FISHERIES RESEARCH BOARD OF CANADA

MANUSCRIPT REPORTS OF THE BIOLOGICAL STATIONS

No. 399

Title

Meat Yield of Clams (_Mya arenaria_)

and

Percentage Total Dry Solids of Clam Meats

Author

L. W. Thurber

(Revised by J. C. Medcof)

1949

TABLE OF CONTENTS

PART II

DRY SOLIDS CONTENT OF CLAM MEATS

(g) Correlation of total solids with meat-yield.

(h) Conformity of Canadian packs to 18% standard.

(i) Year-to-year differences.

(j) Commercial handling.

(i) Shucking and trimming.

(ii) Washing meats in freshwater.

3. Summary of Part II.

PART III

SIGNIFICANCE OF THIS STUDY

INTRODUCTION

The writer was engaged at the Atlantic Biological Station, St. Andrews, N.B., from June 1 to September 15, 1949, under the direction of Dr. J. C. Medcof, to investigate two problems.

The first had to do with meat-yield and water content of soft-shelled clams (Mya arenaria) and factors influencing them both before and after digging. This problem of water content is of current importance because of its bearing on the marketing of Canadian shucked clams in the United States.

Several times in the past two years American officials of the State and Federal Food and Drug Departments have criticized some packs of Canadian clams because of their high water content - greater than 82%. This is sometimes due to packers or re-packers "soaking" the clam meats in freshwater to increase their weight and consequent market value by osmosis. It was felt that in some cases at least other causes were responsible for the high water content of certain Canadian clam packs. The purpose of the study was to discover whether or not this feeling was justified.

The second problem reported on elsewhere, was to assess the value of manual collection of adult clam drills (Polinices heros) as a means of controlling their destruction of soft-shelled clams. This problem was attacked through field experiments at Holt's point (Passamaquoddy bay, N.B.) and was designed to supplement other investigations of clam drills conducted by this station.

The writer wishes to gratefully acknowledge the assistance of Messrs. Elmer Anthony, Donald McLeese, and Robert Krotkov in field work, and Mrs. Juanita Conley in measuring specimens and compiling records, and thank others of the Atlantic Biological Station staff who assisted in the investigation. For access to outside data pertinent to the meat-yield and water-content investigations due acknowledgment has been made in the text of the report. It is felt, however, that special thanks should be extended to Mr. J. S. MacPhail and Dr. J. C. Medcof whose invaluable co-operation, assistance and advice made these investigations interesting and, it is hoped, worthwhile.

PART I. MEAT-YIELD OF CLAMS

1. Methods and sources of information.

There were three sources of information on yield, laboratory measurements, field tests and records from commercial shucking plants.

(a) Laboratory measurements.

In determining the meat-yield of clams, a routine method was adopted which was adhered to throughout the study.

Care was taken when shucking to ensure that all the meat, including the two adductor muscles, was removed from the shell and unless otherwise stated the shucked meat was trimmed only to the extent of removing the mantle epithelium. The meats were then washed free of dirt by placing them in a 16-mesh seive and agitating them in sea-water (salinity 31 - 32‰) for a period of 5 - 10 seconds. The meats were then removed from this seive and placed in another that was similar and allowed to drain until dripping ceased.

The drained meats were then placed in circular aluminum pans (diameter 100 mm. and weight 25 grams) for weighing. Weighings were made on a balance sensitive to the nearest 0.10 gm. In most cases several clam meats were placed in each pan but records were kept of the numbers used and the average weight ("meat-yield") of individual clams was readily calculated. In cases where both water-content and meat-yield were to be determined from the same sample the meats were cut with scissors into small pieces before weighing. This was to facilitate drying. When this was done, care was taken that all body juices expressed during the cutting were collected in the weighing pans. It may be desirable to outline the procedure in detail.

About six clams were cut into a pan and the total weight of the clam meats and the pan was found. This weight let us say, for example, was 45 grams. Then the meat weight was 45-25 gms. = 20 gms. and the average meat-yield per clam was 20/6 = 3.3 gms.

Shell-length was taken as the most convenient expression of clam size. A sliding-jaw, bar caliper graduated in eighths of an inch was used for length measurements which were made to the nearest eighth of an inch.

Most of the laboratory yield measurements reported here were made by the writer but some were assembled by Mr. MacPhail.

(b) Field measurements.

Several field determinations of meat-yield of clams were made previous to this summer's work. Mr. J. S. MacPhail and Dr. J. C. Medcof, of the Atlantic Biological Station conducted most of these but Dr. L. P. Chiasson of St. Francis Xavier University made some observations. The results appear in Atlantic Biological Station Manuscript Reports on clam investigations for the years 1945-1948. In most cases the meat-yield of struck half-bushel lots was measured after supervised shucking in shucking plants.

(c) Records from commercial shucking plants.

The managers of two commercial shucking plants in Nova Scotia have generously supplied information from their operational records for our analysis. These were Mr. Ross Carey of General Seafoods Ltd., Ostrea Lake, and Mr. Fred Amero of the International Shellfish Co., Digby, N.S. Because of the nature of these data they must be regarded as confidential and treated as such. That is to say, they should not be quoted outside this report which is itself confidential.

2. Factors affecting meat yield.

(a) Individual variation.

The writer noted variations in the meat-yield of individual clams of the same size and from the same place on the flat. These are set forth in table 4 and summarized below.

Summary of Table 4 showing meat-yield of various-sized clams and variations in yield for clams of each particular size.

Length of Clam	No. of clams tested	Min. wt.	Max. wt.	Av. wt.
1½"	2	1.9 gms.	2.6 gms.	2.3 gms.
2	6	3.9	7.0	5.2
2¼	6	6.7	8.0	7.3
2½	6	8.9	11.1	9.8
3	4	13.0	18.0	15.4

These determinations on clams taken from a fixed sampling station in Brandy Cove at a time of the year when yield was not changing rapidly show relatively small within-size-class variations. Had they been made all on the same date we may safely assume that the variations would have been even less. The results show what sort of sampling error is encountered and what allowance must be made for it in interpreting the results that will be presented in later sections of this report.

(b) Size of clams.

Sissiboo river field tests indicated that the yield of trimmed meats per unit volume of whole clams decreased slightly as the size increased (Medcof, 1945) but the 1945 Petpeswick records show no appreciable yield variation with size (Chiasson, 1945). Tests conducted in 1946 at Petpeswick indicated a decrease in yield only for sizes ranging above 2½". (Tables 1, 2, and 3).

Table 4 records of laboratory tests show that there is a clear relationship between the meat-yield and size of individual clams. Because this relationship is so important in considering such problems as optimum minimum legal-size limits, all the data gathered this summer (Tables 4-7, 16, 20, 21, 22, 36 and 37) have been combined in the following table and plotted in figure 1. The curve in this graph is drawn purely by inspection.

Combined data showing the relationship of clam-size to untrimmed meat-yield.

Length of Clam inches	N.B. average meat weight grams	N.S. average meat weight grams	General average meat weight grams
1¼	1.5	--	1.5
1½	2.0	1.5	1.8
1¾	2.9	--	2.9
2	4.4	3.4	3.9
2¼	6.2	5.7	6.0
2½	8.5	9.0	8.8
2¾	13.0	10.2	11.6
3	16.2	14.2	15.2
3¼	20.8	22.6	21.7
3½	18.9	24.3	21.6
4	36.0	--	36.0

(c) Beach level.

The effects of beach level on meat yield were conspicuous in practically every test made. Data gathered from 1945 field tests indicate that the yield of trimmed meats is greatest for clams from the lower beach levels (Tables 9 and 10). The 1947 field tests show the same trends (Table 11).

This year's laboratory tests on individual clams accord with the field tests. The highest average yield was from clams at low-tide level. This shows clearly in the records for 2" clams from the St. Andrews beach (Table 5) which averaged 4.1 gms. at high-tide level, 4.5 gms. at half-tide level and 5.4 gms. at low-tide level. L'Etang river (Table 7) stocks also show the beach level effect, the average weight of 2" clams from the high levels being 3.7 gms. and from low levels, 4.8 gms.. Table 6 listing data for Oak Bay suggests greater yields for low than for high-level clams too, but the differences from high to low are smaller.

Mr. MacPhail assembled laboratory records on yields of individual clams from the Pottery Bridge flat, St. Andrews, N.B. They accord with the writer's and extend them. In June 1948 MacPhail relaid marked native clams from the high beds there, to three plots at successively lower positions on the flat. The lowest was well below the level of naturally-occurring clam beds and could be reached only at low spring tides. The other two were in the "clam zone" where the species occurs naturally in abundance. In January 1949 he randomly selected groups of clams whose length ranged from 48-53 mm., from the three plantings and from the high level bed which served originally as the source of seed stock for the plantings. The results are summarized in table 8. The individual yield data appear in the 1949 MS. reports of the Atlantic Biological Station.

Within the "clam zone" the yield increased towards low-water mark but conditions still lower on the beach seem to be less favourable to fattening for the yields were less.

The results of laboratory and field tests assembled in this section (2c) show that the difference between the meat-yield of clams from high- and low-beach levels on the same flat varies from 10 to 25% being greater in some areas than in others. This is a matter of commercial importance because shucking costs are much the same for all clams whereas their marketed value varies directly with their meat-yield.

(d) Position in estuary.

Field tests conducted at Sissiboo in 1945 by Medcof gave no clear indication that "position in the estuary" influences meat-yield. However, general observations lead him to believe that "yield decreases towards the heads of inlets". Further tests conducted at Petpeswick in 1947 by J. S. MacPhail supported this belief. Table 12 shows that the greatest yield is at the mouth of the harbour where water circulation is good, while yield at the head of the harbour is low.

Laboratory tests carried out by the writer show this "position" effect. The limited August tests on samples from the Sissiboo area (Table 13) gave confusing results but the September data clearly show that yield decreases towards the head of the inlet. Clams from the mouth of the river had a 31% higher meat yield than those furthest up. Digdeguash river, N.B., clams (Table 14) gave an even clearer picture. Here the 1¾", 2" and 2½" clams from the lower reaches of the river showed a meat yield 41%, 19% and 22% greater, respectively, than the same sized clams from the upper end of the clam-producing area.

MacPhail has assembled laboratory records for Pocologan and Lepreau basin, N.B., which accord with the writer's observations in showing the "position" effect but in his data this is masked somewhat by the "beach-level" effect just described. His extensive data are nevertheless summarized in table 15. In May, 1949, at Pocologan he relaid seed stock from high beaches in the upper harbour to two low flats at the mouth. In November, 1949, he measured the untrimmed meat-yield of individual clams 48-53 mm.

long selected randomly from the seed source and the relay plots. Similar work was done at Lepreau harbour except that only one relay plot was established.

As might be expected the differences in yield observed in MacPhail's tests were greater than might have been anticipated from either the beach-level effect or the position-in-the-estuary effect alone. However, since the former has been carefully measured (see above) the latter can be estimated by difference.

The clam industry is well aware of the "position" effect and both canners and shuckers try to avoid purchase of up-harbour clams as long as supplies from down-harbour are adequate. The latter are much more lucrative to handle.

(e) Salinity.

The effect of salinity on meat-yield is rather difficult to ascertain. In nature it is often complicated by the "position effect" just described. The simplest way to judge the effect is to compare average yields from a variety of habitats in each of several high and low salinity areas. From limited observations salinity effects appear to be great. Table 16 shows three areas in Nova Scotia where the writer considers yield to be influenced by salinity more than by other factors and the two areas where salinity is high have greater meat-yields than the low salinity area.

It might be argued that Thorne cove and Deep brook beds are relatively more "open", that is, nearer the harbour mouth and therefore less subject to the "position effect" than the River Philip bed. The same criticism cannot be made of the government reserve area in the Sissiboo river (Table 12) which has high salinity and yields that are just as much higher than River Philip as the two Annapolis basin areas. From this we conclude that low meat-yields can be expected from low salinity areas.

(f) District.

In spite of the fact that many factors affect yield and that there is much within-district variation there are nevertheless characteristic district-to-district differences. In laboratory tests the St. Lawrence estuary samples (Table 20) showed lower yields than those from any other area tests, probably because of the low salinity of their overlying waters. Laboratory records show low yields in the Gulf of St. Lawrence as well as in the estuary of the St. Lawrence (See River Philip, Table 16).

