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# Length Frequency Observations of Lophius Americanus Taken During One Trip Aboard a Commercial Scalloper

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# LENGTH FREQUENCY OBSERVATIONS OF *LOPHIUS AMERICANUS* TAKEN DURING ONE TRIP ABOARD A COMMERCIAL SCALLOPER

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## *Introduction*

The goosefish, *Lophius americanus* (Cuvier and Valenciennes 1837), is a marine benthic anglerfish of the western Atlantic Ocean, occurring from the northern Gulf of St. Lawrence to Cape Hatteras and occasionally beyond. Until recently regarded as a trash fish and discarded by commercial fisherman, it has nonetheless persisted in commercial catches, particularly those of the sea scallop, *Placopecten magellanicus*, which shares a great part of its range. In recent years, *L. americanus* has become an important marketable bycatch of scalloping operations, with the cheeks, tail, and liver being sold as "monkfish."

With a few exceptions, *L. americanus* has received little of the attention in the literature of its more esteemed congenerics of the eastern Atlantic and Mediterranean region. This study attempts to establish a size-frequency distribution for *L. americanus* taken by commercial scallopers at one point in time in the Mid-Atlantic Bight, and to use regression analysis to investigate trends of size in relation to water depth and latitude.

## *Methods and Materials*

*Lophius americanus* specimens were collected aboard the scalloper Alpha and Omega II between 2 November and 10 November of 1993. Two standard 15-ft scallop dredges were used, one fitted with rings of 3" interior diameter and one of 3.25" interior diameter. Tows lasted for 50 to 55 minutes. A total of 1316 specimens were taken at 52 stations, with sample locations ranging from south of Montauk Point to northeast of the Virginia Capes, in depths ranging from 21 to 44 fathoms.

Total lengths of all *L. americanus* specimens were obtained to the nearest 1 mm on a measuring board. Total lengths were regressed on depth and latitude (Loran) using simple linear regression (Minitab).

## *Results*

A plot of *L. americanus* length frequencies is shown in Figure 1, with lengths placed in 10-mm groupings. *L. americanus* of 140-150mm were the smallest to be harvested by the gear, and a major peak in frequency of occurrence appeared at about 250 mm, followed by a sharp decline. Minor peaks occurred at 320-400 mm, 460-520 mm, and 580-620 mm, roughly. These four peaks may coincide with Armstrong's (1987) size-at-age estimations of 169 and 167 mm (females and males, respectively) for age 1, 313 and 332 mm for age 2, 412 and 425 mm for age 3, and 526 and 519 mm for age 4, with the shift to the greater lengths observed in this study attributed to a difference in sampling times between the two studies. While sex determinations were not performed in this study, 54% of all specimens caught were below 290 mm, Armstrong's (1987) size-at-first-reproduction for males. Fully 79.9% were below 390 mm, the size at first reproduction for females.

Regression analysis showed no significant relationship between median total length of *L. americanus* and latitude. However, median total length did tend to decrease with increasing depth ($p<0.0005$, R-squared=33.4%; see Figure 2).

