequently lightly spotted but without definite moustache. Blind side white. Peritoneum unpigmented.

No defined pigmentation patterns in dorsal and anal fins. Fins rather lightly pigmented becoming increasingly darker posteriorly. Caudal fin base with a small darkly pigmented area on scale-covered portion. Caudal fin rays and membrane on blind side of caudal fin with pepper dot pigmentation. Distal portion of caudal fin not usually pigmented.

<u>Geographic Distribution</u> (Fig. 22).

<u>Symphurus</u> <u>minor</u> occurs in the western North Atlantic primarily on live bottom substrates along the southeastern coast of the United States and into the eastern Gulf of Mexico along the west Florida coast as far west as the region of DeSoto Canyon. Apparently, the advancement of this species into the central and western Gulf areas is prevented by the rapid change in sediments occurring in the region of the Mississippi outflow. As yet, this species has not been recorded from live bottom habitats in the western Gulf of Mexico or Yucatan Peninsula regions.

Along the Atlantic coast of the United States <u>S</u>. <u>minor</u> regularly occurs as far north as Cape Hatteras, North Carolina. There are at least two records, almost a hundred years apart, which record this species much further north. Ginsburg (1951) included three specimens in the type series for <u>S</u>. <u>minor</u> which wre collected off Nova Scotia (44°23'N). More recently, Markle et al. (1980) reported capturing a single larva in their ichthyoplankton work on the Scotian shelf. Such isolated occurrences of <u>S</u>. <u>minor</u> in these far northern regions represent expatriated individuals which were most likely transported northward by the Gulf Stream.

The majority of the specimens examined in the present study were collected from the southern tip of Florida and the west Florida shelf. The distribution of <u>S</u>. <u>minor</u> closely parallels that of <u>S</u>. <u>urospilus</u>, another live-bottom inhabitant.

Bathymetric Distribution

Symphurus minor has been collected on the open shelf over a relatively wide depth range from 11-146 m. However, the center of abundance for this species, based on the frequency of occurrence and the relative abundance of specimens, occurs at depths between 20-50 m. Data summarized in Table 56 indicate that 62/77 (80%) of the specimens were captured between 20-50 m. Only seven fish were collected shallower (11-20 m) and another six were collected deeper. The deepest capture reported for the species is for three specimens taken off the Nova Scotian shelf by the *Albatross* at 170 m.

It is interesting to note that this species co-occurs throughout its range in the southeastern United States with another member of the 1-4-2 ID pattern group (*S. parvus*) but the two species are not syntopic with respect to bathymetry. *Symphurus parvus* usually occurs much deeper (40-100 m) and the two are not frequently captured simultaneously. The regular occurrence *S. parvus* (based on frequency of captures) in deeper waters (usually with high mud component) than those normally occupied by *S. minor* clearly indicates that these otherwise closely related species have quite different ecological requirements. Each species appears to have a distinct preference for a specific substrate type (coralline sand vs. mud) or temperature regime (or both).

Table 56. Summary of depth of capture for 77 specimens of *Symphurus minor*.

Depth	11-20	21-30	31-40	41-50	51-60	61-70	170
Frequency	7	15	23	24	2	3	3

Size and Sexual Maturation (Fig. 23).

Symphurus minor is a diminutive species attaining lengths of only about 71 (this study) to 78 mm SL (Ginsburg 1951). The largest specimens in this study were females (68.1, 69.1, 70.2 and 70.6 mm SL). The largest males were only slightly smaller, measuring 63.3 and 64.4 mm SL, respectively. Most specimens ranged in size from 40-60 mm SL.

Based on the reproductive stages of females, it appears that this species matures at sizes between 29.0-40.0 mm SL. The smallest female with elongate gonads was 29.2 mm SL. The smallest gravid female measured 31.6 mm SL, but most gravid females were larger, ranging from 41.0-70.6 mm SL. All females larger than 40 mm SL had elongate ovaries. Several small females (33.8-38.1 mm SL) had gonads which were just undergoing elongation.

Based on gonad condition in females, spawning appears to take place during summertime. Most gravid females were collected from June-September. Ripening females appear in collections made from January to March. Females collected from November through early March had long thin gonads showing little evidence of gonad ripening. Topp and Hoff (1972) noted that specimens on the west Florida shelf collected in April had ripening gonads and the smallest specimens (11-13 mm SL) in their study were collected in July, August and November, indicating late spring or summer spawning.

Other ecological information on *S. minor* is wanting. Struhsaker (1969) reported the species as common (present in 10-50% of the trawling stations) along the open shelf of the southeastern United States. Topp and Hoff (1972) collected 14 specimens (11-70 mm SL) at water temperatures ranging from 18.5-23.3°C with salinities ranging from 35-36.5 o/oo.

Material Examined

Measured and Counted 31 Specimens, 21 Lots.

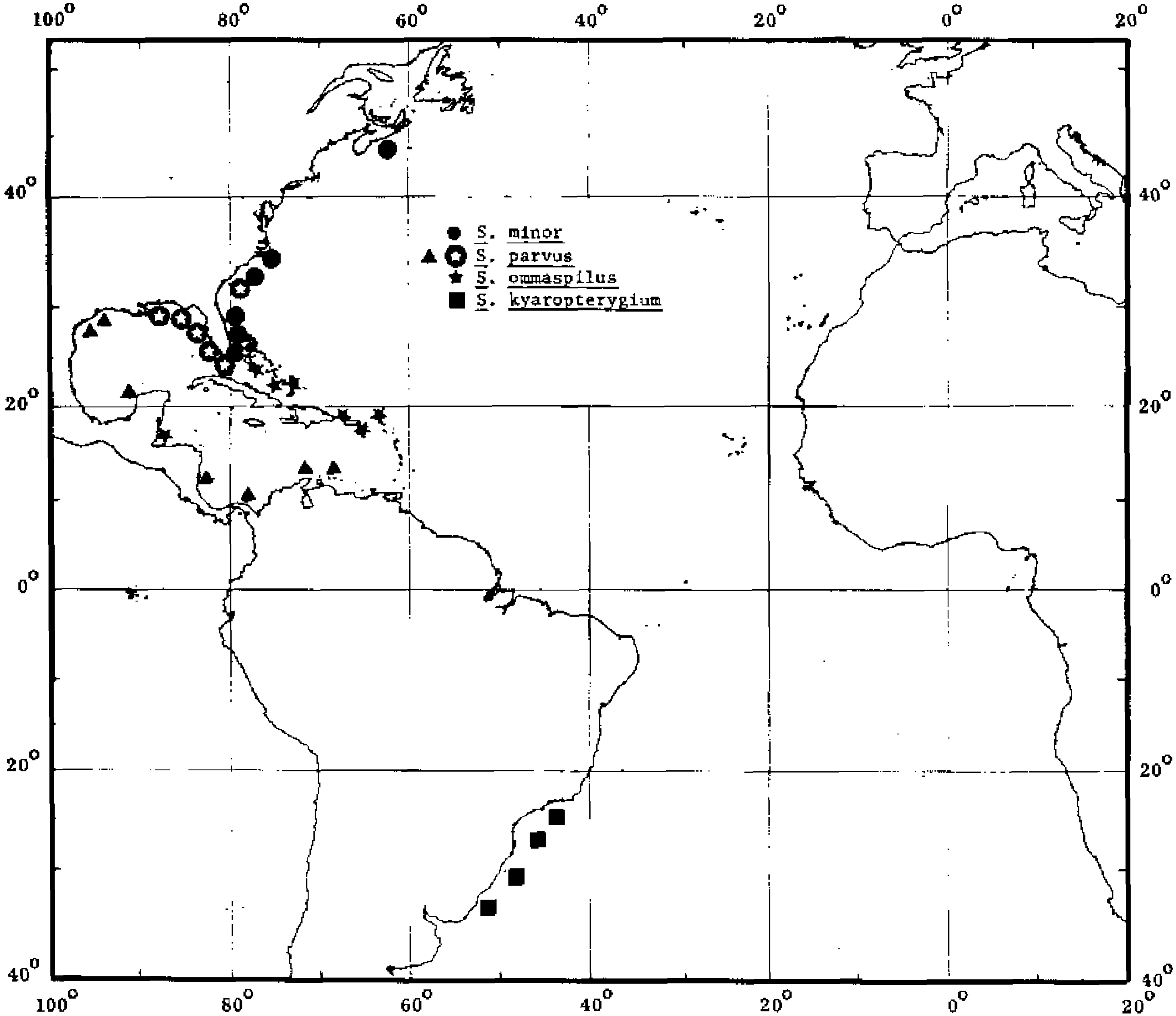
USNM 131643; Holotype (36.2); 28°46'N 84°49'W; 48M; 15 III 1885. USNM 152734; Paratypes; 2(23.9-33.6); 28°46'N 84°49'W; 48M; 15 III 1885. USNM 131591; Paratypes; 3(27.2-56.7); 29°11'30"N 85°29'W; 48M; 07 II 1885. USNM 134272; Paratype; (26.3); 34°26'N 76°12'W; 40M; 19 X 1885. USNM 131293; Paratype; (33.1); 29°15'30"N 82°29'30'W; 50M; 17 II 1885. USNM 92614; Paratypes; 3(22.6-47.3); 44°23'30"N 61°44'15"W; 170M; 07 VII 1885. GCRL V76.14893; 3(51.8-59.5); 16 mi. off Perdido Bay, FL; 22M; 14 IX 75. GCRL V81.17370; (69.1); 32°05'N 79°38'W; 39M; 17 II 77. GMBL 79-106; 2(63.0-63.1); 30°44.2'N 80°13.9'W; 45M; 01 V 79. ORII 10740; 2(55.4-61.7); 30°48'N 75°51'W; 33M; 30 VII 69. UF 24577; (48.4); 34°23'N 76°14'W; 26M; 23 VIII 77. UMML UNCAT GERDA 1237; (62.4); 24°47'N 82°58'W; 44M; 07 III 70. USA 1786; (52.3); 30°00'N 87°12'30"W; 29M; 22 IV 75. USA 1864; 2(47.3-49.9); 30°05'N 87°34'W; 26M; 21 IV 75. USA 1907; (55.4); 29°30'N 86°53'W; 20M. USA 2185; (54.4); 29°04'N 85°14'W; 38M; 25 VI 75. USA 3733; 2(34.7-70.2); 30°07'N 86°45'30"W; 46M; 08 III 77. USNM 155230; Paratype; (70.6); 31°40'N 80°24.5'W; 22M; 14 III 40. USNM 155232; Paratype; (64.5); 32°34.5'N 79°19.5'W; 31M; 09 III 40. UWF 2964; (35.6); 28°36'N 84°15'W; 37M; 29 VI 77.

Counted 48 Specimens, 32 Lots.

FDNR 2977; (44.7); West Egmont Key, FL; 25M; 17 XII 64. FDNR 5144; 2(26.6-39.3); 27°37'N 83°07'W; 18M; 02 XI 67. FDNR 6536; (31.6); 26°24'N 82°38'W; 48M; 05 III 81. FDNR 6540; (44.8); 26°24'N 82°38'W; 37M; 07 IV 67. FDNR 6542; (40.1); 27°37'N 83°28'W; 37M; 20 V 67. FDNR UNCAT MOTE 310.111 ST

16A; 2(56.6-56.7); 25°45.7'N 83°11.07'W; 54M; 02 XII 82. FDNR UNCAT MOTE 31093 ST 8; 2(63.7-65.5); 26°16.72'N 83°12.81'W; 48M; 05 III 81. GMBL 76-279; (42.3); 29°59'N 80°39'W; 35M; 17 IX 76. MCZ 58655; 2(43.2-46.2); 32°44.5'N 79°00.2'W; 24M; 24 III 72. ORII 21868; (42.2); 28°40'N 80°16'W; 35M; 05 IV 77. UF 20442; 2(54.6-58.8); 29°31'N 85°55'W; ca. 40M; 27 XI 69. UF/FSU 20904; 2(54.1-68.1); 30°06'N 86°25'W; 40M; 25 I 71. UF 20918; 4(46.1-64.2); 29°28'N 85°09'W; 20M; 06 IV 71. UF 20937; (48.2); 29°41.5'N 86°06'W; 49M; 09 VII 71. UF 21066; (57.1); 26°58.5'N 83°24.5'W; 49M. UF 21419; 2(50.5-64.4); 28°33'N 84°40'W; 61M; 01 XII 70. UF 21511; 3(53.7-61.5); 30°10'N 86°41.5'W; 36M; 21 VII 73. UF/FSU 21385; 2(47.2-47.8); 29°00'N; 86°38'W; 34M; 03 X 70. UMML UNCAT SB3182; (47.8); 29°58'N 80°33.5'W; 40M. UMML UNCAT SB3183; 2(41.4-48.0); 29°53.5'N 80°24.5'W; 46M; 08 VII 61. UMML UNCAT GERDA 1089; 2(49.6-69.5); 24°24'N 82°43'W; 51M; 27 IV 69. UNC 3913; (42.5); 33°42.2'N 76°41.9'W; 27 IV 65. USA 2140; (35.3); 29°50'N 86°06.5'W; 42M; 20 VII 75. USA 2989; 3(47.4-55.7); 30°10'N 87°05'W; 28M; 14 IX 75. USA 3727; (37.5); 30°06'N 86°44'30"W; 62M; 08 III 77. USNM 131590; Paratype; (29.2); 29°11'30"N 85°29'W; 48M; 07 II 1885. USNM 155231; Paratype; (44.9); 32°52'N 79°04'W; 20M; 12 II 40. USNM 155233; Paratype; (63.3); 31°46.4'N 79°47.5'W; 44M; 13 III 40. UWF 1321; (26.8); 26°25.5'N 82°59.5'W; 37M; 22 X 75. UWF 1468; (38.1); 29°49.9'N 86°05.1'W; 37M; 19 X 75. UWF 3714; (34.1); 29°45'N 86°00'W; 42M; 04 VI 78.

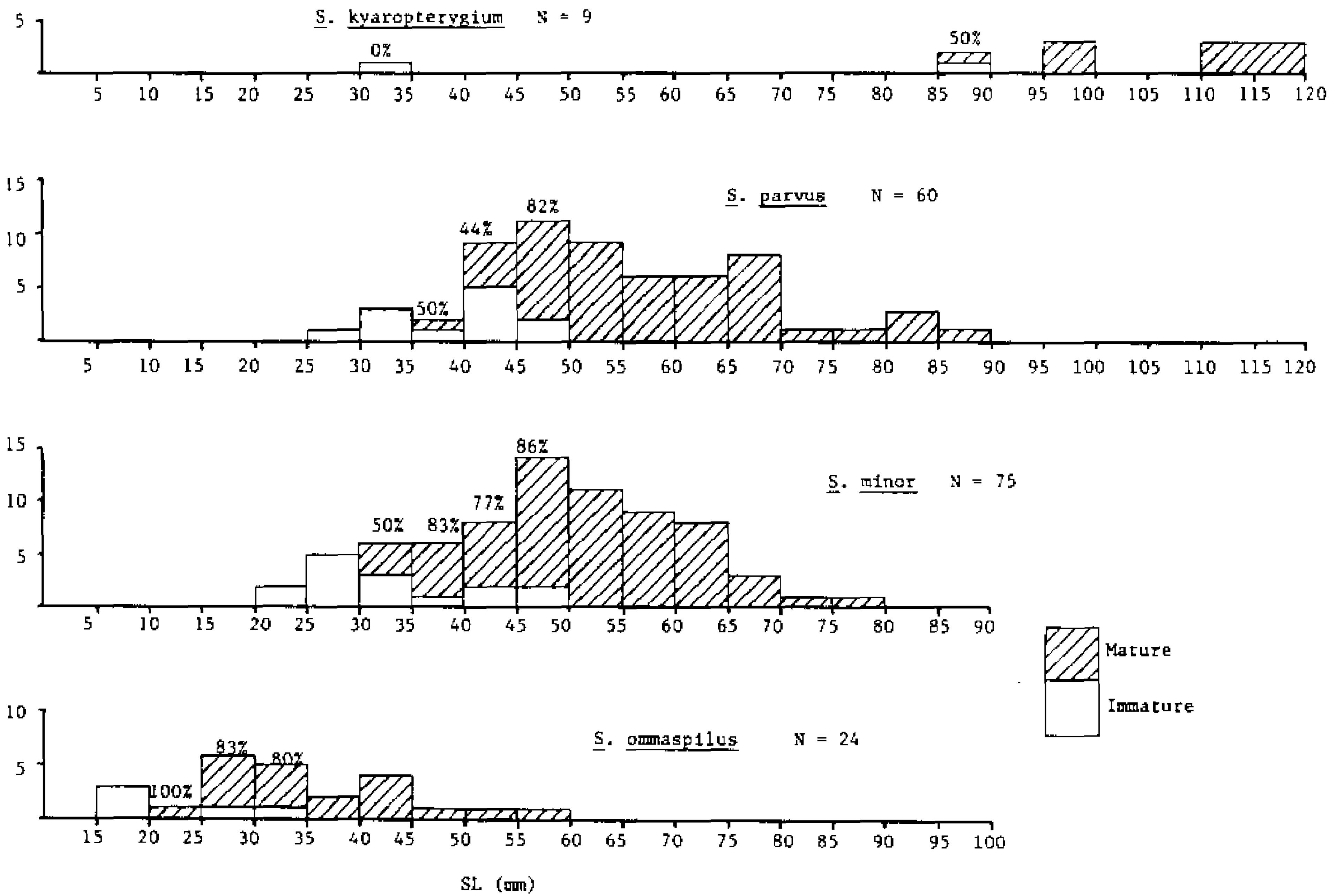
Figure 22. Geographic distribution of four 1-4-2 ID pattern species. Species are *Symphurus kyaropterygium*, *S. minor*, *S. ommaspilus* and *S. parvus*.



Atlantic 1-4-2 Species

Figure 23. Frequency histogram comparing maximum sizes and size of sexual maturation for four species with the 1-4-2 ID pattern.

1-4-2 Species



S. kyaroptervgium N = 9
0%
50%
S. parvus N = 60
44%
82%
50%
S. minor N = 75
86%
77%
50%
83%
S. ommaspilus N = 24
83%
80%
100%
Mature
Immature
SL (mm)

Symphurus parvus Ginsburg 1951

(Fig. 46C)

Pygmy Tonguefish

Aphoristia pigra

Goode and Bean (in part) 1886: 154; (Specimens from _Albatross_ Station 2318 and Station 2405 may have been this species).

Aphoristia diomedeana

Goode and Bean (in part) 1895: 460; Specimen from _Blake_ Station XXV examined.

Symphurus pusillus

?Kyle 1913: 145; Description and figure of symmetrical larva possibly of this species.

Symphurus parvus

Ginsburg 1951: 192; Original description and photograph.

Briggs 1958: 298; Listed Florida.

Topp and Hoff 1972: 85; Occurrence, distribution and ecology on west Florida shelf; some ecological information.

Remarks

Goode and Bean (1886) listed seven paratypes for *Aphoristia pigra*. Four were collected from *Albatross* Station 2318 and two were taken at Station 2405. Their study material, however, included specimens of at least two species as was pointed out by Ginsburg (1951). Ginsburg noted that the four specimens from *Albatross* 2318 designated as paratypes of *A. pigra* were actually *S. parvus*. Ginsburg designated three of these (USNM 74330) as paratypes of *S. parvus*. The fourth specimen, presently contained in the same bottle with the others, was not designated as a paratype because this specimen was on loan to P. Chabanaud of the Paris Museum and not included in the original account of *S. parvus*.

In his examination of the specimens comprising the original description of *A. pigra*, Ginsburg (1951) noted that he could not find any of the specimens from *Albatross* 2405. However, in his description of *S. parvus*, Ginsburg lists six specimens from *Albatross* 2318. These specimens are now catalogued with the following numbers: USNM 84491-one specimen; USNM 152733-one specimen; and USNM 74330-four specimens. Since only four specimens were originally collected from *Albatross* 2318 (as indicated by Goode and Bean), it is possible that the lots (USNM 84491 and USNM 152733) now catalogued separately (the specimens were originally in the same jar) may represent the two former paratypes of *A. pigra* from *Albatross* 2405. A check through the labels contained with the specimens and through museum registers at the USNM could not resolve this problem. It appears that if the labels with the specimens were mixed-up or the collection data for the specimens were mis-labelled, it happened before these specimens became part of the official USNM collection.

The result of this discussion is that if these two specimens, USNM 84491-now the holotype of S. parvus and USNM 152733-now a paratype of S. parvus were actually collected at Albatross 2405 instead of Albatross 2318 (as presently labelled), then the proper coordinates and collection information for the type locality of S. parvus are: 28°45'N 85°02'W; 55M; 15 III 1885 and not 24°25'45"N 81°46'W; 82M; 15 I 1885.

Study Material: 74 specimens, 21.8-87.3 mm SL. 67 x-rayed, 33 measured.

Diagnosis

This species is structurally nearest the south Atlantic S. kyaropterygium and the north Atlantic S. minor with which it is sympatric (though not syntopic) throughout most of its distribution. Symphurus parvus can be distinguished from both species on the basis of meristic characters (see Figs. 19-21 for frequency distributions of meristics for the four species with a 1-4-2 ID pattern). In comparison with Symphurus kyaropterygium, S. parvus has modally lower dorsal (75-86 vs. 83-87) and anal fin ray counts (60-70 vs. 67-72) and one less vertebrae (44-46 vs. 47-48). Symphurus parvus is considerably smaller than S. kyaropterygium with pronounced differences in both maximum size and size at sexual maturity attained by both species (see Fig. 23 for comparisons of size and sexual maturity). *Symphurus parvus* reaches a maximum size of about 87 mm SL and females mature at sizes ranging from 35-45 mm SL. In contrast, *S. kyaropterygium* reaches adult sizes of at least 110 mm SL and an 85.5 mm SL female had undeveloped ovaries indicating that this species reaches full maturity at comparatively larger sizes (ca. 90 mm SL) than *S. parvus*.

Symphurus parvus is similar in meristics, body size and pigmentation and is completely sympatric (but not syntopic) with *S. minor*. *Symphurus parvus* can readily be distinguished by its modally higher counts (vertebrae 44-46 vs. 41-43; dorsal rays 75-86 vs. 69-81; and anal rays 60-70 vs. 56-64). Also, *S. parvus* averages a somewhat larger size than *S. minor* (see Fig. 23). *Symphurus parvus* generally occurs at greater depths (and perhaps different substrates) than *S. minor* (see below). Overall though, these two species are quite similar in size, pigmentation and meristics.

Symphurus parvus is also similar in size and some meristics and partially overlaps the depth range of *S. pelicanus*. The differences, however, between *S. parvus* and *S. pelicanus* are considerable. In particular, *S. parvus* has 10 caudal rays (vs. 12), unpigmented peritoneum (vs. black peritoneum), ID pattern (1-4-2, or 1-5-2 vs. 1-3-2 in *S. pelicanus*), and *S. pelicanus* lacks membrane ostia and a pupillary operculum (both well-developed in *S. parvus*). The two species differ somewhat in body shape, *S. pelicanus* has a longer caudal fin and more slender body. There are differences in pigmentation between these species. The most obvious differences are the lack of a pepper-dot pattern on the blind surface of *S. parvus* (present in *S. pelicanus*) and the absence of a caudal blotch in *S. pelicanus* (well-developed in *S. parvus*).

Description

A diminutive species attaining maximum lengths of about 88 mm SL. ID pattern 1-4-2 or 1-5-2 (Table 9). Caudal rays 10 (Table 10). Dorsal rays 75-86 (Table 11). Anal rays 60-70 (Table 12). Vertebrae 43-47, usually 44-46 (Table 13). Hypurals 4. Longitudinal scale rows 59-78 (Table 14). Scale rows on head posterior to lower orbit 13-18, usually 15-16 (Table 15). Lateral scale rows 26-35, usually 29-34 (Table 16). Proportional measurements appear in Tables 57-58.

Body relatively deep, 24.8-32.8% SL; greatest depth in anterior third of body. Head relatively wide (21.1-27.9 % SL); with relatively short somewhat pointed snout (14.6-22.9% HL). Snout covered with small ctenoid scales. Posterior extension of maxilla reaches to front margin of lower eye or to middle of lower eye. Eyes relatively large (10.5-19.7% HL); usually equal in position. Ventral surface of upper eye and dorsal surface of lower eye covered with 4-8 small ctenoid scales; 1-4 small ctenoid scales in narrow interorbital space. Pupillary operculum well-developed. No scales on dorsal and anal fins. Dorsal and anal fins with membrane ostia present in proximal membrane at bases of fin rays.

Teeth on blind side jaws well developed. Teeth on eyed side very small. In upper jaw, teeth extend over anterior half or three-fourths of premaxilla (only rarely covering entire jaw); teeth in lower jaw extending over entire length, or less frequently, only covering anterior three-fourths of dentary.

Table 57. Summary of morphometrics expressed in thousandths of Standard Length, except SL (in mm), for *Symphurus parvus*.

Character	N	RANGE	MEAN	SD
SL	34	33.8-87.3	54.4	11.68
BD	34	248-328	295.3	16.73
PDL	34	36-69	53.8	7.22
PAL	34	211-305	249.4	21.54
DBL	34	931-964	946.4	7.24
ABL	34	702-795	758.2	21.19
PL	26	54-86	70.6	8.70
PA	34	38-71	55.2	8.21
CFL	30	112-151	129.2	9.29
HL	34	180-260	230.0	16.55
HW	34	211-279	250.5	14.16
POL	34	118-162	146.5	10.05
SNL	34	32-54	44.0	6.00
UJL	34	38-55	48.3	4.91
ED	34	27-44	35.1	4.24
CD	34	29-55	42.9	6.85
UHL	33	107-181	159.2	13.60
LHL	33	88-139	110.9	11.39

Table 58. Summary of morphometrics expressed in thousandths of Head Length (except HW/HL) for *Symphurus parvus*.

Character	N	RANGE	MEAN	SD
HW/HL	34	0.97-1.39	1.1	0.08
POL	34	595-688	637.7	23.82
SNL	34	146-229	191.9	19.30
UJL	34	185-252	210.1	16.87
ED	34	105-197	153.2	20.71
CD	34	123-263	187.0	31.45
OPLL	33	246-371	291.6	30.69
OPUL	33	102-246	176.9	31.70
UHL	32	410-943	684.0	94.94
LHL	32	398-614	482.6	49.06

Pigmentation

Eyed surface usually light brown or yellowish with a variable number and arrangement of irregular dusky markings; sometimes body rather faintly cross-banded with dark brown bands. The bands diffuse, irregular, incomplete, often widely interrupted. Most often remnants of bands appear as two pigmented areas on the same vertical at the bases of the dorsal and anal fins. The most conspicuous pigmentation is a well-developed dark brown, oblong blotch located a short distance before caudal fin base. This blotch usually 4-6 scales in length and 6-9 scales wide (usually reaching across entire body). Caudal blotch separated from caudal fin base by 3-4 lightly pigmented scales. Operculum not pigmented other than general body color. Inner lining of operculum and isthmus unpigmented. A small brown spot of variable intensity usually present in the angle of the opercle. A dark brown moustache usually well-developed on ocular side upper lip; moustache extends to angle of the maxilla; lower lip only infrequently lightly spotted but without definite moustache. Blind side white. Peritoneum unpigmented.

No defined pigmentation patterns in dorsal and anal fins. Fins rather lightly pigmented becoming increasingly darker posteriorly. Dorsal and anal fins lightly colored, irregularly flecked and shaded; flecks usually more dense in posterior third of fins. Caudal fin usually more darkly pigmented than vertical fins. A small diffuse spot on proximal region of fin that is covered with scales; the distal scaleless portion of the caudal fin usually completely pigmented to its extremity. Caudal fin rays and membrane on blind side of caudal fin with pepper-dot pigmentation.

Geographic Distribution (Fig. 22)

Although *Symphurus parvus* occurs in collections spanning a relatively wide geographic range in the western North Atlantic, the majority of specimens have been collected along the southeastern and southwestern coasts of Florida, including the Florida Keys and west Florida shelf (Topp and Hoff 1972) and from several localities in the Gulf of Mexico. Collections of this species in the open Atlantic, along the southeastern United States coast, have occurred most frequently at the tip of southern Florida and along the southeast coast of the Florida peninsula. North of the region of Palm Beach, FL this species has seldom been collected. Of the 74 *S. parvus* examined, only one (VIMS UNCAT 87 mm SL; 34°23'N 75°58'W; 80M) was taken north of the south-central Florida region (south of Cape Lookout, NC). In the Gulf of Mexico, it is known from several localities off Louisiana, Texas and on the Yucatan shelf (Springer and Bullis 1956; this study). It also occurs in the Caribbean Sea along the continental margins of Belize, Honduras, Panama and as far eastward as Venezuela. Ginsburg (1951) thought that this species would eventually be found in the West Indies, but thus far, it has not been collected there or in the Bahamas.

Bathymetric Distribution

Symphurus parvus occurs over a wide bathymetric range from 20-146 m (Table 59). The greatest number of specimens (51/65, 78%), however, have been collected between 41-90 m. Only four specimens were taken at depths shallower than 40 m and an additional nine were trawled from depths greater than 90 m. Topp and Hoff (1972) collected this species from a similar depth range (37-109 m) on the west Florida shelf. Although this species has been collected from depths >90 m, its occurrence in such deep water is apparently unusual. The deepest recorded capture of this species is for a single specimen collected at 146 m while the next deepest captures are for several specimens taken between 101-110 m.

Topp and Hoff (1972) reported that S. parvus is nowhere abundant and this may be the case as most of the collections examined in this study contained only a single individual. However, it is also possible that the general rarity of this species in collections may only reflect the inefficiency of trawls in capturing this small-sized, relatively deep-water species.

Table 59. Summary of depth of capture for 65 specimens of *Symphurus parvus*.

Depth	20	21-30	31-40	41-50	51-60	61-70	71-80	81-90	91-100	101-110	146
N	1	1	3	6	22	6	5	12	2	6	1

Size and Sexual Maturation (Fig. 23).

Symphurus parvus is a diminutive tonguefish species, attaining maximum sizes of approximately 88 mm SL. The largest specimens examined were both males (84.7 and 87.3 mm SL). The largest female was only slightly smaller, measuring 80.6 mm SL.

Of 70 specimens examined, there were 32 females and 38 males. Seventeen females were gravid. Fifteen others had ovaries that were either ripening or just undergoing elongation. Based on reproductive states of females, it is evident that this species matures sexually at sizes of 40-45 mm SL. The smallest gravid female was 39.8 mm SL and all females larger than 45 mm SL were mature. Only four of the smallest females (21.8, 30.8, 43.5 and 46.5 mm SL) were immature with ovaries just undergoing elongation. Topp and Hoff (1972) reported that two females (37 and 43 mm SL) were just undergoing posterior elongation of the ovaries while a 62 mm SL specimen had developing ovaries.

Based on the appearance of gravid females in collections, it appears that S. parvus spawns during summertime. All gravid females, with a single exception, were collected during June-August. A single gravid fish was taken in late April.

Ecology

Little is known concerning the ecology of this species. Topp and Hoff (1972) collected this species over a temperature range of 18.8-24°C and salinities of 33.8-36.3 o/oo on the west Florida shelf.

Material Examined

Measured and Counted 33 Specimens, 26 Lots.

USNM 84491; Holotype (64.0); 24°45'45"N 81°46'W; 82M; 15 I 1885. USNM 152733; Paratype (69.0); 24°25'45"N 81°46'W; 82M; 15 I 1885. USNM 74330. Paratypes; 3(45.9-55.1); 24°25.45'N 81°46'W; 82M; 15 I 1885. USNM 153088; Paratype (38.2); Palm Beach, FL; 46M; April 1950. USNM 153090; Paratype

(55.5); Off Sombrero Light, FL; 101M; 06 VI 50. USNM 153097; Paratype (42.2); Off Palm Beach, FL; 73M. AMNH 18887; 2(45.4-47.1); SE Pompano Beach, FL; 101M; 01 VIII 49. FMNH 46371; (46.8); 21°38'N 92°10.5'W; 17 VIII 51. FMNH 88816; 2(52.8-59.3); 12°16'N 82°53'W; 55M; 02 VI 62. MCZ 50863; (55.3); 7 mi. E Sombrero Light, FL; 70M. UF 20586; 3(47.5-62.4); 28°44'N 85°06'W; 18 IV 70. UF 21834; (58.5); 24°25'35"N 81°52'30"W; 64M; 29 IV 76. UF/FSU 20769; 2(47.7-58.8); 28°33'N 84°39'W; 55M; 17 VII 71. UMML 3680; (43.2); SE Ship Channel out of Key West, FL; 52M; 30 XII 58. UMML 10737; (43.3); Off Sombrero Key, FL; 146M; July 1949. UMML 15589; (43.6); 25°38-47'N 80°05'W; 79M; 01 IV 64. UMML 20911; (62.0); 24°49'N 80°38'W; 48M; 15 IX 65. UMML 26769; (71.3); 09°31.3-32.5'N 76°15.4-17'W; 57M; 13 VII 66. UMML 29281; (63.1); 09°37.9'-37.6'N 75°50.4-51.5'W; 37M; 13 VII 66. UMML 30114; (56.9); 10°56-56.9'N 75°26-26.9'W; 43M; 01 VIII 68. UMML 30123; (46.5); 10°40'N 75°31'W; 27M; 01 VIII 68. USA 6361; (84.7); 29°23'N 87°48'30"W; 90M; 15 III 78. USNM 74330; (50.5); 24°25.45'N 81°46'W; 82M; 15 I 1885. USNM 153087; (50.2); Off Palm Beach, FL; 1950. USNM 161351; (33.8); Off Palm Beach, FL; 64M; January 1951. VIMS UNCAT DELII ST21; (88.2); 34°23'N 75°58'W; 80M; 12 III 82.

Counted 38 Specimens, 24 Lots.

FDNR 6537; (49.1); 27°36'N 84°13'W; 73M; 03 VII 66. FDNR 6543; (30.8); 27°37'N 83°28'W; 36M; 11 VIII 67. FDNR 6615; (55.3); 27°37'N 83°58'W; 55M; 12 V 67. FMNH 88816; 3(39.8-46.8); 12°16'N 82°53'W; 55M; 02 VI 62. FDNR UNCAT MOTE 210III; (42.4); 26°45.86'N 83°21.44'W; 50M; 29 X 80. FDNR UNCAT MOTE 31093; 2; 26°16.72'N 83°12.81'W; 48M; 05 III 81. FDNR UNCAT MOTE

310.111 ST5A; 5(44.1-67.3); 26°45.70'N 84°00.13'W; 90M; 31 I 82. FDNR UNCAT MOTE 310.111 ST16A; 2(56.6-56.7); 24°45.70'N 83°11.07'W; 54M; 02 12 82. TCWC 3321.1; (78.0); 28°04'N 95°19'30"W; 55M; 03 XII 80. TCWC 3406.2; 6(62.4-68.8); 28°18.2'N 94°04'W; 55M; 18 VII 70. UF 21280; (41.5); 28 56'N 85°20'W; 01 XI 70. UF/FSU 21301; (53.5); 28°32.5'N 84°39'W; 55M; 02 IV 71. UMML 17406; (58.3); 24°21'N 82°37-34'W; 59M; 13 IV 65. UMML 30081; 2(54.1-56.6); 08°57.5-09°00.3'N 76°33.6-30.5'W; 59M; 12 VII 66. USA 4906; 2(47.4-70.3); 27°50'N 84°31'W; 102M; 24 VIII 77. USA 4915; (80.6); 27°50'N 84°31'W; 102M; 24 VIII 77. USNM 47657; 1. USNM 153098; (31.1); Off Palm Beach, FL; 74M. USNM UNCAT OR 5680; (43.5); 12°16'N 71°08'W; 20M; 08 X 65. USNM UNCAT OR5739; (45.5); 09°43'N 79°20'W; 95M; 19 X 65. UWF 1484; (26.6); 29°45.4'N 87°46.4'W; 40M; 18 X 75. UWF 2670; (48.2); 26°24'N 83°49'W; 92M; 15 VII 76.

Other Material

UF 36456; 3(21.8-50.4); 24°24.34'N 81°58.26'W; 64M; 04 VI 80.

<u>Symphurus</u> <u>ommaspilus</u> Böhlke 1961.

(Fig. 46D)

Ocellated Tonguefish

<u>S</u>. <u>pusillus</u>

?Kyle 1913: 145; Symmetrical larva with figure, possibly of this species.

<u>S</u>. <u>marginatus</u>

Metzelaar 1919: 134; St. Eustatius Island; misidentification.

<u>S</u>. <u>ommaspilus</u>

Böhlke 1961:2-3; Original description with photograph; Holotype ANSP 93810 (41.1 mm SL); W side of the southern of the two Long Bay Cays, Andros Island, Bahamas (24°06'15"N 77°32'15"W).

Robins and Randall 1965:334; Bahamas; counts, measurements.

Böhlke and Chaplin 1968:225; Bahamas, key, figure, comments.

<u>Study Material</u>: 28 specimens, 14.4-56.4 mm SL; 28 x-rayed and measured.

<u>Diagnosis</u>

The combination of a 1-4-2 ID pattern, membrane ostia, 10 caudal rays, 74-79 dorsal rays, 60-64 anal rays, well developed pupillary operculum, and single ocellated spot on dorsal and anal fins distinguish this species from all other tonguefishes. Among the 1-4-2 ID pattern species, S. ommaspilus most closely resembles S. minor and S. parvus in meristics and body size but differs in pigmentation. Symphurus ommaspilus has a single ocellated spot on the dorsal and anal fins (vs. absent in the other species) and S. ommaspilus lacks the caudal blotch on the body (present in the other two species). Meristic features for the three species overlap partially with S. ommaspilus intermediate between S. minor and S. parvus (see Figs. 19-21 comparing meristics for these species). It differs from S. minor in its modally higher number of dorsal rays (74-79 vs. 69-77), anal rays (60-64 vs. 55-63), and vertebrae (43-44 vs. 41-43). In addition to pigmentation differences noted above, S. ommaspilus differs further from S. parvus in its lower number of dorsal (74-79 vs. 75-86), anal (60-64 vs. 60-70) and vertebral numbers (43-44 vs. 44-46).

Symphurus ommaspilus differs from all other 10-caudal rayed Symphurus species in its much lower meristics, unique pigmentation, small body size and presence of membrane ostia in the dorsal and anal fins.

Description

Symphurus ommaspilus is a dwarf species attaining maximum adult lengths of approximately 60 mm SL. ID pattern 1-4-2 (Table 9). Caudal rays 10 (Table 10). Dorsal rays 74-79 (Table 11). Anal rays 60-64 (Table 12). Vertebrae 43-44 (Table 13). Hypurals 4. Longitudinal scale rows 58-64 (Table 14). Scale rows on head posterior to lower orbit 14-17 (Table 15). Lateral scale rows 27-33, usually 29-31 (Table 16). Proportional measurements appear in Tables 60-61.

Body relatively deep (27.9-34.8% SL); with relatively short snout (14.7-33.0% HL). Head moderately wide (22.7-29.2 SL). Snout covered with small deciduous scales. Posterior extension of maxilla usually reaching to mid-point of lower eye; occasionally only reaching front margin of lower eye. Eyes relatively large (11.5-17.5% HL); usually equal in position or upper eye slightly in advance of lower eye. Eyes usually with only 2-3 scales present in narrow interorbital space. Pupillary operculum well-developed. Dorsal fin origin usually at vertical equal to mid-point of upper eye; occasionally reaching anterior margin of eye; or rarely, only rear edge of pupil of upper eye. No scales on dorsal and anal fins.

Teeth well developed on blind side jaws; teeth present usually only on anterior half of ocular side premaxilla; sometimes extending for almost three-fourths of the length of premaxilla. Dentary on eyed side with teeth present over one-half to three-fourths of its length; less frequently with teeth along entire margin.

Scales relatively large, ctenoid on both sides of body.

<u>Pigmentation</u>

Eyed surface with whitish ground color. Body with variable quantity of indistinct and irregular flecks of darker brown pigment sprinkled over surface. These brown pigment flecks heaviest in posterior one-third of body. Posterior darkening of body surface terminates at proximal region of caudal fin. Occasionally pigment concentrated into 1-2 incomplete bars at or slightly posterior to body mid-point. Operculum not noticeably pigmented

Table 60. Summary of morphometrics expressed in thousandths of Standard Length, except SL (in mm), for *Symphurus ommaspilus*.

Character	N	RANGE	MEAN	SD
SL	28	14.4-56.4	34.3	11.02
BD	28	254-348	300.2	17.41
PDL	28	40-87	58.8	11.08
PAL	28	224-326	267.2	22.70
DBL	28	846-975	941.5	25.83
ABL	28	612-773	730.6	32.31
PL	25	54-104	82.8	11.63
PA	27	49-90	62.6	9.43
CFL	26	92-160	128.3	14.16
HL	28	196-268	231.4	13.99
HW	28	227-292	253.8	14.62
POL	28	119-190	144.9	13.38
SNL	28	30-73	48.1	8.46
UJL	28	38-56	47.4	4.73
ED	28	24-42	32.0	4.45
CD	28	36-64	48.2	7.31
UHL	28	140-171	155.1	8.00
LHL	28	96-135	111.2	11.81

Table 61. Summary of morphometrics expressed in thousandths of Head Length (except HW/HL) for *Symphurus ommaspilus*.

Character	N	RANGE	MEAN	SD
HW/HL	28	1.02-1.18	1.1	0.05
POL	28	546-802	627.1	46.48
SNL	27	147-330	210.6	34.19
UJL	28	164-277	205.7	23.31
ED	28	114-175	138.4	16.58
CD	27	162-274	206.0	30.69
OPLL	28	147-277	196.0	29.31
OPUL	28	210-346	279.4	31.45
UHL	28	571-784	673.1	52.91
LHL	28	418-580	481.5	45.47

other than general body color. Inner lining of operculum and isthmus not pigmented. No evidence of moustache on ocular side upper lip. Blind side off-white or yellowish. Peritoneum unpigmented.

The only conspicuous color pattern on the fins, diagnostic for the species, is the presence of a large, distinctly ocellated spot in both the dorsal and anal fins near the posterior fifth of the body (approximately 10-14 rays before the end of each fin). The remainder of the fin rays in both dorsal and anal fins sprinkled with brown pigment at irregular intervals, but heaviest in regions corresponding to band development on body. In posterior third of fins the pigment is heaviest and covers both rays and fin membranes. Caudal fin unpigmented other than pigment on proximal third of fin.

Geographic Distribution (Fig. 22).

Symphurus ommaspilus is apparently widespread throughout the insular regions of the Caribbean Sea, but not frequently captured in any great numbers. The combination of small size and cryptic habits may prevent this species from being captured more frequently. Only three of the lots studied contained more than two fish (one lot each with 3, 5, and 7 individuals). About half (N=13) of the specimens available for this study were collected in the Bahamas. Additional collections have been made at Glover's Reef off Belize, St. James Virgin Islands, Puerto Rico, St. Eustatius, St. Barthelemy, Curacao and French West Indies. Apparently, the species rarely frequents reef areas on the continent (only one citation at Glover's Reef in

Belize). Thus far, the species has not been recorded from areas adjacent to reefs in the Florida Keys.

Size and Sexual Maturation (Fig. 23).

Symphurus ommaspilus is a dwarf species of tonguefish. Most individuals in this study ranged between 25-40 mm SL. The distribution of size frequencies for specimens examined is presented in Figure 23. Maximum sizes in *S. ommaspilus* apparently do not exceed about 60 mm SL. The three largest specimens examined measured 53.6, 55.0 and 56.4 mm SL. All three were gravid females. The largest males were substantially smaller, measuring only 41.0 and 42.7 mm SL. This species matures at very small sizes. The smallest gravid females were 28.4 and 30.3 mm SL. Most females between approximately 23-30 mm SL showed signs of gonad elongation and development.

The smallest fish examined, 14.4 mm SL, was completely metamorphosed with complete squamation and had already assumed a benthic lifestyle. This was an immature specimen (sex unknown) with little indication of any gonadal development.

Ecology

Symphurus ommaspilus inhabits white sandy bottoms in clear shallow waters adjacent to coral reefs. Most field data associated with collections indicate this species occurs in waters shallower than 10 meters. The majority of specimens have been collected between 1-15 m (Fig. 13). The deepest capture is 27 m.

Material Examined: All Measured and Counted

ANSP 93810; Holotype (40.9); Andros Island, Bahamas; 1M; 12 VII 57. ANSP 93811; Paratype (36.4); Bahamas (25°07'N 77°11'15"W); 11M; 16 V 56. AMNH 26260; (56.4); Cat Island, Bahamas; No Depth; 11 X 65. AMNH 29196; 5(14.4-42.7); Hogsty Atoll, Bahamas; 10M; 13 III 66. AMNH 30969; 2(27.7-32.0); Ragged Island, Nurse Cay, Bahamas; 2M; 12 I 68. ANSP 103419; (20.1); St. Barthelemy, FWI; 8M. ANSP 143267; (18.3); S of Nassau, Bahamas; 15M. FMNH 94820; (53.6); Glovers Reef, Belize; 13M; 24 VI 80. UMML 12813; (33.4); E Shore Oyster Cay, Bahamas; No Depth; 20 VIII 63. UMML UNCAT 571; (55.0); Gum Key, Bahamas; 06 VI 48. UPRM 2660; 7(20.7-48.1); Aguadillo, Puerto Rico; 12M. VIMS UNCAT; 3(32.6-41.0); Tague Bay, US Virgin Islands; 1M; 16 IV 78. ZMA 119.422; (23.6); St. Eustatius; No Depth; 1904-1905. ZMA 116.187; (32.0); Curacao; 9M; November, 1975. ZMUC 8652; (42.7); Crux Bay, St. James, Virgin Islands; 27M; 09 III 06.

CHAPTER 6.6

Species with a 1-4-3 ID Pattern and 10 Caudal Rays

Symphurus diomedeanus (Goode and Bean 1885)

(Fig. 47A)

Spottedfin Tonguefish

Aphoristia diomedeana

Goode and Bean 1885a: 589; Original description, off Tortugas, Florida.

Goode and Bean 1895: 460; (in part, more than one species included in account); description, counts and figure of holotype; data from additional specimens from Gulf of Mexico and Caribbean also included.

Jordan 1886: 603; Listed, West Indies.

Symphurus diomedeanus

Jordan and Goss 1889: 101; Considered as geographical variety and possible synonym of *S. plagiusa*.

Jordan and Evermann 1898: 2711; after Goode and Bean.

Chabanaud 1939: 26; Listed, Gulf of Mexico.

Longley and Hildebrand 1941: 49; Listed, Tortugas, Florida.

<u>Symphurus sumptuosus</u>

Chabanaud 1948: 509; Original description, Rio de Janeiro, Brazil; Holotype BMNH 1923.7.30:345.

<u>Symphurus diomedianus</u>

Ginsburg 1951: 194; Redescription, synonymy, figure, distribution from North Carolina to Brazil.

Springer and Bullis 1956: 55; Listed, Gulf of Mexico localities.

Briggs 1958: 297; Listed, Florida.

Hoese 1958: 346; Listed, Texas.

Duarte-Bello 1959: 65; Listed, Cuba.

Bullis and Thompson 1965: 34; Listed, North Carolina and Florida localities.

Moe and Martin 1965: 149; Listed off Tampa, Florida.

Caldwell 1966: 84; Listed, Jamaica.

Cervignon 1966: 817; Listed, Venezuela.

Carvalho et al. 1968: 3; In key, listed, Brazil.

Struhsaker 1969: 298; App.B; Listed, SE US coast localities.

Moe 1968: 172; Reversed, partially ambicolorate specimen from Gulf of Mexico.

Starck 1968: 31; Listed, Alligator Reef, Florida.

Francisco 1970: 111; Listed, Venezuela.

Topp and Hoff 1972: 79; Synonymy, counts, figure, distribution and ecology on southwest Florida shelf.

Miller and Jorgenson 1973: 305; Meristics, including vertebrae counts for four specimens.

Palacio 1974: 86; Listed, Colombia.

Chittenden and McEachran 1976: 94; Listed, northwestern Gulf of Mexico.

Menezes and Benvegnu 1976: 148; Description, counts, figure, senior synonym of *S. sumptuosus* Chabanaud 1948 and *S. pterospilotus* Ginsburg 1951.

Chittenden and Moore 1977: 111; Listed, 110 meter contour central and western Gulf of Mexico.

Lema and Oliveira 1977: 5; In key.

Ogren and Brusher 1977: 101; Listed, St. Andrews Bay, Florida.

Soares 1978: 24; Listed, Rio Grande do Norte, Brazil.

McCaffrey 1981; Listed, northeastern Gulf of Mexico.

Nonate et al. 1983: 151; Listed, northern coast of San Paulo State, Brazil.

Darcy and Gutherz 1984: 93; Listed, west Florida shelf.

Symphurus pterospilotus

Ginsburg 1951: 194; Original description, figure; Isla de Flores, Uruguay; Holotype USNM 87770.

Soares 1978: 24; Listed Rio Grande do Norte, Brazil.

Lema et al. 1980: 45; Listed Porto Belo and Florianopolis, Brazil.

Lazzaro 1977: 69; In key.

Study Material: 303 specimens, 57.9-183 mm SL. 209 x-rayed, 41 measured.

Remarks

Goode and Bean (1885) first described *Symphurus diomedeanus* from a single specimen collected off Tortugas, Florida. In 1895, Goode and Bean reported on additional specimens but data from more than one species was included in this account. In his revision of western Atlantic tonguefishes, Ginsburg (1951) discovered that the specimen from *Albatross* station 2121-2122 included in Goode and Bean's (1895) account of *S. diomedeanus* actually belonged to *S. pelicanus*. This specimen (USNM 74331) now forms part of the type series for that species.

Symphurus diomedeanus was apparently named after the research vessel *Albatross*. Goode and Bean chose the Greek word *Diomedea* as the stem root for the name of this species. *Diomedea* is a generic name for albatrosses. At the time of the original description in 1885, symphurine tonguefishes were included in the genus *Aphoristia* which has a feminine gender. In order to agree in gender, Goode and Bean used the specific name *diomedea*. Later, when *Aphoristia* was recognized as a junior synonym of the masculine genus *Symphurus*, the specific name for this species was changed to *diomedeanus* (Jordan and Goss 1889). This spelling prevailed until Ginsburg's revision in 1951. In this paper, Ginsburg, either by design or by accident, emended the spelling of the trivial name for this species from *diomedeanus* to *diomedianus*. Ginsburg provided no comments regarding the spelling change and it is difficult to determine whether or not the change in spelling was intentional. Whether intentional or not, it was incorrect to change the spelling of the stem root of *diomedea* and the proper spelling of the specific name for this species is diomedeanus which agrees in gender with the masculine genus Symphurus (G. Steyskal, person. commun.).

In 1948, Chabanaud described S. sumptuosus based on a single specimen collected from off Rio de Janeiro, Brazil. The holotype of this species was characterized by having 10 caudal rays and spotted dorsal and anal fins. In the original description, Chabanaud did not compare his new species with any other previously described western Atlantic tonguefishes, especially S. diomedeanus (Goode and Bean 1885), a species also possessing 10 caudal rays and spotted dorsal and anal fins, first described from the Tortugas, Florida region. It was Ginsburg (1951) who first recognized that S. sumptuosus Chabanaud 1948 was conspecific with S. diomedeanus (Goode and Bean 1885). Ginsburg pointed out that the holotype of S. sumptuosus agreed with S. diomedeanus in the number of caudal, dorsal and anal rays and scales, in the presence of spots on the dorsal and anal fins and the absence of a spot on the caudal fin. In the present study, holotypes of both species were radiographed and it was found that the holotype of S. sumptuosus also agrees with S. diomedeanus in the number of vertebrate, as well. I agree with Ginsburg, therefore, that S. sumptuosus is a junior synonym of S. diomedeanus.

In his revision of western Atlantic tonguefishes, Ginsburg (1951) described a second nominal species (S. pterospilotus) from southern South America which possessed a pattern of spots in the dorsal, anal and caudal fins. As was the case for S. sumptuosus, the description was again based on a single specimen. Symphurus pterospilotus was characterized by having a unique combination of a spotted caudal fin, spotted dorsal and anal fins and

11 caudal rays. The unique combination of a spotted caudal fin and 11 caudal rays were the characters that influenced Ginsburg to describe this specimen as representing a previously undescribed species. In all other counts except caudal rays, this specimen exceeded those for S. urospilus and these two species were considered distinct. The counts for S. pterospilotus, however, overlapped those for S. diomedeanus, but Ginsburg concluded that the spot on the caudal fin and the difference in caudal rays (11 vs. 10 in S. diomedeanus) were sufficient enough to recognize this specimen as representing an undescribed species.

Menezes and Benvegnu (1976) discussed the status of southern South American tonguefishes with spotted dorsal and anal fins. They found that the two characters (11 caudal rays and a spot on the caudal fin in addition to spots on the dorsal and anal fins) which distinguish S. pterospilotus from S. diomedeanus are also found among samples of S. diomedeanus. They concluded that the specimen of S. pterospilotus described by Ginsburg was a specimen of S. diomedeanus with the unusual condition of 11 caudal rays and a spot on the caudal fin in addition to spots on the dorsal and anal fins. Menezes and Benvegnu commented on the occurrence of S. diomedeanus with partial or complete spots on the caudal fins. With respect to caudal ray counts, the usual condition in this species is 10 but other counts (9 or 11) do occur, if only rarely (see Table 10). For example, data in Table 10 shows that only 5/196 (2.5 %) of the specimens examined in the present study had 11 caudal rays. Additional supportive evidence that these two nominal species are conspecific occurs in the vertebral counts. Examination of radiographs of the holotype of S. pterospilotus and comparison with counts observed for S. diomedeanus reveals identical vertebral counts. Therefore, based on this evidence, I agree with Menezes and Benvegnu that S. pterospilotus is a junior synonym of S. diomedeanus and that only one, widespread species, S. diomedeanus (Goode and Bean), with 10 (occasionally 11) caudal rays and spotted fins occurs throughout the western Atlantic.

Diagnosis

Symphurus diomedeanus is distinguished from all other tonguefishes by the unique combination of a relatively large body size (185-200 mm SL), a 1-4-3 ID pattern, 10 caudal rays, presence of a pupillary operculum, absence of small rows of scales on the blind side dorsal and anal fins and by the usual presence of well-developed spots on the posterior portions of the dorsal and anal fins.

