C U R A T O R I A L   R E P O R T   N U M B E R   1 0 5

REPORT ON THE FISH OTOLITH COLLECTION AT THE NOVA SCOTIA MUSEUM OF NATURAL HISTORY

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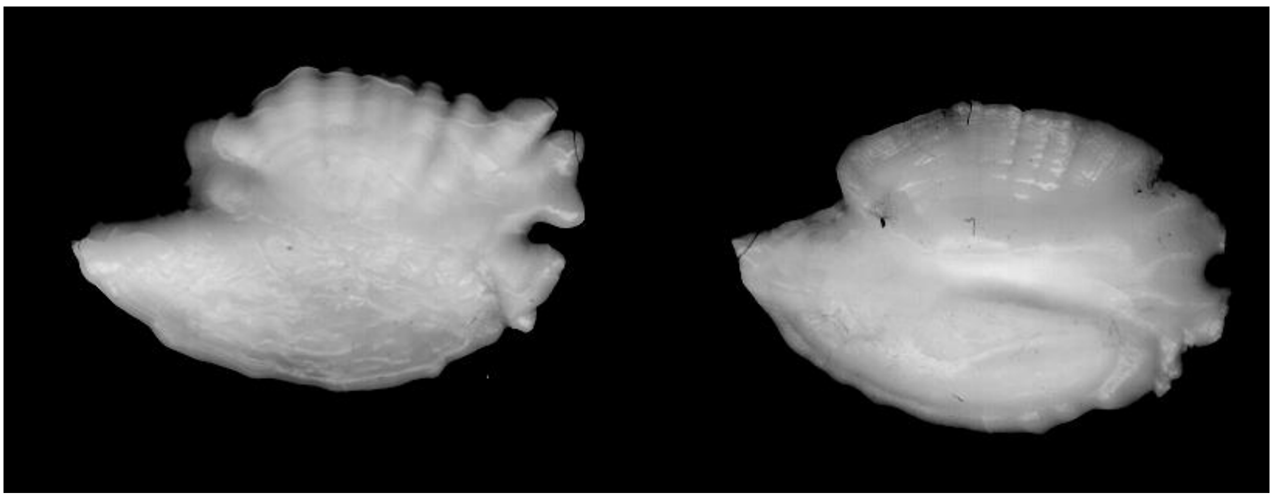

CURATORIAL REPORTS

The Reports of the Nova Scotia Museum make technical information on museum collections, programs, procedures, and research accessible to interested readers.

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I. INTRODUCTION

The present report deals with a collection of otoliths from modern teleost fishes donated by the author to the Nova Scotia Museum (NSM), Halifax, Canada. This collection of 976 specimens represents 62 species belonging to 28 families. Their taxonomic arrangement, which follows Nelson (1996), is also used by the N. S. Museum for its fish collection.

Otoliths have been found in abundance in geological strata (Nolf, 1995); in archaeological sites (Bullen, 1949; Fitch, 1972; Huddleston and Barker, 1978) and in the digestive tract, excreta, and pellets of fish predators, such as larger fish, aquatic birds and mammals (Bowen and Harrison, 1996; Fitch and Bronwell, 1968).

Otoliths often constitute the only remains of past fish faunas available to paleontologists and archaeologists. Otoliths are very valuable for the direct or indirect study of the life history of individual fish (hatching season, age, growth rate, migrations, spawning grounds, etc.) and fish-population structure (length, age, and sex distribution). Within certain limitations, they are of primordial value in the reconstruction of the environment (distribution of water bodies, water temperature, etc.), and human activities of times past.

Two large samples, 109 codfish from Prospect Bay, N. S. and 43 silver hake from Passamaquoddy Bay, N. B., have been studied and added to this paper, although the otoliths have been discarded after they were measured and weighed. These two samples are included here for their large size, geographical proximity, and possible value in faunal analysis of archaeological and ecological material found in the Atlantic Provinces.

My attempts to locate otolith collections in the Atlantic Provinces have been unsuccessful. Apparently there are no collections. It is, therefore, recommended that otoliths be added to any collection of fish skeletons, since otoliths are more reliable material for extracting certain biological information of the species concerned than most fish bones.

Blacker (1974) has detailed the advances in otolith research and Secor, et al. (1995) have presented up-to-date knowledge on otolith studies. In both, among others, the reader can find abundant bibliography on any topic related to otoliths.

II. MATERIAL

This collection consists exclusively of sagittae, the largest otolith found in the sacculus of the inner ear of fishes. Throughout this document the term otolith(s) refers to the *sagitta*. Both otoliths, right and left, have been extracted from fresh specimens or specimens preserved in alcohol for a few days.
All otoliths have been stored dry in small vials. An identification tag bears the accession number corresponding to that of the NSM files. The accession number allows the retrieval of information regarding the individual fish: fish length and weight; time, place, water depth, and method of capture; length and weight of the otoliths, and other pertinent data.

III. METHODS

III.1 Extraction of otoliths

A good collection of otoliths is a must for archaeological and dietary studies. To prepare one, the use of fresh or frozen fish specimens is recommended. The use of alcohol or formalin hardens the tissues and facilitates the extraction of the otoliths, but the use of unbuffered formalin is not recommended because it penetrates the otolith and alters its consistency. Otoliths obtained from preserved fishes have often been affected in their structure by the preserving chemicals, with the result that they are a poor material for measuring and weighing purposes.

A little practice in removing the otoliths will produce good and fast results. For fish that are not required for any other scientific purpose, the fastest method is to place the fish or only its head in warm, not boiling, water. Once the fleshy tissues are softened, the skin, muscles, and bones of the occipital and otic areas located at the rear of the skull can be removed with a pair of tweezers, until the otoliths appear.

It is convenient to store the right and left otolith in separate vials, taking note of which is the anterior end of the otolith, along with other useful data. This precaution will save a lot of time, if later one needs to study the otoliths of each side separately.

Another fast method consists in making a horizontal cut through the top of the skull between the eyes and the gill membrane (Fig. 1, A). If the otoliths do not appear after the first cut, more cuts a little deeper should be done until the otoliths are seen. By grasping the head with one hand and moving it downward, and at the same time pushing the body down with the other hand, as if breaking the fish at the level of the "neck," the otoliths can be easily removed. For flat fishes, the cut is made after placing the fish on "edge." (Fig. 1, B).