Both laboratory tests and shucking house records show that the Fundy area has high yields (Tables 1-20 and 34). A comparison of shucking house records (Tables 33 and 34) shows further that the outer coast of Nova Scotia has yields that are intermediate between the Fundy and the St. Lawrence areas.

(g) Density of clam population.

The writer performed no laboratory tests to investigate the relationship between density of clam population and meat yield but 1945 Petpeswick field tests (Table 23) indicate that yield is reduced slightly when clams are crowded to a density of 20 or more per sq. ft.. Later field tests at Petpeswick in 1947 (Table 24) suggest that this relationship may not be consistent.

The last and most extensive field tests were at Petpeswick. These were conducted on clams that were carefully planted at densities of 20, 40 and 80 per square foot in adjacent plots on a sandy beach in 1944. Two types of seed stock, "stunted" and "normal", were used in the 20- and 40-per-sq.-ft. plots but only normals were used in the 80 plots. The size at planting was $1\frac{1}{2} - 1\frac{3}{4}$". Four years later, in September 1948, 15 struck half-bushel lots were taken from each of these plots and their yields compared (Table 25).

The results for normal clams indicate that the yield drops slightly but regularly as crowding increases and that the clams grown at higher densities were smaller. It has already been shown in section 2b that there is a size effect. The meat-yield per unit volume is often higher for small than for large clams, other things being equal. This size-effect probably masked the crowding effect in the 1948 experiment and this same complexity may account for the lack of consistency among our other data (Tables 24 and 25). It is not unreasonable to suppose, therefore, that there is a real crowding effect and that it is greater than that evidenced by the 1948 data for normal clams. Without more critical observations it is impossible to make a more definite statement.

(h) Seasonal trends.

The best source of information we have on seasonal trends is the series of shucking house records supplied by the General Seafoods Shucking Plant, Ostrea lake, N.S. (Tables 26-32). These data apply to commercial packs of meats that have been trimmed and washed in freshwater. Their treatment, however, was the same at all seasons so it is reasonable to assume that the changes shown in them reflect changes in the raw material itself.

In April the yield is low but it increases gradually through May until a peak is reached in June and early July. This is when the animals are loaded with spawn. There is a rather sudden drop in July corresponding with the initiation of spawning in that area, and a protracted post-spawning period of low yields in August and early September. There is a tendency for yields to increase in late September and early October. Records are not complete enough to show what happens during the winter but there appears to be little change at that season.

The same seasonal trends appear in the 1946 records for the Bay of Fundy (Digby, N.S.) shucking plant of the International Shellfish Co. (Tables 33 and 34).

(i) Year-to-year differences.

Yield shows seasonal cycles but there are also conspicuous year-to-year differences. Both types of variation are important commercially because it is just as costly to process low-yielding clams as high and the dollar returns are lower.

The only evidence we have of year-to-year differences comes from shucking house records (Table 32). The May 1948 yields were the highest recorded in Halifax county. This may be related to excessively heavy precipitation. Dr. Medcof inspected these clams and states that they were unusually fat but not "watery". Halifax county clam diggers claim that heavy rainfall in spring generally has this effect on yield and precipitation was unusually heavy in the spring of 1948. Rainfall may be important in the fertilization of the water by washing in nutrient salts from the land and thus regulating the production of plankton organisms that are important in the clam's diet.

There was little fattening during the spring of 1949 and the shuckers report that the clam "livers" were very small. Presumably the animals did not feed heavily that year.

By comparing the average yield for six-month periods (May - October) it will be seen that imposed on the grosser variations in monthly yields the averages for the several years differed appreciably. The extremes differed by as much as 7 - 8%. This might seem trivial to the casual observer but in commercial operations it is significant and managers of shucking houses follow annual variations in yield with keen interest.

(j) Storage.

In 1947, field tests were conducted to determine the effect of storage on meat yield of clams held at ordinary summer air temperatures (August) in a shed for varying lengths of time (Table 35). The results indicate that storage up to 24 hrs. has no adverse effects but when it is extended beyond 24 hours there is a sharp drop. The field tests indicate the commercial importance of reducing the storage period to a minimum.

In September, 1949, laboratory tests were conducted by the writer with clams from Brandy cove stored in the "cool room", the "freezer", in "open air" and in the "basement" (Table 36). The yields of individual clams were measured after different periods of storage. The tests were poorly designed in that the first observations were made 48 hours after the experiment began but in spite of this the results clearly show that storage at high temperatures effect a more rapid reduction in yield than storage at low temperatures. The value of "cool rooms" for holding "shell stock" in shucking plants is indicated by this laboratory experiment.

Shucking plant records similarly show the disadvantages of long storage of clams in the shell and how this may be partly offset by storage in a cool room. The General Seafoods plant at Musquodoboit harbour installed a cold room for holding shell stock in the autumn of 1947. Comparison of day-to-day yield variations before and after the installation (Tables 28 and 30) shows that the drop in yield, especially over week ends, during storage is greatly reduced. This is more clearly shown when the data are plotted (Fig. 3). The "saw-teeth" conspicuous in the 1946 curve are practically absent from the 1948 curve.

Freezing results in yield losses but we cannot say that this was entirely a storage loss. The frozen meats were soft and watery after thawing so that it seems unwise to compare their yields with those of other lots in the test.

Storage out-of-doors in the direct sunlight (average temperature 73°C.) had the greatest effect of any storage treatment tested. At the end of the 1½ days, yield had decreased 14% and the meats had begun to spoil. At the end of 2½ days yield had decreased 20%, the meats stank and were in such a poor state that the remainder of the sample was discarded. The results of these laboratory tests on individual clams accord reasonably well with the mass tests conducted by Mr. MacPhail at Petpeswick (Table 35) and show the great folly of leaving catches of clams exposed to direct sunlight in boats, on wharves or on beaches while awaiting the arrival of the "pick-up" trucks.

(k) <u>Commercial processing</u>.

The effects of shucking on meat-yield of unit volumes of whole clams are indicated in tables 1-2, 10-12, 23-25 and 35. These show that the total weight of whole clams is made up as follows:

Shells 43% (range 38-59%).

Necks and "strings" 6.8% (range 6.2 - 8.4%).

Unwashed meat 19% (range 18-21%).

Water lost at shucking 31% (range 14-36%).

The water loss in the above listing is calculated by subtracting the weights of shells, necks and strings and unwashed meat from the total weights of the whole clams. According to these figures the neck trimming and removal of the mantle epithelium ("string") reduces the weight of the clam (meat-yield) by about 25%.

"Popping" (the removal of the digestive glands from the meats after shucking) is resorted to occasionally in spring periods of heavy production when meats are to be frozen, because "un-popped" meats often exude an unsightly brown liquid when thawed. Tables 27, 28 and 32 show that this reduces the yield by 10 - 20% (average 16%).

Washing the meats in freshwater under commercial conditions also affects the yield, more or less, depending on the method employed. Many precise measurements have been made but they are not easy to interpret because several things happen during washing. In the first place considerable sand and bits of shell are removed which is desirable. Besides this, however, many of the adductor muscles ("buttons" as they are called in the shucking plants) are detached from the meats and lost. More of these seem to be lost during washing with sprays on perforated draining trays than when meats are washed in tubs with false bottoms or in blowers. The removal of sand and shell and the loss of "buttons" tends to reduce the weight of the washed meat.

There is, however, an osmotic action which takes place when the meats are washed in freshwater and this works in the opposite direction. There is some reason to believe that this is greater when washing is done in tubs or in blowers than when they are washed under a spray but most of the data gathered are inconsistent and permit no critical statement on this point (see Tables referred to at the beginning of this section). These tables of results of field tests show that there is sometimes a loss but more often a gain when the meats are washed under commercial conditions. Generally the gain is about 5% but it reaches 10% in some cases.

Results of 1949 laboratory tests conducted by Mr. J.S. MacPhail show what weight changes can be expected (Figure 4) when the washing time is varied. MacPhail washed the meats in salt-water to free them of sand and shells and was careful that no "buttons" were lost at any stage and the meats were carefully drained before exposure to freshwater. By taking these precautions it was possible to get a true measure of the absorption of water in the washing process. He placed the meats in a large basin of water and stirred them gently from time to time during the fresh-water exposure.

It is surprising to find that the meat weight increases more by water absorption during the first ten minutes of washing

(12 - 13% of the original weight) than it does in the next fifty minutes (8 - 9% of the original weight).

MacPhail's figures show how "adulterating" clam meats by soaking in freshwater may add to the shucker's income. One hour's soaking in freshwater will add 20% to his pack. How frequently soaking is practised is uncertain and how it affects the keeping quality and other characteristics of the pack were not investigated. It would seem, however, that the weight increase achieved by leaving meats exposed to freshwater for periods in excess of the time required for adequate cleansing is less than is generally supposed.

In addition to the early field tests on Nova Scotia clams and Mr. MacPhail's laboratory tests on Charlotte co., N.B., clams, we have the results of a single field test by the writer on one half-bushel lot of 2-2½" Oak Bay, N.B., clams on September 9, 1949. These were "cut out" by a commercial shucker at the Holt Brothers plant at St. Andrews, N.B. The necks and "strings" and any adductor muscles that were left attached to the shells were collected. They weighed 15 ounces. The trimmed, washed meats weighed 112 ounces. No direct determination of water absorption was made. These results do not accord too well with the more extensive data assembled earlier.

Laboratory yield tests on individual Brandy cove clams (Table 37) show that the two adductor muscles which are usually lost in shucking constitute about 9% of the total weight of untrimmed meats. The neck makes up a considerable but varying percentage of the weight. For 2", 2½" and 3½" clams it constitutes 20%, 15% and 9% respectively. Because the relative size of the necks decreases with length it might be expected that the trimmings from small clams would constitute a higher percentage of the total weight than for large clams. A study of tables 2 and 3 suggests that under commercial shucking conditions this is indeed the case but that the difference is slight. The weight of the discarded parts (necks and strings) expressed as a percentage of the combined weight of the whole, unwashed meat (weight of unwashed trimmed meat plus weight of trimmings) is 25, 26, 23.4 and 24% for 1½ - 2", 2 - 2½", 2½ - 3" and 3 - 4" clams respectively. From this it may be judged that the commercial shucker is inclined to remove a relatively smaller portion of the neck in trimming small clams than in trimming large.

(l) Miscellaneous.

In addition to the factors discussed above there are others which affect yield and shucking operations sufficiently to make their mention worthwhile in this report.

(i) The volume of an individual clam of any particular size, varies a good deal from place to place. Wide, short, thickshelled clams are found where growth is slow and meats thin. Narrow, long and thin-shelled clams are found in areas where growth is good and meats fat (MacPhail's results 1947). Because the same factors that affect yield often affect shell shape, these shell characteristics sometimes interfere with the clear demonstration of other features like yield variations with beach level which may, nevertheless, be quite apparent on visual inspection.

(ii) Yield of meats per bushel of "round" clams increases when the soil in clam beds is loosened by digging. (Medcof's report 1947). It is therefore important to avoid dug-over areas in gathering samples for yield tests.

(iii) The time required to shuck ½ bu. lots of clams is doubled when size is decreased from 2-2½"(2 hrs. 40') to 1½-2" (5 hrs. 40') and halved (1 hr. 25') when it is increased from 2-2½" to 2½-3" (Table 3).

(iv) The numbers of Petpeswick clams per bushel (Imperial) and per barrel, vary with their size according to the following table. This information based on records in Table 3 is useful in considering some of the results presented above.

Length of clam	No. per bu.	No. per bbl.
* 1¾"	2200	5500
2"	1600	4000
* 2¼"	1180	2950
2½"	920	2300
* 2¾"	700	1750
3"	560	1400

* known figures - others interpolated from 1947 report.

3. Summary of Part I.

1. Of all factors affecting meat-yield of individual clams, size is the most important.

2. For any particular size the individual yield variations range from 5 - 25% depending upon the uniformity of conditions in the area of collection.

