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Canadian Atlantic
Herring

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by Judith H. Stoddard

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TECHNICAL REPORT NO. 79

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TECHNICAL REPORT NO. 79

FAT CONTENTS OF
CANADIAN ATLANTIC
HERRING

by

Judith H. Stoddard

This is the thirteenth FRB Technical Report from the
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FAT CONTENTS OF CANADIAN ATLANTIC HERRING

INTRODUCTION

Studies of the condition (fatness) of herring (Clupea harengus L.) were carried out in 1966 and the results recorded in Technical Report No. 5 of the Fisheries Research Board of Canada (1967). This study was expanded in 1967 in order to obtain wider knowledge about the effects of season, size and sex on fat contents. Such studies not only interest the scientist, but are of considerable importance to industry as well since profit from industrial uses of herring depend to a large extent on the recovery of oil.

Samples obtained in 1967 covered most of the important herring fishing areas off the east coast of Canada including the Bay of Fundy, Passamaquoddy Bay, Gulf of St. Lawrence, Nova Scotia Atlantic coastal and offshore areas and Georges Bank. Collections were made throughout the year. Altogether 1647 individual herring grouped in 227 samples were examined.

Similar studies on the fat content of C. harengus carried out by Battle et al. (1936) and by Leim (1943, 1957), are reviewed in Technical Report No. 5.

MATERIALS AND METHODS

Sampling methods:

About half the herring for fat analysis were caught by either purse seine (25%) or otter trawl (23%) in various parts of the Gulf of St. Lawrence, Bay of Fundy and Passamaquoddy

Bay, and from off the coast of Nova Scotia. Otter trawl samples from the Passamaquoddy Bay area were taken by the M.V. Mallotus, while the E.E. Prince made collections from Browns Bank, LeHave Bank, the Bay of Fundy and the Lurcher area (cruise No. 9); from Browns Bank (cruise No. 10) and from Orphan Bank (cruise No. 12).

Almost a third (30%) of the samples were obtained from gill nets and weirs. Thirty-five samples (16%) were taken from gill net catches in the Bay of Fundy, the Gulf of St. Lawrence and along the Nova Scotia coast. Thirty-two (14%) were obtained from weirs in the Bay of Fundy, along the Nova Scotia coast, and, primarily, in the Passamaquoddy Bay area.

A small number of samples (3%) were taken by other methods: three from traps along the Nova Scotia coast, one by drag seine off the Wolves, one with a Dutch herring trawl from the Magdalen Islands (E.E. Prince cruise No. 12) and three with a mid-water trawl over Georges Bank (unidentified vessel). Data on the method of capture were not available for approximately 19 per cent of the samples.

Treatment of samples:

Samples from the Gulf of St. Lawrence, the Bay of Fundy and the Nova Scotia areas were collected by field technicians. For shipment to St. Andrews, samples were placed in plastic bags and frozen immediately. The number of fish in these samples varied from 1 to 25. In a few cases where the fish were sexually mature, the sexes were separated for analysis.

Generally the herring were measured prior to freezing. However, this was not always possible under field conditions and in these instances, the herring were either measured while frozen or thawed and measured before analysis. Attempts were made to obtain samples containing fish of nearly equal size, but this was seldom practicable.

For Passamaquoddy Bay samples, however, it was possible to select for size. The number of fish in each sample varied from 3 to 30, the number chosen depending on the size of the fish. There was an additional sample of 73 small herring (average length 82 mm) obtained from one catch. Whenever the catch distribution allowed, samples of different sizes were obtained. Upon return to the station, the fish were measured and the samples frozen. In addition to the fat samples, stomachs were removed from 20 herring in each catch. These were preserved in 4 percent formalin for analysis at a later date.

Number of samples:

There were 66 samples (340 fish) from the Bay of Fundy (Table I); 45 samples (211 fish) from the Gulf of St. Lawrence (Table II); 77 samples (943 fish) from the Passamaquoddy Bay area (Table III); and 36 samples (145 fish) from the Nova Scotian coast and offshore areas (Table V). The 29 samples (364 fish) from the Hardwood Island area were included in the Passamaquoddy Bay area samples (Table II), but are also treated separately (Table V). In addition, 3 samples (8 fish) from Georges Bank were analyzed (Table X).

Analyses of samples:

All samples were analyzed at the Fisheries Research Board's Biological Station in St. Andrews, N. B.

The procedure employed in this study was that followed by Leim (1957). It involved the use of ethyl ether as the fat extractant. Three 5-gram aliquots from each sample were analyzed and the average value was used.

Variations in per cent fat content with time and with size of the fish were examined for each area, for males and females, for spring and fall spawning herring, and for all samples combined irrespective of area of capture, sex or spawning season. Whenever possible, comparisons with similar analyses on 1966 samples were made.

RESULTS

The results are tabulated in Tables I to XI inclusive. It should be noted that the Georges Bank samples have not been included in any of the calculations and comparisons made throughout. This omission was necessary because of inability to place them in any one of the major areas examined. The three available samples are treated separately.

Figures 1 and 2 show the localities from which samples were collected. For each area examined, time of year has been plotted against per cent fat content (Figs. 3-7 inclusive). In the instances where separate analyses were made on males and females from the same catch, their fat values were averaged and plotted. In other cases, where more

than one sample was obtained from a catch, the fat values were averaged if their length and fat content values were similar.

In addition, for each area examined, the average length (mm) of each sample was plotted against per cent fat content (Figs. 8-12 inclusive). The same averaging methods were used as for the seasonal analyses.

For male and female samples, per cent fat content was plotted against week collected (Fig. 13), and against length in mm (Fig. 14). The combined samples from all areas were examined in the same manner (Figs. 15 and 16 respectively). The combined samples were collected throughout the year (Fig. 15), while the period of collection for male and female samples extends from June to mid-October only (Fig. 13).

Variations in per cent fat content for 1966 and 1967 herring from the Gulf of St. Lawrence collected from early June to late July were compared (Fig. 17). A similar comparison was made for spring and fall spawning herring collected from mid-May to early July of 1967 (Fig. 18).

DISCUSSION

General discussion:

The fat content varied from sample to sample within an area. The highest value recorded was 24.91 per cent (Wolves Islands, N. B., December 27, 1967). The highest value recorded for 1966 samples was 17.06 per cent (Beaver Harbour, N. B., November 23, 1966). Both these high values

occurred in the Passamaquoddy Bay area, and in the latter months of the year.

The lowest fat value recorded was 1.13 per cent (Moose Island, N. B., May 30, 1967). The corresponding low value for 1966 was 3.39 per cent (Birch Cove, Bocabec Bay, N. B., August 4, 1966). Proximity of the two areas appears to be the only relationship between these low values.

The herring from the Nova Scotia coastal and offshore areas had a higher fat content (13.17%) than those from the Gulf of St. Lawrence (11.57%), Bay of Fundy (10.90%), or Passamaquoddy Bay (9.04%) areas. In 1966 the highest (10.62%) and lowest (8.94%) area average fat contents were also from Nova Scotia and Passamaquoddy Bay herring respectively. The overall average fat content for 1967 was higher (11.17%) than that for 1966 (9.82%).

In 1967, herring from the Gulf of St. Lawrence were larger (325 mm mean length) than those from the Nova Scotia coastal and offshore areas (321 mm), the Bay of Fundy (268 mm), or Passamaquoddy Bay (158 mm) areas. In 1966, herring from the Gulf of St. Lawrence were also larger (315 mm) than those from Nova Scotia (314 mm), the Bay of Fundy (281 mm) or the Passamaquoddy Bay area (205 mm). The size was similar for both years, with the fish of 1966 slightly larger (279 mm) than those for 1967 (268 mm).

In considering the comparisons which have been made between the 1966 and 1967 samples with regard to fat values and lengths, it should be noted that the period of collection was much shorter in 1966 (from May 16 to September 9, except

for two collections made on October 27 and November 23) than in 1967 (from January 26 to December 27). Moreover, the number of fish analyzed was smaller in 1966 (691) than in 1967 (1639). A summary of the comparisons is presented in Table VI. The Hardwood Island samples have been included in the Passamaquoddy Bay calculations, and the 3 samples (8 fish) from Georges Bank have been excluded.

Size comparisons:

Whenever possible, comparisons of fish of different sizes from the same catch were made to determine whether there is a consistent relationship between fat content and length of fish. Sixteen such comparisons are tabulated chronologically in Tables VIIa and VIIb. In cases where there were two (or three) samples of approximately equal size from the same catch, the mean lengths and per cent fat contents were averaged for comparative purposes.

The thirteen comparisons in Table VIIa show an increase in per cent fat content with increasing length. Only three (Table VIIb) show no consistent relationship. Only one of six similar comparisons done on 1966 samples, showed a positive correlation between size and the amount of fat (Trinity Ledge, N. S., August 18, 1966).

Sex comparisons:

Twenty-eight comparisons (Table VIII) made between males and females from the same catch indicate that sex is not related to per cent fat content in any consistent manner. In 17 cases, females were fatter, and in 11 cases males were fatter.

In the instances where males were fatter than females, the values were from .07 to 4.97 per cent (mean 1.94%) more than those for the corresponding female sample. Where females were fatter, their fat values were from .06 to 5.15 per cent (mean 2.23%) higher. The mean difference between the sexes was 2.11 per cent. Overall, females were slightly larger (323 mm) and fatter (12.59%) than males (316 mm and 12.01% respectively).

The fish analyzed for sex comparisons were collected at irregular intervals from June 2 to October 13, 1967. The month in which they were caught did not determine the fatter sex. The monthly sample ratios of fatter females to fatter males were as follows: June, 6:3; July, 4:2; August, 6:3; September 1:2; and October, 0:1.

In 14 similar comparisons done in 1966, there was also no consistent variation in per cent fat content attributable

to sex. Females were fatter in 8 cases and averaged 322 mm in length and 9.63 per cent fat content. Males were smaller (319 mm) and less fat (9.30%).