I found a way to extract the otolith for commercial fish, such as salmon, trout, cod, etc. whose appearance fishermen don't want to spoil (Fig. 1, C). Place the fish on its back; firmly grasp the lower mandible placing the fish body away from you. Once the fish is resting on the table, the upper palate will then be exposed. Deep in the mouth and close to the gullet, two bulging areas, right and left, will be easily seen. These are the otic capsules where the otoliths are enclosed. Cut them open with a scalpel or sharp knife and push the slivers of bone outwards. The otoliths can easily be removed with tweezers. Once the mouth is closed, the fish doesn't show any damage that could make it unfit for sale.

III.2 Live fish length and weight measurements

Length

The length of the fish specimens was taken by trained personnel in the lab or in the field, when the fish was in a fresh condition or after thawing frozen specimens. Several methods have been used in biological work to measure the length of fishes. The three most common lengths taken for teleost fishes are: total, standard, and fork lengths. Researchers have used one or another depending on the purpose of the research, the species studied or the one best representing its relationship to the weight of the fish. The lengths recorded for this work were taken in a straight line between two points avoiding following the curvature of the body.

Theoretically, the fish length is the distance from the most anterior projecting point of the head to the end of the longest radius of the tail (Fig. 2). In practice, as many as seven different lengths can be found in fish literature.

Two total lengths for fishes with homocercal tail i. e. with both caudal lobes of equal length:

a) Normal total length, taken as stated earlier but with the caudal fin extended in its natural position (Fig. 2, AG), and

b) Maximum total length (also called "pinched length") taken with both caudal lobes squeezed towards the midline (Fig. 2, A'I).

c) One, bilobular length, for fishes with heterocercal tail, i. e. caudal lobes of unequal length.

d) Normal bilobular total length, taken to the centre of an imaginary line that joins the tips of the two caudal lobes in their natural position (Fig. 2, A'H).

e) Evidently, the differences between these methods are small, but, depending on the relative size of the length of fish body and the tail length, the difference can, in some cases, be noticeable.

f) The Standard length is usually taken in three ways:

g) Sometimes, it was taken till the end of the last vertebra (Fig. 2, AD),

h) In fishery research, this length is taken from the most anterior projecting point to the end of the urostyle (Fig. 2, A'O), and

i) In systematic work, it is taken from the same anterior point to the end of the fleshy portion of the body at the base of the caudal fin (Fig. 2, AE).

j) The Fork length, most commonly used in fishery work, extends from the most anterior projecting point of the head to the end of the shortest caudal fin rays, which usually coincides with the angle formed by the two lobes (Fig. 2, AF).

In fish literature, one can find formulae relating any two of the above-mentioned measurements, making it possible to convert one to the other.

In this paper, the total length (b) was taken for most fishes. When the fork length (i) was taken, it was later converted to the total length using the appropriate equation. Whenever the length was taken in inches and decimals of an inch the results were converted to the decimal system with an approximation of one millimetre.

Royce (1942) has studied statistically the relationship between the total length and the standard length with fish weight. He concluded "that the weight could be estimated more accurately from the total length than from the standard length," at least for the four following species: *Perca flavescens*, *Stizostedion vitreum*, Ambloplites rupestris and *Salvelinus* (*Cristivomer*) *namaycush*.

Weight

Fish were weighed in the lab or in the field using the decimal system down to the nearest gram or, if in pounds, down to the nearest ounce. Measurements taken in pounds and ounces were later converted to the decimal system. Total weight, and, sometimes, dressed weight were taken from fish in the field, i.e. with viscera (gonads, liver, heart, intestines, and stomach) in place. Dressed weight refers to fish eviscerated.

III.3 Otolith length and weight measurements

Maximum length is the dimensional parameter most commonly used by researchers to measure otoliths. It is also the easiest to take and its error is minimal. Some authors are taking also the otolith width, especially in studies of the diet of marine mammals, since this dimension is the least affected by the digestive processes. Unfortunately, this advantage is reduced by the fact that often it is difficult to locate where the maximum width is.

The maximum length and width of the otoliths were taken with calipers with a precision of 0.1 of one mm. Weight was taken using scales able to weigh within an error of less than 0.001 of one gram. For the calculation of the formulae relating otolith dimensions to fish length or weight, the otolith length and weight were used. In either case, the average length and weight of both otoliths was used for each individual fish.

III.4 Method used to estimate live fish length

Many studies have proven that there is a good correlation between the length of the fish and the maximum length of the sagitta for fishes of the same species (Aurioles, 1991; Freyre and Mollo, 1987, Southward, 1972). In most papers, this relationship has been expressed as being linear, according to Lee's formula

$$Y = a + bX$$

in which Y is the length of the fish and X, the length of the otolith. The coefficient a represents the intercept of the regression line with the y axis and the coefficient b the slope of the same line. In fishery biology, it was found to be more accurate or useful in some instances, the use of the standard or the fork length instead of the total length. In these cases, new formulae can be calculated in a similar way. It is true that in many cases this relationship is not linear when specimens of all sizes from larvae to adults are considered. For archaeological and ecological work the linear regression is still valid in many cases, since the material found in many archaeological sites does not generally represent the total gamut of sizes of a particular species. Hook size is very selective and obviously the fish taken with them have a rather narrow range of sizes. Nets, on the other hand, are less selective than hooks, and the fish taken show a wider range of sizes.

Fish size selectivity extends to natural fish concentrations. Fishes segregate themselves often in the wild by size --juveniles, spawners, old individuals (cod, salmon) and sometimes, as in redfish (Sebastes), by sexes, until they mix in the feeding or in the spawning grounds. A similar situation occurs in the study of the diet of fish predators. A predator selects the size of its prey according to its own size; large predators do not feed, as a rule, on small larvae. There are a few exceptions: the baleen whales and basking sharks that feed on plankton and small larvae. Even humans select the size of the fish they consume. Small fish, larvae and juveniles, are eaten whole, and so otoliths are also ingested. If the fish is of medium or large size, the heads are discarded before or after the cooking and eating processes.

Taking into account the natural behaviour and fishing gear, linear regression formulae calculated from samples within a narrow fish size range can be acceptable and useful in calculating the size of the live fish. Regression formulae reflect better than ratios the relationship between the length of the fish and their otoliths.

Inflexions in the growth lines reflect the changes in the life history of the fish, such as the onset of sexual maturity, new diet, a change in the habitat, or old age. Therefore, when dealing with archaeological and ecological samples it is best to take a sample of recent fish (juveniles, maturing, mature, or old fish) whose otolith size "matches" the size of the otoliths found.

