SHELLFISH INVESTIGATION
PROGRESS REPORT #18
August 1949

HORSECLAM CONDITION STUDIES

Introduction:

A follow up on regulations imposed on the horseclam, Schizothaerus nuttallii, after the public hearing on shellfish July 22, 1948 has been carried on at the Newport laboratory through field examination and laboratory tests. Regulations affecting horseclams imposed at the hearing were in essence: a personal limit of "36 clams of all species in aggregate, exclusive of razor clams, and not more than 18 of which may be horseclams.....provided further that it shall be unlawful to take, catch, or dig horseclams for any purpose whatsoever, during the period January 1 to June 30, both dates inclusive of any year; and providing further that in digging or taking clams for personal use the first 36 clams taken, dug, or caught shall be counted as and shall constitute for that day the personal use bag limit.....".

The closed season, Jan. 1 to June 30, has been checked in particular by a series of monthly samples from the various bays ---- Tillamook, Netarts, Yaquina, and Coos Bay, the only Oregon bays having significant horseclam beds where any appreciable digging takes place.

Standard Procedure:

In November 1947 one hundred thirty eight specimens of horseclams ranging in size from 101 millimeters to 151 millimeters were dug in Yaquina Bay; eighteen clams of which were dug Nov. 10, thirty five November 13, twenty November 25, and sixty five November 26. Upon arrival at the laboratory with each group of specimens the clams were placed in a salt water live box, and held over night in order they might regain normal water content. The day following digging the clams were removed from the holding tank and allowed to drain twenty minutes, whereupon they were weighed

and measured individually. The purpose was to arrive at a length-weight relationship.

Figure #1 shows a scatter diagram of length versus weight. The length data was then grouped in 10 millimeter groups, the average weight then computed for the size ranges and plotted on graph paper, Graph #2. This gave nearly a straight line relationship for the length range 101 to 151 millimeters. Attempting to straighten the line by semi-log, Graph #3, and log-log, Graph #4, proved unsuccessful. Looking back at the raw data and the fact that Graph #1 was nearly a straight line it was decided to plot a line of regression by the least of squares method and use this in determining weights for given sizes or visa versa. Calculations gave the statistical equation y_x = 10.29 X - 609.49 for the range 101 to 151 millimeters. Substituting values for "X" (length) we find the following length-weight relationship: (length in millimeters, weight in grams)

L	W	L	W	L	W	L	W	L	W	L	W
100	220*	110	322	120	425	130	528	140	631	150	734
101	230	111	333	121	436	131	539	141	641	151	744
102	240	112	343	122	446	132	549	142	652		
103	250	113	353	123	457	133	559	143	662		
104	261	114	364	124	466	134	569	144	672		
105	271	115	374	125	477	135	580	145	683		
106	281	116	384	126	487	136	590	146	693		
107	292	117	394	127	497	137	600	147	703		
108	302	118	405	128	508	138	611	148	713		
109	312	119	415	129	518	139	621	149	724		

* Beyond limits of line of regression.

This work has been used as a base for all sampling since and has been designated Yaquina Bay Standard Length - Weight Data until such time data for the other bays is collected.

Yaquina Bay Standard will be used for samples taken in other than Yaquina Bay. While this procedure will not give the exact picture as far as per cent meat recovery from whole meat, it will be correct in magnitude and in seasonal fluctuations.

Since November 1947 a total of 23 samples have been taken from all the bays for condition determinations. The clams are allowed to "recuperate" in the live box over-night, removed the following day, allowed to drain 20 minutes, and then weighed. The shell is then removed and the meats allowed to drain 10 minutes before being weighed. After weighing, the clam bodies (viscera, gills, mantles, and muscles) and necks are divided (see Figure 1-A); these two portions then are weighed separately. The body mass is now cleaned by removing the gills and dark visceral mass (see Figures 1-B, 2-A, and 2-B). This portion is the critical part of the body of the clam as pertaining to meat yield as it varies with the condition of the ovaries and body fat (glycegen) which varies with the time of year.

The mantles are rid of a dark strip of skin and the body mass reweighed.

Cleaning the necks brought complications. After several horseclam meat yield tests had been run it was concluded that there was a great deal of variation in the cleaning of the horseclam necks between one sample and another, and depending on the individual doing the cleaning. The formula for calculating percent meat recovery from uncleaned whole weight used up to this time was:

$$\frac{\text{Wt. of Cleaned necks} + \text{Wt. of Cleaned Bodies}}{(\text{Yaq. Bay Stand. Wt. for given Length}) \times (\text{No. of spec. in sample})} = \% \text{ Recovery from uncleaned Whole Weights}$$

Several workable methods for removing the outer skin on the neck are known: (1) dip necks in boiling water for 30 seconds, then peel off the outer skin, (2) freeze uncleaned necks - upon thawing the outer skin peels off, (3) soak in fresh water for 4-6 hours before attempting to remove outer skin. All these methods are tricky and many times usable meat sticks to the outer skin and is lost. Another variable is the cutting off of the tip of the siphon (neck) which is colored and tough. The portion to be cut off varies with the individual doing the cleaning. Method (1) has been used by this laboratory. Figure 1-C shows the dressed neck.

