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Trapping Oyster Drills In Virginia I. The Effect Of Migration And Other Factors On The Catch

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TRAPPING OYSTER DRILLS IN VIRGINIA

I. THE EFFECT OF MIGRATION AND OTHER FACTORS ON THE CATCH [1]

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Introduction

Virginia oystermen have tried trapping of drills as a control measure and discarded it as ineffective and too costly. It is true that their efforts were sporadic and lacking in persistence, and the effects of their trapping were not adequately appraised. They expected returns in the form of increased yields too quickly. Nevertheless, these brief trials have convinced even the most progressive oystermen that trapping drills is not the answer to their predation problem. In Chesapeake Bay, consequently, no conscious effort is made to control drills. Oyster grounds are often allowed to lie fallow for several years, a practice which may decrease the drill population if the grounds are properly cleaned, but the reasons behind this rotation are vague and usually associated with the character of the bottom. To regulate drills oystermen have been urging the development of chemical controls and mechanical dredges.

On the seaside of the Eastern Shore of Virginia, the problem of drill control is more acute and urgent; consequently, many oystermen exercise some type of check on these predators. Whereas in Chesapeake Bay chiefly spat and yearling oysters are lost to the drills and the evidences of damage are not apparent at harvest time, in Eastern Shore waters, rapid growth of thin-shelled oysters together with a large race of drills permits predation of all sizes of oysters including significant numbers of those ready for market. These losses are conspicuous and the importance of drills is fully recognized.

On the Eastern Shore several methods have evolved for restricting damage by drills. For many years the State of Virginia has paid 75 cents to $1.00 per gallon for drills picked from the public grounds at low tide. On private grounds thorough cleaning by dredging followed by trapping and hand-picking are believed by many to be necessary and effective measures. Some planters have used the stratagem of leasing new ground from the state for each crop and turning back the old with a substantial population of drills on it. Other planters have found that moving seed from the intertidal seedbeds in midwinter, when the drills have moved to lower tidal levels and become inactive, is effective in preventing the transplantation of drills. The latest and perhaps the most effective method of obtaining drill-free seed is the use of a rotary drum which sorts out drills at a cost of five to ten cents a bushel. This device, developed originally by Mr. H. M. Terry of

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Willis Wharf, Virginia, though not yet widely used, has great promise for the industry on Eastern Shore.

The status of drill trapping as a management tool is unsettled. In Chesapeake Bay drill traps are considered ineffective; on the Eastern Shore they are used but their importance has not been adequately demonstrated. Yet in Delaware Bay, Stauber (1943), in the most extensive investigation of drills along the Western Atlantic, has apparently demonstrated that trapping together with other control activities can greatly increase yields. Stauber's unpublished manuscript, which has been extensively quoted and paraphrased by Carriker (1955), presents a comprehensive picture of the control and manipulation of drill populations in Delaware Bay and deserves the scrutiny of the large group of workers now investigating drills under the impetus of Saltonstall funds. It appears that Stauber's conclusions on control of drills can be summarized in three principles: (1) Continuous control measures must be applied by a majority of oystermen; (2) All of the control measures, that is cleaning grounds, trapping before and after planting, cleaning the seed of drills, destruction of egg cases, etc., must be used when indicated; frequent sampling of drill populations to establish the need for particular control measures is necessary; (3) The correct timing and sequence of these measures is essential.

If drill control is feasible in Delaware Bay, why can it not be applied in Chesapeake Bay? J. B. Engle of the U. S. Fish and Wildlife Service is now conducting experiments in Chesapeake Bay and on the Eastern Shore of Maryland in an attempt to answer this question. Meanwhile, numerous phases of the biology of drills, which although pertinent to their control are yet obscure, need to be studied. Among these are the age composition of the population, and the effects on control measures of type of bottom, availability of food, migration, and size of plot.

In most studies the age composition of the drills and recruitment to the populations have been ignored. Thus one of the best indices of the effects of control measures is unused. In fact no adequate method of assessing the density and status of drill populations has yet been developed. Reduction of drill populations has been measured in terms of the trends of successive catches obtained during control activities. These catches may be influenced by many factors of the environment and the true population level thereby masked.