Besides the 29 comparisons, there were seven other samples for which the sex of the sample was known. In all, 34 samples of males (103 fish) and 35 of females (102 fish) were analyzed. Considering all samples, females were on the average fatter (12.72%) and larger (320 mm) than the males (11.99% and 312 mm respectively). Males from the Gulf of St. Lawrence were fatter (13.47%) and larger (327 mm) than those from the Nova Scotia area (11.94% and 327 mm respectively), the Bay of Fundy (11.49% and 305 mm), and the Passamaquoddy Bay area (10.04% and 168 mm). The same trend occurred for females with those from the Gulf of St. Lawrence fatter (13.42%) and larger (334 mm) than those from the Nova Scotia area (13.18% and 332 mm), the Bay of Fundy (12.41% and 309 mm), and the Passamaquoddy Bay area (7.31% and 286 mm).

Per cent fat contents of males and females were grouped by weekly intervals from June 1 to October 18 and a mean calculated for each interval. Analysis of the changes in mean fat content with time (Fig. 13) did not indicate any significant difference between males and females.

Males ranged in size from 266 to 349 mm and females from 258 to 353 mm. The per cent fat contents of each sex were grouped by 5 mm length intervals and a mean calculated for each interval. One male sample of 168 mm mean length was excluded. Examination of changes in mean per cent fat with length (Fig. 14) did not indicate any significant difference

between males and females.

Bay of Fundy:

Sixty-six samples (340 fish) from the Bay of Fundy (including Yarmouth County in Nova Scotia) were obtained at irregular intervals from February 1 to October 13, 1967 (Table I). Included in this group are six samples taken during the E.E. Prince cruise No. 9. The samples were taken at approximately 43°55'N and 66°38'W (station No. 4, July 24, 1967) and at approximately 44°46'N and 65°51'W (station No. 6, July 25, 1967).

For the 1967 samples, the average fat value was 10.90 per cent and the average fish length 268 mm. In 32 samples (189 fish) analyzed from the same general area in 1966, the average fat value was lower (10.00%) and the average length greater (281 mm). The period of observation was shorter in 1966 (from May 16 to October 26).

In the cases where the sexes were analyzed separately, the females were fatter in 9 of the 11 sex comparisons. A total of 16 female and 16 male samples were analyzed. The females were slightly fatter (12.41%) and larger (309 mm) than the males (11.49% and 305 mm respectively). No analyses of the effect of sex on fat content were carried out on herring caught in this area in 1966.

Analysis of the changes in per cent fat content with time for the Bay of Fundy herring (Fig. 3) indicates a decrease in per cent fat from February 1 to March 5, with a corresponding increase from early June. The lowest fat values occurred on

March 5 (5.62%, Partridge Island, N. B.) and on June 11 (4.60%, Sandy Cove, N. S.). This appears to indicate that from March to early June the fat contents were minimal. The increase in per cent fat following this period appears to level off in July and August. The maximum fat value occurred on June 23 (18.47%, NE Lurcher, N. S.).

It appears that, in the Bay of Fundy, there is no consistent relationship between per cent fat and length (Fig. 8).

Gulf of St. Lawrence:

Forty-five samples (211 fish) were analyzed from the Gulf of St. Lawrence (Table II). Collections from this area were made at irregular intervals from May 17 to September 28, 1967. The two samples from off East Point, P.E.I., were taken at 46°31'10"N and 62°05'00"W.

The average fat content was 11.57 per cent and the average size 325 mm. Of 45 samples (191 fish) analyzed from this area in 1966, both the average fat value (9.73%) and the average length (315 mm) were lower than in 1967. The period of observation was somewhat shorter in 1966 (May 16 to August 31).

Of 7 sex comparisons done in 1967, females were fatter in 4 cases. A total of 7 males and 8 female samples were analyzed. The males were slightly smaller (327 mm), but fatter (13.47%) than the females (334 mm and 13.42% respectively). In 1966, a total of 13 male and 13 female samples were analyzed. As in 1967, males were slightly smaller (319 mm), but fatter (9.66%) than the females (322 mm and 9.47%

respectively). Females were fatter in 7 of the 13 comparisons.

Analyses of the changes in fat content with time for the Gulf of St. Lawrence (Fig. 4) indicate a rapid increase in per cent fat in May and early June. There appears to be a further increase followed by a corresponding decrease after mid-July. However, the highest fat value (20.80%) was obtained from a sample taken on August 25, 1967 at Orphan Bank, N. B. The lowest value (3.22%) was obtained from a sample taken at Caraquet, N. B. on June 5, 1967.

Results were similar for samples analyzed in 1966. There was a rapid increase in fat values for late May and early June, but no further change from the June condition in the remaining samples (collected from July 29 to August 31). The fat values from early June to late July may have remained constant or behaved similarly to those from the same period in 1967 (Fig. 17). The lowest fat value for 1966 was obtained on May 17 (4.57%; Grand Anse, N. B.); the highest value on August 2 (14.28%; Caraquet, N. B.).

Two populations are represented in the Gulf of St. Lawrence data of 1967. The samples from May 17 to June 12 are spring spawning herring, except for one fall spawning sample taken on June 2 from Orphan Bank. The samples from August 23 to September 28 are fall spawning herring. The spawning period of the remaining samples could not be determined. The spring spawning herring average 5.93 per cent fat, the fall spawning herring 12.48 per cent. The low average for the spring spawners is probably due to the spawning process and prior poor feeding conditions. The high average for the fall spawners

would result from extended summer feeding. The fall spawners appear to decrease in per cent fat as the spawning season approaches.

Except for one sample with an average length of 236 mm, the fish analyzed from this area ranged in size from 304 to 346 mm. The fat values for this size range varied from 3.22 to 20.80 percent. There appears to be no correlation between per cent fat content and length of fish (Fig. 9). Spring spawning samples are indicated by the low fat values. The high values represent fall spawning samples mainly, but the spawning season of some was not determined.

Passamaquoddy Bay:

The most thorough analysis on fat content of herring was done on fish collected from the Passamaquoddy Bay area because of proximity to the laboratory. The Passamaquoddy Bay area is defined by a line extending from West Quoddy Head to North Head in Grand Manan to Point Lepreau, N. B. This area includes Deer Island, Campobello and Wolves, but excludes Grand Manan.

Of 77 samples (943 fish), collected from January 26 to December 27, 1967 (Table III), the average fat content was 9.04 per cent and the mean length was 158 mm. In 1966, 36 samples (257 fish) collected from May 25 to August 30, with one sample collected on November 23, were analyzed from this same area. The mean fat value was only slightly lower (8.94%), but the mean length was greater (205 mm) than in 1967.

Of 13 size comparisons from this area (Table VIIa and b), 12 showed a positive correlation between length and fat content. One from 1967 and four similar comparisons made in 1966 showed no consistent relationship between the two variables.

There was only one instance where the sexes were analyzed separately (June 14, 1967, St. Andrews Point, N. B.). In this comparison, the males were fatter (10.04%), but smaller (168 mm) than the females (7.31% and 286 mm respectively). No sex comparisons were done in 1966.

Analysis of the per cent fat content with respect to time for the herring from the Passamaquoddy Bay area (Fig. 5) appears to indicate that fat values decrease from January to May. The lowest fat values occurred on May 30--at Moose Island, N. B. (1.62%) and in the Hardwood Island area (1.64%). This is followed by an increase in fat values which appears to level off around August. The highest value occurred on December 27, (24.91%; Wolves Island, N. B.).

The seasonal trend is more apparent if the mean per cent fat content for each month (Table IX) is examined.

The mean per cent fat content decreases from January (9.11%) to a minimum value in April (3.21%). There is a corresponding increase thereafter which levels off from August (12.22%) to November (13.85%). The high mean value (20.16%) for December may be an anomaly. Food conditions probably account for the seasonal trend in fat content found for Passamaquoddy Bay area herring since fat values are low during the winter when food conditions are poor, and increase there-

after as the availability of food improves. Spawning would have little effect on fat contents here since the majority of samples consisted of immature herring.

No such year-long treatment was possible for 1966 since samples were collected during 5 months only. The monthly means for May (7.79%), June (7.70%), July (9.17%) and August (9.58%) show an increase similar to, but smaller than that for the corresponding period in 1967. The lowest fat value for 1966 occurred on August 4 (3.39%; Birch Cove, N. B.) and the highest fat value on November 23 (17.06%; Beaver Harbour, N. B.). The mean maximum value for each year occurred in the latter months of the year.

There appears to be a direct correlation between length and per cent fat (Fig. 10) for herring ranging in size from approximately 130-185 mm.

Nova Scotia Coastal and Offshore Areas:

Thirty-six samples (145 fish) were analyzed from the Nova Scotia coastal and offshore areas (Table IV). The coastal area included all samples taken along the Atlantic coast from Shelburne County to Victoria County. The offshore samples were taken by otter trawl from Browns and LaHave Banks during E.E. Prince cruise No. 9. The tows were made at approximately 42°46'N; 64°30'W (station No. 1); 42°19'N; 65°24'W (station No. 2); and 42°46'N; 65°57'30"W (station No. 3).

The samples were collected from May 29 to August 23, 1967. The average fat content was 13.17 per cent and the average length 321 mm. Only 9 samples (54 fish) were collected from this same area in 1966 (from May 25 to August 18). Both

the average fat content and the average length were lower in 1966 (10.62% and 314 mm respectively).

Of 9 sex comparisons made from this area, females were fatter in 5 cases. In all, 10 female samples and 10 male samples were analyzed. On the average, females were fatter (13.18%) and larger (332 mm) than males (11.94% and 327 mm). In one comparison done in 1966 (St. Ann's Bay, N. S., May 25), the females were larger (321 mm) but the fat content was much less (5.20%) than for males (302 mm and 10.47%).

Examination of per cent fat with respect to time (Fig. 6) appears to indicate a rapid increase in fat content during May, June and July and a decrease thereafter. The samples consist of both spring and fall spawning herring. All August samples consisted of fall spawners and the decrease may be due to the maturation process.

There is no correlation between length and per cent fat content (Fig. 11).

Hardwood Island Area:

It was considered desirable to obtain regular samples from one locality throughout the year in order to follow the changes in fat content that might occur within a small area. It was possible to collect 29 samples (364 fish) within a mile and one-half radius of Hardwood Island at weekly intervals from April 18 to September 25 (Table V). These samples were examined separately, but the period of observation was not extensive enough for the desired purpose.

The average per cent fat content of the samples was 7.01% and the average length 152 mm. The lowest value (1.56%)

occurred on May 30 and the highest value (16.58%) on August 9. It appears that per cent fat increases with time (Fig. 7), and with length (Fig. 12).