To statistically justify a change in formula "uncleaned neck" weights of ten sets of data were compared with "cleaned neck" weights of the same sets. There were 281 clams total in the comparison. The relative standard deviation (C) was then calculated with the following results:

	Uncleaned Clam Necks	Cleaned Clam Necks
Standard Deviation (S)	14.2	11.85
Rel. Standard Deviation (C)	22.68%	26.74%
A difference of (C)	4.06%	

The average weight per clam neck was first calculated for each set of data for (1) "uncleaned neck" weight and (2) "cleaned neck" weight. The "uncleaned neck" weights giving less deviation it was decided that the "uncleaned neck" weight should be used in computing the percent meat recovery from whole weight. All back meat yield tests were recalculated and all following tests have been made using this method. The corrected formula reads:

$$\frac{\text{Wt. of Uncleaned necks for given Length}}{\text{(Yaq. Bay Stand. Wt)}} \div \frac{\text{Wt. of Cleaned bodies}}{\text{(No. of spec.) in sample}} = \% \text{ Recovery from Uncleaned Whole Weights in relation to Standard Weight}$$

A correction factor was needed for some of the meat yield data sheets as "uncleaned neck" weights were missing in back samples. All available sets of data where both "uncleaned" and "cleaned" neck weight figures were present were compared. Ten (10) complete sets of data were on hand. The sum of "cleaned neck" weights divided by the sum of "uncleaned neck" weights gave the factor .697.

$$\frac{(C)\text{Cleaned}}{(U)\text{Uncleaned}} = .697 \quad \text{or}$$

$$C = .697\ U \text{ or}$$

$$U = \frac{C}{.697}$$

Incomplete back data sheets were completed through the use of the derived formula.

The following general form is useful when making a meat yield test:

MEAT YIELD TEST — HORSECLAMS

Date:_____ Bay:_____

*No. of specimens:_____
*Average length:_____

Total weight of clams in shell (whole weight) (drained 20 min.):_____

Total weight of clams - shells removed (drained 10 minutes):_____

Weight of "uncleaned bodies" (including mantles, visceral mass, and muscles):_____

*Weight of "uncleaned" necks:_____

*Weight of "cleaned" bodies:_____

Weight of "cleaned" necks:_____

* Asterisk denotes most important items needed for a meat yield test. Others are used for reference figures.

This is done for any sample of horseclams brought into the laboratory and is the standard method used in working up samples.

Results:

Percent meat recovery from uncleaned whole weights was calculated for each of the 23 samples, the Yaquina Bay Standard Length - Weight Data being used in each case. Figure 3 shows results of calculations. Distribution of samples lies between the range 15.0% and 33.1%. Grouping the samples from all bays and plotting for the years 1947, 1948 and 1949 didn't give a very clear picture because of the lack of samples for the late fall months (see Graph 5). Grouping all samples according to month only (disregarding years) showed a clearer but incomplete picture (see Graph 6).

Inspection of Graph 6 shows the clams to be in poorest condition in March and April with gradual improvement until a peak is reached in November, December, and

HORSECLAMS
PERCENT RECOVERY FROM UNCLEANED WHOLE WEIGHTS
Figure 3

	Months																			
	N(47)	M(48)	A	M	J	J	A	S	O	N	D	J(49)	F	M	A	M	J	J	A
T															(13)* 15.6		(27) 20.4**		(9) 33.1
N																	(3) 17.2	(15) 22.4	(28) 25.1
YB	(31) 28.2	(18) 16.8		(22) 23.0			(18) 27.9								(19) 15.0		(33) 17.2	(35) 20.7	(22) 23.1
CB				(23) 17.2		(54) 16.9										(43) 18.7**		(36) 26.3	(18) 25.5**
TOT.	28.2	16.8		40.2		16.9	27.9								30.6	18.7	54.8	69.4	106.8
AV.	28.2	16.8		20.1		16.9	27.9								15.3	18.7	18.3	23.1	26.7

This represents 497 clams tested, or an average of 26.2 clams per set tested.

T - Tillamook Bay N - Netarts Bay YB - Yaquina Bay CB - Coos Bay

* Numbers in parentheses indicate number of cla ms in set.

** Represents two samples (sets) combined from same bay at same date.

January during which time the clams are preparing for spawning. The indicated sudden drop in condition in January and February (line drawn by inspection only) coincides with spawning, hence loss of body weight.

There has been talk among sports diggers as well as commercial diggers that the season as it now stands should be changed to a longer open season and a shorter closed period. As shown by graph 6 the information is incomplete for the winter months. Before any change of season, if any, is invoked data for the winter months must be gathered. No change in regulations is recommended at this time.

It should be understood that the conclusions reached here are based entirely on the percentage meat recovery from whole weights and not on abundance counts, condition of horseclam beds as related to number of clams per given area, or intensity of the digging. Should these other conditions be serious enough to outweigh the "condition factor" they would of course have priority.