Cole (1942) attempted to separate age-groups by dissecting length-frequency curves according to the freehand drawing method of Buchanan-Wollaston and Hodgson (1929). He apparently concluded that after an age of one to two years the annual increment in height is only two or three millimeters and that this estimate is confirmed by the distance between the growth marks on the tip of the shell bordering the siphonal canal. This may be correct but the attempt to separate age-groups with such narrow ranges of height seems precarious. Although he avoids the use of the term annuli, he apparently concludes that these growth marks are such. A clear demonstration of the meaning of these growth marks is needed. The near-absence of yearlings and sometimes two-year-olds in Cole's samples is remarkable also.

Perhaps the most confused subject in the biology of drills is the availability and choice of food. The kinds and amounts of food available for drill populations to use are probably quite incompletely known, yet the whole theory behind trapping is that of differential choice of available foods. For example, the extensive inshore areas covered with eel-grass may be important nursery grounds for Urosalpinx and to ignore this area in attempts to control drills on nearby oyster grounds may be shortsighted.

The relation of migration and size of plot in control activities is the basis of the experiment reported in this paper. The oyster industry of Virginia utilizes public and private grounds which are interlaced spatially throughout our tidal waters in an intricate pattern. We have many grounds of an acre or two which are adjacent to public grounds not attended in respect to drill control. What is the minimal size of oyster plots wherein drill control is feasible and migratory populations of drills less important than resident populations? Stauber indicates considerable success in controlling drills on 20-acre plots and believes that migration is secondary to the effects of the resident population.

Trapping Drills on Wormley's Rock

In 1952 a study was begun of the effects of trapping on the control of drills in a small plot. Wormley's Rock, an abandoned public ground which was long ago depleted and is prevented from recovering by failure of the set to survive, was chosen for the experiment. Much of the sponge-riddled shell, encrusting sponges and other debris which fouled the ground was removed by dredging for several days, but very few drills were caught in the dredges. Two adjacent plots of three acres each were defined by stakes and approximately 10,000 bushels of shell planted. Trapping was begun on the experimental plot in late April and continued almost weekly until October; the control plot was not disturbed. Eight lines each having eight traps were placed in the experimental plot with the traps 50 feet apart and kept as stationary in position as possible (Fig. 1). The trapping was done in 15 to 18 feet of water, and, in contrast to most similar experiments, traps were attached to a taut main line by 20 to 25 foot snoods. Thus each trap remained upon the bottom with a minimum of dragging until it was fished. Traps were fished, always at periods of slack tides, from small rowboats and records kept of the numbers of drills on individual traps. Adjacent to Wormley's Rock are private grounds which in the summer and fall of 1952 had a crop of large oysters ready for market. It was hoped that evidence of migration could be detected without the use of marked drills and that the data would be amenable to the statistical analysis applied to latin squares. However, the arrangement of traps in a latin square was specially planned to detect the movements of marked drills released in various concentrations and at locations within and outside the trapped plot. Unfortunately, the release of marked drills was deliberately withheld in the belief that their presence might complicate the analysis of the movements of the natural population. The use of marked drills, once deferred, was an objective never accomplished. Depletion of the drill population was an objective secondary to a study of drill movements but setting and survival of spat were observed on both plots as an indication of the practicality of trapping.

Approximately 9,000 drills, or an average of 152 drills per trap, were removed from the three-acre experimental plot in 1952. The catch per unit of effort (Fig. 2) indicates that Eupleura were much more available during