3. Trimming clam meats reduces yield by about 25%.

4. Small clams have heavier necks in proportion to their body weight than large clams.

5. Ordinary freshwater washing of trimmed meats by commercial shucking plants increases yield by 1 - 10%.

6. Yield is greatest at low beach levels and decreases toward high levels. Yield differences of 10 - 25% between levels is common.

7. Yield is greatest near the mouth of an estuary and decreases toward the head. Differences of 20 - 40% in yield between the extreme positions are common.

8. High salinity areas show higher clam meat-yields than low salinity areas.

9. There is considerable variation in yield from district to district. The Fundy area has the highest yields, the outer coast of Nova Scotia intermediate and the estuary and gulf of the river St. Lawrence have the lowest.

10. Crowding in clam populations reduces yield when the density exceeds 20 clams per sq. ft. of beach.

11. Yield shows conspicuous seasonal variations. It is low in early spring, high in June, low after the summer spawning and high again in autumn. There is little change in winter.

12. "Popping" meats decreases yield by about 16%.

13. There are year-to-year differences of 7 - 8% in average yield that may be significant in commercial operations. Their cause is still obscure.

14. Storage at ordinary summer air temperatures for more than 24 hours reduces the yield, the amount of the reduction depending on the period and conditions of storage.

15. By lowering the storage temperature the yield loss during storage is reduced.

PART II. DRY SOLIDS CONTENT OF CLAM MEATS

1. Methods and sources of information.

(a) Introduction.

To determine the amount of water in shucked shellfish meats, the U.S. authorities have devised an analytical method which has been applied in tests of Canadian clams sold in the United States. A modification of this method has been used at the Fish Inspection Laboratory at Halifax, N.S., in making tests on clams from areas about Charlottetown, P.E.I., and Halifax, N.S. Another modification was developed at the Atlantic Biological Station this summer because facilities available and the need for information in addition to that on water content alone, made this desirable.

It is sometimes assumed that when the water content exceeds 82%, clam meats have been "soaked", i.e. been exposed too long, and possibly deliberately, to freshwater. Such treatment is considered "adulteration" and high values have been considered just grounds for prosecution. One of the main purposes of this part of the study was to judge the fairness of this attitude.

(b) Standard Massachusetts method.

An outline of a standard method entitled, "The Determination of Added Fresh Water in Shucked Clams" was obtained from Mr. Phileas A. Racicot, Senior Chemist in the Food and Drugs Division of the Massachusetts Department of Public Health. The significant steps in this procedure are as follows:

(i) Preparation of sample: A representative sample of about one-half pint of shucked meats is placed in a 20 mesh seive, eight inches in diameter and two inches in depth. All shell fragments are removed, then all free liquid is thoroughly shaken out. The sample is transferred to a Waring Blendor and ground to a homogeneous batter.

(ii) Determination of total solids: Two grams of the batter is accurately weighed out on an analytical balance in a tared platinum dish, two inches in diameter at the bottom, two and one-half inches in diameter at the top and one-half inch in depth. This is placed on a steam bath and dried for two hours. The dish is then removed from the steam bath, the bottom and side wiped dry and clean and immediately weighed to the fourth decimal. The weight of total solids divided by 2 and multiplied by 100 gives the weight of total dry solids as a percentage of the wet weight.

(iii) Remarks. In the preparation of the sample it is very important that the clams be drained until dripping ceases. Constant analytical results depend on the elimination of free liquid. Another precaution in the preparation of unwashed (in freshwater) samples is to wash the sample with a 3% solution of sodium chloride for a period of not over 30 seconds. The reason for this is that tests on unwashed clams with sand or mud adhering give falsely high values for total solids. Washing in a 3% solution of salt will not add water to the tissues of salt-water animals.

(c) Modified method.

It was found necessary to modify this method because we frequently wished to determine the meat yield as well as total solids content of individual clams simultaneously and the method just described does not permit this. The method developed at the start of the study and used throughout is briefly described below.

(i) Collecting samples in the field. The specimens used in the various tests were dug mostly by the writer but lots from distant areas were shipped to St. Andrews by other field workers to whom the importance of representative sampling had been made clear. Care was taken to avoid complicating the results by factors other than the one under test. For instance in comparing stocks from different harbours, sampling stations were chosen at such points that beach levels and positions in estuaries were comparable and other factors like density of crowding of clam stocks and sampling dates were made to coincide as nearly as possible.

(ii) Laboratory treatment. Tests were made on the collected samples as soon as possible after digging. With the exception of those used in the storage tests or shipped from other areas, the period between digging and testing was seldom more than twelve hours and clams were held during this period in rockweed (Fucus) in the cool basement.

The clams were then processed as described in the section "Laboratory Measurements", in Part I of this report.

The number of meats in each pan varied with the size of the clams on test because whenever possible approximately 20 gms. of meat was put into each pan. This quantity of wet meat when dried still weighed enough to prevent the weighing error (balance was sensitive to differences of 0.1 gms.) from influencing the results unduly.

After determining the wet weight of the meats the pans were placed on an electric hotplate to drive off all fluid water, thus decreasing the subsequent drying time. The pans were then placed in an electrically-heated constant-temperature drying oven, set at 105° C., and allowed to dry to a constant weight. This usually required four to six hours. The dry weight of individual clams, the percentage of total solids and the percentage of water in clams was then calculated as follows:

If the meats from six 2" clams had a wet weight of 20.0 gms. (average of 3.3 gms. per clam) and a dry weight of 3.0 gms. (average of 0.5 gms. per clam), then the "percent total solids" would be $\frac{3.0}{20}$ gms = 15%, and the percentage of water in the clams would be 100% - 15% = 85%. The entire procedure was recorded as follows:

No. of clams	Size	Wet wt.	Dry wt.	% Dry wt.	% water	Av. wet wt.	Av. dry wt.
6	2"	20.0gms.	3.0gms.	15	85	3.3gms.	0.5gms.

(d) Critique of modified method.

Since this method differed in some respects from the U.S. method it was considered important to find out whether the two treatments gave similar results when comparable samples of the same stock were tested.

(i) Sensitivity. The U.S. method involves the drying of 2.0000 gms. of wet meat. Accurate weighing of this quantity of meat on an analytical balance to the fourth decimal as called for in the instructions, involves a weighing error of $\frac{1}{20,000}$ or 0.005%. The writer used a balance sensitive to the nearest 0.1 gms. and 20.0 gms. of wet meat. The weighing error in our determinations is therefore 0.5%, considerably larger than in the U.S. method, but is nevertheless considered insignificant in this kind of test.

(ii) Washing. The U.S. method calls for washing meats to remove sand and other foreign particles using a 3% solution of common salt in water for a period not exceeding 30 seconds. Since ordinary sea-water was readily available at the Atlantic Biological Station its salinity was tested against that of the 3% solution for washing. A 3% solution was prepared and the salinities of this and of a sample of sea-water from the end of the wharf were compared by titration. The following results were obtained:

Salinity of 3% NaCl solution	31.33‰
Salinity of sea-water	32.05‰

The agreement was so close that it was decided to use sea-water and this practice was followed consistently. The station records show that there was no significant fluctuation in the salinity of the water at the wharf during the summer. The washing time was standardized at 5-10 seconds.

(iii) Draining. The Massachusetts Food and Drugs Department's directions for draining washed meats are not consistent. At one point they specify that "all free liquid is thoroughly shaken out", and at another they caution the experimenter to continue draining until "dripping ceases". In this summer's work the latter instruction was followed consistently because differences in the degree of draining create experimental error that can be reduced by uniformity of treatment.

(iv) Use of Waring Blendor vs. scissors. The wet weights of individual clam meats had to be determined in this study because meat-yield and dry solids content were worked out on the same samples. Consequently the practice of macerating meats in a Waring Blendor could not be followed because a considerable amount of meat always adheres to the walls of the "Blendor" jar and prevents a true measure of yield. The meats were therefore cut into small pieces with scissors. Tests were conducted on Brandy Cove clams to see if this treatment yielded results that were significantly different from those obtained by following the standard U.S. procedure. The following table summarizes the results. From these it appears that differences are not great enough in most cases to be considered significant.

Comparison of the two methods using Brandy Cove clams (July 28,1949).

Length of Clam	Modified method: No.of clams	Wet wt. (gms.)	Dry wt.	% T.S.	Av. % T.S.	U.S.method: Wet wt. (gms.)	Dry wt.	% T.S.	Av. % T.S.
2½"	5	37.1	8.6	23.2	22.8	33.8	7.3	21.6	21.8
	5	39.8	8.9	24.4		33.1	7.3	22.0	
3"	1	14.3	2.7	18.8	18.1	10.8	2.1	19.4	19.4
	1	11.4	2.2	19.3		10.9	2.1	19.3	
3¼"	1	17.8	3.9	21.9	19.6	12.7	2.6	20.5	20.3
	1	12.8	2.2	17.2		10.0	2.0	20.0	
3½"	1	25.6	5.3	20.7	21.4	20.7	4.2	20.3	20.1
	1	19.5	4.3	22.0		18.2	3.6	19.8	
			Av.	20.7			Av.	20.4	

(v) Sampling error. The directions for "Preparation of Samples" in the U.S. method for determining solids content, call for the blending of a half-pint of the sample of meats to be tested. If 2" clams were used this would involve 30 to 40 clams. The methods used during this study made it necessary that the numbers tested be much smaller. Consequently some knowledge of individual variation in the water content of clam meats is necessary as a basis for comparison of results obtained by the two methods. The data presented in table 4 and summarized below show that the % water content calculated for individuals of any particular size class seldom differed by more than 1% from the average when the precautions listed under "Collecting samples in the field", are followed. This circumstance, the fact that most samples involved several specimens and that there was close agreement of results obtained from following the U.S. and the "Modified Method", lend confidence to whatever conclusions are drawn from the results assembled during this study even though comparatively small numbers of test animals were involved.

Summary of Table 4 data to show individual variation in total solids content of clams.

Length of Clam	Dry Wt. in Grams			% Total Solids		
	Min. Wt.	Max. Wt.	Av. Wt.	Min.%	Max.%	Av.%
1½"	0.38	0.48	0.43	18.5	20.0	19.3
2"	0.73	1.45	1.06	18.7	22.7	20.5
2¼"	1.50	1.78	1.65	20.3	23.7	22.5
2½"	1.85	2.70	2.13	19.7	24.3	21.7
3"	2.50	3.80	3.15	19.2	21.7	20.5

(vi) Storage. Due to the limited number of tests conducted to determine the effects of storage on solids content, only a sketchy picture has emerged (Table 12b). Storage up to six days in the basement and cool room had no effect. Freezing for four days on the other hand, brought about a reduction. Open air storage resulted in a notable increase in % total solids.

The results of these tests indicate that no allowance need be made for the effects of storage in considering most of the results presented here but that the values obtained for samples shipped to the laboratory from distance points during warm weather are likely to be somewhat high.

2. Factors affecting solids content.

There were three sources of information on meat-yield, field tests, shucking-house records and laboratory tests, and all these contributed to our understanding. In the study of total solids, however, we have only laboratory records to depend on. Most of the data presented here were assembled by the writer but records from other laboratories have been made available to him for study. These must be treated confidentially.

(a) Size (length) of clam.

The relationship between the size of clams and their solids content was explored in tests with Brandy cove stocks. There is some inconsistency among the data but on the average clams of intermediate size ($2\frac{1}{4}$ - $2\frac{1}{2}$") have the highest solids content and there is a drop of about 1% for every half-inch difference in size above or below this level (Table 4). Similar trends appear in the Workshop cove (Table 21) and Pottery Bridge (Table 22) stocks but are less conspicuous in the Sissiboo stocks (Tables 13 and 14). This size effect is relatively minor and need not therefore be considered in discussions of industrial problems involving gross differences in total solids.

(b) Beach level.

The effects of beach level on solids content may be deduced from results which apply to clams from the Fundy area of New Brunswick. There is a regular increase from high to low levels, the difference in solids between the extremes is approximately 3% for St. Andrews harbour and L'Etang river (Tables 5 and 7). Oak Bay (Table 6) shows the same trends but less conspicuously.

These data indicate that this beach-level effect is common throughout our clam-producing districts and it should be considered in any discussion of total solids problems.

(c) Position in estuary.