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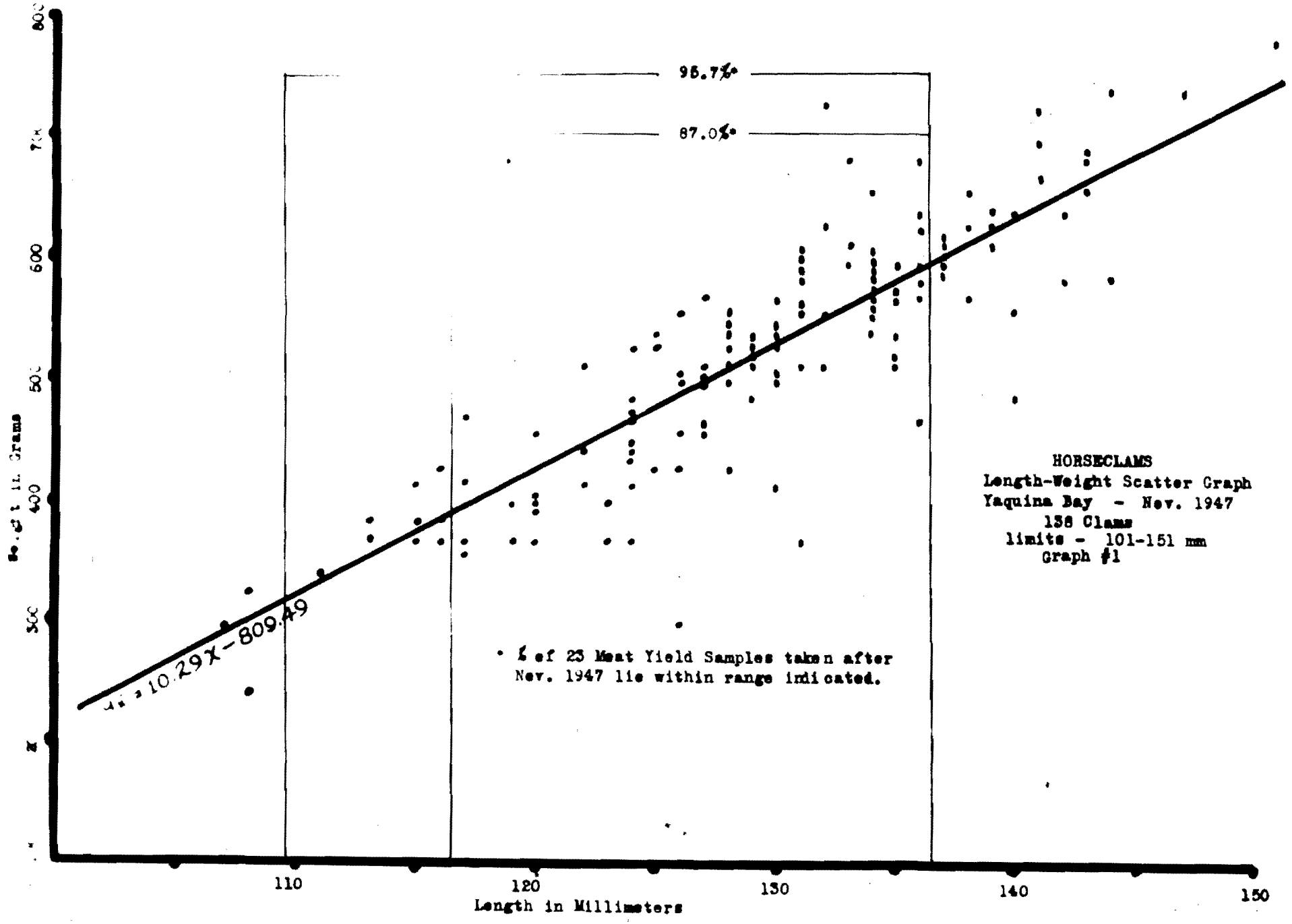
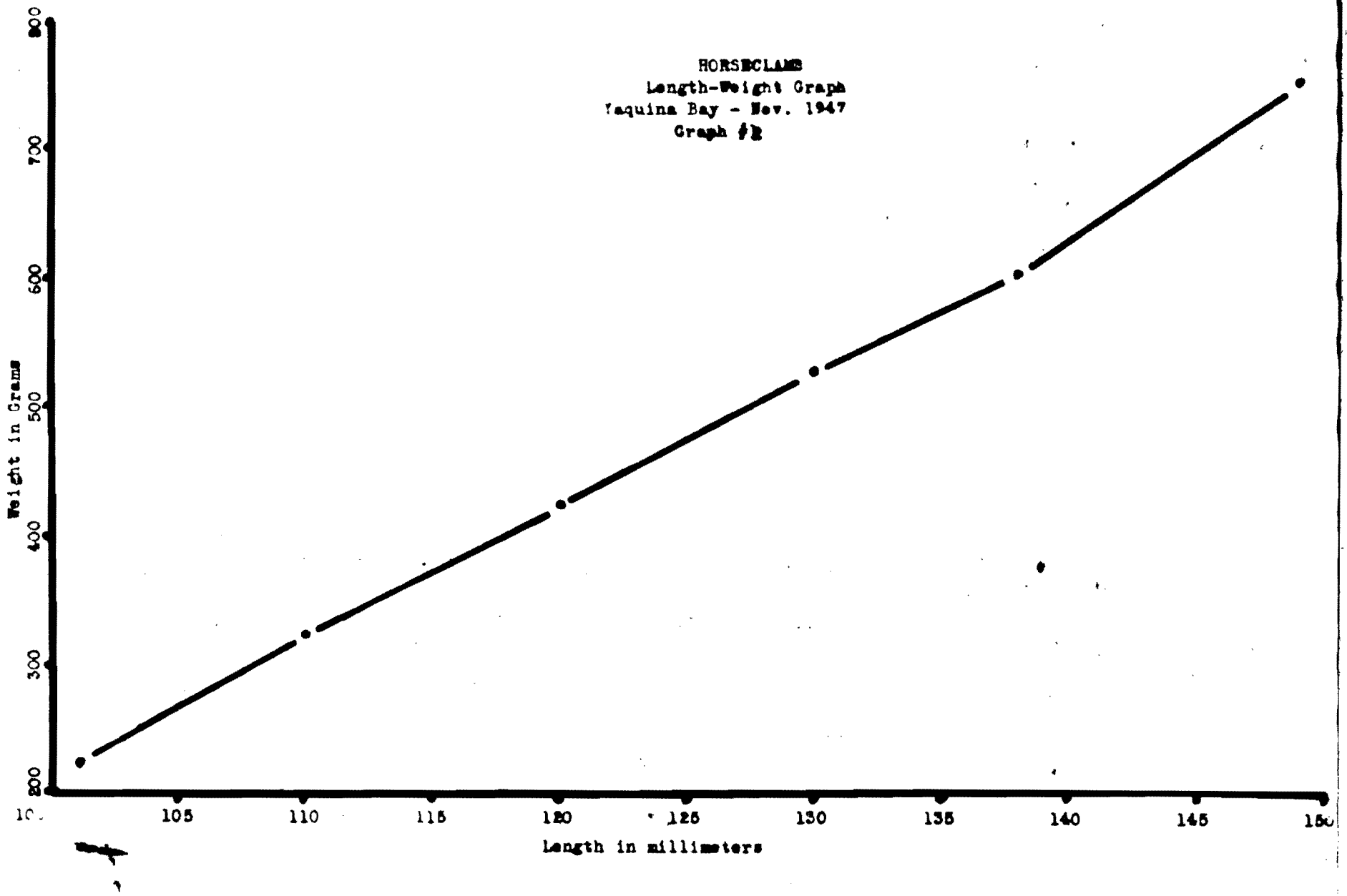