Even for some otoliths which are a little smaller or larger than those in the sample studied, say, by a 5%, it is also possible to extrapolate the fish length at each end of the regression line.
When regression equations are not available, the ratio otolith length/fish length (OL/FL) can be useful, although the results are less accurate.

No tests have been made for the fish in this collection to find the best function, since the material available came from diverse commercial activities and as such the fish size has already been selected by the fishing gear, the requirements of local markets, and legal regulations.

For the calculation of the regression formulae provided, the values of both otoliths, right and left, were averaged. When only one otolith was available, its length and weight were used. Since in most cases there is no significant difference between the length and the weight of the otolith from each side (Rojo, 1977), the error resulting in these few cases is negligible. There are some exceptions to this situation. Gaemers and Crapon (1986) found sexual dimorphism in the size and morphology of the otoliths of males and females in Haplochromine fishes (Cichlidae).

The value of each measurement (maximum length, width, and thickness of the otolith) should be tested to find the one most closely correlated to the total length.

The weight of the otolith represents better the size of the fish when studying the calorific value in human or animal diets. Unfortunately, the weight of the fish shows greater variability than length for fishes of the same age, due to external and internal circumstances, such as, stomach content, sex, maturity stage, health condition, degree of parasitism, etc.

Only samples with more than 10 specimens have been used for the calculation of regression formulae and correlation coefficients. Otoliths collected during the same growing season from the same area have been culled together in the statistical analysis.

Tables with the original data for each species and sample are presented in Section XI. Pertinent references have been added at the end of each table for those species for which similar regression formulae have been published elsewhere. These formulae should be used taking into consideration the variability of fish growth for the same species in different localities and years. This variability is greater for samples from far away places and for long time intervals.

Equations calculated for live fish length and weight by different authors that worked with the same species in this study were added for comparative purposes

III.5 Method used to estimate live fish weight

For the calculation of live weight using the otolith length, a widely acceptable formula is the power function (Y = aXb or logY = log a + b logX), where Y is the total weight of the fish and X, the length of the otolith. The constants, a and b represent respectively the intercept and slope of the regression line. The correlation coefficient between the weight of the fish and the length of the otolith is always smaller than that obtained between the length of the fish and the length of the otolith, since the weight of the fish shows greater variation in relation to length or age.

Linear regressions are also provided in this document to estimate the total weight of the fish using the weight of the otolith, when the size of the latter warrants it.

For the estimation of the dietary value of the fish consumed by humans, it is more useful sometimes to use the "dressed" weight of the fish, i. e. the weight after evisceration. In some cultural or economic groups, some of the viscera (liver, gonads) are also consumed due to their high nutritional value. Since in modern practice these viscera are removed when "dressing" the fish, they should be considered when estimating the dietary value of the fish.

IV. PURPOSE AND USEFULNESS OF THE COLLECTION

The purpose of this collection is to provide reference material for the identification of some fish species of Atlantic Canada, in particular, of Nova Scotia. Collections of this kind are useful in palaeontological, biological, archaeological, and ecological research.

Otoliths, as opposed to bones and scales, base their usefulness on the fact that they can withstand for a longer time the deteriorating environmental factors and the action of digestive juices of predators. Therefore, they constitute scientific tools when fish bones and scales have been already destroyed. Otoliths are also more useful than bones, spines, scales or any other fish remains in providing biological or ecological information since there are stored in them more data about the life history of their possessors. They represent a true “curriculum vitae”.

The varied and singular morphology of otoliths makes it possible, in most cases, to identify the fish down to the species level and estimate the length and weight of the fish at the time of death with acceptable accuracy. From the arrangement of the deposition layers of calcium carbonate, we can estimate the hatching time, the age, and growth rate for each individual fish. A growth pattern can be easily deduced for a large group of fish, making it possible to separate fish stocks. Fish migrations and first spawning can also be ascertained in many cases.

Their chemical composition allows us to draw certain conclusions about the environmental conditions of the fish habitat. The presence of some elements (Sr, K, Mn, etc.) provides clues about the origin of the different stocks congregating together in the same spawning or feeding grounds. The oxygen isotope ratios give information about the temperature of the water (Devereux, 1967). By immersing fish eggs and embryos in staining solutions with fluorescent chemicals, such as alizarin complexone (Tsukamoto, 1988), tetracycline (Hettler, 1984), etc., it is possible to study growth, migrations, and stock origin.
Fossil otoliths have been found in great abundance especially in Tertiary deposits. Paleontologists have described some 1,000 extinct species, a number surpassing by far those described by fossil bones (Nolf, 1995). The comparison of fossil otoliths and those of recent fishes provides information to trace past geographical boundaries; to reconstruct the environmental conditions of temperature, salinity, and water depth; and to study the structure of the faunal aggregates, among other possibilities.
Biologists use otoliths to study the age of individual fishes; to make growth back-calculations of a specific fish; to estimate the average growth rate of a particular population; to establish systematic and evolutionary relationships among species; to study the distribution and composition of modern faunas; to discriminate between different stocks of a large area; etc.

Archaeologists can use otoliths to identify fish species, to calculate the size of individual fishes, to estimate the MNI, to study the seasonality of campsite, to understand the action of taphonomic factors affecting the otoliths, such as predation by larger fishes, transportation by humans in commercial activities or by domestic animals, weathering due to climatic factors, etc. The *sagitta* is easily recognized because of its size. Since the other two otoliths, the lapillus and the *asteriscus*, are in many cases too small to be detected by sight, wet-sieving methods using a 1 mm mesh sieve are recommended to recover them.

Ecologists can profit from a collection of otoliths in the identification of fish species in the diet of piscivorous predators (larger fishes, birds and mammals); in the calculation of the size and number of the prey; in the estimation of the temperature, salinity and faunal distribution of past environments;

etc. Similarl, as in dendrology work, fish otoliths have been used to estimate climatic changes for past periods of time.

There is an abundant bibliography about otoliths, both for biological and archaeological studies, which is omitted here. The references cited in this paper can be used as a guide for further sources.