Georges Bank:

Three samples (8 fish) were collected and analyzed from Georges Bank. The average fat content of these samples was 8.71 per cent and the average size 314 mm. The data are presented in Table X.

Analysis of only 3 samples renders suspect any attempt to account for the large variation in per cent fat content between the August and October samples. However, Georges Bank herring are known to be fall spawners and the variation may be related to their spawning period. High fat values (as for August 1) probably result from prior heavy feeding followed by utilization of the accumulated fat reserves in preparation and completion of spawning.

For 3 samples (18 fish) collected in 1966 from Georges Bank on August 19 and 20, the fat contents ranged from 8.40 to 11.23 per cent. The samples consisted of maturing herring, which may be expected to decrease in per cent fat content with time as in the 1967 samples. The higher August fat value in 1967 may be due to heavier feeding than in 1966 or may be an aberrant experimental result.

Relationship between spawning season and fat content:

For this analysis, data from all areas were combined and the samples were divided on the basis of spawning season. Fall spawners included 66 samples from the Bay of Fundy, 77 samples from the Passamaquoddy Bay area, 16 samples from the

Gulf of St. Lawrence, and 26 samples from the Nova Scotia areas. Spring spawners included 15 samples from the Gulf of St. Lawrence and 4 samples from the Nova Scotia areas. The spawning period could not be determined for 14 samples from the Gulf of St. Lawrence and 6 samples from the Nova Scotia areas. The 3 samples from Georges Bank were excluded.

Per cent fat content relationships with length and time were examined for both spring and fall spawning herring.

Analysis of the changes in per cent fat content with time does not indicate any difference in seasonal variation between spring and fall spawning herring, but this may result from insufficient spring spawning samples. For fall spawning herring, the number of available samples (185) was larger and the period of observation more extensive (January 26 to December 27, 1967). In contrast, only 19 definite spring spawning samples were available and these were collected over the short period from May 17 to July 10, 1967.

Examination of spring and fall spawning samples collected from mid-May to early July verifies the expectation that during this period both will show a similar rapid increase in fat content (Fig. 18). No other comparisons can be made between the two because of inadequate spring spawning samples.

The seasonal variation in fat content should not be similar for both spring and fall spawning herring because they spawn at different times of the year. During the winter, both spring and fall spawners are expected to decrease in per cent fat content because of poor feeding conditions. As a result, both spawning groups are in their poorest condition in early

spring. The spring spawning herring, however, must utilize energy during the winter to develop sex products for spawning in the spring. At this time, therefore, spring spawners are expected to show lower per cent fat values than fall spawners. As the availability of food increases from early spring, both are expected to show a similar rapid increase in per cent fat (Fig. 18) to maximum yearly values. However, during the best part of the feeding season, fall spawning herring must now utilize energy to develop sex products for spawning. Consequently, spring spawners are expected to show higher per cent fat values than fall spawners since none of their fat reserves will have been used in maturation. Fall spawners are able to regain some fat loss following spawning because food is still available. With the advent of winter, both spawners decrease in per cent fat content.

Since no differences in the seasonal variations in fat content were apparent between spring and fall spawning herring, all samples were combined and considered together.

The samples were separated into weekly intervals according to the date of capture and a mean was calculated for each interval. A recognizable trend of seasonal variation is indicated from analysis of the weekly change in fat content (Fig. 15). The apparent decrease during the winter months is attributed to poor feeding conditions at that time. The herring appear to be in their poorest condition during early spring and this is followed by an increase in per cent fat. This increase is probably due to increased availability of food. The data from August on represent only fall spawning

herring. The advent of spawning probably accounts for the decrease in per cent fat indicated in August. Following this spawning period, the fat content appears to increase again slightly and feeding advantages might explain this improvement.

The samples were further separated into 10 mm size groups. A mean per cent fat was calculated for each group, and the relationship between length and fat content examined (Fig. 16). For herring ranging in size to approximately 230 mm, there appears to be a positive correlation between length and per cent fat. The larger sized herring do not show the same relationship.

CONCLUSIONS

Analysis of per cent fat with length within each area does not indicate any consistent relationship. There is also no consistent relationship between mean length and mean per cent fat for any area during either 1966 or 1967, but the smallest fish were the least fat in both years. Furthermore, although the herring were, on the average, fatter in 1967, they were smaller than in 1966.

In examination of the seasonal variations in per cent fat, it was difficult to determine yearly trends for each area since the sampling periods were often inadequate. However, a yearly trend was indicated by grouping the samples into weekly intervals (Fig. 15) which becomes more apparent when the monthly mean per cent fat is calculated (Table XI).

The monthly means calculated for 1966 samples show a trend similar to those for corresponding months in 1967.

The size comparisons did not indicate any consistent relationship between length of the sample and per cent fat. Of 20 comparisons done in 1966 and 1967, 13 showed a positive correlation and 7 no correlation between per cent fat and length.

Moreover, the sex comparisons indicated that sex does not affect per cent fat content in any consistent manner. Of 43 sex comparisons done in 1966 and 1967, the females were fatter in 23. Separate examinations of the per cent fat contents of males and females indicate no significant difference with respect to time or length. There is, however, an area trend in the size and per cent fat averages for males and females.

Separate analyses of spring and fall spawning herring did not indicate any difference in their seasonal trends of fat content. Both spawners were expected to show a similar decrease in per cent fat during the winter and an increase thereafter as food becomes more available in the spring. However, the range of seasonal variation in per cent fat is expected to be higher for spring spawners. This difference was not apparent because of inadequate sampling.

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MADE IN

HOWARD

Table I. Fat Contents of Herring from the Bay of Fundy, 1967.

Date	Locality	No. of		Mean Length	% Fat Content		
		Fish	Sex		Range	Mean	
Feb.	1	Whale Cove, G.M.	13	-	133	6.20- 6.80	6.41
"	2	Musquash Head, N.B.	13	-	130	8.42- 9.10	8.75
"	5	Seal Cove, G.M.	13	-	134	5.96- 6.35	6.09
"	10	North Head, G.M.	12	-	153	7.30- 8.27	7.70
"	20	"	6	-	202	7.78- 8.03	7.88
Mar.	5	Partridge I., N.B.	17	-	114	5.62- 5.95	5.76
June	2	SW Buoy, Yarmouth Co.	3	♂	297	12.14-12.30	12.21
"	2	"	3	♂	258	12.45-13.01	12.66
"	2	"	3	♂	266	12.72-13.05	12.92
"	4	Hd. St. Marys Bay, N.S.	6	-	187	9.89-10.18	10.05
"	6	Little River, Digby Neck	6	-	274	10.20-11.15	10.56
"	9	Brier I., N.S.	3	♂	270	9.17-10.90	9.76
"	9	"	3	♂	279	10.27-11.87	11.11
"	10	Griffen Cove, N.S.	6	♂	237	9.28- 9.42	9.37
"	10	Plympton, N.S.	6	-	177	10.31-11.41	10.98
"	11	Sandy Cove, N.S.	6	-	257	4.60- 5.09	4.76
"	13	Lower West Pubnico	3	♂	352	14.97-17.04	15.79
"	13	"	3	♂	349	10.45-11.95	11.23
"	14	Long Island, N.S.	6	-	268	7.73- 8.04	7.84
"	17	NW of Lurcher Light	3	♂	286	10.28-10.69	10.54
"	17	"	3	♂	305	14.98-16.13	15.51
"	23	St. Ann Pt., N.S.	6	-	339	11.59-13.98	12.81
"	23	NE Lurcher	3	♂	281	11.51-12.23	11.84
"	23	"	3	♂	343	10.05-13.71	12.28
"	23	"	3	♂	342	12.38-13.24	12.95
"	23	"	3	♂	271	10.96-12.63	12.00
"	23	"	3	♂	282	16.38-18.47	17.36
"	30	W. of Cape St. Mary	6	-	252	10.72-12.98	11.73
July	6	SW Buoy, Yarmouth Co.	2	♂	319	11.30-12.22	11.70
"	7	Long Island, N.S.	6	-	314	6.55-11.00	9.20
"	7	Cape St. Mary, N.S.	3	-	317	9.87-10.46	10.15
"	8	"	3	♂	334	7.46- 9.53	8.29
"	8	"	3	♂	323	13.08-13.52	13.36
"	11	W. of Cape St. Mary	3	♂	283	13.41-13.66	13.54
"	11	Cape St. Mary, N.S.	3	♂	267	11.63-12.39	11.95
"	13	Sandy Cove, N.S.	3	♂	336	9.71- 9.83	9.77
"	13	"	3	♂	324	14.01-15.56	14.92
"	24	Lurcher area (EEP9 #4)	6	-	246	10.49-11.08	10.73
"	24	"	6	-	251	7.96- 8.30	8.18
"	24	"	8	-	237	6.46- 8.87	7.41
"	25	Bay of Fundy (EEP9 #6)	4	-	288	8.94-10.21	9.70
"	25	"	6	-	260	7.93- 8.85	8.25
"	25	"	6	-	276	9.56-10.11	9.84
"	31	Long Island, N.S.	6	-	295	9.41- 9.65	9.49

Table I. (Cont'd).

Date	Locality	No. of		Mean Length	% Fat Content	
		Fish	Sex		Range	Mean
Aug. 3	Long Island, G.M.	6	-	216	16.65-17.41	17.01
" 7	Long Island, N.S.	6	-	277	10.64-11.33	10.98
" 7	NW of Digby Gut (Yankee Bank)	7	-	289	8.64- 9.41	9.05
" 10	SW Buoy, Yarmouth Co.	3	♂	311	12.66-13.89	13.43
" 10	"	3	♀	291	12.75-13.32	13.02
" 10	Whale Cove, G.M.	6	-	227	12.01-12.38	12.18
" 10	SW Buoy, Yarmouth Co.	3	♂	282	10.90-11.98	11.34
" 10	"	3	♀	330	11.64-12.14	11.87
" 16	Lurcher Shoal	3	♂	324	9.93-10.21	10.10
" 16	"	3	♀	320	12.29-12.66	12.44
" 17	Whale Cove, G.M.	6	-	223	15.41-16.63	16.03
" 22	Long Island, N.S.	6	-	270	7.14- 7.75	7.35
" 24	W. of Cape St. Mary	6	-	232	7.97- 8.73	8.33
" 30	Whale Cove, G.M.	6	-	248	13.57-13.94	13.75
Sept. 4	"	6	-	291	10.37-11.68	10.87
" 12	Lurcher Shoal	6	-	315	11.15-11.78	11.47
" 19	"	3	♂	321	7.02- 7.21	7.08
" 19	"	3	♀	314	8.33- 8.55	8.43
" 21	Whale Cove, G.M.	6	-	170	14.40-14.51	14.45
Oct. 12	Duck I. Sound, G.M.	8	-	107	11.99-12.17	12.10
" 13	Trinity Ledge	3	♂	319	12.08-12.88	12.47
" 13	"	3	♀	318	9.56-11.08	10.41

Table II. Fat Contents of Herring from the Gulf of St. Lawrence, 1967.