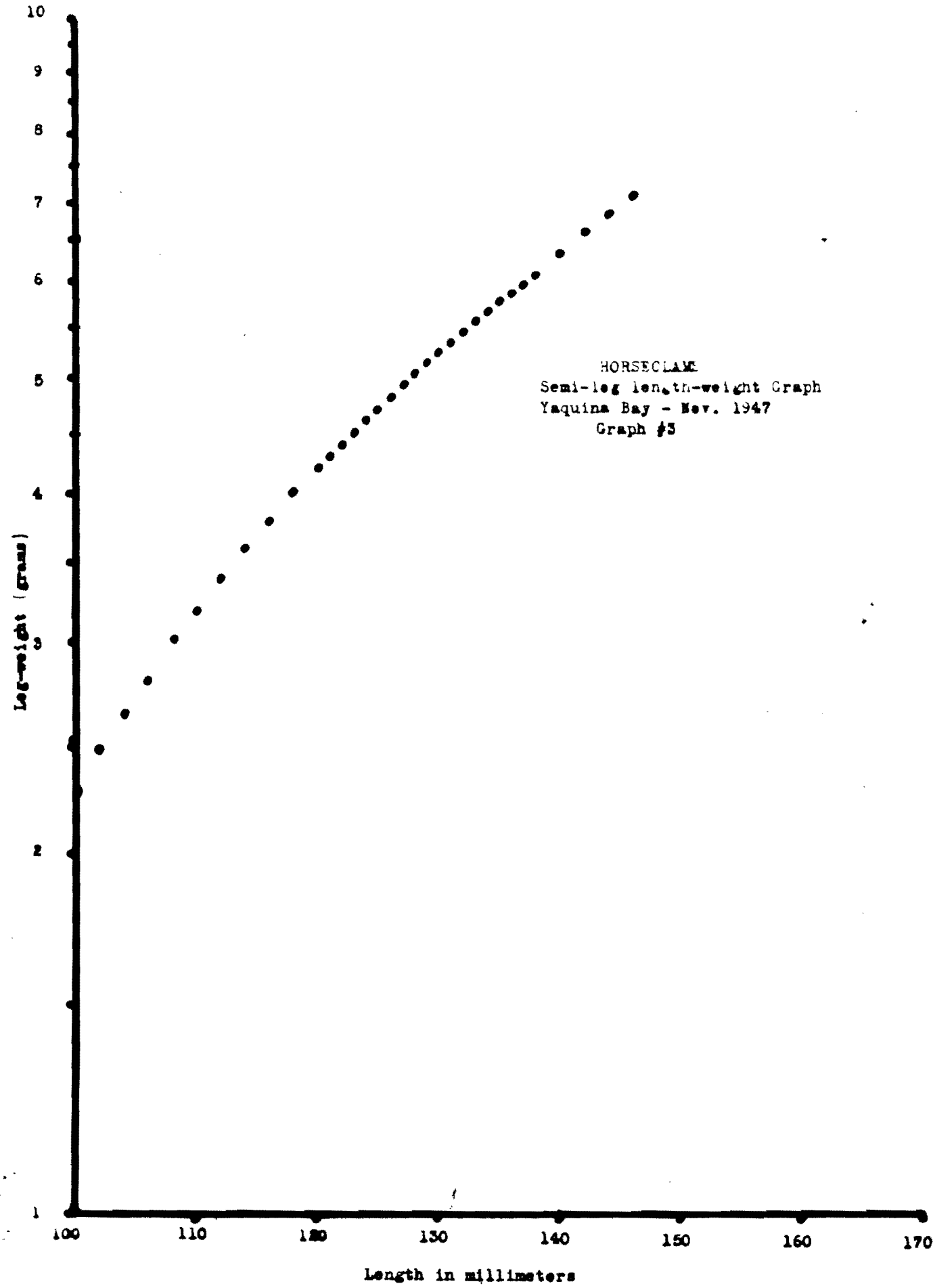
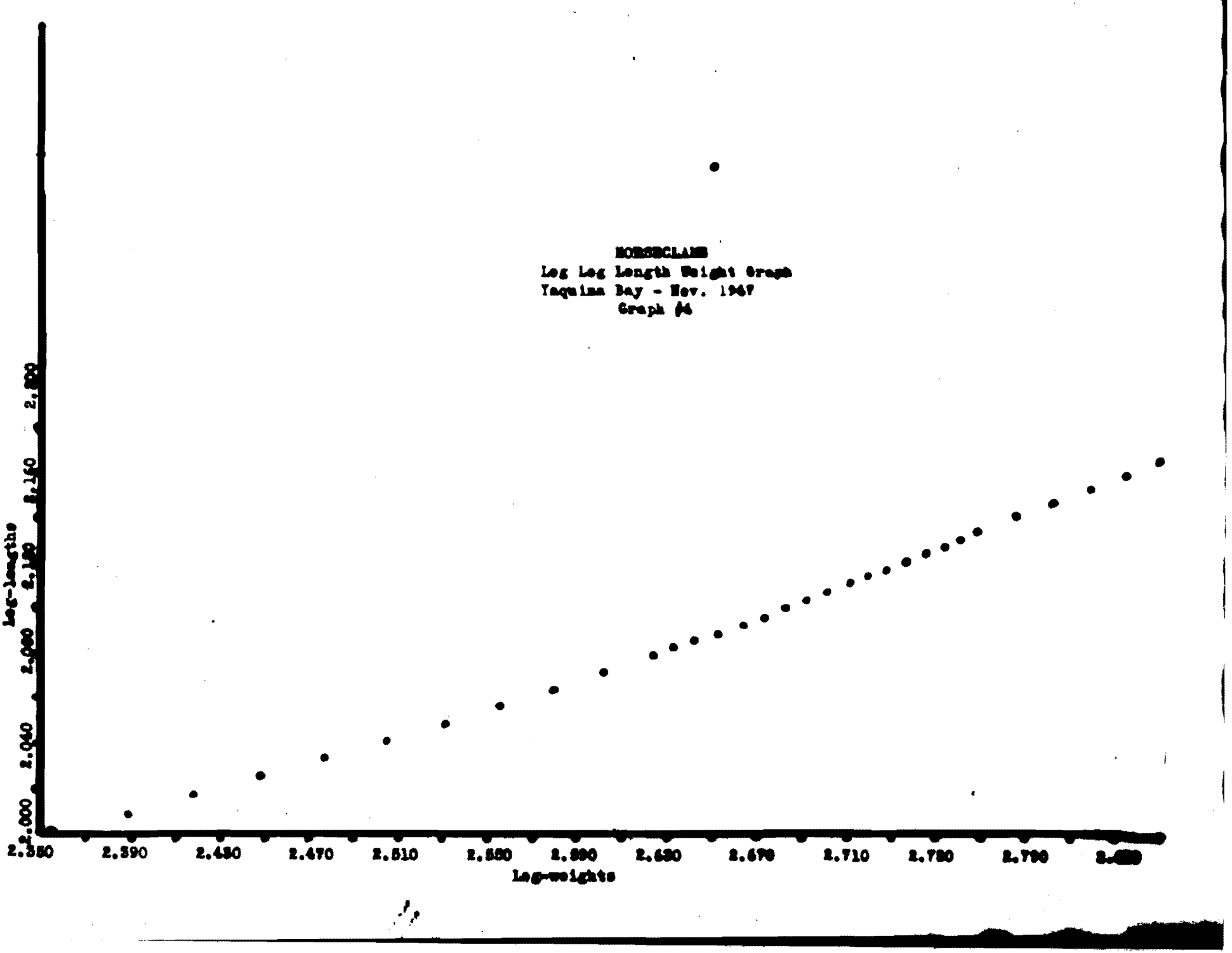
Aquatic Biologist