In overall size and meristics, this species is most similar to S. plagiusa. It has 10 caudal rays like S. plagiusa, but differs in many characters including its modally higher counts (vertebrae 48-50 vs. 44-48; dorsal rays 86-96 vs. 83-91; anal rays 69-80 vs. 67-75), presence of a pupillary operculum (absent in S. plagiusa) and absence of squamation on the blind side posterior rays of the dorsal and anal fins (present in S. plagiusa). These two species are also quite distinct in pigmentation pattern. Symphurus diomedeanus usually has a variable number of well-developed black spots on the dorsal and anal fins (absent in S. plagiusa) and there is no black spot on the inner portion of the operculum (usually present and well-developed in S. plagiusa). The two species also differ markedly in bathymetric distribution, so much so, that the two species are not usually collected simultaneously. Symphurus diomedeanus occurs commonly and abundantly on the inner continental shelf at depths between 18-100 meters, but usually deeper than 20 meters (see below). In contrast, S. plagiusa is an inshore species with a center of abundance occurring in nearshore embayments and estuaries and only rarely extends out into the deeper waters commonly inhabited by S. diomedeanus (see depth distribution under the account for S. plagiusa).

Meristics of Symphurus diomedeanus overlap at least partially those for at least 13 other western Atlantic tonguefishes. Among other species possessing 10 caudal rays, S. diomedeanus partially overlaps counts for S. kyaropterygium and both species possess a well-developed pupillary operculum. There are several differences between these two species, however, including overall size (185 mm SL vs. 120 mm SL), ID pattern (1-4-3 vs. 1-4-2 in S. kyaropterygium), absence of membrane ostia in S. diomedeanus (vs. present) and S. diomedeanus typically has higher meristics (vertebrae 48-50 vs. 47-49; dorsal rays 86-96 vs. 83-87; anal rays 69-80 vs. 67-72). These two species differ in pigmentation, S. diomedeanus usually has spots on the posterior portions of the dorsal and anal fins (absent in S. kyaropterygium) and lacks the well-developed, dark brown caudal blotch characteristic of S. kyaropterygium.

Symphurus diomedeanus is similar in overall body shape, caudal ray count and overlaps partially the meristics of S. trewavasae. The two species differ in several characters including ID pattern (1-4-3 vs. 1-3-3), presence of a pupillary operculum in S. diomedeanus vs. absent in S.

trewavasae and pigmentation pattern (spotted fins and uniform body color vs. no spotted fins and banded body color in S. trewavasae).

Symphurus diomedeanus is similar in ID pattern, body shape, overall size and overlaps, at least partially, the meristics of several western Atlantic tonguefishes possessing a 1-4-3 ID pattern including S. urospilus, S. civitatium, S. plagusia, S. tessellatus, and undescribed species E. It differs from all of these species principally in caudal ray count (10 vs. 11 in S. urospilus or 12 in the other four species) and modal counts of vertebrae and dorsal and anal rays. Other differences between S. diomedeanus and the 12 caudal-rayed species possessing a 1-4-3 ID pattern are the presence of a pupillary operculum (vs. absent) and the spotted fins (fin pigmentation, if present, not in shape of well-developed, spherical spots).

Symphurus urospilus is similar to S. diomedeanus in overall body size and in that it possesses a well-developed pupillary operculum, however, it differs markedly from this species in body shape and pigmentation pattern. Symphurus urospilus has a relatively wide body and wide head with a relatively rapid taper. In contrast, the body is not nearly as wide nor does it taper as rapidly in S. diomedeanus. Symphurus urospilus lacks pigment spots on the dorsal and anal fins (usually present in S. diomedeanus) but characteristically possesses a single, ocellated spot on the caudal fin (usually absent in S. diomedeanus but if there is a caudal spot present, it occurs in combination with spots on the posterior portions of the dorsal and anal fins) and S. urospilus typically has well-developed crossbands (vs. more or less uniform coloration in S. diomedeanus). The two species, although partially overlapping in some meristic features, are further distinguished by vertebral counts (48-50 in S. diomedeanus vs. 45-47 in S. urospilus).

Symphurus diomedeanus can be distinguished from three dwarf species (S. rhytisma, undescribed species A and B), which have some similar counts, in several features including its relatively large size (to 185 mm SL vs. about 60 mm SL); ID pattern (1-4-3 vs. 1-3-2); presence of a pupillary operculum (vs. absent) and caudal ray count (10 vs. 12). There are also pigmentation differences (usually spotted dorsal and anal fins vs. no spotted pattern).

Symphurus diomedeanus overlaps meristics of several deep-water, 1-3-2 ID pattern species including S. nigrescens, S. piger, S. pusillus and undescribed species C but can readily be distinguished from all four species by modal differences in meristics, by its unpigmented peritoneum (vs. black), presence of a pupillary operculum (vs. absent), ID pattern (1-4-3 vs. 1-3-2) and in the number of caudal rays (10 vs. 12).

Description

Symphurus diomedeanus is a relatively large tonguefish attaining adult sizes of approximately 207 mm SL. The usual ID pattern is 1-4-3, less frequently 1-5-3, 1-4-2 or 1-3-4 (Table 9). Caudal rays normally 10, rarely 9 or 11 (Table 10). Dorsal rays 86-96, usually 88-93 (Table 11). Anal rays 69-80, usually 72-77 (Table 12). Vertebrae 47-50, usually 48-50 (Table 13). Hypurals 4. Longitudinal scale rows 79-96, usually 82-94 (Table 14). Scale rows on head posterior to lower orbit 17-22, usually 17-20 (Table 15).

Lateral scale rows 34-47 (Table 16). Proportional measurements appear in Tables 62-63.

Body relatively deep (depth 26.8-32.4% SL); maximum depth in anterior one-third of body. Head relatively wide (19.9-26.3% SL); with short, rounded snout (13.0-20.9% HL). Snout covered with small ctenoid scales. Dermal papillae well developed on blind side snout, chin and dorsal portion of the head at base of dorsal fin. Posterior extension of maxillary reaches only to about the middle of the lower eye or only to the front margin of the pupil of the lower eye. Lower lip on ocular side without a distinct, fleshy ridge on posterior margin. Eyes relatively large (8.2-15.6% $\bar{X}$= 13.0% HL); usually equal in position, although occasionally upper eye slightly in advance of lower eye. Eyes not covered with scales; usually with only 1-3 small, ctenoid scales in narrow interorbital space. Pupillary operculum well-developed. Dorsal fin origin usually at a vertical equal to front of upper eye; occasionally anterior to eye or sometimes reaching only the mid-point of upper eye. Scales usually absent on dorsal and anal fins; occasionally with 1-2 scales at fin-ray bases in larger specimens. Scales on both sides of body large and strongly ctenoid.

Teeth well developed on blind side jaws. Lower jaw on ocular side usually with a single, mostly incomplete row of slender teeth in middle of jaw; upper jaw on ocular side without teeth or with only a few present at premaxillary symphysis.

Table 62. Summary of morphometrics expressed in thousandths of Standard Length, except SL (in mm), for *Symphurus diomedeanus*.

Character	N	RANGE	MEAN	SD
SL	41	88.8-175.0	131.8	22.91
BD	41	268-324	297.4	11.86
PDL	41	33-55	42.5	4.17
PAL	41	179-238	208.5	12.63
DBL	41	945-967	957.5	4.18
ABL	41	751-823	783.2	18.14
PL	41	46-64	54.4	5.20
PA	40	28-82	50.3	11.46
CFL	40	96-120	107.9	6.20
HL	41	162-204	181.9	11.04
HW	41	199-263	223.9	15.30
POL	41	81-143	119.9	10.47
SNL	41	23-39	31.4	3.32
UJL	41	29-42	34.8	3.87
ED	41	15-30	23.8	3.33
CD	40	29-52	38.1	5.12
UHL	41	122-170	148.5	10.43
LHL	41	78-117	94.8	8.24

Table 63. Summary of morphometrics expressed in thousandths of Head Length (except HW/HL) for *Symphurus diomedeanus*.

Character	N	RANGE	MEAN	SD
HW/HL	41	1.11-1.41	1.2	0.06
POL	41	483-721	658.5	35.47
SNL	41	130-209	172.5	17.31
UJL	41	165-223	191.2	15.78
ED	41	82-156	130.5	15.71
CD	40	152-294	210.5	29.52
OPLL	41	240-375	304.3	32.00
OPUL	41	183-284	225.8	21.35
UHL	41	700-929	817.2	57.16
LHL	41	446-608	521.5	40.02

Pigmentation

Eyed surface somewhat variable in color. Most specimens almost uniformly dark brown; occasionally with faint traces of wide, diffuse, irregularly defined crossbands. Crossbands, when present, usually incomplete, not continued onto fins; only slightly darker than background coloration. Some specimens irregularly mottled or blotched with darker shaded areas. Specimens collected from sandy substrates usually with a lighter brown or even yellowish coloration. Operculum not pigmented other than general background color. Inner operculum and isthmus not pigmented. Slight moustache on ocular side upper lip; lower lip frequently spotted but without definite moustache. Blind side unpigmented, creamy white to yellowish. Peritoneum unpigmented.

In anterior two-thirds of body, rays and membranes of dorsal and anal fins lightly pigmented. Posterior dorsal and anal fins variably dusky, but pigmentation generally increasing in intensity in posterior third of body. Sometimes posterior third of fins, including caudal fin, nearly black. The most conspicuous pigmentation is the presence of a variable number of rounded, dark brown or black spots on the posterior third of the dorsal and anal fins. Occasionally specimens with a single spot eccentrically placed on distal third of caudal fin. Most often there are 1-4 spots on each fin, but as many as five spots have been observed (Topp and Hoff 1972). Fin spots are usually situated about mid-way between the fin base and the distal tips of the fin rays. Fin spots usually unequal in number and irregularly spaced. The most posterior spot usually placed a short distance from caudal fin base. Spots moderately or sharply marked; occasionally the first 1-3 spots poorly defined or irregularly rounded; the more posterior spots generally with a well-defined, rounded shape. In specimens with darkly pigmented fins, the spots sometimes faint or hardly perceptible against the dark background color of the fins.

Geographic Distribution (Fig. 24)

Symphurus diomedeanus has the most extensive range of any of the western Atlantic tonguefishes. It is a widespread temperate and tropical species ranging from the Cape Hatteras region of North Carolina, southward through the Gulf of Mexico and Caribbean Sea and extending as far south as southern Brazil and Uruguay. In the Gulf of Mexico, it is known from the Tortugas area around to southern Texas, and on the Yucatan shelf (Topp and Hoff 1972). Throughout the southeastern United States and eastern Gulf of Mexico at least, this species is numerically the most important tonguefish in depths greater than 18 and shallower than 80 m. This species is the most common tonguefish between 37-73 meters on the southern Florida shelf (Topp and Hoff 1972) and has also been ranked as "very common" (present in more than 50% of trawl stations) along the southeastern United States (Struhsaker 1969, App. B).

Bathymetric Distribution

Symphurus diomedeanus occurs on the open continental shelf at moderate depths. Depth of occurrence is summarized for 278 individuals and presented in Table 64. For specimens examined in this study, the overall depth range is considerable, ranging from 6-150 m. The center of abundance for this species (251/278, 90%), however, occurs at depths between 21-60 m or perhaps slightly deeper to 80 m. A similar bathymetric distribution for this species was reported by Topp and Hoff (1972) for specimens collected during the Hourglass cruises off west Florida. Topp and Hoff found that most S. diomedeanus on the west Florida shelf were taken at and beyond the 37 m stations and collections of this species declined at both the deepest and the shallowest stations, suggesting a rather narrow depth range. The deepest reported occurrence is from 146-183 m, reported by Longley and Hildebrand (1941) from Tortugas, Florida. Apparently, this species does not usually range into shallow areas as few specimens have been recorded from depths less than 20 m (see Table 64). Moe and Martin (1965) reported three specimens collected in 3-5 m off Tampa Bay, Florida. This is the only documented occurrence of the species in the Gulf of Mexico waters shallower than 18 m. Cervignon (1966) reported an occasional occurrence off Venezuela in depths less than 30 m, but referred to a greater abundance in deeper waters.

Table 64. Summary of depth distribution (in meters) for 278 S. diomedeanus.

DEPTH	6-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80
NUMBER	1	1	13	83	55	54	23	23

DEPTH	81-90	91-100	101-110	111-120	121-130	131-140	141-150
NUMBER	8	11	0	2	1	0	3

Size and Sexual Maturation

Symphurus diomedeanus is a relatively large-sized tonguefish. In terms of relative maximum size, *S. diomedeanus* is the third largest species occurring in the Atlantic (only *S. jenynsi* and *S. tessellatus* are larger). Maximum reported size for the species is 207 mm SL, from a specimen collected off the coast of North Carolina (Ginsburg 1951). The largest specimen in the present study was a female measuring 178 mm SL while the second largest, a male, was 177 mm SL. Mature females ranged from 93.0-178 mm SL; immature females from 84.6-119 mm SL; and males measured from 66.8-177 mm SL. Most mature fish (56 females, 45 males) ranged in size from 120-150 mm SL. Of the specimens examined, only 11 females and eight males exceeded 150 mm SL. In their study of *S. diomedeanus* collected off the west coast of Florida, Topp and Hoff (1972) reported a size range of 48-174 mm SL (all but one specimen exceeded 100 mm SL). They also reported mean sizes for females (149.1 mm SL) and males (146.8 mm SL).

Of interest is the general absence of smaller size classes in the collections. In this study, only eight fish smaller than 100 mm SL were available for study and the smallest specimen ever reported measured only 48 mm SL (Topp and Hoff 1972). It is unknown if the general absence of small fish in collections reflects selectivity of collecting gear (mostly trawls) or whether smaller specimens of *S. diomedeanus* occur in habitats not generally sampled or inaccessible to conventional gears.

Among the 154 specimens for which size and sex information was summarized, there were 70 gravid females, five immature females and 79 males. From these data, it appears that sexual maturation occurs at a relatively large size in S. diomedeanus. The smallest mature females measured 93.0, 98.3, 102 (2 specimens) and 107 mm SL, respectively. The majority of mature females were larger, usually between 120-150 mm SL. Only five immature females were found among the 75 females represented in the collections and the smallest of these were 84.6 and 86.2 mm SL. The largest immature females measured 110 and 119 mm SL. These larger immature females overlap in size with the smallest mature fish, especially in the size range from approximately 110-120 mm SL.

Ecology

Symphurus diomedeanus occurs on diverse substrates ranging from mud to calcareous sands. Springer and Bullis (1956) reported this species from substrates with a high mud component while Topp and Hoff (1972) collected most of their specimens from calcareous substrates. Specimens included in the present study were collected on both substrate types. Topp and Hoff noted that this species was not collected where appreciable proportions of quartz sand were present.

The only report on food habits of this species is that of Topp and Hoff (1972). Of 140 specimens examined, only 49 contained food. Symphurus diomedeanus eats a broad spectrum of benthic invertebrates and includes in its diet such prey as polychaetes, bivalves, gastropods, gastropod eggs, amphipods and small crabs. Crustaceans, particularly crabs, were the most frequently encountered food items followed by polychaetes and gastropods.

Topp and Hoff (1972) found this species at bottom temperatures ranging from 17.5-28°C and salinities of 32.3-36.7 o/oo.

Material Examined

Measured and Counted 41 Specimens, 17 Lots.

USNM 37347; Holotype (138); 25°04'30"N 82°59'15"W; 48M; 19 III 1885. USNM 87770; Holotype of *S. pterospilotus* (115); Isla de Flores, Uruguay; 1925. BMNH 1923.7.30;345; Holotype of *S. sumptuosus* (112); Sao Francisco, Brazil. MCZ 40943; 2(149-156); 11°32'N 71°44'W. MNHN 1975-269; 9(91.7-163); 18°18'S 38°53'W; 38M; 29 XI 61. TU 10594; 2(136-137); 26°10'N 96°54'W; 33M; 03 VI 54. UMML 10551; (164); 31°38'N 79°40'W; 79M; 08 X 57. UMML 10552; (166); 31°49'N 79°31'W; 82M; 08 X 57. UMML 10580; (164); 32°27'N 78°54'W; 51M; 24 VI 57. UMML 11160; (137); 28°07'N 95°53'W; 37M; 26 I 58. UMML UNCAT GERDA 1030; (97.5); 24°34'N 81°06'W; 63M; 26 II 69. UMML UNCAT GERDA 1237; 5(106-151); 24°47'N 82°58'W; 44M; 27 III 70. UNC 1563; 3(137-162); 29°40'N 80°17'W; 73M; 03 IX 56. UNC 1565; (173); 30°32'N 80°19'W; 42M; 10 I 57. USA 5959; 3(88.8-140); 28°29'N 84°21'W; 40M; 05 II 78. USNM 158306; 2(121-143); 21°09'N 91°41'W; 51M; 13 V 54. VIMS 1137; 6(97.1-175); 34°28'N 76°15.3'W; 35M; 21 XI 71.

Counted 168 Specimens, 71 Lots.

ANSP 101294; 2(129-134); 24°32'N 81°17'W; 73M; 27 X 60. FMNH 45428; (150); 30°04'N 86°57'W; 92M; 14 XI 52. FMNH 45429; 6(119-144); 20°18'N 91°48'W; 42M; 07 XII 52. FMNH 46370; 6(116-132); 19°48'N 91°20'W; 25 VIII 51. FMNH 61301; 3(145-156); 42M; 21 III 54. FMNH 86363; (132); 07°40'N 57°34'W; 51M; 31 VIII 58. FMNH 86415; (147); 07°12'N 56°47'W; 49M; 01 IX 58. FMNH 88848; (126); 28°45'N 92°17'W; 51M; 13 IX 62. FMNH 88853; (126); 02°09'S 42°44W; 59M; 10 III 63. FMNH 90083; (126); 06°03'N 52°22'W; 66M; 13 IX 58.

FMNH 90085; (129); 05°46'N 52°02'W; 70M; 12 XI 57. FMNH 90541; (113); 07°20'N 56°49'W; 60M; 01 IX 58. FMNH 90942; 3(81.1-111); 06°40'N 54°25'W; 48M; 15 IX 58. FMNH 91115; (120); 04°05'N 50°27'W; 92M; 13 XI 57. IMS 548; 4(102-119); Campeche, Mexico; 26M. MCZ 11377; 2(60.2-81.7); Vitoria, Brazil; (1862 or 1865). MCZ 39982; 5(116-132); Rio de Janeiro, Brazil;(1862 or 1865). MCZ 58654; 24(123-159); 24°36'N 83°10'W; 55M; 18 X 66. TU 10594; 2(135-136); 26°10'N 96°54'W; 33M; 03 VI 54. TU 12956; (86.2); 26°10'N 97°00'W; 20M; 03 VI 54. TU 82932; (161); 29°58'N 86°31'W; 79M; 05 IV 73. TU 82989; (156); 29°52'N 86°16'W; 64M; 05 IV 73. TU 83888; (166); 29°50'N 86°05'W; 40M; 05 VI 73. ALA 5871.21; 3(141-152); 29°54'N 87°12'W; 10 VIII 79. UF 12785; (141); 21°14'N 98°28'W; 46M; 13 V 59. UF 17018; (142); 21°09'N 91°41'W; 51M; 13 V 54. UF/FSU 21434; (164); 29°43'N 86°00'W; 18 I 71. UF 30333; (147); 21°11'N 91°49'W; 48M; 28 VIII 80. UF 35415; 2(101-102); 24°47'N 81°41'W; 38M; 19 V 78. UMML 7746; (91.5); 18°35'N 64°42'W; 49M; 27 IX 59. UMML 11153; (125); 06°13'N 52°53'W; 55M; 11 XI 57. UMML 11226; (149); 20°06'N 91°47'W; 42M; 3 V 58. UMML 17441; 2(66.8-74.2); 24°50'N 80°37'W; 37M; 14 IV 65. UMML 20932; (113); 24°50'N 80°38'W; 44M; 15 IX 65. UMML 23893; (104); 08°49'N 81°22'W; 31M; 21 VI 66. UMML 26697; (107); 09°45'N 76°09'W; 76M; 16 VI 66. UMML 30188; (98); 11°52'N 70°22'W; 35M; 27 VI 68. UMML UNCAT OR710; 3(131-139); 20°18'N 91°48'W; 37M; 07 XII 52. UMML UNCAT OR4856; (92.9); 11°08'N 74°23'48"W; 183M; 19 V 64. UMML UNCAT OR4866; (105); 10°57'36"N 75°10'W; 27M; 23 V 64. UMML UNCAT OR4875; 2(102-112); 10°53'N 75°22'W; 42M; 23 V 64. UMML UNCAT SB2382; 2(152); 24°42'N 80°46'W; 82M; 26 X 60. UMML UNCAT SB2407; 2(129-139); 24°32'N 81°17'W; 73M; 27 X 60. UMML UNCAT SB2911; (110); 34°30'N 76°12'W; 37M; 12

III 61. UMML UNCAT SB3322; (144); 32°27'N 78°32'W; 123M; 09 VIII 61. UMML UNCAT SB3658; 2; 28°56'N 88°19'W; 80M; 27 VII 62. UMML UNCAT SB5743; 2(146-150); 32°11'N 79°08'W; 90M; 18 V 64. UNC 1552; 3(159-178); 32°22 79°06'W; 46M; 01 XI 56. UNC 4031; (151); 34°48'N 75°31'W; 119M; 13 III 61. UNC 14920; 2(142-165); 32°12'N 78°12'W; 31M; 26 VI 78. USA 3563; 6(119-145); 30°04'N 86°48'W; 91M; 29 VIII 76. USA 5748; 6(144-177); 27°40'N 84°11'W; 79M; 03 II 78. USA 5959; 3(89.0-138); 28°29'N 84°21'W; 40M; 05 II 78. USNM 113251; 1; 40M. USNM 133935; (151); 22°08'N 86°51'W; 46M; 30 I 1885. USNM 157692; (116); 20°05'N 91°28'W; 31M; 26 VIII 51. USNM 159610; (133); 05°52'N 52°03'W; 73M; 12 XI 57. USNM 159617; 2(124-134); 05°35'N 51°50'W; 66M; 12 XI 57. USNM 159619; 2(135-150); 05°46'N 52°02'W; 70M; 12 XI 57. USNM 274483; 4(132-148); 05°46'N 52°02'W; 68M; 12 XI 57. USNM UNCAT ATLANTIS; 2(113-119); 12°14.5'N 70°20'W; 73M; 10 XI 58. USNM UNCAT OR5344; (148); 28°12'N 80°05'W; 60M; 14 III 65. USNM UNCAT OR5346; 3(131-152); 28°22'N 80°05'W; 60M; 14 III 65. USNM UNCAT OR5621; 4; 11°24'N 63°52'W; 49M; 24 IX 65. USNM UNCAT OR5697; (133); 12°07'N 72°13'W; 48M; 12 X 65. USNM UNCAT OR5699; (83.9); 12°13'N 72°25'W; 68M; 12 X 65. USNM UNCAT OR5703; (137); 11°58'N 72°29'W; 35M; 12 X 65. UWF 3230; 2(127-145); 28°56'N 85°20'W; 01 XII 70. VIMS 1599; (92.0); 34°15'N 76°04'W; 70M; 10 XI 69. VIMS 2503; 13(93.3-169); 34°27'N 76°16'W; 33M; 30 IV 73. VIMS UNCAT DEL82-02 ST 58; (149); 33°56'N 76°46'W; 40M; 16 III 82.

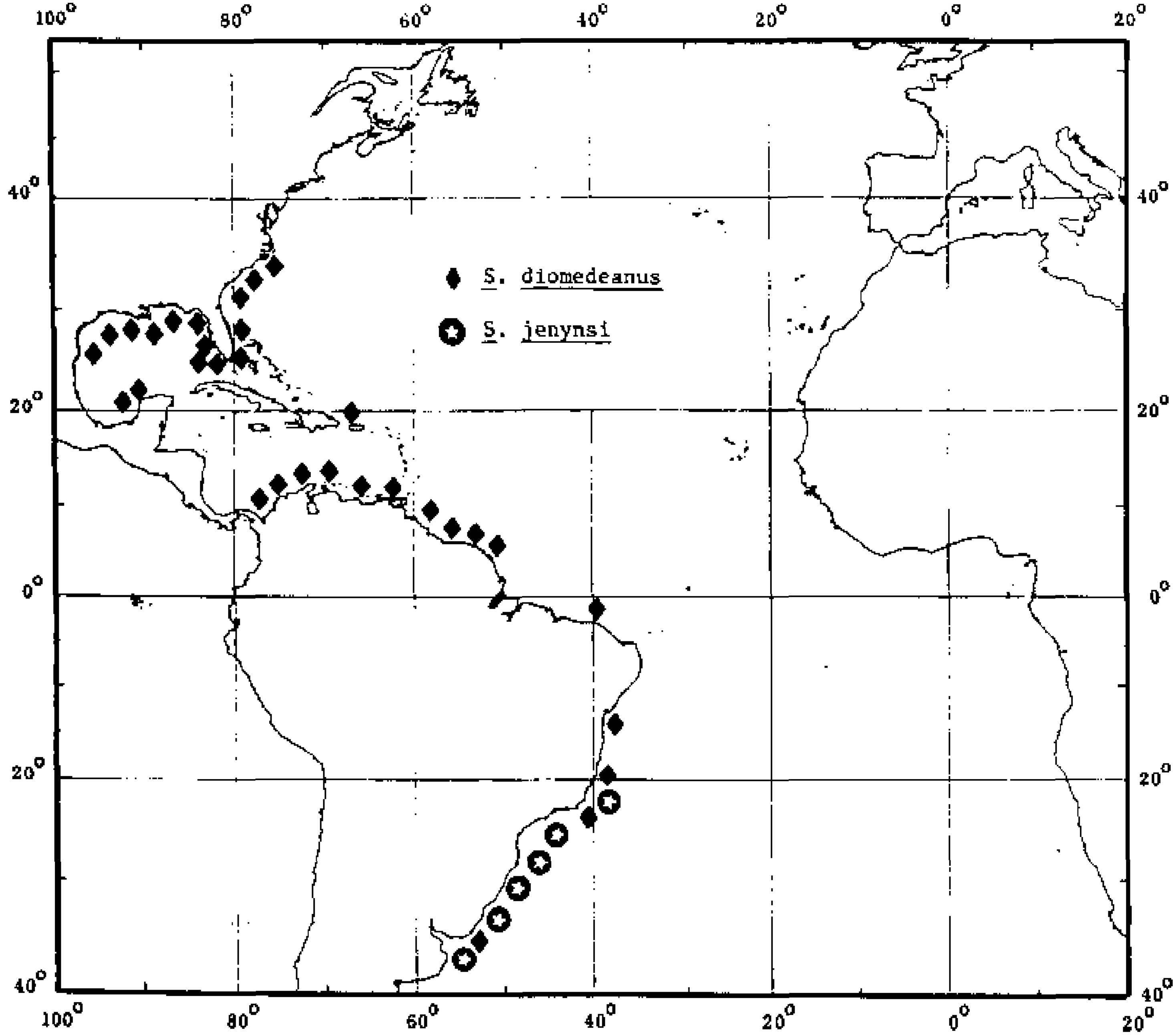
Other Material

FDNR 12562; 2(140-150); 24°27'N 82°58'W; 78M; 24-25 VIII 81. FDNR UNCAT Mote 310.111 ST 33A; (136); 26°24'N 83°22'W; 55M; 06 II 82. FDNR UNCAT

Mote310.111 ST 33A; (127); 26°16'N 84°05'W; 145M; 06 II 82. FDNR UNCAT BLM II-76-TDS; (150); 26°16'N 82°44'W; 30M; 19 VII 81. FMNH 94457; (174); 29°17'N 80°19'W; 44M; 05 II 61. FMNH 94464; (94.6); 04°02'N 50°33'W; 70M; 12 XI 57. TU 75908; (132); 27°35'N 80°04'W; 38M; 05 IX 65. TU 79168; 14(119-148); 27°35'N 80°04'W; 38M; 05 IX 65. ALA 3617.12; 8(103-134); SSE Horn Island, MI; 08 VII 69. UF 11650; (118); 20 mi. NE Dry Tortugas, FL; 146M; May, 1962. UF 35442; 3(116-161); 25°17'N 82°32'W; 33M. UF UNCAT; (104); 24°44'N 82°42'W; 32M; 24 IV 81. UMML 110156; (97.6); W Coast, FL; 12 VII 35. UMML 570; (134); 20 mi. NE Tortugas, FL; March, 1950. UMML 1646; (148); 30°14'N 80°16'W; 24M; 09 III 56. UMML 3088; 2(87.4-124); 24°45'N 82°10'W; 24M; 26 V 57. UMML 10539; (148); 29°19'N 80°15'W; 64M; 01 VI 57. UMML 10546; 3(147-157); 28°58'N 80°13'W; 55M; 01 VI 57. UMML 10553; (167); 32°32'N 79°01'W; 64M; 25 VI 57. UMML 10554; (148); 29°26'N 80°16'W; 70M; 02 VI 57. UMML 10555; (154); 29°03'N 80°13'W; 51M; 01 VI 57. UMML 11205; 2(128-136); 29°10'N 80°19'W; 46M; 01 VI 57. UMML 17395; (123); 24°25'N 82°56'W; 64M; 12 VI 65. UMML 17431; 3(118-127); 24°23'N 82°57'W; 90M; 13 IV 65. UMML 20972; (142); 25°11'N 80°10'W; 112M; 26 I 66. UMML 20993; (156); 25°13'N 80°10'W; 98M; 26 I 66. UMML 20997; (162); 25°13'N 80°10'W; 98M; 26 I 66. UMML UNCAT GERDA 1001; 2(112-134); 27°13'N 79°54'W; 61M. UMML UNCAT GERDA 1002; (126); 27°19'N 79°59'W; 41M. UMML UNCAT GERDA 1089; (110); 24°34'N 81°06'W; 51M. UMML UNCAT GERDA 1236; 3(123-130); 24°46'N 82°57'W; 44M. UMML UNCAT GERDA 1238; (101); 24°48'N 82°58'W; 44M. UMML UNCAT GERDA 1240; (127); 24°53'N 82°56'W; 44M. UMML UNCAT SB1554; (151); 38M; 19 I 60. UMML UNCAT SB1557; (153); 29°30'N 80°19'W; 49M; 19 I 60. UMML UNCAT SB2383; (107); 24°43'N 80°43'W; 88M; 26 X 60. UMML UNCAT SB3200; (165); 28°33'N

$80^{\circ}09'$W; 51M; 09 VII 61. UMML UNCAT SB3203; (153); $28^{\circ}33'$N $80^{\circ}15'$W; 35M; 09 VII 61. UMML UNCAT SB3250; (156); $27^{\circ}50'$N $80^{\circ}07'$W; 37M; 12 VII 61. UMML UNCAT SB3689; 2(171-183); $27^{\circ}49'$N $80^{\circ}09'$W; 27M; 25 I 62. UMML UNCAT SB3691; (154); $27^{\circ}54'$N $80^{\circ}08'$W; 37M; 25 I 62. UMML UNCAT SB5096; (153); $27^{\circ}55'$N $80^{\circ}07'$W; 37M; 26 IX 63. UMML UNCAT SB5100; 3(134-163); $27^{\circ}43'$N $80^{\circ}07'$W; 37M; 28 IX 63. UMML UNCAT SB5101; (132); $27^{\circ}47'$N $80^{\circ}13'$W; 37M; 28 IX 63. UMML UNCAT SB5102; 2(137); $27^{\circ}52'$N $80^{\circ}08'$W; 38M; 28 IX 63. UMML UNCAT SB5116; 2(171-180); $28^{\circ}31'$N $80^{\circ}14'$W; 42M; 24 VI 64. UMML UNCAT SB5125; (150); $28^{\circ}40'$N $80^{\circ}11'$W; 48M; 29 IX 63. UMML UNCAT SB5126; 4(138-155); $28^{\circ}40'$N $80^{\circ}11'$W; 48M; 29 IX 63. UMML UNCAT SB5690; (166); $29^{\circ}35'$N $80^{\circ}19'$W; 48M; 02 V 64. UMML TABL 67-283; (105); Key Biscayne, FL; 6M; 13 X 67. USA 4952; 3(120-132); NW Tampa, FL; 32M; 26 VIII 77. USNM 73261; (57.9). USNM 129945; (136); $24^{\circ}25'30''$N $81^{\circ}47'45''$W; 92M; 15 I 1885. USNM 236120; 9(134-157); $27^{\circ}16'30''$N $80^{\circ}01'$W; 53M; 15 III 65. UWF 3684; (62.9); Gulf of Mexico; 20 I 74.

Figure 24. Geographic distribution of _Symphurus_ _diomedeanus_ and _S_. _jenynsi_.



Atlantic 1-4-3 Species with 10 Caudal Rays

Symphurus jenynsi Evermann and Kendall 1907

(Fig. 47B)

Plagusia

? Jenyns 1842: 140; Coast of Patagonia.

S. plagusia

? Berg 1895: 79; Mar del Plata, Montevideo.

S. jenynsi

Evermann and Kendall 1907: 108; Original description, with figure. Type probably from market at Buenos Aires.

Devincenzi 1920: 135; Uruguay.

Devincenzi 1924: 136; Rio de La Plata, Brazil; Uruguay.

Chabanaud 1939: 26; Listed, South Atlantic (market at Buenos Aires).

Lahille 1939: 203; Argentina.

Chiesa 1945: 101; Argentina 35-39°S.

Ginsburg 1951: 200; Redescription, counts and measurements; distribution.

Carvalho et al. 1968: 21; Southern Brazil and Argentina.

Roux 1973: 176; Southern Brazil and Argentina.

Lazzaro 1973: 247; Argentina.

Benvegnu 1973: 499; Southern Brazil and Uruguay.

Kawakami 1976: 629; Ecological distribution, feeding habits.

Menezes and Benvegnu 1976: 139; Redescription, counts and measurements; ecological distribution.

Lema and Oliveira 1977: 6; Santa Catarina and Rio Grande do Sul, Brazil; north of Uruguay.

Chao et al. 1982: 73; Seasonal occurrence in Patos Lagoon, Rio Grande do Sul, Brazil.

Lucena and Lucena 1982: 55; North of Brazil to Argentina.

Inada 1986: 316; Listed, Argentina.

S. bergi

Thompson 1916: 414; Montevideo; Original description, with figure.

Devincenzi 1920: 136; Rio de La Plata, Brazil; Uruguay.

Devincenzi 1924: 136; Rio de La Plata, Brazil; Uruguay.

Chabanaud 1939: 26; Listed American Atlantic: Montevideo.

Lahille 1939: 203; fig. 15, Argentina.

Chiesa 1945: 102; Argentina 35°and 38°S.

Barcellos 1962b: 12; Rio Grande do Sul, Brazil.

S. jenynsii

Barcellos 1962a: 12; Rio Grande do Sul.

Menezes 1971: 61; Santa Carolina and Rio Grande do Sul, Brazil.

S. meridionalis

Lema and Oliveira 1977:8; Figs. 1-3; Original description; Rio Grande do Sul, Brazil.

Lema et al. 1980: 43; Listed; Rio Grande do Sul and Porto Belo, Brazil.

Lucena and Lucena 1982: 55; (in part); Equals S. jenynsi; Specimen MCP 8009 previously reported as meridionalis.

Remarks

There are several discrepancies between Evermann and Kendall's (1907) original description and the holotype specimen of *Symphurus jenynsi*. For example, they listed the following counts for the holotype: dorsal rays 108; anal rays 93; caudal rays 12. The actual counts taken from a radiograph of this specimen are: dorsal rays 110; anal rays 95 and caudal rays 10. In the original description, the scale count is listed as approximately 120, but there is no indication of how the reported scale count was made. Since this count can vary considerably depending on where on the body the count is made, the count reported in the original description is higher than observed in the present study and is considered unreliable. Another discrepancy occurs in the description of teeth in the type specimen. The authors stated that there were no teeth on the eyed-side upper jaw. Examination of the holotype revealed that there is a small patch of teeth present on the anterior margin of the eyed-side premaxilla.

In 1916, Thompson described a second tonguefish species, *S. bergi*, from the Montevideo region. It is unclear whether Thompson actually examined the holotype of _S. jenynsi_, but it seems that he did not. In his description of _S. bergi_ he stated that "in comparing the specimens at hand with the description of _Symphurus jenynsi_ Evermann and Kendall from the same locality, the following differences are found: only in a single case does the number of dorsal rays fall as low as 109, none being 108; the scales in longitudinal series vary from 100 to 114, and in no case reach 120; there are, distinctly, teeth on the eyed side of the upper jaw, which is stated by Evermann and Kendall to be without teeth; the eyes are far from being "on the same line", the lower beginning below the end of the anterior third of the upper, instead of "slightly advanced;" and finally, there are not 12 but 10 caudal rays. The differences are obviously great, although the general appearances are similar." Ginsburg (1951) examined types of both nominal species and concluded that they were conspecific. Subsequent authors (Menezes and Benvegnu 1976; Lema et al 1980; Lucena and Lucena 1982) also considered there to be only one species represented among the material described as _S. jenynsi_ and _S. bergi_. Examination of radiographs of both types and the type series of _S. bergi_ further support the recognition of only one species, _S. jenynsi_.

In 1977 Lema and Oliveira described a third nominal species, _S. meridionalis_, with high meristic features from off the coast of southern Brazil. They based their description on three specimens and listed distinct differences between this and _S. jenynsi_ in caudal ray number (11 vs. 10) and eye diameter. Examination of both the types and radiographs of the type series of _S. meridionalis_ revealed that all three specimens possess only 10 caudal rays. The reported differences in eye size between the two species are not clearly distinct. Measurement of 30 S. jenynsi revealed that eye size varies from 7.4-9.5% HL. Eye sizes for the three specimens of S. meridionalis lies well within this range. Based on overall similarities in size, body shape, meristics, morphometrics and pigmentation, it is concluded that S. meridionalis is a junior synonym of S. jenynsi.

Study Material: 96 Specimens, 18.8-319.0 mm SL. 96 x-rayed, 30 measured.

Diagnosis

Symphurus jenynsi is one of the most distinctive species in the entire genus. It is the largest species in the genus (attaining SL in excess of 300 mm) and differs from all other tonguefishes by the unique combination of a 1-4-3 ID pattern, 10 caudal rays, unpigmented peritoneum, and elevated meristics (among the highest found in all Atlantic species). Except for similarities in caudal ray number, there are no other species among those with a 1-4-3 ID pattern which overlap S. jenynsi in meristic counts.

Other Atlantic tonguefishes with high meristics similar to those for S. jenynsi include two eastern Atlantic species, S. vanmelleae and S. ligulatus, and the western Atlantic S. nebulosus. These three species are small, bathyal species which differ from S. jenynsi in the following characters: ID pattern (1-4-3 vs. 1-2-2-1 in S. vanmelleae; 1-2-2 in S. ligulatus and S. nebulosus), caudal ray count (10 vs. 12 in S. vanmelleae; 14 in S. ligulatus and S. nebulosus) and peritoneum color (black vs. unpigmented in S. jenynsi). In addition, these three deep-sea species are relatively slender, small-sized fishes seldom attaining lengths greater than 140 mm SL (usually much smaller) compared to S. jenynsi which attains sizes over 300 mm SL.

Description

The largest species of the genus attaining maximum sizes of at least 319 mm SL. ID pattern 1-4-3, less frequently 1-5-3 or 1-3-4 (Table 9). Caudal rays 10, rarely 9 (Table 10). Dorsal rays 107-114 (Table 11). Anal rays 91-99 (Table 12). Vertebrae 57-60, usually 58-59 (Table 13). Hypurals 4. Longitudinal scale rows 102-118, usually 104-115 (Table 14). Scale rows on head posterior to lower orbit 21-25, usually 22-24 (Table 15) (Menezes and Benvegnu (1976) reported 106-124 longitudinal scale rows.) Lateral scale rows 41-51, usually 44-48 (Table 16). Proportional measurements appear in Tables 65-66.

Body relatively elongate, depth 23.1-32.8% SL; with a gradual taper. Maximum depth usually at a point almost equal or equal to body midpoint. Body beginning to taper posteriorly at about middle of standard length, varying a little both ways (some evidence to show shape changing with growth, beginning to taper more posteriorly in the largest specimen). Head rather narrow; head length almost equal to head width (HW/HL 1.02-1.48); head with relatively short snout (20.2-26.9% HL); covered with small ctenoid scales. Dermal papillae in some individuals well developed on blind side snout, chin and dorsal portion of head near base of dorsal fin; dermal papillae not evident on eyed-side snout. Posterior extension of maxilla usually reaches to rear margin of pupil of lower eye; occasionally extending

Table 65. Summary of morphometrics expressed in thousandths of Standard Length, except Standard Length (in mm), for *Symphurus jenynsi*.

Character	N	RANGE	MEAN	SD
SL	31	60.6-319.0	150.0	50.33
BD	31	231-328	256.8	19.75
PDL	31	26-51	38.8	5.70
PAL	31	161-239	202.9	17.85
DBL	31	949-974	961.2	5.70
ABL	31	753-840	793.3	22.34
PL	31	49-72	57.8	5.52
PA	31	30-74	49.4	10.93
CFL	31	61-111	83.5	10.93
HL	31	133-202	170.6	12.97
HW	31	185-231	203.4	10.68
POL	31	69-140	109.1	14.92
SNL	31	28-51	40.6	4.44
UJL	31	25-48	39.4	4.33
ED	31	12-16	14.4	0.99
CD	31	29-52	42.4	4.90
UHL	31	116-147	132.0	8.10
LHL	31	72-101	86.2	7.22

Table 66. Summary of morphometrics expressed in thousandths of Head Length (except HW/HL) for *Symphurus jenynsi*.

Character	N	RANGE	MEAN	SD
HW/HL	31	1.02-1.48	1.2	0.09
POL	31	442-698	638.3	60.73
SNL	31	202-269	237.2	18.06
UJL	31	191-268	231.0	13.89
ED	31	74-95	84.4	5.41
CD	31	164-370	249.6	35.61
OPLL	31	177-329	267.6	31.45
OPUL	31	185-308	234.9	29.41
UHL	31	672-1016	777.9	79.47
LHL	31	434-642	507.2	40.45

only to mid-point of lower eye. Eyes small, 7.4-9.5% HL; usually equal in position, occasionally upper eye slightly anterior in position. Eyes and interorbital space with from 3-8 rows of small ctenoid scales. Pupillary operculum absent. Dorsal fin origin usually anterior to upper eye, occasionally reaching only to forward margin of upper eye. Dorsal fin with usually a single ray in advance of upper eye. Scales usually absent on dorsal and anal fins.

Teeth well-developed on blind side jaws. Lower jaw on ocular side without teeth; upper jaw on ocular side with a small number of slender teeth at anterior edge anterior to tubular nostril.

Pigmentation

Eyed surface usually uniformly light brown with a variable number (usually 7-10, but up to a maximum of 20) of irregular, sometimes complete, darker brown crossbands. Bands not continued onto dorsal and anal fins. Bands begin at the level of the operculum and continue along the body to a short distance anterior to caudal fin bae. In specimens without definite bands, the eyed surface is covered with an irregular arrangement of diffuse dark brown markings. Operculum pigmented with a small, rounded dusky blotch which is only slightly obvious against the background color of the operculum. Inner lining of the operculum on both sides and the isthmus lightly pigmented. Both lips on ocular side usually lightly spotted; occasionally with a light moustache on upper lip. Blind side off-white. Peritoneum unpigmented.

Dorsal and anal fins without distinctive markings; pale anteriorly, becoming progressively darker posteriorly; their posterior third almost completely dark. Caudal fin dusky, without definite markings; entire length of rays pigmented.

Geographic Distribution (Fig. 24).

Symphurus jenynsi occurs from Eastern Brazil to Argentina but is predominantly found in colder waters of the western South Atlantic (Menezes and Benvegnu 1976). On the Brazilian coast there are only two records north of Florianopolis (28°21'S): one at 26°14'S (coast of the state of Parana) and another at 22°27'S (near Cabo Frio, Rio de Janeiro). The bulk of the specimens examined in the present study were caught between Santa Catarina and Uruguay.

Bathymetric Distribution

Although *Symphurus jenynsi* occurs over a wide depth range (from 12-190 meters) apparently it is a resident species of the shallow inner continental shelf (Menezes and Benvegnu 1976). It is most frequently taken in relatively shallow waters between 12-60 meters and the majority of specimens have been captured between 12 and 25 meters (Table 67). Menezes and Benvegnu found both small (16-30 mm SL) and adult specimens inhabiting similar depths on the inner shelf. There are no reports of this species utilizing shallow estuarine areas during any stage of its life history.

Table 67. Summary of bathymetric distributions for *Symphurus jenynsi*. Data includes information reported by Menezes and Benvegnu (1976).

Depth	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90	91
Number	31	5	1	8	2	1	1	0	1

Size and Sexual Maturation

Symphurus jenynsi is the largest species in the genus, attaining lengths greater than 300 mm SL. The largest specimen examined in the present study was 319 mm SL. Menezes and Benvegnu (1976) reported it as the largest tonguefish present in Brazilian waters with several individuals reaching lengths beyond 250 mm.

Specimens in this study ranged in size from 18.8-319 mm SL. Of 64 specimens for which sex could be determined, 35 were males, 24 were females and five were juveniles of unknown sex. Females (58.1-250 mm SL) were somewhat larger than males (32.2-200 mm SL). The sex of the largest specimen (319 mm) could not be determined because its internal organs had undergone considerable degradation in preservative.

Based on the reproductive stage of the females, it appears that sexual maturity occurs at a relatively large size in S. jenynsi. Although none of the females examined were were found to be gravid, all females over 115 mm SL appeared to be mature with elongate ovaries. Only one female (224 mm SL) contained developing ova. The five smallest females (from 58.1-87.7 mm SL) had ovaries which were just starting to elongate.

Ecology

Beyond depth of capture and size information, there is not much known concerning the biology of this species. Kawakami (1976), in the only study reporting on the feeding habits of S. jenynsi, noted that polychaetes were the primary food item but other benthic prey, including gammaridean amphipods, cumaceans and mysids were also eaten.

Material Examined

Counted and Measured 35 Specimens, 11 Lots.

FURG 940; 4(60.6-163); Costa Mar, Brazil; 28 X 80. FURG 3007; 6(136-200); 32°09'S 51°55'W; 14M; 01 IX 82. FURG 3040; (250); 32°35'S 52°13'W; 17M; 03 IX 82. FURG 3091; 9(106-148); 32°47'S 52°22'W; 11M; 23 I 83. FURG UNCAT; 7(118-231); 32°23'S 52°43'W; 44M; 03 IX 83. USNM 86170; 3(116-135); Montevideo, Uruguay; 1913. USNM 86683; (131); Montevideo, Uruguay; 09 XII 22. USNM 87771; (319); Montevideo, Uruguay. MCN 2401; Holotype of S. meridionalis; (173); Praia de Cassino, RS, Brazil; 50M. MCN 2399; Paratype of S. meridionalis; (172); Praia do Farol da Conceicao (Sao Jose do Norte), RS, Brazil. MCN 2400; Paratype of _S. meridionalis_; (139); Praia em frente ao Alfred Hotel em Torres, RS, Brazil; 50M.

Counted 58 Specimens, 15 Lots.

USNM 55573; _S. jenynsi_ Holotype; Market at Buenos Aires, Argentina. USNM 76852; _S. bergi_ Holotype; Montevideo. USNM 76892; _S. bergi_ Paratypes; 9 specimens; Montevideo. CAS-SU 22725; _S. bergi_ Paratypes; 13 specimens; Montevideo. MCP 8009; (169); Porto Belo, SC, Brazil. MCZ 11384; 2(110-144); Montevideo; 1872. MZUSP 12555-560; 6(32.2-150); 31°27'S 51°05'W; 17M; 12 IV 72. MZUSP 12843; 10(30.3-93.0); 31°28'S 52°15'W; 20 I 72. MZUSP 12849; 11(18.8-75.8); 30°49'S 50°28'W; 10 IV 72. MZUSP 12886; 3(157-164); 33°47'S 53°16'W; 01 XI 72. UMMZ 95496; (224); Argentina.

Symphurus plagiusa (Linnaeus 1766)

(Fig. 48A)

Blackcheek Tonguefish

Pleuronectes plagiusa

Linnaeus 1766: 455; Original description based on specimen from Charleston, South Carolina.

Plagusia fasciata

DeKay 1842: 304; South Carolina, based on an unpublished illustration by Holbrook.

Storer 1846: 480; After Holbrook.

Glossichthys plagiusa

Gill 1861: 51; New combination.

Apionicthys plagiusa

Günther 1862: 490; Based on misinterpretation of Linnaeus' *Pleuronectes plagiusa*.

Plagusia plagiusa

Gill 1864: 215; Substitute for *Pleuronectes* Linnaeus (Preoccupied in Crustacea).

Aphoristia ornata (not of Lacepede)

Goode and Bean 1885b: 196; Substitution name based on misinterpretation of collection information associated with Linnaean holotype.

Aphoristia fasciata

Jordan 1885: 395; Followed Goode and Bean's (1885b) rejection of the Linnean holotype; Suggested that proper senior synonym is Aphoristia (= Plagusia) fasciata Holbrook (in DeKay 1842).

Aphoristia plagiusa

Jordan 1886a: 53; Synonymized with Aphoristia ornata Poey (=S. tessellatus this study) from Cuba.

S. plagiusa

Jordan and Goss 1889: 325; Synonymy, in key, discussion of nomenclature. Possible senior synonym of S. elongatus, S. atricauda, S. plagusia, S. pusillus and S. diomedeanus.

Jordan and Evermann 1898: 2710; Synonymy, in key; Counts, measurements and distribution.

Hildebrand and Cable 1930: 476; Description of larval stages.

Chabanaud 1949a: 87; Compared with S. plagusia.

Ginsburg 1951: 195; (in part); Redescription, counts, measurements, photograph; More than one species included in redescription; Cuban specimens are S. tessellatus.

Dawson 1962: 138; Anomalies.

Böhlke and Chaplin 1968: 226; Listed; Eleuthera Island and Great Bahama Bank, Bahamas.

Dahlberg 1970: 260; Reversed specimen.

Dahlberg 1972: 95; Anomalies.

Topp and Hoff 1972: 87; Counts, figure, distribution on west Florida shelf; Review of life history information.

LeGrande 1975: 516; Karyotype.

Menezes and Benvegnu 1976: 145; Compared and diagnosed from S. trewavasae.

Olney and Grant 1976: 229; Description of early larval stages from lower Chesapeake Bay.

Lema et al. 1980: 43; Discussion of previous reports from South Atlantic.

Wheeler 1985: 71; Clarification of holotype status.

Gartner 1986: 141; Anomalies.

Symphurus plagusia (not of Schneider, in Bloch and Schneider 1801)

Chabanaud 1939: 26; Listed, American Atlantic and Gulf Coasts.

Misidentifications

Regan 1914: 23; Brazil (=S. trewavasae).

Chabanaud 1948b: 134; reversed specimen from off LA; (=S. civitatium).

Lazzaro 1973: 245; Listed, Argentina (=S. trewavasae).

Roux 1973: 176; Listed, Brazil (=S. trewavasae).

Lema and Oliveira 1977: 7; Listed; southern Brazil (=S. trewavasae).

?Sanson et al. 1978: 11; Listed as rare in Cuba; (probably based on misidentifications of S. plagusia and S. tessellatus).

Remarks

Symphurus plagiusa is based on the holotype skin described as Pleuronectes plagiusa by Linnaeus in 1766. The specimen was sent to Linnaeus from South Carolina by Garden. Apparently, the writing on the label is upside down in relation to the fish (see Wheeler 1985:71) and when in correct position for reading the label, results in the fish appearing to be dextral instead of, as in life, sinistral. The upside down label has confused several investigators who have examined this specimen beginning with Linnaeus who incorrectly placed (1766:455) this species in the group of dextral Pleuronectes. Günther (1862:490) was also confused by the position of the writing on the label and he tentativley suggested the placement of Pleuronectes plagiusa among the dextral flatfishes, perhaps to be included in the dextral genus Aplonichthys.

Confusion concerning the identity and placement of Linnaeus' species, especially among American authors, began in the late 1880's when Goode and Bean published their paper on Linnean types of American fishes (1885b). In this paper (p. 196), they suggested that the Linnean species, Pleuronectes plagiusa, was not representative of any American tonguefish. Goode and Bean (1885b:196) examined and measured the holotype skin and deduced from their measurements and scale count that this specimen was not conspecific with the common American tonguefish species. They concluded that the Linnaean specimen was considerably too slender, more so than any specimens of tonguefish from the coastal United States and, additionally, the scale count (77) was substantially lower than counts observed in western Atlantic tonguefishes. In addition to these observations, Goode and Bean also noted that specimen No. 27 of the 1763 consignment in the Linnean collection was an exotic, not an American species. Based on these findings, Goode and Bean concluded that Pleuronectes plagiusa Linnaeus could not be the type of or the proper name for the common tonguefish species along the Atlantic coast of the United States, but instead, was probably the type of some African or Indian species. They suggested that the proper name for the common tonguefish species occurring off the eastern and gulf coasts of the United States was Aphoristia ornata Lacepede.

Jordan (1885:395) accepted Goode and Bean's findings and also rejected the Linnean specimen as the holotype for the American species. However, instead of accepting Aphoristia ornata as the next available name for this species, Jordan suggested that the American species should stand as Aphoristia fasciata (Holbrook). This name was based on an unpublished figure of Plagusia fasciata Holbrook, which was discussed briefly in DeKay (1842:304). Jordan suggested this name as the senior synonym for the American species because he believed that the West Indian species Aphoristia ornata Lacepede was distinct from the species occurring on the Atlantic and Gulf coasts of the United States. Interestingly, in the same paper, Jordan equivocated this position when he stated that "it [meaning Lacepede's tonguefish may be that this ornata is the original plagiusa."

The entanglement of nomenclature between the nominal West Indian species described by Lacepede and the American species described by Linnaeus is reflected in other articles by Jordan and his co-workers. For example, Jordan (1886a:31) later identified a specimen of tonguefish from Cuba as the Aphoristia (=Pleuronectes) plagiusa of Linnaeus. But in this paper, Jordan clearly indicated that he had a very poor concept of the subtle morphological variation exhibited by these tonguefishes. He stated "that the four American species of Aphoristia are very closely related, perhaps to be considered geographical varieties of a single species." Three of these four species (S. elongatus and S. atricaudus from the eastern Pacific and S. plagiusa from the western Atlantic) are currently recognized as valid species (this study and Mahadeva 1956).

In another paper, Jordan (1886b:603) again used Aphoristia plagiusa (Linnaeus) for a species of tonguefish listed in his checklist of West Indies fishes. Although no voucher specimens were deposited, I believe that these citations refer to specimens of S. plagusia or S. tessellatus and not the common species of the American coastline.

In their review of the flounders and soles of Europe and America, Jordan and Goss (1889:324) disagreed with Goode and Bean's (1885b) statements regarding the status of the Linnean holotype. In their review, they acknowledged that the tonguefish that Garden had sent to Linnaeus probably came from the United States and not from Africa or India. They accepted the name Symphurus (= Pleuronectes) plagiusa (Linnaeus) as the senior synonym for the common coastal tonguefish of the United States and northern Mexico.