V. MORPHOLOGY OF THE LABYRINTH OF FISHES

Teleost fishes possess three pairs of otoliths, which differ in location, function, size, shape, and structure. All of them are enclosed in a special organ called *membranous labyrinth* (Fig. 3), a name that refers to its membranous structure and to its labyrinthine layout of three canals and three chambers. This *membranous labyrinth* is enclosed in a complex set of bones called the *bony labyrinth* or *otic capsule*. It is filled with a liquid called endolymph. Surrounding it there is another fluid --the perilymph that fills the spaces of the *bony otic capsule*.

The *membranous labyrinth* (see table below) consists of an upper section, called *pars superior* that comprises three semicircular canals and a small chamber - the *utriculus*. Two of the canals are vertical and more or less perpendicular to each other; while the third canal is horizontal. All three canals are connected to the small chamber, the *utriculus*. The sensory maculae, located at the base of each canal, are stimulated by water vibrations. These sensory organs are innervated by the stato-acoustic nerve (cranial nerve VIII) and provide the fish with information about its relative position in the water and also about sound characteristics (orientation and distance).

The *utriculus* encloses a small otolith named *lapillus* (pl. *lapilli*), *utricular otolith* or *utriculolith*. The name *lapillus* means “little stone.”

The lower section, pars inferior, consists of two chambers, a large one, the *sacculus*, which connects with the *utriculus*, and posteriorly, one much smaller, the *lagena*.

Embedded in the *saculus* is the otolith *sagitta* (pl. *sagittae*). It has also been called *sacculolith* and *saccular otolith*. *Sagitta* means arrow because of its common arrowhead shape. The posteriormost chamber, the lagena contains the *asteriscus* (pl. *asterisci*), *lagenar otolith*, or *lagenalith*. *Asteriscus* means “little star,” name given because of its shape.

Sections	Organs	Otoliths
	Semicircular canals	
Pars superior		
	Utriculus	Lapillus
	Sacculus	Sagitta
Pars inferior		
	Lagena	Asteriscus

In most fishes, the largest otolith is the *sagitta*, while the last two are very small, although visible to the naked eye. In Cypriniformes, Characiformes, and Siluriformes, the *sagitta* is the smallest otolith. In Cyprinidae, the *asteriscus* is the larger, but in Cobitidae and Homalopteridae, the *lapillus* is the largest one.

VI. MORPHOLOGY OF THE SAGITTA

The *sagitta* presents a large variety of shapes and features of different shapes and sizes (Hunt, 1992; Schmidt, 1968). Its outline, size, weight, and features can slightly vary from fish to fish, and even on both otoliths of the same fish. A definite and rich terminology has been developed to account for all these features. Although many terms are in Latin, they are very often accepted and used in the vernacular languages.

The following are the definitions of some of the main features. The reader should bear in mind that not all of them are present in every *sagitta* (Fig. 4).

Margin is the overall edge of the otolith when seen on its outer or inner faces; it is also called rim. Often, it can be subdivided into four margins named according to their position: dorsal, ventral, anterior, and posterior. The margin can be knobbed, serrated, toothed, scalloped, lobulate, crenulated, indented, smooth, etc. according to the shape of its projections or the size and absence of the same. The knobs, teeth, notches, or lobes are separated by furrows more or less wide and deep.

Angles are the points of inflexion or change in direction of the margins. They are named according to their position on the rim: pre-, mid-, or postdorsal on the upper rim and pre-, mid- or postventral on the ventral rim. Not all otoliths show clear bends in their outline. As a result, this feature is a little subjective to be used as an accurate guide.

The margins and angles determine the general shape of the otolith (round, subquadrangular, oval, elongated, lanceolate, lenticular, triangular, irregular, etc.). The shape of the *sagitta* changes as the fish grows. In juveniles, the *sagitta* is rounder and often lacks the expansions typical of adults' otoliths.

Rostrum (pl. *rostra*) is the anterior ventral projection. It is usually the largest of all expansions. *Antirostrum* is the dorsal protrusion opposing the *rostrum*. Very often the *antirostrum* is very short or it is missing completely.

Pararostrum is the dorsal posterior expansion of the *sagitta*.

Postrostrum is the ventral posterior expansion. These last two projections are often missing.

Faces are the surfaces presented in outer and inner views of the *sagitta*: the outer, external or lateral, and the inner, internal, or mesial. Along the mesial face or surface runs a wide and long furrow. The faces can be flat but, but the lateral face is, generally, convex, while the mesial is concave.

Sulcus acusticus (pl. *sulci acustici*) is the name given to the furrow located on the mesial face of the *sagitta*, through which runs a branch of the stato-acoustic nerve. The sulcus is often split into two sections: the *ostium* and the *cauda*. Depending on the location of the *sulcus* on the otolith face, it is called *medial sulcus* when it is equidistant of the dorsal and ventral margins. When closest to the dorsal, it is called *supramedial sulcus*, and *inframedial sulcus* if closest to the ventral margin. The *sulcus* that opens on both ends of the otolith is called biostial.

Above and below the sulcus run two, more or less prominent crests (*crista*, pl. *cristae*), named the dorsal and ventral.

Areas or fields are two large depressions, one found between the dorsal margin and the dorsal crest, called the dorsal area or dorsal field, and another between the ventral crest and the ventral rim, named the ventral area or ventral field.

Ostium (pl. *ostia*) (= mouth) is the anterior part of the *sulcus acusticus*. It is called open when it reaches the anterior border, and closed when it ends short of it.

Excissura ostii (pl. *excissurae*), *ostial excissure*, *excissura major* is the section of the anterior margin between the *rostrum* and *antirostrum*, when the *ostium* reaches the margin.

Cauda (pl. *caudae*) (= tail) is the posterior part of the *sulcus*. It can also be classified as open or closed. *Excissura caudae* (pl. *excissurae*), *caudal excissura*, *excissura minor* is the border between the *pararostrum* and *postrostrum*, when the *cauda* reaches the posterior margin.

Collum (pl. *colla*) is the ridge that occupies the narrowest place of the *sulcus* and divides it into two sections

Primordium (pl. *primordia*) (= core) is the initial complex structure of an otolith, consisting of granules of fibrous material surrounding one or more optically dense nuclei from 0.5 to 1 mm in diameter. In the early stages of otolith growth, if several *primordia* are present, they generally fuse to form the otolith core. The synonymous terms used in the past in many papers are *nucleus* and *kernel*. It is recommended that these terms be discontinued.

Within a single species, there is a direct relationship between otolith size (length and weight) and fish size. This relationship can be used to estimate the length and weight of the live fish.