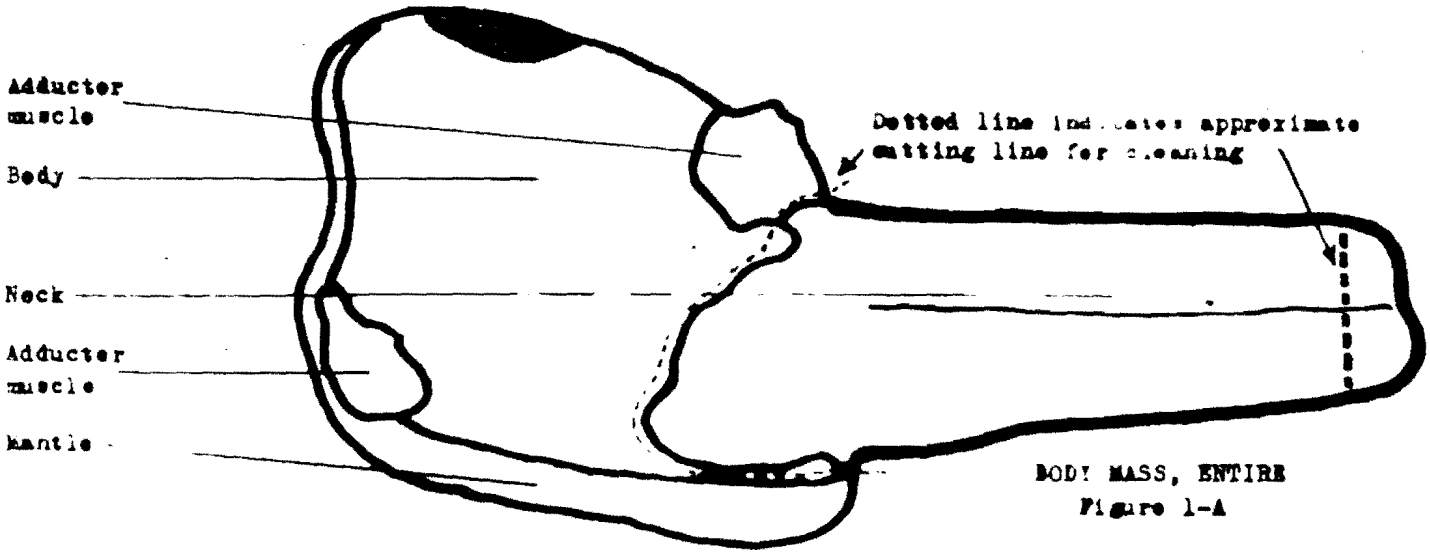

95.7%*
87.0%*
Y = 10.29X - 809.49
110
120
130
140
150
Length in Millimeters
HORSECLAMS
Length-Weight Scatter Graph
Yaquina Bay - Nov. 1947
138 Clams
limits - 101-151 mm
Graph #1
* % of 23 Meat Yield Samples taken after Nov. 1947 lie within range indicated.


HORSECLAMS
Length-Weight Graph
Yaquina Bay - Nov. 1947
Graph #2
Weight in Grams
800
700
600
500
400
300
200
105
110
115
120
125
130
135
140
145
150
Length in millimeters