Additionally, Jordan and Goss no longer considered that Lacepede's Achirus ornatus was referrable to this species and they also indicated that it was doubtful to what species the Lacepede description applied. However, it is still clearly evident in this and later papers that Jordan and his co-authors (Jordan and Goss 1889; Jordan and Evermann 1898) still failed to recognize the slight interspecific variations in morphology and meristics expressed in this group of tonguefishes. Jordan and Goss stated (p. 326) that the characters separating no less than eight nominal species comprising both Atlantic and Pacific shallow and deep-water species, were only of slight value, and doubtless all specimens would ultimately prove to be geographic varieties of a single species. All eight species are considered valid (this study; Mahadeva 1956). The conclusions reached by Jordan and Goss regarding the status and nomenclature of the Linnaean species, Pleuronectes plagiusa, were also followed by Jordan and Evermann (1898:2710).

Following findings of Jordan and Goss and Jordan and Evermann, Symphurus plagiusa (Linnaeus) has continued to be used as the senior synonym for the common, shallow-water tonguefish occurring along the southern and Gulf of Mexico coasts of North America. This name has been used in studies published during the early and mid 1900's (see synonymy in Topp and Hoff 1972:87) but the status of the type skin of Linnaeus's species was never definitively settled.

In his revision of western Atlantic tonguefishes, Ginsburg (1951:195) only briefly addressed the nomenclatural problem of Pleuronectes plagiusa Linnaeus. Ginsburg did not directly examine the holotype skin, but he did discuss the findings of Goode and Bean (1885b) regarding the disparity in their measurements between whole, preserved specimens and the original holotype skin. Ginsburg essentially agreed with Goode and Bean that their measurements of the holotype of Pleuronectes plagiusa did not apply to the common American species. Ginsburg also agreed with Goode and Bean in selecting Plagusia fasciata DeKay as the next available name for this species. Ginsburg, however, effectively chose not to make any changes in prevailing nomenclature for this species because he felt that further study of Goode and Bean's measurements were needed and additional study was necessary to determine the identity of the holotype skin. Ginsburg provided no further resolution of any of the questions regarding the status of the Linnean holotype, but rather, he simply accepted useage of Symphurus plagiusa (Linnaeus) for the common American tonguefish.

It was not until 1985 when Wheeler (p. 71) settled the controversy surrounding the status of Pleuronectes plagiusa Linnaeus. In this paper, Wheeler provided information on possible reasons why earlier ichthyologists (Linnaeus, Günther and Goode and Bean) had been confused about the capture location and identity of the holotype skin of Pleuronectes plagiusa Linnaeus. It seems that at least some of the confusion surrounding both the origin of the holotype skin and the identity of this species arises from the writing on the label which, as was mentioned earlier, is upside down in relation to the fish. It also seems that Goode and Bean erred in their study of the correspondence between Garden and Linneaus referring to capture location of the holotype. Wheeler stated that Goode and Bean's doubts about the holotype skin resulted from their misreading the Garden correspondence in which No. 27 of the 1763 consignment was indicated as an exotic, not a North American specimen. However, the holotype of Pleuronectes plagiusa (also No. 27) belongs to the 1761 consignment, not the 1763 consignment. In the 1761 consignment the holotype skin is listed as "Pleuronectes, here called Taper Flounder.". There is thus no doubt that this specimen is the holotype of *Pleuronectes plagiusa* Linnaeus 1766 and its capture location is South Carolina.

Historically, other generic names have been used for this species, especially following the subdivision of Linnaeus' polytypic genus *Pleuronectes*. Gill (1861:51) first used the genus *Glossichthys* and later *Plagusia* (1864:215) to accomodate the Linnaean species. *Plagusia* is preoccupied in Crustacea and in both cases these are junior synonyms of *Symphurus* Rafinesque.

Study Material: 379 Specimens, 18.0-171 mm SL. 139 x-rayed, 30 measured.

Diagnosis

A medium sized tonguefish readily distinguishable by the combination of 10 caudal rays, 1-4-3 ID pattern, lack of a pupillary operculum, small rows of scales on the blind side posterior rays of the dorsal and anal fins, the usual presence of a black spot on the upper angle of the eyed-side operculum and the unique combination of meristics including vertebrae, dorsal rays and anal rays. A large proportion of the *Symphurus plagiusa* population is ecologically separated from other tonguefish species and this species is usually the only one commonly taken in shallow water embayments and estuarine environments throughout its range (New York-Campeche, Mexico). Only rarely is it taken with other tonguefishes in these environments.

This species is most similar in meristics, body shape and overall size to the widespread, western Atlantic *S. diomedeanus* and the South Atlantic, *S. trewavasae*. *Symphurus plagiusa* differs from *S. diomedeanus* in several characters including the following: _S. plagiusa_ lacks a well-developed pupillary operculum and spots on the dorsal and anal fins (both present in _S. diomedeanus_); _S. plagiusa_ usually has a well-developed black pigment spot situated on the upper lobe of the operculum (absent in _S. diomedeanus_); _S. plagiusa_ has a row of 5-6 small ctenoid scales present on the posterior rays of the blind side dorsal and anal fins (absent, or only 1-2 scales at bases of fin rays in _S. diomedeanus_); finally, _S. plagiusa_ has lower meristics when compared with _S. diomedeanus_ (vertebrae 45-49, usually 46-48 vs. 47-50, usually 48-50; dorsal rays 83-91 vs. 86-96; and anal rays 67-75 vs. 69-80).

In the number of caudal rays _S. plagiusa_ agrees with _S. trewavasae_ but differs readily from this species in several characters including ID pattern (1-4-3, 1-4-2 vs. 1-3-3), relatively smaller eye size (8.3-12.6 vs. 11.4-16.2 % HL); and meristics (vertebrae 46-48 vs. 47-51, usually 48-49; dorsal rays 83-91 vs. 88-94; anal rays 67-75 vs. 73-78). _Symphurus plagiusa_ also differs in depth of occurrence and is predominantly a shallow-water and estuarine species whereas _S. trewavasae_ of all sizes occur in offshore waters on the continental shelf.

Symphurus plagiusa is not easily confused with other Atlantic 10-caudal rayed tonguefishes of the _S. minor_ group. It differs from all four of these species in lacking a pupillary operculum and membrane ostia (vs. present in all four species); pigmentation (black opercular spot present, lack of a caudal blotch and lacking spots on dorsal and anal fins in _S. plagiusa_ vs. no black opercular spot (all four species) and presence of caudal blotch in _S. minor_, _S. parvus_ and _S. kyaropterygium_ and presence of an ocellated spot on the dorsal and anal fins in _S. ommaspilus_.

In the Atlantic south of Cape Hatteras, North Carolina and throughout the Gulf of Mexico, medium to large-sized Symphurus plagiusa are frequently collected with all sizes of S. civitatium in moderate shelf depths (to about 40-50 meters). The two species can readily be distinguished by several characters. First off, S. plagiusa has a normal caudal ray count of 10 (12 in S. civitatium); S. plagiusa has a relatively larger eye (8.3-12.6 % HL vs. 7.0-11.0 % HL) and the eyes are more nearly equal in position (subequal in S. civitatium). Also, in S. plagiusa there is a row of 4-8 small, ctenoid scales on the posterior blind side rays of the dorsal and anal fins (absent, or only 1-2 scales at ray bases in S. civitatium). These two species also vary in the posterior extension of the maxillary with respect to the lower eye. The posterior margin of the maxillary extends only as far backward as the mid-eye region in S. plagiusa and often only reaches the front margin of the pupil of the lower eye while in S. civitatium the jaws usually extend a little further rearward reaching to the rear margin of the pupil and occasionally to the rear margin of the eye. There are also pigmentation differences between these two species. Many individuals of S. plagiusa have a well-developed black spot in the upper lobe of the operculum and the inner opercular linings on both sides of the fish are heavily pigmented. In comparison, there is no well-developed black spot on the operculum of S. civitatium, although some individuals possess a diffuse dark brown blotch on the operculum. Also, in S. civitatium, the inner lining of the blind side operculum is not heavily pigmented. Another difference in pigmentation between these species occurs in the coloration of the posterior sections of the dorsal and anal fins. In both sexes of S. plagiusa the fins are uniformly colored and are generally only lightly shaded or moderately dusky while in male S. civitatium the fins become progressively darker in the posterior one-third of the body and may become almost completely black in color.

Description

Symphurus plagiusa is a medium-sized tonguefish attaining maximum adult lengths of approximately 171 mm SL. The usual ID pattern is 1-4-3, less frequently 1-4-2 or 1-3-3 (Table 9). Caudal rays normally 10 (Table 10). Dorsal rays 83-91, usually 84-90 (Table 11). Anal rays 67-75 (Table 12). Vertebrae 45-49, usually 46-48 (Table 13). Hypurals 4. Longitudinal scale rows 76-86 (Table 14). Scale rows on head posterior to lower orbit 15-19, usually 17-18 (Table 15). Lateral scale rows 30-39 (Table 16). Proportional measurements appear in Tables 68-69.

Body relatively deep (depth 28.3-32.6 % SL); maximum depth in anterior one-third of body. Head relatively wide (21.2-26.5 % SL); with short rounded snout (19.4-24.7 % HL). Snout covered with small ctenoid scales. Dermal papillae well developed on blind side snout, chin and dorsal portion of the head at base of dorsal fin; in larger specimens, dermal papillae extend onto ocular side snout. Posterior extension of maxillary reaches to about the middle of lower eye, or occasionally only reaching to front margin of pupil of lower eye. Lower lip on ocular side with a fleshy ridge a short distance before posterior margin. Eyes relatively large (8.3-12.6 % HL); usually equal in position, although occasionally upper eye slightly anterior to lower. Eyes not scaly; usually with 1-3 small, ctenoid scales in narrow

Table 68. Summary of morphometrics expressed in thousandths of Standard Length, except Standard Length (in mm), for *Symphurus plagiusa*.

Character	N	RANGE	MEAN	SD
SL	30	64.7-171.6	103.8	33.72
BD	30	283-326	304.7	8.89
PDL	30	22-51	38.4	6.23
PAL	30	140-243	199.7	27.69
DBL	30	933-979	960.6	11.82
ABL	30	727-826	787.6	20.52
PL	29	51-79	67.4	6.80
PA	30	36-75	54.7	9.51
CFL	30	94-141	106.6	9.65
HL	30	145-210	192.5	13.73
HW	30	212-265	234.9	14.57
POL	30	111-145	128.9	7.93
SNL	30	34-49	42.0	4.39
UJL	30	33-46	38.9	2.94
ED	30	15-23	19.5	2.08
CD	30	42-71	53.6	7.44
UHL	30	147-182	167.2	10.01
LHL	30	91-123	102.5	7.89

Table 69. Summary of morphometrics expressed in thousandths of Head Length (except HW/HL) for *Symphurus plagiusa*.

Character	N	RANGE	MEAN	SD
HW/HL	30	1.07-1.46	1.2	0.09
POL	30	619-842	671.8	39.31
SNL	30	194-247	218.2	16.35
UJL	30	180-242	202.8	14.83
ED	30	83-126	101.6	9.81
CD	30	213-391	278.7	39.81
UHL	30	734-1046	871.8	78.06
LHL	30	436-707	535.2	58.15

interorbital space. Pupillary operculum absent, although occasionally some specimens have an irregular margin on the upper side of the iris which could be mistaken for a small, poorly developed pupillary operculum. Dorsal fin origin usually at a vertical equal to the front margin of the pupil of the upper eye or occasionally with the first dorsal fin ray situated anterior to the front margin of the eye. A row of small, well-developed ctenoid scales present on the blind side posterior dorsal and anal fin rays. Body scales large, strongly ctenoid on both sides of body.

Teeth well-developed on blind side jaws. Lower jaw on ocular side usually with a single, mostly incomplete row of slender teeth; upper jaw on ocular side usually lacking teeth altogether, or possessing a small number of slender teeth anterior to anterior nostril.

<u>Pigmentation</u>

Eyed surface pigmentation very variable, ranging from uniformly, dull brown to marked with sharply contrasting, dark brown cross bands. Cross bands highly variable in number and degree of development but not continued onto dorsal and anal fins. When present, banding in various stages of development from almost solidly continuous across body or developed to various degrees with some being interrupted, incomplete or irregular, or occasionally with bands only faintly indicated. In some specimens, there are sometimes developed either a few or many intensely dark, very small specks in lieu of crossbanding. Individuals fron sandy habitats occasionally have a generally lighter, almost whitish background color. A large black spot centered on the upper lobe of the opercle, present in the majority of specimens, especially those recently preserved. The black opercular spot usually faint or absent in the smaller specimens and occasionally absent also in some larger fishes. Inner operculum and isthmus on both sides of fish heavily pigmented. Slight moustache on ocular side upper lip; lower lip frequently spotted but without definite moustache. Blind side unpigmented, creamy white. Peritoneum unpigmented.

No defined pigmentation in fins. Dorsal, anal and caudal fins faintly or moderately dusky, usually with darker pigment streaks along the rays.

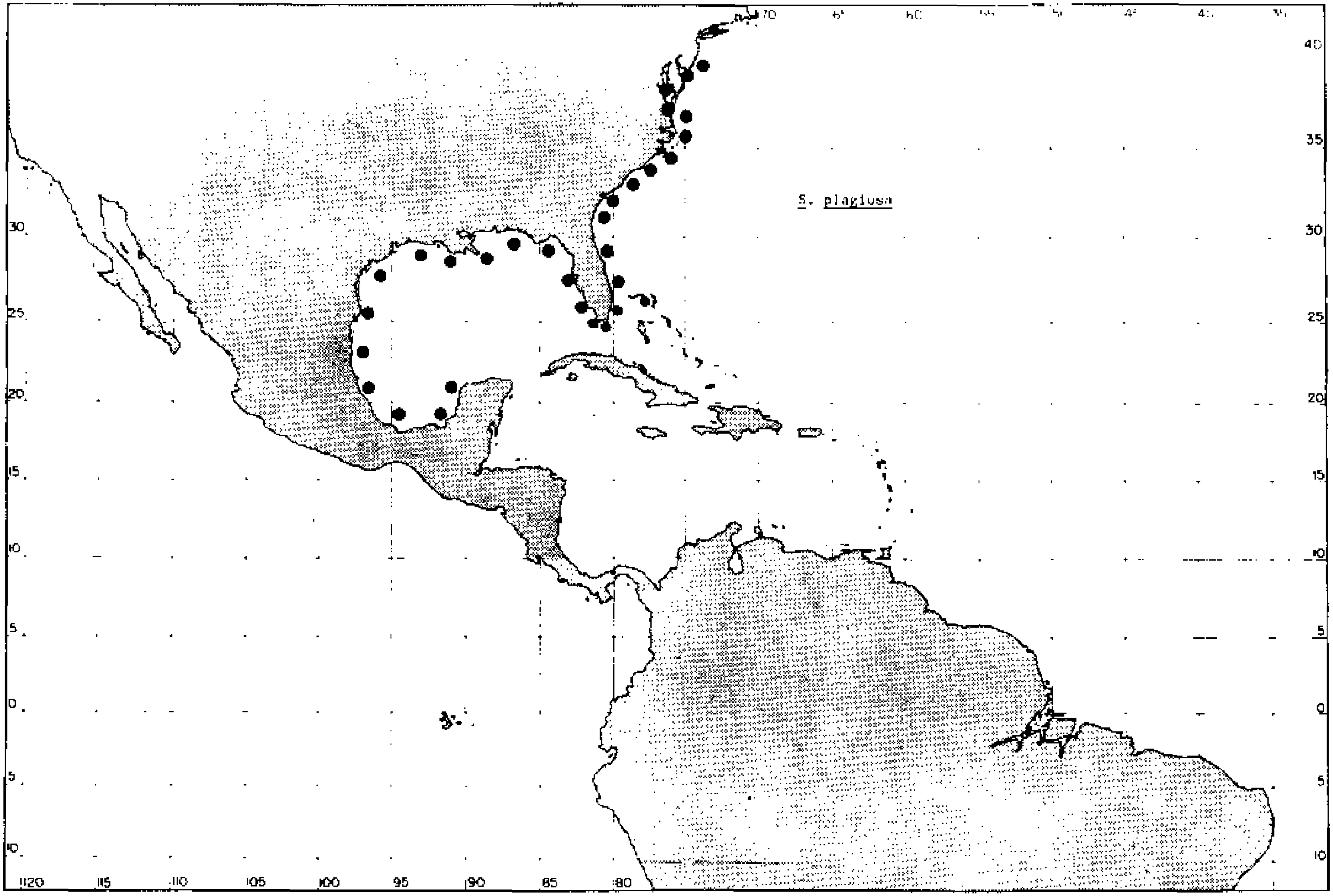
Geographic Distribution (Fig. 25)

Symphurus plagiusa is the most commonly occurring, shallow-water tonguefish along the Atlantic and Gulf of Mexico coasts of the United States and northern Mexico. The center of abundance for this species occurs in the estuarine and nearshore muddy habitats from Chesapeake Bay southward through the Gulf of Mexico to northern Mexico. Along the Atlantic Coast of the United States, S. plagiusa occurs primarily from Chesapeake Bay southward to southern Florida, including the Florida Keys. The species ranges further northward along the coast, but citings north of Chesapeake Bay have only been sporadic captures (Ginsburg 1951; Dorfman et al 1974; Wilk et al 1977; and Materials Section for Delaware Locations). The northernmost captures of this species have occurred in the New York Bight and Long Island Sound. In the Gulf of Mexico, Symphurus plagiusa is also the most common tonguefish occurring in shallow, nearshore and estuarine waters. Symphurus plagiusa has been taken in the Florida Keys and at numerous localities throughout the northern Gulf of Mexico (Topp and Hoff 1972). The southernmost occurrence is the Campeche Peninsula in northern Mexico (this study).

Briggs (1958:298) incorrectly reported that the geographic distribution of S. plagiusa encompassed a range from Long Island to Argentina (40°S). Apparently, in addition to S. plagiusa, Briggs also included distributional information for S. plagusia and S. tessellatus in this account.

Beyond the coastal margins of eastern North America, Symphurus plagiusa has been reported from a number of localities in the Caribbean Antilles (Ginsburg 1951; Topp and Hoff 1972; Sanson et al. 1978) and Bahama Islands (Böhlke and Chaplin 1968). There are voucher specimens from the Bahamas deposited in Academy of Natural Sciences of Philadelphia (see Materials Section). However, other than these specimens, all other reported occurrences of S. plagiusa from Cuba, Puerto Rico and other Caribbean localities are not verified by voucher specimens. Ginsburg reported two specimens from Cuba but these were misidentified and are actually specimens of S. tessellatus both of which aberrantly have only 10 (instead of 12) caudal rays. One specimen (USNM 107365) has the following counts, dorsal 87 and anal 71 (within the range for S. plagiusa) while the other specimen (USNM 37750) has 92 dorsal rays and 78 anal rays. The counts of this last specimen are greater than the variation observed in S. plagiusa and are more typical of counts observed in S. tessellatus. All museum specimens that I have examined, which were collected from localities in Cuba and Puerto Rico, and that had previously been identified as S. plagiusa, have been misidentified. Most were individuals of S. plagusia or S. tessellatus. It

Figure 25. Geographic distribution of *Symphurus plagiusa*.


S. plagiusa

is difficult to determine whether these specimens were initially misidentified or whether the specimens were correctly identified but then labelled incorrectly (because of the similarities in the names plagiusa and plagusia). Regardless of the circumstances, the conclusions reached in the present study are that S. plagiusa does not occur in any Caribbean localities from which it has previously been recorded and, thus far, the only documented occurrences beyond North American continental localities are for the Bahama Islands.

All reports of this species from southern South America (Regan 1914; Lazzaro 1973; Roux 1973; Lema and Oliveira 1977; Lema et al 1980) are likewise based on misidentifications (see Menezes and Benvegnu 1976). Most of these are actually specimens of S. trewavasae.

Bathymetric Occurrence

Symphurus plagiusa is a shallow-water species (Table 70) primarily inhabiting nearshore and estuarine mud bottoms in coastal embayments and estuaries. This species occurs in and comprises a significant portion of fish communities of every major estuarine system from Chesapeake Bay southward including estuaries throughout much of the northern Gulf of Mexico (Topp and Hoff 1972). It is the most euryhaline of American tonguefishes, having been recorded from a salinity range of 0.0-42.9 o/oo (Topp and Hoff 1972; see also Springer and Woodburn 1960 and Swingle 1971). All life history stages are found in nearshore and estuarine mud-bottom habitats. Juveniles especially, occur in extremely shallow saltmarsh tidal creeks (Swingle 1971; Shealy et al. 1974; Stickney 1976; Ogren and Brusher 1977;

Naughton and Saloman 1978); and some have even been captured in small, intertidal tributaries (Bozeman and Dean 1980; Wyanski, Virginia, person. commun.).

Table 70. Summary of depth of capture (in meters) of 285 Symphurus plagiusa.

Depth	0-10	11-20	21-30	31-40	41-50	51-60	61-70	72	119	183
Number	120	149	10	4	3	1	2	1	1	1

Although Ginsburg (1951) and others (Swingle 1971; Shealy et al. 1974; Topp and Hoff 1972) have noted that the majority of this species' population was centered in inshore waters, not all individuals are restricted to inshore habitats. Larger individuals (>100 mm SL) are quite regular in occurrence at moderate shelf depths (10-30 meters) along the Mid-Atlantic, southeastern and Gulf coasts of the United States (Struhsaker 1969; Topp and Hoff 1972; and Materials Examined Section) where they are collected with S. civitatium. In fact, in some coastal locations, captures of this species may even be large enough to comprise small percentages of industrial fisheries (Roithmayr 1965; Anderson 1968). On the nearshore shelf, Symphurus plagiusa is taken most frequently over muddy bottoms and there are very few reports and only small numbers taken over live bottom (calcareous) substrates (Topp and Hoff 1972; McCaffrey 1981; Darcy and Gutherz 1984).

Symphurus plagiusa rarely occurs in waters deeper than approximately 40 meters. There are, however, several reports from depths greater than this. Bullis and Thompson (1965) collected S. plagiusa at a depth of 92 meters. Staiger (1970) reported a single specimen (62 mm SL) taken at 132 meters on the Pourtalis Terrace (identity of this specimen not confirmed) and Chittenden and Moore (1977) listed this species as occurring at the 110 meter bathymetric contour off Louisiana and Northern Texas (specimens not examined in the present study). The deepest occurrence for this species is for a single specimen collected at 183 m.

Since most specimens collected on the open shelf are larger individuals, it is possible that this species undergoes an ontogenetic movement from shallow, estuarine and saltmarsh environments, first to more open embayments, and finally to suitable substrates on the nearby open shelf (Topp and Hoff 1972).

The general occurrence of S. plagiusa corresponds with the distribution of soft mud and sandy bottoms in protected embayments and estuaries. A preference for protected waters with muddy substrates is reflected in the almost universal occurrence of S. plagiusa in species lists of community studies conducted in these habitats and the sporadic occurrence and general scarcity of this species in shallow water habitats in high energy (coarse sand) surfzone areas (Modde and Ross 1981).

Ecology

Considerable information is available on various aspects of the life history of S. plagiusa. Most earlier citations regarding geographic and bathymetric distributions are listed in the synonymies provided in Jordan and Goss (1889) and Topp and Hoff (1972). Topp and Hoff (1972) provide a detailed discussion of the general ecology of S. plagiusa and the reader is referred to that study for further information. The following brief discussion is based on information gathered from specimens examined in the present study. Additional information provided in published studies listed above will serve to direct the reader to major contributions on the ecology of S. plagiusa published since Topp and Hoff (1972).

Symphurus plagiusa is a medium-sized tonguefish attaining maximum lengths of approximately 171 mm SL (this study). Most adults measured in this study ranged from 120-150 mm SL. Fish larger than this were generally rare in the collections. Moe and Martin (1965) reported a specimen measuring 174 mm TL and Topp and Hoff (1972) reported a size range of 109-166 mm SL for the 14 individuals collected in their study. The following studies provide information on relative abundance, seasonality and length-frequency relationships for this species (Alabama-Swingle 1971; South Carolina-Shealy et al. (1974; Florida-Ogren and Brusher 1977; Naughton and Saloman 1978; Northern Gulf of Mexico-McCaffrey 1981).

Symphurus plagiusa apparently feeds close to the substrate as most studies list benthic prey items and sand grains in food habit studies. Stickney (1976) reported that in Georgia estuaries this species feeds primarily on benthic mollusks and crustaceans. Topp and Hoff (1972) found that the six individuals which they examined had fed on a variety of benthic prey, including crab and other crustacean remains, polychaetes, amphipods, cumaceans and brachiopods. Other food habit information is available in Reid (1954) and Springer and Woodburn (1960).

Olney and Grant (1976) provide a description of early life history stages from Chesapeake Bay.

Geographic Variation

Ginsburg (1951) provided information on geographic variation in meristics for *S. plagiusa*. He found that this species was comparatively homogeneous with respect to meristic variation. He analyzed variation in dorsal and anal counts for fishes segregated into three major geographic regions and found that there were only slight differences in *S. plagiusa* collected from the three regions. *Symphurus plagiusa* from the northern part of the Gulf of Mexico averaged the highest counts, those from Key West to Tampa, inclusive, the lowest, and the population on the Atlantic coast was intermediate between the other two.

Material Examined

Measured and Counted 30 Specimens, 3 Lots.

VIMS 1315; 26(64.7-143); James River, VA; 9M; 22 IV 71. VIMS 1598; 3(156-171); 34°26'N 76°17'W; 35M; 22 IV 71. UF 35425; (124); 24°40'N 81°53'W; 10M; 20 V 78.

Counted 109 Specimens, 32 Lots.

ANSP 101977; (132); Hatchett Bay, Eleuthera Island, Bahamas; 6-13 II 60. ANSP 111567; 3(120-126); 3 mi. offshore Great Bahama Bank, Eleuthera Island, Bahamas; 9M; 20 IV-3 V 60. FDNR 5197; (138); 26°24'N 82°06'W; 07 IV 67. FDNR 10772; (147); 6.5 mi. NNE South Shoal Light, Key West, FL; 15M; 08 IV 78. FDNR UNCAT MOTE 310.93; 2(108-123); 24°48'N 82°13'W; 24M; 19 XI 80. IMS 553; 8(113-144); Morros, MX; 14M; 16 II 51. IMS 554; 10(113-144); 30 mi. NW Campeche, MX; 16M; 6-7 II 51. IMS 555; 6(125-147); W Campeche, MX; 26M; 27-29 VII 51. TCWC 461.3; 2(95.4-107); Galveston, TX; 28 VII 75. TCWC 528.1; 2(53.9-76.4); Galveston, TX; 1M; 31 VII 75. TCWC 547.4; 5(72.6-102); 29°15'15"N 94°55'06"W; 1M; 29 VII 75. TCWC 4160.10; (92.8); 29°23'N 94°29'W; 15M; 27 X 73. UF 35435; (124); 24°43.5'N 82°09'W; 20M; 20 V 78. UMML 1781; 2(133-150); 20°05'36"N 91°13'W; 22M; 08 XII 52. UMML 5217; (110); 3 mi. N Smith Shoal Light, Key West, FL; 16M; 01 VI 59. UMML 20825; 6(111-143); 5 mi. NW Smith Shoal Light, Key West, FL; 6M; XII-I 63-64. UMML 31721; (116); 24°50'N 80°37.5-35.5'W; 39M; 26 II 69. UMML UNCAT TABL 67-283; (128); 7 mi. S Bear Cut Bridge, Key Biscayne, FL. USNM 158222; 3(109-130); Dolphin Island, Miss; 16M; 06 V 54. USNM 187151; (125); Delaware River, DE; 1951-52. USNM 187180; 2(44-46); White Creek, Indian River, DE; 03 IX 57. USNM 265181; (131); 20°54'N 73°33'W; 183M; 26 V 65. USNM 274481; 4(114-129); ~24°30'N; 12M; 17 III 47. USNM 274482; 3(121-141); ~24°30'N; 12M; 17 III 47. USNM UNCAT SB 5320; (151); 28°13.5'N 80°21'W; 21M; 14 XI 63. VIMS UNCAT 82-02 ST70; 7(102-106); 34°39'N 76°37'W; 14M; 16 III 82. VIMS UNCAT 82-02 ST71; 8(99.7-126); 34°35'N 76°35'W; 17M; 16 III 82. VIMS UNCAT 82-02 ST72; 5(107-120); 34°34'N 76°33'W; 14M; 16 III 82. VIMS UNCAT

82-02 ST88; (147); 35°13'N 75°25'W; 21M; 17 III 82. VIMS UNCAT; 22(47.7-107); Calcasieu Lake, LA; 1982. VIMS UNCAT ALBIV ST66; 2(108-111). VIMS UNCAT ALBIV ST 86; (133).

Other Material 240 Specimens, 62 Lots.

AMNH 11899; (53.2); Cape Lookout, NC. ANSP 8684; (114); Mississippi Sound, LA. ANSP 94304; (22.2); Marquesas Key, FL; 1M; 18 III 54. ANSP 144732; 2(73.1-75.3); Port Isabel Ship Channel, TX; 16 IV 48. ANSP 144935; 2(48.8-61.0); Port Isabel Ship Channel, TX; 30 XI 47. ANSP 144937; (81); Port Isabel Ship Channel, TX; 26 III 48. FMNH 38320-23; 4(27.3-42.7); Charleston Harbor, SC; 09 VI 39. FMNH 55920; (124); unknown locality. FMNH 88735; 4(104-124); 30°09'N 88°41'W; 16M; 22 VI 63. GCRL V76:15111; 4(26.3-30.4); 1 mi. E Ocean Springs, Miss.; 1M; 09 VI 50. MCZ 58653; 5(119-133); EASTWARD STA 19811. TCWC 461.3; 8(42.2-53.3); Galveston, TX; 28 VII 75. TCWC 528.1; 7(43.4-51.0); Galveston, TX; 1M; 31 VII 75. ALA UNCAT (Removed From UAB 2385.07); 4(60.5-87.6); Mobile Bay, AL. UF 10295; 5(142-149); 9 mi. W Boca Grande Sea Buoy, GMX, FL; 15M; 22-23 VI 60. UF 26740; (135); 24°45'N 82°07'W; 20 V 70. UF 35471; (151); 29°58.4'N 81°17.1'W; 14M; 15 V 81. UF 35486; 29°58.1'N 81°16.9'W; 14M. UF 38895; (121); Core Creek, N Newport River, NC; 16 IV 73. UMML 2916; (130); Between Jacksonville, FL-Brunswick, GA; 68M; Jan. 56. UMML 5193; (108); 24°45-50'N 82°10-30'W; July, 56. UMML 5723; (163); off Boca Grande, FL; 12M; 24 V 59. UMML 6204; 4(56.7-99.5); Coot Bay Canal, FL; 13 IV 59. UMML 10541; 3(156-157); 35°00'N 75°30'W; 46M; 17 VI 57. UMML 10543; (161); 34°58'N 75°32'W; 55M; 17 VI 57. UMML 10578; (158); 34°59'N 75°20'W; 64M; 17 VI 57. UMML 11198; (141); 29°26'N 84°54'W;

18M; 25 VII 58. UMML 14210; (146); Biscayne Bay, FL; 28 V 63. UMML LRR 1788; (37.5); Vero Beach, FL; December, 1950. UMML UNCAT TABL 67-289; (96.5). UMML UNCAT SB1288; (144); 34°41'N 76°50'W; 11M; 20 IX 59. UMML UNCAT SB3464; 18(118-152); 30°31'N 81°22'W; 13M; 05 10 61. UMML UNCAT SB3972; (135); 28°56'N 91°27'W; 6M; 11 IV 62. UMML UNCAT SB4636; 3(109-143); 24°50.5'N 82°12'W; 26M; 14 XII 62. USNM 59056; 5(34-47.2); Long Island Sound, CT; 24M; 17 IX 1892. USNM 73260; (50.2); 37°54'N; 11M; 13 II 1902. USNM 265180; 2(20.0-38.7); 2.8 mi. S Lower Matecumbe Key, FL; 1M; 09 II 61. USNM UNCAT OR5809; (161); 28°19'N 80°34'W; 13M; 01 XII 65. VIMS 1314; 3(76-122); York River, VA; 3 XII 51. VIMS 3852; (118); Tidepool, Dauphin Island, AL; 26 VIII 74. VIMS 7315; 16(52.9-83.4); Pinellas County, GMX, FL; 1M; 04 VI 77. VIMS UNCAT; 20(15-30); Wassaw Sound, GA; 15 IX 80. VIMS UNCAT; 7(15-30); Wassaw Sound, GA; 12 IX 80. VIMS UNCAT; 20($\leq$ 25); Wassaw Sound, GA; 15 X 80. VIMS UNCAT; 3(< 20); Wassaw Sound, GA; 12 XII 80. VIMS UNCAT 82-02 ST72; 3(100-124); 34°34'N 76°33'W; 14M; 16 III 82. VIMS UNCAT 82-02 ST45; (158); 33°43'N 78°11'W; 17M; 14 III 82. VIMS UNCAT 82-02 ST84; (147); 35°05'N 75°57'W; 12M; 17 III 82. VIMS UNCAT 83-02 ST80; (137); 35°01'N 76°05'W; 119M; 22 III 83. VIMS UNCAT 83-08 ST23; 6(77-148); 34°58'N 76°04'W; 10M; 15 IX 83. VIMS UNCAT 83-08 ST38; (133); 34°35'N 76°34'W; 11M; 16 IX 83. VIMS UNCAT 83-08 ST54; (120); 33°48'N 78°02'W; 12M; 18 IX 83. VIMS UNCAT 83-08 ST55; (107); 33°51'N 78°06'W; 13M; 18 IX 83. VIMS UNCAT 83-08 ST93; (158); 35°30'N 75°13'W; 33M; 21 IX 83. VIMS UNCAT 83-08 ST96; 2(117-126); 35°45'N 75°22'W; 12M; 21 IX 83. VIMS UNCAT 84-02 ST50; (132); 34°35'N 77°00'W; 15M; 06 III 84.VIMS UNCAT 84-02 ST61; 3(124-137); 34°57'N 76°08'W; 11M; 07 III 84. VIMS UNCAT 84-02 ST62; 8(106-148);

$35^{o}00'$N $76^{o}03'$W; 12M; 07 III 84. VIMS UNCAT 84-02 ST63; 9(127-151); $35^{o}04'$N $75^{o}56'$W; 13M; 07 III 84. VIMS UNCAT 84-02 ST64; 14(116-149); $35^{o}07'$N $75^{o}51'$W; 14M; 07 III 84. VIMS UNCAT 84-02 ST67; 13(98-162); $35^{o}12'$N $75^{o}38'$W; 12M; 08 III 84.

Symphurus urospilus Ginsburg 1951

(Fig. 48B)

Spottail Tonguefish

Symphurus urospilus

Ginsburg 1951: 193; Original description; Savannah, GA; Holotype USNM 155225.

Springer and Bullis 1956: 65; Listed, Gulf of Mexico.

Briggs 1958: 298; Listed, Florida.

Bullis and Thompson 1965: 35; Listed, NE FL and FL Keys.

Moe and Martin 1965: 149; Listed, Tampa Bay, FL.

Beaumariage 1968: 8; Listed, St. Petersburg, FL.

Struhsaker 1969: 298, App. B; Listed, SE United States.

Topp and Hoff 1972: 90; Listed, SW FL.

Vergara Rodriguez 1976: 6; Listed, Cuba.

Study Material: 122 specimens, 26.2-166 mm SL. 115 x-rayed; 55 measured.

Diagnosis

The combination of 11 caudal rays, a 1-4-3 ID pattern, well-developed pupillary operculum and presence of a single, large, ocellus on the caudal fin distinguish *S. urospilus* from all other *Symphurus*. Other New World species with spotted fins differ in caudal ray count (S. atramentatus, eastern Pacific, 12 caudal rays; S. diomedeanus and S. ommaspilus, western Atlantic, 10 caudal rays) and either lack a caudal spot altogether, or if a caudal spot is present (occasionally in S. diomedeanus), there are spots present also on the dorsal and anal fins.

Excluding caudal ray counts, there is almost complete overlap in meristics between S. urospilus and two sympatric (but not syntopic) western North Atlantic species, S. plagiusa and S. civitatium. In addition to differences in caudal ray counts (11 vs. 10 in S. plagiusa), there are obvious differences in pigmentation patterns of S. urospilus (with a single spot on the caudal fin and no pigment spot on the operculum) and S. plagiusa (caudal spot absent and opercular spot usually present). Additionally, S. urospilus has a well developed pupillary operculum (absent in S. plagiusa). There is partial overlap in counts between S. urospilus and S. civitatium but the two species are quite distinctive. In S. urospilus there is a well developed caudal spot and pupillary operculum (both absent in S. civitatium). Also, S. urospilus has 11 caudal rays (12 in S. civitatium), and lower meristics with usually 45-47 vertebrae (47-49 in S. civitatium), 83-91 (vs. 86-93) dorsal rays and 64-74 (vs. 70-78) anal rays.

Description

Symphurus urospilus is a medium-sized tonguefish attaining maximum adult lengths of approximately 166mm SL. The usual ID pattern is 1-4-3, less frequently, 1-4-2 and 1-5-3 (Table 9). Caudal rays usually 11, only rarely otherwise (Table 10). Dorsal rays 83-91 (usually 85-89) (Table 11), Anal rays 64-74 (usually 68-72) (Table 12). Vertebrae 44-48 (usually 45-46) (Table 13). Hypurals 4. Scales large, strongly ctenoid on both sides. Longitudinal scale rows 67-82 (usually 70-80) (Table 14). Scale rows on head posterior to lower orbit 12-17 (usually 15-16) (Table 15). Lateral scale rows 29-40, usually 31-35 (Table 16). Proportional measurements appear in Tables 71-72.

Body deep (depth 28.0-36.0% SL); maximum depth in anterior one-third of body. Head wide (22.4-30.8% SL); snout relatively short, rounded (13.8-25.5% HL), covered with small ctenoid scales. Dermal papillae well developed on blind side of snout, chin and dorsal portion of the head near base of dorsal fin; in larger specimens, dermal papillae extend onto ocular side of snout. Posterior extension of maxilla reaches to about middle of lower eye. Lower lip on ocular side bears a distinct, fleshy ridge a short distance before posterior margin. Eyes relatively large (10.2-17.0% HL); usually equal in position, although occasionally upper eye slightly anterior to lower. Eyes without scales; usually with only 1-2 small, ctenoid scales in narrow interorbital space. Pupillary operculum well-developed. Dorsal fin origin usually at a vertical equal to front of upper eye; occasionally anterior to eye or sometimes reaching only the mid-point of upper eye. Scales usually absent on dorsal and anal fins; occasionally with 1 or 2 scales at fin-ray bases in larger specimens.

Teeth well developed on blind side jaws. Lower jaw on ocular side usually with a single, mostly incomplete row of slender teeth; upper jaw on ocular side usually lacking teeth altogether, or possessing a small number of slender teeth anterior to anterior nostril.

Table 71. Summary of proportional measurements for *Symphurus urospilus*. Measurements, except Standard Length (mm), are expressed in thousandths of Standard Length.

Character	N	Range	MEAN	SD
SL	55	37.1-166.0	116.8	23.50
BD	55	285-366	336.6	14.97
PDL	54	19-52	33.9	7.47
PAL	54	166-240	195.1	14.86
DBL	55	941-981	965.6	8.13
ABL	55	730-874	801.8	23.63
PL	54	50-87	67.8	8.58
PA	54	35-73	52.3	8.06
CFL	55	80-139	117.5	10.04
HL	54	155-213	180.6	10.08
HW	54	224-308	267.2	16.93
POL	54	76-131	111.2	11.63
SNL	53	25-44	35.5	4.40
UJL	54	31-51	39.8	4.10
ED	53	18-36	22.6	2.71
CD	53	35-70	51.0	7.44
UHL	55	131-212	181.6	13.63
LHL	54	79-115	100.0	8.15

Table 72. Summary of morphometric measurements for *Symphurus urospilus*. Measurements, except Head Length (mm), expressed in thousandths of Head Length.

Character	N	Range	MEAN	SD
HW/HL	54	1.1-1.7	1.5	0.12
POL	54	439-773	617.7	56.17
SNL	53	138-255	196.0	20.83
UJL	54	188-261	220.6	17.37
ED	53	102-170	126.0	12.93
PDL	55	108-285	188.4	38.19
CD	53	158-391	280.1	42.60
UOP	55	135-268	214.9	26.78
LOP	55	250-427	331.9	36.80
UHL	54	698-1175	1009.2	87.52
LHL	55	417-725	554.1	51.64

Pigmentation

Eyed surface usually dark brown with 4-11 (usually 6-10) well-developed, complete, sharply-contrasting dark brown crossbands. Bands not continued onto dorsal and anal fins. The first band crosses immediately behind eyes and the second crosses the forward part of the operculum. Usually the darkest bands are the third and fourth which are placed on the body just posterior to the operculum. Bands variable in number along trunk. The last band situated a short distance from caudal region. Occasionally bands scarcely evident against general dark background. Individuals from sandy habitats occasionally have a lighter, almost whitish background color. Operculum not pigmented other than general background color. Inner operculum and isthmus not pigmented. Slight moustache on ocular side upper lip; lower lip frequently spotted but without definite moustache. Blind side clear, creamy white. Peritoneum unpigmented.

Distal half of caudal fin with a single, well-developed spot. Caudal spot clearly evident even in smallest (26.2mm SL) specimen examined. This spot generally circular in outline and surrounded by a clear, whitish area. Proximal half of caudal occasionally with a small pigment blotch of variable intensity. Extreme tips of caudal rays usually unpigmented or occasionally with faint, light brown pigmentation. No defined pigmentation patterns in dorsal and anal fins. Dorsal and anal rays and membranes highlighted with dark brown pigment which is darkest in regions of crossbands. Distal tips of dorsal and anal rays unpigmented.

Geographic Distribution (Fig. 26.)

Symphurus urospilus is a warm-temperate species with a fairly restricted distribution in the western North Atlantic. Along the Atlantic coast of the southeastern United States, it occurs primarily from North Carolina, south of Cape Hatteras to southern Florida. In the Gulf of Mexico, it has been taken at the southern tip of Florida, including the Florida Keys region and Tortugas, and is common in the eastern Gulf along the west Florida shelf at least as far north and west as Apalachee Bay. It has not been reported from shelf areas of the central and western Gulf of Mexico, except for two lots collected off Galveston, Texas. It is apparently common in the Campeche Bank region of the Yucatan Peninsula. There is a single citation from Cuba (Vergara Rodriguez 1976).

Size and Sexual Maturity

The largest specimen (166 mm SL) examined in this study was a male. The largest female was somewhat smaller, measuring only 149 mm SL. Based on the reproductive state of females, it appears that sexual maturity occurs around 100 mm SL. No females (with a single exception) less than 100 mm SL were gravid. Six females between 91.9-99.9 mm SL had ovaries which were elongating but they did not contain ripe ova. Two of the smallest females (37.1-41.3 mm SL) showed no sign of gonad elongation. The smallest gravid female was 88.8 mm SL, but this was apparently an unusual specimen, as most gravid females were between 101-149 mm SL. Topp and Hoff (1972) noted that specimens caught in September off the West Florida shelf had ripe and ripening gonads, and a specimen collected in late August had developing ova.

Their smallest specimen (27 mm SL) was collected in November, further suggesting a late summer-early fall spawning period.

Ecology

The general occurrence of *S. urospilus* corresponds with the distribution of live bottom habitats along the southeast coast of the United States and the Yucatan Peninsula of Mexico (Fig. 26). Although this species has been taken at depths ranging from 5-322 m (Table 73), its center of abundance occurs primarily in the relatively narrow depth zone between 11-40 meters. It is not known to occur in estuarine areas, and the two smallest specimens (26.2 and 27.0 mm SL, respectively) examined in this study were collected on the shelf at depths occupied by adult fishes.

Little is known regarding the life history of this species. From their small sample, Topp and Hoff (1972) noted that on the west Florida shelf, specimens of *S. urospilus* were collected at bottom temperatures of 16.4-30.0°C and bottom salinities of 32.8-36.2°/oo. They also noted that three specimens examined for food items had fed on crustaceans and a gastropod.

Table 73. Summary of bathymetric distribution (in meters) for 112 specimens of *S. urospilus*.

DEPTH	5-10	11-20	21-30	31-40	>41
N	11	31	49	17	4
%	10	28	44	15	4

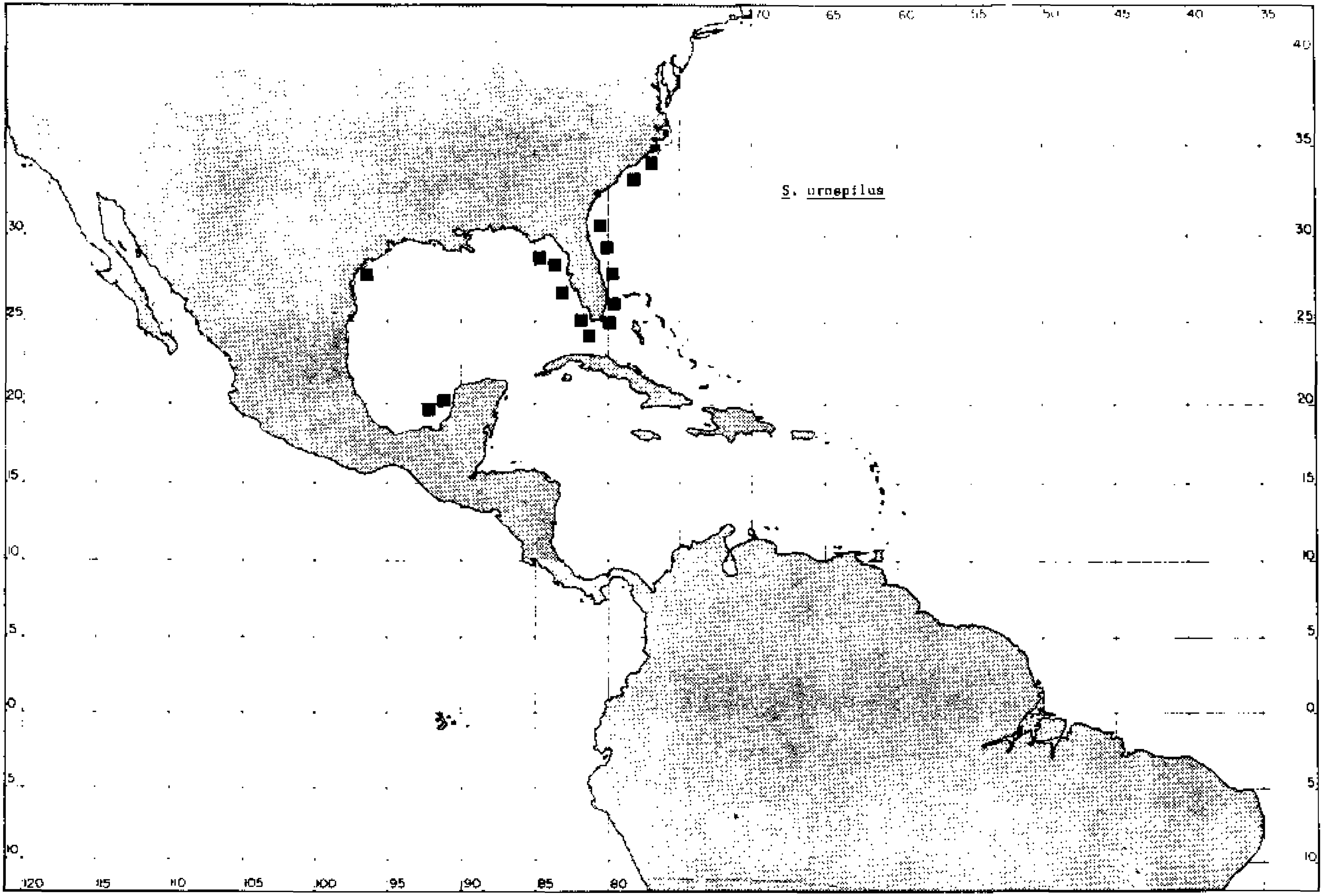
Geographic variation

Results of specimens analyzed for geographic variation in selected meristics appear in Table 74. Specimens from the southeastern coast of the United States and western Gulf of Mexico had similar counts for dorsal and anal fin rays and vertebrae. These counts were consistently higher than corresponding counts observed in eastern Gulf of Mexico specimens.

Table 74. Summary of geographic variation in meristic counts for *S. urospilus*. Abbreviations- SEUS- southeastern United States; EGMX- eastern Gulf of Mexico; WGMX-western Gulf of Mexico including Yucatan shelf region.

CHARACTER	N	AREA	MEAN	RANGE	SD
DORSAL RAYS	20	SEUS	86.6	84-90	1.35
	70	EGMX	85.0	82-88	1.24
	26	WGMX	87.3	84-89	1.25
ANAL RAYS	20	SEUS	70.4	67-72	1.14
	70	EGMX	69.0	64-71	1.27
	26	WGMX	71.0	68-74	1.37
VERTEBRAE	20	SEUS	45.8	45-47	0.52
	70	EGMX	45.2	44-46	0.51
	26	WGMX	46.3	45-48	0.60

Figure 26. Geographic distribution of Symphurus urospilus.


S. urnepilus

Material Examined

Measured and Counted 55 Specimens, 30 Lots.

Atlantic Coast

USNM 155225; Holotype (136); Savannah, GA; 32°01'N 80°11' 30"W; 22M; 3 II 40. GMBL 74-11; (142); 32°02'N 79°25'W; No Depth; 14 VIII 74. GMBL 74-183; (137); 32°41'N 79°38'W; 11M; 25 X 74. GMBL 75-154; (125); 23°30'-29°12'N 80°51-55'W; 17M; 12 IX 75. GMBL 76-266; (98.9); 32°57'N 79°09'W; 14M; 6 IX 76. GMBL 76-273; (124); 31°07'N 80°56'W; 15M; 13 IX 76. MCZ 58651; 2(125-141); 30°50.4-51.8'N 80°55.5-56.3'W; 20M; 17-22 III 71. MCZ 58652; (132); 30°42'N 81°04'W; 14M; 17 III 81. TU 14789; 2(142-166); 29°03'N 79°59'W. 322M; 13 VI 56. UF 13238; (146); 32°86'N 79°03'W; 42M; 1 XI 56. UF 28318; (141); 33°28'N 78°07'W; 26M; 22 VI 78. USNM 267315; 5(129-146); 30°37'N 80°59'W; 28M; 26 VIII 65.

Eastern Gulf of Mexico

USNM 73262; Paratype (42); Pepperfish Key, FL; 29°32'N 83°58'30"W; 19M; 7 XI 01. FDNR 800; (88.8); 24°41'N 82°35'W; 26M; 26 VIII 58. FDNR 1595; (114); 24°42'N 82°16'W; 29M; XI 59. FDNR 2144; (104); NW Marquesas Key, FL; 18M; 1 V 62. FDNR 9857; (132); 18 mi. NW Smith Shoal Light, FL; 23M; 7 XI 77. FDNR 10155; (90.4); 8 mi. W Boca Grande, FL; 15M; 30 XI 77. GCRL V76-14878; (144); 16 mi. off Perdido Bay, FL; 22M; 14 IX 75. UF 35443; (142); 25°17.5'N 82°32'W; 33M; 21 V 78. USNM 73259; (41.3); 29°39' 30"N 83°53'10"W; 28M; 7 XI 01. USNM 158315; 2(141-149); 25°50'N 82°30'W; 28M; 8 IV 54. UWF 2323; 8(101-126); 24°45'N 82°33'W; 31M; 11 XII 76. UWF 2356;

(111); 24°47'N 82°39'W; 33M; 11 XII 76. UWF 2406; (111); 24°48'N 82°32'W; 31M; 12 XII 76.

Western Gulf of Mexico

TCWC 3303.1; 2(98.7-99.7); 28°36-14'N 95°12-07'W; 37M; 3-4 XII 80. TCWC 3307.1; (94.3); 28°20'N 95°08'W; 36M; 1 XII 78.

Mexico Yucatan Shelf

IMS 559; 3(104-105); Porta Morros, Mexico; 14M; 16 II 51. IMS 560; 9(103-112); W of Campeche, Mexico; 27M; 27-29 VII 51. UF 30363; (141); 20°54'N 91°30'W; 34M; 29 VIII 80.

Counted 67 Specimens, 22 Lots.

Atlantic Coast

UMML 2914; (128); Between Jacksonville, FL. and Brunswick, GA; 64M; Jan. 56. USNM 156068; (56.7); 28°21' 30"N 78°49'W; 18M; 7 XII 62.

Eastern Gulf of Mexico

FDNR 2460; (141); 60 mi. W of Tarpon Springs, FL; 20 VI 64. FDNR 4448; 2(109-133); 26°24'N 82°28'W; 18M; 3 IX 65. FDNR 4880; 2(115-122); 27°37'N 83°07'W; 18M; 1 XII 66. FDNR 4995; (132); 26°24'N 82°28'W; 18M; 14 II 66. FDNR 5059; 4(135-157); 26°24'N 82°28'W; 18M; 21 VII 66. FDNR 10206; (128); 20 mi. N New Grounds Shoal Light, FL; 31M; 2 XII 77. FDNR 10231; (112); 14 mi. NE Pulaski Shoal Light, FL; 31M; 2-3 XII 77. FDNR 10771; 2(128-133); 6.5 mi. NNE Smith Shoal Light, FL; 15M; 8 V 78. FDNR 10932; (102); Cedar

Keys, FL; 9M; 8 VI 78. FDNR 11533; (115); 29°07'N 80°44'W; 18M; 20 IX 73. FDNR 12849; (146); 30°40'N 80°47'W; 28M. FDNR 14632; (53.0); 26°24'N 82°28'W; 18M; 21 VII 66. FDNR 14670; (109); 26°24'N 82°28'W; 18M; 21 VII 66. FDNR UNCAT MOTE 310.111; 2(27.0-46.8); 25°17'N 82°09'W; 23M; 12 II 82. UF 21903; 10(91.9-101); 25°41'N 81°40'W; 5M; 1 XI 75. UF 43331; (97.9); 24°51'N 82°23'W; 4 V 61. UMML 1787; (112); 45 mi. NW Key West, FL; 26M; 15 VI 53. UMML 3083; 13(100-127); 24°45'N 82°20'W; 24M; 26 V 57. UMML 4699; 3(113-119); 24°45'N 82°20'W; 18M; 10-12 III 58.

Mexico Yucatan Shelf

FMNH 45430; 9(115-137); 20°05'N 91°13'W; 22M; 8 XII 52.

Other Material 6 Specimens, 3 Lots.