The effects of position in an estuary or harbour on solids content of clams was explored in Sissiboo river, N.S. (Table 13) and Digdeguash river, N.B. (Table 14) stocks. These August and September observations indicate that the solids content values are high in the seaward beds and low near the heads of the inlets. Differences of 5 - 6% were observed showing that position in estuary is important to consider in total solids problems.

(d) District-to-district variations.

By comparing results for samples that may be considered typical of the principal clam producing areas, conspicuous differences will be found. St. Andrews (Table 4) and Annapolis basin (Table 16) areas may be considered typical of the Fundy districts. River Philip (Table 16) and the Quebec (Table 20) results may be taken as representative of conditions in the gulf and estuary of the St. Lawrence river. In St. Lawrence areas the solids content (18.5 and 16.6%) average much lower than the Fundy (21.7 and 23.7).

No observations were made by the writer on samples from the outer coast of Nova Scotia but Mr. M. Voth of the U.S. Federal Food and Drugs Department has given us access to certain confidential records of his department pertaining to tests made on samples he took from commercial shucking houses in the Maritimes during a survey conducted in September, 1948. The finished products of three plants in the Fundy area showed a solids content averaging 20.5%. For three plants on the outer coast of Nova Scotia it averaged 18.4%. These records suggest that outer-coast clam stocks have total solids that are intermediate between the Fundy and St. Lawrence extremes. Records in tables 17 and 18 support the same conclusions.

(e) Effect of salinity of natural waters.

It seems reasonable to assume that the generally low values obtained for St. Lawrence areas (See sub-section "d" above) are due to the low salinities that prevail there.

(f) Seasonal variations.

Records compiled by the writer cover too brief a period to show seasonal differences although data presented in table 4 suggest that there was a rise in total solids during the month of August at St. Andrews. Mr. E. P. Sidaway, Chemist, of General Sea Foods, Halifax, N.S., has given us access to records he compiled in 1948 and 1949 from analyses of samples of the finished product of his company's Nova Scotia clam shucking plant (Tables 17 and 18) which are descriptive of seasonal trends.

Although these determinations apply to commercial packs and therefore to trimmed meats washed in freshwater, the plant processing treatment was the same at all seasons and it is safe to assume that the changes shown in the end product are a direct reflection of seasonal differences in the original raw material itself.

The clearest story on seasonal changes in the percent dry solids is found in table 17. Values are low in early spring but rise as the animals fill with spawn. The peak comes in late June and early July. There is a sharp drop in July coincident with the spawning season in these waters and a protracted post-spawning "low". There is an autumnal recovery, whose extent is unknown and some indication (See tables 17 and 18) of a falling off during the winter or very early spring.

(g) Correlation of total solids with meat-yield.

The similarity of this seasonal cycle to that involving meat-yields, is so striking (See Part I, Section 2h) that the corresponding yield data from tables 31 and 32 have been entered in tables 17 and 18 which list Mr. Sidaway's determinations. In spite of disparities there is a good correlation evident between total solids content and meat-yield. This shows up best when the data are represented graphically (Fig. 2). Without doubt a more reliable correlation would have appeared if the data had been assembled in a controlled experiment. The line in the graph is drawn purely by inspection but it indicates that the % total solids is roughly equal to 2.7 times the meat yield expressed in pounds per hod ($\frac{1}{2}$ Imperial bushel) or 0.54 times the yield expressed in pounds per barrel ($2\frac{1}{2}$ Imperial bushel).

This demonstration of this correlation is regarded as important because it explains why so many of the factors discussed here are important in both studies reported. It also allows us to judge ahead of time how some new factor will affect one characteristic if we know how it influences the other.

(h) Conformity of Canadian packs to 18% standard.

It seems clear from figure 2 that when commercial meat-yields drop below 31 pounds per barrel the total solids will be less than 18%. Mr. Sidaway's total solids data summarized in table 17 have been re-arranged (Table 19) to show the degree of conformity at different seasons of the Musquodoboit harbour pack to the 18% total solids standard. In the summer months (July and August) when both demand and production of clams is high, half the pack appears to be below standard. At other seasons the sub-standard fraction is less. From what was said in the section "District-to-district Variation", it may be assumed that the proportion of the pack from the St. Lawrence areas that would be classed as sub-standard would be much higher because the outer coast of Nova Scotia, to which Mr. Sidaway's results apply, shows higher total solids for clams than the St. Lawrence districts. When it is remembered that reductions in solids take place during freshwater washing it is even doubtful that any commercial pack of St. Lawrence stocks could conform to the 18% standard during the summer months.

(i) Year-to-year differences.

There are no available data on year-to-year differences in the total solids but there is good reason to believe that these occur because it was shown in Part I of this report that there are significant year-to-year differences in meat-yield and in the section "g" above it was shown that meat-yield and solids content are directly related.

(j) Commercial handling.

Processing in shucking plants might be expected to affect the solids content of clam meats in two ways:

(i) By shucking and trimming.

(ii) By washing in freshwater.

The writer made only one test to discover what commercial handling actually does. This was possible through the co-operation of Messrs. James and Wendell Holt, operators of a clam-shucking plant at St. Andrews, N.B..

(i) Shucking and trimming. Whole meats of clams were tested after being carefully shucked, only their mantle epithelia being removed. For comparison the necks were removed from a similar lot of clams from the same sample. The % total solids was the same, 21.2, in both cases (Table 37). Apparently this type of trimming has no effect on the results of the tests.

As a check on this conclusion dry solids determinations were run on samples of necks along (Table 37). These showed a slightly higher value (22.2%) than that for whole meats. The difference, however, is so slight and the total weight of the neck is so small that the trimming effect is masked by experimental error in the determinations.

In commercial shucking one or both adductor muscles are frequently left attached to the shells and discarded. Checks made on these (Table 37) showed that their solids content was 24%, i.e. 3.5% higher than that of whole meats. No test was made of meats from which muscles had been deliberately removed, for comparison with results for whole meats. However, the muscles, like the necks, constitute a relatively small part of the whole meat, as the table shows, and one or other often stays in the meat in commercial handling. It is assumed, therefore, that any effect their loss during shucking might have on solids content would be minor - definitely less than the experimental error in these determinations. This effect may be neglected for purposes of this report and in discussion of problems where total solids is an important consideration.

(ii) Washing meats in freshwater. In mid-August a half bushel of 2 - 2½" clams was sorted out from a commercial digger's catch on the Oak Bay, N.B., flat. A sample of these was kept for laboratory tests and the remainder processed at Holt Brothers' clam shucking plant by a commercial shucker. They went through the following stages of treatment:

(1) Washing in cold freshwater for 1 minute.

(2) Dipping in hot water (81.5° C.) for about 10 seconds.

(3) Dipping in cold water again (5 - 10 seconds).

(4) Shucking and trimming - (A sample of the meats was

separated from the rest after this treatment. The rest got the full treatment).

(5) Washing for 20 seconds on a perforated steel table directly under a strong spray of freshwater.

(6) Agitation for 3 - 4 minutes on the table in contact with some freshwater during inspection for loose pieces of shell, etc.

(7) Packing directly into a shipping can from the table.

The can was taken directly to the laboratory and two lots of 6 meats each were tested according to the regular laboratory procedure. At the same time, tests were made on the meats separated after stage 4 of the processing treatment and on meats from the sample of whole clams reserved from the original half-bushel.

Comparison of laboratory and commercially processed 2 - 2½" clams.

Processing Method	Weight in grams Wet.wt.	Dry wt.	% Dry Solids	
Lab: trimmed, salt-water wash	30.1	7.3	24.2	Av. 24.1
" " "	31.0	7.4	23.9	
Plant: trimmed, salt-water wash	30.0	7.0	23.3	Av. 23.8
" " "	31.6	7.7	24.3	
Plant: trimmed, freshwater wash	34.1	7.8	22.9	Av. 22.8
" " "	33.1	7.5	22.6	

The results presented in the accompanying table show that any differences that may exist between "laboratory" and "plant" trimming had minor effects on the determinations. The exposure of the plant-trimmed meats to freshwater, however, resulted in a 1% reduction in the total solids. This is considered low. It is to be expected that washing in blowers or tubs would result in greater reductions.

An appreciation of what more extended washing or "soaking" can do is shown by records compiled by R. E. S. Homans at the Fish Inspection Laboratory this year (Figure 4). Apparently the reduction in total solids is very rapid at first and slower and slower as time goes on. This suggests that total solids may not be a satisfactory indication of "soaking" because differences between meats that are adequately washed which may require up to 20 or 30 minutes exposure to freshwater in commercial operations and those that are over-washed, may be very slight.

3. Summary of Part II.

(1) By taking due precautions to insure representative sampling, reliable estimates of total dry solids of clam stocks can be had from testing a small number of individual clams rather than the relatively large numbers used when commercial packs are tested.

(2) Storage in the basement and "cooler" has little effect on total solids content. Freezing reduces it and storage at summer air temperatures has the reverse effect.

(3) There is little variation in total solids with clam size but the highest values were obtained from 2¼ - 2½" (medium-sized) clams. Generally both larger and smaller clams show lower values.

(4) Solids content increases steadily from high to low beach levels. The difference averages 3%.

(5) Solids content is higher near the mouth of an inlet than towards the head. Differences as great as 6% have been observed between extremes in some inlets.

(6) District-to-district variation in solids content is great, amounting to as much as 7%. The Fundy area showed the highest values, the outer coast of Nova Scotia, intermediate and the St. Lawrence estuary and gulf, the lowest values of all.

(7) The salinity of natural waters affects solids content and appears to be one of the main factors responsible for the district-to-district variation.

(8) There is a clear correlation between solids content and meat-yield.

(9) There is a seasonal cycle of change in solids content that follows that of meat-yield: an early spring low, a rise to a pre-spawning peak; a spawning depression; an extended post-spawning low followed by an autumn rise.

(10) In outer-coast districts of Nova Scotia where solids contents are intermediate, half the summer pack of shucked clams fall below the 18% Massachusetts standard. It seems unlikely that any significant part of the St. Lawrence district's summer pack could conform to this standard and that difficulties would be experienced at other seasons as well if the standard were insisted on.

PART III. SIGNIFICANCE OF THIS STUDY

It is evident from this report that both meat-yield and solids content of clams are influenced to varying extents by several factors. Some of the factors are "natural" and others "artificial" in the sense that they are effective during commercial handling. The latter are subject to some control but the degree of control that can be applied is limited by the inherent needs of processing itself -- clams must be washed clean, they must be trimmed. The "natural" factors are largely beyond human control - clams will always be thinner after spawning than before, and thinner in the Gulf of St. Lawrence than in the Fundy district.

If industry is to take full advantage of our shellfish resources, it seems obvious that it should be well aware of all the factors that affect the characteristics of the material being handled regardless of whether these are natural or artificial factors. Besides this there seems to be an advantage in standardizing the product by setting up minimum requirements for conformity. Granting this, it is only logical that the minimum requirements be set only after due consideration of the effects they will have both on the producer and consumer. What is needed as a basis for intelligent regulation is a clear understanding of what factors are at work, how they operate and to what degree they affect the characteristics of the final product.

A review of the several subjects touched on in this report will show that much has been done to clarify thinking on many of these problems but that there are still large gaps in our information which should be filled before a full appreciation of the problems is possible. Probably no gap is greater than our lack of information on what happens in the washing process and how "soaking" (excessive washing), can be recognized in the finished product at various times and stages in its voyage from producer to consumer.

The main contribution of this report is the demonstration of gross differences in the raw material the clam industry handles and how these differences arise. With such differences in raw material it follows that gross differences must appear in the finished product regardless of how carefully it is handled. This information should be useful to industrial operators. Some are vaguely aware of the influence beach level, season and other such factors have on meat-yield, but they have no clear conception of the extent of these effects. It seems desirable that this information should be placed in their hands.

The results should be equally if not more important to administrative authorities in clearing the way for the emergence of sound policies for control. For instance, the data on meat-yield relative to clam size when considered with what knowledge we now have on growth rate and natural mortality rates should be helpful in the choice of a minimum legal size limit which should insure a high sustained production from our clam flats. The data on total solids should be helpful in the choice of some reliable index for detecting "soaked" clams. The consumer should be protected from this type of adulteration but the processing industry should not be unduly hampered in its reasonable exploitation of our shellfish resources. The present minimum standard of 18% total solids was, no doubt, set up with this in mind but it is quite clear from this study that so far as Canadian clam stocks are concerned the standard is inappropriate.