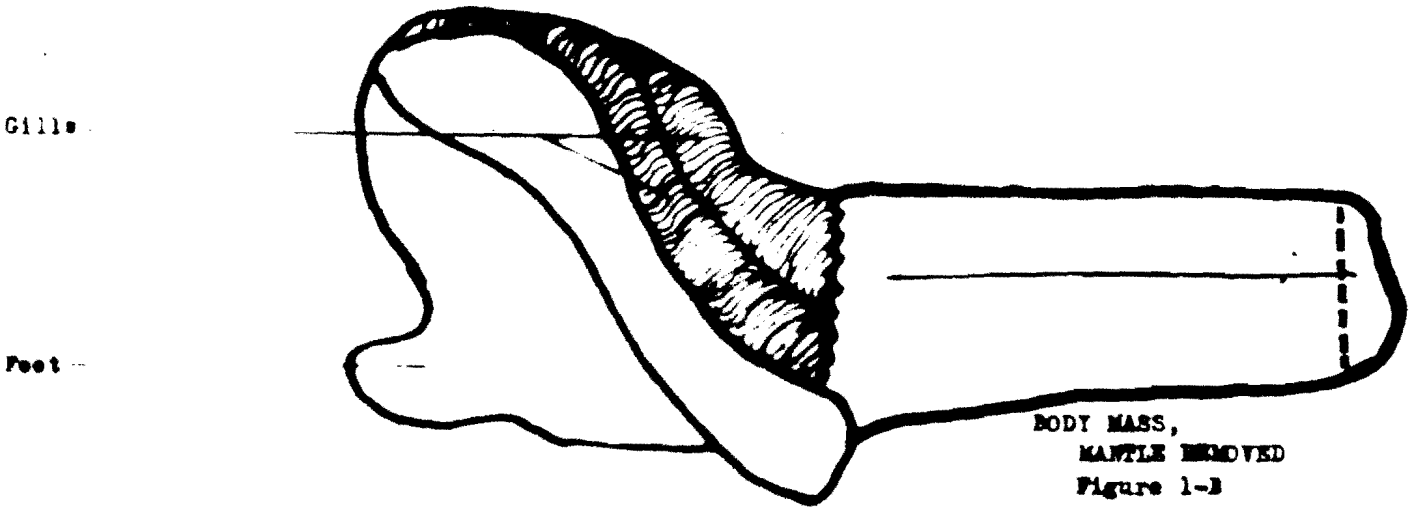


HORSECLAM
Semi-log length-weight Graph
Yaquina Bay - Nov. 1947
Graph #3

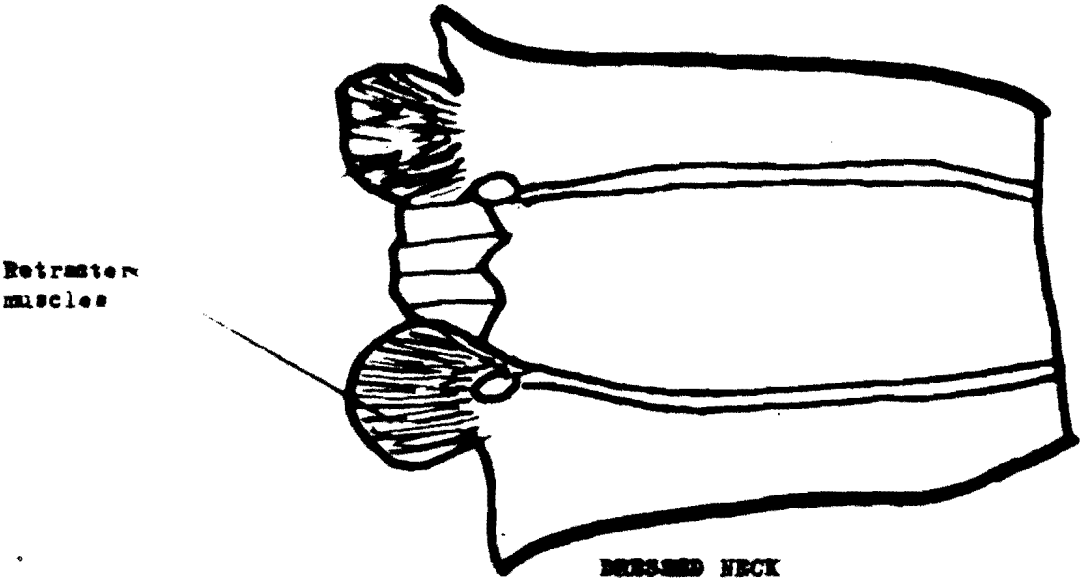

HORSECLAMS
Log Log Length Weight Graph
Yaquina Bay - Nov. 1947
Graph #6
Log-lengths
2.000
2.040
2.080
2.120
2.160
2.200
2.350
2.390
2.430
2.470
2.510
2.550
2.590
2.630
2.670
2.710
2.750
2.790
Log-weights