There are some species (for example Salmon and *Anarhichas*) whose adult individuals are of large-size but have small *sagittae* Their ratio OL/FL (otolith length/fish length) in these cases can reach high values (in *Salmo salar*, 1:80-100 and in *Anarhichas lupus*,1:110-160). On the contrary, some fishes of small size when adults possess very large otoliths, such as *Aplodinotus* with a ratio of 1: 25-33.

In this report, I have followed the terminology recommended by the Glossary Committee struck by the Symposium of Fish Otolith: Research and Applications (1993). Some terms have been borrowed from Schwarzhans (1978) and Gaemers (1985).

VII. CHEMICAL COMPOSITION OF THE OTOLITHS

The otoliths of teleosts are acellular concretions of calcium carbonate in the form of aragonite that is deposited in the form of crystallized fibrils and arranged along the otolith long axis, roughly perpendicularly to the outer margin of the otolith. These crystals are embedded in a proteinaceous matrix. The typical protein of otoliths, called otolin, has a molecular weight exceeding 150,000, and intersects the aragonite fibrils. Otolin constitutes between 0.2 and 10% of the volume (Degens, et al, 1969).

Owing to their mineral composition, otoliths make remarkable fossils or subfossils that can resist environmental deterioration for a considerable time, except in very acidic soils. They can also withstand the digestive processes in the stomach of predators, while bones are digested beyond recognition. The partial decalcification of the surfaces due to environmental factors or the action of digestive juices affects the weight, especially of the long and narrow otoliths. This has to be taken into consideration when calculating the length and weight of the live fish.

VIII. EVOLUTIONARY HISTORY OF THE OTOLITHS

In lampreys and hagfishes the statoliths are made by the aggregation of microscopic crystals, known as otoconia (sing. otoconium) and bound by a protein matrix. Their chemical composition is calcium phosphate (Studnika, 1912).

In sharks, rays, and chimaeras, the otoconia, free or aggregated, are sometimes mixed with exogenous material, such as lava dust or sand particles called otarenae (sing. otarena) that have entered into the labyrinth chambers with sea water via the endolymphatic pores that open on the top of the skull. The otoconia are made of vaterite, aragonite, or calcite, which are the trimorphous expression of the same mineral, calcium carbonate. They differ in the structure and arrangement of the microscopic crystals that form them. These forms crystallize in hexagonal, rhombohedral, and orthorhombic patterns, respectively. Vaterite is the least stable of the three, the calcite being the most stable.

In more advanced fishes, cladistians, chondrosteans, holosteans, and teleosteans, the crystals take a definite specific form and reach a large size. In these cases the statoliths receive the more common name of otoliths or ear stones.

In *Acipenser*, *Lepisosteus*, *Polypterus*, and Dipnoans, the otoliths are exclusively made of vaterite, while, in teleosteans, the calcium carbonate take the form of aragonite. *Acipenser* has both statoconia and otoliths.

A few teleost species (*Oncorhynchus tshawystcha*, *Mola sp*. and Opah sp.) have microscopic and irregular otoliths made of vaterite.

IX. PRACTICAL APPLICATIONS OF THE STUDY OF OTOLITHS

There is an abundant bibliography about otoliths, applicable to biological, archaeological, ecological, and palaeontological fields. The references cited here can be used as a guide for further search.

The information that otoliths are able to provide can be retrieved directly, by the examination of their external morphology and internal structure, or indirectly, by using the measurements taken of them or by chemical analysis of their composition.

Otoliths have stored in their structure enough information to reconstruct many of the circumstances of the life of the fish, such as: 1) the identification of the taxonomic group (family, genus and species) to which the fish belong; 2) the size (length and weight) at the time of death; 3) the biological age of the fish, its birth date (year, season or even month); 4) seasonality or time of capture; 5) the growth pattern of a particular fish and as a consequence the growth pattern of a population or species; 6) the onset of sexual maturity; 7) migrations; 8) identification of stocks and population structure; 9) the environmental conditions during the growth of the fish; 10) estimation of MNI; 11) the human activities related to fish remains, etc.

IX.1 Fish identification

The basic objective of the use of the otolith as a research tool is the identification of the fish species to which it belongs. Fortunately, the morphological features of the *sagitta* are so varied and well defined that they make possible, in most cases, the specific identification as it has been recognized by numerous authors (Casteel, 1974). The otolith characteristics most valuable for identification purposes are: its shape; its outline, which can be smooth, scalloped, serrated, or notched; the shape and the relative size of the acoustic groove in relation to the total length of the otolith; the shape and size of the ornamentations; and the features of the *ostium* and *cauda*.

It should be noted here that since the otolith shape changes with age, it is difficult to identify the fish species from otoliths of juvenile fishes. The *sagitta* of juveniles lacks the specific features that are attained in adults. A collection of otoliths should include, therefore, otoliths from individuals of each sex, different sizes, and a variety of habitats.

There are already classification keys (Härkönen, 1986; Casteel, 1974; Fitch and Barker, 1972; Frost, 1981; Schmidt, 1968) for specific families or genera. When not available, it is rather easy to prepare one for local species. No key has been prepared for this report due to the incomplete character of the otolith collection.

Section XII presents illustrations of the otoliths of the species studied in this report, along with useful individual data of the same.

IX.2 Estimation of the live fish size

One of the most valuable uses of otoliths in faunal studies is the estimation of the live fish size (Priegel, 1963; Witt, 1960). In section 3.3, we already have expanded on the methodology to obtain the live fish size using otolith dimensions.

The otoliths, along with other skeletal elements, can be used with relative accuracy to estimate the length and weight of the live fish, depending on the degree of their preservation (Frost and Lowry, 1968; Desse, et al. 1990).

Otolith features (maximum length, maximum width, weight, and age) are used to estimate the live size of the fish. In this report the maximum length and the weight have been used as the independent variables. In both cases the average value of the length and of the weight, for both otoliths of each fish, were used.

Numerous biological papers offer regression and correlation coefficients between the otolith length or weight and the size of the live fish. Unfortunately, many are useless for the archaeologist since they were based on fish populations far removed from the archaeological site or taken from deep marine waters. If no regression equations are available for a given fish in a given place, it is easy to calculate one. The study sample should be taken from the closest possible area, assuming always that the climatic conditions and the water quality are similar to those present for the archaeological remains.