**Figure 1.** *Lophius americanus* total length frequencies, for the overall cruise.

Length Frequency Distribution
by americanus
Mid-Atlantic - November 1993

# L. americanus Length Frequencies

## ~~Overall Cruise~~

N = xxx tows, xxx

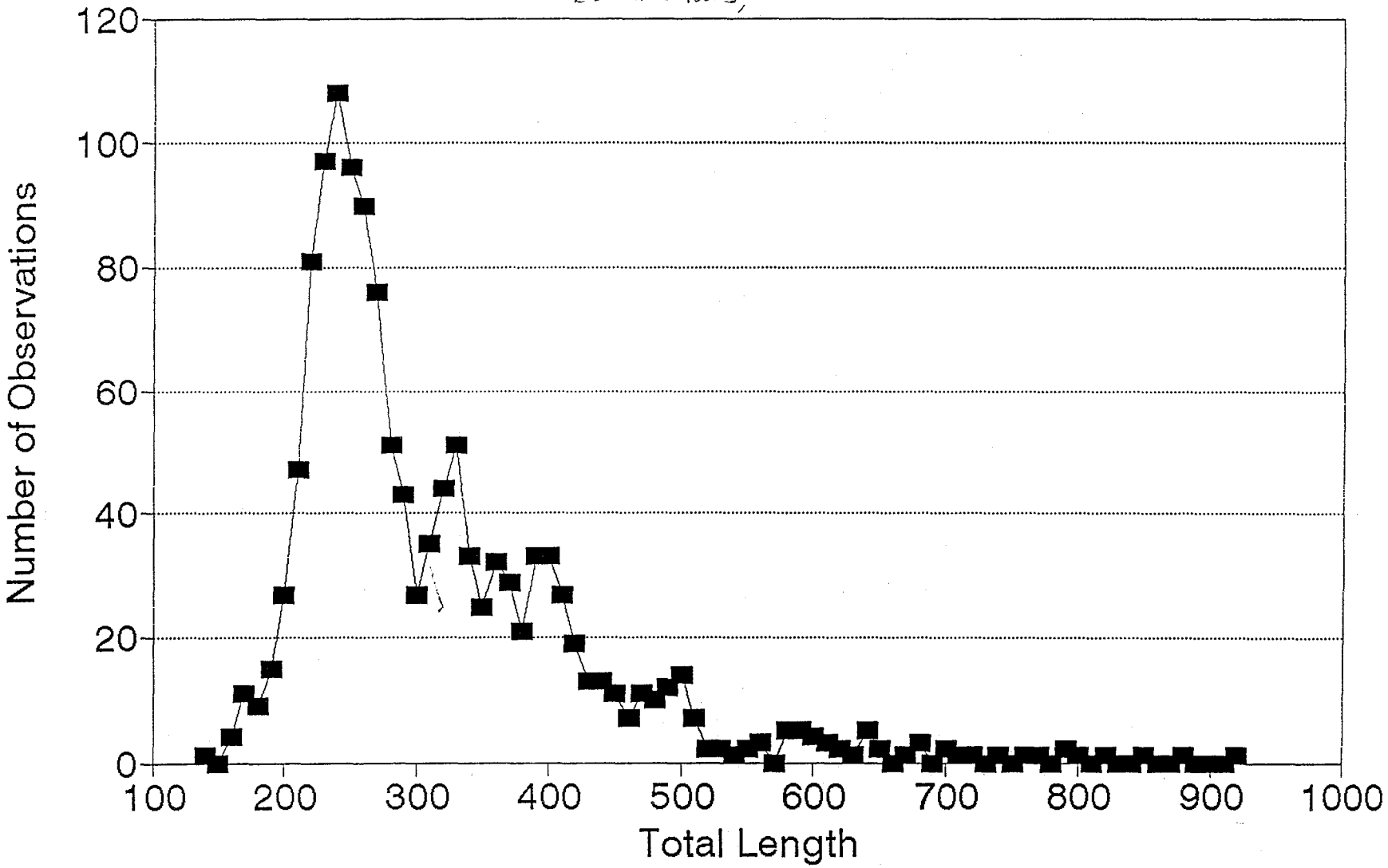


**Figure 2.** Regression of *L. americanus* median total length on water depth, each pooled by station.

The regression equation is
Median Total Length = 563 - 8.17*Depth

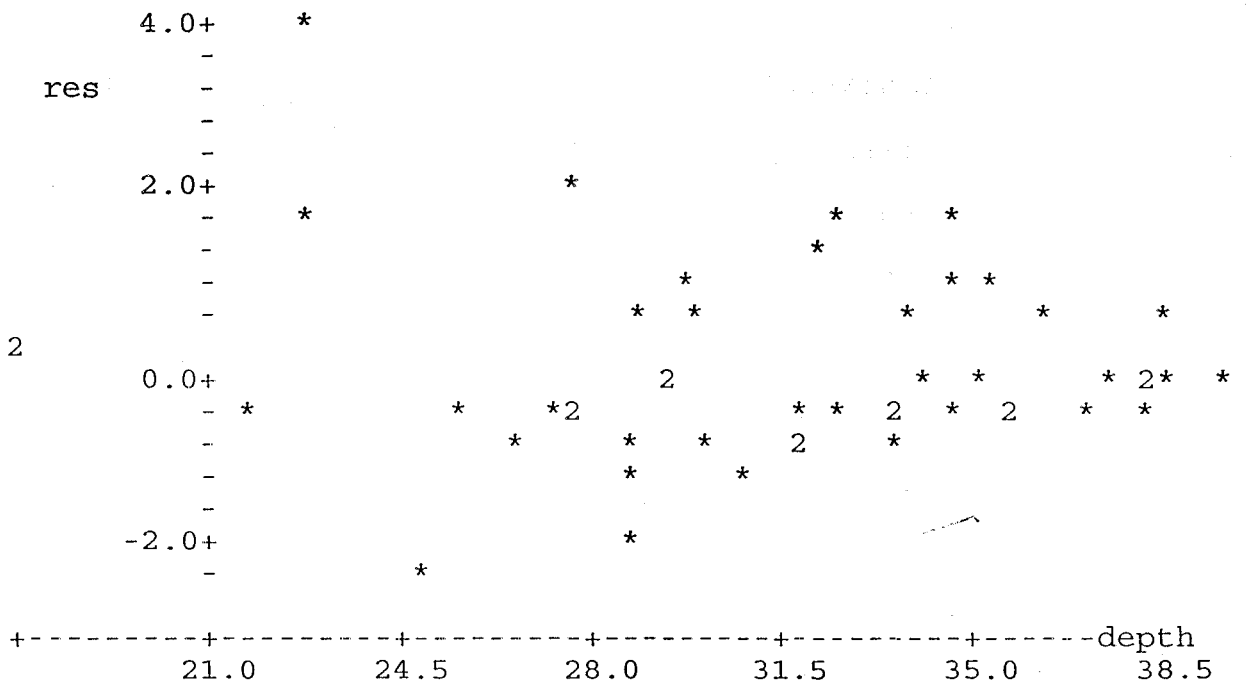
| Predictor | Coef | Stdev | t-ratio | p |
|---|---|---|---|---|
| Constant | 562.83 | 53.82 | 10.46 | 0.000 |
| Depth | -8.168 | 1.682 | -4.86 | 0.000 |