BODY MASS, ENTIRE
Figure 1-A



BODY MASS,
MANTLE REMOVED
Figure 1-B



DISSECTED NECK
(cut open)
Figure 1-C

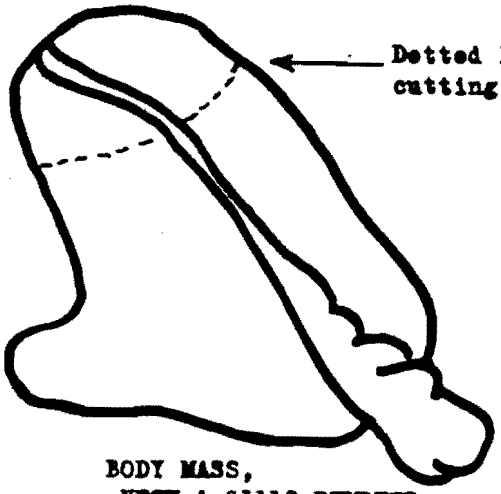


Figure 2-A

BODY MASS,
NECK & GILLS REMOVED

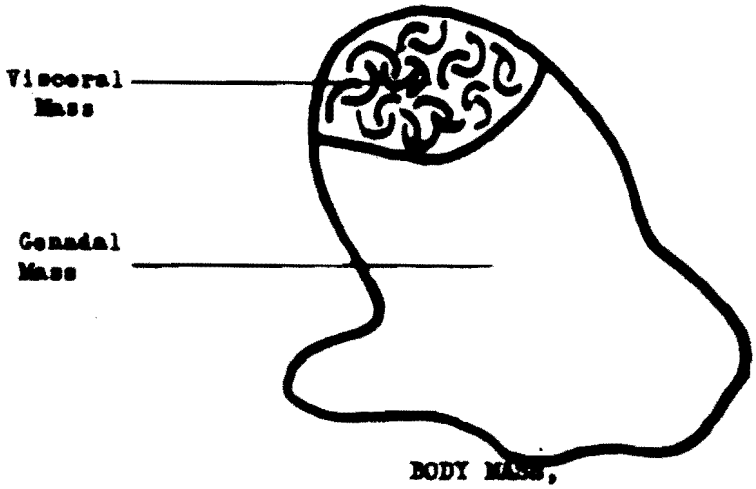
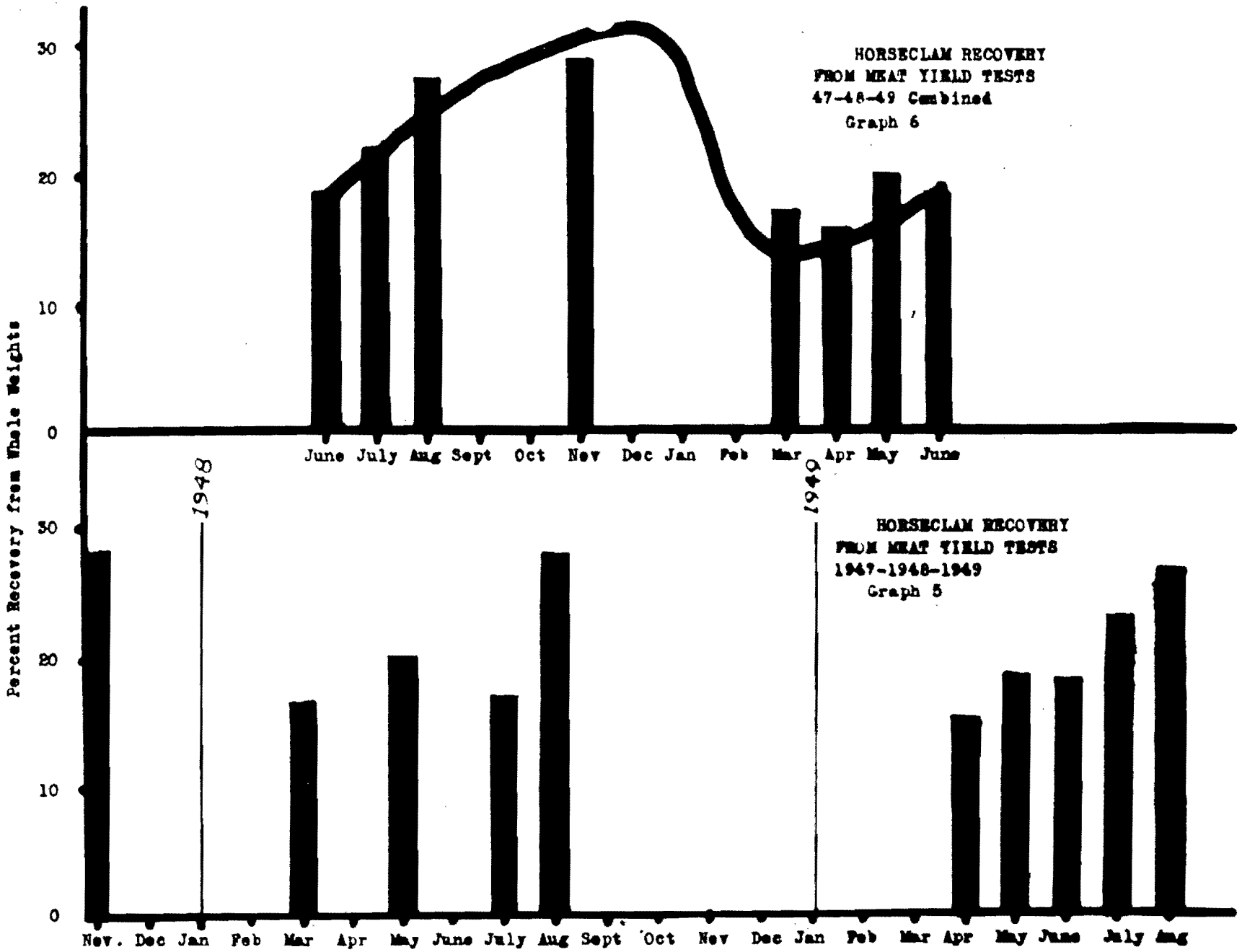


Figure 2-B

BODY MASS,
NECK & GILLS REMOVED
SAGITTAL SECTION


HORSECLAM RECOVERY
FROM MEAT YIELD TESTS
47-48-49 Combined
Graph 6
30
20
10
0
June July Aug Sept Oct Nov Dec Jan Feb Mar Apr May June
1948
1949
HORSECLAM RECOVERY
FROM MEAT YIELD TESTS
1947-1948-1949
Graph 5
Percent Recovery from Whole Weights
30
20
10
0
Nov. Dec Jan Feb Mar Apr May June July Aug Sept Oct Nov Dec Jan Feb Mar Apr May June July Aug

FURTHER HORSECLAM CONDITION STUDIES

This report is intended as a supplement to Progress Report #18, August 1949, which dealt with the physical condition of primarily the gonad of the horseclam throughout the various months of the year as related to the present regulation of a closed season from January 1st through June 30th. Spawning season of the horseclam has previously been designated for the Oregon Bays as chiefly February and March. This report will further discuss this matter with additional notes on the spawning season this year.

Yaquina Bay because of its central locality and accessibility has been thr primary subject of concentrated research with Coos and Tillamook bays being secondary.

The following points are taken from Progress Report #18:

1. Standard length-weight relationship for Yaquina Bay horseclams of the lengths 100 mm to 151 mm for the month of November has been established as a basis for comparison for other months of the year. These length-weight figures are used for computations in the following formula.

