PROGRESS REPORT NO. 23

RAZOR CLAM INVESTIGATION
January thru April 1951

General

On December 31 Mr. Donald Twohy left the investigation and returned to Oregon State College to complete work on his Master of Science degree and Mr. Charles Woelke was transferred from marine fisheries to assume Mr. Twohy's duties.

During the one good tide series in January several random digs were made, condition factors (dressed weights) were taken, screening was done 1.3 miles north of the wreck of the Peter Iredale, stadia readings were taken for contour studies, commercial shell samples were collected and several plankton tows were made. The remainder of the month was spent finishing work on the past season's plankton tows and measuring commercial shell samples collected last fall.

The first part of February, Mr. Twohy came up from college to help with the field work for several days during the only good tide series of the month. The field work followed the same pattern as that done in January. The remainder of February was spent working up the razor clam statistics from 1941 through October of 1950 for the statistical bulletin. A few days were spent finishing up measurements on the commercial shell samples.

The annual change over from evening to morning tides during March resulted in poor tides for the month and as a consequence only moderate success was achieved at both screening and random digging. During the latter part of the month a low surf permitted some fairly good digging. Plankton tows and some counts of sport diggers were taken.

With both the staff meeting and the P.F.B. meeting taking place during March, lab work was somewhat neglected. Mr. Twohy came up from Corvallis for several days between winter and spring quarters and the method to be used in aging of shells was thoroughly discussed. Since then most of the free time has been spent taking edge to check measurements and aging the commercial samples and random digs. The random digs have been measured and aged through March of 1951. The commercial shell samples have been aged (200 shells per tide series)through July of 1950 and measured through March of 1951. These data have all been forwarded to Mr. Twohy for incorporation into his paper on the razor clam which is to be completed in the near future.

Unusually fair weather during April made for ideal field work conditions and every opportunity to collect data was utilized. Excellent random digs were made, sport census work was begun in earnest, screening was brought to a close, since the 1950 year class is now too large for successful screening (random digging shall now be done to follow the growth of the year class through the fishery), stadia readings were taken, plankton tows were made, and commercial shell samples were collected. Work was also started toward finding how much wastage of razor clams occurs.

Transit Work Program

General Theoretical Discussion of Razor Clam Availability

There has been some suspicion that the razor clam population could biologically be in excellent condition while both commercial and sport diggers would do very poorly. Regardless of the overall condition of the stocks the factor of greatest importance to the public lies in the clams harvested. It is of extreme importance from the management aspect to determine if a poor harvest could possibly be due to factors other than a corresponding condition of the stocks.

Assuming that the stocks are in good condition the presence or absence of clams in the digger's bag becomes a function of availability. Availability to the digger is a result of many factors which may be broken roughly into two categories. First of all the clam beds must be accessible to the digger and secondly the clam must betray his position by some visible means, either by "showing" in the surf or causing a "sink hole" to be formed on the exposed beach. Causes for the action of the clam which makes his position known are not too well understood. Speculation runs rampant in efforts to explain this situation.

Some of the more plausible answers offered by local inhabitants are as follows. The amount and possibly types of food present may be influential, since the clams seem to show well during heavy plankton blooms which the diggers call brown or dirty water. The stage of the tide appears to be significant in that after the change of the tide the clams stop "showing" in the surf and at this time the greater share of the commercial diggers leave the beach. In general clams will show best on the build up toward the lowest tide of a series (for example when over a period of successive days the tides are 0.0, -0.5, -1.0, -1.3, -1.5, -1.4, -1.0, etc. the best digging seems to occur on the first four days, even though the tides on the two following days will be lower). Some commercial diggers feel that this is due to the clams either staying deep in the sand, or not showing due to the previous day's digging activities. In any event clamming is often significantly poorer on the last half of a low tide series. The clams on occasions are said to be excellent weather forecasters in that often for several days preceding a heavy storm they will show poorly.

All of these and many other explanations have varying degrees of merit, however, none of them appear to be necessarily the complete and final answer. As yet little has been done to explain these reactions of the clam itself other than to make general notations as to weather conditions, surf conditions, etc., when digging or interviewing diggers for digger census work.

Work is being done on the actual availability (or accessibility) of the clam beds to the diggers. Marking experiments here in Oregon as well as in Washington would seem to indicate the tremendous mobility of the razor clam is restricted primarily to a rapid descent to a depth which places many amateur diggers in an ungracious position on their knees with head down, arm and shoulder in the sand and with their posterior portions exposed to a most relentless surf. From these marking experiments it would seem that once the free swimming clam larvae have settled down and taken on the adult mode of life, we can expect them to move but very little on their own initiative within a restricted area. This of course is under normal conditions, there are some indications that storms of unusual magnitude may cause a "washing out" of clam beds which quite probably either destroys or redistributes the populations.

Beach Changes

In bays and inlets where flat sand beaches occur one will observe row upon row of riffles on the surface of the sand where the gradient of the beach is slight. These same ridges or riffles occur on flat sandy bottoms on the continental shelf but on a larger scale and carry right in to the shore in the form of bars. These bars would seem to shift in toward the beach during periods of relatively calm surf through a process of erosion from the seaward side and deposition on the top and shoreward sides of the bar. However, as the inner beach is reached, this shoreward march of bars is stopped by the increasing gradient of the beach, thus the beach "builds up" and takes on an increased or irregular slope which sometimes results in a narrower beach. This building up also results in "offshore" bars being built up to a height which causes them to be exposed on very low tides. These bars are referred to as "boat bars" by the fishery. It is apparent however that if nature is to maintain a reasonable balance, what goes up must come down. Therefore, when the heavy fall storms occur, vast quantities of sand are redistributed seaward by the receding surf. The result is a leveling of the beach. This is merely a theoretical explanation but bars do occur--the gradient of the beach does change--and the width of the beach changes.

Summation

Now, if we accept that: 1. The clams migrate little after setting; 2. the beach builds up and becomes narrow and forms offshore bars on some occasions and is leveled out and becomes broad on others; then we can surmise that a steep gradient on a narrow beach will prevent the diggers from reaching as far out from the high water line as they may at a time when the beach is broad and level. This change of gradient may have a tremendous effect on the availability of the clams at any one time and the subsequent apparent abundance of clams to the diggers. It may further be added that if this is the condition that actually exists any program of intelligent management must be fully aware of the nature and significance of the changes in availability of clams as related to those changes in beach contour. These changes could very well act in such a manner as to restrict digging over much of the year and act as a check against serious over-exploitation of the total population. (This is not to say that the available inner beach population may not be "dug back", but that the population as a whole is so placed as to prevent this situation from being representative of the entire stock.)