Table 1. Yield of trimmed meat from half-bushel lots of Sissiboo river clams of various sizes from half-tide level, July, 1945.

Lot No.	Source	Length range (inches)	No. in lot	(Weight in ounces) Whole clams	Shells and necks together	Unwashed meats	Washed meats*
S1	Centre of reserve area	$1\frac{1}{2}$ - 2	913	452	220	100	102
S2	" " " "	2 - $2\frac{1}{2}$	501	452	212	95	93
S3	" " " "	2 - $2\frac{1}{2}$	496	460	228	94	98
S4	" " " "	2 - $2\frac{1}{2}$	549	444	220	93	94
S5	" " " "	$2\frac{1}{2}$ - 3	347	460	212	93	92
Average			454	454	218	95	96
% of total weight of whole clams					48%	21%	21%
Change in meat weight from washing							1.1% gain

* Washed in a spray and a tub.

Table 2. Yield of meats from half-bushel hods of Petpeswick cove clams of various sizes, July, 1945.

Hod no.	Source	Range ins. mean mm.	No. in lot	Weight in ounces: Whole clams	Shells	Necks	Unwashed meats	Washed meats *
P1	Centre of cove flat	$1\frac{1}{2}$ - 2 45.9	1170	504	287	35	105	112
P2	" " " "	2 - $2\frac{1}{2}$ 56.6	615	520	214	35	98	112
P3	" " " "	2 - $2\frac{1}{2}$ 57.0	674	548	264	36	104	118
P4	" " " "	2 - $2\frac{1}{2}$ 58.5	618	532	253	41	90	103
P5	" " " "	$2\frac{1}{2}$ - 3 65.4	410	504	204	34	100	110
P6	" " " "	3 - 4 79.3	233	532	288	34	108	111
Average				523	252	36	101	111
% of total weight of whole clams					48%	6.9%	19%	21%
Change in meat weight from washing								10% gain

* Washed under a spray and in a tub.

Table 3. Effects of size of clams on meat yield of half-bushel lots of Petpeswick cove clams, July 3 - Aug. 12, 1947.

Hod No.	Source	Population density per sq.ft.	Range ins.	Size mm.	No. in lot	Weight in ounces: Whole clams	shells	necks	Unwashed meats	Washed meats*	Time req'd. for shucking
1	Cove N. & E. of Latin Square	20 - 25	$1\frac{1}{2}$ - 2	45.4	1099	466	176	32	97	108	5 hrs.40 min.
2	"	20 - 25	2 - $2\frac{1}{2}$	54.8	572	455	180	29	90	96	2 hrs.30 min.
3	"	20 - 25	2 - $2\frac{1}{2}$	55.3	603	482	186	29	98	102	2 hrs.30 min.
4	N. of Latin Square	20 - 25	2 - $2\frac{1}{2}$	54.9	605	453	166	34	103	108	2 hrs.45 min.
5	Reserve area and west of Gully		$2\frac{1}{2}$ - 3	66.0	350	451	178	26	95	99	1 hr.25 min.
Average						461	177	30	97	103	
% of total weight of whole clams							38%	6.5%	21%	22%	
% change in meat weight from washing										6.2% gain	

* Washed in a tub only

Table 4. Wet and dry weights of untrimmed meats and percent of dry solids of meats from various-sized individual clams from Brandy cove sampling station, July-September, 1949.

Date of Digging	Length of clam (inches)	Meat yield in grams		Percent of total solids	
		Wet	Dry	Determinations on individual clams	Means
July 27-29	1½	2.6	0.48	18.5	19.3
		1.9	0.38	20.0	
	2	5.1	1.00	19.6	
		3.9	0.73	18.7	
		7.0	1.45	20.7	19.8
		4.5	0.90	20.0	
	2¼	7.4	1.50	20.3	20.3
	2½	9.4	1.85	19.7	
		10.8	2.20	20.4	20.3
		9.2	1.90	20.7	
	3	13.0	2.50	19.2	
		16.7	3.30	19.8	20.0
		18.0	3.80	21.1	Average: 19.9%
Aug. 17	2	5.3	1.20	22.7	22.0
		5.2	1.10	21.2	
	2¼	6.7	1.52	22.7	22.8
		7.3	1.67	22.9	
	2½	9.4	2.05	21.8	23.1^{-}
		11.1	2.70	24.3	Average: 22.6%
Sept. 2-3	2¼	7.4	1.72	23.2	
		8.0	1.78	22.3	23.1
		7.1	1.68	23.7	
	2½	8.9	2.05	23.0	23.0
	3	13.8	3.00	21.7	Average: 22.8%
Over-all average					21.7%

Table 5. Yield of untrimmed meat and percent dry solids in individual clams from different beach levels in St. Andrews harbour (above the Market Wharf), Aug. 2, 1949.

Beach level and length of clam (inches)	Meat yield in grams		% dry solids		
			Beach level		
	Wet	Dry	High	Medium	Low
High tide					
1½	1.8	0.36	20.0		
	1.6	0.30	18.7		
	1.8	0.35	19.5		
1 7/8	3.1	0.60	19.4		
2	4.2	0.80	19.0		
	3.9	0.77	19.7		
2¼	4.8	0.90	18.8		
Medium tide					
1½	1.6	0.31		19.4	
	2.4	0.49		20.4	
	1.8	0.38		21.1	
2	4.3	0.88		20.4	
	4.7	1.98		20.8	
	4.4	0.88		20.0	
2¾	11.5	2.40		20.9	
3	11.3	2.20		19.5	
Low tide					
2	5.4	1.20			22.3
2¼	7.9	1.80			22.8
2½	10.9	2.45			22.5
	9.2	2.00			21.8
3	18.8	4.20			22.3
	14.9	3.10			20.8
	22.9	5.30			23.1
3¼	28.4	6.00			21.1
Average for St. Andrews:			19.3%	20.3%	22.1%

Table 6. Yield of untrimmed meat and % dry solids of meats of individual clams from different beach levels at Oak Bay, August 28, 1949.

Beach level and Length of clam (inches)	Meat yield in grams Wet	Dry	% Dry solids beach level High	Medium	Low
High tide		Oak Bay - near mouth of river			
2	3.6	0.78	21.7		
Low tide					
2	4.8	1.11			23.1
2¼	6.6	1.44			21.8
2½	8.2	1.67		20.4	
Medium tide		Oak Bay - 1/3 way up river			
2	3.9	0.87		22.3	
Low tide					
2¼	7.7	1.88			24.4
High tide		Oak Bay - 2/3 way up river			
2	4.9	1.11	22.7		
Medium tide					
2	5.4	1.31		24.3	
2¼	7.1	1.70		24.0	
High tide		Oak Bay - head of river			
2	4.5	0.86	19.1		
Medium tide					
2½	9.3	2.22		23.9	
Average for Oak Bay			21.2	23.0	23.1

Table 7. Yield of untrimmed meat and % dry solids of individual clams from different beach levels at L'Etang river, August 31, 1949.

Beach level and length of clam (inches)	Meat yield in grams		% dry solids Beach level	
	Wet	Dry	High	Low
High tide	L'Etang river - Back Bay (nearest mouth of river)			
2	3.7	0.80	21.6	
Low tide				
2	4.7	1.06		22.6
2½	7.0	1.57		22.5
High tide	L'Etang river - Brown's Cove (farther up river)			
2	3.6	0.68	18.9	
Low tide				
2	4.6	0.98		21.3
High tide	L'Etang river - Hickey's Cove (farhter up river)			
2	3.8	0.76	20.0	
2¼	5.9	1.22	20.7	
Low tide				
2	5.4	1.34		24.8
2¼	6.8	1.67		24.6
High tide	L'Etang river - Pull and Be Damned (head of river)			
2	3.7	0.71	19.2	
Low tide				
2	4.3	0.98		22.8
2½	7.8	1.65		21.2
Average for L'Etang river -			20.1	22.7

Table 8. Yield of untrimmed meat of Pottery Bridge flat clams from different beach levels, January, 1949.

Source of clams	No. of clams tested	Av. length m.m.	Av. wt. of untrimmed meat grams
High level bed (source of stock for plots in 1948)	34	50.7	5.0
Half-tide level plot	37	51.1	6.0
Low-level plot	29	51.3	5.9
Lowest plot (seldom exposed)	34	50.7	5.6

Table 9. Meat-yield of half-bushel hods of clams from different beach levels in Petpeswick cove, July, 1945.

Lot no.	Source	Size range	No. in lot	Weight in ounces: Total	Shells	Necks	Unwashed meats	Washed meats*
P7	Low flat W. of Latin Square near Channel	2 - 2½"	942	580	240	52	--	118
P8	High flat N.W. of Ches. Young's near Sedge bank	2 - 2½"	803	610	360	48	--	108
Average			872	595	350	50	--	113
% of total weight of whole clams					59%	8.4%		19%

* Washed under a spray and in tub.

Table 10. Meat-yield of half-bushel lots of clams from different beach levels in Sissiboo river, N.S., July, 1945.

Lot no.	Source	Size range	No. in lot	Weight in ounces: Total	Shells and necks	Unwashed meats	Washed meats*
S7	High level 50' above 75' plot	2 - 2½"	544	412	220	82	80
S8	Upper middle 75' below S7	2 - 2½"	515	452	220	94	95
S9	Lower middle 190' below S7	2 - 2½"	525	444	212	92	97
S10	Low level at channel below S7	2 - 2½"	494	428	228	94	92
Average			520	434	220	91	91
% of total weight of whole clams					51%	21%	21%
Change in meat weight as a result of washing							0%

* Washed under a spray and in a tub

Table 11. Effects of beach level on meat-yield of half-bushel lots of Petpeswick cove clams, July 3 - Aug. 12, 1947.

Hod No.	Source	Population density per sq. ft.	Range (inches)	Size mm.	No. in lot	Weight in ounces: Whole clams	Shells	Necks	Unwashed meats	Washed meats*	Time required for shucking
11	High level Mussel Gully	40	2 - 2½	51.8	711	460	185	31	86	92	2 hrs.45 min.
12	Low level Mussel Gully	40	2 - 2½	53.3	606	475	204	27	88	94	2 hrs.30 min.
13	High level Cove Flat	40	2 - 2½	53.3	654	471	184	37	96	101	2 hrs.50 min.
14	Low level Cove Flat	40	2 - 2½	54.8	649	456	176	36	88	94	2 hrs.45 min.
Average				53.3	655	466	187	33	90	95	
% of total weight of whole clams							40%	7.1%	19%	20%	
Change in meat weight as a result of washing										5.6% gain	

* Washed in a tub only

Table 12. Effects of position in harbour on meat-yield of half-bushel lots of Petpeswick Harbour clams, July 3 - Aug. 12, 1947.

Hod No.	Source	Population density per sq. ft.	Range (inches)	Size mm.	No. in lot	Weight in ounces: Clams	Shells	Necks	Unwashed meats	Washed meats*	Time required for shucking
(a) 7	Cove	40	2 - $2\frac{1}{2}$	52.2	671	457	157	29	92	100	2 hrs.50 min.
(b) 10	False Gully	40	2 - $2\frac{1}{2}$	54.6	738	450	185	40	100	108	3 hrs.10 min.
(c) 12	Mussel Gully	40	2 - $2\frac{1}{2}$	53.3	606	475	204	27	88	94	2 hrs.30 min.
Average				53.4	672	461	182	21	93	101	
% of total weight of whole clams							39%	4.6%	20%	22%	
Change in meat weight as a result of washing										8.6% gain	

* Washed under a spray and in a tub

(a) Near harbour mouth but water circulation reduced.

(b) Opposite mouth of harbour.

(c) As far up harbour as digging is practical - circulation reduced.

Table 13. The effect of position in estuary on meat-yield and % dry solids of individual clams from the Sissiboo river, August and September 1949.