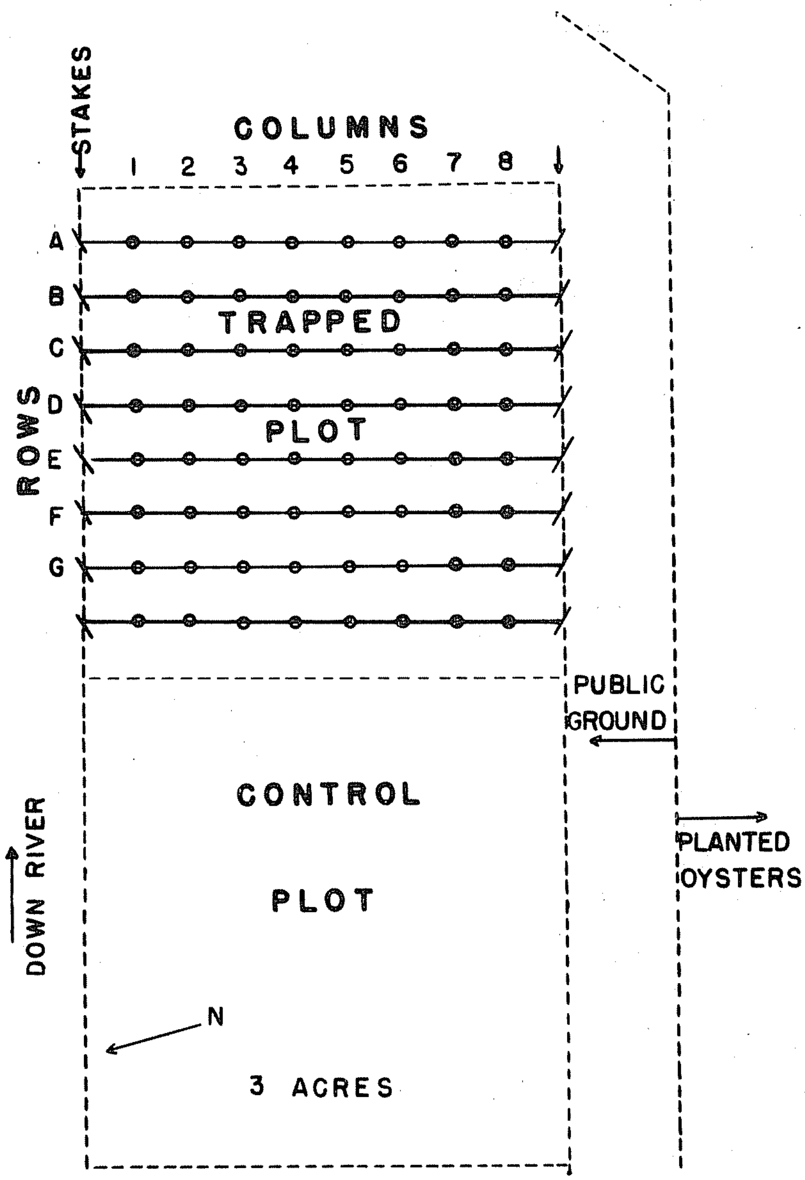

Fig. 1. A sketch of the drill-trapping experiment on Wormley's Rock, York River, Virginia, 1952. Eight traps were attached to each of eight lines (A to H) running at right angles to the current. Traps were approximately 50 feet apart.

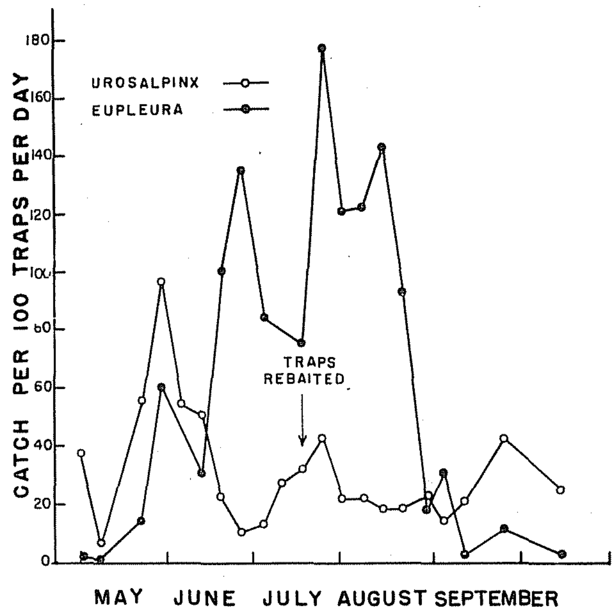

Fig. 2. The availability of drills on Wormley's Rock, York River, baited with seed oysters.

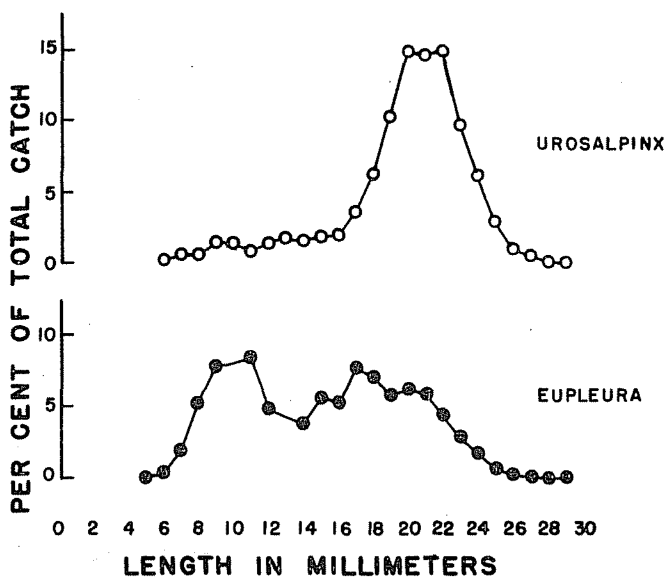

Fig. 3. The length-frequency distribution of all drills caught by traps at Wormley's Rock, York River, Virginia, May to October 1952.