Introduction to Actual Transit Work

With these various beach changes in mind the razor clam investigation set out on a program designed to measure these changes and determine the significance if any of these changes in relation to the razor clam population. It is also hoped that in the near future a study may be made on the aforementioned boat bars, which at certain times of the year seem to support a good share of the commercial digging, to determine whether these bars eventually become available to the sport fishery or whether the two fisheries tend to operate on two different portions of the populations during some parts of the year.

Materials and Methods

For these aforementioned purposes a low priced transit was purchased, a stadia rod made and a 100 foot steel tape procured. Six 10-foot lengths of one and 1-1/2 inch pipe were driven into the sand as markers. The method followed was to drive one pivot stake (Fig. 2) above the high water line from which the rest of the stakes were oriented. An additional stake was placed above the high water mark as a precaution against the possible loss of the first stake. A series of two (including the pivot stake) or more stakes were placed in a line toward low water to insure taking the contour of the same section of beach at all times. Distances were measured and angles taken between all stakes plus angles on at least one permanent land mark such as a house, flag pole, street end, etc. Though stakes are lost with discouraging regularity due to tourists displaying their brute strength, washing out from surf action, or being buried in the sand due to the sand building up on the beach, these angles and measurements make it possible to replace any or all lost markers so long as one stake remains in place.

Six areas of this type have been set up on the Clatsop Beaches for study (Fig. 1). One of these areas was completely lost (0.3 mile north of the Necanicum River) due to a northward shift of the river last winter. Originally it was hoped that monthly readings could be taken on each strip, however, this has not been possible (Table 1). The program has been in operation since last August and as yet there are not sufficient data to show any conclusive results, however, definite measurable changes do and are occurring on the beach and it is hoped that when a full year of data have been accumulated some significant information will be on hand.

Procedure

In actual operation the transit is set up at the upper or pivot stake, No. 2 in Fig. 2, and the lense is centered on stake No. 3, the instrument is then leveled. The height of No. 2 is taken in order to determine the change of the sand level in reference to previous readings (this will enable us to detect any gross changes in the level of the upper beach as well as plot all readings with reference to the same date and the sand level on that date). The height of the transit lense is recorded, then one person paces down the beach with the stadia rod and readings are taken to the nearest 1/8 foot at 100 foot intervals from the transit, the person carrying the rod places a "pin" as a marker in the sand at each point a reading is taken. Since the distance is known between the stakes a correction can be made for variation in the pacing. When the rod drops out of the reader's line of vision the transit is moved to the pin marking the last reading taken, the height of the transit is again taken and the readings are continued on down the beach and into the surf as far as the rod carrier's courage will permit. The distance from the starting point to the edge of the surf is also recorded.

In working up the data in the lab the method shown in Table 2 is followed. The elevations shown in the right hand column, which have been corrected to the 10/25/50 sand level are plotted (Fig. 3).

Results and Discussion

Figure 3 is the graphic picture of the Gearhart strip to date. With the exception of the first set of readings the height of the tides are quite comparable and all readings have been taken within one hour of low water. It is of particular interest to note the wide range of distances reached beyond No. 2 stake on the various dates. Though the range of the tide on the last seven sets of readings has been only 0.3 foot (-0.8 to -1.1) the distances involved ranged from 600 to 1200 feet. This shows that the actual area available to the diggers has varied by 100 percent during the past ten months. It must be noted that these distances in themselves are not completely reliable, since the surf conditions on the various dates were not the same and this factor plays a significant role in determining just how far one can go out on the beach. In the case of the actual drop in elevation from No. 2 stake however the surf does not act as a controlling factor so far as actual data collection are concerned and probably for the purposes of this discussion will better show the actual beach change. The shifts in position of the -10 and -15 foot levels have been plotted on Figure 3 to show how these levels are affected by the change of beach contour. These two levels may have little direct influence on the actual digging of the adult clams, but if the larvae set on definite levels of the beach the location of those levels is very important. If the clams should habitually prefer to set at the -15 foot level and this level happens to be only 700 feet from high water during the setting season then we might expect these clams to be readily available to the fishery on nearly any reasonably good tide. On the other hand if the set should occur when the -15 foot level was 1,000 feet from high tide then they would be considerably less accessible. Data gathered by random digging indicates that the greater portion of the current population in this particular area is located from the 1,000 foot line on out. In any event it is evident that there is a definite change in the general character of the beach after the first fall storms, which occurred the first week in October, for previous to that time the beach had a rather irregular contour whereas after this date and through the winter months the beach had a fairly even gradient. The March and April readings are beginning to show an irregular plot again.

Recommendations:

Strip digging should be done directly adjacent to the contour study areas before any definite statements can be made as to how close a relationship exists between these observed changes in the beach and the availability of the clam population. A base line should be established between the strips so that the various levels of each strip may be compared with that same level in another in absolute values. The study of one or more of the off-shore bars should be made as soon as possible. If the hoped for results are achieved with this program a valuable tool will be available for utilisation in any future regulation of the razor clam fishery.

Review of 1950 Plankton Work

The plankton tow program inaugurated in 1949 was continued through 1950 to further study the early life history of the razor clam. The primary objectives held in mind were to set the spawning season, more definitely identify the larva and obtain a series of clams from the earliest possible stages through to the adult organism.

Methods and Materials

Tows were taken with a parachute silk net of about 70 meshes per inch, or a mesh size of between 5 and 6 (Sverdrup, Fleming and Johnson, 1942)*. All tows were preserved with 10 percent formalin upon returning from the beach.

Due to the routine of the summer work the tows were nearly all taken about 1-1/2 to 2 hours after low water in conjunction with temperature and salinity samples. When possible tows were taken at Seaside (usually 12th Avenue), by the Gearhart and Sunset Beach entrances and just north of the wreck of the Peter Iredale. These tows ranged from five to ten minutes in length and were as a rule taken by walking through knee-deep surf holding the net by the hoop at the mouth. To avoid fouling the net with sand stirred up about one's feet, the hoop was held slightly ahead of the body. In taking these tows the best results were obtained on the lee side of a bar where there is usually less sand being thrown about by the surf.