FDNR 6544; (25.0); 27°37'N 83°07'W; 18M; 2 XI 67. UF 44364; 4(124-140); 30°43'N 80°30'W; 38M; 11 VI 85. UMML 20824; 2(105-119); 5 mi. NW Smith Shoal Light, Key West, FL; Dec.-Jan. 63-64.

CHAPTER 6.7

Western Atlantic Shallow-water Tonguefishes With a 1-4-3 ID Pattern and 12 Caudal Rays

In the western Atlantic, the species of shallow-water, 12 caudal-rayed tonguefishes possessing a 1-4-3 ID pattern range from North Carolina to Uruguay. These tonguefishes are quite common and locally abundant in beach seine and trawling studies conducted throughout much of this geographic range. Considerable nomenclatorial and taxonomic uncertainty has been associated with these western Atlantic tonguefishes. Most of the confusion in nomenclature is centered around the shallow-water species collected in the Caribbean Sea and along the coasts of Central and South America. The confusion has resulted partly from the vague descriptions of the earliest authors who provided little or no diagnostic information in their descriptive accounts. Also contributing to the confusion was the fact that these authors did not deposit type specimens preventing comparative studies by other ichthyologists.

Historically, at least 10 different combinations of names have been applied to the western Atlantic, shallow-water species possessing 12 caudal rays. The most consistent treatment, lasting nearly 90 years, has been to recognize only one widespread, polytypic species of shallow-water, 12 caudal-rayed tonguefish. This practice began with Kaup in 1858 and has continued until the present study, although some authors, for example

Menezes and Benvegnu (1976), have questioned the accuracy of recognizing only one species among all of the specimens collected. In these most recent studies, authors have failed to recognize the presence of multiple sympatric species among their material, instead, they have considered there to be only a single, widespread, polytypic species of shallow-water, 12 caudal-rayed western Atlantic tonguefishes.

In the present study, five species (mostly sympatric, but not completely syntopic) of shallow-water, 12 caudal-rayed tonguefishes are recognized (see below). Examination of approximately 800 specimens of shallow-water, 12-caudal rayed *Symphurus* from North Carolina and the Caribbean southward to Uruguay reveals that not one widespread, polytypic species ranges from the Caribbean to southern Brazil and Uruguay, but instead, evidence is presented which indicates that four morphologically similar species should be recognized. Two of these species, *S. plagusia* (Schneider, in Bloch and Schneider 1801) and *S. tessellatus* (Quoy and Gaimard 1824), have previously been described. Two additional species (undescribed species D and E) are described below. The fifth species in this group (*S. civitatium*) is completely allopatric from the others and occupies mud substrates along the nearshore continental shelves of the eastern and Gulf coasts of the United States.

Listed below is a discussion of the nomenclatorial history of the shallow-water, 12 caudal-rayed tonguefishes of the western Atlantic. Because of their common occurrence, these species are included in almost every study on shallow-water fishes of the Caribbean and Central America. Therefore, references to these species are both numerous and begin with the oldest literature dealing with fishes of this region. Since little descriptive or ecological information was provided in most of the original accounts of these tonguefishes, it was often impossible when reviewing the literature to accurately determine which species the author may have studied. For example, in studies dealing with tonguefishes occurring in the Caribbean and along the coasts of Central and South America, the possibility exists of any combination of four species being considered in the accounts. Since most of these studies considered nearshore fishes, most of the literature dealing with specimens from these regions is discussed under the account of _S. plagusia_. Only those studies that specifically dealt with species other than _S. plagusia_ are included in the synonymies of the remaining species of shallow-water, 12 caudal-rayed tonguefishes. Most southern South American references to tonguefishes belonging to this group refer to _S. tessellatus_ and are included in the synonymy of that species.

<u>Symphurus plagusia</u> (Schneider, in Bloch and Schneider 1801)

(Fig. 49B)

<u>Plagusia</u>

Browne 1756; Jamaica; non-binomial; Suppressed under the Plenary Powers for nomenclatorial purposes in Direction 32 (signed, 26 November 1955; published 17 May 1956) Opininion 89 (see Hemming and Noakes 1958:9).

<u>Pleuronectes plagusia</u>

Browne 1789: 445; Jamaica; non-binomial; Suppressed under the Plenary Powers for nomenclatorial purposes in Direction 32 (signed, 26 November 1955; published 17 May 1956) Opininion 89 (see Hemming and Noakes 1958:9).

Schneider, in Bloch and Schneider 1801: 162; (after Browne); No original material examined, based strictly on the description provided by Browne.

Cuvier 1817: 224; Listed.

Cuvier 1829: 344; Listed.

<u>Achirus ornata</u>

Lacepede 1803: 659, 663; Vague description of a tonguefish donated to France by Holland but of uncertain geographic origin.

Cuvier 1829: 344; Listed.

Aphoristia _ornata_

Kaup 1858: 107; New combination; Synonymized with _Plagusia_ _tessellata_ Quoy and Gaimard 1824.

Günther 1862: 490; Synonymy, meristics; Synonymized with _Plagusia_ _tessellata_ Quoy and Gaimard 1824.

Goode and Bean 1885b: 196; Substitute name for _Pleuronectes_ _plagiusa_ Linnaeus 1766.

Jordan 1885: 395; Possible synonymy of _A_. _ornata_ Lacepede 1803 with _Pleuronectes_ _plagiusa_ Linnaeus 1766; _Aphoristia_ _ornata_ Lacepede 1803 from Jamaica distinct from _A_. _fasciata_ (=_Plagusia_ _fasciata_) Holbrook in DeKay 1842.

Aphoristia _fasciata_ (not of DeKay)

Goode and Bean 1895: 458; Figured, listed in key; Jamaica.

Aphoristia _plagiusa_

Jordan 1886a: 31; Cuba; Equals _A_. _ornata_ of Poey.

Jordan 1886b: 603; West Indies; Equals _A_. _ornata_ of Poey.

Symphurus _plagusia_

Jordan and Goss 1889: 100; Synonymy, nomenclature review; Distribution, comparison with _S_. _plagiusa_; Synonymized with _Plagusia_ _tessellata_ Quoy and Gaimard 1824.

Jordan and Evermann 1898: 2709; Synonymy, counts, measurements, description; Essentially discussion of Jordan and Goss; Distribution West Indies to Brazil; Cuba to Rio de Janeiro.

Menezes and Benvegnu 1976: 142; Recommended re-examination of Ginsburg's diagnoses of two subspecies; Description, life history information and distribution in Brazil.

Symphurus plagusia plagusia

Ginsburg 1951: 199 (In part); Synonymized with Plagusia tessellata Quoy and Gaimard 1824; Description and diagnoses of two new subspecies; Included four species in material studied.

Caldwell 1966: 84; Listed, offshore locations near Jamaica.

Carvalho et al 1968: 22 (In part); Brief description, listed in key; Brazil.

Palacio 1974: 87 (In part); Listed from Colombia.

Remarks

The earliest description of a western Atlantic, shallow-water, 12 caudal-rayed tonguefish is for a specimen collected in Jamaica that Browne (1756) first described as Plagusia (1756) and later (1789) as Pleuronectes plagusia. He described this specimen as a small sinistral flatfish with dorsal, anal and caudal fins united (tail ending in sharp point), lacking pectoral fins and lateral lines. His description was clearly that of a tonguefish, however, he provided no figure or useful diagnostic counts or characters to unequivocally identify his specimen. Browne's names were later suppressed under the plenary powers for nomenclatorial purposes in Opinion 89 of the Commission for Zoological Nomenclature (see Hemming and Noakes 1958:9).

In 1801, Schneider (in Bloch and Schneider) first made Browne's tonguefish, Pleuronectes plagusia, available as a binomial. Schneider's Pleuronectes plagusia was based entirely on the description of the tonguefish from Jamaica listed in Browne's works (1756; 1789). The description in Schneider (in Bloch and Schneider 1801) is identical to that provided by Browne and additionally, all indications are that Schneider did not directly examine any specimens of this species. Dr. Paepke of the Berlin Museum has informed me (pers. commun.) that no remarks were made in the ledger indicating that specimens were available for examination when Schneider wrote the description of Pleuronectes plagusia. Additionally, Dr. Paepke also stated that there are no specimens of this species in the Bloch and Schneider collection. Therefore, from all accounts, it appears that the description of Pleuronectes plagusia Schneider, in Bloch and Schneider 1801 was copied directly from Browne's work and that no type exists for this species. In order to stabilize the nomenclature for this species, it seems appropriate to designate a neotype for this species despite the fact that the original description of Pleuronectes plagusia is quite vague. The rationale for continuing to use this name is as follows. This name represents the oldest binomial generally considered to represent a species of this group and this name has also been the one most consistently applied for any shallow-water, 12 caudal-rayed tonguefish. Since the original description is based on a specimen from Jamaica, it seems appropriate to select a topotype specimen as the neotype. Unfortunately, no specimens of S. plagusia from Jamaica were available during the present study. All of the tonguefishes that I examined from Jamaica were specimens of S. tessellatus that were trawled from relatively deep water stations, at depths deeper than those usually occupied by S. plagusia. Therefore, designation of a neotype for S. plagusia will have to await the procurement of a specimen collected from Jamaica.

Pleuronectes plagusia Schneider in Bloch was listed in Cuvier's works (1817; 1829) but no additional information improving the description of this species was provided.

Many authors have included in the synonymy of Symphurus plagusia the specimen of Achirus ornatus referred to by Lacepede (1803:663). The description of this specimen is very brief and does not include a figure or locality data. The only information Lacepede provides is that the fish was donated to France by Holland. Lacepede provided the following information on this specimen: dorsal and anal fins joined, 95 dorsal rays, 82 anal rays; 8 or 9 dark transverse bands and a lateral line on each side. Notably absent in his account is the caudal fin ray count for this specimen. The lateral line referred to in the description may refer to the mid-body myomere separation that is apparent on some tonguefish specimens (especially those that have partially dehydrated after preservation). Based on the counts listed by Lacepede, it is possible that this specimen belongs to S. plagusia (sensu strictu). The description of dark, transverse bands and the meristics listed in the description of Achirus ornata, could also apply to a number of other western Atlantic tonguefishes. Among shallow water species possessing twelve caudal rays, this account could apply to at least three species, new species E, S. plagusia (Schneider, in Bloch and Schneider 1801) and S. tessellatus (Quoy and Gaimard 1824). Of these three species, the description is more typical of S. tessellatus. However, the exact placement of Achirus ornatus Lacepede can not be determined because of the vague description and the unknown capture location for the specimen on which this name is based. Therefore, in this study, Achirus ornata Lacepede 1803 is regarded as a nomen dubium.

In 1824, Quoy and Gaimard described Plagusia tessellatus from Rio de Janeiro Bay, Brazil. Although no figure of this specimen was provided, the descriptive account of meristics and color pattern and other characters leave little doubt as to the identity of this specimen. They described the dorsal fin as originating above the eyes and being formed of 99 rays; the anal fin has 78 rays. The color is described as brown with small transverse bands of the same color. No type exists for this species, however, the original description is reasonably complete to allow identification of this specimen. Unfortunately, most authors, beginning with Kaup (1858) and continuing to Ginsburg (1951) regarded this species as a junior synonym of S. plagusia (Schneider, in Bloch and Schneider 1801). It is unlikely that the specimen described by Quoy and Gaimard belongs to S. plagusia (sensu strictu) because their S. tessellatus specimen has slightly higher meristics, darker banding and the origin of the dorsal fin is described as being above the eyes and not in front of the eyes which is the more typical condition in S. plagusia.

A second tonguefish species from Brazil, Plagusia brasiliensis, was described by Agassiz (in Spix and Agassiz 1829-1831). This specimen was figured and a good description was provided. The specimen has 98 dorsal rays, 84 anal rays and 12 caudal rays. It agrees in meristics and color pattern with Plagusia tessellatus and is placed in the synonymy of that species. The type of Pl. brasiliensis was thought to have been destroyed during the Second World War (Whitehead and Myers 1971), however, recently Kottelat (1984) listed the holotype specimen (MHNN 691) as still being in existence. I have not examined the specimen yet.

Beginning with Kaup (1858), all of the previously described species of shallow-water, 12 caudal-rayed, western Atlantic tonguefishes were regarded as a single species. It was Kaup who placed Achirus ornatus Lacepede, Plagusia brasiliensis Agassiz in Spix and Agassiz (Kaup cited authorship of this species as Cuvier in Spix) and Plagusia tessellatus Quoy and Gaimard (Kaup listed Valenciennes as the author of this name) in synonymy and proposed the new combination Aphoristia ornata Kaup to accomodate a single species ranging from the Caribbean Sea all the way to southern South America. Günther (1862) followed Kaup in regarding Aphoristia ornata to include the nominal species Pleuronectes plagusia Browne, Plagusia brasiliensis Agassiz and Plagusia tessellatus Quoy and Gaimard.

Subsequent authors including Jordan and Goss (1889) and Jordan and Evermann (1898) continued to include three species in the synonymy of Symphurus (=Aphoristia) plagusia (Schneider, in Bloch and Schneider). The three species included P. tessellatus Quoy and Gaimard, P. brasiliensis Agassiz, in Spix and Agassiz and A. ornatus Lacepede. Jordan and co-workers still considered there to be only one widespread polytypic species of shallow-water, 12 caudal-rayed *Symphurus* occurring in the western Atlantic. The senior synonym for this taxon was *Symphurus plagusia* (Schneider, in Bloch and Schneider 1801) and the range of this species encompassed shallow-waters from the West Indies to southern Brazil and Uruguay.

All subsequent authors from Jordan and Evermann (1898) to Ginsburg (1951) recognized only one widespread species of shallow-water 12 caudal-rayed tonguefish in the western Atlantic. The first modern nomenclatural rearrangement for this complex of species occurs in Ginsburg's (1951) revision of western Atlantic tonguefishes. In this revision, Ginsburg continued to recognize a single widespread, polytypic species, *S. plagusia* (Schneider, Bloch and Schneider 1801). However, he allocated his study specimens to two allopatric subspecies. He considered *S. plagusia plagusia* as a northern subspecies ranging from the West Indies to Central America and characterized by somewhat lower meristics. The second subspecies, *S. p. tessellatus*, had a more southern distribution ranging along the coasts of Brazil and Uruguay and had higher meristics. In this revision, Ginsburg described a second species (*S. civitatum* = *civitatium*, this study) of shallow-water, 12-caudal rayed tonguefish from the continental margins of southeastern and Gulf of Mexico locations. He equivocated in his description of this new species in stating that this form could also be recognized as a third, northern subspecies of a widespread *S. plagusia*.

Subsequent workers have utilized the subspecies designations proposed by Ginsburg for Caribbean and South American shallow-water 12 caudal-rayed tonguefishes. But more recently, several studies have noted that both the supposed subspecies occur in sympatry in South America. For example, Carvalho et al. (1968) found both subspecies in northern Brazil and Palacio (1974) reported both subspecies from Colombia.

In their revision of western South Atlantic tonguefishes, Menezes and Benvegnu (1976) reported that all their specimens were quite similar, lacking the variation reported for specimens collected in more northern regions. Using the name S. plagusia, they considered their specimens to represent a single taxon but they also pointed out that the sympatric co-occurrences of both subspecies in other South American localities indicated that the subspecific status designated by Ginsburg should be re-examined.

In the process of examining available material of S. plagusia, I attempted to locate all 25 specimens listed by Ginsburg (1951) in the material examined section of S. plagusia plagusia. I was successful in locating 19 of the 25 specimens used in the description of this subspecies. Among the material Ginsburg identified as S. plagusia plagusia were representatives of at least four sympatric species. Examination of these specimens revealed that of the original 25 specimens, 12 were S. tessellatus, one was a specimen of new species E and one specimen was identified as S. parvus. The specimens incorrectly identified by Ginsburg as S. p. plagusia are small juveniles of S. tessellatus collected from shallow-water habitats. Many of these were collected in the late 1890's and early 1920's and were old and completely devoid of any obvious pigment pattern. As a consequence, the specimens provided little clue that more than one species were represented among these shallow-water collections. Additionally, since most of Ginsburg's Caribbean and Central American specimens came from shallow water collections, very few adult *S. tessellatus* were available to his study, therefore he was unable to unravel size-related differences among the three sympatric species occurring in this region (the two smaller species, *S. plagusia* and new species E, and the much larger *S. tessellatus*).

Ginsburg did not list museum numbers for the 34 specimens that he assigned to *S. p. tessellatus* so that it is difficult to ascertain if more than one species was included in his account of this subspecies. However, of the eight lots that I examined that were designated as *S. p. tessellatus* by Ginsburg, only one species, *S. tessellatus* (Quoy and Gaimard 1824), was represented. Therefore, Ginsburg's *S. p. tessellatus* are *S. tessellatus* (Quoy and Gaimard 1824).

Study Material: 33 specimens (34.8-130 mm SL); 33 x-rayed, 14 measured.

Diagnosis

A medium-sized *Symphurus* (up to 130 mm SL) with a 1-4-3 ID pattern, 12 caudal rays, clear peritoneum and modal vertebrae counts of 49-50. This species most closely resembles *S. civitatium* but differs in its modally higher meristics (vertebrae modally 49-50 versus 47-49 in *S. civitatium*; dorsal rays 91-97 vs. 86-93; anal rays 75-81 vs. 70-78), somewhat smaller body size (130 mm SL vs. 160 mm SL) and size at maturity (80 mm SL vs. 100 mm SL in *S. civitatium*). It appears that the two species differ in the degree of development of sexually dimorphic coloration. In *S. plagusia*, both sexes are more or less uniformly pigmented with only slight evidence of banding on the body and the vertical fins of both sexes are uniformly colored with no darkening in the posterior portion of the body. In contrast, in S. civitatium the males and females show considerable differences in pigmentation. Females tend to have well-developed cross bands on the body and crossbands, although present also in the males, are less conspicuous. Male S. civitatium have the posterior portions of the dorsal and anal fins considerably darkened with black pigment (absent in females). Additionally, the two species also differ in their general ecologies. Symphurus plagusia is a shallow-water inhabitant (all sizes in shallow water) whereas S. civitatium occurs in deeper waters (commonly taken at depths of 20-70 m).

All sizes of Symphurus plagusia are collected with small juveniles and small adults of S. tessellatus. Despite overall similarities in meristic counts, the two species are quite distinctive and may be identified by a number of characters including pigmentation patterns, relative eye sizes, modal differences in meristics and maximum body size. The easiest way to distinguish these two species is by pigmentation pattern. Symphurus plagusia is uniformly colored with only slight evidence of narrow crossbands in some individuals. There is no striking black pigment spot on the outer operculum of this species (some individuals have a diffuse blotch on the inner operculum where the pigmentation of the eyed side inner operculum shows through). In S. tessellatus, all individuals display a bold pattern of wide crossbands and there is a well-developed, black spot on the outer operculum. *Symphurus plagusia* has a smaller eye (6.4-9.5, $\bar{x}$ = 8.2 % HL vs. 7.9-11.4, $\bar{x}$ = 9.5 % HL in *S. tessellatus*).

The two species differ significantly in overall body size and size of sexual maturation. *Symphurus plagusia* is a medium-sized tonguefish reaching overall sizes to about 130 mm SL and attaining sexual maturity at sizes as small as 80 mm SL. *Symphurus tessellatus* is a much larger species attaining maximum lengths of 220 mm SL and does not attain sexual maturity until reaching sizes of approximately 120 mm SL.

Other distinctions between this species and *S. tessellatus* include the absence of scales on the posterior portions of the blind side dorsal and anal fins (present in *S. tessellatus* larger than about 70 mm SL), and the modally lower meristics (vertebrae 49-50 vs. 50-53; dorsal rays 91-97 vs. 91-102 (usually 93-101); anal rays 75-81 vs. 77-86).

Further distinctions between these two species include the shape of the head and the relative positions of the dorsal fin origin and the posterior margin of the jaws. *Symphurus plagusia* has an almost squarish snout with a wide space between the upper eye and the dorsal fin base. In *S. tessellatus*, the snout is more pointed and the space between the upper eye and the dorsal fin base is comparatively more narrow. In *S. plagusia*, the dorsal fin origin is usually anterior to the eye while in *S. tessellatus* the dorsal fin originates slightly more posteriorly, usually originating above the front margin of the pupil of the upper eye or even as far back as the mid-eye region. The jaws extend usually to the posterior margin of the lower eye or in some cases, actually extend slightly posterior to the rear margin of the lower eye in *S. plagusia* while in *S. tessellatus* the jaws appear to be somewhat shorter reaching only to the middle of the lower eye or to the rear margin of the lower eye.

Further differences in the ecologies of these two species are discussed under the account of _S. tessellatus_.

This species overlaps almost completely the meristics of undescribed species E. The two species can be distinguished, however, by differences in body and head shapes, pigmentation patterns, differences in predorsal lengths and the relative size of the eye. Undescribed species E has a pointed snout with a narrow space between the upper eye and the dorsal fin base vs. squarish snout with wide space between upper eye and dorsal fin base. The body shape of undescribed species E is more rounded with a rapid taper after about dorsal rays 25-35 (vs. somewhat elongated in _S. plagusia_ with a more gradual taper). Additionally, undescribed species E has a relatively large eye (8.2-11 % HL, usually 9.0-10.0 % HL) when compared to _S. plagusia_ (usually between 7.0-9.0 % HL). There are slight differences in the pigmentation patterns of the two species. _Symphurus plagusia_ is generally uniformly colored with only slight evidence of crossbanding and the fins are uniformly colored. In contrast, undescribed species E usually has numerous, well-developed crossbands and the vertical fins have an alternating series of blotches and clear areas.

Symphurus plagusia is also similar to undescribed species D with respect to caudal ray count, small eye size and the presence of a fleshy ridge on the eyed-side lower jaw. It differs from this species, however, in its much lower meristics (49-50 vertebrae vs. 52-55 in undescribed D; dorsal rays 91-97 vs. 99-104; anal rays 75-81 vs. 82-88) and pigmentation pattern.

Undescribed species D has sharply contrasting crossbands, fin blotches and a black spot on the outer operculum (vs. relatively uniform body color with faint crossbands, uniform fins and no pigment spot on the outer operculum). Further differences between these two species are listed in the diagnosis of undescribed species D.

Description

Symphurus plagusia is a medium-sized tonguefish attaining maximum sizes of approximately 130 mm SL. The usual ID pattern is 1-4-3 (Table 9). Caudal rays 12 (Table 10). Dorsal rays 91-97 (Table 11). Anal rays 75-81 (Table 12). Vertebrae 49-50 (Table 13). Hypurals 4. Longitudinal scale rows 79-89 (Table 14). Scale rows on head posterior to lower orbit 18-22 (Table 15). Lateral scale rows 35-42 (Table 16). Proportional measurements appear in Tables 75-76.

Body relatively deep (depth 27.8-31.9% SL); maximum depth in anterior one-third of body. Head relatively wide (21.8-25.6% SL); with moderately long (20.5-25.0% HL), somewhat squarish snout. Snout covered with small ctenoid scales. Dermal papillae well developed on blind side snout and chin region. Posterior extension of maxilla reaches to posterior margin of lower eye; less frequently lower jaw extends only to rear edge of pupil of lower eye. Lower lip on ocular side bears a distinct, fleshy ridge a short distance before posterior margin. Eyes small (6.4-9.5% HL); usually slightly sub-equal in position with upper eye anterior to lower. Eyes not covered with scales; usually 1-2 small ctenoid scales in narrow interorbital space. Pupillary operculum absent. Dorsal fin origin far

Table 75. Summary of morphometrics, expressed as thousandths of Standard Length (except SL in mm) for *Symphurus plagusia*.

Character	N	RANGE	MEAN	SD
SL	14	57.4-130.3	98.8	22.29
BD	14	278-319	292.1	13.05
PDL	14	23-50	32.9	6.87
PAL	14	166-244	209.3	18.60
DBL	14	950-977	967.1	6.87
ABL	14	758-802	785.6	15.38
PL	14	51-73	63.6	5.76
PA	14	38-60	50.0	7.00
CFL	14	88-111	100.3	7.13
HL	14	174-216	189.6	11.98
HW	14	218-256	236.4	13.25
POL	14	110-143	125.9	9.26
SNL	14	36-54	43.3	4.21
UJL	14	38-52	43.1	4.56
ED	14	12-18	15.3	2.02
CD	14	39-67	52.1	7.99
UHL	14	125-186	160.1	15.93
LHL	14	81-115	96.8	10.22

Table 76. Summary of morphometrics expressed as thousandths of Head Length (except HL and HW) for *Symphurus plagusia*.

Character	N	RANGE	MEAN	SD
HL/HW	14	1.2-1.3	1.2	0.38
POL	14	630-714	665.8	25.18
SNL	14	205-250	229.1	15.62
UJL	14	200-250	227.6	14.99
ED	14	64-95	81.9	9.57
CD	14	222-374	275.1	40.32
OPLL	14	250-346	296.9	29.10
OPUL	14	169-272	211.9	27.24
UHL	14	695-926	843.1	63.80
LHL	14	427-606	510.3	53.23

forward, at a vertical equal to anterior margin of upper eye or with the first ray inserting anterior to forward margin of upper eye. Scales large, ctenoid on both sides of body. Scales absent on dorsal and anal fins.

Teeth well developed on blind side jaws. Lower jaw on ocular side without teeth or with a short row of small teeth developed only on anterior one-half to one-third of dentary. Upper jaw usually with a small single, mostly incomplete row of slender teeth on region of premaxilla anterior to anterior nostril.

Pigmentation

Eyed surface usually uniformly light brown or yellowish, occasional specimens with numerous (8-14), narrow, faint crossbands. Crossbands are not continued onto dorsal and anal fins. The crossbands mostly complete in anterior trunk region, elsewhere on body, the crossbands are present and obvious only as vertical markings at the margins of the body along the bases of the dorsal and anal fins. Operculum usually not pigmented other than general body color. However, in some specimens, there is a dusky blotch on the upper opercular lobe. This dusky blotch results from pigment on the inner lining of the eyed-side operculum showing through to the outer side of the body. Inner lining of operculum and isthmus on eyed side usually dusky, but some specimens have heavier, dark brown pigmentation on inner opercular lining; inner operculum and isthmus on blind side usually unpigmented or occasionally with small patch of pepper-dot pigment on ventral edge. Lips on ocular side usually with a slight moustache on upper lip and diffuse pattern of melanophores on lower lip. Blind side unpigmented, creamy white. Peritoneum unpigmented.

Dorsal and anal fins dusky; all fin rays, beginning with the first ray of each fin, streaked with darker brown pigment. In some specimens, there is an alternating series of light and darker pigmented areas. In these fish, heavier pigmented rays (usually 2-3) are separated by about 4-5 lightly pigmented rays. Caudal fin with darker brown pigment on basal half of scale-covered portions of fin; distal half with pigment streaks only on the fin rays.

Geographic Distribution (Fig. 27).

Symphurus plagusia has a relatively wide distribution in shallow-waters of the tropical western Atlantic. In the northern part of its range, this species occurs from the Caribbean islands of Puerto Rico, Cuba and Hispaniola to the contintental margins of Central America at Belize, Nicaragua, Costa Rica and Panama. Additional specimens have been collected along the northern margin of South America at Colombia and Surinam. This species extends southward along the coast of Brazil at least as far south as Rio de Janeiro, Brazil.

Based on the small number of specimens available, it is either not generally abundant or occurs in a specialized habitat not generally sampled.

Bathymetric Distribution

Symphurus plagusia is a shallow-water species commonly inhabiting depths between the shoreline and 10 meters. All life-history stages occur in these shallow areas and only occasionally are individuals taken at deeper locations. The majority of specimens (20/25, 80%) were taken between 1-10 m. The deepest captures were of specimens taken at 61 m (a single specimen) and three specimens taken at 40 m.

Size and Sexual Maturation

Symphurus plagusia is a medium-sized tonguefish attaining adult sizes to 130 mm SL (Fig. 28). The largest fish examined was a male (130 mm SL); the largest female was only slightly smaller (127 mm SL). There were five males and 23 females among the fishes for which sex could be determined.

Based on the reproductive stages of females, it appears that sexual maturity occurs at a relatively large size in this species. Females smaller than 80 mm SL were generally immature with gonads undergoing elongation. Females larger than 80 mm SL were mature. Only one of nine females, smaller than 80 mm SL (79.3 mm SL) was sexually mature. Other females between 65-80 mm SL had ovaries which were just undergoing posterior elongation.

Ecology

Little is known concerning the biology of this species. The general rarity of *S. plagusia* in collections indicates that it occurs in habitats generally not sampled. There was little habitat information associated with the collections and the substrate type(s) that this species frequents remains largely unknown.

Material Examined

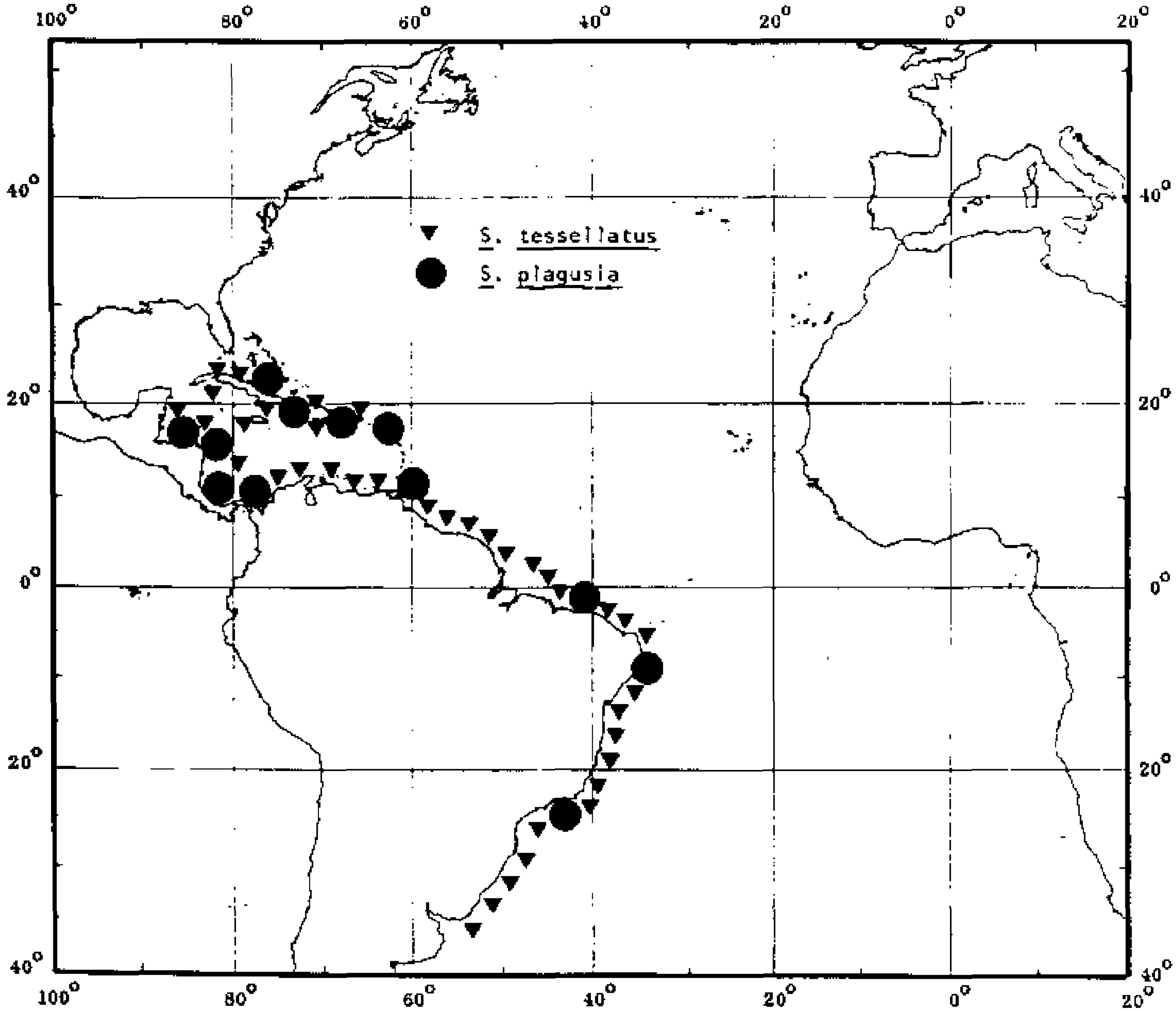
Counted and Measured 14 Specimens, 10 Lots.

ANSP 121326; 2(112.9-118.3); Atafona, Brazil 23°02'S 44°01'W; VII-VIII 63. FMNH 3286; (83.1); Mayaguez, Puerto Rico; 20 I 1899. FMNH 61572; (117.0); Allasco Bay, Puerto Rico; 10 I 54. FMNH 88853; 2(120.0-130.3); 02°09'S 42°44W; 40M; 10 III 63. GCRL V77:15694; (57.4); Canal Zone, Panama; 08 II 77. UF 10762; (79.6); Costa Rica; VIII 63. UF 12059. (127.1); Mayaguez, Puerto Rico; 16 IV 64. UFPB 884; (101.4); Praiade Jacare, Brazil; 13 XI 81. UFPB 896; 3(79.3-87.5); Rio Paraiba do Norte, Brazil; 30 VII 81. UPRM 1828; (89.4); Icacos Bay, Trinidad; 04 V 64.

Counted 19 Specimens, 12 Lots.

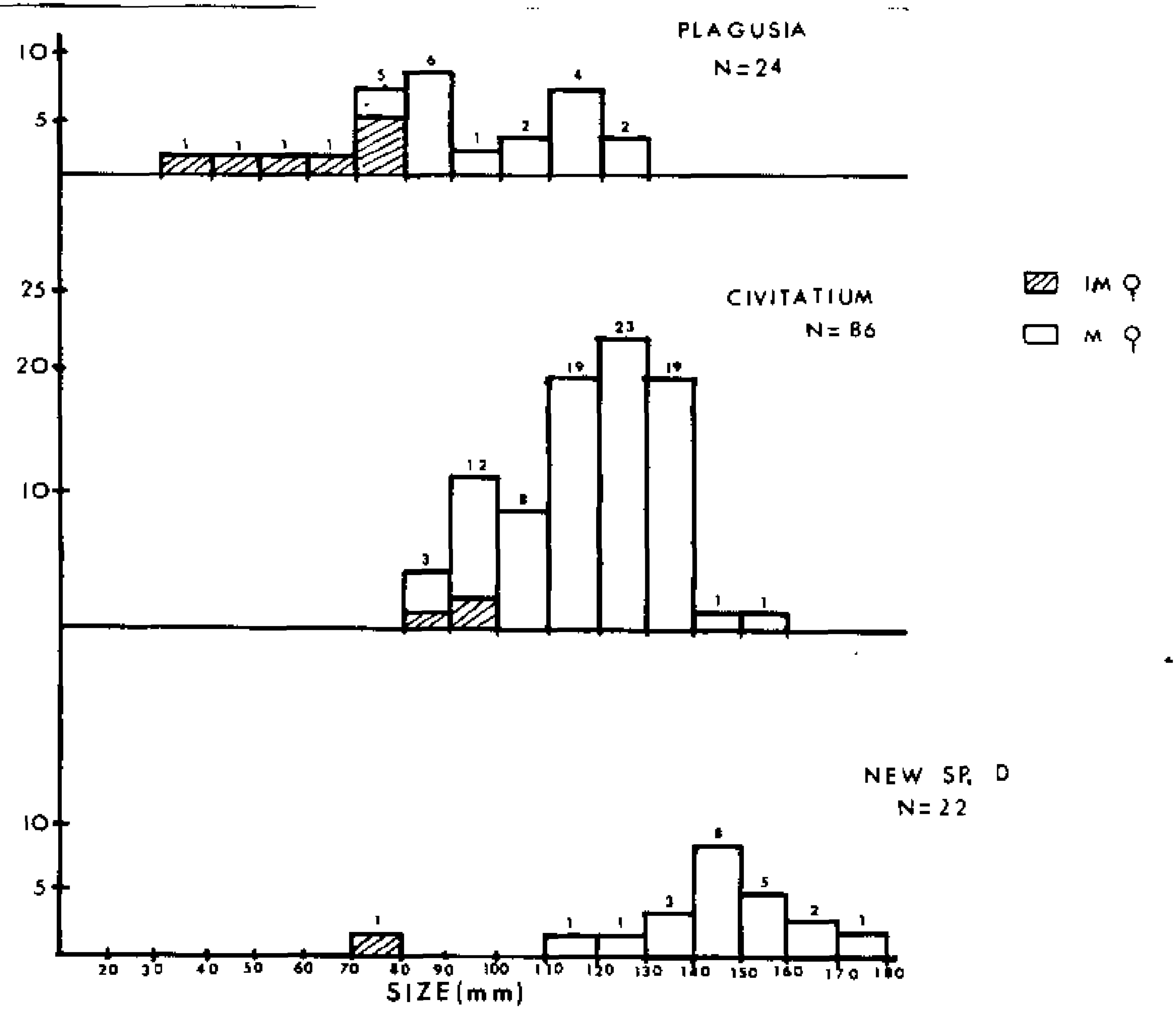
ANSP 118542; (47.4); Puerto Yabucoa, Puerto Rico; 25 I 71. ANSP 129952; (112.7); Puerto Yabucoa, Puerto Rico; 21 VII 73. ANSP 129985; (98.2); Puerto Yabucoa, Puerto Rico; 25 VII 73. ANSP 132030; (102.9); Puerto Yabucoa, Puerto Rico; 24-27 VII 73. FMNH 94818; (54.3); Brus Lagoon, Honduras; 1M; 10 V 75. FMNH 94882; (34.8); Roatan; 1M; 01 V 75. UF 38896; 5(82.8-90.8); Haiti; 07 IV 79. UMML UNCAT PILS 687; (121.5); 07°42'N 57°32'W; 27M; 15 VII 68. USNM 50178; 4(61.9-83.1); Ponce, Puerto Rico; 31 I 1899. USNM 81654; (54.9); Colon, Panama; 05 I 1911. USNM 236252; (110.5); 06°34'N 54°28'W; 37M; 28 VI 72. USNM UNCAT OR2310; (79.4); 05°30'N 52°10'W; 51M; 12 IX 58.

Figure 27. Geographic distribution of Symphurus plagusia and S. tessellatus.



Atlantic 1-4-3 Species with 12 Caudal Rays

Figure 28. Frequency histogram of relative sizes and sexual maturity for *Symphurus plagusia*, *S. civitatium* and Undescribed Species D.


PLAGUSIA
N=24
CIVITATIUM
N= 86
NEW SP. D
N= 22
IM ♀
M ♀
SIZE (mm)

Symphurus civitatium Ginsburg 1951

(Fig. 49A)

Offshore Tonguefish

S. civitatum

Ginsburg 1951: 198; Original description; Gulf of Mexico and coast of SE US.

Topp and Hoff 1972: 78; General absence from west Florida shelf.

Resendez Medina 1979: ; Occurrence in _____ Lagoon, Mexico.

Lazzaro 1977: 69; Continental shelf of Uruguay.

Baughman 1950: 137; Listed, Freeport, Texas.

Study Material: 347 Specimens, 22.0-149 mm SL. 169 x-rayed, 31 measured.

Remarks

In the original description, Ginsburg (1951: 198) stated that this species and S. plagusia differed enough to consider them as distinct species but that it was also possible to regard them as representing subspecies of a more widespread, polytypic species. It was shown earlier (p. 410) that Ginsburg had more than one species in his account of S. plagusia and therefore his subspecific designations in this species were unfounded. Symphurus civitatium should be regarded as a distinct species within the complex of closely related, largely sympatric, shallow-water 12 caudal-rayed Symphurus species (see diagnosis below).

Some comments are necessary with respect to the specific name, civitatum, applied by Ginsburg for this species. The etymology of this name is unclear from the orginal description. I think that the name was derived from the genitive plural of civitas (meaning of the citizenry). If this is correct, then the proper genitive plural for this word is civitatium and not civitatum as indicated by Ginsburg. If this assumption is correct, then the spelling should be changed accordingly. In this note, if civitatium is formed from the genitive plural form of civitas then the spelling of the specific name for this species remains unchanged regardless of generic assignment of the species. Therefore, spelling changes such as S. civitatus (Bailey et al. 1960 and other checklists of common and scientific names) are incorrect.

Diagnosis

Symphurus civitatium is a medium-sized tonguefish (to 152 mm SL) easily identified by the combination of a 1-4-3 ID pattern, 12 caudal rays, unpigmented peritoneum, relatively small eye (7.0-11.0% HL) and 47-49 vertebrae. This species overlaps meristics of 14 other Atlantic tonguefishes but differs from all other Atlantic species in aspects of its morphology and ecology. It is most similar to the Caribbean and South Atlantic species, S. plagusia. Symphurus civitatium differs from this species in its lower meristics (vertebrae modally 47-49 versus 49-50 in S. plagusia; dorsal rays 86-93 vs. 91-97; anal rays 70-78 vs. 75-81), somewhat larger body size (152 mm SL vs. 130 mm SL) and size at maturity (100 mm SL vs. 80 mm SL in S. plagusia). It appears that the two species also differ in development of sexually dimorphic coloration of males. In *S. plagusia*, both sexes are more or less uniformly pigmented with only slight evidence of banding on the body and the vertical fins of both sexes are uniformly colored with no darkening in their posterior extent. In contrast, mature males of *S. civitatium* show considerable sexual dimorphism in pigmentation. Females have well-developed crossbands on the body and uniformly colored fins. Males may have crossbands, although they are usually less conspicuous. Male *S. civitatium* also have the posterior portions of the dorsal and anal fins considerably pigmented (black) when compared to females (black pigment on posterior dorsal and anal fins absent). Additionally, the two species differ in the depth of occurrence commonly inhabited. *Symphurus plagusia* is a shallow-water inhabitant (all sizes) whereas *S. civitatium* commonly occurs in deeper waters on the open shelf between 20-70 m.

Among other species of shallow-water tonguefishes with a 1-4-3 ID pattern and 12 caudal rays, *Symphurus civitatium* overlaps partially the meristics of two Caribbean and South Atlantic species, undescribed species E and *S. tessellatus*. *Symphurus civitatium* overlaps almost completely the meristics of undescribed species E. The two species can be distinguished, however, by modal differences in meristics, differences in the shape of the head and by pigmentation patterns. *Symphurus civitatium* has the lower meristics (vertebrae 47-49 vs. 49-50; dorsal rays 86-93 vs. 89-96; anal rays 70-78 vs. 74-80). Undescribed species E also has a more pointed snout with a narrow space between the upper eye and the dorsal fin base (vs. squarish snout with wide space between upper eye and dorsal fin base in *S. civitatium*). There are slight differences in the pigmentation patterns of the two species. Symphurus civitatium has narrow crossbands with uniformly colored fins (becoming darker in the posterior portions of sexually mature males). In contrast, undescribed species E usually has numerous, well-developed crossbands and the vertical fins have an alternating series of blotches and unpigmented areas.

Despite some similarities in meristics, S. civitatium and S. tessellatus are quite distinctive and may be identified by differences in pigmentation patterns, modal differences in meristics and maximum body size. The easiest way to distinguish these two species is that S. civitatium has numerous narrow crossbands and lacks a black opercular spot (vs. in S. tessellatus all individuals display a bold pattern of wide crossbands and there is a well-developed, black opercular spot). Other distinctions between this species and S. tessellatus include the absence of scales on the posterior portions of the blind side dorsal and anal fins (present in S. tessellatus larger than about 70 mm SL), and the modally lower meristics (vertebrae 47-49 vs. 50-53; dorsal rays 86-93 vs. 91-102 (usually 93-101); anal rays 70-78 vs. 77-86). The two species differ significantly in overall body size and size at sexual maturation. Symphurus civitatium is the smaller of the two species, reaching overall sizes of approximately 152 mm SL and attaining sexual maturity at sizes as small as 100 mm SL. Symphurus tessellatus is a much larger species attaining maximum lengths of 220 mm SL and does not attain sexual maturity until reaching sizes of approximately 120 mm SL.

Symphurus civitatium overlaps meristics of another 11 species of Atlantic tonguefishes. It co-occurs with S. diomedeanus and S. plagiusa and may be collected with both. It differs from these species primarily in caudal ray count (12 vs. 10 in the others) and pigmentation patterns. *Symphurus diomedeanus* usually has spotted dorsal and anal fins and a well-developed pupillary operculum (both absent in *S. civitatium*). *Symphurus civitatium* can be distinguished from *S. plagiusa* by several characters. The two species differ in pigmentation, *S. plagiusa* usually has a well-developed black pigment spot on the outer operculum (absent altogether or only a diffuse blotch in *S. civitatium*) and the inner opercular linings on both sides of the fish are heavily pigmented (only the eyed-side opercular lining is pigmented in *S. civitatium*). *Symphurus plagiusa* has larger eyes (8.3-12.6 vs. 7.0-11.0% HL) and the eyes are usually equal in position (slightly subequal in *S. civitatium*). Also, the jaws reach only as far posteriorly as the mid-eye region in *S. plagiusa* while in *S. civitatium* the jaws reach the rear margin of the pupil, the rear margin of eye or even extend slightly beyond the posterior margin of the lower eye in *S. civitatium*). In larger *S. plagiusa*, there are 4-8 rows of scales on the blind side dorsal and anal rays (absent or only 1-2 scales along the bases of the fins in *S. civitatium*).

Symphurus civitatium is not easily confused with other species (*S. kyaropterygium*, *S. trewavasae*, *S. normani*, *S. piger*, *S. nigrescens*, *S. pusillus* and undescribed species A and undescribed species B) with which it overlaps in meristics. *Symphurus civitatium* differs from all of these in ID pattern (1-4-3 vs. other patterns). In addition to ID pattern, *S. civitatium* differs from the South Atlantic *S. kyaropterygium* in caudal ray number (12 vs. 10) and in lacking a pupillary operculum and a caudal blotch (both present in *S. kyaropterygium*). It differs from the South Atlantic *S. trewavasae* principally in caudal ray count (12 vs. 10) and modal differences in meristics. *Symphurus civitatium* can be distinguished from *S. normani*, *S. piger*, *S. nigrescens*, *S. pusillus* and undescribed species A and B by ID pattern (1-3-3 in *S. normani*, 1-3-2 in all the others). *Symphurus normani* also possesses scales on the blind side dorsal and anal fins (absent in *S. civitatium*). *Symphurus civitatium* differs from the 1-3-2 species (except undescribed species A and B) in having an unpigmented peritoneum (black in the others). *Symphurus civitatium* differs further from undescribed species A and B by body size (152 vs. <50 mm SL) and pigmentation (dark brown with crossbands and uniformly pigmented fins vs. light brown or yellowish body with reticulate pattern in undescribed species A and dark, chocalate brown body with X and Y markings and fins with alternating series of blotches and unpigmented areas in undescribed species B.

Description

Symphurus civitatium is a medium-sized tonguefish reaching maximum lengths of approximately 152 mm SL. The usual ID pattern is 1-4-3, less frequently 1-4-2 and 1-5-3 (Table 9). Caudal rays usually 12 (Table 10). Dorsal rays 86-93 (Table 11). Anal rays 70-78 (Table 12). Vertebrae 47-49 (Table 13). Hypurals 4. Longitudinal scale rows 66-83, usually 74-83 (Table 14). Scale rows on head posterior to lower orbit 16-20 (Table 15). Lateral scale rows 26-39 (Table 16). Proportional measurements appear in Tables 77-78.

Body relatively deep (depth 24.7-32.8% SL); greatest depth in anterior third of body. Head wide (21.2-27.1% SL); with relatively short, somewhat squarish snout (16.9-23.1% HL). Snout covered with small ctenoid scales. Dermal papillae well developed on blind side snout and chin regions. Posterior extension of maxilla reaches to middle or posterior margin of the pupil of the lower eye. Lower lip on ocular side bears a distinct, fleshy ridge a short distance before posterior margin. Eyes relatively small (7.0-11.0% HL); slightly subequal in position. Eyes not covered with scales; usually only 1-3 small ctenoid scales in narrow interorbital space. Pupillary operculum absent. Dorsal fin origin usually situated anterior to anterior margin of upper eye; occasionally only reaching front margin of pupil of upper eye. Scales usually absent on blind side dorsal and anal fins; occasionally specimens with 1-3 small scales at proximal base of fin rays but without scales in short rows on distal portions of fin rays.

Teeth well developed on blind side jaws. Lower jaw on ocular side with a single, mostly incomplete row of slender teeth on anterior third of jaw. Upper jaw on eyed side with only a small row of teeth on anterior third of premaxilla; or occasionally premaxilla lacking teeth altogether.

<u>Pigmentation</u>

Body coloration generally similar for both sexes (differences in pigmentation due to dimorphism are pointed out). Eyed surface usually light to dark brown with dark brown crossbands developed or absent. Crossbands, when developed, narrow, numerous (6-14) sometimes sharply contrasting (especially in mature females) otherwise faint and barely perceptible against dark body coloration. Crossbands not continued onto dorsal and anal fins. The first band crosses the head a short distance anterior to opercular opening. Bands along the trunk are 3-4 to 5-6 scale rows wide. Often the last two bands immediately before caudal fin base conjoined. Operculum on eyed side often with a dusky blotch on dorsal margin. This dusky blotch results from the dark pigmentation of the inner lining showing through to the outer surface. Lining of inner operculum and isthmus on eyed-side usually heavily pigmented; lining of blind side operculum and blind side isthmus usually not pigmented. Moustache usually developed on eyed-side upper lip; lower lip on eyed-side frequently pigmented but usually without definite moustache. Blind side unpigmented, off-white. Peritoneum unpigmented.

Pigmentation of the dorsal and anal fins is similar in both sexes, however, males tend to have darker fins generally. In the anterior two-thirds of the body, each ray of the dorsal and anal fins, beginning with the first ray, streaked with brown pigment similar in shade and intensity to body color. Rays pigmented for entire length except for distal portions near tip of fin which are unpigmented. Fin membranes in anterior three-quarters of body unpigmented. In posterior one-third of body, dorsal, anal and caudal fins more heavily pigmented and considerably darker than anterior two-thirds of fin. Fin membrane in posterior quarter of body heavily pigmented. Basal third of caudal fin only lightly pigmented; posterior two-thirds of caudal fin and membrane heavily pigmented. Distal tips of middle caudal fin rays unpigmented or middle fin rays of caudal streaked with pigment but intervening membrane unpigmented.

Table 77. Summary of morphometrics expressed in thousandths of Standard Length, except SL (in mm), for *Symphurus civitatium*.

Character	N	RANGE	MEAN	SD
SL	30	48.8-149.3	108.6	24.96
BD	30	247-328	306.9	16.42
PDL	29	22-46	34.5	6.78
PAL	30	147-238	202.4	19.75
DBL	30	925-982	963.0	13.22
ABL	30	745-891	797.9	31.36
PL	30	49-85	63.0	8.83
PA	26	33-74	44.7	10.23
CFL	29	87-124	108.6	9.32
HL	30	170-219	191.3	11.55
HW	30	212-271	238.3	14.42
POL	30	117-187	134.3	13.64
SNL	30	31-47	39.5	3.55
UJL	30	37-54	43.5	4.88
ED	30	13-21	16.6	2.01
CD	29	39-68	50.6	7.32
UHL	30	139-184	158.9	11.60
LHL	30	87-118	103.9	6.86

Table 78. Summary of morphometrics expressed in thousandths of Head Length (except HW/HL) for *Symphurus civitatium*.

Character	N	RANGE	MEAN	SD
HW/HL	30	1.02-1.47	1.2	0.10
POL	30	645-740	692.0	27.45
SNL	30	169-231	206.4	13.84
UJL	30	181-289	227.7	24.14
ED	30	70-110	87.8	10.26
CD	29	225-331	267.9	30.55
OPLL	29	253-388	321.3	34.80
OPUL	29	178-329	230.0	34.86
UHL	30	636-996	832.6	82.14
LHL	30	462-629	543.0	46.00

Geographic Distribution (Fig. 29).

Symphurus civitatium occurs in the western North Atlantic along the southeastern coast of the United States from Cape Hatteras, NC to the Yucatan Peninsula in Mexico. In the open Atlantic, *S. civitatium* ranges as far north as the Cape Hatteras region. From there, it extends southward to the southern tip of Florida. There is a single record for this species from Bermuda.

In the Gulf of Mexico *S. civitatium* occurs most commonly west of Apalachicola Bay in northern Florida. It is one of the most commonly collected tonguefishes on the shallow shelf regions of the Central and western Gulf of Mexico from Alabama to Texas. Along the coast of northern Mexico, this species occurs on sandy substrates at least as far south as the East Mexican shelf (Cabo Rojo, Veracruz to Sabuncuy, Yucatan).

Topp and Hoff (1972) noted the general absence of this species along the west Florida shelf. They were able to find just a single record (from Ginsburg 1951) for *S. civitatium* in the eastern Gulf of Mexico (from St. Joseph Bay). They did not collect any specimens of this species during the Hourglass cruises. Examination of collection data for 347 specimens from this study also reveals a general absence of this species from the western Florida shelf. Only two lots reported this species from the Tortugas region off the southern Florida region.

Symphurus civitatium occurs on sandy substrates throughout its range. The distribution of this species, both in terms of depth of occurrence and geographic extent, apparently coincide with the general distribution of sand substrates on the open continental shelf. The general scarcity of this species on the west Florida shelf and the Yucatan Peninsula, for example, are due primarily to the strikingly different substrate compositions in these regions. Along the west Florida shelf, Topp and Hoff (1972) reported substrates to consist of lithified sediments of cemented lime, including 1)nearshore deposits of cemented shell beachrock, 2)limestone, ranging from soft marl to conglomeritic and foraminiferal limestone, 3)small patches of living and dead coral, and 4)calcareous algae, primarily in 55-92 m. They noted that the substrates of the Yucatan Peninsula are similar in composition to those of the west Florida shelf. In comparison, substrates in the Central and western Gulf of Mexico (roughly from the Mississippi Delta to Cabo Rojo, Veracruz) consist of sands, silts and clays, delivered primarily by the Mississippi and Rio Grande Rivers. Sand-size particles are found only in bays and inshore areas along most of the coast, while fine silt occurs across the entire shelf (van Andel 1960).

Substrate preference may also affect the distribution of this species along the southeastern coastline of the United States. Apparently, the depth of occurrence (11-40 m, see below) for S. civitatium coincides with sand-silt substrates on the inner portions of the shelf and this species is generally absent from live-bottom habitats occurring at similar depths.

Bathymetric Distribution

All life history stages of Symphurus civitatium are found on the open shelf. Although this species has been collected over a wide depth range from 1-73 meters (Table 79), its center of abundance, based on overall frequency of capture and general abundance, occurs between 11-45 meters.

Approximately 91% (199/216) of the specimens examined in the present study were captured at these depths. The deepest captures of this species were made at 73 and 62 m, where a single fish was taken each time. It is also unusual for this species to occur in shallow or inshore regions. Only 4 fish were collected in waters shallower than 10 meters. Three of these fish were small juveniles (<35 mm SL).