The age of the fish estimated from otoliths can also be used to estimate the size of the fish, but caution should be taken because of the wide variability between age and size (length or weight) of the fish. The table given below shows the different lengths of 6-year-old codfish taken in a short period of time (1954, 1956, and 1957) in the Northwest Atlantic waters using otter trawlers with nets of similar mesh size. The dates given refer to the year of publication of the corresponding reports.

ICNAF area	Fork length (cm)	Mean length (cm)	Sample size N	Author
1 B (W. Greenland)	62.44		18	Rojo (1958)
1 B "	51-74	64.22	116	Hansen (1958)
1 D "	58.47		40	Rojo (1958)
2 J (Labrador)	50.30		47	Rojo (1958)
3 N (Grand Bank)	45-74	57.50	75	Rodríguez and Rojo (1958)

Thompson (1943) presented a more striking example for 4-age cod (Gadus morhua) in different banks of the North Atlantic. Although most of these data might not have archaeological interest, their cautionary value is evident.

Length (cm)	Bank
40	Norwegian Coast
42.5	Grand Bank (Nfld)
47	Iceland
57	Nantucket Shoal (USA)
68	North Sea
88	Faroe Islands

Roni and Quinn (1959) have also found geographic variation between several populations of Chinook salmons between 42o and 65o North latitudes along the Western American coast.

IX.3 Otolith structure and estimation of its biological age

One of the most important applications of otolith study in biology, archaeology, and ecology is the determination of the biological age of the individual fish at the time of its capture or death. This determination is possible by the very nature of the internal structure and chemical composition of the otoliths.

Otoliths are acellular concretions that grow by the cyclic deposition of layers of crystals of Ca2CO3, rather than by osteogenesis, the typical formation process of bone by *osteoblasts* and *osteocytes*. Otoliths are more faithful chronometers than scales and bones because they are not subject to resorption, especially during the spawning migration and spawning activities.

Otoliths show an alternation of concentric bands of calcium carbonate deposited at regular intervals (diurnal, seasonal and annual). These bands, alternatively opaque and translucent, can be seen by transparency in whole otoliths (salmonid, flatfishes) or by sectioning them (gadids). Panella (1971) has shown that otoliths are built up by daily deposition of inorganic and organic matter, that also show the two kinds of bands representing periods of growth and repose. This cyclical pattern of band deposition allows for the interpretation of annual growth and the estimation of the age of the fish. This fact has been extensively applied in age determination of teleost fishes (Bagenal and Tesch, 1978; Clay and Clay, 1991).

The opaque band, also known as D-zone (dark zone), appears dark when viewed with transmitted light. This zone contains more organic matrix and lesser amount of calcium carbonate. The translucent, known as L-zone (light zone) appears light when viewed with transmitted light. This zone is also named hyaline in many papers, term which should be avoided according to the recommendation of the Glossary Committee struck by the First International Symposium of Fish Otoliths (1993). On the contrary, in otoliths studied under reflected light, the dark zone appears bright, and the translucent zone appears dark.

Otoliths grow fast during favorable periods of temperature and, consequently, abundance of food. This usually happens during the spring, autumn and fall in temperate zones when favorable environmental conditions prevail. The length of the growth season for each species or stock depends on the latitude where the fish is located and of course on its genetic make-up. During slow growth, usually in the winter, the daily deposited layers are packed tightly, resulting in narrower bands, called appropriately winter bands.

Each pair of a dark and its contiguous transparent band represents a year’s growth, called an annulus (pl. annuli). Tropical fishes also show this typical pattern of growth even when the seasons in the tropics are not as well differentiated as in temperate zones.

The most important fish families from which otoliths have been used to estimate the age of individual fishes are: Anguillidae, Clupeidae, Engraulidae, Batrachoididae, Gadidae, Atherinidae, Malacanthidae, Haemulidae, Scombridae, Bothidae, Pleuronectidae, and Carangidae.

Obviously, reading otolith ages accurately requires practice and good knowledge of the biology of the fish (timing and length of the spawning period, environmental conditions of the body of water, migrations, feeding habits, onset of sexual maturity, time of the formation of the growth bands, growth pattern, etc.). Fortunately, there is an abundant bibliography on the life history of fishes for most species consumed by present and past human populations.

IX.4 Seasonality

Another useful aspect in the study of fish remains from an archaeological or ecological point of view is the determination of the time of death or capture of the specimen. This information is crucial in archaeological studies to determine the seasonality of the campsite or the time of the year of its human occupation.

This information can be obtained rather easily by the examination of the organic remains present. Fish remains (bones, otoliths, spines, teeth, scutes or scales) provide two sources of direct information on seasonality: one, by their presence, especially for anadromous and catadromous fishes; the other, by the study of their internal structure.

The presence of bones from adult migratory fishes (salmon, sturgeon, gaspereau, etc.) gives a clue as to the time of year corresponding to their anadromous migration into freshwater spawning grounds. However, otoliths offer better possibilities to directly assess more accurately the seasonality of the campsite, even, in some cases, the estimation of the month of the capture of the fish.

The cyclic growth of the otolith permits the evaluation of the growth in the last year of the life of the fish. When the month of capture is not known, a comparison of the width of the outermost layer in the otolith with that of the previous year will provide an estimation of the time of the year of its capture. If the outer layer is much narrower than the preceding one, then the capture occurred in the spring, summer or fall of the same year of the capture. If the width is of similar size as the previous growth season, it means that the growth period for the year of the death of the fish had ended. Then, the fish had been caught between November and February, when growth slows down or stops completely for most fishes in the temperate zones. Evidently this estimation can be refined when the characteristics of the growth of the fish in question is well known.

The width of the outer layer is proportional to the part of the year elapsed since the beginning of the growing season. In a study of 28 north temperate and 12 subpolar fish populations, growth started in most cases by February and ended as late as November (Beckman and Wilson, 1995).

A second approach is the study of the internal structure of the subdaily growth bands deposited in the otolith during the last year of life of the fish. When the growth bands are clearly marked and their "reading" possible, the estimation can be accurate within a month of the actual death.

There is some variation in the length of the growing season for different species and different habitats. Within the same species it depends on the latitude and ultimately on the temperature of the water and food availability of that year. Other factors, such as the gonad ripening, migrations, parasitism, etc. also can affect the growth of the fish.

Casteel (1972) pointed out a similar estimation of the time of internment of people by studying the fish remains found at burial grounds. These remains can be the result of grave offerings or come from the stomach content of humans or domestic animals.