s = 57.21  R-sq = 33.4%  R-sq(adj) = 32.0%

Analysis of Variance

| SOURCE | DF | SS | MS | F | p |
|---|---|---|---|---|---|
| Regression | 1 | 77168 | 77168 | 23.57 | 0.000 |
| Error | 47 | 153855 | 3274 | | |
| Total | 48 | 231023 | | | |

MTB > plot residuals versus depth



## *Discussion*

Seasonal movements of *L. americanus* from shallow to deep water, presumably in response to falling temperatures, have been documented for the Gulf of St. Lawrence region (Jean 1965). However, no documentation exists for spatial differences in size distribution. That median length should decrease with increasing depth, therefore, is intriguing. But this phenomenon, if indeed it exists, may be explained similarly by temperature-related migrations. Jean (1965) found that the offshore movements of *L. americanus* were related to temperatures falling to the lower limit of *L. americanus'* tolerance range, around 0 degrees C. In the Mid-Atlantic Bight in the late fall, however, the influx of warm slope water makes bottom temperatures approach 15 degrees C; *L. americanus* in Virginia waters are most common at temperatures of 7-11 degrees C (Wenner 1978). Thus, *L. americanus* may move inshore to find cooler water. Size-related differences in the timing or rate of this migration may explain the greater likelihood of *L. americanus* specimens in deeper waters being small ones.

While *L. americanus* is known to be relatively long-lived (females to 11 years, males to 9 (Armstrong 1987)), the relative paucity of larger specimens may suggest that mortality, due to the combination of fishing and natural causes, is high. However, the possibility remains that larger *L. americanus* are more adept at avoiding a scallop dredge. It must be remembered too that this study serves only as a snapshot taken at one point in time over a limited range of latitudes and depths. As little is known of *L.*

*americanus'* migratory behavior in the Mid-Atlantic, the conclusion that the larger fish simply were somewhere else cannot be discounted. Indeed, Markle and Musick (1974) reported finding *L. americanus* at 840 m depth, well beyond the range of commercial scallopers.

Weight indices for *L. americanus* in the Mid-Atlantic have decreased in recent years (Mid-Atlantic and New England Fishery Management Councils, Goosefish Scoping Document, 1993). In fact, the summer weight abundance index for 1991 is at 11% of the 1966 level. During this same period, however, indices based on number of fish did not decrease. Thus, "a decrease in the average size of individuals (MAFMC and NEFMC, Goosefish Scoping Document, 1993)" seems to have occurred. There is little doubt that this is due to the increase in fishing pressure on *L. americanus* as North Atlantic groundfish stocks have in recent years become depleted.

The growth of a directed trawl fishery for *L. americanus* underscores the need to develop some sort of management strategy for this species. However, this will prove quite difficult to accomplish. Management for marine fisheries typically is based on one of two concepts, the first of which is that of spawning stock biomass (SSB). A percentage of SSB forms the basis for the definition of overfishing. Biomass estimates for *L. americanus* are difficult to formulate because it is not known how much if any biomass exists in very deep water beyond the reach of harvesting or survey gear (MAFMC and NEFMC, Goosefish Scoping Document, 1993). Specific migration patterns also are not understood.

The second concept upon which management strategies may be

based is that of fishing mortality. This also will be difficult to estimate for *L. americanus*, for a couple of reasons. First, the fishery for *L. americanus* is non-directed, that is, most are caught as bycatch by vessels pursuing other groundfish or scallops. Thus it is difficult to obtain information on the amounts and sizes of specimens landed. This is made more difficult by the fact that *L. americanus* is landed often in parts, with tails, cheeks, and livers separated at sea. Secondly, while in general only *L. americanus* above a certain size will be retained by fisherman (about 300mm by the scallop fisherman observed in this study), many may be caught below this size. Though these small specimens may be returned to the water, it is not known how many may survive long, after possibly having been injured in the harvesting gear or succumbed to pressure changes between the sea floor and the vessel deck.

Development of a management plan for *L. americanus* will be complicated too by the fact that other, directed fisheries must not be constrained if possible by regulations regarding the nondirected *L. americanus* fishery.

Despite its contrivances, this study shows that the majority of *L. americanus* found were below size-at-first-reproduction. That the greatest contributors to population fecundity should be present at such low numbers should perhaps arouse some concern. Clearly, a greater understanding of factors such as fishing and natural mortality of this species, as well of biomass distribution, should be a goal of future research, especially at a time when dwindling North Atlantic finfish stocks may create new fishing pressure on those species once overlooked.

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