The tows were quickly scanned upon return to the laboratory and as a rule five bivalve larvae were removed and preserved in Bouins solution for possible sectioning and mounting at some future date. Then, the tows were preserved in formalin for later gross study.

When time permitted all tows were given a more careful check and

*The Oceans, Sverdrup, Fleming and Johnson, 1942.

finally a series from Seaside and Gearhart were exhaustively examined and every larva found was separated out for further observation. These larvae were then measured on their anterior-posterior axis (length) and dorso-ventral axis (width—actually depth). During the measuring process the larvae were roughly classified into seven types (Fig. 4) on the basis of general outline, size, special characteristics and stage of development (i.e. straight hinge, umbo, etc.).

From these larvae, dead shells collected in the September 1, 1950 tow at Sunset Beach and the August 29, 1950 screening sample from 1.3 miles north of the Peter Iredale, a series of larvae and shells were selected for mounting in Karo syrup and subsequent photographing.

Results

Table 3 is a summary of all the plankton tows taken in 1950. Of the 57 tows taken, all were checked with varying degrees of care as indicated on the table, ranging from 10 to 15 minutes of rapid scanning to several hours search (25 of the tows) in an effort to remove and save every larva from the sample.

No bivalve larvae were found prior to May 25, 1950 and none were found on October 23, 1950. Between these dates larva were present in all but five of the tows. Larvae were most abundant between June 7 and August 8. Table 4 shows the frequency of occurrence of all types of larvae saved between these dates. Prior to and following these times less than five larvae were found per tow and they were all preserved in Bouins solution making it impossible to measure or type them.

As mentioned previously the bivalve larvae were roughly broken into seven types. The next step was to single out from the 268 larvae measured, those of the S. patula. Type 1 were first removed from the picture when they were fairly conclusively shown to be the larva of <u>Mytilus</u> sp. This conclusion was reached after comparisons were made with the photos of larva of this genus Sullivan (1948)*. The length-width data taken were plotted (Fig. 8A) to further establish the homogenity of these larva and as one might expect they fell into a very definite pattern. One may also note in respect to these larva that they did not appear in the tows until June 22.

Further examination of the larval types led to the suspicion that No. 4, 5, and 7 were but various stages of development of the same species with No. 7 the straight hinge, No. 5 the early umbo and finally No. 4 the late umbo stages. Again comparison with Sullivan (1948) showed a marked similarity to those of the Atlantic Coast relative of S. <u>patula</u>, <u>Ensis directus</u>. Type No. 7 may be compared to photos 1 and 2, stage No. 5 to 3 to 5, and No. 4 with 6 and 7 on plate VI of Sullivan's paper. Comparison with photos of larvae from Washington beaches gave additional evidence of strong similarities.

As with Type 1, 4, 5, and 7 were plotted (L-W) with the results shown in Figure 8B, these plotted data would seem to further corraborate the visual similarities of these larva. Though the dates of occurrence of types 4, 5, and 7 do not follow the exact pattern one would expect to see (Table 4) in that No. 7 reaches its peak abundance (in relation to other larva occurring in the tow) about the same time as No. 5, it should be noted that these were the smallest and most difficult to find as well as the most fragile, thus the shells were more subject to destruction from the formalin preservative which unfortunately was not neutralized. However, the relationship of No. 4 to No. 5 would seem to be in accordance with the pattern of development and mortality in that the peak of abundance is earlier

*Bivalve larvae of Malpeque Bay, P.E.I., Charlotte M. Sullivan, Fisheries Research Board of Canada, Bulletin No. 77, Ottawa, Canada, 1948.

and of greater magnitude than that of No. 4. Also the appearance of No. 5 precedes that of No. 4 by about one month except one in the June 7 tow which was only a shell and not a complete larva.

If we accept No. 1 as being Mytilus sp. and 4, 5, and 7 as S. patula larvae, the former represents 12 percent of the larva collected and the latter 71 percent for a total of 83 percent of the total taken in the tows inspected, which would be the expected picture since these are the two dominant bivalves of the area.

It should be noted that during the course of the summer's work several small shells found in screening operations were identified as those of Pecten sp. Also occasional shells of adult Macoma sp., Schizothaerus nuttallii and Tellina bodegensis may be found on the Clatsop beaches. Live adults of Tellina and Macoma have been found in the area just inside the mouth of the Necanicum River. No live specimens of S. nuttallii have been encountered as yet, though they are reportedly found in the rocky area between the "cove" and tip of Tillamook Head. A careful survey has yet to be made to determine exactly what species of bivalves do occur in the area. However, the remaining 17 percent of the larva probably represent some or all of the aforementioned species.

From dead shells, screening results and plankton tows a series of positive prints have been made. The size range was from 750 u to 9.7 millimeters. The 9.7 millimeter shell was obviously a juvenile razor clam (from comparison with the adult). Using the radiating rib just anterior to the hinge ligament, hinge teeth, the thin "bill" or "ridge" just posterior to the hinge ligament, "circuli like" striations or ridges on the smaller clams plus the aforementioned plotting of types 4, 5, and 7 the series was filled in from the larva thru the post larva to the juvenile clam.

It should be noted that no live clams were taken between 750 u and about 4 millimeters, the shells used for photos between these two sizes were taken in the plankton net off Sunset Beach on September 1, 1950. At this size the clams seemed to have settled to the bottom and given up an active planktonic existence, but were still so small as to wash through the 16/inch mesh wire screen used for finding the small clams after they have set. This in-between size is the weakest link in the whole series and it is at this stage that nearly all of the aforementioned comparative characteristics were utilized to assure correct completion of the series.