Table 79. Summary of bathymetric distribution for 216 S. *civitatium*.

Depth	1-10	11-20	21-30	31-40	41-50	51-60	62	73
Number	4	57	74	57	11	11	1	1

Size and Sexual Maturity

Symphurus civitatium is a medium-sized species of tonguefish, reaching a maximum length around 152 mm SL (Fig. 28). The largest fish examined, a female (152 mm SL), was only slightly larger than the largest male (149 mm SL). Most of the fishes examined ranged in size from 80-140 mm SL.

Based on the reproductive stages of females, it appears that this species matures at sizes usually larger than 90 mm SL. Of 86 females, three were immature. The immature females ranged in size from 83-95 mm SL. The two smallest gravid females ranged in size from 80-90 mm SL. The majority of gravid females were larger, ranging in size from 91-140 mm SL.

<u>Material Examined</u>

<u>Measured and Counted</u> 27 Specimens, 14 Lots.

USNM 155227; Holotype (110); 29°06'30"N 89°40'W; 17M; 08 VII 38. ALA 3015; 3(75.5-85.2); AL; to 30M; 1968. ALA 606.29; (94.4); Horn Island, MS; VII-VIII 58. FMNH 45109; 3(138-149); 27°43'N 96°51'W; 27M; 26IX 50. FMNH 45979; (110); 29°22'N 88°40'W; 51M; 22 X 53. IMS 544; 3(121-130); W Campeche, Mexico; 27M; 22-29 VII 51. TU 75907; 3(131-136); 27°35'04"N 80°04'04"W; 26M; 05 IX 65. UF 13062; (130); 28°35.5'N 80°08'W; 62M; 21 II 65. UMML 1783; (130); 20°12'N 91°40'W; 37M; 11 XII 52. USNM 154946; Paratype (139); Cape Canaveral, FL; 18M; 04 IV 40. USNM 157403; Paratype (109); 35°21'10" 75°22'40"; 26M; 19 X 1884. VIMS UNCAT; 2(48.8-72.2); Calcasieu Lake, LA (30°93'N); February, 1982. VIMS UNCAT; 9(88.6-108); 3 mi. offshore, Port Aransas, TX (28°97'N); 15M; 16 IX 82.

<u>Counted</u> 142 Specimens, 42 Lots.

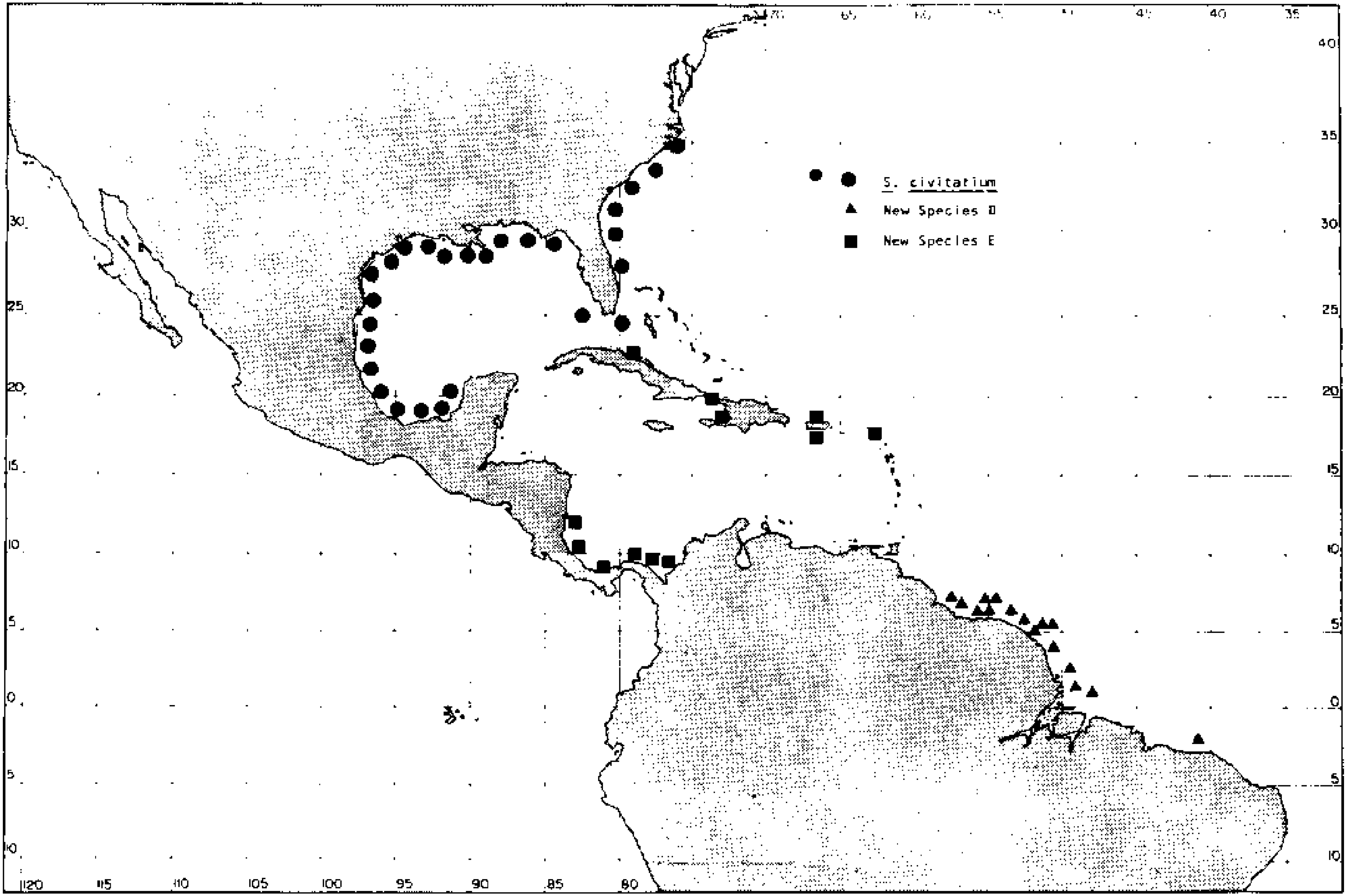
ALA 301.17; 2(85.4-94.3); Dauphin Island, AL; 28 IX 52. ALA 353.05; (108); Mobile Ship Channel, AL; 06 IX 51. ALA 2385; 13(85.8-103); Dauphin Island, AL; 15 VII-20 VIII 66. FMNH 45427; 7(126-140); 20°18'N 91°48'W; 42M; 07 XII 52. FMNH 46369; 11(115-138); 19°48'N 91°20'W; No Depth; 25 VIII 51. GCRL V79.16383; 2(76.0-86.5); Lagunas de Terminos, Punta Zachtal, Campeche, Mexico; No Depth; 17 xi 70. IMS 543; 16(126-142); Pta Frontera, Mexico; 31M; 29 VII-06 VIII 51. TCWC 4187.4; (100); 29°10'N 94°30'W; 14M; 28 IX 73. TCWC 4189.21; 18(97.8-124); 28°26'N; 95°23'W; 28M; 29 IX 73. TCWC 4195.31; 9; 28°25'N 95°18'W; 35M; 31 X 73. UMML 1784; (130); 20°12'N 91°40'W; 37M; 11 XII 52. UMML UNCAT OR5121; 3(136-140); 28°34'N 80°15'W; 42M; 19 XI 64.

UMML UNCAT OR5344; (131);28°12'N 80°05'W; 60M; 14 III 65. UMML UNCAT SB5105; (118); 27°57'N 80°03'W; 55M; 28 IX 63. UMML UNCAT (Removed from UMML 11160); (128); 28°07'N 95°53'W; 37M; 26 I 58. USNM 86139; Paratypes 2(118-126); Aransas Pass, TX; 15M; 05 III 17. USNM 86140; Paratype (120); Calcasieu Pass, LA; 9M; 15 II 17. USNM 86153; Paratype (120); St. Joseph's Bay, FL; No Depth; 27 I 17. USNM 120081; Paratype (111); Galveston, TX; No Depth; 1941. USNM 120082; Paratype (81.5); Aransas Pass, TX; No Depth; 07 VIII 41. USNM 154945; Paratypes 3(122-130); 28°54'N 91°41.5'W; 18M; 11 VII 38. USNM 154947; 5(110-123); 28°55.5'N 91°46'W; 18M; 11 VII 38. USNM 154948; Paratypes 2(120-124); 28°58'N 91°40.5'W; 16M; 12 XI 38. USNM 154949; Paratypes 2(105-129); 28°41.5'N 91°10'W; 15M; 11 XI 38. USNM 154950; Paratypes 2(122-124); 28°47'N 91°21.5'W; No Depth; 11 VII 38. USNM 154951; Paratype (126); 29°12'N 89°50.5'W; 13M; 08 VII 38. USNM 154952; Paratype (117); 28°43'N 91°13'W; 15M; 11 VII 38. USNM 154953; Paratypes 2(102-105); 29°12.5'N 89°57'W; 7M; 10 VII 38. USNM 154954; Paratypes 3(114-118); 28°35.5'N 91°01.5'W; 22M; 13 VII 38. USNM 155226; Paratype (114); 28°45'N 91°17.5'W; 16M; 11 VII 38. USNM 157399; Paratypes 3(109-121); Grand Terre, LA; No Depth; 02 VII 30. USNM 157400; Paratypes 3(99.7-118); Grand Terre, LA; No Depth; 27 VI 30. USNM 157401; Paratype (117); Galveston, TX; 10M; 26-27 II 17. USNM 157402; Paratype (117); Mobile, AL; 13M; 07 II 17. USNM 157693; 5(117-126); 20°05'N 91°28'W; 31M; 26 VIII 51. USNM 157694; 3(128-132); 20°05'N; 91°28'W; 31M; 26 VIII 51. USNM 274484; (117); 28°13.5'N 80°21'W; 22M; 14 XI 63. USNM 274485; (132); N of Soto La Marina, Mexico; No Depth; 15 III 47. USNM UNCAT Removed from USNM 157692; (127); 31M. USNM UNCAT SB5320; 14(114-142); 28°13'N 80°21'W; 22M; 14 XI 63.

Other Material 178 Specimens, 24 Lots.

ALA 798.14; 2(108-110); Gulf Shores, Breton Island, AL; No Depth; 3 VIII 59. ANSP 55825; (125); Breton Island, LA; November, 1930. ANSP 94305; (25); Key West, FL; 1M; 21 III 58. ANSP 137573; (79.3); Bermuda; Washed onto shore. BMNH 1931.11.5.75; 1; Reversed Specimen; Breton Island, LA. CAS-SU 40556; (133.4); Freeport, TX; 28 IV 40. FMNH 45980; 2(110-120); 28°45'N 89°15'W; 60M; 23 X 53. FMNH 45981; 2(109-119); 28°56'N 89°09'W; 59M; 25 X 53. FMNH 79851; 3(139-152); 27°43'N 96°53'W; 26M; 14 XII 50. FMNH 86369; (113); 29°42'N 88°29'W; 37M; 10 VIII 51. FMNH 89568; 2(119-121); 29°42'N 88°29'W; 37M; 10 VIII 51. GCRL V79:16384; (32.7); Laguna el Carmen, Tabasco, Mexico; 02 III 78. TCWC 2251.1; (126); 29°09'N 88°52'W; 73M; 10-16 XII 63. TU 92501; 25(82.0-120); 29°11'05"N 80°53'05"W; 12M; 24 II 70. TU 5374; 18(113-137); 29°14.4'N 88°52.4'W; 32M; 11 VIII 52. UF 35486; (125); 29°58.1'N 81°16.9'W; 14M. UF/FSU 20946; (115); 29°41'N 88°14.5'W; 45M; 22 VII 71. UMML UNCAT OR5344; (131); 28°12'N 80°05'W; 60M; 14 III 65. UMML UNCAT OR5346; 3(118-134); 28°22'N 80°05'W; 60M; 14 III 65. UMML UNCAT SB5105; (104); 27°57'N 80°03'W; 55M; 28 IX 63. UMMZ 199071; 5(46.0-57.3); Texas; 08-09 IV 39. UNC UNCAT; 3(22-24); Cape Fear River, NC; August, 1981. USA 1905; 25(91.9-122); 29°57'N 87°54'W; 26M; 20 IV 75. USA 4070; 20(111-127); 10mi. SSE Port Aransas, TX; No Depth; 3 XII 75.

Figure 29. Geographic distributions of *Symphurus civitatium*, Undescribed Species D and Undescribed Species E.


S. civitatium
New Species D
New Species E

Symphurus tessellatus (Quoy and Gaimard 1824)

(Fig. 50A).

Plagusia tessellata

Quoy and Gaimard 1824: 240; Original description; Counts and color description; Rio de Janeiro Bay, Brazil.

Plagusia brasiliensis

Agassiz, in Spix and Agassiz 1831: 89; Original description; Counts, color description and figure; Brazil.

Castelnau 1855: 79; Brief description and figure.

Aphoristia ornata

Kaup 1858: 106 (In part); Synonymized with *S. plagusia* Schneider, in Bloch and Schneider 1801.

Günther 1862: 490 (In part); Synonymized with *S. plagusia* Schneider, in Bloch and Schneider 1801.

Kner 1865-67: 292; Listed, Rio de Janeiro, Brazil.

Aphoristia fasciata (not DeKay)

Goode and Bean 1895: 458; In key and figured; Jamaica.

<u>Symphurus plagusia</u>

Jordan and Goss 1889: 324 (In part); Synonymized with <u>S</u>. <u>plagusia</u> Schneider, in Bloch and Schneider 1801.

Berg 1895: 79; (In part); Mar del Plata-Montevideo; counts include <u>S</u>. <u>jenynsi</u>.

Jordan and Evermann 1898: 2709 (In part); Synonymized with <u>S</u>. <u>plagusia</u> Schneider, in Bloch and Schneider 1801.

Thompson 1916: 416; After Jordan and Goss; counts, measurements, brief color description.

de Vincenzi 1920: 135; Rio de la Plata; diagnosed from <u>S</u>. <u>jenynsi</u>.

de Vincenzi 1924: 281; Listed, Uruguay; counts.

Puyo 1949: 178 (In part); French Guyana; figure, counts, color description.

Lowe-McConnell 1962: 694 (In part); Listed, British Guiana.

Caldwell 1966: 84; Collections from offshore localities, Jamaica.

Menezes and Benvegnu 1976: 142; Synonymized with <u>S</u>. <u>plagusia</u>.

Soares 1978: 23; Listed, Rio Grande do Norte, Brazil; counts, color description and figure.

Lema et al. 1980: 44; Rio de la Plata region, RS, Brazil; synonymy.

Rosa 1980: 222 (In part); Listed, Paraiba, Brazil.

Lucena and Lucena 1982: 56; Listed, collections in southern Brazil.

<u>Symphurus plagusia tessellatus</u>

Ginsburg 1951: 199; Diagnosis and description of subspecies from South America (Brazil-Uruguay).

Cervignon 1966: 816; Listed, Venezuela; (probably <u>S</u>. <u>tessellatus</u> based on high meristics, color description and large size reported).

Carvalho et al. 1968: 22 (In part); Occurrence of subspecies in Brazil.

Palacio 1974: 87 (In part); Colombia; all specimens listed as <u>S</u>. <u>p</u>. <u>plagusia</u> were misidentified (all were <u>S</u>. <u>tessellatus</u>).

Lema and Oliveira 1977: 7; Recorded from SC, Brazil; in key; suggested that <u>S</u>. <u>civitatium</u>, <u>S</u>. <u>tessellatus</u> and <u>S</u>. <u>plagusia</u> are geographic races of the same species.

<u>Symphurus pterospilotus</u> (=<u>S</u>. <u>diomedeanus</u> Goode and Bean)

Lema et al. 1977: 7 (In part); Specimens mis-identified.

<u>Remarks</u>

Comments regarding the nomenclatorial history of this species were reviewed under the remarks section in the account of <u>S</u>. <u>plagusia</u>. All authors since Kaup (1858) have considered <u>S</u>. <u>tessellatus</u> and <u>S</u>. <u>plagusia</u> as conspecific. However, results of this study indicate that both <u>S</u>. <u>plagusia</u> and <u>S</u>. <u>tessellatus</u> are valid species.

The original description of <u>Plagusia tessellata</u> by Quoy and Gaimard (1831) provides sufficient information to clearly identify their specimen. This is the earliest name applied to a tonguefish collected from the southern Brazil region and therefore has priority over <u>Plagusia brasiliensis</u>

Agassiz, in Spix and Agassiz (1824) which is regarded as a junior synonym of Symphurus tessellatus (Quoy and Gaimard 1824). The type specimen of Pl. brasiliensis was thought to have been destroyed during the Second World War (Whitehead and Myers 1971), however, recently Kottelat (1984) listed the holotype specimen (MHNN 691) as still being in existence. I have not examined this specimen yet.

In their revision of the tonguefishes of the western South Atlantic, Menezes and Benvegnu (1976) reported that their specimens had high meristics and the pigmentation consisted of sharply contrasting crossbands with dorsal and anal fins becoming almost black in their posterior extent. These authors found little variation in their material and believed that only a single species was present on the inner continental shelf of southern South America. Menezes and Benvegnu (1976) used the oldest available name, Symphurus plagusia (Bloch and Schneider), for their species. Additionally, these authors suggested that sub-specific designations for S. plagusia, as proposed by Ginsburg (1951), should be re-examined.

Based on the high counts and the color description of their specimens (strongly banded with fins becoming black posteriorly) and the capture location (open shelf region where S. plagusia (sensu strictu) is rare), it is probable that Menezes and Benvegnu had studied only a single species. However, since S. tessellatus is removed from the synonymy of S. plagusia, the appropriate name for their specimens is S. tessellatus (Quoy and Gaimard).

Study Material: 432 specimens, 13.4-220 mm SL. 227 x-rayed, 23 measured.

Diagnosis

A large Symphurus (up to 220 mm SL) with a 1-4-3 ID pattern, 12 caudal rays, unpigmented peritoneum and 50-54 vertebrae. This species most closely resembles and is completely sympatric with undescribed species D, undescribed species E and S. plagusia. It differs from new species D in having 4-8 small, but well-developed accessory scales on the blind side dorsal and anal rays (in specimens larger than 60 mm SL), a larger eye (79-114, $\bar{x}$ = 95.2% HL vs. 68-104, $\bar{x}$ = 84.3% HL), slightly lower meristics (dorsal rays 91-102 vs. 99-106; anal rays 77-86 vs. 81-88; vertebrae usually 50-53 vs. 53-54 vertebrae), somewhat larger body size (220 mm SL vs. 190 mm SL), and S. tessellatus lacks the fleshy ridge on the eyed-side lower lip (usually present and well-developed in the undescribed species). The posterior extension of the jaws is slightly more anterior in S. tessellatus, reaching to about the rear edge of the pupil or rear edge of the eye. In the new species, the jaws extend to the posterior edge of the eye and in many specimens, the jaws actually extend posteriorly beyond the eyes.

These two species differ also in pigmentation. Symphurus tessellatus generally has about nine wide, dark-brown crossbands; the undescribed species has narrower, more numerous bands (10-14, usually 10-12). Additionally, in S. tessellatus the posterior third of the dorsal and anal fins, as well as the caudal fin are usually dark brown or black with no indication of blotches. In undescribed species D, the dorsal and anal fins are not usually dark brown or black but rather, there is an alternating series of blotches and clear areas in the posterior two-thirds of the dorsal and anal fins.

Symphurus tessellatus, especially large juveniles and small adults (to approximately 150 mm SL), are superficially similar in overall body shape, relative eye size and body pigmentation (crossbanding) to new species E. However, it is easily recognized and distinguished from the new species by differences in body pigmentation, meristics and body size. Symphurus tessellatus has a black opercular spot (absent in new species E) and fewer (7-9), broad crossbands (vs. 9-15, narrow crossbands in new species E). Also the posterior margins of the dorsal, anal and caudal fins of adult S. tessellatus are black and there is black pigment patches on the blind side of the body, whereas in new species E, the posterior vertical fins are pigmented with an alternating series of blotches and unpigmented areas with no progressive posterior darkening and the blind side is without black pigment patches. Symphurus tessellatus has modally higher counts (vertebrae 50-53 vs. 49-50; dorsal rays 91-102 vs. 89-96; anal rays 77-86 vs. 74-80) when compared to new species E. Further differences between these species are the presence of scales on the blind side dorsal and anal fins of S. tessellatus (absent in new species E) and S. tessellatus attains considerably larger adult sizes (220 vs. 130 mm SL) and matures at larger sizes (>110 vs. 80 mm SL). There are ecological differences between the two species, especially with respect to depth of occurrence. Symphurus tessellatus undergoes an ontogenetic migration from shallow, near-shore habitats to deeper shelf depths of up to 80 m. In contrast, all sizes of new species E are usually taken in beach seine collections with some adults occurring at least as deep as 25 meters.

Symphurus tessellatus can be readily distinguished from S. plagusia by several characters. Symphurus tessellatus has accessory scales on the dorsal and anal fin rays of the blind side which are not present in S. plagusia. Additionally, S. tessellatus lacks a fleshy ridge on the eyed-side lower lip (present in all sizes of S. plagusia but is best developed in younger stages). Further differences between these two species occur in the dorsal fin origin. Usually there is one ray anterior to the eye in S. plagusia while in S. tessellatus the origin of the dorsal fin is slightly more posterior and the first ray is situated above the front edge of the pupil or the mid-eye region. When viewed from the blind side, the more posterior origin of the dorsal fin in S. tessellatus is apparent in the number of rays occurring along the dorsal margin in the space above the two nostrils. In S. tessellatus usually only the first dorsal ray occurs above the space between the nostrils while the second ray lies above the posterior nostril or even slightly beyond the rear nostril. In S. plagusia usually the first two dorsal rays occur along the dorsal margin in the space above the two nostrils, and in many specimens, the first dorsal ray is situated anterior to the anterior nostril.

The eye is somewhat larger (7.9-11.4 $\bar{X}$ = 9.5% HL) and more elliptical in S. tessellatus (smaller, 6.4-9.5 $\bar{X}$ = 8.2% HL and rounder in shape in S. plagusia). With respect to the rearward extension of the jaws, the jaws appear to be somewhat shorter in S. tessellatus reaching only to the middle of the lower eye or to the rear margin of the pupil of the lower eye, while in S. plagusia the jaws extend usually to the posterior margin of the lower eye or in some cases, actually extend slightly posterior to the rear margin of the lower eye.

The two species also differ in meristics. Symphurus tessellatus has higher counts (dorsal rays 91-102 vs. 91-97; anal rays 77-86 vs. 75-81; vertebrae usually 50-53 vs. 49-50). Symphurus tessellatus is also a larger fish attaining adult sizes to 220 mm SL (vs. 130 mm SL in S. plagusia). There are differences in the ecologies of the two species. Symphurus tessellatus juveniles co-occur in estuarine and shallow mud-flat habitats with all sizes of S. plagusia. Adult S. tessellatus, unlike adults of S. plagusia, are found offshore at depths usually from 11-70 meters.

The two species have quite different pigmentation patterns. The condition in S. tessellatus is given first: large black spot on outer edge of operculum vs. dusky blotch on inner operculum; inner lining of eyed-side operculum heavily pigmented vs. little or no spotting on inner lining; relatively few, wide, sharply contrasting crossbands vs. numerous diffuse, often faint crossbands; posterior third of the dorsal and anal fins and the entire caudal fins usually dark black vs. alternating blotching of the dorsal and anal fins and uniform brown caudal fin.

Description

Symphurus tessellatus is a large tonguefish, attaining adult sizes to 220 mm SL. The usual ID pattern is 1-4-3 (Table 9). Caudal rays 12 (Table 10). Dorsal rays numerous, 91-102 (Table 11). Anal rays also numerous, 77-86, usually 78-84 (Table 12). Vertebrae 49-54, usually 50-53 (Table 13).

Hypurals 4. Scales large, strongly ctenoid on both sides of body. Longitudinal scale rows 81-96, usually 83-92 (Table 14). Scale rows on head posterior to lower orbit 18-23, usually 20-22 (Table 15). Lateral scale rows 38-45 (Table 16). Proportional measurements appear in Tables 80-81.

Body relatively elongate; body depth moderate, 24-31% of SL; greatest depth usually occurring in anterior third of body. Head relatively wide (17-19.9% SL); with moderately long pointed snout (19.6-23.1 % HL). Snout covered with small ctenoid scales. Dermal papillae well developed on blind side snout and chin but not excessively dense, occasionally extending onto eyed-side snout. Posterior extension of maxilla usually reaches to middle or rear edge of pupil of lower eye. Eyes moderate (7.9-11.4% HL); usually sub-equal in position. Eyes without scales; usually with 1-3 small ctenoid scales in narrow interorbital space. Pupillary operculum absent. Dorsal fin origin usually at a vertical equal to front of upper eye or occasionally only reaching to middle of upper eye. Four to eight accessory scales present on blind side dorsal and anal fin rays (best developed in posterior third of fins of larger (>70 mm SL) juveniles and adults).

Teeth well-developed on blind side jaws. Lower jaw on ocular side usually with a single, mostly incomplete row of slender teeth; upper jaw on ocular side either with a very short row (covering no more than one-third of premaxilla) of teeth anterior to anterior nostril or lacking teeth altogether.

Table 80. Summary of morphometrics expressed as thousandths of Standard Length (except SL in mm) for *Symphurus tessellatus*.

Character	N	RANGE	MEAN	SD
SL	22	97.9-202.8	145.0	27.66
BD	22	247-312	280.2	18.82
PDL	22	32-48	41.7	4.48
PAL	22	181-227	204.7	10.58
DBL	22	952-968	958.3	4.48
ABL	22	771-876	798.0	22.90
PL	22	44-73	59.0	6.47
PA	22	27-56	41.5	6.01
CFL	22	72-118	90.9	10.36
HL	22	170-199	186.6	7.37
HW	22	193-247	218.6	15.58
POL	22	117-135	125.9	5.38
SNL	22	35-46	40.3	2.55
UJL	22	41-52	46.3	3.12
ED	22	15-21	17.6	2.04
CD	22	33-63	46.4	6.51
UHL	22	113-163	143.3	12.03
LHL	22	80-114	97.8	10.56

Table 81. Summary of morphometrics expressed as thousandths of Head Length (except HL and HW) for *Symphurus tessellatus*.

Character	N	RANGE	MEAN	SD
HL/HW	22	1.08-1.36	1.2	0.08
POL	22	593-723	674.9	25.07
SNL	22	196-231	215.7	9.25
UJL	22	222-278	248.1	15.58
ED	22	79-114	95.2	10.06
CD	22	173-322	245.0	31.85
OPLL	22	243-359	306.8	31.68
OPUL	22	161-252	205.7	24.03
UHL	22	682-891	774.2	56.18
LHL	22	422-593	523.1	46.26

Pigmentation

The general pattern of body pigmentation is similar for both sexes at all sizes but differs in the intensity of pigmentation with sexual development. Males, especially those in breeding condition, usually have more intense banding, dark black fins, a dark black pigment spot on the operculum and some have irregular, black pigment patches on the posterior portions of the body on the blind side. In contrast, breeding females, are also banded but the bands are less apparent and the fins in the posterior portion of the body are dark brown but not usually black. No black pigment patches on the blind side were noted in females.

Eyed surface background pigmentation somewhat variable ranging from dark to light brown but usually with 5-9 (usually 5-7) well-developed, sharply contrasting, relatively wide, dark brown crossbands on head and trunk. The first two bands are relatively constant in position. The first crosses the head region immediately posterior to the eyes. The second band crosses the body immediately behind the opercular opening.

Along the trunk, the bands are variable in number and irregular in degree of completeness, especially those in the region between opercular opening to a point about two-thirds of trunk length. Usually there are 3-4 well-developed and a lesser number of incomplete bands along the trunk. The two posteriormost bands, located a short distance anterior to the caudal fin base, are slightly arched and usually darker than the other trunk bands.

Outer surface of operculum usually with a distinct, dark brown or black pigment spot on ventral edge slightly forward of posterior margin of operculum. This pigment spot is variable in shape, ranging from an almost spherical spot to a dorso-ventrally oriented elongated black blotch covering most of the lower opercular region. The intensity of pigmentation in the spot appears to be maximally developed in sexually mature adults with ripened gonads. Inner operculum and isthmus heavily pigmented on blind and eyed sides of body. Moustache well-developed on ocular side upper lip. Lower lip frequently spotted but without well-defined moustache. Blind side usually clear, creamy white, however, some males in breeding condition develop irregular patches of black pigment on the caudal third of the blind-side body. Peritoneum unpigmented.

In the anterior portions of the dorsal and anal fins, usually the fin rays have streaks of brown pigment and the rays are more heavily pigmented than the fin membrane while in the posterior two-thirds of the body, both the fin rays and the fin membranes becoming increasingly darker. In males, the fins become almost uniformly black while in females, the posterior portions of the fins, although darker than the anterior regions, are more usually dark brown.

Size and Sexual Maturity

Symphurus tessellatus is the second largest tonguefish species in the Atlantic (only *S. jenynsi* is larger). Size-related life history information was summarized from measurements of 375 fish. Males and females attain nearly similar sizes, but females are slightly larger. The largest fish measured in this study was a female of 220 mm SL; the largest male was slightly smaller and measured 205 mm SL.

There were 214 males, 145 females and 16 immature fish (sex could not be determined because the gonads were undeveloped) among the material examined. Based on the reproductive stages examined for 145 females, it appears that this species matures at sizes between 104-120 mm SL, but more usually at sizes larger than 115 mm SL (Fig. 30). Of the 145 females, 26 ranging from 49.5-119 mm SL, were immature. The smallest of these immature females, measuring 49.5 and 62.8 mm SL, had ovaries which were scarcely elongate. Other immature females, ranging from 68.6-119.2 mm SL, had only partially elongate ovaries which no indication of developing ova.

There were 119 mature females ranging in size from 104-220 mm SL. Most of these exceeded 140 mm SL. There were only six mature females smaller than 125 mm SL present among the fish examined. Only two of these six were smaller than 110 mm SL.

Geographic Distribution (Fig. 27).

Symphurus tessellatus is a widespread tropical species, ranging from the larger Caribbean Islands such as Cuba, Haiti and Puerto Rico to Uruguay. In the West Indies, adults and juveniles have frequently been taken in abundance at several localities, but the local distribution of this species appears to be limited by the distribution of soft silt and mud sediments. These bottom types are more common on the larger islands with higher elevations that support river and estuarine habitats. It has been taken at several inshore locations in Puerto Rico, Cuba and Haiti and a large number of adults were collected by the RV OREGON on the shelf area southwest of

Jamaica (Caldwell 1966). Juveniles of this species have been taken from several inshore areas in Jamaica as well.

Along the continental margin it has been frequently captured on muddy bottoms from Belize and Nicaragua south to southern Brazil and Uruguay (28^{o}S). In the northern part of its range along Central America, it has been collected as far north as Belize ($17^{o}12'$N) but thus far is unknown from the Yucatan Peninsula or Campeche Bay. The absence of this species in the Yucatan region may be explained by changes in the sediments of this region. The Yucatan Shelf is a broad limestone plateau with a minimum of land-derived detrital sediments (Harding 1964; Topp and Hoff 1972). Instead of the soft sediments of more southern locations, sediments in this region are firmer, consisting of skeletal remains of various planktonic and benthonic organisms, ooids, calcareous pellets, lithic fragments and grapestone aggregates. The dramatic change from soft, mud sediments to firmer sediments in the Yucatan region prevents the northward distribution of S. tessellatus into the waters of southern Mexico.

From Belize and Honduras south to Venezuela and along the entire coastline of northern South America from the Guianas to about the southern Brazil, this species is one of the most abundant and frequently trawled tonguefish species (Meek and Hildebrand 1928; Cervignon 1966; Palacio 1974; Carvalho et al. 1968; Menezes and Benvegnu 1976). Menezes and Benvegnu (1976) described S. tessellatus as the most abundant tonguefish collected along the Brazilian coast from $26^{o}49'$S to about 4^{o}S in northern Brazil. South of 28^{o}S it appears to be much rarer and many of the specimens (all that I examined) collected from Rio Grande do Sul and south are juveniles.

The two specimens from Uruguay (the most southerly occurring specimens examined in the present work) were juveniles (119 and 113 mm SL, respectively). The small size of these specimens suggests that adult S. tessellatus are not regular components of the ichthyofauna of Uruguay and northern Argentina, but rather, this information indicates that juveniles either seasonally migrate or are passively transported into waters along the continental shelf and coastline of Uruguay and northern Argentina. The general absence of large adults and the occurrence of small juvenile fishes of this species indicates that the region south of about Rio Grande do Sul, which comes under periodic influence from the cold Falkland Current, does not harbor large populations of this essentially tropical species so common to areas further north.

The specimen from Argentina described by Lazzaro (1973) as S. plagiusa and cited in the distribution section of Menezes and Benvegnu (1976) for S. plagusia (=tessellatus) is not a specimen of S. tessellatus. Based on counts and the figure provided by Lazzaro, it more closely matches the meristics and shape of S. trewavasae. Additionally, the specimen reported by Lazzaro (1977) as S. civitatum is not S. civitatium nor any of the other 12 caudal-rayed Symphurus with an unpigmented peritoneum such as S. tessellatus or S. plagusia. The body shape, meristics and depth of occurrence (183 meters) indicate that this was more probably S. ginsburgi.

Bathymetric Distribution

Throughout its range, *Symphurus tessellatus* is commonly taken by beach seine in nearshore habitats and by trawl in deeper areas. Individuals of this species have been collected from a depth range of 1-86 meters. There is an ontogenetic migration offshore, juveniles occur commonly in medium to high salinity regions of estuaries and in high salinity, soft bottom habitats in nearshore mudflats. Adults generally range into deeper water, although a few large fishes examined in this study were taken in relatively shallow water. Most of the 349 *S. tessellatus* examined in this study for which depth information was available were collected in depths between 1-70 meters (Table 82). The majority of shallow water captures were of specimens smaller than 130 mm SL. The largest individuals were generally collected by otter trawl on the nearby shelf. The deepest capture is for a single specimen taken at 86 meters and 21 other individuals were taken at 73 meters, but the majority of captures, and the center of abundance for this species, occurs in depths between 1-50 meters (81% of the individuals in this study). Interestingly, Menezes and Benvegnu (1976) report that in southern Brazil, *S. plagusia* (=*S. tessellatus*) occurs only in shallow water (<12 meters) while in the northern part of its range in Brazil, it is known to occur deeper. They suggested that in southern Brazil, perhaps the presence of *S. jenynsi* at shelf depths greater than 12 meters somehow prevented the occurrence of *S. plagusia* (=*tesselllatus*) at these depths. A more likely explanation is that *S. tessellatus* is primarily a tropical species reaching its southern limit of distribution in southern Brazil south of Rio de Janeiro. Its bathymetric distribution may be limited not by competitive interaction from another tonguefish species, but rather, its offshore distribution may be restricted by cooler temperatures on the shelf. The appearance of S. jenynsi, a temperate species, in these regions indicates that temperature may strongly influence the offshore distribution of S. tessellatus in this region.

Throughout its range to at least Rio de Janeiro, juveniles of this species occur in similar habitats and are often collected with a complete size range of S. plagusia. In the Caribbean region, juveniles of S. tessellatus are also taken with a complete size range of new species E. Along the northeastern coast of South America from Surinam to eastern Brazil, large adults of this species are collected in deeper areas with a wide size range of specimens of undescribed species D.

Table 82. Summary of bathymetric distribution for 349 individuals of Symphurus tessellatus. Numbers in the table represent the frequency of occurrence followed by the per cent occurrence in parenthesis.

DEPTH	1-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	86
N	35(10)	89(26)	8(2)	85(24)	65(19)	18(5)	27(8)	21(6)	1(.3)

Material Examined

Counted and Measured 23 Specimens, 8 Lots.

ANSP 121549; 10(108-203); Rio de Janeiro, Brazil; July-August 1963. UF 35275; (172); French Guiana 05°14'N 52°06'W; 45M; 11 XII 77. UFPB 143;

5(96.6-135); Ria Paraiba do Norte, Brazil; 27 IV 78. UPRM 2717; (142); Puerto Rico; 8M; 14 III 66. UPR 2760; (142); Mayaguez, Puerto Rico; 12M; 15 III 66. UPRM 2859; (111); Mayaguez, Puerto Rico; 9M; 29 IV 66. UPRM UNCAT (Removed from UPRM 740); (130); Anasco River, Puerto Rico; 1-2 VII 53. UPRM UNCAT (Field No. JSR 66-34); 2(130-133).

Counted 204 Specimens, 45 Lots.

PUERTO RICO

MCZ 28843; (91.8); Puerto Rico; 1898-99. UF UNCAT (Removed from UF 12059); (146); 16 IV 64. UPRM 1590; 2(159-173); Mayaguez; 03 III 62. UPRM 2743; 15(114-172); Mayaguez; 6M; 15 III 66. UPRM UNCAT (Removed from UPR 736); 2(128-143); Rio Anasco; 17 VIII 51. UPRM UNCAT; 3(126-158); Field No. J-S-R 66-49; Puerto Rico. USNM 126448; (132); Mayaguez; 1899.

CUBA

MCZ 11269; (111); Cuba. USNM 35108; (81.3); Havana. USNM 37750; (68.6); Havana. USNM 107365; (61.0); Siguanea Bay, Cuba; 6M; 12 IV 37. USNM 154857; (131); Cuba.

DOMINICAN REPUBLIC

USNM 108369; (123). USNM 108372; (126).

HAITI

ANSP 81861; (97.7); Port-au-Prince, Haiti; November 1949. ANSP 83626; 8(83.3-113); Port-au-Prince; 1949. ANSP 97661; 6(114-146); Port-au-Prince; 1936. UMMZ 142422; (127); Haiti; 15 IV 83. USNM 133671; 3(109-124); Port-au-Prince; 1-4 I 47. USNM 164849; 2(87.7-133); Haiti; 1927.

JAMAICA

LACM 6215; (142); 17°52'N 77°53'W; 40M; 15 V 62. LACM 6217; 10(123-152); 17°46'N 77°30'W; 16M; 15 V 62. UMML 4831; (115); Hunts Bay; 03 VIII 58. UMML UNCAT OR3546; 3(118-160); 17°45'N; 77°38'W; 35M; 15 V 62. UMML UNCAT OR5397; (144); 17°55'N 77°51'W; 39M; 18 V 65. USNM 37348; (79.9); Jamaica. USNM UNCAT OR5397; 6(128-161); 17°55'N 77°51'W; 40M; 18 V 65. USNM UNCAT OR5398; 2(130-146); 17°53'N 77°50'W; 42M; 18 V 65. USNM UNCAT OR5399; 2(128-138); 17°51'N 77°49.5'W; 49M; 18 V 65.

HONDURAS

FMNH UNCAT (Removed from FMNH 94818); 5(38.1-56.0); Brus Lagoon, Honduras; 10 V 75. FMNH 94819; 5(37.7-49.5); Brus Lagoon, Honduras; 10 V 75. UMML TABL 105167; 2(130-134); 15°49.15'N 83°44'W; 31M; 07 IV 67. UMML TABL 105168; 2(126-141); 15°48'N 83°54'W; 24M; 07 IV 67. UMML TABL 105169; 5(111-164); 15°49.5'N 83°44'W; 31M; 07 IV 67. UMML TABL 105170; 3(130-148); 15°54'N 83°40'W; 37M; 08 IV 67. UMML TABL 105171; 3(132-155); 15°54'N 83°40'W; 37M; 08 IV 67. UMML TABL 105233; 2(138-147); 15°45'N 83°32'W; 35M; 09 IV 67.

<u>BELIZE</u>

UMML TABL 105234; 4(132-160); 17°12'N 88°11.2'W; 19M; 09 V 67. UMML TABL 105235; 9(134-160); 17°12'N 88°11.2'W; 19M; 18 V 67.

<u>PANAMA</u>

GCRL V74:12698; 2(13.4-65.8); Canal Zone; 05 III 74.

<u>COLOMBIA</u>

UMML UNCAT OR4875; 4(145-155); 10°53'N 75°22'W; 42M; 23 V 64. UMML UNCAT OR4892; (148); 09°30'N 76°07.5'W; 41M; 26 V 64. USNM UNCAT ORII 10241; (147); 08°59'N 76°27'W; 26M; 29 XI 68.

<u>VENEZUELA</u>

ANSP 121394; 7(67.9-152); Venezuela; 15 III 62. FMNH 88650; 16(155-200); 12°19'N 70°34'W; 73M; 27 IX 63. UMML UNCAT (Removed from UMML 30188); (173); 11°52'N 70°22'W; 35M; 27 VI 68. UMML UNCAT OR4402; (171); 12°19'N 70°34'W; 73M; 27 IX 63. UMML UNCAT OR4495; (145); 10°29'N 62°30'W; 9M; 24 X 63.

<u>TRINIDAD</u>

UPRM UNCAT (Removed from UPR 1828); (142); Trinidad; 04 V 64.

GUYANA

FMNH 86364; (162); 08°09'N 58°23'W; 42M; 29 VIII 58. FMNH 90546; 23(152-204); 08°32'N 59°10'W; 43M; 28 X 58. GCRL V69:3835; (196); 08°13'N 58°40'W; 37M; 27 IV 69. GCRL V69:3838; 3(192-202); 09°14'N 60°19'W; 44M; 25 IV 69.

SURINAM

FMNH 86459; (161); Surinam; COQUETTE 1957. GCRL V69:3836; 6(164-196); 06°56'N 54°05'W; 59M; 02 V 69. USNM UNCAT ORII 12042; (168); 06°12'N 53°23'W; 46M; 01 VII 72.

BRAZIL

FMNH 90544; 3(183-196); 01°57'N 48°12'W; 55M; 14 XI 57. FMNH 91129; (197); 02°29'N 48°54'W; 86M; 15 XI 57. MCZ 11381; 14(93.9-202); Rio de Janeiro; 1865. MCZ 24939; (174); Rio de Janeiro; 1865. UFPB 1120; 5(51.5-115); Rio Paraiba do Norte; 30 VIII 81. UFPB UNCAT (Removed from UFPB 884); 9(55.7-123); Rio Paraiba do Norte; 13 XI 81. UFPB UNCAT (Removed from UFPB 896); 2(100-110); Rio Paraiba do Norte; 30 VII 81. USNM 159225; 2(182-187); 01°57'N 48°12'W; 55M; 17 XI 57.

Other 205 Specimens, 70 Lots.

CUBA

MCZ UNCAT (Removed from MCZ 25982); (89.9); Cuba.

HONDURAS

UF 33892; 4(138-154); 15°45'N 83°32'W; 35M; 09 IV 67. USNM UNCAT OR6417; 6(136-161); 15°56'N 83°55'W; 47M; 02 II 67.

NICARAGUA

UMML UNCAT PILLS 1331; 2(126-140); 11°51'N 83°35'W; 20M; 28 I 71. UMML UNCAT PILLS 1333; 9(56.4-142); 12°16'N 83°31W; 12M; 28 I 71.

PANAMA

GCRL V76:14930; 2(173-177); Colon, Panama; April 1974. MCZ 58656 (31.1); Panama; 09 IX 64. UF/FSU 25622; (57.5); Canal Zone, Panama; 1974. UF/FSU 26003; (62.8); Canal Zone, Panama; August 1974. UMML 26664; 2(123-141); 09°18.2-18.4'N 80°03.3-04'W; 24M; 20 VII 66. USNM 81652; (89.4); Porto Bello; 24-28 IV 11. USNM 81653; 2(61.1-67.6); Fox Bay; 11 I 11. USNM 81655; 2(38.1-43.5); Fox Bay; 27 I 12. USNM 144792; (65.1); Canal Zone; 04 III 37. USNM UNCAT PEL 1631; 8(169-220); 08°25'N 79°56'W; 10M; 19 XII 63.

COLOMBIA

UMML 22247; 22(84-148); 08°48-46.8'N 76°39.7-42.8'W; 20M; 12 VII 66. UMML 31320; (133); 08°51.9-53.9'N 76°37.2'W; 12 VII 66. USNM UNCAT ORII 11233; (152); 08°50'N 76°48'W; 49M; 02 XI 70. USNM UNCAT ORII 12032; (194); 06°46'N 54°27'W; 49M; 28 VI 72. USNM UNCAT ORII 12039; 9(191-207); 06°54'N 53°58'W; 64M; 30 VI 72. USNM UNCAT (Removed from USNM 236252); 3(162-173); 06°34'N 54°28'W; 37M; 28 VI 72.

VENEZUELA

ANSP 120209; (133); Venezuela; 23 VII 60-17 III 62. GCRL V69:3837; (163); 08°52'N 59°58'W; 29M; 26 IV 69. MCZ 41081; (104); 10°17'N 69°45'W; 1958. UMML 30197; 30(84-183); 11°25.1-25.8'N 70°52.1-50'W; 18M; 27 VII 68. UMML 30223; (160); 11°55-55.3'N 71°00-59.9'W; 11M; 28 VII 68. UMML UNCAT P-711; 2(138-185); 10°49'N 63°13'W; 48M; 19 VII 68. UMML UNCAT P-750; (187); 10°36'N 68°12'W; 24M; 25 VII 68. UMML UNCAT OR4473; 6(158-201); 10°11'N 64°48'W; 35M; 19 X 63. USNM UNCAT OR4403; 10(144-197); 12°17'N 70°34'W; 73M; 27 IX 63. USNM UNCAT OR 5666; 4(161-185); 11°50'N 70°40'W; 59M; 10 V 65.

TRINIDAD

USNM 113251; (124); 10°37'N 61°42'W; 60M; 3 II 1884. USNM 123112; (179); Gulf of Paria.

GUYANA

UMML UNCAT PILLS 686; (152); 07°00'N 57°08'W; 26M; 15 VII 68.

FRENCH GUIANA

UF 44365; (168); 05°05'N 51°58'W; 45M; 11 XII 77.

SURINAM

UMML 12251; (162); 06°18'N 55°11'W; 18M; 20 II 63. USNM 159236; (177); 06°41'N 54°17'W; 46M; 14 IV 57. USNM 159567; (205); 06°42'N 54°12.5'W; 44M; 14 VI 51. USNM 159612; (204); 06°41.5N 54°14.5'W; 44M; 14 VI 57. USNM 159618; (194); 06°42.5'N 54°10'W; 42M; 14 VI 57. USNM UNCAT OR2310; (82.3); 05°30'N 52°10'W; 51M; 12 IX 58. USNM UNCAT ORII 10231; 5(126-142); 09°33'N 76°02'W; 49M; 28 XI 68.

BRAZIL

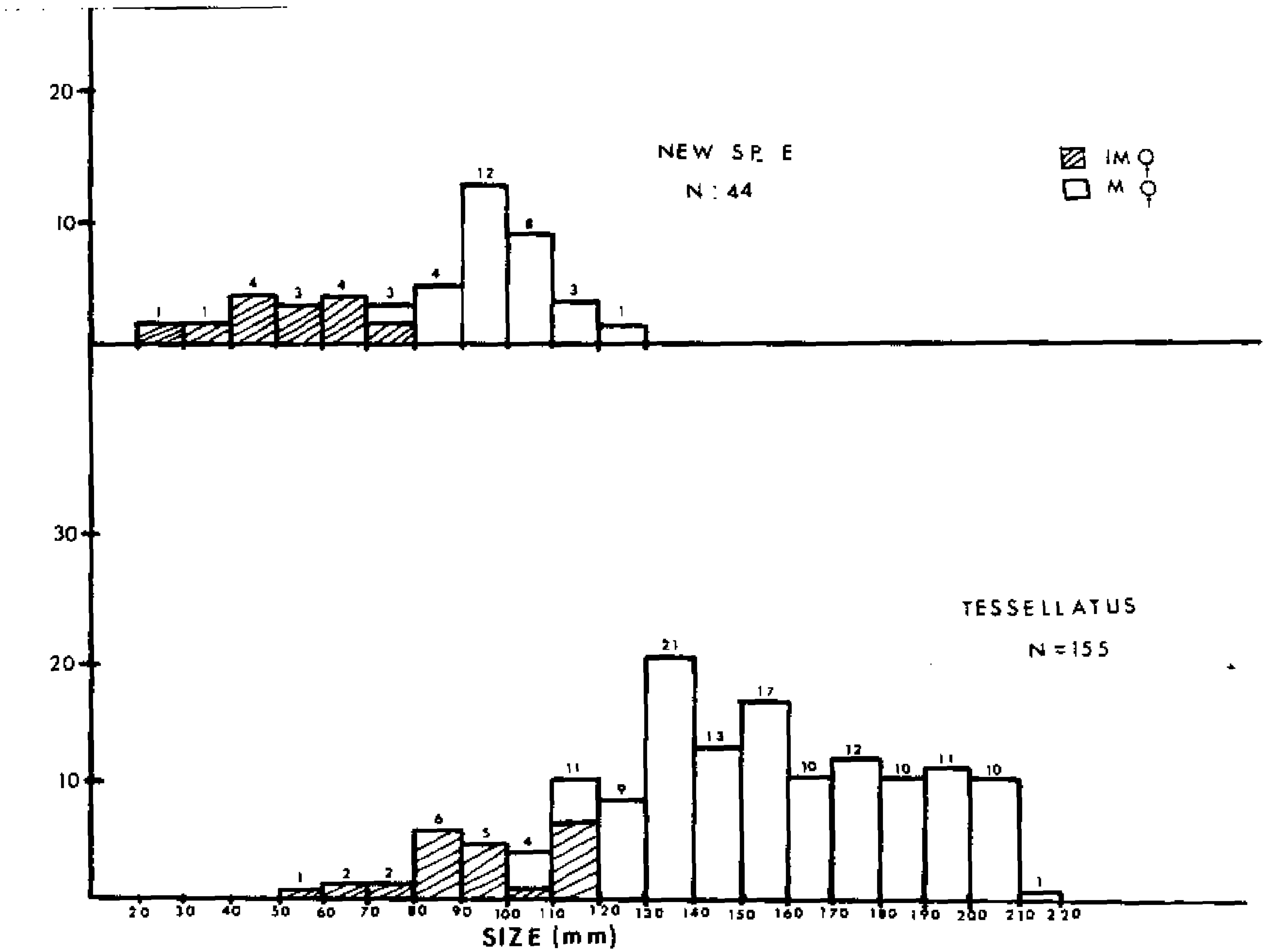
FMNH 88193; (160); Bahia, Brazil; No Depth; 13 IV 08. MCP 1198; (116); Florianopolis, Brazil; 30 X 68. MCP 1199; (114); Florianopolis, Brazil; 30 X 68. MCP 1200; (118); Florianopolis, Brazil; 30 X 68. MCP 1202; (116); Florianopolis, Brazil. 30 X 68. MCP 2193; (156); Florianopolis, Brazil; X 1968. MCP 2194; (112); Florianopolis, Brazil; X 1968. MCP 3139; (126); Florianopolis, Brazil; X 1968. MCP 5663; (180); Port Belo, SC, Brazil. MCP 7270; (128); Port Belo, SC, Brazil; 3-4 XI 73. MCP 7327; (126); Porto Belo, SC, Brazil; 01 VIII 73. MCP 7345; (130); Porto Belo, SC, Brazil; 31 VII-01 VIII 73. MCZ 889; 2(123-139); Rio de Janeiro, Brazil. MCZ 11149; (160); Rio de Janeiro, Brazil. MCZ 11323; (105); Pernambuco, Brazil. MCZ 11378; 3(68.7-96.1); Pernambuco, Brazil. MCZ 11379; (147); Santos, Brazil. MCZ 11380; (91.7); Curaca, Brazil. MCZ 11382; (137); Rio de Janeiro, Brazil. UF 19938; 3(109-133); Sao Paulo, Brazil; 13 VII 61. UFPB 882; 5(36.0-115);

Cabedelo, Brazil; 29 X 81. UFPB UNCAT (Removed from UFPB 993); 5(57.8-107); Ilha da Restinga, Rio Paraiba do Norte, Brazil. UMML 13292; (186); 04°38'N 51°05'W; 59M; 26 II 63. UMML 13977; (157); 02°10'S 42°24'W; 48M; 11 III 63. USNM 83172; (94.4); Rio de Janeiro. USNM 159237; 6(165-191); 02°00'N 48°19'W; 46M; 16 XI 57.

URUGUAY

USNM 87772; (119); Montevideo. USNM 87773; (113); Montevideo.

Figure 30. Frequency histogram of size and sexual maturity for *Symphurus tessellatus* and Undescribed Species E.



NEW SP. E
N : 44
IM ♀
M ♀
TESSELLATUS
N = 155
SIZE (mm)

Symphurus Undescribed Species D

(Fig. 50B)

Symphurus atricaudus

Puyo 1949: 179; French Guyana; counts, color description, poor figure; distinguished from *S. plagusia*.

Remarks

Since not all specimens listed in the synonymies of *S. plagusia* and *S. tessellatus* could be examined, it is impossible to determine if any specimens of new species D were included among material listed in earlier published accounts on *Symphurus* from the northern South American coast. It is possible that specimens of new species D were included in the study by Lowe-McConnell (1962) since some of the trawl stations sampledin that study occurred at the appropriate depth range to capture new species D. Lowe-McConnell listed all tonguefish captured in that study as *S. plagusia* and did not include any descriptive accounts for these specimens.

The fish described by Puyo as *S. atricaudus* (Jordan and Gilbert) is clearly not *S. atricaudus*. The new species may be distinguished from the eastern Pacific *S. atricaudus* by the following characters: dorsal rays 99-106 (vs. 94-101); anal rays 81-88 vs. 77-84; scales 85-98 vs. 104-115. Additionally, new species D lacks a pupillary operculum and scales on the blind side posterior rays of the dorsal and anal fins (both present in _S. atricaudus_).

Study Material: 67 specimens, 75.8-189 mm SL. 43 x-rayed, 56 counted and 14 measured.