the warmest months of the summer but that Urosalpinx were caught more frequently earlier and later in the season. The greatest catches of Urosalpinx occurred at the end of May when water temperatures exceeded 20°C. (Hewatt and Andrews, 1954), and preceded the peak period of egg-laying by almost a month. It is possible that drill activities were inhibited in early May by salinities which dropped to 11 parts per thousand at Gloucester Point, (Hewatt and Andrews, 1954). The catch of Urosalpinx did not seem to be greatly affected by rebaiting but the greatest catches of Eupleura came in mid-summer immediately after new bait had been put out. There was no clear evidence of depletion of either species of drill.

The catch of Urosalpinx consisted almost entirely of large drills over 15 mm. in height. Smaller drills, presumed to belong to the 1951 year-class, were very few in number. The length-frequency curve for all Urosalpinx shows a single mode at 20 to 22 mm. (Fig. 3). The early catches of Eupleura also consisted mostly of large drills but a distinct group of small drills entered the catch in mid-June. These small drills appeared suddenly in the catch of June 19 (Fig. 4) on row A with a total of 301 Eupleura as compared to 44 on row B which had the next highest catch. By June 26 the catch had increased in all traps but especially in rows B and C and column 1. Thus the catches increased in all the traps on the margins of the plot except those next to the control plot, and the catches were very high in the corner A8 nearest the private oyster grounds. The bimodal frequency distribution of Eupleura lengths persisted throughout the summer although the pattern of greater catches on the outside traps became less distinct. It is believed that these small Eupleura under 15 mm. were yearling drills of the 1951 year-class.

Drills of the current year-class did not appear until July 31 when a few Urosalpinx one and two millimeters in length were found but not included in the counts. It is probable that some current year-class drills were included in the later catches of September and October but small Urosalpinx were always scarce. Eupleura of the current year-class were either absent or not recognized as such. On Wormley's Rock there was little evidence that drills hatched in 1952 increased the catch in late summer.

The distribution of the total catch by traps from April to October is depicted by contour maps in Figure 5. For Urosalpinx a more or less linear decrease diagonally from the southeast corner (A8) to the northwest corner (H1) can be seen, and this is apparently related to the distance from the planted oyster beds. If it is assumed that the lowest catches, those found in the northwest corner, approximate a measure of the resident population, then this depleted ground sustained a meagre group of drills and migration appears to have been of considerable importance. The catch of Eupleura was greatest in the southeast corner but also high along all margins of the plot except that bordering the control plot. Again migration, although not measured, appears to have been of considerable importance.