Discussion

In view of the fact that no bivalve larva were found prior to May 25, 1950 it would seem that the first spawning occurred sometime during the latter half of May. Since the tows are only qualitative and in no sense quantitatively comparable one can only infer relative abundance between the several types of larva in the tows and the dates of their occurrence. Even these factors however provide some interesting possibilities. As previously pointed out the low number of type 7 larva early in June could be explained by the difficulty of finding them as well as their delicate nature plus the damaging affects of the formalin. If this be the case then the small numbers of No. 7 larvae in respect to the subsequent numbers of No. 4 and No. 5 types may not be as inconsistent as they first appear to be. Assuming that No. 7 larva are those of S. patula, no definite date for the first spawning can be stated, however, it would appear to have lasted until sometime around the first third of June. A second spawning would seem to have taken place in the middle or the latter half of July; however, again this apparent situation could be due to the failure to find the larva even though they were present in the tows in small numbers over the entire period. In any event there are fairly definite indications that during the summer of 1950 the spawning was spread over a period of six to eight weeks, whether this was a continuous spawning or an interrupted one can not definitely be stated. This same picture may be derived by taking the No. 4 or No. 5 larval types. Again one must be cautioned that until further studies are made these types of larva must still be only tentatively considered as being those of S. patula even though the circumstantial evidence would indicate this to be the case. Future sectioning of the gonad samples taken through the season and preserved should aid in clarifying the situation somewhat. Until this is done one must assume on the basis of the plankton tows that the spawning started sometime in mid-May and continued until mid-July, the magnitude of the spawning being entirely unknown, though there in all probability were two peaks of spawning with a small dribble occurring between these peaks.

Summary

In summarizing one may say that the 1950 plankton program was moderately successful in the accomplishment of its original objectives, though it leaves much to be desired.

On the credit side it would appear that the larva of S. patula has been fairly successfully identified and a good series of early stages have been collected and mounted.

On the less successful side we must place the spawning season since the data are lacking insofar as the establishment of the beginning and ending of the spawning season as well as the indication of the time at which the peak (if any) of spawning occurs.

Recommendations

In view of the fact that in the future both the time and the personnel may not be available to carry on quite such an intensive plankton program and also with an eye toward further increasing the information now on hand the following recommendations are tentatively made:

1. One plankton tow per week at one station rather than four as in the past season, to begin in mid-April.

2. If possible take a series of tows at one or one-half hour intervals over a tide cycle to determine the optimum time for taking the tows.

3. Devise some method of taking quantitative tows so that the season's data will be comparable. Possibly some sort of rack could be made to hold the net while a measured volume of water was poured through it (here again some sort of cycle or series of samples made to find the volume of water necessary for an adequate sample).

4. Further effort should be expended to collect live specimens between 750 u and 3.5 mm.

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Aquatic Biologist.

Table 1

Summary of Contours Taken Through April 25, 1951

Area I	Area II	Area III	Area IV	Area V	Area VI
8/17/50	8/17/50	8/28/50	8/25/50	8/28/50	8/28/50
9/12/50	9/14/50				
10/24/50	10/25/50	10/24/50		10/23/50	10/23/50
	11/8/50		11/8/50		
1/5/51	1/5/51	1/5/51			1/5/51
	2/3/51		2/3/51	2/3/51	2/3/51
	3/6/51				3/6/51
	4/25/51	4/24/51	4/26/51	4/26/51	4/25/51

Area I   0.3 miles north of the Necanicum River
Area II   2.0 miles north of Gearhart entrance
Area III   1.5 miles north of Sunset Beach entrance
Area IV   Off 9th Avenue in Seaside
Area V   1.0 miles south of the Peter Iredale entrance
Area VI   1.3 miles north of the Peter Iredale entrance

Table 2

Method Followed in Working up Stadia Readings for Plottings

Distance from Stake No. 2	Stadia Readings	Elevation from No. 2	Elevation from 2 in Reference to the 10/25/50 Sand Level
Hgt. of trans. @2	4'	0	-1/2'
100'	6-1/8'	-2-1/8'	-2-5/8'
200'	8-3/4'	-4-1/4'	-5-1/4'
300'	11-1/8'	-7-1/8'	-7-5/8'
Hgt. of trans. @300'	4-1/8'	-7-1/8'	-7-5/8'
400'	6'	-9'	-9-1/2'
500'	8'	-11'	-11-1/2'
600'	9-1/2'	-12-1/2'	-13'
700'	9-5/8'	-12-5/8'	-13-1/8'
800'	9-5/8'	-12-5/8'	-13-1/8'
900'	11'	14'	-14-1/2'
Hgt. of trans. @800'	4'	-12-5/8'	-13-1/8'
1000'	7'	-15-5/8'	-16-1/8'
1050'	8-1/2'	-17-1/8'	-17-5/8'

Area II
Date: 4/25/51
Time: 9:20 a.m.
Low Water: 9:25 a.m.

Hgt. of No. 2 stake 4/25/51	3-3/4'
Hgt. of No. 2 stake 10/25/50	3-1/4'
Correction for change of sand level	-1/2'

Table 3

Summary of all Plankton Tows Taken in 1950

Date	Where Tows Were Taken: Seaside	Gearhart	Sunset Beach	Peters Iredale	Misc.	Total No.
3/31/50	x	x	x	x	x at So. Jetty	5
4/25/50	x(3)					3
5/23/50					x Crab Boat off So. J.	2
5/25/50		$\underline{x}l$	xl			2
5/30/50		xl	$\underline{x}$			2
6/4/50	$\underline{x}l$(2)					2
6/7/50	$\underline{x}l$(2)					2
6/11/50	$\underline{x}l$(2)	$\underline{x}l$				3
6/13/50	$\underline{x}$					1
6/22/50					$\underline{x}$ Seaside Aquarium (2)	2
6/27/50	$\underline{x}l$	$\underline{x}$	$\underline{x}$			3
6/30/50	$\underline{x}l$	$\underline{x}$	$\underline{x}$	$\underline{x}$		4
7/3/50	$\underline{x}$	$\underline{x}l$	$\underline{x}$	$\underline{x}$		3
7/13/50	$\underline{x}$	$\underline{x}l$	$\underline{x}$			3
7/19/50	x	$\underline{x}l$	x	$\underline{x}$		4
7/27/50	$\underline{x}l$	$\underline{x}$	x			3
8/2/50	$\underline{x}l$	x	x			3
8/10/50	$\underline{x}l$(2)	$\underline{x}l$(2)	$\underline{x}l$(2)	$\underline{x}$		7
8/12/50			$\underline{x}$			1
8/20/50		$\underline{x}$				1
8/26/50		$\underline{x}$				1
9/1/50			$\underline{x}l$			1
10/23/50				xl		1
Totals	18	15	14	6	4	57

Key:

x = Tow taken, no larvae found.