Diagnosis

A relatively large-sized _Symphurus_ with a 1-4-3 ID pattern, 12 caudal rays, clear peritoneum and 52-55 vertebrae. This species most closely resembles and is largely sympatric with _S. tessellatus_ and _S. plagusia_. The most conspicuous differences between the new species and _S. tessellatus_ are that the new species lacks secondary squamation on the dorsal and anal fins (present and well-developed in _S. tessellatus_) and the new species usually has a prominent fleshy ridge on the eyed-side lower jaw (absent in _S. tessellatus_). Other differences between these two species occur in meristics. All meristics are somewhat higher in the new species (53-54 vertebrae vs. 50-53), dorsal and anal fin rays (99-104 vs. 91-102 and 82-88 vs. 77-86 (usually 78-84), respectively). The new species is somewhat smaller in size (189 mm SL vs. 220 mm SL) than _S. tessellatus_ and also matures at somewhat smaller sizes. The new species also differs from _S. tessellatus_ in subtle features of its pigmentation. _Symphurus tessellatus_ usually has a large black spot on the outer edge of the eyed-side opercle, while in the new species, the black spot is more or less poorly developed, usually forming a more diffuse dusky blotch. Additionally, the new species usually has multiple, narrow, sharply contrasting crossbands while in *S. tessellatus* the crossbands are much wider and fewer in number. The caudal and posterior portions of the dorsal and anal fins of the new species are also pigmented differently than those of *S. tessellatus*. In *S. tessellatus*, the posterior portions of the dorsal, anal and the entire caudal fin are covered with a dark brown or black pigmentation. In contrast, undescribed species D has an alternating pattern of dark-brown blotches and clear areas in the posterior portions of the dorsal and anal fins, also the caudal fins of many of the specimens of undescribed species D examined were not uniformly and intensely pigmented, but always had clear sections varying in width from two to four or five rays alternating with more darkly shaded regions.

The new species is structurally similar to *S. plagusia* with respect to caudal ray count, small eye size and the presence of a fleshy ridge on the eyed-side lower jaw. The most notable differences between these two species occur in meristics. The new species has considerably higher meristics (vertebrae 52-55 vs. 49-52; dorsal rays 99-104 vs. 91-97; anal rays 82-88 vs. 74-82). Further differences between these species are the placement of the dorsal fin and the posterior extension of the jaws in relation to the lower eye. In *Symphurus* n. sp. D, the dorsal fin usually only extends to the front or mid-eye level while in *S. plagusia* the first and occasionally the second rays of the dorsal fin are usually anterior to the upper eye. Another difference between these two species occurs with respect to the rearward extension of the eyed-side jaws. The jaws in *Symphurus* n.sp. D reach only to the middle of the lower eye or occasionally to the rear margin of the pupil of the lower eye while in S. plagusia the jaws extend usually to at least the posterior margin of the lower eye and in some cases the jaws actually extend slightly beyond the rear margin of the lower eye. There are some minor differences in morphometrics between the two species; the new species has a slightly larger eye (6.8-10.4, $\bar{X}$=8.4% HL vs. 6.4-9.4, $\bar{X}$=8.2% HL) and narrower body (23.1-29.7% SL vs. 27.8-31.9% SL in S. plagusia).

The new species attains larger sizes (up to 190 mm SL) compared to S. plagusia (largest only 131 mm SL). Additionally, these two species apparently have quite different life history patterns. They have sympatric distributions, but are not syntopic with respect to bathymetric distribution. All individuals of new species D have been collected in coastal seas at depths ranging from 7-110 meters. In contrast, although a small number of individuals of S. plagusia have been taken as deep as 40 meters, these were adults (>110 mm SL). The majority of specimens of S. plagusia examined in the present study were collected in shallow waters by beach seine and small otter trawls. All of the juveniles and most of the adults of S. plagusia have been taken at very shallow depths in nearshore habitats including estuarine locations. In contrast, thus far, no individuals of new species D are known from estuarine habitats, though it should be noted that estuarine environments have not been as thoroughly collected along the northeastern margin of South America where the new species occurs.

Description

Symphurus new species D is a relatively large-sized tonguefish attaining maximum adult lengths of approximately 190 mm SL. The usual ID pattern is 1-4-3 (Table 9). Caudal rays 12, less frequently 11 (Table 10). Dorsal rays numerous, 99-106 (Table 11). Anal rays also numerous, 81-88, usually 83-88 (Table 12). Vertebrae 52-55, usually 53-54 (Table 13). Hypurals four. Scales large, strongly ctenoid on both sides of body. Longitudinal scale rows 85-98, usually 86-93 (Table 14). Scale rows on head posterior to lower orbit 19-23, usually 19-20 (Table 15). Lateral scale rows 36-42, usually 38-40 (Table 16). Proportional measurements appear in Tables 83-84.

Body relatively elongate with a gradual taper. Body depth relatively narrow, 23-30% SL, and nearly uniform from a point equivalent to approximately anal rays 10-15 and extending posteriorly to the mid-point of the body. Head relatively wide (19.8-28.1% SL); with moderate, slightly rounded or truncate snout (19.0-22.7% HL). Snout covered with small ctenoid scales. Dermal papillae well developed on blind side snout and chin but not excessively dense, occasionally extending onto eyed-side snout. Posterior extension of maxilla usually reaches to rear edge of pupil of lower eye, or, occasionally jaws extend to or slightly beyond the posterior margin of the lower eye. Lower lip on ocular side bears a distinct, fleshy ridge located a short distance before posterior margin of jaws. Eyes relatively small (6.8-10.4% HL); usually sub-equal in position. Eyes without scales; usually with only 1-3 small, ctenoid scales in narrow interorbital space. Interorbital space sometimes equalling half the diameter of the fixed eye.

Table 83. Summary of morphometrics expressed in thousandths of Standard Length (except SL in mm) for *Symphurus* new species D.

Character	N	RANGE	MEAN	SD
SL	14	75.8-164.3	142.5	21.09
BD	14	231-297	274.5	17.19
PDL	13	32-47	38.6	4.13
PAL	14	189-243	205.6	13.32
DBL	13	953-968	961.4	4.13
ABL	14	765-837	793.7	18.74
PL	12	40-64	54.3	6.08
PA	12	20-60	41.2	12.62
CFL	14	80-99	88.9	5.53
HL	14	168-218	182.3	11.58
HW	14	198-281	216.8	21.37
POL	14	112-153	124.8	9.38
SNL	14	34-46	38.0	3.21
UJL	14	37-50	43.3	3.24
ED	14	12-19	15.4	1.95
CD	14	39-63	45.4	6.39
UHL	14	126-151	139.4	6.81
LHL	14	79-111	92.9	8.13

Table 84. Summary of morphometrics expressed as thousandths of Head Length (except HW/HL) for *Symphurus* new species D.

Character	N	RANGE	MEAN	SD
HW/HL	14	1.08-1.53	1.2	0.11
POL	14	651-722	683.8	20.64
SNL	14	190-227	209.0	11.67
UJL	14	221-258	238.3	11.74
ED	14	68-104	84.3	10.52
CD	14	214-291	248.4	23.62
OPLL	14	264-341	292.3	23.77
OPUL	14	174-246	210.6	20.39
UHL	14	661-814	767.4	44.73
LHL	14	464-556	510.3	28.01

Pupillary operculum absent. Dorsal fin origin usually at a vertical equal to front of upper eye or only occasionally extending slightly beyond anterior margin of upper eye. Scales always absent from the distal two-thirds of dorsal and anal fin rays. Scales when present at dorsal and anal fin ray bases not numbering more than one or two and occurring only sporadically on certain dorsal and anal fin rays.

Teeth well developed on blind side jaws. Lower jaw on ocular side usually with a single, mostly incomplete row of slender teeth; upper jaw on ocular side either lacking teeth altogether, or with a very short row (covering no more than one-third of premaxillary) of teeth anterior to anterior nostril.

Pigmentation

Eyed surface ranging from dark to light brown with 10-14 (usually 10-12) well-developed, sharply contrasting, somewhat narrow, dark brown crossbands on head and trunk. On the head, the first band crosses immediately posterior to the eyes while the second band is situated a short distance (usually only 3-4 scales separate the two) posteriorly. Throughout most of their length these two bands are separate, however, in several specimens, these first two bands coalesce on the ventral portion of the operculum forming a wide, somewhat circular spot. The bands on the head are somewhat narrower than those on the mid-region and posterior portions of the body.

Band number variable along trunk. Bands on trunk region vary in degree of completeness, especially in region between opercular opening to a point about two-thirds of the trunk length. Some bands are complete and continued onto dorsal and anal fins as dark brown blotches, while others are incomplete on the body and not continued onto the fins. The last band, situated a short distance from caudal region, somewhat expanded and slightly arched.

Outer surface of eyed-side operculum pigmented with a dark, diffuse pattern of melanophores. In many individuals these melanophores are coalesced into a somewhat rounded pigment spot. In the majority of individuals, these melanophores appear to be the remnant of a poorly-defined band on the lower operculum. Inner operculum and isthmus more heavily pigmented on the eyed surface; on the blind surface, pigmentation on the inner operculum restricted to a small band of pepper-dot melanophores along the ventral margin. The isthmus on the blind side is not heavily pigmented but often has a pepper-dot pattern as well. Moustache well-developed on ocular side upper lip. Lower lip frequently spotted but without well-defined moustache. Blind side clear, creamy white. Peritoneum clear. blind side ovarian membrane with small melanophores.

Dorsal, anal and caudal fins with alternating series of blotches. Dorsal fin scarcely pigmented in anterior half of body. At about body mid-point, there are a series of alternating blotches and clear areas in the dorsal fin. Blotches in the fins range from 3-5 fin rays wide and include the adjoining fin membrane as well. The anal fin has a similar pattern of alternating blotches and clear areas as in the dorsal fin, except that the blotches occur in three-fourths of the fin length. Only the anterior one-fourth of the anal fin is without blotches. In both the dorsal and anal fins, the blotches coalesce in the posterior sixth of the fins and form a continuous color band on the fins. In this region, the fins become gradually darker and the blotches, although still present become much more difficult to discern. The caudal fin is heavily pigmented on the distal two-thirds of the fin. The proximal third is relatively lightly pigmented. In most specimens, the entire caudal fin is not uniformly pigmented, but rather, a small cluster of rays (usually 2-4) are more lightly pigmented than the rest, giving the appearance of alternating blotches and clearer areas. In a small number of specimens, the entire caudal fin was heavily pigmented with no pattern of alternating clear areas.

Geographic Distribution (Fig. 29).

New species D is a tropical species with a fairly restricted distribution. It occurs along the continental margin of northeastern South America from Guyana ($57^{o}W$) to northeastern Brazil. All but one specimen have been collected north of the Amazon outflow. There is a record for a single specimen from $2^{o}S$ and since little systematic sampling has been conducted in this region, it is probable that the new species will be found more frequently in shelf depths in other areas south of the Amazon outflow.

Bathymetric Distribution

Based on the available depth information for 67 specimens, it appears that this species occurs strictly at moderate shelf depths and does not utilize nearshore habitats or estuarine environments as nursery areas such as was found for *S. plagusia* and *S. tessellatus*. As stated earlier, all specimens ranging in size from 76-189 mm SL have been collected in seaside habitats at depths ranging from 7-110 meters. The majority of specimens, 52/57 (91%), were collected between 11 and 70 meters (Table 85). At these depths it is occasionally collected with adult _S. tessellatus_, however, size differences between the two species in these collections are quite striking. All _S. tessellatus_ collected with the new species were large adults (>130 mm SL), while a mixture of sizes, representing juveniles as small as 78 and 82 mm SL were represented among the new species material. One collection (UMML uncat P-687) contained a single specimen each of new species D and _S. plagusia_.

Size and Sexual Maturity

There were 39 males, 23 females and 5 specimens of unknown sex among the material examined. The sexes were similar in size; males ranged from 82.2-181 mm SL; females ranged from 75.8-180 mm SL (the length of the largest specimen was taken from a radiograph). Based on the reproductive stages of females, it appears that this species attains sexual maturity at sizes of about 110 mm SL (Fig. 28). All females larger than 111 mm SL had elongated ovaries. The smallest female (75.8 mm SL) was only partially elongated and considered to be immature. The next smallest female was 111 mm SL and had small developing ova in the gonads. All other females were larger than 130 mm SL and had elongated ovaries.

Table 85. Summary of bathymetric distributions for 57 specimens of *Symphurus* Undescribed species D.

Depth	7-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90	110
N	2	11	7	5	5	1	23	-	2	1

Material Examined

Counted and Measured 14 Specimens, 13 Lots.

BMNH 1950.5.15:51; (139); Georgetown, British Guiana. FMNH 86362; (155); 01°57'N 48°15'W; 48M; 17 XI 57. FMNH 86365; (148); 07°05'N 57°12'W; 33M; 01 IX 58. FMNH 88846; (132); 06°54'N 57°47'W; 18M; 25 III 63. FMNH UNCAT (Removed from FMNH 90544); (164); 01°57'N 48°12'W; 55M; 14 XI 57. UMML 11549; (156); 05°57'N 52°18'W; 70M; 22 II 63. UMML 12254; (141); 06°17'N 53°35'W; 40M; 21 II 63. UMML 12262; (148); 05°24'N 51°34'W; 64M; 23 II 63. USNM 159559; (75.8); 06°04'N 54°51'W; 70M; 13 V 51. USNM 159606; (144); 06°24'N 55°00'W; 27M; 11 V 57. USNM UNCAT ORII 12042; 2(143-151); 06°12'N 53°23'W; 46M; 01 VII 72. ZMA 111.212; (158); 05°15'N 55°15'W; 12M; 13 X 69. ZMA 111.234; (140); 03°45'N 51°45'W; 40M; 16 XI 69.

Counted 28 Specimens, 14 Lots.

BMNH 1961.9.4:117; (189); British Guiana. BMNH 1961.9.4:118; (163); British Guiana. FMNH 86397; (130); 05°05'N 52°14.5'W; 20M; 23 V 57. FMNH-90083; 7(154-180); 06°03'N 52°22'W; 65M; 13 IX 58. FMNH 90085; 5(163-180); 05°46'N 52°02'W; 70M; 12 XI 57. FMNH 90552; 2(142-147); Surinam; 18M; 1957. FMNH

90553; (144); Surinam; 110M; 03 V 57. FMNH 91368; (141); Surinam; 1957. FMNH UNCAT (Removed from FMNH 91129); 2(140-155); 02°29'N 48°54'W; 86M; 15 XI 57. GCRL UNCAT (Removed from GCRL V69:3836); 5(130-165); 06°56'N 54°05'W; 02 V 69. UMML 12249; (143); 06°18'N 55°11'W; 18M; 20 II 63. UMML UNCAT P-687; (136); 07°42'N 57°32'W; 27M; 15 VII 68. USNM 159541; (150); 02°29N 48°55'W; 42M; 15 XI 57. ZMA 111.228; 1; 05°15'N 55°15'W; 12M; 10 X 69.

Other 21 Specimens, 12 Lots.

FMNH 90223; (135); 06°54'N 54°47'W; 18M; 25 III 53. FMNH 91109; (151); 06°24.5'N 55°02.5'W; 27M; 11 V 57. UF UNCAT (removed from UF 44365); (143); 05°05'N 51°58'W; 45M; 11 XII 77. UMML 12265; (150); 02°20'S 40°24'W; 40M; 12 III 63. UMML 12310; 3(139-142); 06°11'N 55°39'W; 15M; 19 II 63. UMML 12498; (158); 07°01'N 54°21'W; 64M; 21 II 63. UMML 13301; 6(111-175); 06°00'N 52°27'W; 64M; 22 II 63. UMML 13307; (166); 05°29'N 51°37'W; 64M; 23 II 63. UMML UNCAT; (160); CAYENNE Station 10, 12. UMML UNCAT PILS 664; 2(104-140); 06°25'N 55°04'W; 7M; 10 VII 68. USNM 159602; 2(82.2-94.8); 06°23'N 55°05.5'W; 27M; 11 V 57. USNM UNCAT; (146); 04°47'N 51°37'W; 33M; 05 V 75.

Symphurus Undescribed Species E

(Fig. 50C)

Symphurus plagusia plagusia

Ginsburg 1951: 220 (In part); Fox Bay, Panama; specimens in USNM 81654 included in account of *S. p. plagusia*

Symphurus plagusia

Austin and Austin 1971: 38 (In part); Guayanilla, Puerto Rico; food habits; nine specimens from UPRM 2926 belong to the new species.

Study Material: 94 Specimens, 24.4-122 mm SL. 69 x-rayed, 20 measured.

Diagnosis

A medium-sized tonguefish (up to 122 mm SL) with a 1-4-3 ID pattern, 12 caudal rays, unpigmented peritoneum, relatively large eye (8.2-11.0% HL) and 49-50 vertebrae. This species most closely resembles and occurs sympatrically with *S. plagusia* and juveniles and sub-adults of *S. tessellatus*. Undescribed species E attains similar sizes, co-occurs with and overlaps completely the meristics of *S. plagusia*. However, it differs from *S. plagusia* in several features, most notably in its somewhat larger eye size (8.2-11.0%, but usually 9.0-10.0% HL vs. 6.4-9.4, but usually 7.0-9.0% HL in *S. plagusia*), body and head shapes and pigmentation pattern. Undescribed species E has a more pointed snout with a narrow space between the upper eye and the base of the dorsal fin (vs. squarish, wide snout with a large distance between upper eye and dorsal fin base in S. plagusia). The body is shaped differently in the two species. In the new species, the greatest body depth occurs in the anterior third of the body and there is a relatively rapid posterior taper. In contrast, in S. plagusia, the greatest body depth is more closer to the body mid-point and there is a more gradual posterior taper. The two species have quite diffe ent pigmentation patterns. In undescribed species E, the body has numerous, narrow crossbands while in S. plagusia the body is a relatively uniform light brown usually without any signs of crossbanding or with only faint crossbands. Another difference occurs in the pattern of pigmentation on the vertical fins. In new species E the fins have an alternating series of blotches and unpigmented areas while in S. plagusia all of the fin rays have a uniform coloration.

Undescribed species E co-occurs in shallow-water environments with juvenile and sub-adults of S. tessellatus. Although similar in body shape, relative eye size and overall appearance to small S. tessellatus, these two species are quite distinct. The two species are most easily distinguished by differences in pigmentation patterns. New species E has numerous (9-15), narrow crossbands, lacks a black opercular spot and has an alternating series of blotches and unpigmented areas in the dorsal and anal fins. In contrast, S. tessellatus has fewer (7-9), wide crossbands, a well-developed black opercular spot and the dorsal and anal fins lack an alternating series of blotches and unpigmented areas but become progressively darker (black in the males) in the posterior portions of the body. Undescribed species E has lower meristics (vertebrae 49-50 vs. 50-53; dorsal rays 89-96 vs. 91-102; anal rays 74-80 vs. 77-86) and lacks scales on the blind side rays of the dorsal and anal fins (present in S. tessellatus larger than 70 mm SL). The two species differ in overall size and size at sexual maturity. New species E is a medium-sized fish attaining maximum sizes of 122 mm SL and reaching sexual maturity at sizes as small as 70-80 mm SL; in contrast, S. tessellatus is a much larger species attaining maximum lengths of 220 mm SL and does not attain sexual maturity until 110 mm SL.

Undescribed species E differs considerably from the remaining two species of shallow-water, 12 caudal-rayed Symphurus with a 1-4-3 ID pattern. It differs from new species D in numerous features, mostly in its much smaller (122 vs. 190 mm SL) and deeper (vs. elongate) body; new species E lacks a black opecular spot (present in new species D) and finally new species E has much lower meristics (vertebrae 49-50 vs. 52-54; dorsal rays 89-96 vs. 99-106; anal rays 74-80 vs. 81-88).

Undescribed species E is also quite distinct and completely allopatric from S. civitatium. The two species differ most notably in pigmentation pattern (fins blotched in new species E vs. progressive darkening in S. civitatium) and modal distributions of meristics (vertebrae 49-50 vs. 47-49 in S. civitatium; dorsal rays 89-96 vs. 86-93; anal rays 74-80 vs. 70-78).

The new species is readily distinguished from all other Atlantic tonguefishes by the combination of 12 caudal rays, unpigmented peritoneum and 1-4-3 ID pattern.

Description

Undescribed species E is a medium-sized tonguefish attaining adult lengths of approximately 122 mm SL. The usual ID pattern is 1-4-3 (Table 9). Caudal rays 12 (Table 10). Dorsal rays 89-96, usually 92-96 (Table 11). Anal rays 74-80 (Table 12). Vertebrae 48-51, usually 49-50 (Table 13). Hypurals 4. Scales moderate in size, strongly ctenoid on both sides of body. Longitudinal scale rows 78-89 (Table 14). Scale rows on head posterior to lower orbit 17-22, usually 19-21 (Table 15). Lateral scale rows 36-44 (Table 16). Proportional measurements appear in Tables 86-87.

Body relatively deep; body depth greatest in anterior third of body followed by relatively rapid posterior taper. Body depth 27.7-32.0% SL. Head relatively wide (22.0-26.8% HL); head width greater than head length (HW/HL= 1.1-1.3). Snout moderately long and pointed, 19.3-25.5% HL. Snout covered with small ctenoid scales. Dermal papillae well-developed on blind side snout and chin but not excessively dense. Posterior extension of maxilla usually reaches to rear of pupil of lower eye and occasionally to rear edge of lower eye. Eyes moderately large, 8.2-11.0% HL; usually slightly sub-equal in position. Eyes without scales; usually 1-3 small ctenoid scales in narrow interorbital space. Pupillary operculum absent. Dorsal fin origin usually at a vertical equal to or with one ray anterior to the front margin of the upper eye.

Teeth well-developed on blind side jaws. Upper and lower jaws on ocular side usually with a small patch of teeth covering anterior one-third of jaw or lacking teeth altogether.

Table 86. Summary of morphometrics expressed in thousandths of Standard Length (except SL in mm) for Symphurus new species E.

Character	N	RANGE	MEAN	SD
SL	20	40.1-121.9	84.5	22.40
BD	20	277-320	300.6	12.14
PDL	20	29-48	36.2	5.45
PAL	20	191-261	223.0	15.89
DBL	20	952-972	964.3	5.70
ABL	20	751-820	781.0	18.89
PL	20	51-75	63.2	6.56
PA	20	35-63	47.6	6.62
CFL	20	87-116	102.4	7.56
HL	20	185-224	199.2	10.94
HW	20	220-268	240.0	11.03
POL	20	119-143	133.6	6.72
SNL	20	36-54	43.5	4.92
UJL	20	37-56	46.2	4.85
ED	20	17-22	19.4	1.56
CD	20	43-64	51.8	5.06
UHL	20	241-348	291.8	32.23
LHL	20	162-274	199.4	26.53

Table 87. Summary of morphometrics expressed as thousandths of Head Length (except HW/HL) for *Symphurus* new species E.

Character	N	RANGE	MEAN	SD
HW/HL	20	1.1-1.3	1.2	0.06
POL	20	632-744	671.6	28.72
SNL	20	193-255	218.4	18.47
UJL	20	195-253	231.3	15.96
ED	20	82-110	97.4	7.18
CD	20	227-305	259.8	19.74
OPLL	20	241-348	291.8	32.23
OPUL	20	153-274	199.0	27.34
UHL	20	725-973	828.0	57.84
LHL	20	437-592	495.7	39.42

<u>Pigmentation</u>

The general pattern of body pigmentation is similar for both sexes at all sizes but there are minor differences in the intensity of pigmentation between the sexes occurring with sexual development. Males, especially those in breeding condition, have more intense pigmentation on the body and posterior portions of the dorsal and anal fins.

Eyed surface pigmentation variable ranging from dark brown to almost yellow but body usually with numerous (10-15) narrow, irregularly complete, sharply contrasting, dark brown crossbands on head and trunk. First band on head immediately posterior to the eyes. Second band crosses head just anterior to opercular opening. Band number on trunk variable. Last band situated a short distance anterior to caudal fin base. Outer operculum not pigmented other than general background color. Inner lining of operculum and isthmus heavily pigmented on eyed side. Inner lining of operculum and isthmus on blind side not pigmented. Slight moustache on ocular side upper lip; lower lip frequently spotted but without definite moustache. Blind side unpigmented, off-white. Peritoneum unpigmented.

There is no sexual dimorphism in pigmentation patterns on the dorsal and anal fins, however, males have darker-colored fins. Dorsal and anal fins, beginning with the most anterior portions with an alternating series of blotches and unpigmented areas. Blotches are variable in shape and usually cover 2-5 rays.

Geographic Distribution (Fig. 29).

The known distribution of undescribed species E are the islands of the Caribbean Sea and the coastal margins of Central and northern South America. In the Caribbean, this species has been collected at St. Martin, Netherlands Antilles, but most of the specimens were taken at Puerto Rico and Haiti. Along the coast of Central America, this species has been collected at locations in Nicaragua, Costa Rica and Panama. It has also been collected along the coast of Colombia.

Bathymetric Distribution

Undescribed species E is a shallow-water inhabitant. All 94 specimens for which depth information was available were taken at depths 25 meters or shallower. The majority of individuals (78/94, 83%) were collected in 20 m or less and 48 (51%) were collected in waters shallower than 10 meters. All life stages are represented among these shallowest collections. The deepest capture (29 m) is for one collection (UMML UNCAT P-1325) of 16 individuals.

Size and Sexual Maturity

Undescribed species E is one of the smallest members of the shallow-water, 12 caudal-rayed tonguefishes that possess a 1-4-3 ID pattern. Adults range in size from approximately 71-122 mm SL. Size-related life history information was summarized from measurements of 83 specimens (Fig. 30). Males and females attain similar sizes. The largest fish measured was a gravid female (122 mm SL); the largest male was only slightly smaller (120 mm SL).

There were 44 males (52.9-122 mm SL), 39 females (55.6-122 mm SL) and six immature (sex could not be determined) fish (24.4-43.8 mm SL) among the material examined. Based on the reproductive stages of females, it appears that this species matures at sizes from 70-80 mm SL. All females larger than 80 mm SL were mature. Of the 39 females, nine, ranging in size from 55.6-79.1 mm SL were immature with only partially elongate ovaries. The smallest of these (55.6, 56.9 mm SL) had only partially elongate ovaries. The larger immature females (58.1-79.1 mm SL) had more developed ovaries but without obviously developing ova.

There were 30 mature females ranging in size from 71.8-122 mm SL. Most mature females exceeded 80 mm SL. The smallest mature female (71.8 mm SL) was unusual, 6/7 others in this size range were still immature.

Ecology

Other than depth of occurrence and geographic distribution, little else is known concerning the ecological requirements of this species. Austin and Austin (1971) included nine specimens of this species in their survey of feeding habits of fishes inhabiting mangrove areas in southwestern Puerto Rico. They found that specimens ranging in size from 30-104 mm SL had fed mostly on polychaetes and small, benthic crustaceans. They also noted that individuals collected at night had undigested food in their stomachs, suggesting a nocturnal feeding behavior.

Material Examined

Counted and Measured 20 Specimens, 7 Lots.

ANSP 118553; (69.8); Puerto Yabucoa, Puerto Rico; 25 I 71. FMNH 61574; (40.7); Port-au-Prince Bay, Haiti; 12 IX 53. UMML 5297; (40.1); St. Martin, Netherlands Antilles; 1M; 02 VII 59. UMML 30087; 6(88.7-98.1); 08°44.5-45.6'N 76°52.71'W; 4M; 12 VII 66. UPRM 740; 2(120-122); Rio Anasco, Puerto Rico; 1-2 VII 53. UPRM 1588; (98.0); Mayaguez, Puerto Rico; March, 1962. UPRM 2926; 8(58.1-97.9); Guayanilla, Puerto Rico; 23 VII 68.

Counted 61 Specimens, 11 Lots.

ANSP 115601; 7(43.3-82.5); Puerto Yabucoa, Puerto Rico; 12-13 VII 69. MCZ 11200; (71.8); Cuba; 1851. UF UNCAT (Removed from UF 38896); 10(80.7-95.4); Haiti; 1M; 07 IV 79. UMML UNCAT 1328; 3(95.8-110). UMML UNCAT PILS 442; (115); 08°49'N 81°13'W; 18M; 21 VII 66. UMML UNCAT PILS 1316; 26(24.4-117); 09°48'N 82°50'W; 19M; 26 I 71. UMML UNCAT PILS 1333; 2(79.1-94.3); 12°16'N 83°31'W; 12M; 28 I 71. UPRM 736; (95.8); Rio Anasco, Puerto Rico; 17 VIII 51. UPRM 740; 8(90.0-122); Rio Anasco, Puerto Rico; 1-2 VII 53. UPRM UNCAT; (100); Field Number JSR 66-49; Puerto Rico. USNM UNCAT (Removed from USNM 81654); (46.2); Colon, Panama; 05 I 1911.

OTHER 18 Specimens, 2 Lots.

MCZ 25982; (108.7); Cuba. UMML UNCAT PILS 1325; 16(52.9-117); 10°40'N 83°29'W; 29M; 27 I 71.

CHAPTER 6.8

Artificial Key to Eastern Atlantic *Symphurus*

1a Dorsal fin with more than 100 rays, body elongate, caudal rays 12 or 14, peritoneum black..2

1b Dorsal fin with fewer than 95 rays, body depth greatest in anterior third of body, caudal rays 12, peritoneum black or unpigmented..........3

2a Caudal rays normally 12, ID pattern 1-2-2-2-1, abdominal vertebrae 3+7, total vertebrae 55-59, DR 101-108, AR 86-93............... *S. vanmelleae*

2b Caudal rays normally 14, ID pattern 1-2-2, abdominal vertebrae 3+6, total vertebrae 56-61, but usually 58-60, DR 102-113, AR 90-102.. *S. ligulatus*

3a Small rows of ctenoid scales present on blind side dorsal and anal fin rays, eye size relatively small usually only 7-9% HL..... *S. normani*

3b Blind side fins without small rows of ctenoid scales, eye size relatively large (larger than 10% HL).................................4

4a Peritoneum black, scales large, 72-91 longitudinal scale rows, and body sizes exceeding 60 mm SL................................. *S. nigrescens*

4b Peritoneum unpigmented, scales relatively small, 97-110 longitudinal scale rows, small body sizes not exceeding 60 mm SL....................5

5a Ocular surface light yellow or cream colored with incomplete crossbands and unpigmented fins, with long snout (23.1-23.5% HL) and long upper jaw (21.5-22.1% HL)............................... Undescribed Species A

5b Ocular surface dark, chocolate brown with alternating X and Y markings and pigmented fins, with short snout (18.2-22.1% HL) and short upper jaw (19.7-22.0% HL).................... Undescribed Species B

CHAPTER 6.9

Artificial Key to western Atlantic *Symphurus*

1a Caudal fin usually with 14 rays, dorsal fin with more than 104 rays, AR 91-99, peritoneum black, ID pattern 1-2-2, body elongate, vertebrae 57-60.. *S. nebulosus*

1b Caudal fin rays less than 14, ID pattern other than 1-2-2, peritoneum black or unpigmented.......................................2

2a Caudal rays 12, peritoneum black, ID patten 1-3-2.......................3

2b Caudal rays 10, 11 or 12, peritoneum unpigmented, ID pattern 1-3-2, 1-3-3, 1-4-2 or 1-4-3..8

3a Blind side with pepper-dot pattern of melanophores (heaviest along bases of dorsal and anal fins), DR 78-85, AR 64-69; vertebrae 44-46, dorsal fin origin in posterior position usually equal only to rear margin of upper eye or occasionally not reaching posterior margin of upper eye...................... *S. pelicanus*

3b Blind side without pepper-dot pattern of melanophores, meristics usually higher, dorsal fin origin usually further forward above middle of upper eye or at front margin of pupil of upper eye..4

4a Fin rays numerous, DR 93-104; AR 80-89, vertebrae usually 52-54, a large dark brown pigment blotch on the caudal region of the body, 5 hypurals in caudal skeleton........................ S. marginatus

4b Dorsal fin rays usually less than 95, vertebrae usually 52 or less, pigment other than large brown caudal blotch, hypurals 4 or 5..5

5a Dorsal rays 80-88, AR 68-75, vertebrae usually 47-49, 5 hypurals in caudal skeleton, scales large, 62-75 longitudinal scale rows, body deep, depth 24-35% SL.................................... S. piger

5b Dorsal rays usually 82-95; AR 71-84; vertebrae 48-52, 4 hypurals in caudal skeleton, scales smaller, 77-100 longitudinal scale rows, body shallower, depth usually ranging between 25-32% SL.................6

6a Dorsal rays 83-88, AR 71-75, vertebrae 48-49, small adult size (usually not exceeding 65 mm SL)........................... S. pusillus

6b Dorsal rays 89-95, AR 71-75, vertebrae 50-52, adult sizes exceeding 65 mm SL...7

7a Snout long, 3.4-6.4% SL, upper jaw length 4.0-5.8% SL, eye 2.5-3.6% SL, western South Atlantic................................ S. ginsburgi

7B Snout short, 3.3-5.0% SL, upper jaw short 3.3-4.7% SL, eye small 2.1-3.2% SL, western North Atlantic................ Undescribed species C

8a Caudal rays 12 9

8b Caudal rays 10 or 11 15

9a Dorsal rays 70-75, AR 55-61, vertebrae 40-42, body size usually less than 50 mm SL .... S. arawak

9b Dorsal fin usually with more than 83 rays, AR 70 or more, vertebrae 47 or more 10

10b Dorsal rays 83-85, AR 68-71, vertebrae 46-48, body size usually less than 45 mm SL, teeth well-developed on eyed-side jaws, ID pattern 1-3-2 .... S. rhytisma

10B Dorsal rays 86-107, AR 70-89, vertebrae 47-54, body size usually larger than 70 mm SL, teeth usually absent or only poorly developed on eyed-side jaws, ID patterns 1-4-3 or 1-5-3 11

11a A large black spot on outer edge of operculum, DR 91-107, AR 77-89, vertebrae 50-55 12

11b Operculum without obvious black spot, DR 86-97, AR 70-81, vertebrae 46-51 13

12a 4-8 rows of small ctenoid scales on the blind side posterior rays of the dorsal and anal fins, ocular side lower lip without fleshy ridge, jaws reaching only to rear edge of pupil or rear edge of eye, crossbands wide usually nine or less, posterior third of dorsal and anal fins becoming progressively darker (black in mature males), dorsal and anal fins without blotches, DR 91-102, AR 77-86, vertebrae 50-53.................... _S. tessellatus_

12b No ctenoid scales on blind side dorsal and anal fins, ocular side lower lip with pronounced fleshy ridge on posterior portion, jaws reaching rear edge of lower eye or extending slightly posterior to rear margin of lower eye, crossbands narrow, numerous (10-14), dorsal and anal fins with alternating series of blotches and unpigmented areas usually without progressive darkening in posterior portions of fins, DR 99-106, AR 81-88, vertebrae 53-54.................................. Undescribed Species D

13a Eye usually 9.0-10.0% of HL, snout pointed, distance between upper eye and dorsal fin base only slightly larger than eye diameter, body with numerous (9-15), narrow crossbands, dorsal and anal fins with an alternating series of pigmented blotches and unpigmented areas................................ Undescribed Species E

13b Eye small, usually only 6.4-9.4% HL, snout squarish, distance from upper eye to dorsal fin base much larger than eye diameter, body uniformly colored or with faint crossbands, dorsal and anal fins without any obvious pigmented blotches.....................14

14a Eye small, usually only 6.4-9.4% HL, vertebrae 49-51, DR 91-97 AR 75-81, scales 79-89, Caribbean Sea...................... S. plagusia

14b Eye larger 7.0-11% HL, vertebrae usually 47-49, DR 86-93 AR 70-78, scales 66-83, Gulf of Mexico and eastern US..... S. civitatium

15a Caudal rays 11, a large ocellated spot on the caudal fin, a well-developed pupillary operculum.............................. S. urospilus

15b Caudal rays 10, no ocellated spot on caudal fin, or if spot present on caudal fin (occasionally in S. diomedeanus) then spots also occur on the dorsal and anal fins..........................16

16a Pupillary operculum present, membrane ostia present, dark blotch on caudal region of body or a single ocellated spot on the posterior dorsal and anal fins, ID pattern 1-4-2, 1-5-2.........................17

16b Pupillary operculum present or absent, without membrane ostia, no dark brown caudal blotch, ID pattern 1-3-3 or 1-4-3...................20

17a A single ocellated spot on the posterior dorsal and anal fins, body white to yellowish, no caudal blotch..................... S. ommaspilus

17b No ocellated spots in the dorsal and anal fins, body with a dark caudal blotch..18

18a Dorsal rays 83-89, AR 67-72, vertebrae 47-49, continental shelf off southern Brazil..................*S. kyaropterygium*

18b Dorsal rays usually less than 83, AR usually less than 68, vertebrae usually less than 47.. 19

19a Dorsal rays 69-77, AR 55-63, vertebrae usually 41-43, commonly collected at depths less than 50 meters........................*S. minor*

19b Dorsal rays 75-86; AR 60-70, usually 62-67, vertebrae usually 44-46, commonly taken deeper than 50 meters.................. *S. parvus*

20a Dorsal and anal fins spotted (usually), pupillary operculum present DR 86-96, AR 69-80, vertebrae 48-50, ID pattern 1-4-3.....*S. diomedeanus*

20b Dorsal and anal fins not spotted, pupillary operculum absent..........21

21a Dorsal rays numerous 107-114, AR 91-99...................... *S. jenynsi*

21a Dorsal rays less than 95...22

22a A black spot on outer operculum, scales present on blind side posterior rays of dorsal and anal fins, ID pattern 1-4-3, DR 83-91, AR 67-75, eye smaller (8.3-12.6% HL), West No. Atl. .... *S. plagiusa*

22b No black spot on operculum, scales not present on blind side dorsal and anal fins, ID pattern 1-3-3, DR 88-94, AR 73-78, eye larger 11.4-16.2% HL), West. So. Atl. .... *S. trewavasae*

CHAPTER 7

Discussion

General Overview

Results of this study indicate that there are twenty-nine nominal species of *Symphurus* in the Atlantic Ocean. Of these 29, 24 were described previously, and five represent new or previously unrecognized species. A list of valid species together with their historical synonyms was presented in Table 1.

The following sections will further discuss observations on the morphological and ecological diversity encountered in this taxon. To begin the discussion a comparison of minimum sizes at sexual maturity and overall maximum adult sizes is made for 27 of the 29 species. This is followed by a discussion of both the ecological and zoogeographic distributions of the species. Finally, ecological requirements relating to bathymetric occurrence and substrate affinities will be discussed with respect to the phylogenetic hypothesis of species groupings outlined in Chapter 5. The results of all three topics are presented in a format which allows for a direct comparison between members within a particular species group and contrasts these parameters between species representing the different species groups.

Body Size

One of the most obvious morphological variations encountered among the 29 species of Atlantic tonguefishes occurs in maximum adult body size and minimum size of sexual maturity (Fig. 31). It is difficult to macroscopically determine maturity stages of male tonguefish because the testes, unlike the ovaries, do not undergo any dramatic posterior elongation when the fish becomes sexually mature. In male tonguefish the testes become slightly more rounded when ripe but it is extremely difficult to accurately determine the stage of ripeness. In contrast, in females, the ovaries begin to elongate very early in life. In juvenile females, the ovaries are elongate but remain very small in diameter and almost tubular in shape. With the onset of sexual maturity, the ovaries expand with ripening ova becoming quite distended and are often clearly visible through the body wall. Because of the greater ease in determining sexual maturity in this sex, only females were considered as indicators of sexual maturity.

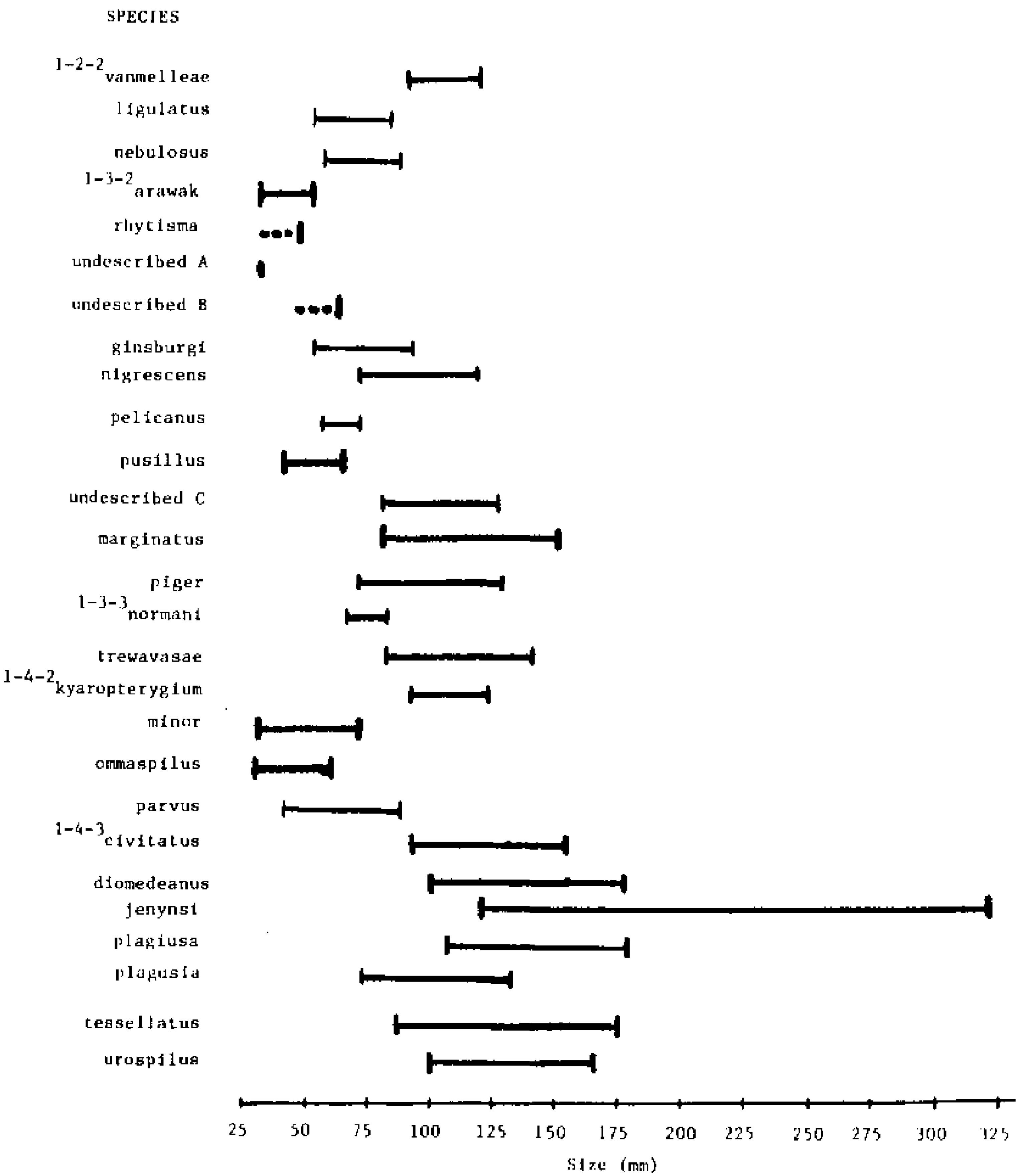
In an effort to examine size related tendencies among the species, the species were assigned to one of four size groups based on a combination of maximum size (in SL) observed for any individual of the species and the minimum size (in SL) recorded for gravid females. Although distinctions between the size groups are somewhat artificial because the species actually form a gradient along a size axis, division of species among the four size groups proved to be instructive when attempting to analyze size-related trends among the species and species groups.

The size classes selected can be conveniently identified as: 1) dwarf species, ranging from 28-72 mm SL and becoming sexually mature at sizes usually less than 50 mm SL and even as small as 28 mm SL; 2) diminutive species, those species ranging from 70-90 mm SL and reaching maturity at sizes usually greater than 50 but less than 70 mm SL; 3) medium-sized species, 115-140 mm SL and reaching maturity at sizes of 70-90 mm SL; and 4) larger species, those ranging in size from 150-320 mm SL and not maturing until reaching sizes usually greater than 90 mm SL.

From Figure 31, it can be seen that Atlantic tonguefishes span a wide and continuous range in body size from about 28-320 mm SL. The majority of Atlantic tonguefishes attain maximum sizes under 200 mm SL and become sexually mature at sizes greater than 50 mm SL. The smallest specimens studied were individuals of the widespread Caribbean species, S. arawak and the undescribed species (A) from Ascension Island. Symphurus arawak matures at sizes as small as 30 mm SL and reaches maximum lengths of only approximately 50 mm SL. Only two specimens of undescribed species A were available for study. Both were females (ca. 28 mm SL) with elongate gonads. By contrast, the largest species studied was the southern South American, S. jenynsi, which matures at relatively large sizes (approximately 120 mm SL) and attains maximum sizes of approximately 320 mm SL.

Seven dwarf species of tonguefishes have been reported from the Atlantic. Included in this group are three Caribbean species, S. arawak, S. ommaspilus and S. rhytisma; two undescribed species (A and B) from Ascension Island and St. Helena-Madeira islands, respectively; and two western Atlantic continental shelf species, S. pusillus and S. minor. The smallest of the dwarf species were those inhabiting sandy substrates adjacent to coral reefs. The two shelf-inhabiting species mentioned above were somewhat

Figure 31. Size index plotted for 27 of 29 Atlantic species of *Symphurus*. Limits of the bar graphs in the figure represent the minimum size of sexual maturation (females only) and maximum size observed for any individual of the species.



SPECIES
1-2-2 vanmelleae
ligulatus
nebulosus
1-3-2 arawak
rhytisma
undescribed A
undescribed B
ginsburgi
nigrescens
pelicanus
pusillus
undescribed C
marginatus
piger
1-3-3 normani
trewavasae
1-4-2 kyaropterygium
minor
ommaspilus
parvus
1-4-3 civitatus
diomedeanus
jenynsi
plagiusa
plagusia
tessellatus
urospilus
25 50 75 100 125 150 175 200 225 250 275 300 325
Size (mm)

larger. In order of increasing maximum size the dwarf species rank as follows: undescribed species A (28 mm SL), S. rhytisma (45 mm SL), S. arawak (50 mm SL), undescribed species B and S. ommaspilus (60 mm SL), S. pusillus (63 mm SL) and lastly, S. minor (72 mm SL). Because of its relatively larger size, it may be argued that S. minor should be included with the next larger size group, however, its placement in the dwarf size group is justified because, although attaining a somewhat larger size when compared with the other dwarf tonguefishes, S. minor achieves sexual maturity at small sizes comparable to those recorded for other members of this size group. Additionally, only a small number of the S. minor studied actually exceeded 70 mm SL; most were smaller than 65 mm SL.

The dwarf tonguefishes were the smallest species studied and are among the smallest of flatfishes. Among western Atlantic flatfishes, only the bothid, Citharichthys gymnorhinos from the Gulf of Mexico, approaches these sizes. This species is reported to reach maximum lengths of less than 55 mm SL and is sexually mature at 30 mm SL (See Topp and Hoff (1972) for more information on maximum sizes and size at maturity for other groups of Western Atlantic flatfishes).

Six species were assigned to the diminutive size group. Diminutive species include two eastern Atlantic species- S. ligulatus and S. normani, and four western Atlantic species- S. nebulosus, S. ginsburgi, S. pelicanus and S. parvus. All of these occupy habitats on the continental shelf or upper continental slope (S. nebulosus and S. ligulatus). The smallest species in this size group was S. pelicanus (maximum lengths about 70 mm and sexual maturity at 55 mm SL). The remaining species were all similar in size (ranging from 82-91 mm SL).

There were eight species in the medium-sized group. These included two eastern Atlantic- S. nigrescens and S. vanmelleae, and six western Atlantic species- undescribed species C, S. piger, S. kyaropterygium, S. plagusia, undescribed species E and S. trewavasae. All medium-sized species, except undescribed species E and S. plagusia, occur on substrates on the continental shelf or upper continental slope (S. vanmelleae). Undescribed species E and S. plagusia occur in shallow-water habitats in the tropical western Atlantic.

The eight largest species of Atlantic tonguefishes occur only in the western Atlantic. Included in this group are S. civitatium, S. diomedeanus, S. urospilus and S. plagiusa from the North Atlantic and Gulf of Mexico; the widely-occurring S. marginatus; and S. jenynsi, undescribed species D and S. tessellatus from the Caribbean and South American regions. The smallest species within this group were S. marginatus (150 mm SL) and S. civitatium (159 mm SL). The largest species studied were S. tessellatus (210 mm SL) and S. jenynsi (320 mm SL).

From the discussion above and Figure 31, the following relationships exist regarding the ecological and zoogeographic distributions of the size-related attributes of the species. With respect to the occurrence of dwarfs among the groups, the following applies. Dwarf species occur primarily in sandy substrates adjacent to coral reefs and tropical seagrass beds (five of seven species). Therefore the geographic distribution of dwarf species largely reflects the distribution of coral reef habitats. Only two dwarf species inhabit substrates on the continental shelf. One species, S. minor, occurs primarily on substrates in live bottom regions along the west coast of Florida and along the southeastern seaboard of the United States (see Fig. 22). The other shelf species, S. pusillus, is quite unusual for a dwarf species. It is the only dwarf tonguefish that occurs in relatively deep water (50-100 m) and is the only dwarf species that occurs primarily outside of tropical and warm-temperate regions (see Fig. 16).

The six diminutive species occupy relatively deep-water habitats on the continental shelf and upper continental slope. There are two Eastern Atlantic, two North Western Atlantic, one Gulf-Caribbean species and one South Atlantic species represented among this size group. Representative species from four of the five species groups are included in this size group. The species and their respective species groups are S. ligulatus and S. nebulosus (1-2-2 group); S. ginsburgi and S. pelicanus (1-3-2 group); and one species each from the 1-3-3 group (S. normani) and 1-4-2 group (S. parvus). This size range, together with the next larger one, harbor the most species and apparently these size ranges are optimal for successful inhabitation of substrates on the continental shelf and upper continental slope environments.

The seven medium-sized species range over a variety of habitats from shallow, muddy estuarine locations to moderately deep substrates on the continental shelf and upper slope regions. Symphurus vanmelleae is a bathyal species, occurring along the outer continental shelf and upper slope of West Africa. A second eastern Atlantic species, S. nigrescens, is a wide-ranging species that has a bathymetric distribution ranging from approximately 50-300 meters. The remaining five species in this size group are western Atlantic in distribution. The species range in habitats from shallow estuarine and nearshore mudflats (S. plagusia and undescribed E) to deep, outer continental shelf depths (S. piger). From a phylogenetic standpoint, members of all five species groups have species falling in this size range. In this size group, Symphurus vanmelleae is the single 1-2-2-2-1 species represented. There are three species from the 1-3-2 group (S. piger, S. nigrescens and undescribed species C). Ther are two species (S. plagusia and undescribed species E) from the 1-4-3 ID pattern group. And finally, there is a single species from each of the following species groups: 1-3-3 (S. trewavasae), 1-4-2 (S. parvus) and 1-4-3 (S. plagusia).

The largest-sized tonguefishes occur in the western Atlantic and with a single exception (S. marginatus) belong to the 1-4-3 species group. Except for S. marginatus which occurs in deep outer shelf waters, the remaining species inhabit relatively shallow-water environments. They occur entirely in the western Atlantic (both north and south of the equator) and in the eastern Pacific. As a species group, they do not usually occur deeper than approximately 110 meters (undescribed species D) in the western Atlantic (see discussion below of vertical occurrences for the species).

It is apparent from this study that size alone is at best only a poor indicator of phyletic relationship in Atlantic symphurine tonguefishes. There was little evidence of any trends in size-related parameters among the species groups other than the fact that the species of the 1-4-3 group are generally larger in size than members of other groups. But even in this group, S. plagusia and undescribed species E, which attain maximum sizes of only about 130 mm SL, were exceptional in their overall small size. Dwarfism is also a poor indicator of phyletic relationship in this genus; dwarfism occurs in three of five species groups with the majority (5 of 7 species) belonging to the 1-3-2 species group. The other dwarf species, S. ommaspilus and S. minor, are members of the 1-4-2 group. As of yet, dwarf species in the 1-4-3 group are unknown. Additionally, there are no known Atlantic dwarf species which belong to the 1-2-2 species group. However, it is interesting to note that there is at least one member (S. novemfasciatus from Taiwan) of this species group that is a dwarf species and it too inhabits shallow-water sandy substrates adjacent to coral reefs.

Since dwarf species occur in several lineages within the genus, it appears that small body size is a convergent adaptational response. Most dwarf tonguefishes inhabit shallow-water, sandy habitats adjacent to coral reefs and tropical seagrass beds, thus it would appear that small size has evolved in response to selection pressures exerted in this type of habitat. Just what selection pressures might be operative is unknown. Robins and Randall (1965) suggested that perhaps, in fishes living on exposed sandy substrates near coral reefs, small body size reflects a generalized adaptational response to the extreme predation pressure exerted by the high concentration of predators generally associated with the coral reef environment. To support this hypothesis, they pointed out that dwarf species occur in unrelated taxa such as cuskeels (Ophidion) which also inhabit sandy habitats adjacent to coral reefs similar to those reported for many of the dwarf tonguefishes.

Zoogeography

Comparisons of zoogeographical distributions for the 29 Atlantic tonguefishes is provided below. These summaries are based largely upon material examined in the present study. Additional information was included from literature sources only from studies in which identifications were believed to be consistent with those of the present study.

In considering zoogeographical and ecological distributions of tonguefishes, it should be pointed out that, for many of the relatively small-sized species, data are largely incomplete because these species have been collected only infrequently. Undoubtedly, geographical ranges reported for these poorly represented species are fragmentary and may reflect little more than the areas that have been trawled successfully or those areas that have even been sampled at all. Therefore, any discussion about geographical or ecological distributions for these species is limited and subject to improvement when additional specimens become available. Despite these limitations, analyses of geographical and ecological distributions for the individual species are provided below and the findings are intergrated with results of the systematic section. In this way, an attempt is made to uncover areas of endemism as a first step to unravelling the mode and direction of speciation in this taxon.

As stated earlier, among the cynoglossid fishes, the genus Symphurus has the most widespread geographical distribution (Fig. 1). Members of this genus occur in all oceans ranging from the deep bathyal depths of the Indo-Pacific and Hawaiian Islands and extending westward to the Mediterranean Sea, west coast of tropical Africa, to continental margins of the New World in both the Atlantic and eastern Pacific to the Galapagos Islands. There are no fossil records for cynoglossids (Menon 1977) so their relative age is unknown. However, Menon (1977) hypothesized that the present-day distribution of Symphurus, the most primitive genus of the Cynoglossidae, in both the east and west Atlantic as well as off the Pacific American coasts suggested that the genus had probably evolved earlier than the Miocene when communication existed between the Indo-Pacific and the Atlantic Ocean through the Mediterrranean and between the American Atlantic and the eastern Pacific through Central America. More detailed analysis of zoogeographical patterns of the species and species groups will have to await further refinement and resolution of monophyletic groups within the genus. Such refinements can only be made with a more detailed osteological study of the entire genus and comparison of osteological findings for polarization of character states with suitable outgroups. Since these aspects are beyond the scope of the present investigation, no further attempt will be made to determine either the direction or underlying causal factors which may have contributed to the present day patterns of zoogeographical distribution observed for the species groups. Instead, discussion of geographical distributions for both the species and the species groups will be made by simply comparing the tonguefish faunas from different zoogeogaphical provinces of the Atlantic Ocean.