Date	Locality	No. of		Mean Length	% Fat Content		
		Fish	Sex		Range	Mean	
May	17	Shippigan Gully, N.B.	6	-	312	7.12- 7.24	7.16
"	18	Escuminac, N.B.	6	-	311	5.07- 5.43	5.27
"	22	"	6	-	316	6.86- 8.37	7.58
"	24	Caraquet I., N.B.	6	-	318	4.06- 4.32	4.15
"	25	Egmont Bay, PEI	6	-	317	3.84- 4.11	3.98
"	26	"	6	-	313	5.60- 5.98	5.73
"	30	"	6	-	310	5.83- 6.67	6.11
June	1	Escuminac, N.B.	6	-	326	6.16- 6.75	6.44
"	2	Orphan Bank	6	-	339	14.36-14.71	14.52
"	2	Magdalen Is., P.Q.	6	-	337	10.17-10.77	10.38
"	2	Caraquet, N.B.	3	♂	325	3.56- 3.92	3.78
"	2	"	3	♂	330	6.82- 6.99	6.89
"	5	"	3	♂	318	3.22- 3.60	3.45
"	5	"	3	♂	324	4.87- 5.44	5.10
"	5	Egmont Bay, PEI	6	-	307	5.95- 6.13	6.02
"	12	"	6	-	313	6.65- 7.26	6.95
"	23	Shippigan Gully, N.B.	3	♂	333	17.00-19.61	18.48
"	23	"	3	♂	304	17.88-19.66	18.89
"	28	Off East Pt., PEI	5	-	324	14.53-14.95	14.72
July	5	"	6	-	236	13.50-14.17	13.77
"	10	Escuminac, N.B.	6	-	329	14.84-16.31	15.50
"	11	N. Rustico, PEI	6	-	326	15.83-17.18	16.67
"	24	Bonaventure I., P.Q.	3	♂	346	18.05-18.47	18.20
"	24	"	3	♂	331	20.03-20.78	20.42
Aug.	1	"	3	♂	334	17.99-18.62	18.34
"	1	"	3	♂	340	18.70-19.29	19.05
"	2	Escuminac, N.B.	3	♂	330	14.90-15.27	15.10
"	9	Port Chandler, P.Q.	6	-	331	13.17-14.72	14.04
"	10	Souris, PEI	3	-	340	16.79-17.28	17.07
"	23	Grande Rivière, P.Q.	6	-	337	13.02-13.93	13.47
"	23	Magdalen Is., P.Q.	2	-	338	11.46-12.01	11.77
"	25	Orphan Bank	6	-	329	17.39-20.80	19.40
"	28	Cap-d'Espoir, P.Q.	6	-	332	12.54-13.38	12.88
"	28	Miscou I., N.B.	3	♂	316	9.00- 9.09	9.03
"	28	"	3	♂	335	9.63-10.24	9.86
"	28	W. of Pictou I., N.S.	6	♂	344	10.69-12.35	11.40
"	29	Paspebiac, P.Q.	6	-	338	12.93-13.46	13.18
"	30	"	6	-	334	13.13-15.86	14.15
"	31	Miscou I., N.B.	6	-	341	12.52-12.71	12.60
Sept.	2	"	6	-	338	9.90-11.05	10.51
"	2	Shippigan, N.B.	3	♂	336	13.86-14.27	14.11
"	2	"	3	♂	324	9.82-10.68	10.16
"	19	E. of Cape Gaspé	6	-	308	14.52-15.55	14.96
"	28	Skinner Cove, N.S.	3	♂	342	9.65- 9.81	9.72
"	28	"	3	♀	333	9.32-10.12	9.65

Table III. Fat Contents of Herring from Passamaquoddy Bay Area, 1967.

Date	Locality	No. of		Mean Length	% Fat Content		Mean
		Fish	Sex		Range		
Jan. 26	Lepreau, N.B.	16	-	122	9.35-9.97		9.76
" 30	"	11	-	115	7.60-9.02		8.46
Feb. 5	"	11	-	117	6.47-7.67		7.03
" 15	"	13	-	109	8.60-9.51		9.20
" 23	"	10	-	141	5.73-6.05		5.85
" 27	"	25	-	125	5.16-5.54		5.35
Mar. 15	"	11	-	151	6.36-6.59		6.48
" 21	Deadman's Head, N.B.	13	-	117	3.56-3.91		3.72
" 21	Lepreau, N.B.	12	-	113	2.22-2.32		2.28
Apr. 13	"	21	-	117	2.51-2.72		2.60
" 18	Hardwood I., N.B.	12	-	119	3.14-4.63		3.81
May 11	"	12	-	132	4.30-5.20		4.66
" 16	SE Hardwood I., N.B.	6	-	175	7.85-8.31		8.10
" 16	"	5	-	217	8.08-8.85		8.44
" 16	"	12	-	125	4.56-4.67		4.61
" 24	"	10	-	136	4.63-4.71		4.48
" 30	"	20	-	115	2.24-2.50		2.39
" 30	"	20	-	96	1.56-1.75		1.64
" 30	Moose Island, N.B.	5	-	133	1.13-2.24		1.62
June 6	"	11	-	113	3.98-5.57		4.62
" 6	St. Andrews Pt., N.B.	10	-	154	3.73-3.78		3.75
" 11	Mill Cove, Campobello I.	6	-	255	8.13-8.31		8.22
" 14	St. Andrews Pt., N.B.	3	♂	286	7.03-7.57		7.31
" 14	"	3	♂	168	9.65-10.40		10.04
" 14	"	10	-	193	4.79-5.70		5.24
" 14	"	20	-	136	3.79-4.89		4.47
" 20	NW Hardwood I., N.B.	25	-	125	2.55-2.79		2.69
" 20	"	9	-	166	4.83-5.25		5.03
" 20	"	5	-	189	7.21-8.66		7.99
" 20	SE Hardwood I., N.B.	10	-	150	3.93-4.27		4.08
" 27	Mill Cove, Campobello I.	7	-	257	8.32-9.69		8.85
" 27	South Hardwood I., N.B.	12	-	159	4.26-6.41		5.02
" 27	McCanns Cove, N.B.	12	-	161	5.74-5.88		5.80
" 27	"	6	-	254	6.65-7.24		6.95
July 6	SE Hardwood I., N.B.	10	-	165	4.68-5.02		4.86
" 6	"	10	-	116	3.03-3.26		3.16
" 12	"	20	-	143	4.18-4.87		4.57
" 12	"	20	-	125	4.50-4.93		4.71
" 18	SW Hardwood I., N.B.	10	-	167	8.77-9.54		9.23
" 18	"	20	-	122	4.81-5.14		5.02
" 18	"	10	-	145	6.45-7.24		6.85
" 21	NW Hbr., Deer I.	6	-	294	15.17-16.14		15.67
" 26	St. Andrews Pt., N.B.	10	-	170	9.30-10.19		9.75
" 26	"	5	-	204	14.88-15.09		14.99
" 26	SW Hardwood I., N.B.	10	-	156	7.98-8.16		8.05

Table III. (Cont'd).

Date	Locality	No. of		Mean Length	% Fat Content	
		Fish	Sex		Range	Mean
Aug. 3	SE Hardwood I., N.B.	15	-	144	6.31- 8.22	7.25
" 3	"	10	-	178	9.39-10.01	9.80
" 9	S Hardwood I., N.B.	15	-	153	5.76- 7.16	6.55
" 9	"	10	-	202	15.15-16.58	16.20
" 9	Navy I., N.B.	15	-	168	13.00-13.24	13.15
" 9	"	5	-	219	19.64-20.40	20.12
" 10	Mill Cove					
	Campobello I.	6	-	279	15.60-16.24	15.86
" 17	Perry, Me.	6	-	271	15.69-17.01	16.50
" 22	Moose I., N.B.	6	-	243	14.72-15.59	15.05
" 23	Navy I., N.B.	73	-	82	3.86- 4.75	4.34
" 23	"	8	-	159	10.06-10.39	10.22
" 23	"	5	-	185	14.86-15.95	15.23
" 28	Deer I.	15	-	90	7.19- 7.36	7.28
" 31	SE Hardwood I., N.B.	10	-	172	12.92-14.13	13.54
Sept. 11	Deer I.	12	-	95	9.20- 9.45	9.33
" 14	St. Andrews Bay	9	-	112	15.40-15.51	15.47
" 14	Hardwood I., N.B.	6	-	192	16.56-16.8+	16.71
" 18	Chatties Pt., Deer I.	10	-	101	13.84-14.60	14.15
" 20	St. Andrews Pt., N.B.	24	-	95	5.68- 5.88	5.75
" 20	"	12	-	183	13.87-14.46	14.10
" 20	Hardwood I., N.B.	10	-	166	10.30-10.63	10.41
" 25	"	20	-	164	13.22-13.81	13.47
" 28	Deer I.	14	-	105	15.30-15.50	15.39
Oct. 3	Wolves Is.	9	-	172	15.67-16.15	15.96
" 9	Chatties Pt., Deer I.	12	-	101	8.80- 9.59	9.07
" 17	Friars Bay,					
	Campobello I.	13	-	107	12.28-12.91	12.60
" 27	Hardwood I., N.B.	15	-	163	13.17-13.36	13.25
Nov. 15	SE Navy I., N.B.	5	-	183	15.44-16.02	15.78
" 15	"	30	-	104	8.93- 9.12	9.06
" 29	Navy I., N.B.	6	-	183	15.51-18.08	16.72
Dec. 27	Perry Shore, Me.	6	-	175	15.46-16.72	15.98
" 27	Wolves Is.	6	-	139	23.74-24.91	24.33

Table IV. Fat Contents of Herring from the Nova Scotian Coast and Offshore Areas, 1967.