$\underline{x}$ = Tow taken, larvae preserved in Bouins.

xl = Tow taken, exhaustively examined, no larvae.

$\underline{x}l$ = Tow taken, exhaustively examined, larvae Bouins preserved.

$\underline{\underline{x}}l$ = Tow taken, exhaustively examined, larvae saved and used for mounting, length-width, etc.

Table 4

Frequency of Occurrence of Larvae

Date	Types of larva								
	1	2	3	4	5	6	7	T	Location
6/4/50	-	-	-	-	3	2	-	5	Seaside
6/7/50	-	-	-	1	21	-	15	37	Seaside
6/11/50	-	-	-	-	16	1	1	19	Seaside
6/11/50	-	-	-	-	9	-	8	17	Gearhart
6/22/50	11	1	-	3	13	3	2	33	Seaside
6/27/50	3	5	-	5	4	1	-	18	Seaside
6/30/50	1	-	-	2	18	-	-	21	Seaside
7/3/50	8	4	4	6	5	2	-	29	Gearhart
7/13/50	7	4	1	7	4	-	-	23	Seaside
7/19/50	-	-	-	12	2	2	-	16	Gearhart
7/27/50	3	1	-	5	9	2	4	24	Seaside
8/2/50	9	2	-	7	7	-	1	26	Seaside
Totals	42	17	5	43	111	13	32	268	

Figure 1

Location of strips set up for contour studies on the Clatsop Beaches

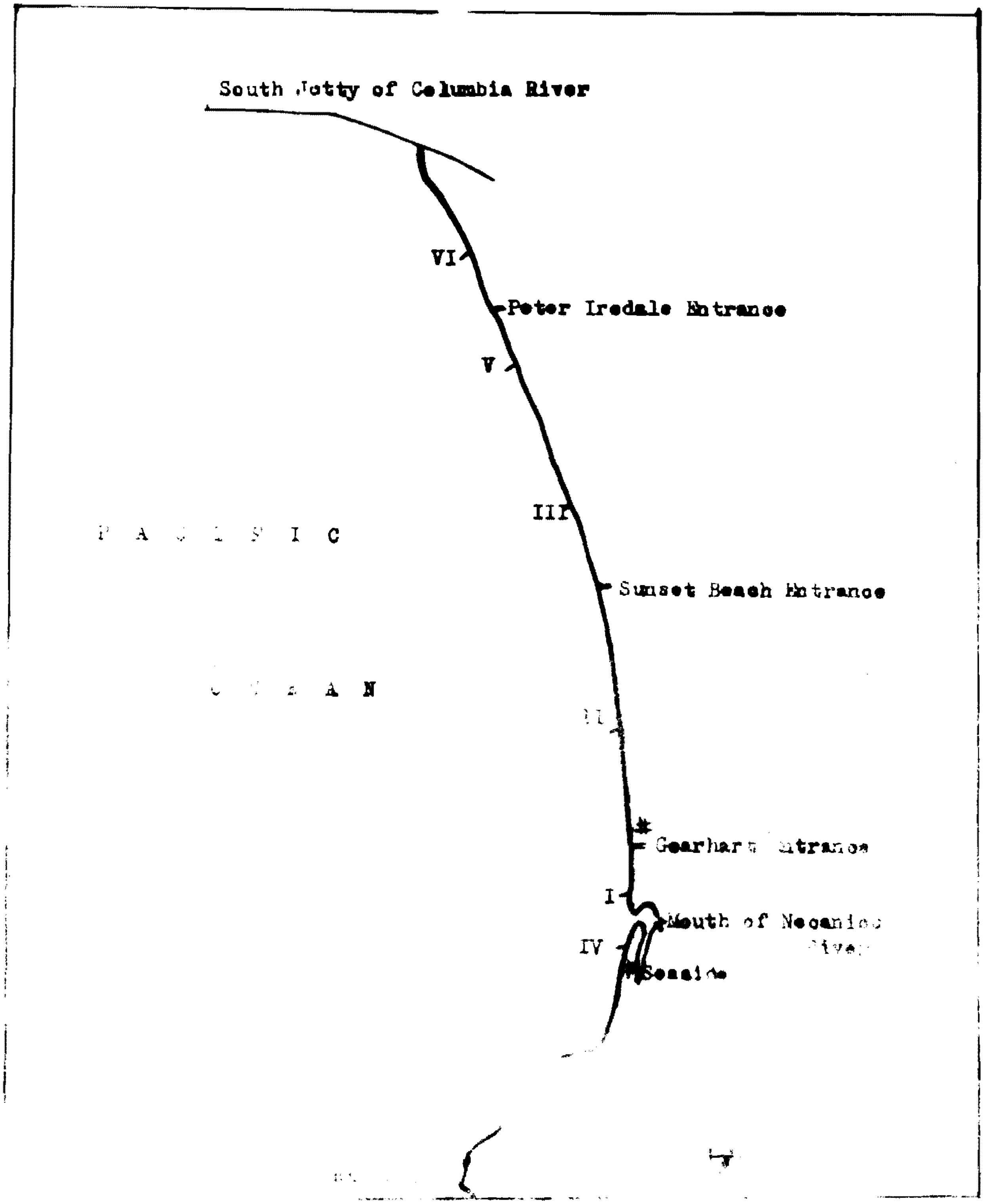


Figure 2

Plat of angles and measurements on strip #II (2.0 mi. No. Gearhart)