2. The derived standard formula for determining percent edible meat recovery from uncleaned whole weights is

$$\frac{\text{Wt. of Uncleaned necks} \div \text{Wt. of Cleaned bodies}}{(\text{Yaq. Bay Stand. Wt. for given length}) \times (\text{No. of spec. in sample})} = \% \text{ Edible Meat Recovery from Uncleaned Whole Weights}$$

3. Horseclams reach their poorest condition in March and April and their best condition in November and December.

The "unusually" cold winter and spring had its effect on the spawning of horseclams in Yaquina Bay. Very few spawned-out gonads were noticed this season and it appeared that those clams that did spawn did not do so completely. (A spawned out gonad is very watery and dark in color and is easily detected).

Furthermore, as could be expected, the spawning season was late, nearly a month so.

A horseclam when dug will squirt water from its mantle cavity, this water from a spawning clam being slightly milky at the peak of spawning. This was noticed during the months of March and April this year.

Looking at the graph on which the years 1949 and 1950 are compared one can see the trend is similar for both years, with the 1950 season showing the clams to be in better condition (fatter - more meat yield) for the same months than the 1949 season. Completeness of spawning is also evident for the two years with 1949 showing the more complete of the two with less edible meat recovery.

Gonad samples have been preserved and will be sectioned and examined in the future for confirmation of the spawning season by this indirect method of determining time of spawning.

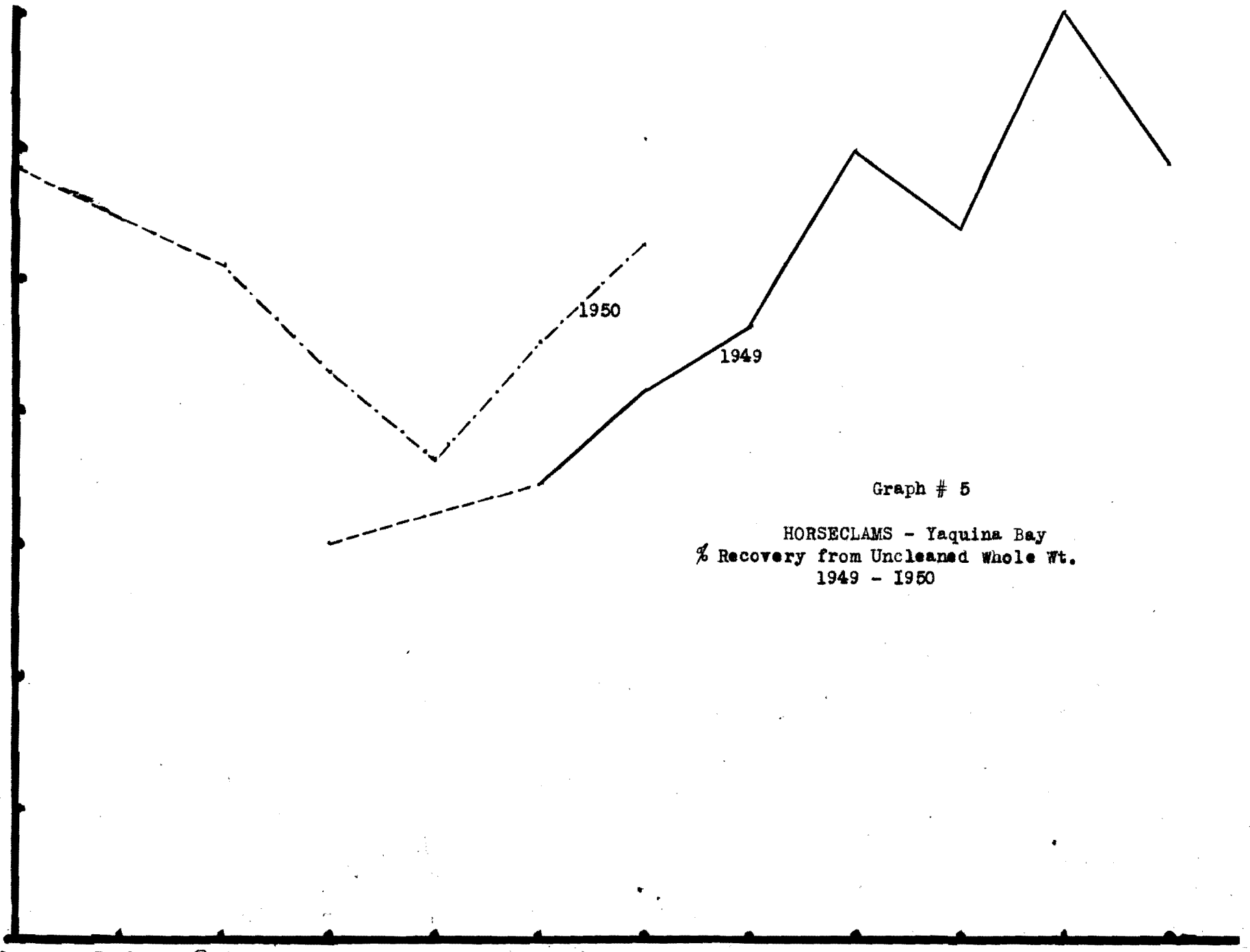
Samples of Yaquina, Coos and Tillamook bays when tested for condition the opening month of the season (July) were as follows:

1. Yaquina Bay - 28.6% Edible Meat Recovery from Uncleaned Whole Weight
2. Coos Bay - 30.7% " " " " " " "
3. Tillamook Bay-26.2% " " " " " " "

(Maximum percent recovery for 1949 was 35 % and minimum was 15%)

The Coos Bay horseclam has consistently been a fatter clam; the reason for this can only be theorized at present. Perhaps it is better food conditions or the beds have a larger flow of water over them. It has been demonstrated (Effects of Water Circulation on the Growth of Quahaugs and Oysters by C. J. Kerswill, J. Fish. Res. Bd. Can. 7 (9) 1949) that water circulation affects growth of shellfish.

Tillamook Bay on the opening month of the season was identical with Yaquina Bay comparing meat yield. Tillamook horseclams in the past have agreed closely in meat yield.



Graph # 5

HORSECLAMS - Yaquina Bay
% Recovery from Uncleaned Whole Wt.
1949 - 1950