Date	Locality	No. of Fish	Sex	Mean	% Fat Content	
				Length	Range	Mean
May 29	St. John I.	10	-	264	4.90-10.97	8.78
June 5	St. Ann's Bay, C.B.	6	-	303	4.35- 5.84	5.11
" 6	St. John I.	4	♂	325	8.66- 9.16	8.87
" 14	Roseway Light	3	♂	345	14.82-15.06	14.94
" 14	"	3	♀	330	14.02-16.13	15.05
" 17	Shelburne Hbr.	3	-	318	17.45-18.54	17.98
" 22	St. John I.	3	-	348	13.55-15.27	14.23
" 26	St. Ann's Bay, C.B.	6	-	302	10.50-10.81	10.66
July 4	"	6	-	313	14.59-15.41	14.88
" 5	NW Hbr., Shelbourne Co.	3	♀	333	17.57-17.85	17.70
" 5	"	3	♂	325	14.46-15.12	14.71
" 6	Shelburne Hbr.	6	-	317	12.46-16.29	14.45
" 10	Ingonish	6	-	347	20.49-21.19	20.91
" 15	Shelburne Hbr.	6	-	238	16.37-18.00	17.13
" 18	Shelburne	3	♂	336	15.36-16.28	15.79
" 18	"	3	♀	328	14.98-15.36	15.16
" 19	Port Latour	3	♂	339	9.21- 9.33	9.29
" 19	"	3	♀	353	10.75-13.04	11.95
" 22	Shelburne Hbr.	3	-	324	15.36-15.78	15.61
" 22	Browns Bank (EEP9#1)	6	-	338	12.82-14.44	13.86
" 22	"	3	-	263	15.47-16.34	15.97
" 22	"	6	-	343	13.35-16.88	14.53
" 22	Browns Bank (EEP9#2)	6	-	317	13.50-13.73	13.64
" 23	Browns Bank (EEP9#3)	4	-	270	11.57-12.42	12.12
Aug. 2	Ingomar	3	♂	309	9.83-10.37	10.12
" 2	"	3	♀	320	13.09-13.62	13.39
" 3	E. of Browns Bank	1	♀	302	14.23-15.74	14.95
" 10	NW Hbr., Shelbourne Co.	3	♂	322	10.26-10.90	10.60
" 10	"	3	♀	327	12.58-13.04	12.87
" 15	Ingomar	3	♂	328	11.82-13.73	12.56
" 15	"	3	♀	352	9.31-10.55	9.86
" 17	Shelburne Hbr.	3	♂	311	12.58-13.25	12.80
" 17	"	3	♀	348	10.76-12.90	12.07
" 17	Port Latour	3	♂	331	8.99-10.93	9.73
" 17	"	3	♀	329	8.57- 9.00	8.81
" 23	Port Mouton	6	-	341	12.73-13.13	13.00

Table V. Fat Contents of Herring from the Hardwood Island area.

Date	Locality	No. of		Mean Length	% Fat Content		Mean
		Fish	Sex		Range		
Apr. 18	Hardwood I, N.B.	12	-	119	3.14-4.63		3.81
May 11	"	12	-	132	4.30-5.20		4.66
" 16	SE Hardwood I., N.B.	6	-	175	7.85-8.31		8.10
" 16	"	5	-	217	8.08-8.85		8.44
" 16	"	12	-	125	4.56-4.67		4.61
" 24	"	10	-	136	4.36-4.71		4.48
" 30	"	20	-	115	2.24-2.50		2.39
" 30	"	20	-	96	1.56-1.75		1.64
June 20	NW Hardwood I., N.B.	9	-	166	4.83-5.25		5.03
" 20	"	25	-	125	2.55-2.79		2.69
" 20	"	5	-	189	7.21-8.66		7.99
" 20	SE Hardwood I., N.B.	10	-	150	3.93-4.27		4.08
" 27	S Hardwood I., N.B.	12	-	159	4.26-6.41		5.02
July 6	SE Hardwood I., N.B.	10	-	165	4.68-5.02		4.86
" 6	"	10	-	116	3.03-3.26		3.16
" 12	"	20	-	143	4.18-4.87		4.57
" 12	"	20	-	125	4.50-4.93		4.71
" 18	SW Hardwood I., N.B.	10	-	167	8.77-9.54		9.23
" 18	"	20	-	122	4.81-5.14		5.02
" 18	"	10	-	145	6.45-7.24		6.85
" 26	"	10	-	156	7.98-8.16		8.05
Aug. 3	SE Hardwood I., N.B.	10	-	173	9.39-10.01		9.80
" 3	"	15	-	144	6.31-8.22		7.25
" 9	S Hardwood I., N.B.	10	-	202	15.15-16.58		16.20
" 9	"	15	-	153	5.76-7.16		6.55
" 31	SE Hardwood I., N.B.	10	-	172	12.92-14.13		13.54
Sept. 14	Hardwood I., N.B.	6	-	192	16.56-16.84		16.71
" 20	"	10	-	166	10.30-10.63		10.41
" 25	"	20	-	164	13.22-13.81		13.47

Table VI. Summary of 1966 and 1967 Herring Fat Analyses

Locality	No. of Samples		No. of Fish		Mean Length (mm)		Mean Fat Content %	
	1966	1967	1966	1967	1966	1967	1966	1967
Bay of Fundy	32	66	189	340	281	268	10.00	10.90
Gulf of St. Lawrence	45	45	191	211	315	325	9.73	11.57
Passamaquoddy Bay	36	77	257	943	205	158	8.94	9.04
Nova Scotia	9	36	54	145	314	321	10.62	13.17
Total	122	224	691	1639				
Mean					279	268	9.82	11.17

Table VIIa. Comparisons Showing a Positive Correlation
Between Fat Contents and Length.

Date	Locality	Mean Length (mm)	Mean Fat Content (%)	No. of Fish
May	16 SE Hardwood I.	125	4.61	12
		175	8.10	6
		217	8.44	5
June	20 NW Hardwood I.	125	2.69	25
		166	5.03	9
		189	7.99	5
June	27 McCanns Cove	161	5.80	12
		254	6.95	6
July	6 SE Hardwood I.	116	3.16	10
		165	4.86	10
July	18 SW Hardwood I.	122	5.08	20
		145	6.85	10
		167	9.23	10
July	25 Bay of Fundy	260	8.25	6
		282	9.77	10*
July	26 St. Andrews Pt.	170	9.75	10
		204	14.99	5
Aug.	3 SE Hardwood I.	144	7.25	15
		178	9.80	10
Aug.	9 South Hardwood I.	153	6.55	15
		202	16.20	10
Aug.	9 Navy Island	168	13.15	15
		219	20.12	3
Aug.	23 Navy Island	82	4.34	73
		159	10.22	8
		185	15.23	5
Sept.	20 St. Andrews Pt.	95	5.75	24
		183	14.10	12
Nov.	15 SE Navy Island	104	9.06	30
		183	15.78	5

*2 samples averaged

Table VIIb. Comparisons Showing no Consistent Relationship
Between Fat Content and Length.

Date	Locality	Mean Length (mm)	Mean Fat Content (%)	No. of Fish
June 14	St. Andrews Pt.	136	4.47	20
		168	10.04	3
		193	5.24	10
		286	7.31	3
June 23	NE Lurcher	278	13.73	9**
		343	12.62	6*
July 22	Browns-LaHave area	263	15.97	3
		341	14.20	12*

*2 samples averaged

**3 samples averaged

Table VIII. Comparisons Between Male and Female Herring From the Same Catch.

Date	Locality	No. of Samples	No. of Fish	Sex	Mean Length	Mean Fat Content %	Difference
June	2 Caraquet, N.B.	1	3	♂	325	3.78	3.11
		1	3	♀	330	6.89	
"	2 SW Buoy, Yarmouth Co., N.S.	2	6	♂	282	12.57	.09
		1	3	♀	258	12.66	
"	9 Brier Island, N.S.	1	3	♂	270	9.76	1.35
		1	3	♀	279	11.11	
"	13 Lower West Pubnico, N.S.	1	3	♂	349	11.23	4.56
		1	3	♀	352	15.79	
"	14 St. Andrews, N.B.	1	3	♂	168	10.04	2.73
		1	3	♀	286	7.31	
"	14 Roseway Light, N.S.	1	3	♂	345	14.04	.11
		1	3	♀	330	15.05	
"	17 NW of Lurcher Light	1	3	♂	305	15.51	4.97
		1	3	♀	286	10.54	
"	23 NE Lurcher	2	6	♂	307	12.14	1.91
		3	9	♀	302	14.05	
"	23 Shippigan Gully, N.B.	1	3	♂	304	18.89	.39
		1	3	♀	333	18.48	
July	5 NW Hbr., Shelburne Co., N.S.	1	3	♂	325	14.71	2.99
		1	3	♀	333	17.70	
"	8 Cape St. Mary, N.S.	1	3	♂	334	8.29	5.07
		1	3	♀	323	13.36	
"	13 Sandy Cove, N.S.	1	3	♂	336	9.77	5.15
		1	3	♀	324	14.92	

Table VIII (Cont'd)

Date	Locality	No. of Samples	No. of Fish	Sex	Mean Length	Mean Fat Content %	Difference
July 18	Shelburne, N.S.	1	3	♂	336	15.79	.63
		1	3	♀	328	15.16	
" 19	Port Latour, N.S.	1	3	♂	339	9.29	2.66
		1	3	♀	353	11.95	
" 24	Bonaventure I., P.Q.	1	3	♂	331	20.42	2.22
		1	3	♀	346	18.20	
Aug. 1	Bonaventure I., P.Q.	1	3	♂	334	18.34	.71
		1	3	♀	340	19.05	
" 2	Ingomar, N.S.	1	3	♂	309	10.12	3.27
		1	3	♀	320	13.39	
" 10	NW Hbr., Shelburne Co., N.S.	1	3	♂	322	10.60	2.27
		1	3	♀	327	12.87	
" 10	SW Buoy, Yarmouth Co., N.S.	2	6	♂	297	12.39	.06
		2	6	♀	311	12.45	
" 15	Ingomar, N.S.	1	3	♂	328	12.56	2.70
		1	3	♀	352	9.86	
" 16	Lurcher Shoal	1	3	♂	324	10.10	2.36
		1	3	♀	320	12.44	
" 17	Shelburne Hbr., N.S.	1	3	♂	311	12.80	.73
		1	3	♀	348	12.07	
" 17	Port Latour, N.S.	1	3	♂	331	9.73	.92
		1	3	♀	329	8.81	
" 28	Miscou I., N.B.	1	3	♂	316	9.03	.83
		1	3	♀	335	9.86	

Table VIII. (Cont'd)

Date	Locality	No. of Samples	No. of Fish	Sex	Mean Length	Mean Fat Content %	Difference
Sept. 2	Shippigan, N.B.	1	3	♂	336	14.11	3.95
		1	3	♀	324	10.16	
" 19	Lurcher Shoal	1	3	♂	321	7.08	1.35
		1	3	♀	314	8.43	
" 28	Skinner Cove, N.S.	1	3	♂	342	9.72	.07
		1	3	♀	333	9.65	
Oct. 13	Trinity Ledge, N.S.	1	3	♂	319	12.47	2.06
		1	3	♀	318	10.41	

Table IX. Monthly Mean Per Cent Fat Contents for the
Passamaquoddy Bay Area.