Position in Estuary	Length of clam (inches)	Weight in grams Wet	Dry	% Total solids	Mean
Sampled August 20, 1949 (some variation in beach level).					
Near mouth:	2	4.7	1.00	21.3	
	2¼	5.6	1.17	20.9	20.9
	2½	7.3	1.50	20.6	
Govt. Reserve (½ mile from mouth)	2	4.6	0.93	20.2	
		4.1	0.87	21.2	
	2¼	6.5	1.32	20.4	20.0
		7.1	1.42	20.0	
	2½	8.6	1.65	19.2	
		9.6	1.80	18.8	
¼ mile above Reserve	2	3.9	0.76	19.5	
		3.7	0.78	20.1	20.9
	2¼	7.0	1.47	21.0	
	2½	9.5	2.00	21.1	
½ mile above Reserve	2	4.7	0.96	20.4	
		5.1	1.03	20.2	
¾ mile above Reserve	2	3.7	0.72	19.5	
		3.4	0.70	20.6	
	2¼	5.4	1.12	20.8	20.5
	2½	8.0	1.60	20.0	
Just below bridge (1 mile above Reserve	2	4.0	0.85	21.2	
		4.0	0.85	21.2	
Sampled September 3, 1949, all lots from close to low-water mark.					
Mouth of river Hankinson's Cove	2	4.6	1.10	23.9	23.9
Government Reserve	2	3.3	0.79	23.9	
		4.1	0.96	23.4	22.7
		3.3	0.69	20.9	
¼ mile above Reserve	2	3.6	0.71	19.7	19.7
½ mile above Reserve	2	4.0	0.91	22.7	22.7
1 mile above Reserve (at Bridge)	2	3.7	0.79	21.3	21.3
¼ mile above Bridge	2	3.5	0.64	18.3	18.3

Table 14. The effects of position in estuary on meat-yield and % dry solids of clams from Digdeguash river, N.B., August 25, 1949.

Position in estuary and length of clam (ins.)	Meat weight in grams Wet	Dry	% total solids	Means
Above bridge 1 mile from mouth				
1¾	2.8	0.57	20.3	
2	3.3	0.66	20.0	
2¼	5.8	1.20	20.7	20.7
2½	9.3	1.96	21.1	
¼ mile below bridge				
1¾	2.9	0.56	19.3	
2	3.8	0.76	20.0	19.7
2½	7.7	1.53	19.9	
½ mile below bridge				
1¾	3.4	0.70	20.6	
2	4.3	0.92	21.4	21.3
2½	9.6	2.10	21.9	
Mouth of river 1 mile below bridge				
1¾	4.8	1.18	24.6	
2½	11.1	2.73	24.6	24.6

Table 15. The effect on untrimmed meat-yield in November 1949 of clams of transplanting (May 1949) from high beaches in the upper harbour to low beaches near the harbour mouth.

Stock sampled	No. of clams tested	Av. length of clams (inches)	Av. meat-yield (gms.)	Yield difference* as a result of transfer %
Pocologan				
Slag flat (seed source)	13	49.9	4.6	--
Kate's ledge relay (harbour mouth)	13	50.9	6.3	37%
Holland's garden relay (harbour mouth)	17	50.6	7.3	57%
Lepreau harbour				
Narrows flat (seed source)	11	51.5	4.7	--
Show bar relay (harbour mouth)	13	51.3	6.2	32%

* This difference is less than the actual increase because in this table we are comparing relative fatness of similar-sized clams. No allowance is made for the much greater growth that took place in the relay plots as compared with that in the seed-source beds.

Table 16. Meat-yield and % total solids of clams from areas of high and low salinities, August, 1949.

Source of clams	Length of clams (inches)	Weight in grams Wet	Dry	% Total solids	
Thorne Cove	2½	13.0	3.2	24.6	
August 22,1949	2¾	15.6	3.85	24.7	
(high salinity)	3	16.0	3.60	22.5	
	3¼	22.6	5.10	22.6	
	3½	24.3	5.20	21.4	Av. 23.2%
Deep Brook					
August 22,1949					
(high salinity)	2¼	8.0	1.93	24.1	
		7.1	1.76	24.8	
	2½	9.7	2.36	24.6	
		9.5	2.50	26.2	
	2¾	9.4	2.1	22.3	
	3	12.3	2.8	22.8	Av. 24.1%
River Philip					
(6 miles below	1½	1.5	0.26	17.3	
Oxford, N.S.)	2	2.8	0.47	16.8	
August 8, 1949.		2.4	0.42	17.5	
(low salinity)		3.1	0.50	16.1	
		2.8	0.45	16.0	
	2¼	4.4	0.73	16.6	
	2½	4.8	0.76	15.8	
	2¾	5.7	0.95	16.7	Av. 16.6%

Table 17. Summary of % dry solids content determinations by E. P. Sidaway on 62 samples of the commercial pack of shucked clam meats by General Seafoods Co's Nova Scotia plant on different dates in 1948 along with records of meat-yield data from Table 30.

Sampling date	No. of Samples tested	Dry Solids Content % (mean value)	Meat-yield in pounds per ½ bushel of whole clams (Table 30).
June 9	6	18.2	7.5
10	2	18.5	7.5*
11	4	19.1	7.6*
15	4	19.6	7.7
18	4	20.2	7.0
21	4	20.0	7.1
24	4	21.3	6.5
July 22	3	18.7	5.7
27	3	17.8	6.0
29	4	17.3	5.8*
Aug. 3	4	17.9	5.6
17	4	17.8	5.6
19	4	17.0	5.2*
24	2	16.3	5.5
26	4	17.3	5.5
Sept. 2	2	17.3	5.3*
9	4	18.2	5.0

* This value interpolated from other data in table 30.

Table 18. Results of separate analyses by E. P. Sidaway of 14 samples of shucked clam meats from General Seafoods' Nova Scotia shucking plant on different dates in 1949 along with meat-yield data from table 27.

Date	% Total dry solids		Meat-yield pounds per ½ bu. of whole clams
	Individual samples	Average	
March 30	15.93		6.1
31	16.75	16.34	5.8
April 4	18.08		5.5
13	15.40		5.6
21	16.53		6.1*
27	18.45	17.12	6.0
May 2	18.05		6.2
9	18.25		5.7
18	18.48	18.29	6.1
June 8	19.10		6.1
16	19.35	19.28	
Aug. 9	15.30	15.30	
Sept. 16	15.28		
22	17.00	16.14	

* This value interpolated from other data in table 27.

Table 19. Seasonal variations in the proportionate numbers of samples General Seafoods' 1948 pack of Nova Scotia shucked clams that fall below the 18% standard for total solids content.

Period	No. of samples with solids content 18% or higher	No. of samples with solids content Less than 18%	Proportion of samples below 18%
June 9 - July 27	32	2	6%
July 27 - Aug. 31	11	11	50%
Sept. 9 - 12	4	2	33%

Table 20. Meat-yield and % total solids of clams from the southern shore of St. Lawrence river, P.Q., June 29 to July 21, 1949.

Source of clams	Length of clams (inches)	Weight in grams		% total solids
		Wet	Dry	
Metis river	2¼	3.9	0.64	16.4
Anse Des Morts	2½	7.3	1.50	20.6
	3¼	17.0	3.10	18.2
Capucins	2¼	4.6	0.83	18.0
	2¾	5.4	1.03	19.1
Cap Chat	2¼	5.0	0.93	18.6
Average				18.5

Table 21. Untrimmed meat-yield and % dry solids of clams from Workshop cove a high level flat at St. Andrews, N.B., July 28, 1949.

Length of clam (inches)	Weight in grams Wet	Dry	% Total solids	
1½	1.6	0.30	18.8	
	1.5	0.29	19.3	
	1.9	0.33	17.4	Av. 18.5
2	3.4	0.56	16.5	
	3.9	0.70	17.9	
	3.6	0.63	17.5	
	4.0	0.68	17.0	
	4.0	0.68	17.0	Av. 17.2
2¼	5.5	1.07	19.5	
	5.9	1.10	18.7	
	5.1	0.90	17.6	
	4.8	0.80	16.7	Av. 17.1
2½	5.1	0.90	17.7	Av. 17.7
3¼	17.1	3.40	19.9	Av. 19.9

Table 22. Untrimmed meat-yield and % dry solids of clams from Pottery Bridge Flat, N.B., Aug. 5, 1949.

Length of clam (inches)	Weight in grams Wet	Dry	% Total solids	
2	4.4	0.92	20.9	Av. 20.9
2½	8.0	1.76	22.0	
	10.0	2.33	23.0	
	7.0	1.53	21.9	Av. 22.3
3	14.1	3.00	21.3	
	16.1	3.90	24.2	
	14.6	3.20	21.9	
	19.2	4.30	22.4	
	13.5	3.20	23.7	Av. 22.7
3½	19.8	4.40	22.2	
	19.6	4.10	20.9	
	19.2	3.70	19.3	
	15.8	2.90	18.4	
	20.0	4.60	23.0	Av. 20.7
4	34.2	7.00	20.4	
	37.9	7.90	20.8	
	26.3	6.00	22.8	Av. 21.3

Table 23. The effect of density of population on meat-yield of half-bushel lots of Petpeswick cove clams taken from west of Latin Square near the gulley, July 1945.

Lot No.	Population density per sq. ft.	Size range (inches)	Mean mm.	No. in lot	Weight in ounces: Total	Shells	Necks	Unwashed meats	Washed meats
P9	8	2 - 2½	56.3	792	632	256	48	120	-
P10	20	2 - 2½	54.4	863	600	244	44	112	-
P11	50	2 - 2½	55.9	811	632	288	40	112	-
Average				822	621	263	44	115	
% of total weight of whole clams						42%	7%	18.5%	

The effect of density of population on meat-yield of half-bushel lots of clams taken from a flat on the south side of Cheticumchec Island, Musquodoboit Harbour, N.S.

Lot No.	Population density per sq. ft.	Size range (inches)	Mean mm.	No. in lot	Weight in ounces: Total	Shells	Necks	Unwashed meats	Washed meats
*P12	5	2 - 2½		726	520	196	36	104	-
P12 adjusted				(910)	(650)	(245)	(45)	(130)	-
P13	20	2 - 2½	55.1	895	600	240	36	108	-
P14	50	2 - 2½	53.8	944	688	280	40	120	-
Average				916	646	255	40	119	-
% of total weight of whole clams						40%	6.2%	18.4%	

* This hod was not quite full when the flood tide interrupted the digging. It was estimated both by counting the number of clams in it and by inspection to be 80% full. On this basis the values recorded have been "adjusted" for comparison with hods that were full.

Table 24. Effects of density or crowding on meat-yield of half-bushel lots of Petpeswick cove clams, July 3 - Aug. 13, 1947.

Hod No.	Source	Population density per sq. ft.	Range (inches)	Size mm.	No. in lot	Weight in ounces: Whole clams	Shells	Necks	Unwashed meats	Washed meats*	Time required for shucking
6	Cove N. of Latin Square	10	2 - 2½	55.1	587	416	155	33	95	102	2 hrs.35 min.
4	"	20	2 - 2½	54.9	605	453	166	34	103	108	2 hrs.45 min.
7	"	40	2 - 2½	52.2	671	457	157	29	92	100	2 hrs.50 min.
8	False Gully Big Flat	10	2 - 2½	54.8	634	451	166	38	97	106	2 hrs.30 min.
9	"	20	2 - 2½	55.1	677	416	163	35	95	106	2 hrs.40 min.
10	"	40	2 - 2½	54.6	738	450	185	40	100	108	3 hrs.10 min.
Average				54.5	652	441	166	35	97	105	
% of total weight of whole clams							38%	8%	22%	24%	
Change in meat weight as a result of washing										8% gain	

* Washed in a tub only

Table 25. The average yield of trimmed meat (un-washed and washed in freshwater) from half-bushel lots of clams dug from the experimental plots at Petpeswick, August 1948, where population densities varied.

Population density per sq.'	No. of ½ bu. lots tested	Av. no. clams per ½ bu.	Av. length of clams mm.	Yield of trimmed meats - oz.	
				un-washed	washed*
20n	15	633	54.2	78	77
20s	15	705	51.2	76	75
40n	15	725	51.1	76	75
40s	15	793	48.7	79	78
80n	15	869	47.2	73	72
Av.				76.4	75.4
change in meat weight as a result of washing					1.3% loss

n means that the seed stock planted in 1944 was normal

s means that it was stunted

* washed under a spray only.