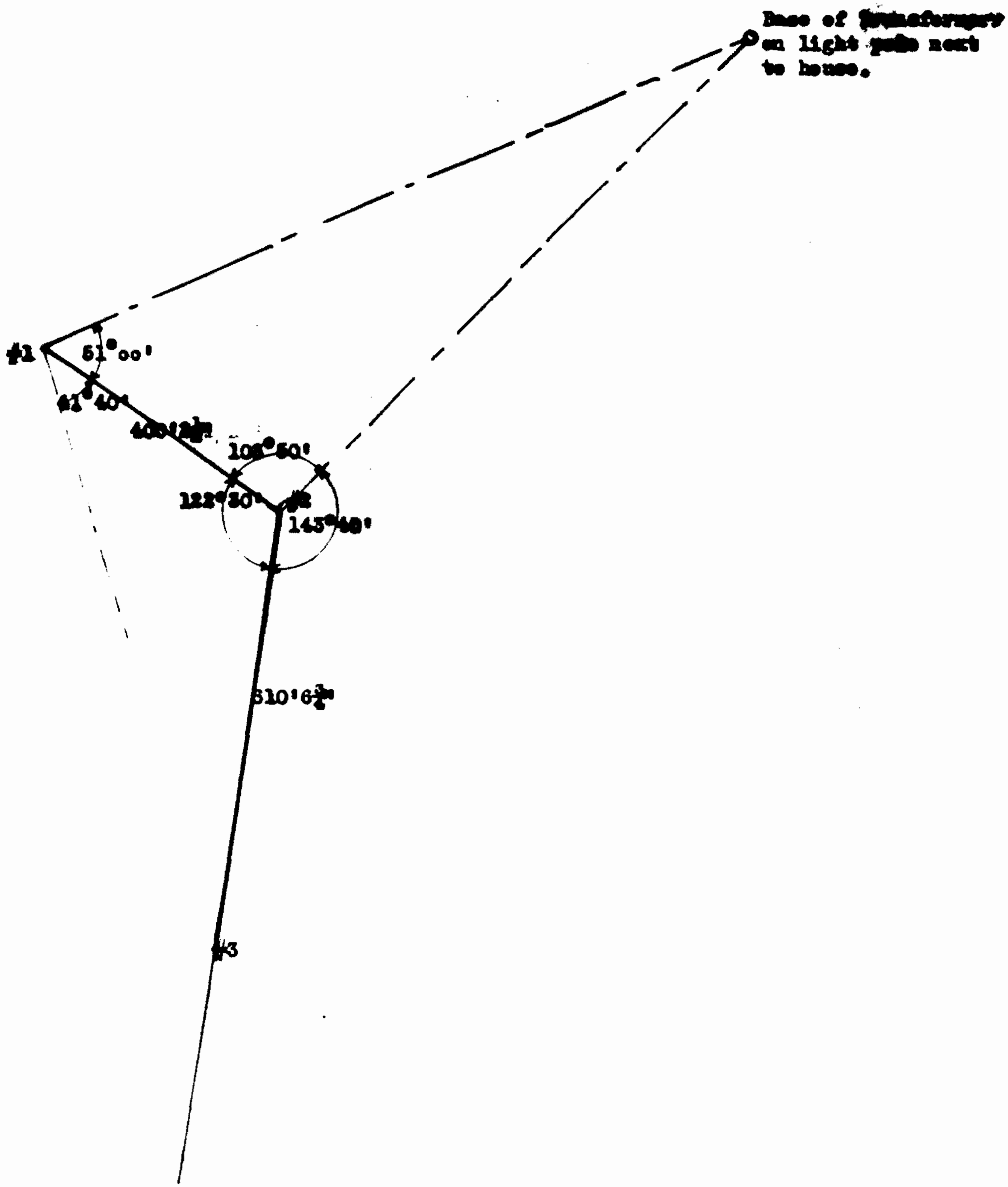


Figure 3
Contours of Strip Number 2 (2.5 miles north of Gearhart entrance) with
-10 and -15 Foot Levels Indicated (Height of Tide in Brackets)

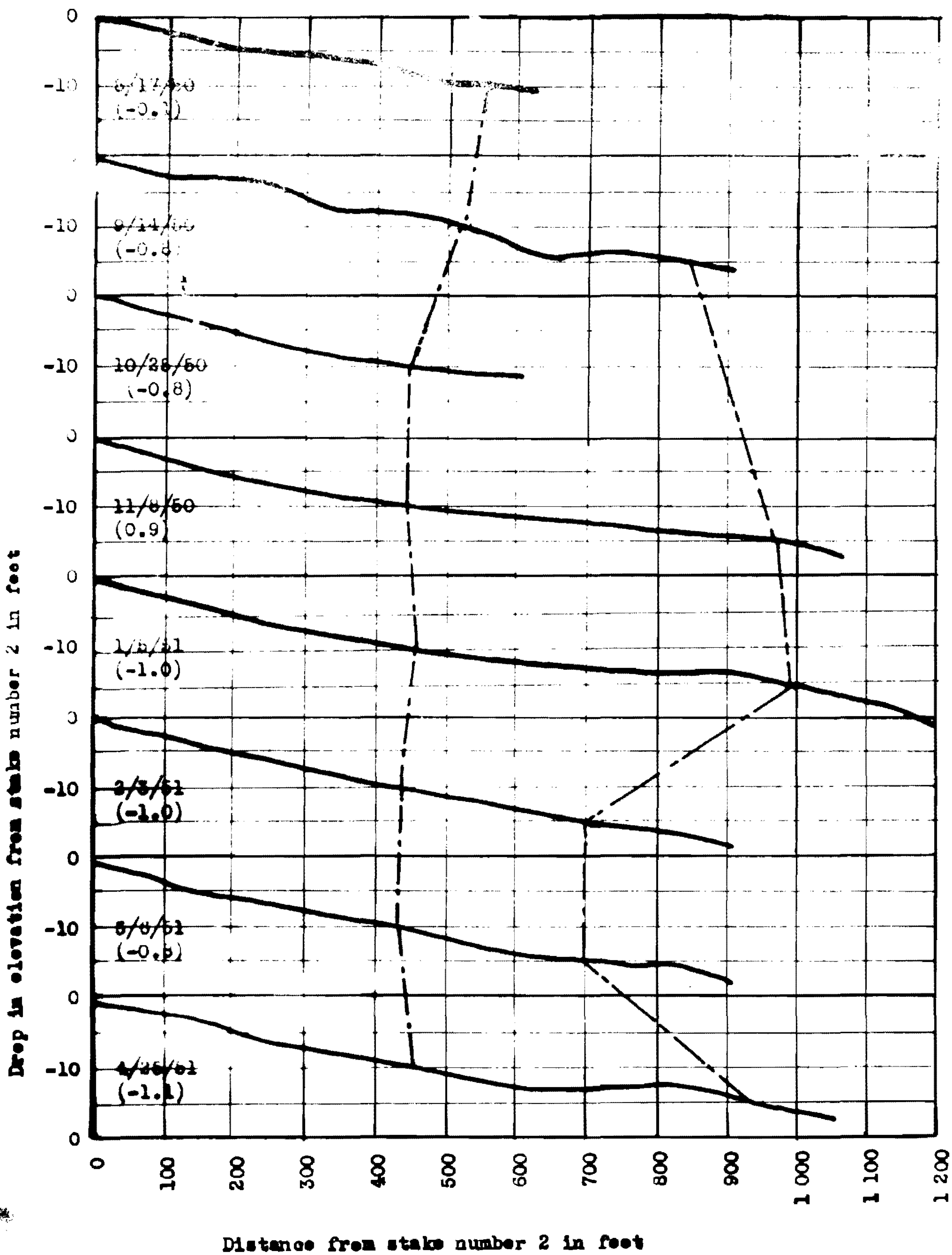
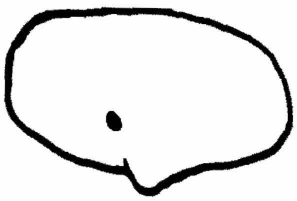