Month	No. of Samples	Mean % Fat Content
January	2	9.11
February	4	6.86
March	3	4.16
April	2	3.21
May	8	4.49
June	15	6.00
July	11	7.90
August	14	12.22
September	9	12.75
October	4	12.72
November	3	13.85
December	2	20.16

Table X. Fat Contents of Herring From Georges Bank.

Date	No. of Fish	Sex	Mean	Fat Content %	
			Length (mm)	Range	Mean
Aug. 1	2	-	317	15.43-15.49	15.45
Oct. 2	3	♂	314	4.51- 4.57	4.54
Oct. 2	3	♀	310	5.47- 7.08	6.14

Table XI. Monthly Mean Per Cent Fat Contents for 1966 and 1967.

Month	1966		1967	
	No. of Samples	Mean % Fat Content	No. of Samples	Mean % Fat Content
January	-	-	2	9.11
February	-	-	9	7.14
March	-	-	4	4.56
April	-	-	2	3.21
May	36	8.46	16	5.29
June	19	9.25	56	9.80
July	21	10.52	48	11.99
August	42	10.12	55	12.55
September	2	6.93	20	11.81
October	1	18.63	7	12.27
November	1	16.74	3	13.85
December	-	-	2	20.16

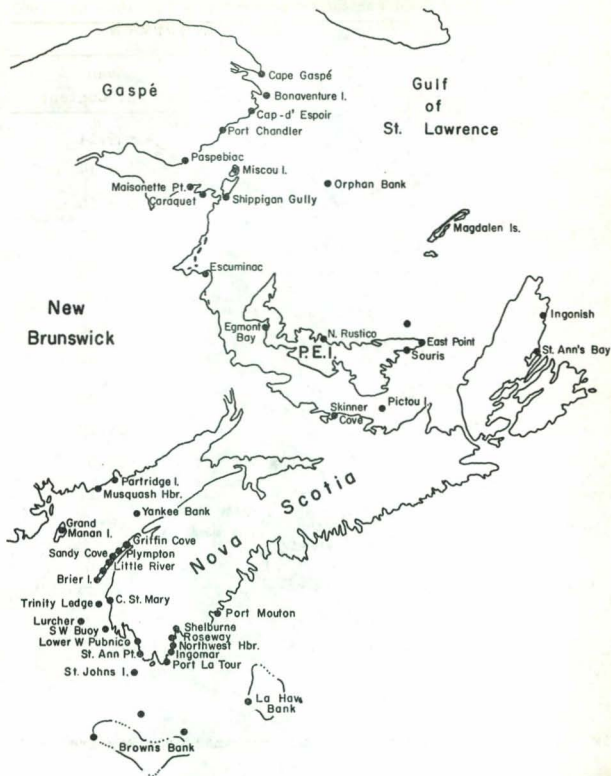


Fig. 1. Sampling localities of the Gulf of St. Lawrence, Bay of Fundy and Nova Scotia coastal and offshore areas.

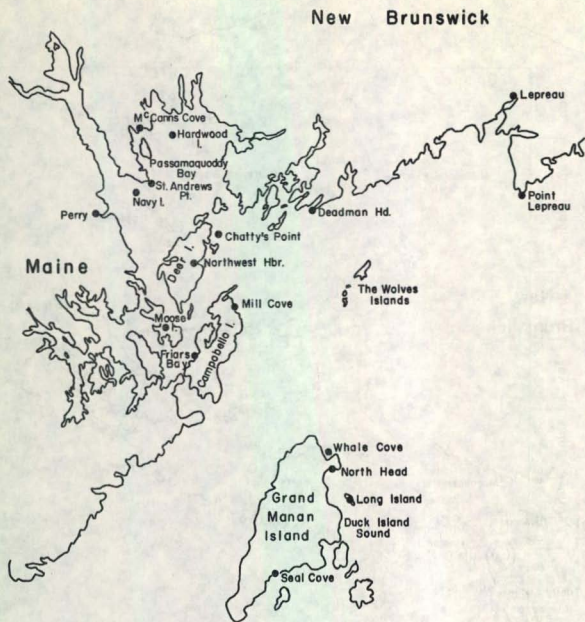


Fig. 2. Sampling localities of the Passamaquoddy Bay area and Grand Manan.

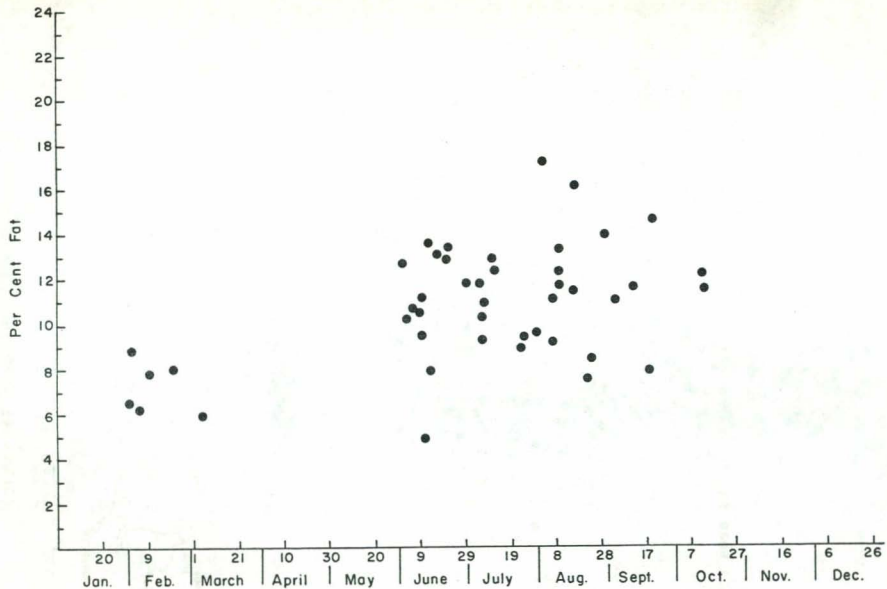


Fig. 3. Seasonal variations in the fat content of herring from the Bay of Fundy, 1967.

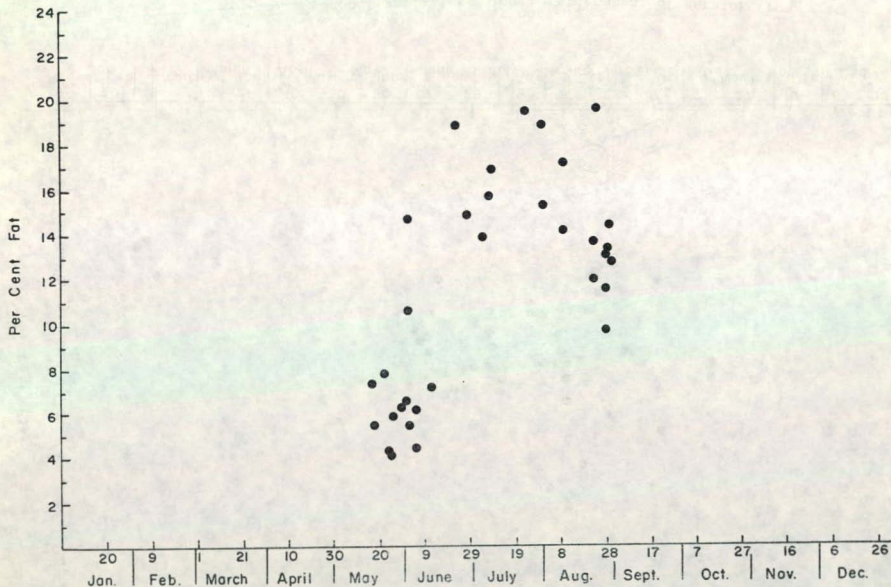


Fig. 4. Seasonal variations in the fat content of herring from the Gulf of St. Lawrence, 1967.

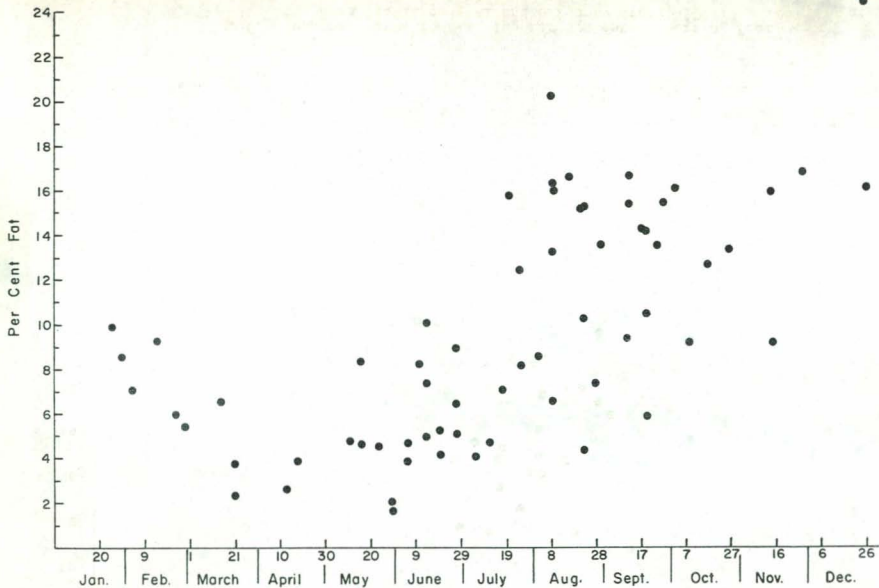


Fig. 5. Seasonal variations in the fat content of herring from the Passamaquoddy Bay area, 1967.