Table 26. Meat-yield of clams from Musquodoboit, Petpeswick and Clam harbour, N. S., (Records from General Seafoods' Shucking Plant), 1944.

Date	Meat Yield in pounds per ½ bu. hod of whole clams							
	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1				6.2	5.8		5.4	5.4
2		7.0		6.4		6.1	6.4	5.5
3		7.1	6.0	5.9		4.6	5.5	
4			5.6	6.2	5.2	5.5	5.5	5.6
5		6.9	7.4	5.9	5.9			5.9
6		7.4	6.8		6.2	5.0	6.6	
7		7.2	6.5	5.7	5.6	5.6		
8		7.6	6.9	6.4	5.3			6.1
9		7.2		5.8	5.7	4.8		
10		6.4	6.9			4.1		
11			6.9	6.3	5.4	4.1		6.7
12		6.6		6.3	6.2	5.3		
13		6.1	7.0		5.7	5.4	5.8	6.3
14		6.8	6.7	6.3	5.8	6.2	6.6	6.6
15	6.5	6.7	7.3	6.1	6.0			5.6
16	5.9	6.1		6.4		5.5	6.3	
17	6.5	6.2	6.7	5.7		5.5	5.5	
18	7.6		6.5	5.9		6.0		5.4
19	6.7	7.5	6.9	6.1	5.5	5.6		
20		7.3	6.9		5.8	5.7	6.0	
21			6.1	5.7	5.8	5.8	6.1	
22	7.9			6.2	6.2		5.9	
23	6.4	6.7		5.7	6.1	5.5		
24	7.0	7.3	6.9	5.9		5.5		
25	7.0		6.7	5.7	5.9			
26	6.3			5.3	6.2	6.0		
27			6.7		5.6		5.6	
28				5.4	6.3	6.0	5.8	
29	7.6		6.4		5.5			
30	7.0			6.0		5.8	6.3	
31	7.0		6.6	5.7		5.6		
Average	6.9	7.5	6.7	6.0	5.7	5.4	6.0	5.9

Table 27. Meat-yield of clams from Musquodoboit, Petpeswick and Clam harbour, N. S., (Records from General Seafoods' Shucking Plant), 1945.

"Popped" meats bracketed. Yield per hod (½ bu.) in lbs.

Date	April	May	June	July	Aug.	Sept.	Oct.
1			7.5			6.3	6.6
2	(5.4)	6.6			6.7		6.1
3	(5.5)			7.6	6.5		7.1
4	(6.0)	7.0	7.7	7.4	6.6	6.0	
5	(5.6)	7.0	7.0	7.1		6.6	6.2
6	(5.7)		7.5	7.2	6.4	6.9	6.9
7	6.3 (5.0)		7.1	7.2	6.4	6.6	
8	6.5 (5.4)	7.0	7.4		7.1	6.4	7.1
9		6.7	8.0	7.5	6.5		6.2
10	6.3 (5.3)	7.2		7.2	7.0	6.8	6.3
11	6.2 (5.2)	6.8	7.2	7.1	6.6	7.0	
12	6.5 (5.3)	6.8	7.6	7.1		6.9	7.3
13	6.2 (5.2)		7.0	7.4	5.1	6.6	
14	6.4 (4.9)	6.3	7.6	7.9	5.3	7.0	
15		6.5	7.8			5.9	
16	5.6 (4.5)	6.8	7.3	7.0	6.5		
17	5.5 (4.3)	6.7		7.5		5.5	
18	4.7 (3.6)	6.5	7.1	6.9	6.5	5.4	
19	6.0 (4.7)	6.0	7.7	7.0		5.8	
20	6.3 (5.2)		7.8	7.0	5.3	6.9	
21	6.6 (5.3)	7.2	7.4	6.5	6.1	6.5	
22			7.6		6.9	6.8	
23	6.6	7.3	6.6	6.3	6.4		
24	6.2 (5.0)	6.7		6.5	7.1	6.4	
25	6.6 (5.1)	7.3	7.1	6.7	6.4	6.9	
26	6.9 (5.7)	7.3	7.6	6.8		6.2	
27	6.6 (5.2)		7.4	6.6	5.4	7.4	
28	6.5 (5.1)	6.8	7.6	7.0	5.5	7.0	
29		7.1	7.7		6.8	6.8	
30	6.4 (5.3)	7.5	7.0	7.0	7.1		
31		7.2		7.3			
Average	6.2 (5.1)	6.9	7.5	7.1	6.4	6.5	6.6

Table 28. Yield of clams from Musquodoboit, Petpeswick, Clam and Cole harbours, N. S., (Records from General Seafoods' Shucking Plant), 1946.

Date	Mar.	April	May	June	July	Aug.	Sept.	Oct.
			Meat yield in pounds per ½ bu. hod of whole clams					
1		5.8	6.1 (5.7)	6.4		5.9		
2		5.8		5.8 (5.1)	6.4	6.2		5.0
3		5.1	6.5		6.4		5.4	
4		5.5	6.3	6.2 (5.9)	6.1			
5		5.4		6.5	6.6	5.5		5.2
6		4.8	5.9	6.6	6.3	5.7	5.2	
7			5.6	6.5		5.5	5.1	5.1
8		5.2	5.1	6.2	6.3	5.3	4.6	5.3
9		6.6	5.4			5.1		5.6
10		7.0	6.2	5.8	6.4	5.4	5.2	5.7
11			6.1	5.3	6.6		5.2	5.8
12		6.3		5.5	6.1		5.3	5.8
13			6.1 (5.5)	6.2	6.6	5.7	5.3	
14			6.4	6.4		5.6	5.4	5.4
15		6.7 (5.6)	6.5	6.7	6.0	6.0		5.2
16		6.5 (6.0)	6.1	6.2	6.3	5.6	5.0	
17		6.1 (5.9)	6.6		6.2	5.6	5.0	
18		6.1 (4.6)	6.2 (5.9)	6.3	6.2		5.2	
19	5.8	5.7 (5.5)		6.5	6.1	5.1	5.4	5.6
20	5.6	5.9 (5.2)	6.6 (4.9)	6.8	5.7	5.6	5.2	
21	5.3		7.6	6.4		5.4	5.3	
22	5.4	5.5 (4.4)		6.8	5.7	5.8		5.8
23	4.5	5.6	6.9			5.6	5.1	5.7
24		5.5 (4.1)	6.2 (5.7)	6.5	6.1	5.7	5.3	5.8
25	4.4	5.5 (4.0)	6.2 (4.8)	6.6	7.2		5.0	5.5
26	5.7	5.4 (4.0)			5.9	5.0	5.0	5.6
27		6.0	6.1	6.1	6.0		5.0	
28	5.7		6.3	6.8		5.3	5.3	
29		5.6 (4.3)	6.3 (6.0)	6.0	5.1	5.1		5.3
30	5.5	6.9 (6.0)	5.6 (5.1)		6.1	5.0	5.2	
31			6.7		6.4	5.0		
Average	5.3	5.9 (5.0)	6.2 (5.5)	6.3	6.2	5.5	5.2	5.5

Table 29. Meat-yield of clams from Musquodoboit, Petpeswick and Clam harbour, N. S., (Records from General Seafoods' Shucking Plant), 1947.

Meat yield in pounds per ½ bu. hod of whole clams

Date	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1		5.1			5.9	6.1		6.4	6.2	5.6
2		5.4		5.7	5.9	6.0	5.4			6.1
3		5.1		6.7	6.1		5.8	6.0		
4				6.0	6.2		5.4	6.1		
5		5.3	6.7	6.4	6.1	6.0	5.5		5.5	
6			6.0	6.6		6.0	5.4		5.6	
7		5.3	6.2	6.8	5.8	5.5		5.9		
8		5.3	6.2		6.2	5.4	5.9	5.8		
9		5.2	6.3	5.6	6.4	5.4	6.0	5.8		
10		5.5	6.0	6.0	6.4		5.9	5.9	5.5	
11				6.1	6.2	5.1	5.6	5.8	5.8	
12		3.2		6.6	6.2	5.7	5.3			
13			5.8	6.2		5.6	5.2	5.5	5.7	
14		5.1	6.3	6.4	5.6	5.6		5.6		
15		5.6	5.9		6.4	5.4	5.4	5.7	5.4	
16		5.6	5.8	6.0	5.9	5.4	5.6	5.6		
17	5.1	5.8	6.1	6.2	6.0		5.6	5.5		
18	5.2	5.0		6.2	5.9	5.3	5.8			
19	5.3	5.6	5.6	6.0	5.9	5.9	5.7	5.3		
20	5.9		5.7	6.0		5.8	5.8	5.1	5.3	
21	4.9	5.3	5.4	6.1	5.9	5.8		5.4	5.3	
22	4.7	5.2	5.2		6.8	5.9	5.7			
23		5.6	5.8	6.3	6.4		5.8	5.4		
24	4.6	6.1	5.2	6.1	7.0		5.6	5.6		
25	4.6	5.5		6.0	6.2	5.2				
26	4.5	5.3	5.6		6.4	5.2	5.7	5.4		
27				5.6			5.8		5.4	
28		5.1	6.3		5.5	5.5		5.7	5.8	
29		5.2	6.0		6.0	5.4	7.7	5.6	5.7	
30		6.5	5.8	5.7	6.1	5.7	5.9	5.9		
31	4.8		4.9		6.1			5.6		
Average	5.0	5.3	5.4	6.1	6.1	5.6	5.8	5.7	5.6	5.9

Table 30. Meat-yield of clams from Musquodoboit, Petpeswick and Clam harbour, N. S., (Records from General Seafoods' Shucking Plant), 1948.

	Yield per hod ($\frac{1}{2}$ bu.) in lbs.							
Date	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1			6.5		5.3	5.1	5.4	
2			6.4	5.5		5.0	5.5	5.4
3			6.7	5.6	5.3		5.5	5.4
4		7.8		6.0	5.3			5.5
5		7.6	6.1	5.8		5.4		
6			6.4	5.9		5.5	5.6	
7		7.5	6.3	6.0	5.4			
8		7.6	6.7		5.2	5.2		5.0
9		7.5	6.5	5.8	5.0	5.3		
10			6.3	6.2			5.5	
11				6.3	5.2			5.0
12		7.6	6.6	6.0		5.1		
13			6.4	6.0			5.6	
14		7.4	6.3	5.8	4.8			
15		7.7	6.1		5.2	5.2	5.2	5.3
16		7.2	6.0	5.5	5.2	5.4	5.5	
17		8.0	5.7	5.6	5.2		5.6	
18		7.0		5.2	5.2	5.2	5.6	5.4
19		6.8	5.6					
20			5.6	5.2		5.4	5.6	
21		7.1	5.9	5.4	5.3	5.6		
22		7.0	5.7			5.4		
23		6.8	5.6	5.2	5.5	5.6		
24		6.5	6.0	5.5				
25		7.1		5.4	5.1			
26			6.1	5.5		5.4	5.5	
27	8.2		6.0	5.3		5.4		
28	8.2	6.5	5.8	5.1	5.2			
29	8.1	6.9			5.4	5.3	5.2	
30			5.8	5.0		5.6	5.5	
31	8.0	5.5	5.4					
Average	8.1	7.2	6.1	5.6	5.2	5.3	5.5	5.3

Table 31. Meat-yield of clams from Musquodoboit, Petpeswick and Clam harbour, N. S., (Records from General Seafoods' Shucking Plant), 1949.

"Popped" meats bracketed. Yield per hod ($\frac{1}{2}$ bu.) in lbs.