Zoogeographic provinces in the Atlantic (Briggs 1974) in which tonguefishes occur are listed in Table 88. There are five tropical provinces (West African, Mid-Ocean Islands, Caribbean, West Indies and Brazilian); five warm-temperate provinces (Mediterranean-Atlantic,

Table 88. Atlantic Ocean zoogeographic provinces (abbreviations in parentheses) in which *Symphurus* have been collected.

PROVINCES

Tropical	Warm Temperate	Cold Temperate
Ascension-St. Helena (MOI)	Mediterranean-Atlantic (MAL)	Western North Atlantic (WNA)
West African (WAF)	Carolinean (CAR)	
Caribbean (CRB)	Eastern Gulf of Mexico (EGMX)	
West Indies (WI)	Western Gulf of Mexico (WGMX)	
Brazilian (BRA)	South Atlantic (SAL)	

Carolinnean, Eastern Gulf of Mexico, Western Gulf of Mexico and South Atlantic); and one cold temperate province (western North Atlantic). Species compositions and relative numbers of tonguefish species for each province are listed in Tables 89-91.

Examination of Tables 89-91 and Figure 1 reveals that symphurine tonguefishes are generally widespread throughout the Atlantic Ocean with species occurring in 11 of a possible 15 zoogeographic provinces. From the Tables (89-91), several interesting facts about zoogeographic distributions of tonguefishes are apparent. Overall, the data indicate that symphurine tonguefishes are generally tropical and warm-temperate fishes. The majority of species occur primarily between 34^{o}N and 25^{o}S latitudes (see also Fig.1). In the western North Atlantic Ocean, only *S. minor* (Ginsburg 1951; Markle et al. 1978) and undescribed species C (this study) are known to range into cooler waters off Nova Scotia (45^{o}N). In the western southern hemisphere, *S. tessellatus*, *S. trewavasae* and *S. jenynsi* (Menezes and Benvegnu 1976)

Table 89. Summary of the distribution of symphurine tonguefishes in tropical Atlantic zoogeographic provinces.

	PROVINCES				
	West African	Mid-Ocean	Caribbean	West Indies	Brazilian
1.	normani	undescribed A	arawak	arawak	arawak
2.	vanmelleae	undescribed B	rhytisma	rhytisma	marginatus
3.	nigrescens	unknown A	marginatus	marginatus	pelicanus
4.			pelicanus	piger	piger
5.			piger	ommaspilus	parvus
6.			undescribed C	parvus	diomedeanus
7.			ommaspilus	civitatus	plagusia
8.			parvus	diomedeanus	tessellatus
9.			diomedeanus	plagiusa	undescribed D
10.			plagusia	plagusia	
11.			tessellatus	tessellatus	
12.			undescribed D	undescribed E	
13.			undescribed E		

Table 90. Summary of the distribution of Symphurine tonguefishes in temperate Atlantic zoogeographic provinces.

PROVINCES

	E. Atlantic-Med.	E. Gulf Mexico	W Gulf Mexico	Carolinean	S. Atlantic
1.	ligulatus	marginatus	marginatus	nebulosus	ginsburgi
2.	nigrescens	piger	piger	marginatus	kyaropter.
3.		pusillus	pelicanus	pusillus	trewavasae
4.		undescribed C	undescribed C	undescribed C	diomedeanus
5.		minor	parvus	minor	jenynsi
6.		parvus	civitatus	parvus	tessellatus
7.		civitatus	diomedeanus	civitatus	
8.		diomedeanus	plagiusa	diomedeanus	
9.		plagiusa	urospilus	plagiusa	
10.		urospilus		urospilus	

Table 91. Summary of the distribution of symphurine tonguefishes in the cold temperate province of the western North Atlantic.

1. _nebulosus_
2. _marginatus_
3. _pusillus_
4. undescribed C
5. _minor_
6. _plagiusa_

range southward to the temperate seas off southern Brazil and Argentina (ca.35°-38°S). In the eastern Atlantic, symphurine tonguefishes (S. nigrescens) reach their northern limit in the Bay of Biscay (ca. 45°N) but are more frequently taken further to the south, especially near the opening of the Mediterranean Sea. Two species (S. nigrescens and S. ligulatus) are locally abundant in the Mediterranean Sea as well. Much farther to the south, tonguefishes (S. normani and S. vanmelleae) extend southward along the continental shelf and slope of tropical Africa (ca. 12°S). The dispersal abilities of tonguefishes (or possible vicariant distribution), with their relatively large-sized (long-lived ?) planktonic larvae, is evidenced by the occurrence of three species at the remote mid-ocean islands of Ascension and St. Helena which are situated approximately 1000 and 1200 miles from the nearest land mass (Briggs 1974).

Other general observations regarding zoogeography of tonguefishes is that there are no cosmopolitan Atlantic species. Instead of cosmopolitan species, there are a series of closely related species pairs that occur in the eastern and western Atlantic or in the North and South Atlantic. Additionally, each geographic province is unique in its mix of species and species groups (Tables 89-91). From a phyletic standpoint (discussed earlier in the treatment on species groups), each species group has a unique geographic distribution. Distributional maps for four species groups were provided earlier (Figs. 5-6).

There are several amphi-Atlantic species pairs between species occurring in the eastern and western Atlantic and secondly for species in the North and South Atlantic. Among the eastern (listed first) and western

Atlantic (listed second) species pairs are: S. ligulatus and its counterpart S. nebulosus; S. nigrescens and S. pusillus; and the two dwarf species from St. Helena-Madeira and Ascension Islands and the closely related Caribbean dwarf species S. rhytisma. The North (listed first) and South Atlantic (listed second) species pairs include: Symphurus parvus which ranges from the south coast of Florida to the southern Caribbean off Trinidad which is replaced in the South Atlantic by S. kyaropterygium; and similarly, undescribed species C which ranges from Nova Scotia to Yucatan is closely related to the South Atlantic S. ginsburgi.

In comparisons of relative diversity in the various provinces, it is apparent that some provinces possess a richer fauna than others. The highest diversity of species (13 and 11 species) occurs in tropical (Caribbean and West Indies) and warm-temperate (Eastern Gulf of Mexico and Carolinean) provinces in the western Atlantic. Boreal provinces of the Eastern Atlantic (no species) and the western North Atlantic (6 species) generally do not support rich tonguefish faunas (either in diversity or relative abundances). One other finding is that the warm-temperate and tropical provinces of the Mediterranean (2 species) and Eastern Atlantic (3 species) regions are relatively depauperate in symphurine tonguefishes when compared with their respective counterparts in the western Atlantic. In fact, the eastern Atlantic region as a whole (including the mid-ocean islands of Ascension and St. Helena) has the lowest number of species (6) of any region. This large difference in diversity between eastern and western Atlantic regions is noted for many other fish groups including needlefishes (Strongylura), halfbeaks (Hyporhamphus), Spanish mackerels (Scomberomorus) and toadfishes of the genus Batrachoides (Collette, person. commun.). The low diversity of symphurine flatfishes may be attributed to either or both of the following. 1) The relatively high diversity of the tonguefish fauna in the western Atlantic (21 species) compared with the eastern Atlantic (7 species) results from a greater number of species in the 1-3-2 group (8 vs. 3) and the occurrence of endemic species in the 1-4-2 group (4 species) and 1-4-3 group (7 species). These species groups are entirely absent from the eastern Atlantic. It appears that in the western Atlantic Symphurus have undergone extensive adaptive radiation both in the widespread 1-3-2 species group and also in endemic groups (1-4-2 and 1-4-3 species). Why there has been such a proliferation of species in the western Atlantic in almost all (3 of 5) of the species groups which occur there is uncertain. It is interesting to note that in the eastern Atlantic there is a second tonguefish genus (Cynoglossus) whose species inhabit ecological habitats normally occupied in the western Atlantic by species of Symphurus. It is quite possible that these Cynoglossus species compete more successfully for available habitats than do the resident Symphurus species. Although an explanation of competitive superiority by cynoglossid tonguefishes is attractive, I don't believe that it is the primary reason for the large differences in diversity of symphurine tonguefishes observed between eastern and western Atlantic regions. The argument against competitive superiority is as follows. The symphurine tonguefish fauna in the eastern Atlantic is comprised largely of 1-3-2 and 1-2-2 species. Species of these groups typically inhabit deeper waters of the continental shelf and upper continental slopes. Shallow-water representatives of these species groups are largely restricted to sandy substrates adjacent to coral reefs. Therefore, it seems unlikely that the reason symphurine tonguefishes are less diverse in the eastern Atlantic is because they have been excluded from shallow-water habitats by superior cynoglossine competitors. Rather, it seems more plausible that the high diversity of tonguefishes in the western Atlantic results largely from an in situ evolution of endemic groups which subsequently have undergone extensive adaptive radiation into a wide variety of niches.

An alternative hypothesis for the high diversity of tonguefishes observed in the western Atlantic is that the diversity of suitable habitats (substrates) available for exploitation by tonguefishes is much greater in western Atlantic than in eastern Atlantic regions. Undoubtedly, the rather narrow continental shelf off tropical West Africa with its highly turbid, cool waters and lack of coral reefs does not provide the diversity of substrates when compared to the rather wide continental shelves and diverse habitats of the western Atlantic off the southeastern coast of the United States and throughout the Gulf of Mexico and Caribbean Seas. Since symphurine tonguefishes have rather well-defined, largely non-overlapping habitat preferences (see below), one would expect a proliferation of species into the greater number of niches (substrates with their accompanying prey and predator suites) available in western Atlantic tropical and warm-temperate provinces.

This next section details the tonguefish fauna occurring in each of the various zoogeographic provinces starting with the tropical provinces (Table 89) and proceeding with discussions of warm-temperate (Table 90) and boreal (Table 91) provinces. An attempt to quantify overall similarities and differences between provinces was made by calculating a pair-wise Index of Similarity (Sorenson 1948) for all of the provinces. The system of notation used in Sorenson's Index is as follows:

$$S = \frac{2\,C}{A+B} \times 100$$

where C - the number of species common to both regions

A - the number of species occurring in province A

B - the number of species occurring in province B

S - the Index of Similarity

Results of calculations of Sorenson's Index are shown in a trellis diagram (Fig. 32).

Of the tropical provinces, the most diverse faunas occur in the Caribbean and West Indian provinces (13 and 12 species, respectively). Next, in order of decreasing diversity, are the Brazilian (9 species), West African and Mid-Ocean Islands (3 species each). Similarity indices for the tropical provinces range from high values (S-76) between Brazilian and West Indian Provinces and Caribbean and West Indian Provinces (S-80), to somewhat lower value for Brazilian and Caribbean Provinces (S-73), to the lowest values of S-0, indicating no common faunal elements between these three

Figure 32. Sorenson's Index of Similarity calculated for occurrences of 29 Atlantic Species of *Symphurus* in 11 Zoogeographic Provinces.

	MOI	WAF	CRB	WI	BRA	MAL	CAR	EGMX	WGMX	SAL	WNA
MOI	--	0	0	0	0	0	0	0	0	0	0
WAF	--	--	0	0	0	40	0	0	0	0	0
CRB	--	--	--	80	73	0	35	43	54	22	10
WI	--	--	--	--	76	0	45	54	57	22	22
BRA	--	--	--	--	--	0	32	42	56	26	13
MAL	--	--	--	--	--	--	0	0	0	0	0
CAR	--	--	--	--	--	--	--	90	74	25	75
EGMX	--	--	--	--	--	--	--	--	88	12	62
WGMX	--	--	--	--	--	--	--	--	--	14	40
SAL	--	--	--	--	--	--	--	--	--	--	0

In the Caribbean province 13 species have been recorded. None of them are endemic to this province. Six are shallow-water species, four inhabit medium shelf depths, and another three species are deep water inhabitants. Three species, S. arawak, S. rhytisma and S. ommaspilus, are dwarf tonguefishes that are commonly associated with sandy substrates in coral reef and turtle grass environments. The other shallow-water species, S. plagusia, undescribed species E and S. tessellatus, inhabit muddy and sandy substrates in inner harbor and mangrove areas and are often collected in the same seine haul. Depth and size distribution data (see below) indicate, however, that these closely-related species only partially overlap in habitat preference. Apparently adults of the species segregate with respect to bathymetry and/or substrate type. Usually only juvenile S. tessellatus are collected in shallow water (<10 meters) while adults occur offshore in deeper regions. In contrast, most S. plagusia were taken by beach seine in shallow water. Except for Symphurus new species D, the other species reported from the Caribbean province are species with widespread distributions in the Caribbean and Gulf of Mexico. These include inner shelf species, S. pelicanus, S. diomedeanus and S. parvus, and three deeper-dwelling species, undescribed species C, S. piger and S. marginatus. Of these three last species, only undescribed species C occurs infrequently. This species reaches its southern limit of distribution at the northern boundary of the Caribbean Province (Fig. 15). The other deep water inhabitants of this province are much more frequent in collections.

The West Indies Province also has a relatively large and diverse fauna (12 species) which is nearly identical in composition with that of the

Caribbean Province (S=80). The only differences are the absences of S. pelicanus, undescribed species C and undescribed species D and the occurrence of S. civitatium and S. plagiusa, two shallow-water inhabitants more frequently and abundantly taken in marginal seas off the continental United States and Yucatan Peninsula of Mexico. The occurrence of S. civitatium in this province is based on the collection of a single specimen which had apparently washed onto a beach at Bermuda (Smith-Vaniz person. commun.). Its inclusion in this province is based on this single citation and its placement in the faunal list of this province needs further substantiation. The other species is S. plagiusa which has a wide geographic distribution along the continental margins of North America but has a limited distribution in the West Indian Province. Although this species has been reported from Cuba (Ginsburg 1951) and the Bahamas (Böhlke and Chaplin 1968), Ginsburg's specimens from Cuba were actually S. tessellatus. Therefore, the only documented occurrence of this species in the West Indian Province is in the Bahamas where it is not uncommon (Böhlke and Chaplin 1968).

The third tropical province in the western Atlantic is the Brazilian Province. Its strong faunal ties with the other western Atlantic tropical provinces is reflected in the high similarity values calculated for all three provinces (Fig. 32). In this province nine species of tonguefishes have been reported. All of these are common to the other western Atlantic tropical provinces discussed above.

The tropical West African Province and the Mid-Ocean Islands, like all the eastern Atlantic provinces are generally depauperate with respect to tonguefish faunas. Each of these provinces has three species. Both provinces are unique in that their faunas are comprised almost entirely of endemic species. Similarity values (Fig. 32) between these two provinces and all other tropical provinces reflect the lack of shared fauna between these regions. The West African Province shares a single species in common with one other province, the Mediterranean-Atlantic (S=40). The other species, _S. vanmelleae_ and _S. normani_, occur nowhere else. The tonguefish fauna of Ascension Island and St. Helena-Madeira is comprised almost entirely of endemic dwarf species collected on sandy substrates. At St. Helena, there is a single record (a juvenile specimen) of a third species of a deep-water tonguefish. Unfortunately, I was unable to identify this specimen because it is poorly ossified and I was not able to obtain a clear image of this specimen when radiographed. Without clearing and staining it is not possible to accurately determine ID pattern, vertebrae number or hypural number. So the status of this specimen will have to await clearing and staining or the collection of additional material. There is no common shared tonguefish fauna between the Mid-Ocean Islands and other Atlantic provinces (Fig. 32).

The South Atlantic warm-temperate province has six species reported from its waters. These include two shallow-water species, _S. plagusia_ and juvenile _S. tessellatus_, and five inner shelf species, adult _S. tessellatus_, _S. diomedeanus_, _S. trewavasae_, _S. kyaropterygium_ and _S. jenynsi_. One additional deep water species, _S. ginsburgi_, is known from this region. This province has a high level of endemic species (4 of 6 species) and this is reflected in the low levels of faunal overlap with other provinces (S values generally ranging from 12-26). The following species are considered unique to this province: S. ginsburgi, S. kyaropterygium, S. trewavasae and S. jenynsi. No tonguefishes have been reported from depths greater than approximately 200 meters in the South Atlantic province. It is unknown what, if any, species might inhabit these depths. This is an area that has not been sampled very thoroughly and remains poorly known.

There are only two species, S. nigrescens and S. ligulatus, known from the Mediterranean-Atlantic warm-temperate province. Symphurus ligulatus is an endemic species. Symphurus nigrescens also occurs along the tropical coast of Africa. The uniqueness of this province is reflected in the almost complete lack of overlap with any other provinces. In addition to the relative paucity of species in this region, another distinctive feature about the tonguefishes is the absence of shallow-water species. Although Symphurus nigrescens has been reported from depths as shallow as 20 meters (Papaconstantinou and Tortonese 1980) most captures for specimens that I have examined and most of the collection depths reported in the literature for this species range between 70-300 meters. The second Mediterranean species, S. ligulatus, is strictly bathyal and inhabits great depths between 200-800 meters.

The three temperate provinces in the western North Atlantic (Carolinean, Eastern Gulf of Mexico and Western Gulf of Mexico) have the highest diversity (10, 9 and 10 species, respectively) of any temperate provinces. These three provinces have much of their fauna in common (S values ranging from 74-90) and differ only in minor aspects of their respective faunas. Additonally, there is a relatively high overlap between these regions and the western tropical provinces (S values ranging from 34-60). The highest overlap (S= 48-60) occurs between the two Gulf of Mexico provinces and the tropical provinces. Of the three temperate provinces, the Carolinean Province has the smallest amount of shared fauna with the tropical provinces (S values ranging from 34-48). These low values undoubtedly reflect the more northerly occurrence of this region and the effectiveness of the Florida Current and Florida Peninsula in separating the faunas of these regions.

The only western Atlantic member (S. nebulosus) of the 1-2-2 species group occurs in the Carolinean Province but is absent from the other two north Atlantic temperate provinces. The remaining species are all rather widely occurring species with the exception of S. minor and S. pusillus. Symphurus minor occurs primarily on live bottom substrates along the southeastern seaboard of the United States and along the west coast of Florida to about DeSoto Canyon area. It has not been recorded from the western Gulf of Mexico. Symphurus pusillus is a deep-sea dwarf species and is known only from a small number (19) of specimens. Thus far, most of the captures of this species have been made along the east coast of the United States to southern Florida. It is unknown from the western Gulf of Mexico and because of its small size and deep-water habitat, it is very possible that this species occurs in other regions but is just not collected by conventional trawling gear.

Although the faunas of these three regions are basically similar, several differences are noted in the general abundance of species in the provinces. For example, in the Eastern Gulf of Mexico, two of the deeper dwelling species, undescribed species C and _S. pusillus_ have not been collected very frequently and most of the captures occurred on the southern Florida shelf. It is thought that these two species may be more abundant along the eastern seaboard of the United States and only occasionally extend into the Gulf of Mexico. Similarly, _S. piger_ is known from a small number of collections around the southern tip of Florida and is included in the Carolinean Province, but is more abundant in the Gulf of Mexico and Caribbean Sea. Another difference occurs in the distribution of _S. civitatium_ between the two Gulf of Mexico provinces. This species is almost completely absent along the live bottom areas of the west Florida coast (only one citation for St. Joseph Bay, Ginsburg 1951; and a few specimens from the south Florida shelf, this study). In the western Gulf of Mexico from just west of the Mississippi River to the Yucatan region _Symphurus civitatium_ is very common and one of the most abundant tonguefishes on inner shelf region. In the Carolinean Province along the south coast of Florida and northward to northern Georgia, this species is again commonly taken on the inner shelf. In the western Gulf of Mexico, undescribed species C and _S. urospilus_, both more common in the other temperate provinces, appear infrequently in the collections.

In the Carolinean Province, Cape Hatteras is an important faunal barrier for many groups of organisms (Briggs 1974). This landmark is an important barrier to dispersal into more northerly waters for inshore species of tonguefishes as well. Comparison of the species lists show that the diversity of tonguefishes (6 species) north of Cape Hatteras (Table 91) is only little more than half that for the area immediately south of

Hatteras (10 species). Of 10 species recorded from the Carolinean Province only six extend into the colder, boreal waters of the western North Atlantic Province. Of six shallow (< 100 meters), common and abundant species in the Carolinean Province, only S. plagiusa, S. minor and S. diomedeanus have been reported north of Cape Hatteras. The remaining three species, S. urospilus, S. parvus and S. civitatium reach their northernmost extension at Cape Hatteras.

Of the six species occurring regularly north of Cape Hatteras, four are deep-sea species, one occurs on the inner shelf, and one is a shallow water species. Of these species, only four extend north to or beyond Long Island. These are (in order of the most northerly record for each): S. minor, undescribed species C, S. pusillus, S. nebulosus and S. plagiusa. Symphurus plagiusa reaches its northern limit around Long Island Sound (Ginsburg 1951). While S. diomedeanus extends along the inner shelf for a short distance just north of Cape Hatteras it probably is not a permanent component of the Carolinean fauna. As mentioned above, both adult and larval Symphurus minor have been recorded off Nova Scotia, however, these specimens were collected almost 100 years apart so it is likely that they represent waifs transported from more southerly latitudes. It is interesting to note that one adult S. minor was a gravid female. It is not known if adult fishes, even small-sized species like dwarf tonguefishes, are transported northward by the Gulf Stream but it seems highly unlikely that adult benthic tonguefishes would be transported. Thus, the collection of a gravid S. minor off Nova Scotia would indicate that this species was in a habitat beneficial for growth and survival after settling out of the plankton. Since nothing is known concerning growth rates of dwarf tonguefishes it is not known if this specimen survived through a winter in waters off Nova Scotia. Since this area is well beyond the normal range for the species, it is doubtful if this is the case. Instead, since _S. minor_ is a dwarf species which matures at small sizes (see above) it is altogether possible that this specimen was transported northward as a larvae, settled out of the plankton and attained sizes large enough during its first summer to attain sexual maturity. For this reason and the general infrequency of captures of this species north of Cape Hatteras, _S. minor_ is not considered a permanent resident of the Western North Atlantic Province.

Among the deep-sea species which regularly occur north of Cape Hatteras, _S. marginatus_ reaches its northern limit in the Mid-Atlantic Bight off the coast of Virginia but appears to be more abundant in collections from the Gulf of Mexico and Caribbean Sea. _Symphurus nebulosus_, _S. pusillus_ and undescribed species C are all permanent residents of the Western North Atlantic Province.

The faunal similarities of the Western North Atlantic Province, as would be expected, are strongest with the proximal Carolinean Province (S=75). This province also has species in common with the other temperate provinces (S values ranging from 40-62). Much of the similarity in the fauna between the temperate and boreal province and between boreal and tropical provinces (S values 12-25) is based on the co-occurrence of widely occurring deep-sea species like _S. marginatus_ and undescribed species C and widely occurring shallow water species like _S. plagiusa_.

Ecological Distributions

In the Atlantic Ocean, Symphurus species inhabit diverse habitats from shallow estuarine areas of only a few centimeters deep (Wyanski, unpublished data) to depths of almost a thousand meters off the continental slope. Factors affecting the distribution of tonguefishes have seldom been investigated although it has been noted (Ginsburg 1951; Topp and Hoff 1972; Menezes and Benvegnu 1976) that tonguefishes inhabit rather discrete depth zones. Ginsburg was limited from making any detailed analysis of either ecological or zoogeographical distributions by the small number of specimens available to him. Menezes and Benvegnu (1976) in their treatment of South Atlantic tonguefishes also noted that individual species had discrete depths of occurrence. These authors were able to compile information on the most common South Atlantic species.

The most comprehensive treatment of the influence of ecological factors on the distributional patterns observed in tonguefishes was made by Topp and Hoff (1972) for a group of six western Atlantic species occurring off the west Florida shelf. Their results are incorporated in the discussion of substrate preferences below.

The species groups, defined in Chapter 5, will form the basis for comparison and discussion of the ecological distributions (based on substrate types and depth of occurrence) and resource partitioning for the species.

Because of their strong interaction and dependence on substrates, any consideration of the distribution of tonguefishes will have to examine directly the distribution of substrate types. But a direct approach examining only substrate types without examining depth of occurrence may be incomplete. The influence of depth and sediments on the distribution of benthic organisms is difficult to separate because these factors are usually closely correlated (Pearcy 1978). Sediment texture generally decreases with increasing depth of water. And small particles are transported from regions of high energy waves and currents into deep, low energy sedimentary environments, while coarse sediments, such as sands, generally are deposited close to their continental source in shallow water. Since preliminary studies cited above have indicated that tonguefishes have well-defined depth preferences (probably linked to particular substrates), then any consideration of ecological distributions will have to examine both sediment distribution and depth of occurrence.

That tonguefishes depend strongly on specific substrate types is evidenced in their use of the substrate by actively burrowing into it in order to escape detection by predators. In addition, they are cryptically colored which helps them avoid notice from predators (and perhaps prey animals, as well). Many species possess disruptive coloration in the form of bars, banding, spots and generalized mottling of the eyed-side surface. Additionally, based on a few observations by myself and food habit studies by others (Topp and Hoff 1972; Stickney 1976; Kawakami 1976), it appears that tonguefishes rely heavily on components of the benthic community for food items. Included in tonguefish diets are polychaetes, tubiculous amphipods, small bivalves, gastropods, and ostracods. Tonguefish digestive tracts also include large amounts of sand grains. Whether sand grains are actively ingested or passively included during the capture of prey items, their presence in the gut indicates that tonguefish, as would be expected from their morphology, feed close to the substrate (if not directly on it). Many tonguefishes have small mouths and appear to be restricted in the size range of organisms they are capable of ingesting. Additionally, many of the species exhibit varying degrees of dentition on the eyed-side jaws which may have significant effects on the types of prey items that these fishes can include in their diets. Although the degree of development of eyed-side dentition can result entirely from non-selective genetic causes, it may also reflect morphological adaptations to particular feeding strategies or to particular prey types. If tonguefishes do focus on particular prey types or suites of prey organisms in the benthic community, than it is not difficult to understand how tonguefishes can be selectively distributed over specific substrate types. In fact, if prey selectivity is high, than distributional patterns of the tonguefishes will be strongly influenced by distribution patterns within the benthic community. According to Thorson (1957), the physical and chemical compositions of sediments may be the main factor in determining the general patterns of distributions of infaunal and epifaunal invertebrates on the level sea floor. Whereas, faunal changes of both benthic invertebrates and vertebrates across the continental shelf and slope have been related to depth-related changes in physico-chemical properties (Sanders and Hessler 1969; Haedrich et al. 1975).

Tonguefish distribution patterns may therefore be related to substrate types in any (or all) of three ways:

1. Direct Influence: Tonguefishes are found on particular substrate types because they actively select these areas for protection, temperature regime, current action etc.
2. Indirect Influence: Tonguefishes have strong food preferences and depend upon small epibenthic and infaunal invertebrate food sources, which themselves exhibit strong substrate selectivity.

or, 3. Direct Influence: Observed depth distributions of Atlantic tonguefishes results from resource partitionin as a countermeasure to competitive interaction among closely related species.

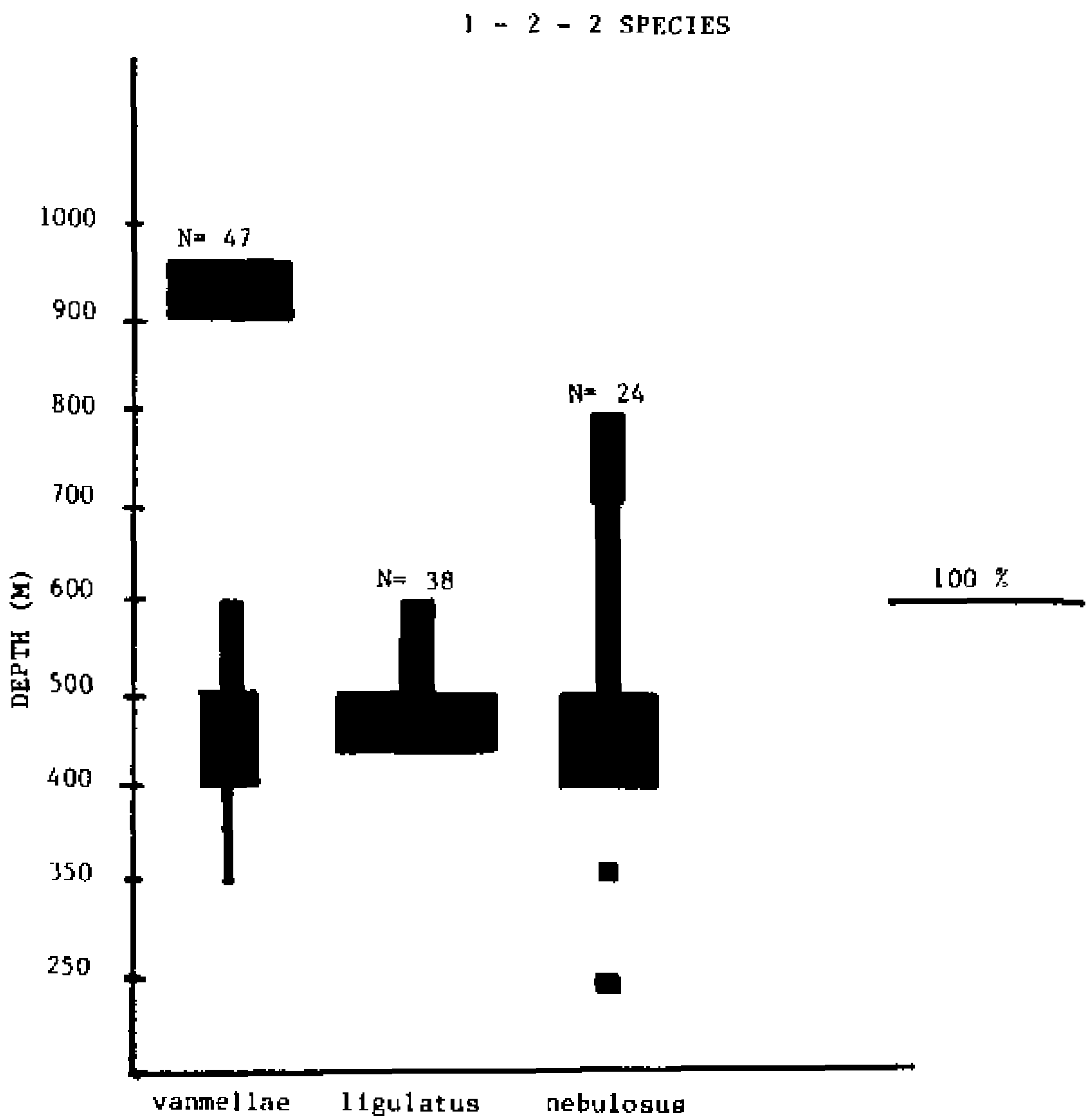
There is so little ecological information available for most tonguefishes, especially regarding food habit data, that it is difficult to disprove any of the hypotheses listed above. Further investigation, fruitful to this discussion, would be an examination of food habits from closely related species to estimate to what degree, if any, there is in dietary overlap.

Rather than actively trying to defend any of the three hypotheses listed above, I will discuss ecological distributions of the individual species and compare them with members of the same species group.

When this type of comparison was made (see below), it became evident that three factors contribute to present-day ecological distributions. Firstly, there is a phylogenetic component which contributes to the depth distribution. Members of particular species groups generally do not overlap in depth of occurrence (and habitat type?). Secondly, there is an ecological component which contributes to observed bathymetric distributions. This is, that distributions appear to correspond directly with the distributions of particular substrate types (or benthic prey communities). And lastly, bathymetric distributions of the species appear to be directly influenced by co-occurrences of sympatric members of the species group. The discussion of ecological distributions will be presented in order by species groups.

The three Atlantic species possessing a 1-2-2-2-1 or 1-2-2 ID patterns have allopatric geographic distributions (Fig. 10) but overlap considerably in depth of occurrence (Fig. 33). All three species inhabit similar bathyal depths (250-900 meters) in their respective geographic ranges on either side of the Atlantic and in the Mediterranean Sea. There is one western Atlantic species, S. nebulosus, and two eastern Atlantic species, S. ligulatus and S. vanmelleae. All three species have wide depth ranges (about 600 meters) which is typical for the species group as a whole (evident from Fig. 7). No other species in any of the other species groups have such wide depth ranges as reported for these species. Most collections of Atlantic 1-2-2-2-1 and 1-2-2 species have been made over soft mud bottoms.

Figure 33. Graphic illustration of the bathymetric centers of abundance for three species of tonguefishes (*Symphurus varmelleae*, *S. ligulatus* and *S. nebulosus*) characterized by 1-2-2-2-1 or 1-2-2 ID patterns.


1 - 2 - 2 SPECIES
DEPTH (M)
1000
900
800
700
600
500
400
350
250
N= 47
N= 38
N= 24
100 %
vanmellae
ligulatus
nebulosus

One possible explanation for these species having such wide depth ranges is that environmental conditions (light, temperature, salinity, substrate type) throughout the depths inhabited by these species are more uniform when compared to similar parameters on the more dynamic, shallower regions of the continental shelf and nearshore regions occupied by the other species groups.

As a species group, the 1-3-2 species inhabit a wide bathymetric range, however, the individual species generally have much more restricted depth ranges than those species of the 1-2-2 group. The two groups of species with a 1-3-2 ID pattern, those with an unpigmented peritoneum and those with a black peritoneum, have quite contrasting bathymetric distributions. Species with an unpigmented peritoneum inhabit relatively shallow (1-45 meters) sandy substrates adjacent to coral reefs (Fig. 34). Two of the four species inhabit sandy substrates on mid-ocean islands. Another two species occur in similar habitats, almost exclusively in the Caribbean Sea.

Members of the 1-3-2 species group possessing a black peritoneum are resident components of the shelf fauna and extend over a considerable range of depths from approximately 20 meters to 700 meters (Fig. 35). In order of increasing depth of occurrence the species rank as follows: S. pelicanus (30-150 meters); S. pusillus (100-300 meters); S. nigrescens (40-710 meters); S. ginsburgi (110-200 meters); undescribed species C (100-510 meters); S. piger (60-510 meters) and S. marginatus (20-700 meters).

Figure 34. Graphic illustration of the depth of occurrence for four dwarf species of *Symphurus* (*S*. *arawak*, *S*. *rhytisma*, undescribed species A and undescribed species B) characterized by a 1-3-2 ID pattern and unpigmented peritoneum.

1 - 3 - 2 SPECIES

CLEAR PERITONEUM

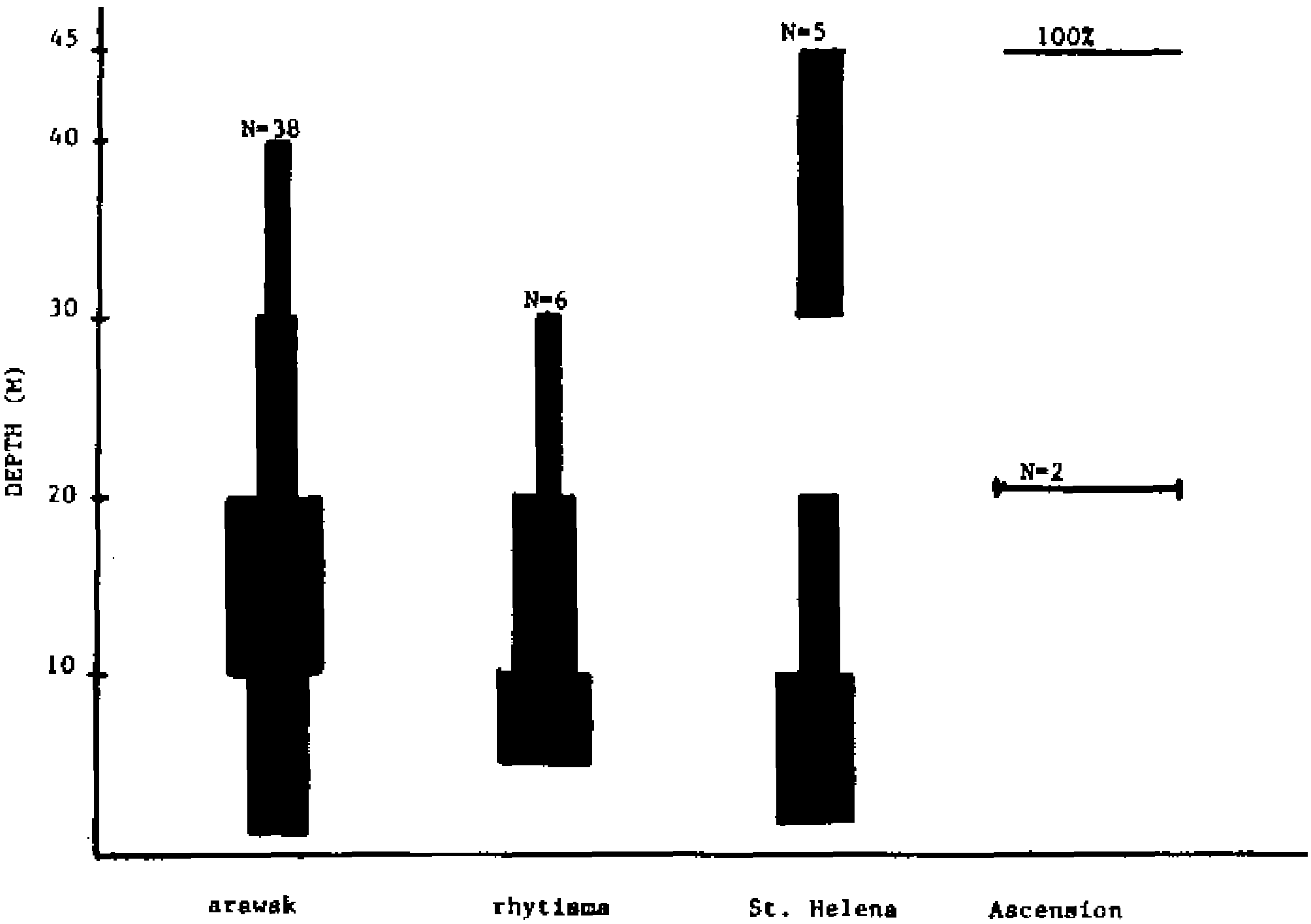
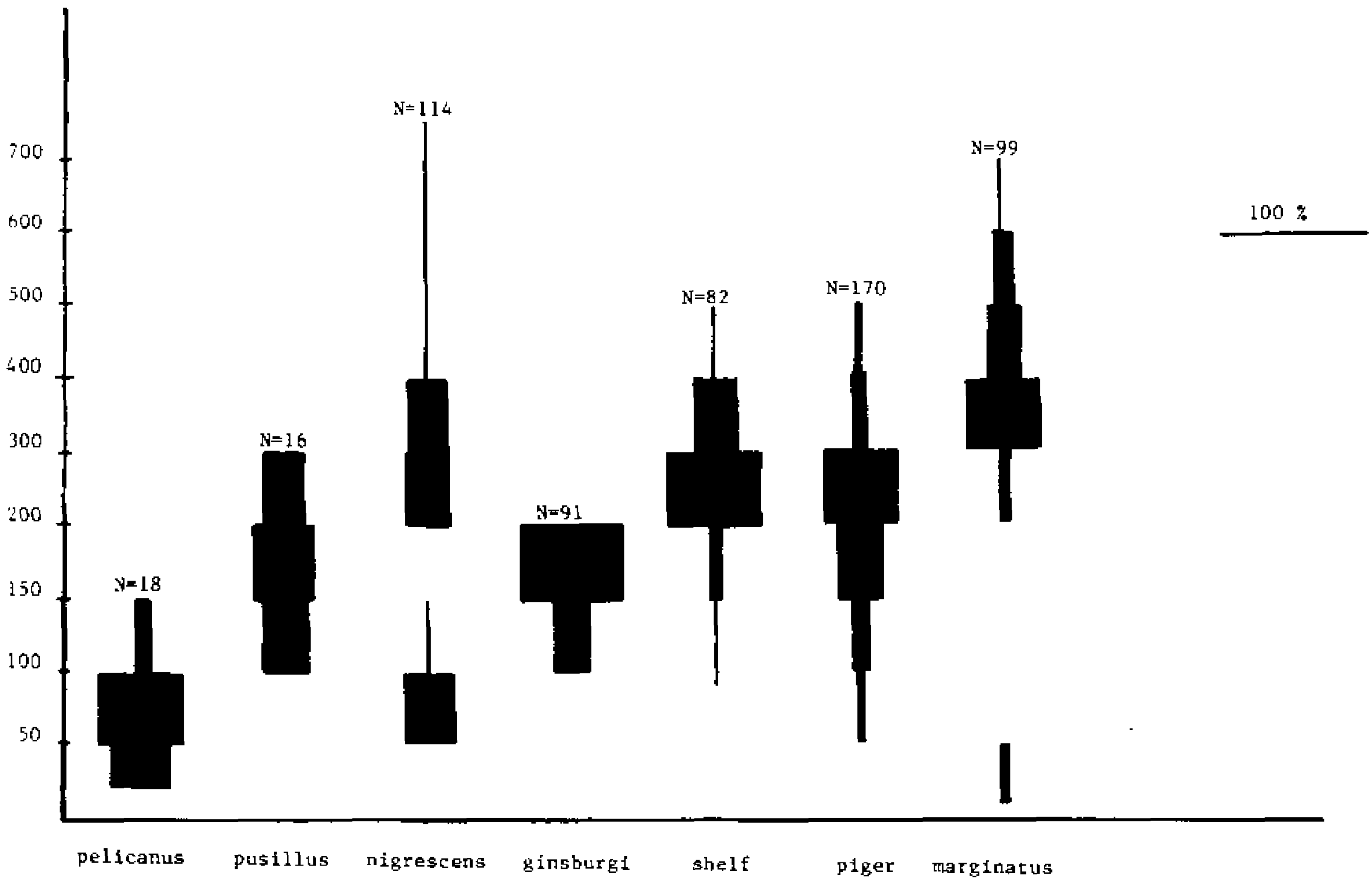


Figure 35. Graphic illustration of the bathymetric centers of abundance for seven species of *Symphurus* characterized by a 1-3-2 ID pattern and a black peritoneum.

1 - 3 - 2 SPECIES

BLACK PERITONEUM



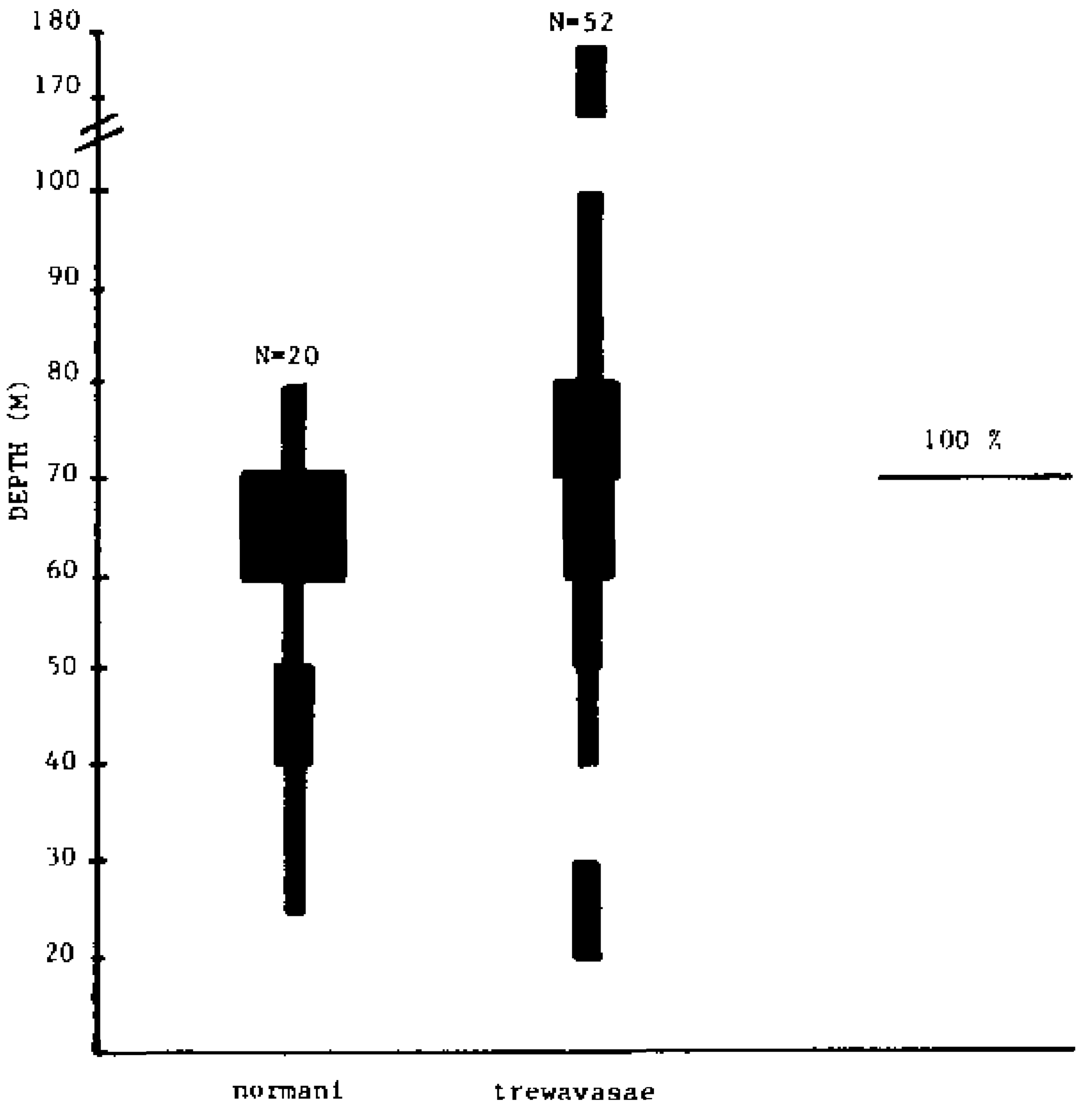
It is interesting to note in Figure 35 that the species which overlap in depth of occurrence (S. pusillus western North Atlantic, S. nigrescens eastern Atlantic and S. ginsburgi western South Atlantic) are completely allopatric with respect to geographic distribution. In a similar fashion, undescribed species C (western North Atlantic, eastern seaboard of US) and S. piger (Caribbean Sea and southern tip of Florida) overlap in depth of occurrence, but again, these species do not usually co-occur geographically. Also evident in Figure 35 is that species which co-occur geographically, such as S. pusillus and undescribed species C, and S. piger and S. marginatus, usually do not overlap extensively with respect to depth of occurrence.

The two Atlantic species with a 1-3-3 ID pattern occupy approximately similar depth regions (Fig. 36) on the inner continental shelf but are completely allopatric in distribution. Symphurus normani occurs at depths from 25-80 meters along the coast of West Africa. Symphurus trewavasae has been collected over a somewhat wider depth range and occurs at shelf depths from about 20-180 meters along the warm-temperate coast of Brazil.

The four species with a 1-4-2 ID pattern are, with one exception, quite dissimilar in depth of occurrence (Fig. 37). All of the species occurring in the western North Atlantic are completely allotopic with regard to depth of occurrence. Symphurus ommaspilus is completely different from the remaining three species in that it occurs primarily on sandy substrates adjacent to coral reefs and turtle grass beds throughout the Caribbean Province. The remaining three species occur on the continental shelves of both North and South America. Symphurus minor appears to prefer substrates

Figure 36. Graphic illustration of bathymetric centers of abundance for two Atlantic species (*S. normani* and *S. trewavasae*) characterized by a 1-3-3 ID pattern.

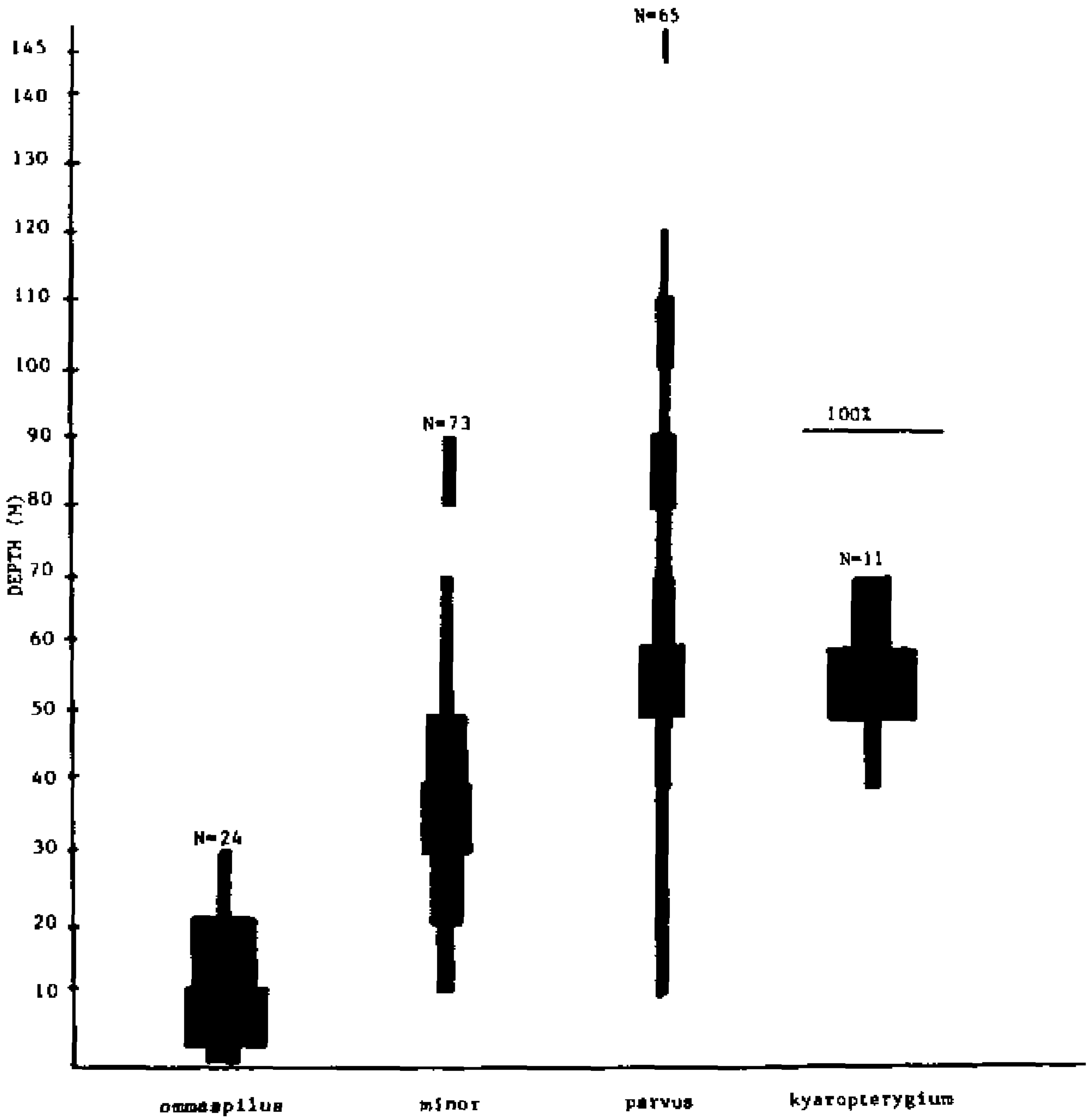
1 - 3 - 3 SPECIES



180
170
100
90
80
70
60
50
40
30
20
DEPTH (M)
N=20
N=52
100 %
normani
trewavasae

Figure 37. Graphic illustration of the bathymetric centers of abundance for four western Atlantic species (*S. kyaropterygium*, *S. minor*, *S. ommaspilus* and *S. parvus*) characterized by a 1-4-2 ID pattern.

1 - 4 - 2 SPECIES

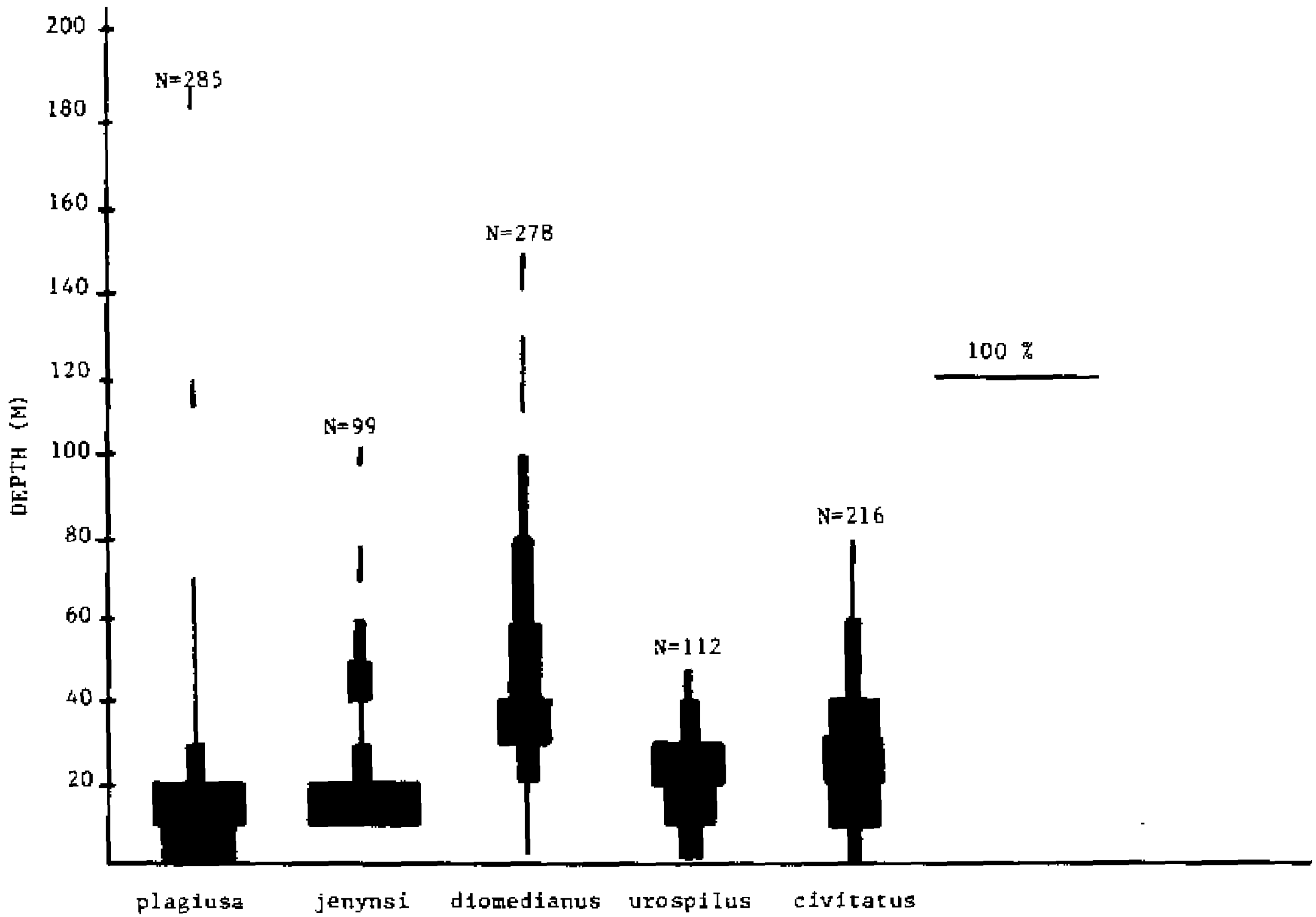

N=24
N=73
N=65
N=11
100%
DEPTH (M)
145
140
130
120
110
100
90
80
70
60
50
40
30
20
10
ommaspilus
minor
parvus
kyaropterygium

derived from limestone or live-bottom habitats. Its center of abundance corresponds closely with the occurrence of live bottom areas along the southeastern coast of the United States and the west coast of Florida almost to the DeSoto Canyon area. The observed depth ranges for this species is 11-50 m. In contrast, S. parvus is largely sympatric with S. minor throughout its range but is almost completely allotopic with regard to depth of capture. Symphurus parvus occurs commonly at depths ranging from 50-100 m, except in the region along the west Florida shelf, where it has been taken somewhat shallower (as shallow as 40 m). The depth of occurrence for S. parvus appears to be identical with that of the southern South American species, S. kyaropterygium. Although this species is poorly represented in collections, available depth records indicate that this species is an inhabitant of the open shelf occurring at depths ranging from 36-69 meters.