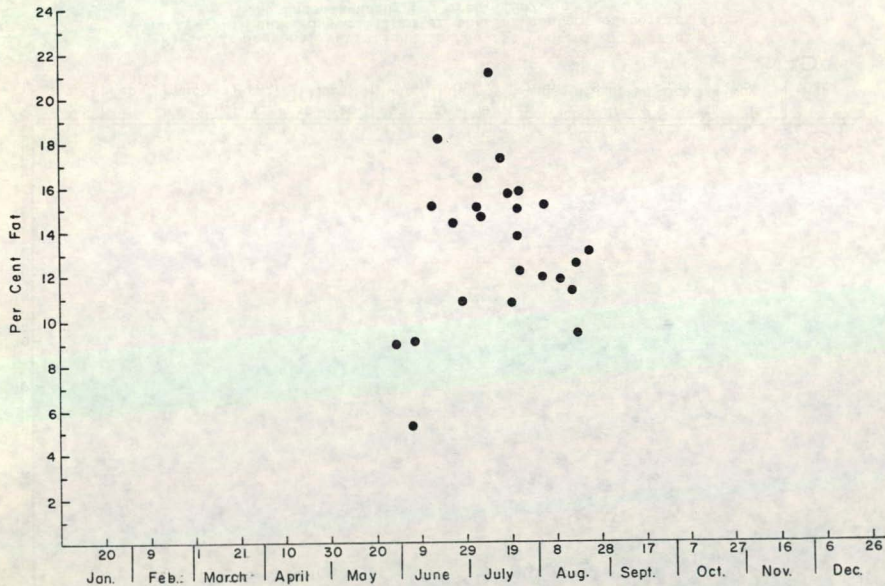


Fig. 6. Seasonal variations in the fat content of herring from the Nova Scotia coastal and offshore areas, 1967.

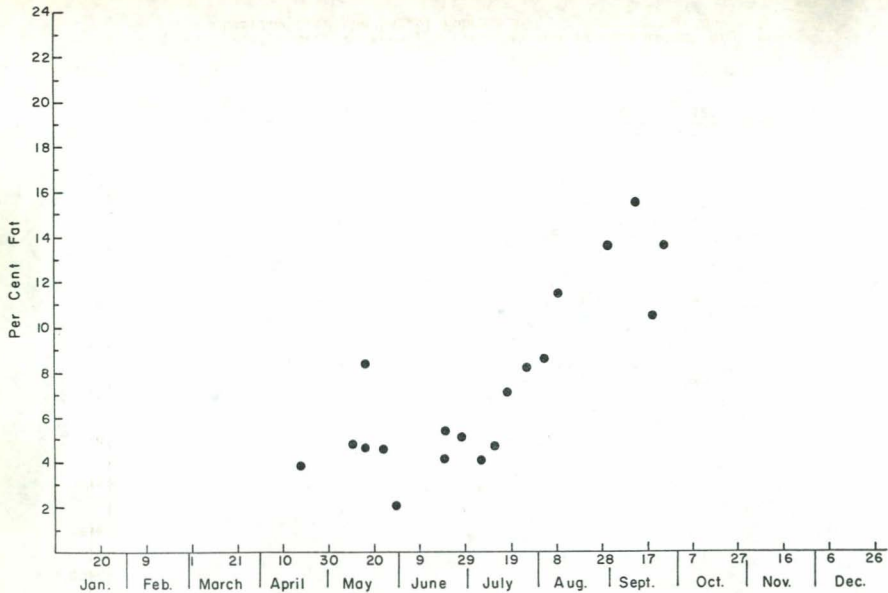


Fig. 7. Seasonal variations in the fat content of herring from the Hardwood Island area, 1967.

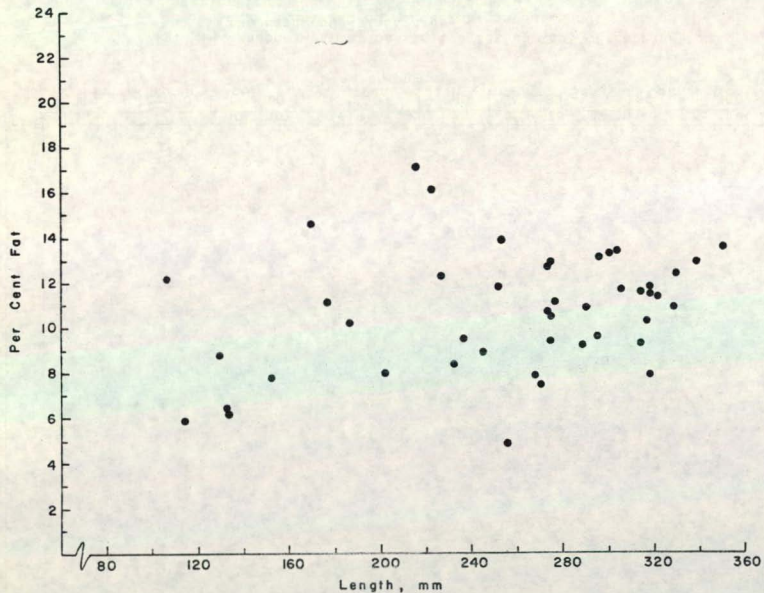


Fig. 8. Relationship between per cent fat content and length of herring from the Bay of Fundy.

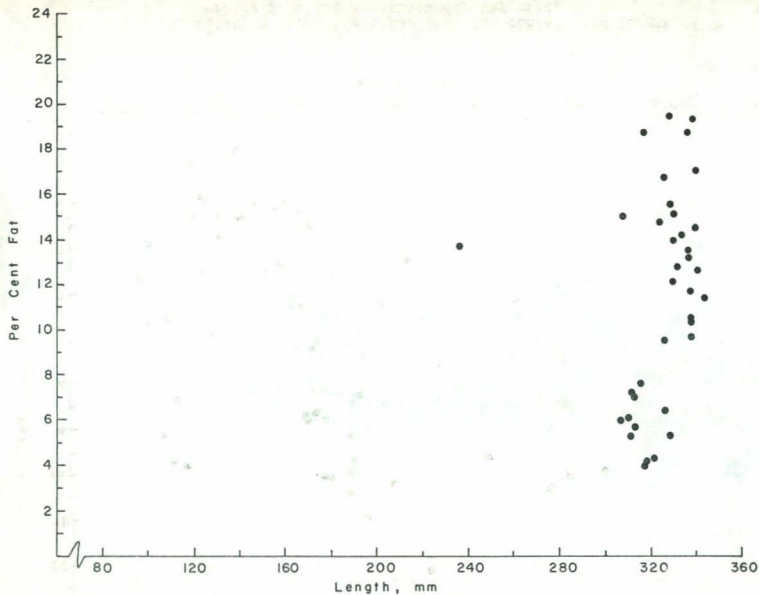


Fig. 9. Relationship between per cent fat content and length of herring from the Gulf of St. Lawrence.

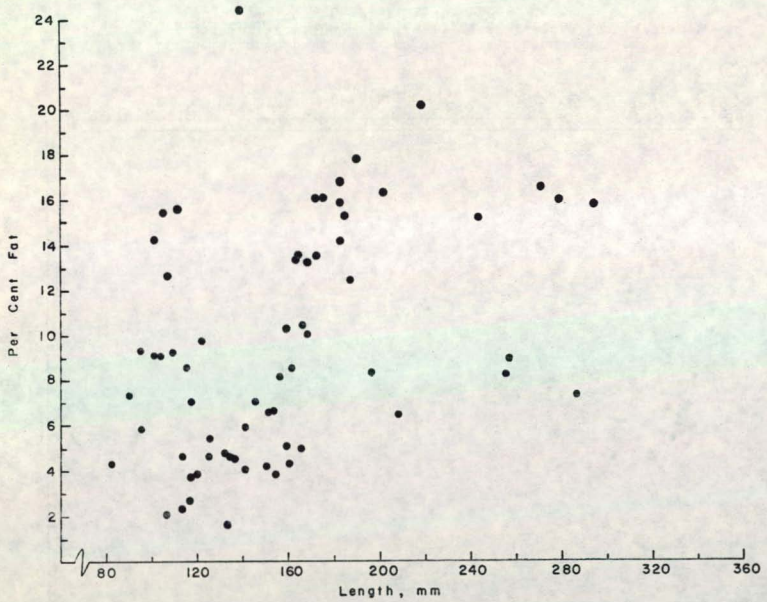


Fig. 10. Relationship between per cent fat content and length of herring from the Passamaquoddy Bay area.

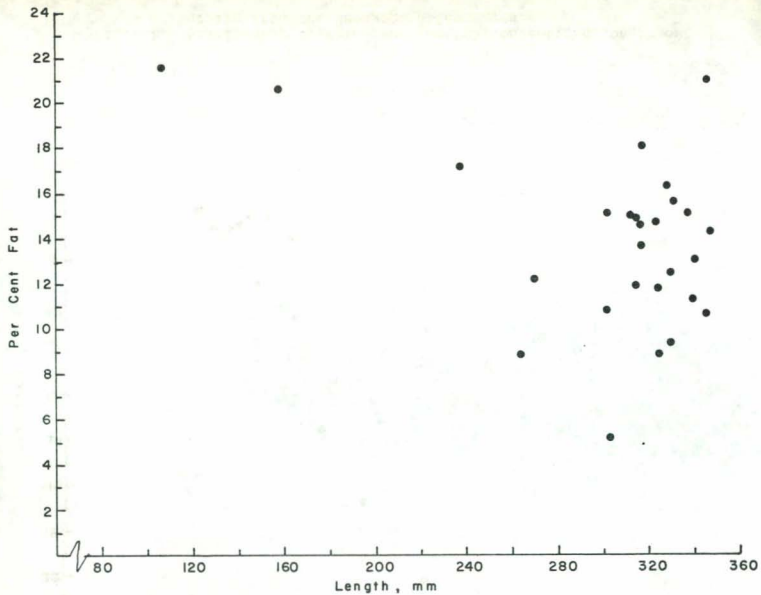


Fig. 11. Relationship between per cent fat content and length of herring from the Nova Scotia coastal and offshore areas.