Date	March	April	May	June
1		5.7 (4.8)		6.4
2		5.7 (4.6)	6.2	6.2
3			5.9	6.3
4		5.5 (5.4)	6.0	6.0
5		6.0 (4.4)	5.8	
6			5.7	5.8
7		5.8 (4.7)	5.7	6.0
8				6.1
9		5.8 (4.8)	5.7	6.2
10			5.9	6.0
11		5.5 (5.4)	5.9	6.1
12		5.6 (4.8)	6.0	
13		5.6 (4.8)	5.8	
14		5.8 (4.9)	6.2	
15		5.8 (4.9)		
16		5.5 (4.7)	5.8	5.9
17			6.0	
18		5.7 (4.8)	6.1	
19		5.7 (4.8)	6.0	
20		6.0 (5.1)		
21			6.0	
22		6.1 (5.1)		
23		5.9 (5.2)	5.7	
24			5.7	
25		6.1 (5.3)		
26		5.7 (4.9)	6.1	
27		6.0 (5.2)	6.2	
28		6.0 (5.3)		
29	5.9 (4.3)	6.1 (5.4)		
30	6.1 (5.0)	5.9 (5.2)		
31	5.8 (4.8)		6.5	
Average	5.9 (4.7)	5.8 (4.9)	5.7	6.1

Table 32. Monthly mean meat-yields in pounds per ½ bu. (Imperial) of whole clams from General Seafoods' plant - 1944-1949.

Year	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year's av. of monthly mean
1944	-	-	6.9	7.5	6.7	6.0	5.7	5.4	6.0	5.9	6.3
1945	-	6.2	6.9	7.5	7.1	6.4	6.5	6.6	-	-	6.9
1946	5.3	5.9	6.2	6.3	6.2	5.5	5.2	5.5	-	-	5.8
1947	5.0	5.3	5.4	6.1	6.1	5.6	5.8	5.7	5.6	5.9	5.7
1948	-	-	8.1	7.2	6.1	5.6	5.2	5.3	5.5	5.3	6.0
1949	5.9	5.8	5.7	6.1							
Overall monthly mean											General mean 6.1

Table 33. Yield of clams from Annapolis basin and Sissiboo river, N.S., (Records from International Shellfish Company Shucking Plant, Digby, N.S., 1946).

	Meat-yield in gallons* per bbl. of round clams							
Date	March	April	May	June	July	Aug.	Sept.	Oct.
1		4.6	3.3	4.5		4.5	4.0	4.2
2		4.5	4.0		4.4	4.4		4.2
3			4.5	4.4	4.5		3.8	4.2
4		4.7	4.4	4.4	4.4	4.3	4.0	4.1
5		4.6		4.5	4.5		3.9	4.0
6		4.9	4.8	4.5	4.6		3.9	
7			4.4	4.4		4.1	4.1	3.9
8			4.3	4.5	3.9	4.2		
9		4.5	4.5		4.5	4.2	4.1	4.1
10		4.6	4.4	4.3	4.5	4.4	3.9	4.1
11		4.6	5.1	4.4	4.5		4.1	4.1
12				4.2	4.6	4.5	4.2	3.9
13		4.7	4.6	4.4	4.5	4.4	3.9	
14			4.8	4.4		4.3		3.8
15		4.5	4.1	4.4	4.5			4.1
16		4.7	4.2		4.6		4.0	4.0
17		4.2	4.3	3.9	4.6	4.2	4.0	3.9
18		4.4	4.5		4.6		4.0	4.1
19		3.9		4.5	4.2	4.2	4.0	4.1
20		3.9	4.6	4.5		4.2	3.9	
21			4.6	4.2		3.9	3.9	4.2
22		4.0	4.4	4.4				4.0
23		4.0	4.1		4.4	4.0	3.8	4.1
24		4.0	4.4	4.0	4.4	4.2	3.9	4.1
25		4.2	4.4	4.3	4.3		4.0	4.0
26		4.0		4.4	4.4	3.9	4.1	4.0
27	4.6	4.2	4.4	4.4	4.5	4.1	4.1	
28	4.1		4.3	4.5		4.1		
29	4.4	4.6	4.4	4.5	4.5	4.1		
30	4.5	4.0	4.4		4.5	4.0	4.1	
31			4.5		4.4			
Av.	4.3	4.4	4.4	4.4	4.5	4.2	4.0	4.1

* 1 gallon (American) holds 8 pounds of clam meat.

Table 34. The yield of commercially shucked meats in pounds per barrel of whole clams for the year 1946.

Clams from Annapolis Basin and Sissiboo River, N.S.			Clams from Halifax County shore of Nova Scotia.		
International Shellfish Company			General Seafoods		
	* Gal. per bbl.	Lbs. per bbl.		Lbs. per ½ bu.	Lbs. per bbl.
March	4.3	34.4	March	5.3	26.5
April	4.4	35.2	April	5.9	29.5
May	4.4	35.2	May	6.2	31.0
June	4.4	35.2	June	6.3	31.5
July	4.5	36.0	July	6.2	31.0
Aug.	4.2	33.6	Aug.	5.5	27.5
Sept.	4.0	32.0	Sept.	5.2	26.0
Oct.	4.1	32.8	Oct.	5.5	27.5
Average	4.3	34.4		5.8	29.0

* 8 lbs. of drained meats equals one gallon.

Table 35. Effects of storage on meat-yield of half-bushel lots of Petpeswick cove clams, July 3 - Aug. 12, 1947.

Hod no.	Source	Population density per sq. ft.	Range (ins.)	Size (mm.)	No. in lot	Weight in ounces: Clams	Shells	Necks	Unwashed meats	Washed meats*	Period of storage	Time required for shucking
15	Reserve Cove flat	20 - 30	2 - 2½	56.3	552	499	187	31	89	90	none	2 hrs.20 mi
2	" " "	"	"	54.8	572	455	180	29	90	96	24 hrs.	2 hrs.30 mi
16	" " "	"	"	55.0	617	429	170	34	81	88	48 hrs.	2 hrs.50 mi
17	" " "	"	"	56.3	523	445	206	27	71	76	96 hrs.	2 hrs.17 mi
Average				55.6	566	457	186	30	83	88		
% of weight of whole clams							41%	6.6%	18%	18%		
Change in meat weight as a result of washing										6%	gain	

* Washed in a tub only.

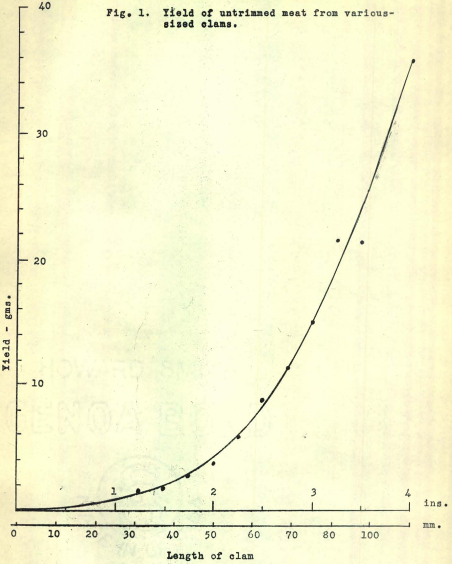
Table 36. Effects of storage on untrimmed meat-yield and % total solids of Brandy Cove clams, September, 1949.

Length of clams and Type of storage	Storage period (days)	Weight in grams Wet	Weight in grams Dry	% Total solids	Length of clams and Type of storage	Storage period (days)	Weight in grams Wet	Weight in grams Dry	% Total solids
Basement-	0	13.8	3.00	21.7	Basement	0	12.5	2.56	20.5
(Temp. 16° C.)	2	12.0	2.25	18.7	(Temp. 16°C)	2	11.2	2.73	24.4
	3	14.9	3.05	20.5		3	11.4	2.70	23.7
3"	4	14.0	3.25	23.2	2¾"	4	11.5	2.93	25.5
	5	12.5	2.85	22.8		5	11.4	2.85	25.0
	6	11.6	2.45	21.1		6	10.9	2.66	24.4
Cool Room	0	4.8	0.93	19.4	Cool Room	0	6.3	1.30	20.6
(Temp. 5°C.)		5.1	1.03	20.2	(Temp. 5°C.)		5.8	1.15	19.8
	2	4.6	1.00	21.8		2	5.2	1.03	19.8
2"	3	4.0	0.84	21.0	2½"	3	4.1	0.88	21.4
	4	4.2	0.94	22.4		4			
	6	4.7	1.00	21.3		6			
		4.2	0.87	20.7					
Freezer -					Freezer -				
(Temp. -6°C.)	0	4.8	0.93	19.4	(Temp. -6°C.)	0	6.3	1.30	20.6
		5.1	1.03	20.2			5.8	1.15	19.8
	2	5.2	0.97	18.7		2	5.2	1.00	19.3
2"	3	4.7	0.94	20.0	2½"	3	7.0	1.33	19.0
	4	4.3	0.82	19.0		4	5.6	1.00	17.9
	6	4.4	0.80	18.2		6			
		5.3	0.92	17.3					
Open Air									
(Temp. 73°C.)	0	8.9	2.05	21.9					
2½	1½	7.7	2.12	27.6					
	2½	7.1	2.05	28.9					

Table 37. The wet and dried weights and % dry solids of untrimmed and trimmed meats and of trimmings of Brandy cove clams, Sept. 7, 1949.

Part of clam	No. of clams	Length of clam (inches)	Weight (gms.) Wet	Dry	% total solids	Av. weight (gms.) Wet	Dry
Whole clam:	5	2¼	37.1	8.6	23.1	7.4	1.7
(including	5	"	39.8	8.9	22.3	8.0	1.8
muslces and	6	"	35.4	7.5	21.2	5.9	1.3
necks)	6	"	34.2	7.0	20.5	5.7	1.2
	6	"	31.5	6.0	19.0	5.3	1.0
					Av. 21.2		
Trimmed:							
(neck only	7	2	34.1	8.1	23.7	5.0	1.2
removed)	7	"	25.6	5.6	21.9	3.7	0.8
	6	2¼	31.8	7.0	22.0	5.3	1.2
	6	"	26.2	5.1	19.5	4.4	0.9
	6	"	26.7	5.3	19.8	4.5	0.9
					Av. 21.2		
Muscles:	7	3½	13.9	3.4	24.5	2.0	0.5
(2 per clam)	18	2½	14.1	3.5	24.8	0.8	0.2
					Av. 24.7		
Necks:	7	3½	14.6	3.2	21.9	2.1	0.5
	18	2½	23.5	5.3	22.5	1.3	0.3
	22	2	18.1	4.0	22.1	0.8	0.2
					Av. 22.2		

Fig. 1. Yield of untrimmed meat from various-sized clams.



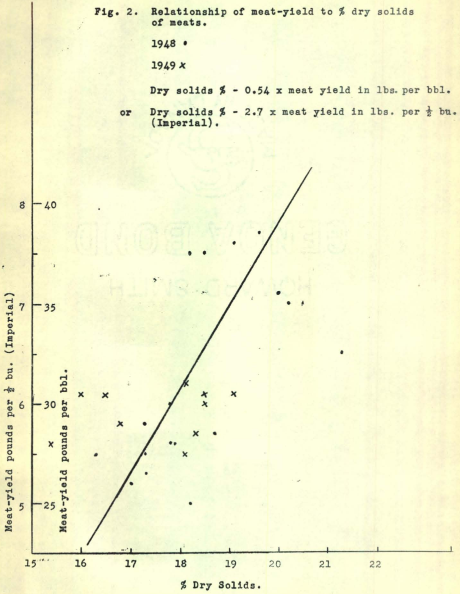


Fig. 2. Relationship of meat-yield to % dry solids of meats.

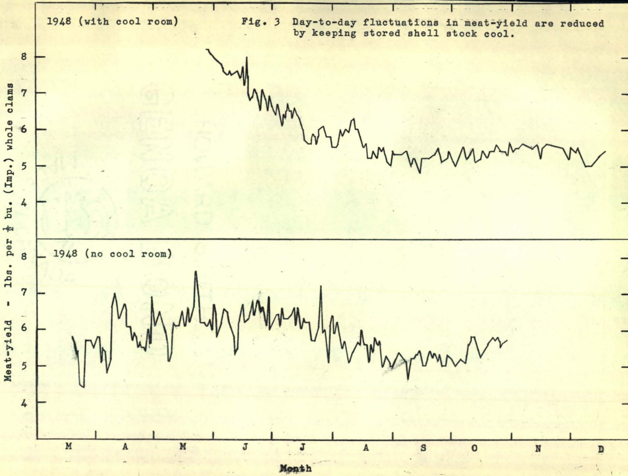


Fig. 3 Day-to-day fluctuations in meat-yield are reduced by keeping stored shell stock cool.

Fig. 4. Effect of freshwater washing on weight and total solids content of clam meat.