The species with a 1-4-3 ID pattern comprise the largest group of shallow-water tonguefish species. The relationships between depth of occurrence and substrate type are best exampled among this group of species (Fig. 38). There appear to be a range of habitat specialists among this group. For example, S. urospilus occurs over live-bottom habitats along the southeastern coast of the United States, west Florida, offshore at Galveston, Texas and on the Yucatan Banks. It is generally absent from the regions along the coast where mud and quartz sand bottoms predominate.

Figure 38. Graphic illustration of bathymetric centers of abundance for five species of western Atlantic *Symphurus* characterized by a 1-4-3 ID pattern.

1 - 4 - 3 SPECIES



DEPTH (M)
200
180
160
140
120
100
80
60
40
20
N=285
N=99
N=278
N=112
N=216
100 %
plagiusa
jenynsi
diomedianus
urospilus
civitatus

Symphurus plagiusa is unique among the 1-4-3 ID pattern species of western North Atlantic tonguefishes that occur north of Mexico in that it is the only species to regularly occur in shallow-water and estuarine areas. It is extremely abundant seasonally in nearshore waters from Texas to Chesapeake Bay and comprises a significant proportion of the trawl catches from these regions. No other tonguefish species overlap in depth of occurrence or habitat (estuarine) with this species. *Symphurus plagiusa* does, however, occur out onto the continental shelf to depths of 20-40 meters, but the majority of the population apparently resides at much shallower depths (Fig. 38).

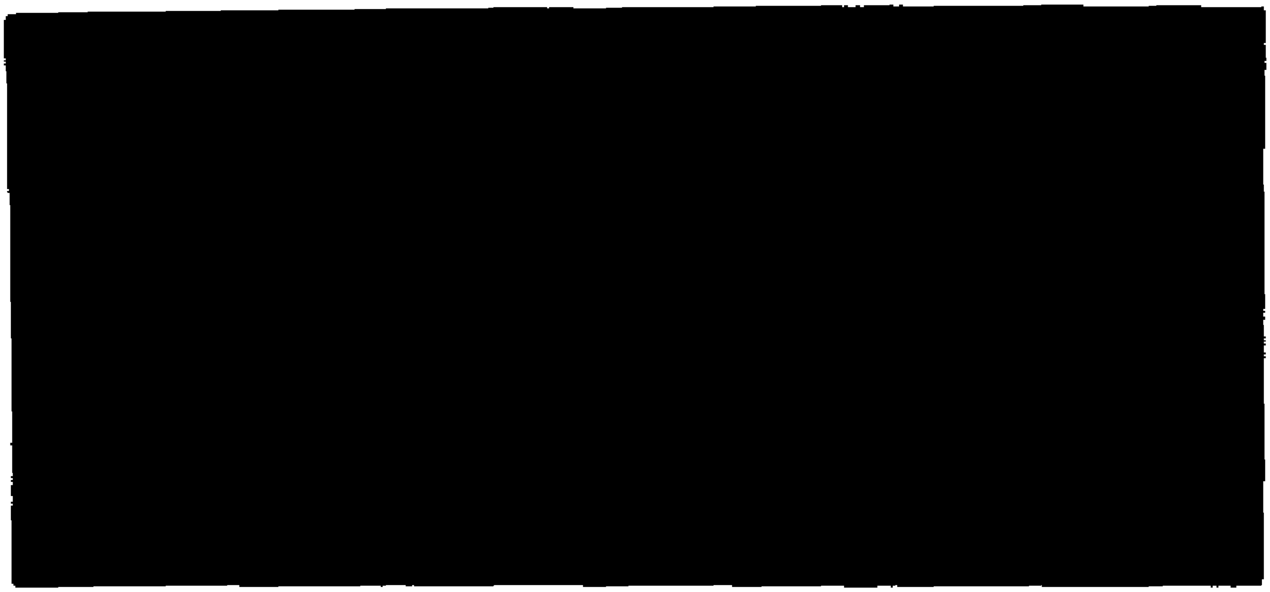
Symphurus diomedeanus is a wide-ranging species. Throughout its geographic range, it is usually taken at depths ranging from 21-100 meters (Fig. 38). At these depths it usually does not co-occur with any other 10-caudal rayed species with a 1-4-3 ID pattern. Off the coast of Central America, it twice occurred in trawl hauls with the 12- caudal rayed *S. tessellatus*. It also is taken occasionally with *S. civitatium* in collections made in the western Gulf of Mexico.

Figure 39.

A. *Symphurus vanmelleae*. IOS DISC ST 10873. 105 mm SL.

B. *Symphurus ligulatus*. ANSP 123249. 84.5 mm SL.

C. *Symphurus nebulosus*. UMO 311.8. 76.7 mm SL.



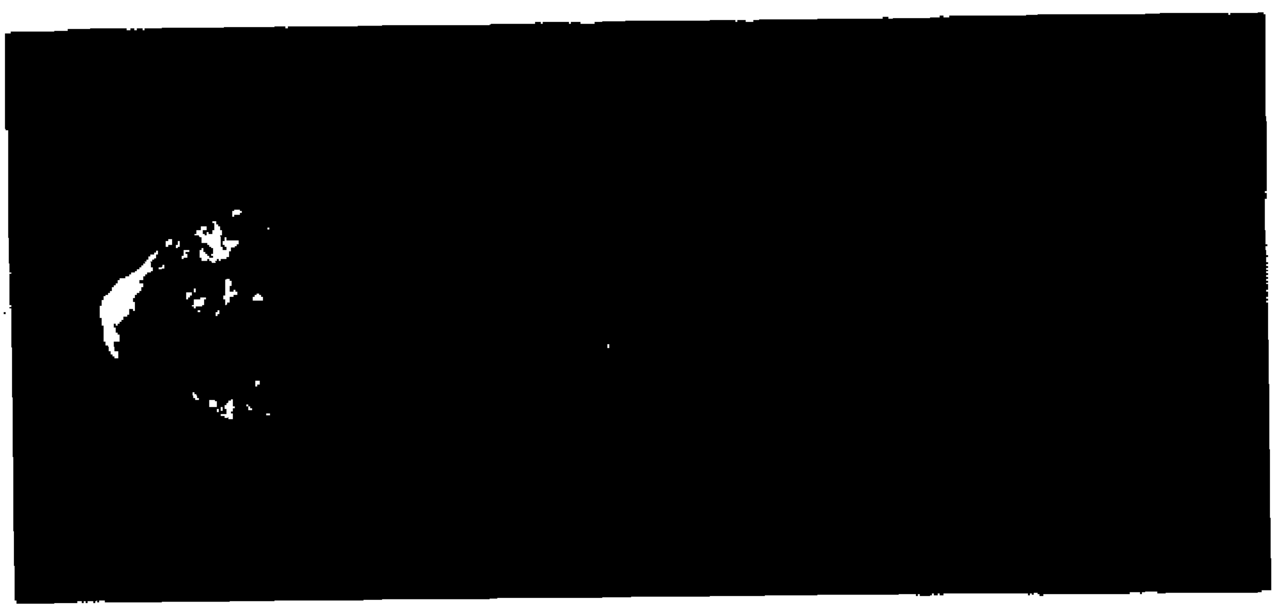


Figure 40.

A. *Symphurus arawak*. USNM 267784. 29.3 mm SL.

B. *Symphurus rhytisma*. FMNH 94821. 21.7 mm SL.

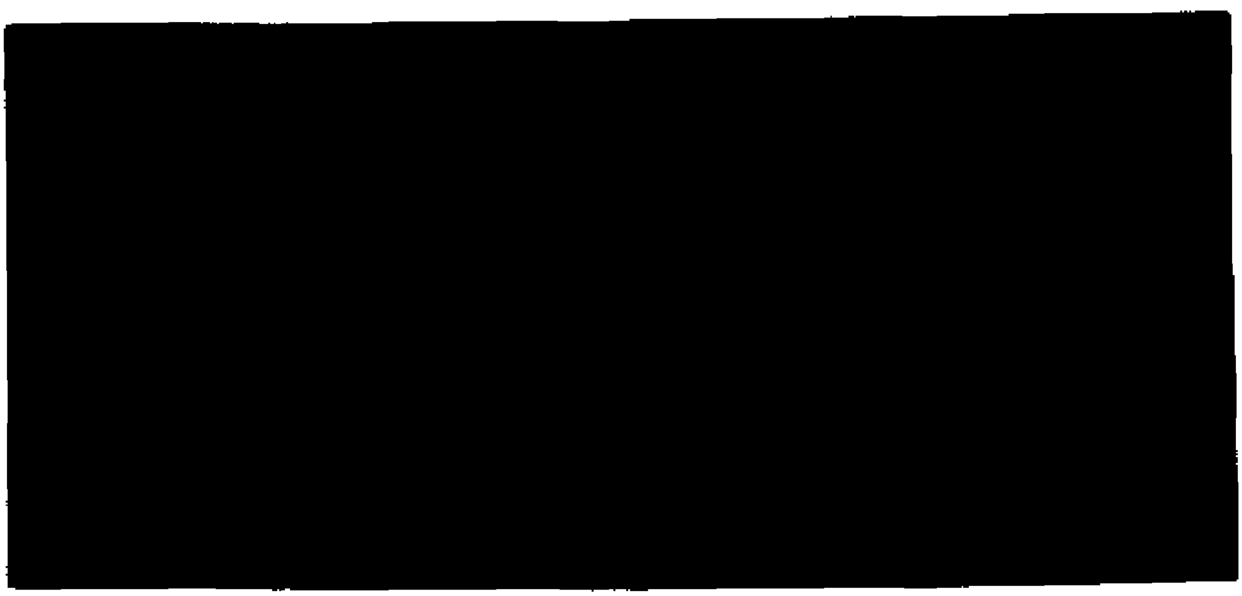


Figure 41.

A. *Symphurus* Undescribed Species A. BMNH 1979.1.5:237. 28.0 mm SL.

B. *Symphurus* Undescribed Species B. BMNH 1984.7.16:246. 59.2 mm SL.

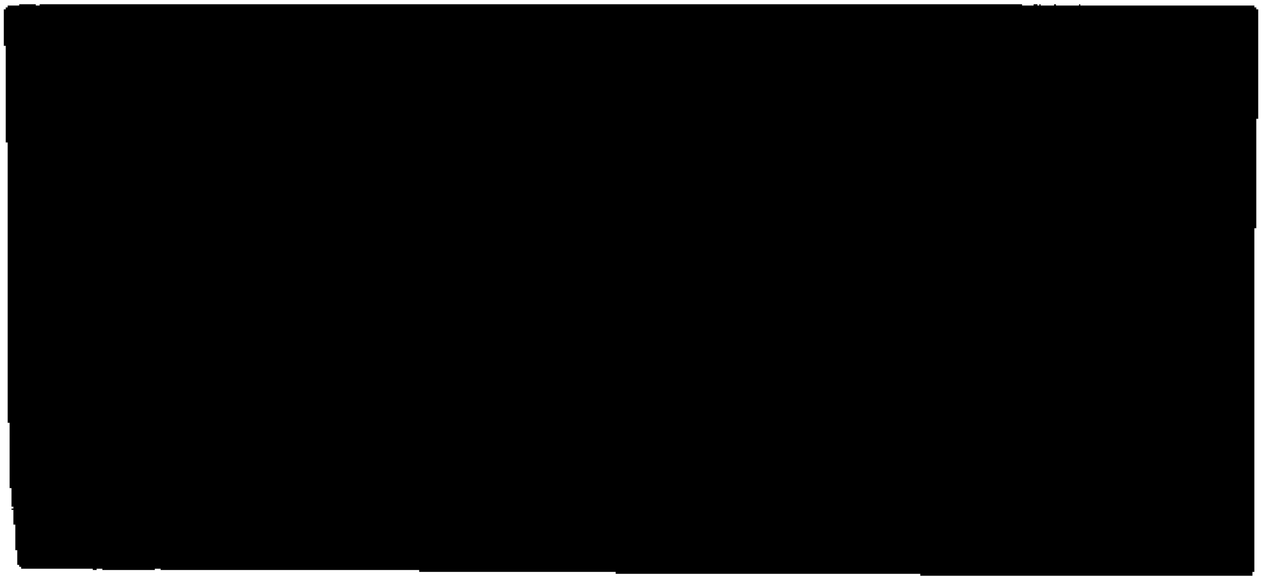
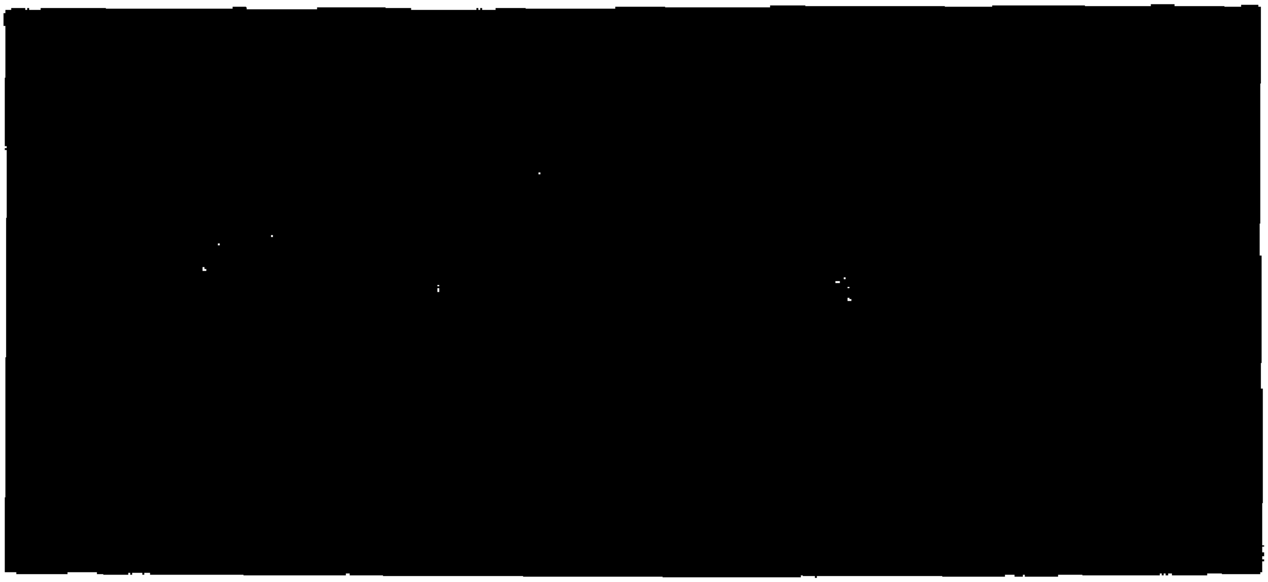


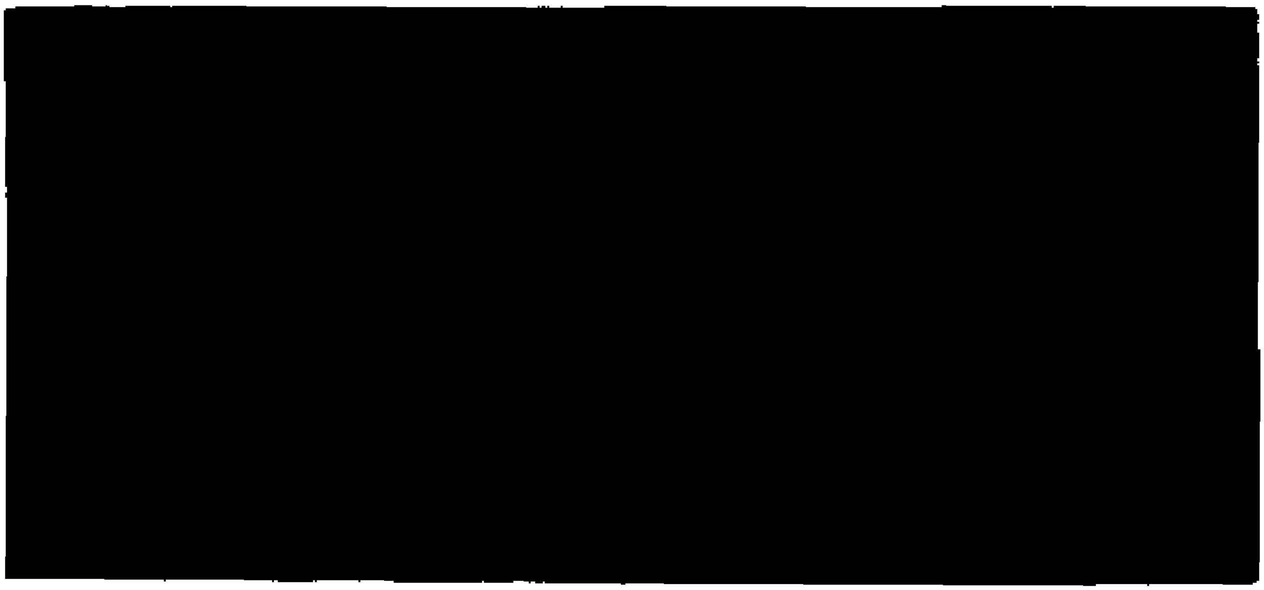
Figure 42.

A. *Symphurus pelicanus*. TCWC 8248.2. 58.3 mm SL.

B. *Symphurus ginsburgi*. Holotype. MZUSP 12339. 61.5 mm SL.

C. *Symphurus* Undescribed Species C. UMML UNCAT G898. 127 mm SL.





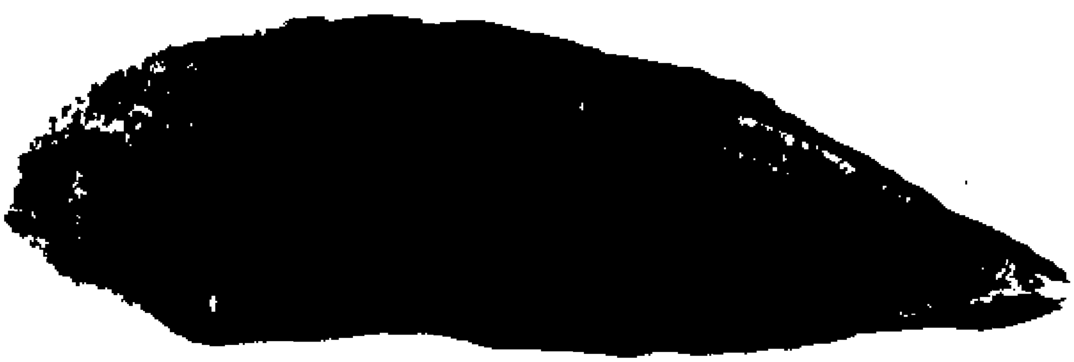
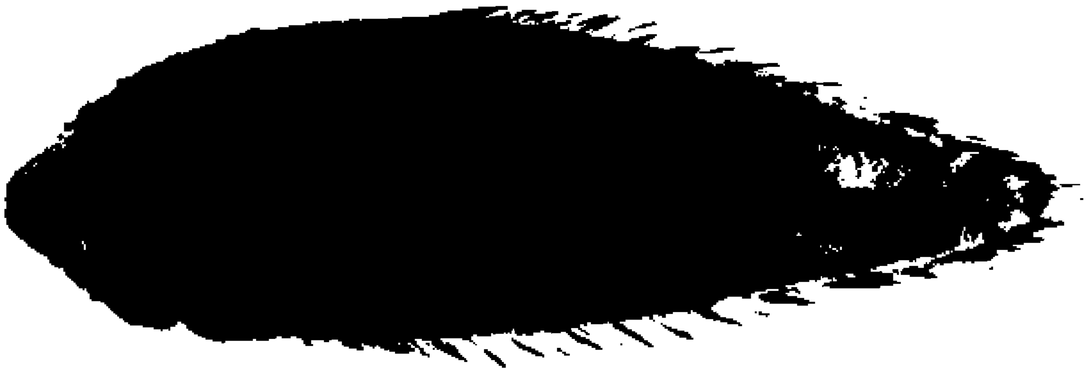


Figure 43.

A. <u>Symphurus nigrescens</u>. IOS 8020. 97.3 mm SL.

B. <u>Symphurus pusillus</u>. USA 4822. 38.5 mm SL.



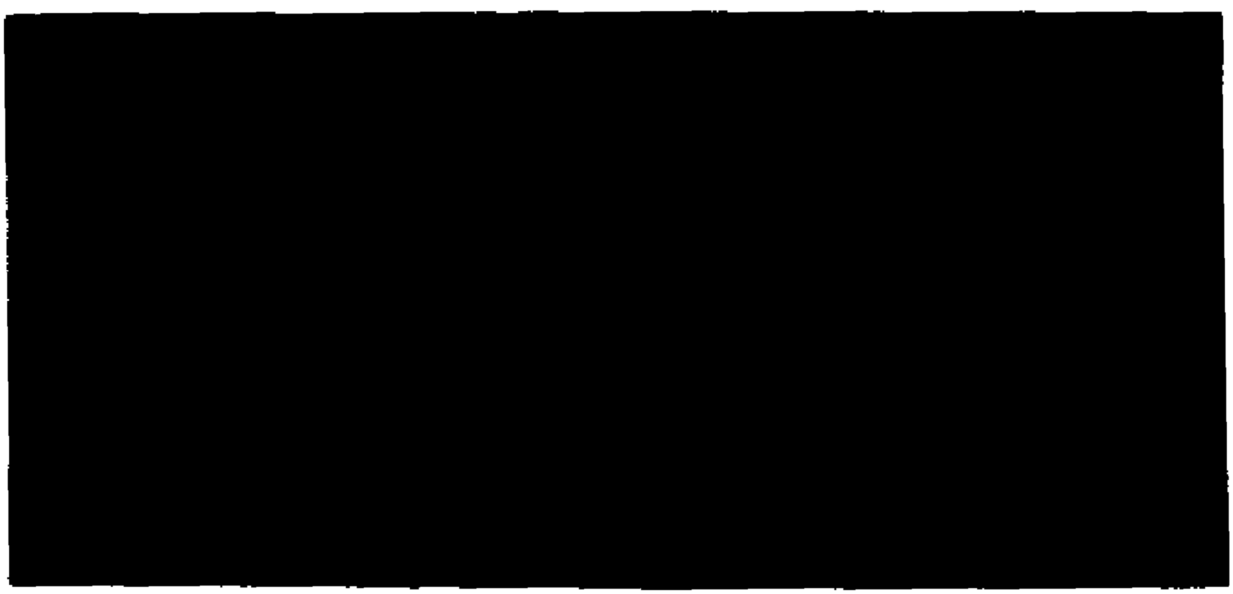


Figure 44.

A. Symphurus marginatus. USNM 236609. 115 mm SL.

B. Symphurus piger. USNM 159211. 106 mm SL.

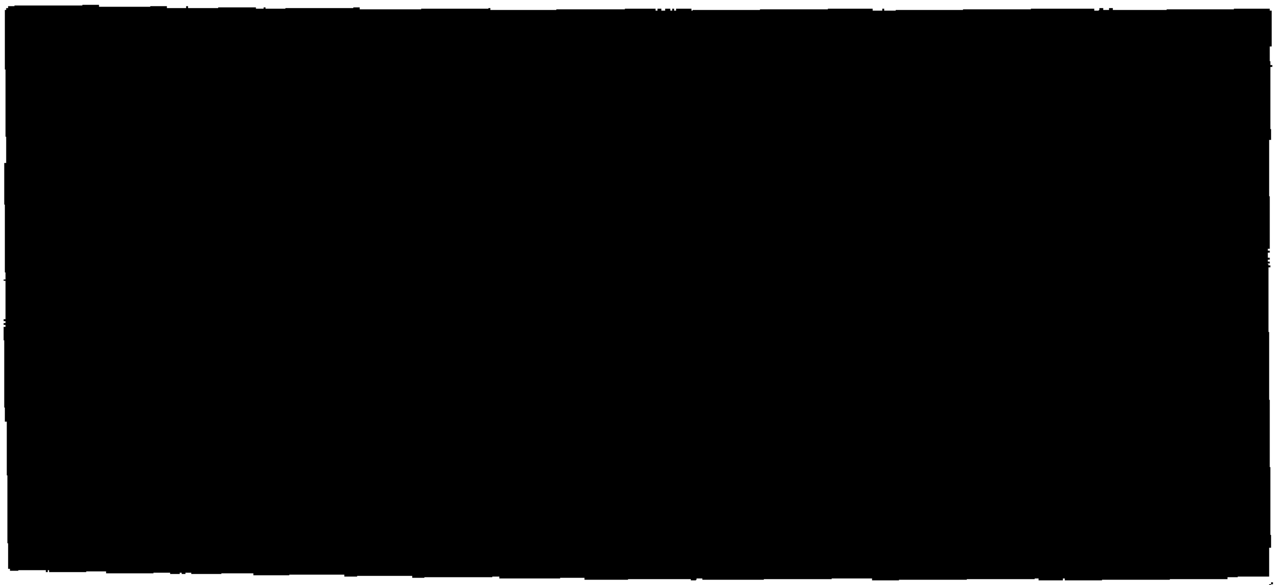
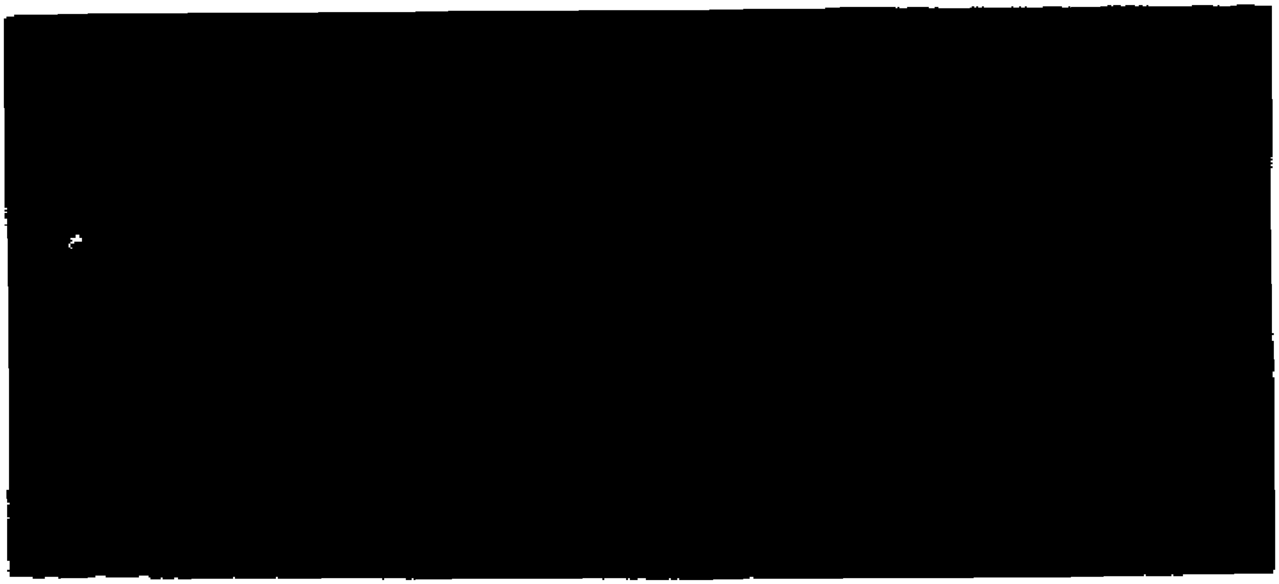


Figure 45.

A. *Symphurus normani*. Holotype. BMNH 1930.5.6:51. 81.4 mm SL.

B. *Symphurus trewavasae*. MZUSP 12457-468. 109 mm SL.



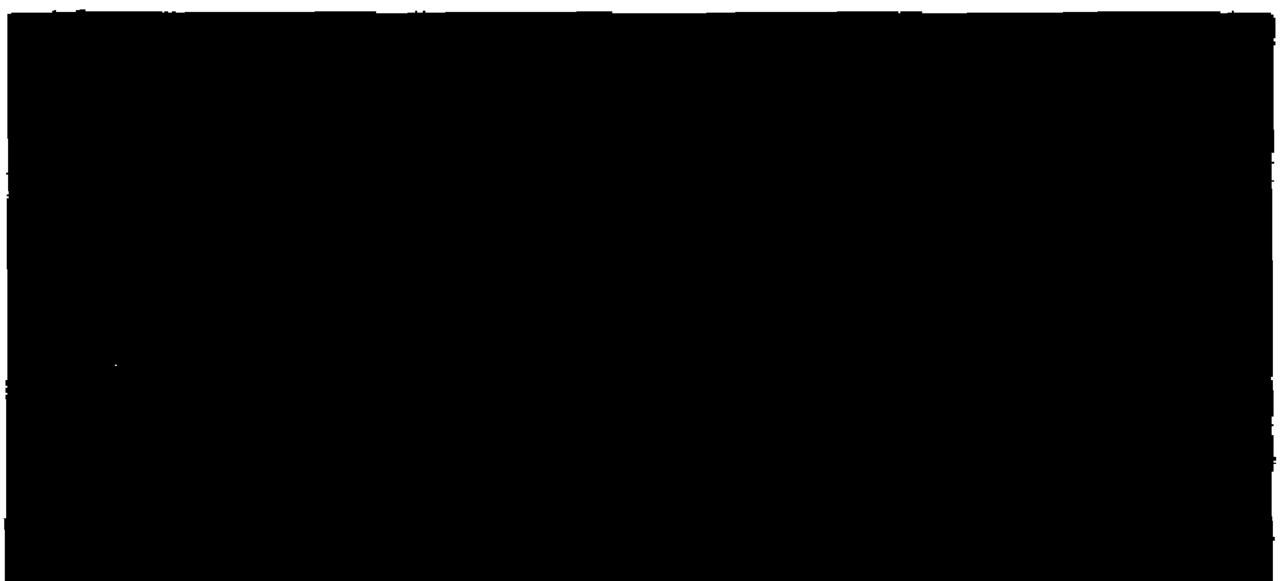


Figure 46.

A. *Symphurus kyaropterygium*. Holotype. MZUSP 12425. 119 mm SL.

B. *Symphurus minor*. GCRL V76:14893. 51.2 mm SL.

C. *Symphurus parvus*. VIMS UNCAT DEL 82-02 ST 21. 88.2 mm SL.

D. *Symphurus ommaspilus*. FMNH 94820. 53.6 mm SL.

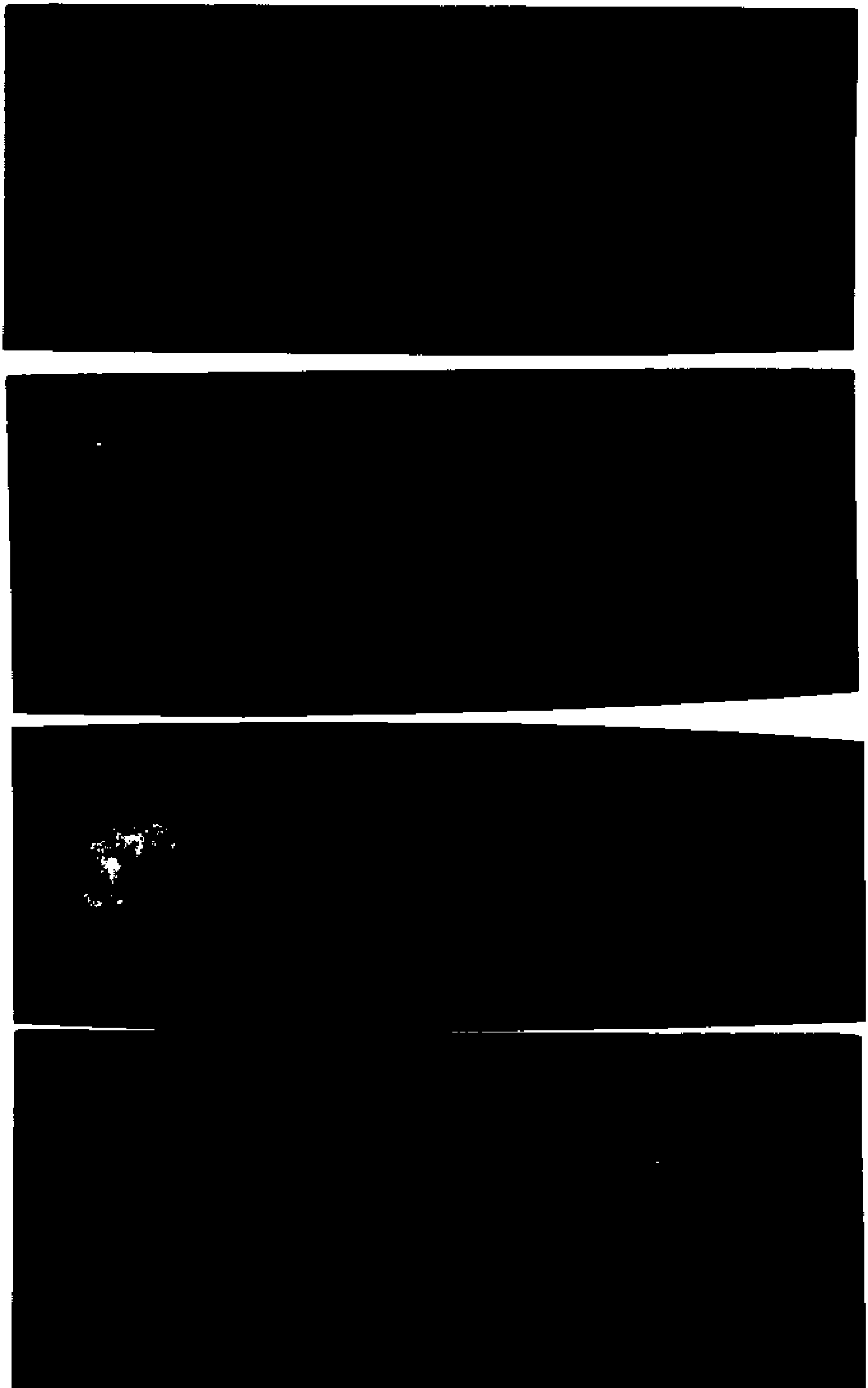


Figure 47.

A. Symphurus diomedeanus. UMML UNCAT P711 (Dark Phase). 136 mm SL.

UMML 17431. (Light Phase). 127 mm SL.

B. Symphurus jenynsi. MZUSP 12555-560. 126 mm SL.

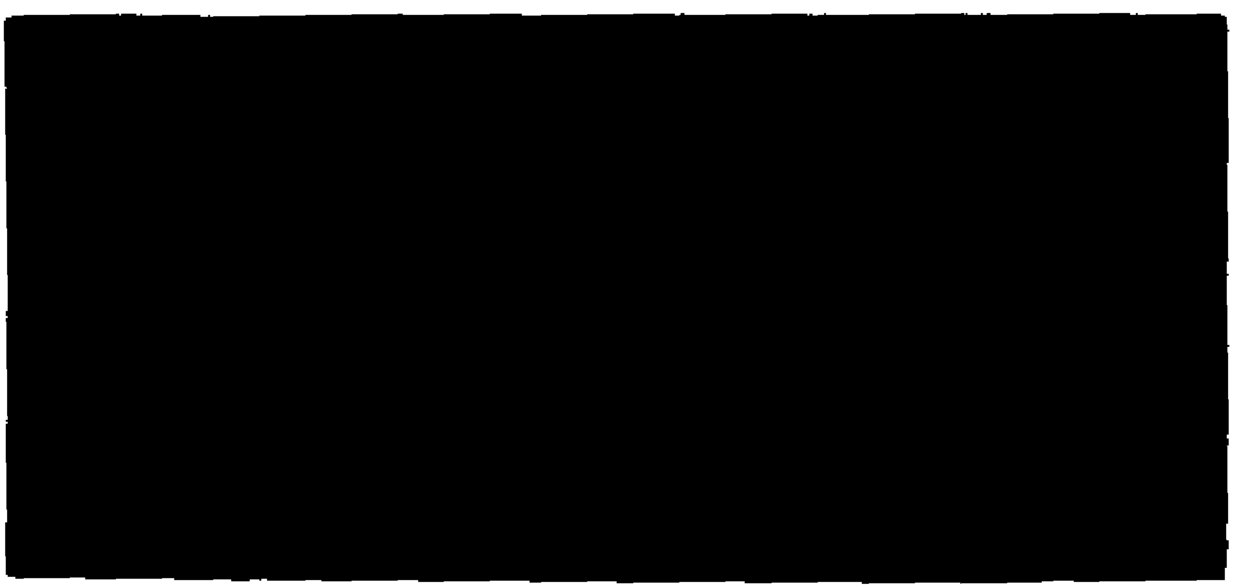


Figure 48.

A. *Symphurus plagiusa*. UF 10295. 137 mm SL.

B. *Symphurus urospilus*. USNM 267315. 129 mm SL.

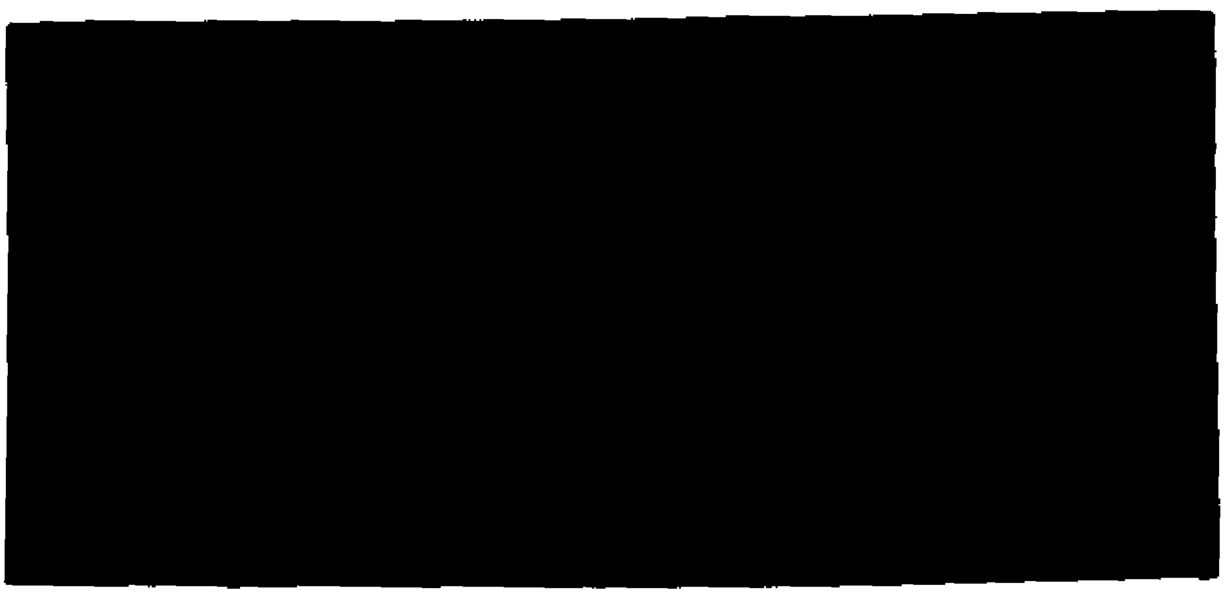
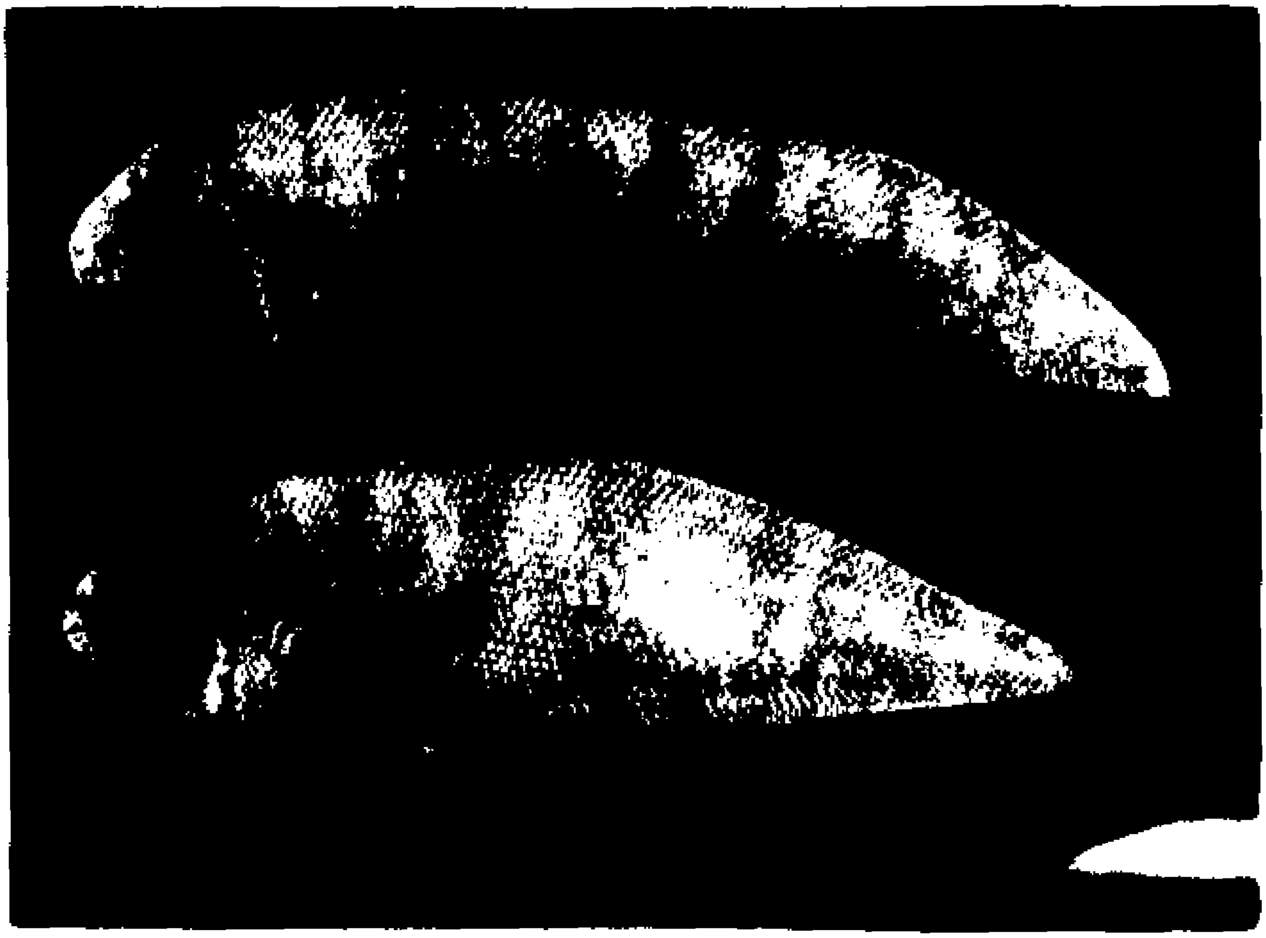


Figure 49.

A. Symphurus civitatium. (Female above and male below). TCWC 4189.21.

Female 112 mm SL. Male 119 mm SL.

B. Symphurus plagusia. ANSP 121326. 112 mm SL.



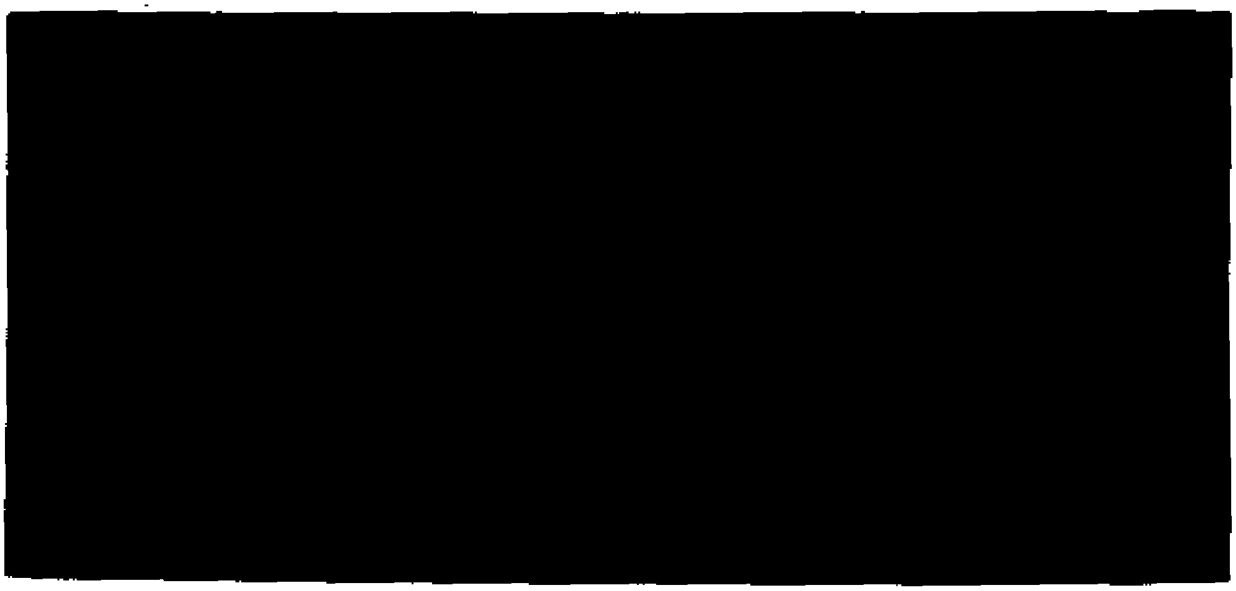
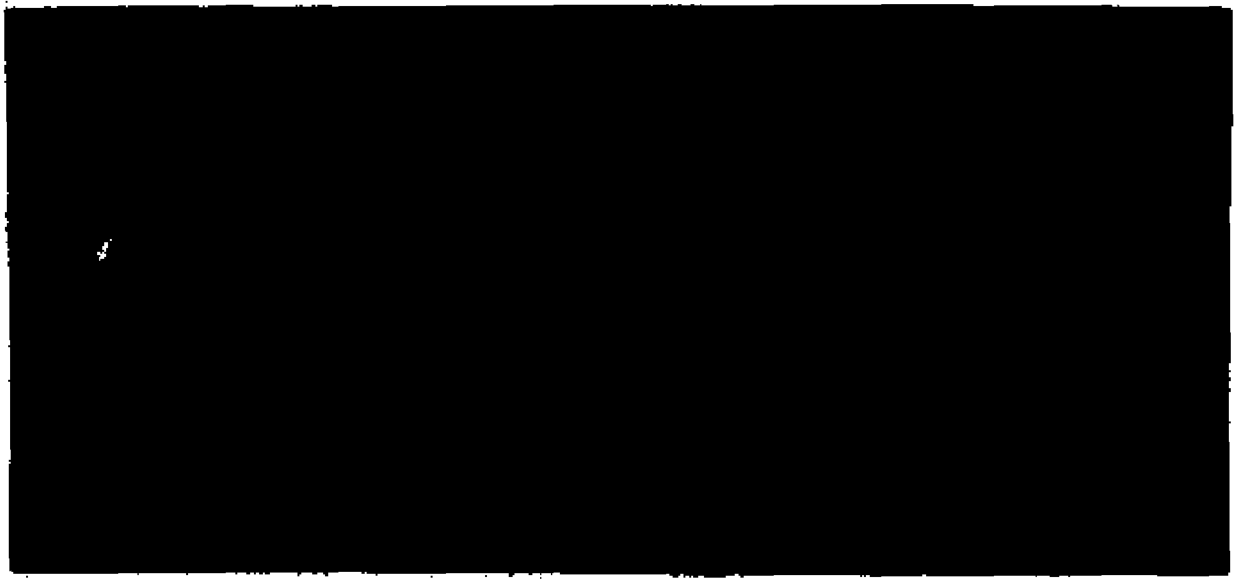


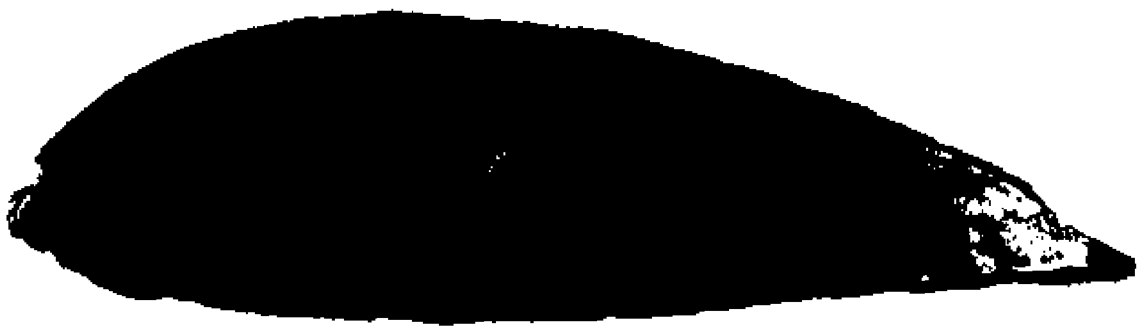
Figure 50.

A. *Symphurus tessellatus*. (Male). USNM UNCAT ORII ST 10231. 132 mm SL.

B. *Symphurus* undescribed species D. USNM UNCAT ORII ST 12034. 152 mm SL.

C. *Symphurus* undescribed species E. UPRM UNCAT JSR 66-49. 101 mm SL.





Appendix

Material examined for interdigitation patterns portion of study. For species marked with an asterisk (*) the material examined for interdigitation patterns is listed under the respective material examined sections of the individual descriptive accounts in the systematic revision chapters (6.1-6.7). Species marked with # sign are known only from the holotype.

#*S. arabicus* BMNH 1939.5.24:1839. Holotype.

S. arawak *

S. atramentatus USNM 41157; 41471 Syntypes; 41367-68. MCZ 35922. CAS-SU 3 Paratypes.

S. atricaudus USNM 27396.

S. australis AMS I-7898 Holotype; I-23870-002,-003,-007.

S. civitatium *

S. diomedeanus *

S. elongatus UMML UNCAT

S. fasciolaris USNM 44406 Holotype.

#*S. fuscus* ZMB 17686 Holotype.

S. gilesii BMNH 1939.5.24:1835-38.

S. ginsburgi *

S. gorgonae BMNH 1926.7.12:81-3 Holtotype and paratypes; 1956.3.1:16-20.

Appendix

Material examined for interdigitation patterns portion of study. For species marked with an asterisk (*) the material examined for interdigitation patterns is listed under the respective material examined sections of the individual descriptive accounts in the systematic revision chapters (6.1-6.7). Species marked with # sign are known only from the holotype.

#*S*. *arabicus* BMNH 1939.5.24:1839. Holotype.

S. *arawak* *

S. *atramentatus* USNM 41157; 41471 Syntypes; 41367-68. MCZ 35922. CAS-SU 3 Paratypes.

S. *atricaudus* USNM 27396.

S. *australis* AMS I-7898 Holotype; I-23870-002,-003,-007.

S. *civitatium* *

S. *diomedeanus* *

S. *elongatus* UMML UNCAT

S. *fasciolaris* USNM 44406 Holotype.

#*S*. *fuscus* ZMB 17686 Holotype.

S. *gilesii* BMNH 1939.5.24:1835-38.

S. *ginsburgi* *

S. *gorgonae* BMNH 1926.7.12:81-3 Holtotype and paratypes; 1956.3.1:16-20.

S. holothuriae BMNH 1892.1.14:34 Holotype. ?ZMC P86117-8.

#S. hondoensis USNM 75675 Holotype.

S. jenynsi *

S. kyaropterygium *

S. leei USNM 41485 Syntypes; 35916; 35906. CAS-SU 39 Syntyes.

S. ligulatus *

Undescribed species A through E *

S. luzonensis USNM 138043 Holotype.

S. macrophthalmus BMNH 1939.5.24: 1825-26 Holotype and paratype.

#S. maldivensis BMNH 1939.5.24:1815 Atelotype.

S. marmoratus USNM 93092 Holotype; 93208 paratype.

S. marginatus *

S. microlepis MCZ 28535 Holotype.

S. microrhynchus ZMA 108.193 Holotype.

S. minor *

S. nebulosus *

Unidentified species A USNM 265183; 245733; 236607.

S. nigrescens *

S. normani *

S. ocellatus BMNH 1922.3.27: Holotype; 1922.3.27:24; 1922.3.274. ZMUC P86102-112; P86103-05. SAM 28814.

S. ommaspilus *

S. orientalis UMMZ 159738. MHNH 1984.633.

S. paitensis USNM 128172 Holotype; 128173 paratype.

S. parvus *

S. pelicanus *

S. piger *

S. plagiusa *

S. plagusia *

S. pusillus *

S. regani ZMA 100.246 Lectotype; 100.247-249 paralectotypes. MNHN 50-1; 50-2; 50-69.

S. rhytisma *

S. sayademalhensis BMNH 1908.3.23:157 Holotype; 1908.3.23:158 paratype.

S. schultzi USNM 138044 Holotype; 138057 Paratype; 138033; 138025; 138046.

S. sechurae USNM 128170 Holotype; 128171 paratypes.

S. strictus USNM 51624 Holotype; 51873 paratype. BPBM 24730.

S. trewavasae *

S. trifasciatus USNM_____ Syntype.

S. undatus USNM 51619 Holotype; BPBM 24982.

S. urospilus *

S. vanmelleae *

S. variegatus SAM 15399 Holotype; BMNH 1904.11.4:2.

S. varius USNM 15392 Syntype; MCZ 28536 syntypes.

S. williamsi BMNH 1895.5.27:224 Holotype.

S. woodmasoni ZMA 100.252.

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