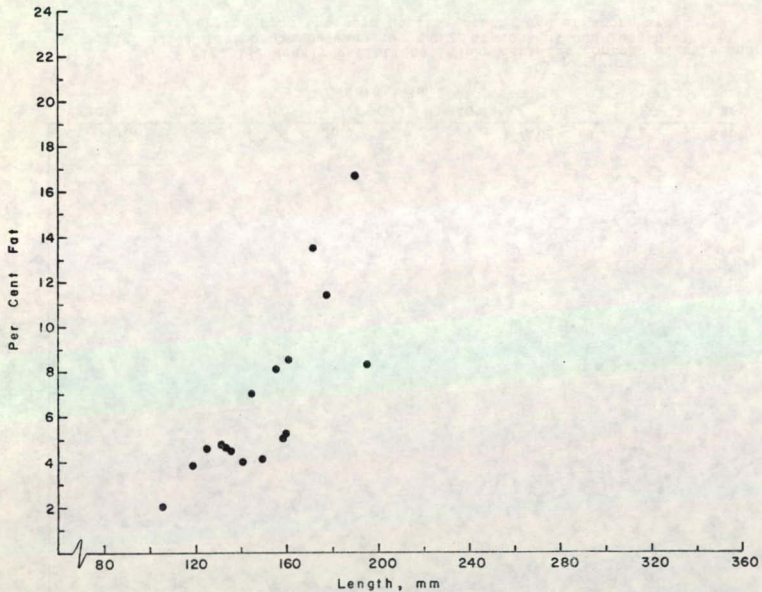


Fig. 12. Relationship between per cent fat content and length of herring from the Hardwood Island area.

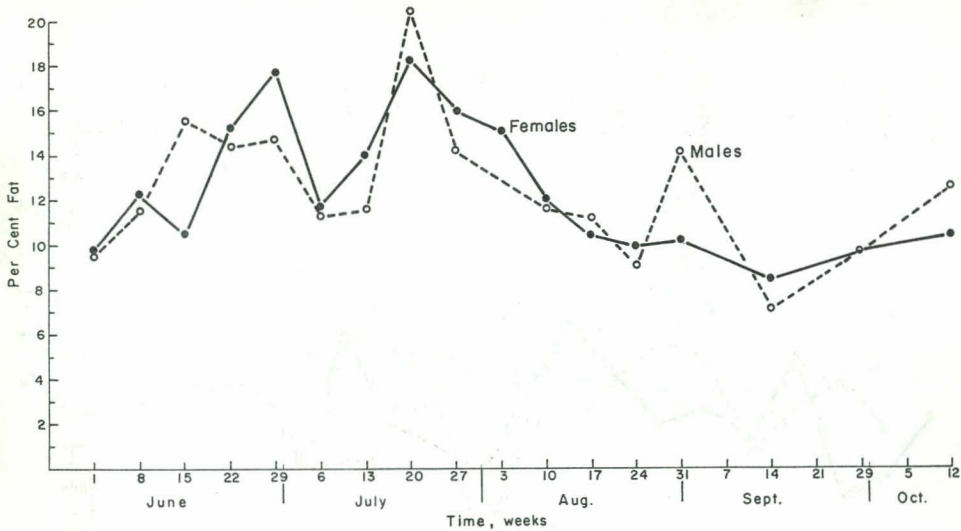


Fig. 13. Weekly variations in per cent fat content of male and female herring, 1967.

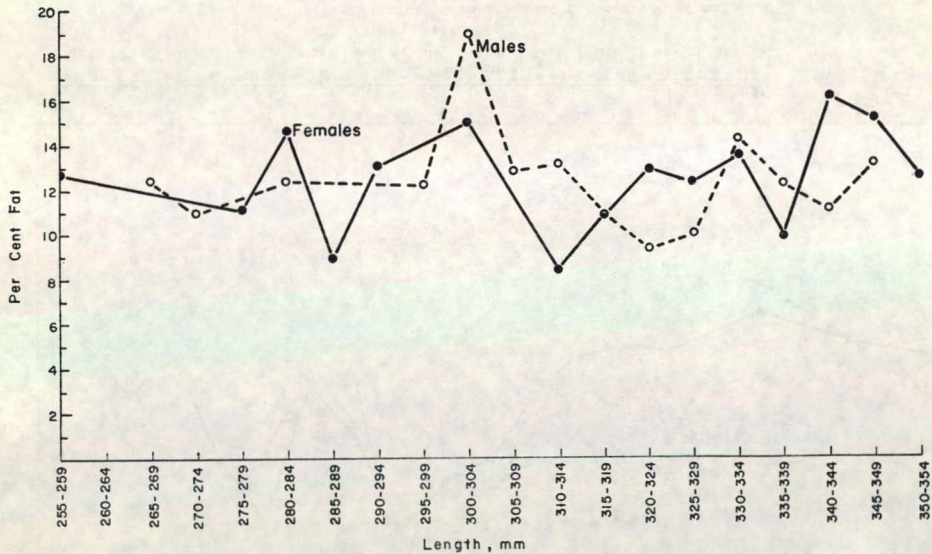


Fig. 14. Relationship between per cent fat content and length of male and female herring samples.

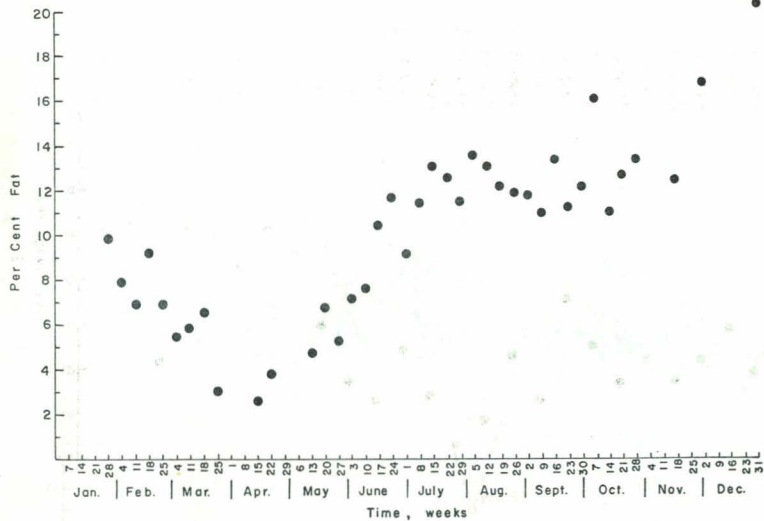


Fig. 15. Weekly variations in per cent fat content for 1967 herring samples.

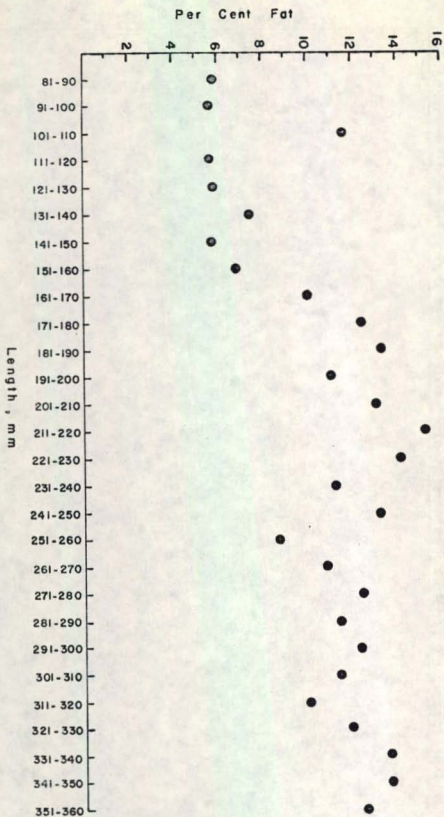


Fig. 16. Relationship between per cent fat content and length for 1967 herring samples.

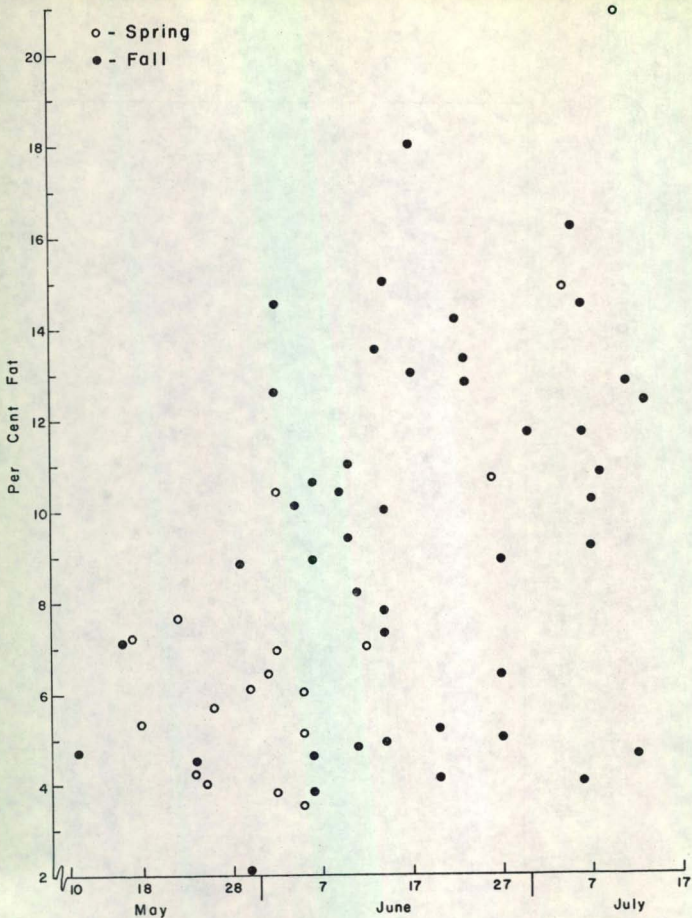


Fig. 18. Variations in per cent fat content of spring and fall spawning herring collected from mid-May to early July, 1967.