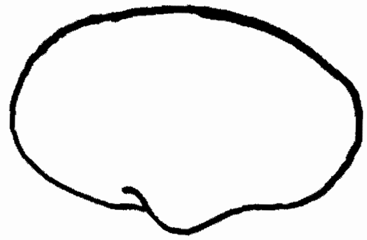
Figure 4

Outlines of General Types of Larvae Found in Clatsop

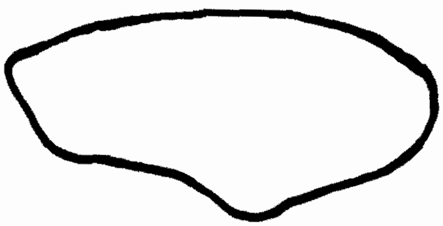
Beach Plankton Tows in 1950



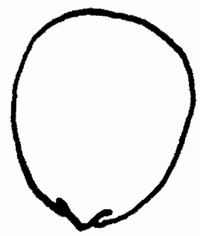
Type 1



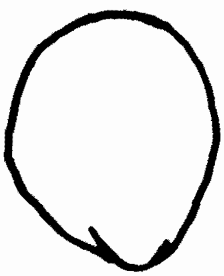
Type 5



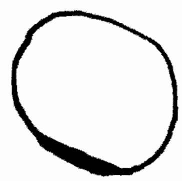
Type 2



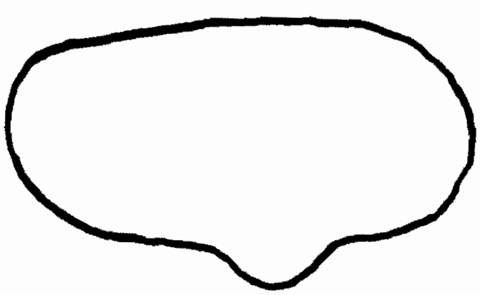
Type 6



Type 3



Type 7



Type 4

Figure 5

Figure 5A Length-width plot of type 1 larvae. (in microns)

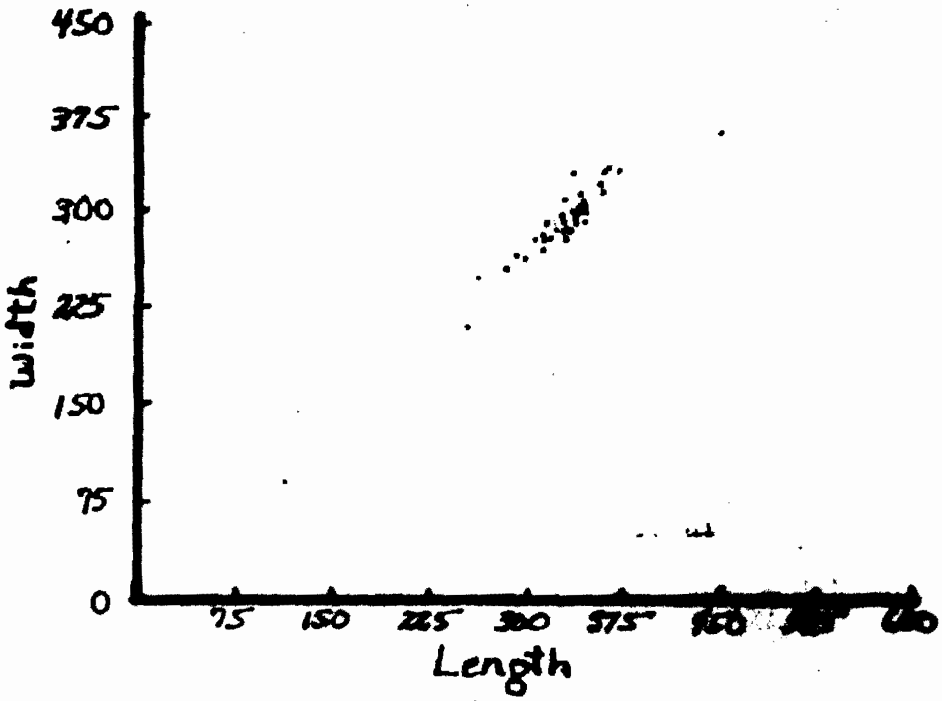
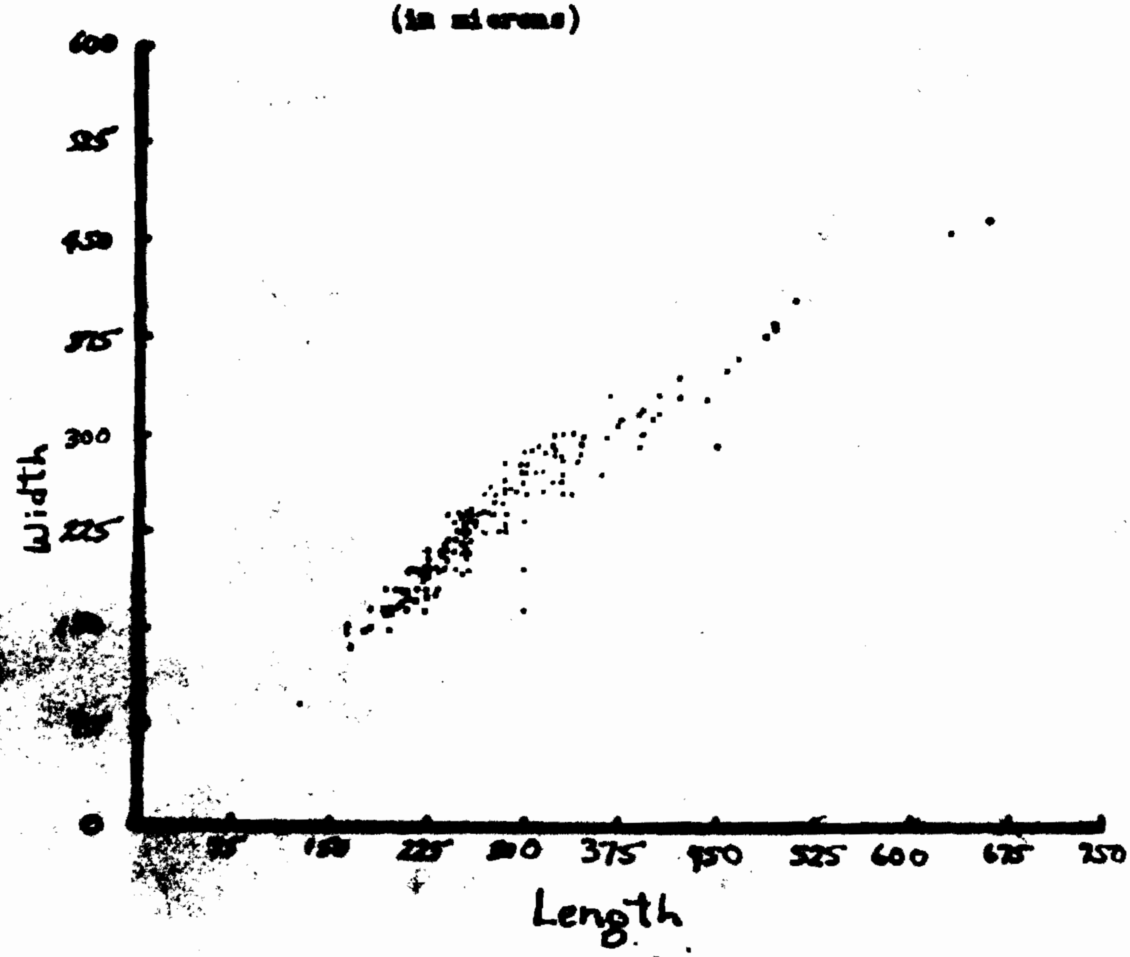