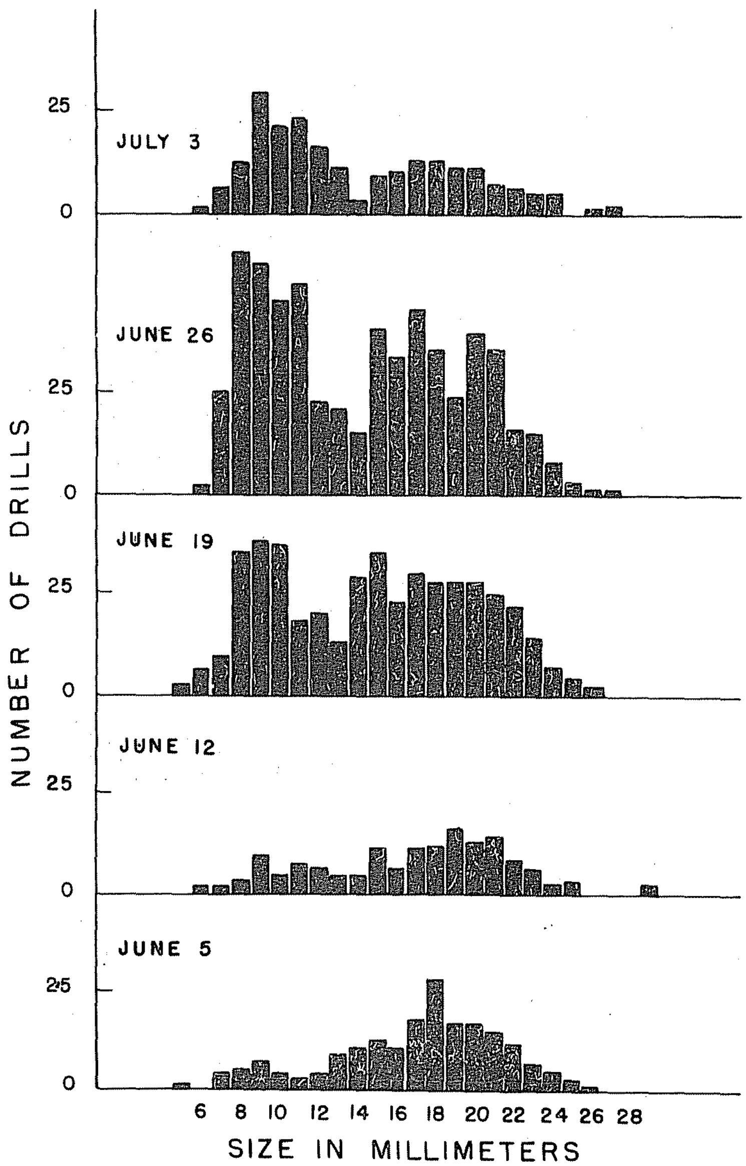

Fig. 4. The length-frequency distribution of Eupleura in successive weekly catches at the time of the sudden appearance of small drills.

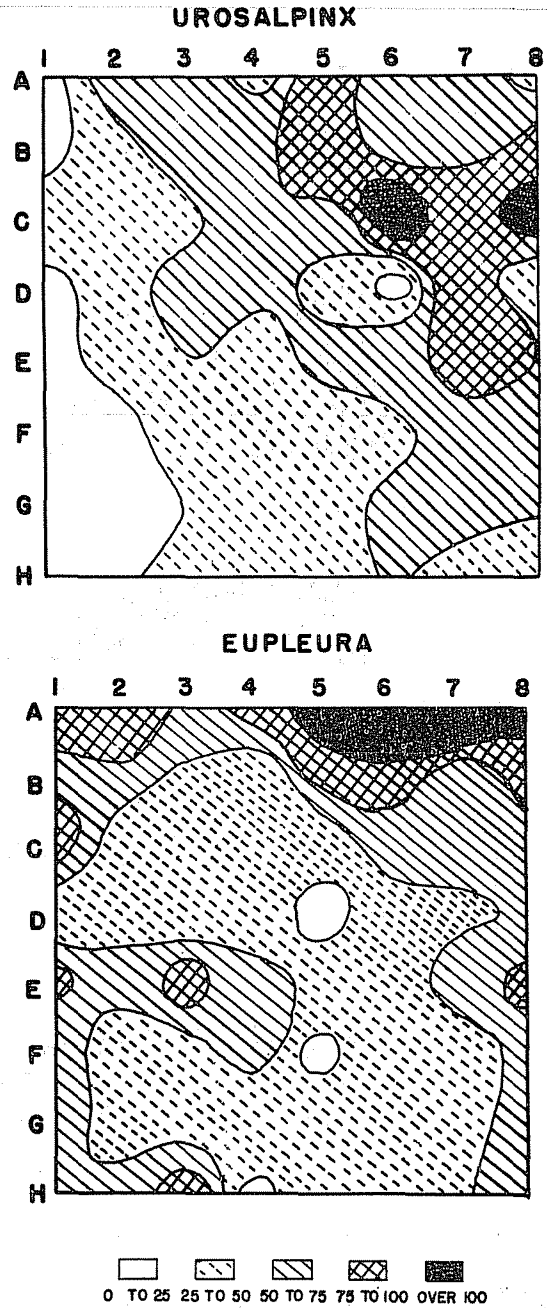

Fig. 5. The distribution of total catch of drills per trap from May to October 1952. The number of drills is indicated by the symbols.