IX.5 Growth patterns

A direct relationship between the growth of the body of the fish and the otolith allows for the use of the size of the otolith to calculate the growth pattern of a fish population.

The otolith grows at a different rate than other calcified structures, such as scales and bones. During slow growth, otoliths grow faster than the body. During rapid growth, the opposite is true (Casselman, 1995).

The deposition of growth bands is a function of multiple factors and, in consequence, the width of each layer varies for individual fishes of the same population. The first year growth depends on the length of the first growing season. During the next few years, depending on the species, the usually wide bands deposited correspond to juvenile growth. After the first spawning season, the bands tend to be narrower and approximately of equal width for several years until they again decrease in thickness with old age. This general pattern, with some variations depending on the species, can be altered during years of greater abundance or by adverse climatic agents and individual condition of the fish.

Taking into account the proportionality between the growth of the fish and that of the otolith, it is possible to estimate the length of the fish at each year of life using the value of the radius of the otolith at the end of the same year. This proportionality can be represented, by the following series

$$\frac{FLt}{ORt} = \frac{FL1}{OR1} = \frac{FL2}{OR2} \;.\;.\;.\;.\;. = \;.\;.\;.\;.\;.\;.\;.\; \frac{FLn}{ORn}$$

in which FLt is the length of the fish at time of capture; FL1, its length at the end of the first year of life; FLn, its length at a particular year. ORt is the length of the otolith radius at time of capture; OR1, the length of the radius from the core to the first annulus; ORn, the length of the radius for any given annulus. A radius is an imaginary straight line that starts at the core of the otolith and bisects all growth annuli. It is convenient to select the area of the otolith where the annuli or rings are most visible.

The size of a fish at age 4, for example, will be

$$FL4 = \frac{FLt \times OR4}{ORt}$$

The individual growth pattern averaged with those of other individuals provides an estimation of the growth pattern of a population in a specific place and time.

Once a normal pattern has been obtained, it is possible to assign a biological or environmental cause to a band which is unusually wide, narrow, or split.

IX.6 The onset of sexual maturity

The onset of sexual maturity is probably the most striking event in the life history of a fish. The cost of reproduction is reflected in the subsequent decrease in growth of the body of the fish and the increase in the mortality rate of the population. At the same time, previous to spawning, many species do not feed or at least not as much as it is normal in other circumstances (Rollefsen (1934). This discontinuity in growth has been shown in the otoliths of Pleuronectes platessa (Rijnsdorp and Storbeck, 1995) and in cod.

IX.7 Fish migrations

Migratory fishes are exposed to extreme environmental conditions (high or low salinity concentration, oxygen abundance or scarcity, food availability, etc.) during their migrations. These conditions are also reflected in the growth pattern as it is laid out in the otoliths.

This effect is chronologically linked in many fishes to the physiological changes due to the maturation process. Both sexual development and migration to the spawning grounds are strong vicissitudes in the life of the fishes and therefore can be assessed in the skeletal parts that show some periodicity in development, such as scales and otoliths. It has been observed in salmon (MacPhail, 1974) an erosion of the scales borders due to the resorption of calcium during the sexual ripening and concomitant anadromous migration.

Once the biology of the fish is known, it is possible to estimate from the width of the otolith zones, the time of the fish migration. The conclusion drawn from the examination of the otoliths is more accurate and valuable when the material available from one or more related places is abundant.

IX.8 Differentiation of stocks

Several studies have used the shape and the pattern of growth bands to identify fish from different origins. Messieh (1972) was able to use the shape of the otoliths to separate herring stocks from the Gulf of St. Lawrence into spring and fall "races". Even when fish from either stock join in the feeding grounds, it is still possible to distinguish one from the other. The fish from the spring season have well developed pararostra, which in most cases equal in length to that of the postrostra. In herring from the autumn season, the pararostrum is always shorter that the postrostrum.

Rollefsen (1934) separated cod from inshore stocks from those from outer areas based on the size of the otolith core. Colura and King (1995) distinguished stocks of the Spotted Seatrout in the Galveston Bay based on the outline of the otolith. Rojo (1977) was able to discriminate codfish stocks from Greenland, Labrador, Grand Bank of Newfoundland, Nova Scotia Banks and Gulf of St. Lawrence, using the relationship between the relative growth of the otolith in relation to the fish length. The results obtained there have a limited value for archaeological research because, except perhaps for the Labrador sample which was taken close to shore, the remaining samples were taken in offshore waters.

IX.9 Environmental conditions

Biological organisms, from bacteria to man, are very sensitive to environmental conditions. Faunal remains, like any biological material, react to the changes of environmental factors.

Once the fish species has been identified and its biological characteristics estimated, it is possible to assess the factors that caused or influenced them. These factors include water temperature, oxygen content, depth of the water body, climatic conditions of rainy and dry seasons for freshwater tropical fishes, sequence of temperature changes, predator stress, etc. It is evident that in order to get a long chronological sequence, a good and large sample of otoliths from the area is required.

Pereira et al. (1995) inferred the variations of the stock strength and climatic conditions for a period extending from 1879 to 1989 using freshwater drum (*Aplodinotus grunniens*) otoliths.

Yet, it should be emphasized that the various environmental conditions can differ in a matter of a few nautical miles at sea and a few kilometres on land and therefore can influence in a different away the biological make up of fishes of the same species. The archaeologist should be aware of the possible differences before applying to one population mathematical formulae obtained from another.

We have already emphasized in Section 9.2 the variability of fish size of the same age in the same area.

IX.10 Estimation of MNI

Evidently, the calculation of the MNI has to be done taking into account all bones present. When otoliths are also present, they can provide a more accurate value of MNI, since fishes have only two sagittae, they are found usually not broken, and it is easy to recognize the right from the left one, except those of very small fishes.

The following general guidelines will help, in most cases, to recognize the right from the left otolith. There is no need to apply all of them; often the first and second will suffice.

1. The *sulcus acusticus* is always on the inner, medial face. The *sulcus* can have one or two open ends. The *ostium* opens in an anterior position and the *cauda*, if present, opens in the posterior end, or, sometimes, ventrally.
2. The *rostrum*, which is the longer anterior expansion, is ventral in position; the *antirostrum* when present is shorter and dorsal to the *rostrum*.
3. The anterior end of the *sagitta* is, generally, pointed and the posterior, round. Gadidae and Merlucciidae are exceptions to this rule.
4. The ventral margin is very often more or less straight, while the dorsal margin is more convex.