Figure 5B Length-width plot of types 4, 6, and 7 larvae. (in microns)



CLAM WASTAGE

General

At the present time in view of the nearly complete lack of information on the subject of wastage it is impossible to even guess the annual loss to the fishery from this source. To obtain data several possible routes of attack may be followed.

1. Check of the beach after the turn of the tide for clams on the surface of the sand and in dug holes. (It has been found in Washington that in some cases in an effort to get a limit of only large size clams as high as 40 percent of the holes will have small clams in them) Possibly routine checks of randomly selected areas at frequent intervals would yield some good data.

2. Check for damaged and whole shells of freshly killed clams at the high tide line of selected areas.

3. Observation and notation of waste anytime it occurs such as observing the numbers of clam holes dug without getting more than the necks by tourists.

4. Discard small clams in the manner followed by commercial diggers and attempt to follow their destiny to see if any, some, most, or all of the clams will dig in and survive or if they become easy prey to predators.

5. Make a survey of auto courts, etc. and inquire about wastage of clams. In all cases the information would be at best relative and would give only the crudest of absolute values, but would give comparable figures from year to year.

Sport Fishery

No data are available on the loss of clams due to the sport fishery. Undoubtedly many clams are injured with shovels and never caught due to inexperience. Also many clams are dug and due to their size are either left in the hole or discarded on the beach. On occasions diggers have been observed at times of good digging to spread their catch on the sand and discard small broken clams and continue to dig until a limit of larger clams has been taken.

One individual checked during the past summer (on June 30, 1950) in the "Cove" had dug 27 clams and picked up 23 clams on the beach ranging from the neck only to entire crushed clams.

No information on wastage by the diggers after leaving the beach has been collected though there is probably some loss from the source.

Waste by the sport fishery alone would be rather difficult to assess since only in the "Cove" could damaged and discarded clams be considered to be those of the sport diggers only.

It should also be mentioned that many tourists are still under the impression that they must observe the 3-1/2 inch size limit which is undoubtedly causing waste--more publicity is needed on this point.

Commercial Digging

The commercial digger wastes clams as a rule in only one instance, that is when the clam is of sub-legal size, in all probability the waste then is not injury to the organism but rather exposure to other predators when the clam is thrown away or left lying on the sand. When an undersized clam is dug one of three alternatives may be followed: 1. replace it in the sand; 2. drop it in the surf, on the sand, or in some other manner dispose of it; 3. market the clam.

The first alternative is biologically the most desirable by far. The second would seem to be the most common practice so far as casual observation would indicate and the third will occur depending on the laxness of the buyers in observing the size regulations and the abundance of larger clams at the time. Another secondary procedure has been encountered in which the diggers pinch and crush the posterior end of the shell so that they are nearly impossible to measure accurately when marketed.

The sub-legal clam presents the most serious problem from the latter part of June, when a greater share of the previous season's clam set reach about 75 millimeters or greater until late fall or early winter when this year class of clams has been entirely recruited into the fishery. On the basis of commercial shell samples this would appear to occur in late October or November sometime. The small clam will also present a problem at anytime commercial digging is restricted to the more heavily dug inner reaches of the beach, either by adverse weather condition causing heavy surf or low tides of poor magnitude (roughly -0.5 or higher).

Thus in obtaining data on clam wastage by commercial diggers one should direct his efforts toward the summer and fall digging as well as nearly any poor low tide. This period of time would probably cover the greatest loss to the fishery from this source.

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