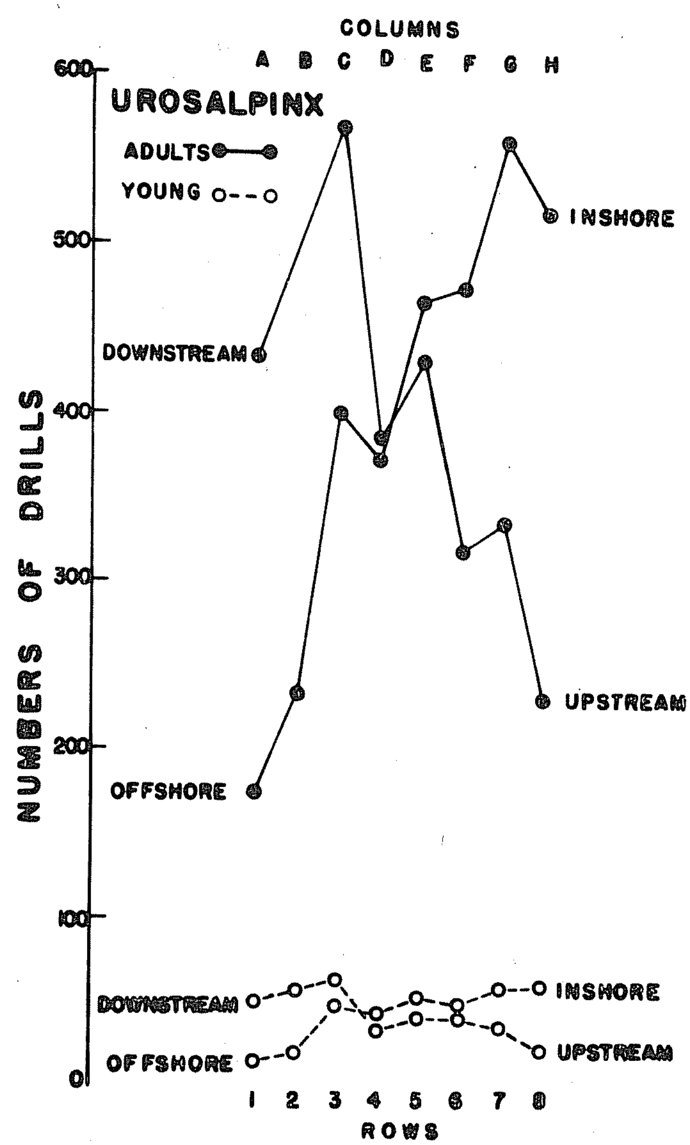

Fig. 6. The distribution by columns and rows of the seasonal catch of adult and young *Urosalpinx* in respect to position upstream, downstream, inshore, and offshore.

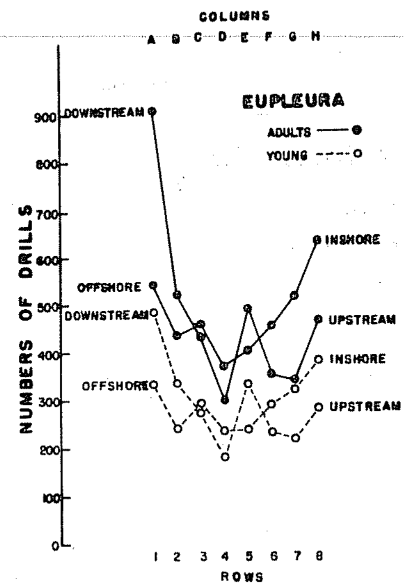

Fig. 7. The distribution by columns and rows of the seasonal catch of adult and young Eupleura in respect to position upstream, downstream, inshore, and offshore.

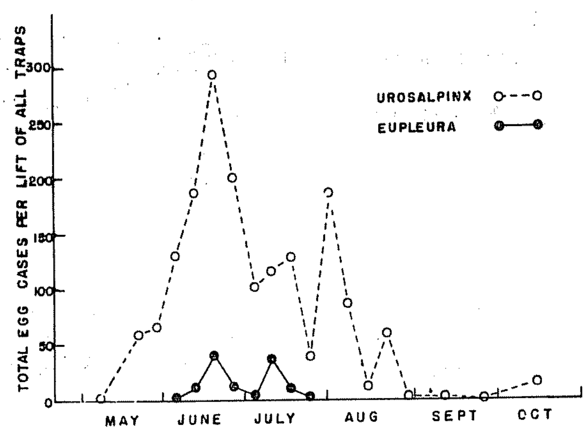

Fig. 8. The seasonal spawning patterns of drills as indicated by counts of egg cases.

Table 1.

The ratio of Urosalpinx and Eupleura caught in traps in Virginia. Traps were fished weekly or monthly and rebaited occasionally.

Date	Location	Number of Urosalpinx	Number of Eupleura	Percent of Eupleura
	York River			
June to Aug. 1943	Wormley's Rock	603	250	29.3
June & July 1948	Wormley's Rock	198	61	23.5
April to Oct. 1952	Wormley's Rock	3342	5813	63.5
	Gloucester Point			
July 1953 to Nov. 1955	Laboratory pier	7343	332	4.3
July 1953 to Nov. 1954	Burke's pier	1651	49	2.9
July to Nov. 1953	Ferry pier	77	8	9.4
July 1954 to Oct. 1955	Off end of			
	Laboratory pier	456	15	3.2
June to Sept. 1942	Hampton Roads			
	Darling's ground			
	Plot 11	1035	126	10.9
	Plot 18	1318	31	2.3
	Plot 20	144	97	40.2
	Ballard's ground			
	Plot A	6851	3956	36.6
	Plot A1	683	286	29.5

A diagram of the distribution of total catch by rows and columns is given in Figure 6 and 7. Small drills under 16 mm. in height, assumed to be young of the year, are given separately. Large and small Eupleura occurred in approximately equal numbers but large Urosalpinx greatly exceeded the small ones in abundance. The catch of large Urosalpinx was much higher downstream and inshore but there was no apparent difference in the small ones. Although the catch of Eupleura was highest downstream and inshore, there was a tendency in both size groups for all borders to have higher catches than the middle of the plot.

According to the literature, Eupleura is comparatively rare, and its predominance in the catches from Wormley's Rock was unexpected. During 1952, Eupleura comprised 63 percent of the catch and the highest percentage for one week's catch was over 93 percent. In Table 1 the sporadic occurrence of Eupleura is suggested; it has been comparatively abundant on Wormley's Rock for many years but is scarce on the sandy shores at Gloucester Point. In Hampton Roads (Newcombe and others, unpublished data) the catch of Eupleura varied with the plots fished, age of the bait and the season. For example, in 1942 on Plot A of Ballard's Ground on Hampton Bar, 46 traps fished on August 10 yielded 15 Eupleura or 2 percent of the drills caught. Rebaited on August 12 and set in a new location on the same plot, 62 traps caught 2,295 Eupleura a week later or 56 percent of the total catch. At the same time traps on another plot (Darling's No. 18) were rebaited but not moved to new locations and these caught no more than 4 percent Eupleura either before or after rebaiting. McHugh (1956) has suggested that Eupleura responds much more quickly to new bait than Urosalpinx. This has been noted also in trays of newly-transplanted seed oysters placed on the bottom at Gloucester Point.

Egg deposition by Urosalpinx began in mid-May and reached a peak in mid-June; some eggs were laid throughout the summer (Fig. 8). Eupleura in contrast, deposited very few egg cases on the baited traps and these were laid in a relatively short period in June and July. All egg cases were removed manually from the baited traps each week.

Discussion

The catch on Wormley's Rock in 1952 of 152 drills per trap, both species included, is much lower than those reported from other areas (Carriker, 1955). Stauber (1943) considered that a catch of 100 drills per trap per season justified trapping from the standpoint of cost but he caught as high as 760 per trap at the beginning of seven years of continuous trapping and 50 per trap at the end of the experiment. Based upon large numbers of drills trapped from a 20 acre plot, he reported densities of nearly five drills per square meter at the beginning and about 0.12 at the end of the experiment. He considered the lower density to be about the minimum level of drill abundance which could be produced by trapping. In the first year of trapping on Wormley's Rock the density of Urosalpinx, per square meter, based upon the total catch from the three-acre plot for the year, was only

0.28 and this includes drills which migrated into the small plot. If both species are included the density still remains below 1.0 drill per square meter. Although these counts are minimal estimates since not all drills are caught, it appears that prior to the manipulations of the experiment, Wormley's Rock may have sustained a very small population of drills, perhaps not subject to much further depletion. While the object of the Wormley's Rock experiment was not primarily to deplete the drill population, it should be noted that Stauber apparently reduced abundance by the use of 25 traps per acre in the early years and 10 traps per acre in the later years. About 21 traps per acre were used on Wormley's Rock, and, as in Stauber's experiments, there was no evidence of depletion of drills the first year.

Stauber (1943) found that in Delaware Bay the peak catches of Urosalpinx occurred in late April or May when temperatures were between 10 and 15°C., and that after temperatures exceeded 15°C. egg deposition began. In Virginia in 1952 the pre-egg-laying activity described by Stauber occurred in late May at temperatures exceeding 15°C., and egg deposition began in the last half of May when temperatures were above 20°C. Thus in Virginia drill movements and reproductive activities occurred later in the season and at temperatures approximately 5°C. higher than those observed in Delaware Bay. These observations, for one year only, confirm those of Federighi for Hampton Roads (1931), and agree with Stauber's tenets that according to the latitude of the region physiological "species" of drills exist with different critical temperatures for spawning and other activities.

On Wormley's Rock the season of activity for Eupleura was shorter and may have been limited in the spring by temperatures. In September, however, when water temperatures were about 25°C., the low catch of Eupleura may have been related to the sets of barnacles and oysters which occurred. Late deposition of eggs and maximum catches in the warmest part of the summer have led to the impression that Eupleura prefers a warmer climate than Urosalpinx.

The relative importance of resident and migratory drill populations was not resolved in this study for the evidence of migration is circumstantial and quantitative data are lacking. Although one may doubt that drills would leave an established population of oysters on the private grounds to migrate to 64 traps on a barren ground, the planting of 10,000 bushels of clean shell on the public ground with all the fouling organisms attracted thereby, could easily have provided the stimulus for migration. Without marked drills to confirm migration, however, this planted shell added confusion to the experiment in so far as the study of the resident population of drills is concerned. The evidence for immigration of drills on the trapped plot is derived mostly from the distribution of catches. For Eupleura, which was caught most heavily on the marginal traps, it might be argued that these traps fished a larger area than those in the center of the plot. The observations that Eupleura appeared suddenly in the marginal traps and that later catches became more uniform over the plot suggest that area fished was not the sole factor involved.

Shells from the two plots never had any appreciable set of oyster spat although shells suspended off the bottom in wire bags did have a fair set in early September. Unfortunately, setting observations were not pursued diligently enough to determine the cause of lack of survival of set. Survival of spat on the two plots was to have been a measure of the practicality of drill trapping. A sample of shell dredged from the experimental plot in the spring of 1953 contained no spat.

After rebaiting traps Stauber (1943) also reports a big increase in the catch of drills during the summer when temperatures were rather steady. He does not refer to the preference of *Eupleura* for new bait which has been so striking in Virginia waters at times. Detailed studies of the food preferences of *Eupleura* have not yet been made, but with the knowledge that *Eupleura* is the most abundant drill on some grounds, it can no longer be treated as another casual predator similar in habits to *Urosalpinx*. Lack of data on distribution makes it impossible to estimate the importance of *Eupleura* in Virginia waters. The appearance of approximately 37 *Eupleura* per trap on Hampton Bar one week following rebaiting indicates that the population of this predator is not negligible on this large oyster-producing area. The rather scattered data suggest that *Eupleura* may be on the increase in Chesapeake Bay; on the other hand, as Carriker suggested, this may be a cyclic response to factors such as temperatures and salinities. It has been observed that *Eupleura* tolerates more mud on the bottom than *Urosalpinx* and Wormley's Rock does tend to be a little muddy despite its basically shelly bottom. The bottom in front of the Virginia Fisheries Laboratory at Gloucester Point, which has few *Eupleura*, is almost pure sand that shifts during storms.

In addition to preferences as to type of bottom and food, *Eupleura* may exhibit differences in habits such as less tendency to climb. We have never found *Eupleura* on the pilings of local piers where *Urosalpinx* is abundant, yet they will climb up on oysters in traps. The near absence of *Eupleura* egg cases on the traps in the presence of so many adults is puzzling and suggests that they do not seek out elevated objects for egg deposition with the same avidity as *Urosalpinx*. The occurrence of small numbers of young *Urosalpinx* in an area where egg cases are fairly abundant, and the great abundance of young *Eupleura* in the presence of few egg cases, although the two relate to different year-classes, are situations which seem perverse and indicate that certain important factors remain concealed in the trapping studies. Even if nearly all the small *Eupleura* caught on Wormley's Rock migrated from adjoining grounds, it is still inexplicable why small *Urosalpinx* did not migrate also.

Summary

The usefulness of trapping cannot be properly evaluated because adequate procedures to estimate populations have not been developed. At present the effects of trapping are inferred by observing seasonal or annual trends in the catch.

The relative importance of migratory and resident populations of drills in the predation of oysters, particularly on small plots, is unresolved. One year of trapping on a three-acre plot on abandoned public grounds suggested that considerable migration occurred. *Eupleura* was much more abundant than *Urosalpinx* in the catches. The greatest catches of *Urosalpinx* were in late May immediately before egg deposition, and *Eupleura* were most available during the warm months of June, July, and August.

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