In most cases, the difference in length between both otoliths of the same individual fish is not significant for small and juvenile fish, but it increases in older individuals. In the family Bothidae, the left *sagitta* is larger than the right one. In cod, the maximum difference which I have found was only 2 mm in a specimen exceeding one meter in total length. Since in all cases the average length between both otoliths has been used in the calculations, the one-millimetre difference of the mean, makes the error negligible when compared with total fish length. There is more error when using bone measurements, since in most cases they show deeper abrasion and more breakage than that found in otoliths.

To calculate the MNI, a method called "matching" is used. It consists in comparing the size, age, proportions, and position of the pair and uneven bones (for example, vertebrae) in the fish, to infer whether they belong to the same individual or not. Otoliths can improve the estimation of MNI because they can provide more information as has been shown in previous sections.

To refine this process of calculating MNI, it is recommended the preparation of tables, graphs, or mathematical formulae relating the size of the fish to the size of the otolith and to other measurements for the most important bones. When small otoliths in an excavation or in the stomach content of fish predators do not match the size of the larger bones, there is always the possibility that the small fish come from the diet of larger ones.

IX.11 Human activities

The most common human activities related to the study of fish remains are commercial transactions, movements of people, and cultural activities, like internment, religious rites, adornment, etc.
If postcranial bones are found, but cranial bones or otoliths are absent, it can indicate that the fish bodies have been carried from the fishing place to the place where they were consumed or bartered. This usually happens with large fish like tuna, sturgeon, cod, etc.

Bones found in burials could indicate the season of the burial or the type of food eaten previous to death, or the status of the person or persons involved.

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XI MORPHOMETRIC AND STATISTICAL DATA OF THE OTOLITHS BY SPECIES AND GEOGRAPHICAL AREAS

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Table 61	*Myoxocephalus scorpio*	N. S.	GB1 #67
Table 62	*Hemitripterus americanus*	N. S.; N. B.	GB1 #94-95
Table 63	*Morone chrispus*	Ontario	GB1 #96
Table 64	*Micropterus dolomieu*	Ontario	GB1 #97
Table 65	*Perca flavescens*	Ontario	WB 2
Table 66	*Stizostedion vitreum*	Ontario	GB1 #54
Table 67	*Aplodinotus grunniens*	Ontario	GB1 #98-100
Table 68	*Lumpenus lumpretaeformis*	Grand Bank	GB1 #16
Table 69	*Lumpenus maculatus*	Newfoundland	GB1 #16
Table 70	*Anarhichas latifrons*	Grand Bank	WB 2
Table 71	Anarhichas lupus	G. Bank; N. B.	"
Table 72	*Anarhichas minor*	G.B; Greenl. Bank	"
Table 73	*Ammodytes americanus*	Grand Bank	GB1 # 31
Table 74	*Scomber scombrus*	N. S.	WB 2
Table 75	*Scophthalmus aquosus*	N B.	WB 5
Table 76	*Hippoglossoides platessoides*	N. S; N. B.	"
Table 77	*Hippoglossus hippoglossus*	Grand Bank	"
Table 78	*Reinhardtius hippoglossoides*	Grand Bank	"
Table 79	*Glyptocephalus cynoglossus*	Grand Bank	"
Table 80	*Limanda ferruginea*	Grand Bank	"
Table 81	*Pseudopleuronectes americanus*	Grand B. N. S. N.B.	"
Table 82	*Gadus morhua*	Prospect Bay. N. S.	
Table 83	*Merluccius bilinearis*	Chebucto Head. N. S.	

GB = green box WB = white box

XII OTOLITH ILLUSTRATIONS

XII.1 Observations

The following 62 tables present graphic, taxonomic, and morphometric information about the otoliths in the collection of the NSMNH. Table numbers correspond to those of tables in Appendix I.

Sections A to D give information on the shape and features of the otolith of each species. Section E, dealing with ratios, provide a feeling of the relationships of the otolith length with that of the fish and with its own width. The data provided here can be supplemented with information given on the tables of Appendix I.

In most cases, the pictures presented on each table represent both otoliths from the same fish. The picture on the left shows the lateral (outer) side of the left otolith, while the right picture represents the medial (inner) side of the right otolith. Both otoliths are oriented with their anterior end towards the fish head, i.e. to the left of the reader. When there was only one otolith available, its both sides were scanned. If it was the left otolith, as in Table 7, the left image is oriented as mentioned above, but the right image is oriented towards the right. On the contrary, if only the right otolith was used, as in Table 1, both images are facing each other; then, the right image only is oriented towards the fish head.

Since otoliths increase their size and change their shape from juvenile to adulthood, otoliths of a medium size fish in each sample were used to avoid extreme features. For cod, an important fish in modern and earlier cultures of the Atlantic region, three pairs of otoliths have been chosen to give some idea of their variability.

XII.2 List of tables

N Species

XIII. ACKNOWLEDGMENTS

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APPENDIX I

Individual (Data) Tables

Table 1

Species	***Alosa aestivalis***	Eng: Blueback herring	Fr: Alose d'été
Location	Little River (Cumberland Co.) N. S.		
Date	July 4, 1998		

NSM#	Sex	FL(mm)	FW(g)	OL(mm)			OH(mm)	OW(g)
				L	R	Mean	Mean	Mean
12716	F	283		3.3	3.2	3.25	-----	0.003 (lost)
12721	M	295	164.3	2.9	3.4	3.15	2.60	0.005

Ratio FL/OL Min. 87.08 Max. 93.65
Ratio OL/OH 1.2 (both specimens)

Table 2

Species	***Alosa pseudoharengus***	Eng: Alewife	Fr: Gaspereau
Location	Gaspereau River, N. S.		
Date	May 15, 1998		

NSM#	Sex	FL(mm)	FW(g)	OL (mm)			OH(mm)	OW(g)
				L	R	Mean	Mean	Mean
12477	F	262	196.5	3.4	3.3	3.35	1.95	0.002
12478	F	282	273.5	-----	3.8	3.80	2.10	0.001
12482	F	293	266.5	3.2	3.6	3.40	1.90	0.001
Location	St. Margaret's Bay							
Date	Aug.6, 1998							
12800		259	145.3	2.2	3.3	2.75	1.85	0.003
12803		221	76.3	2.8	2.7	2.75	1.85	0.002
12804	F	307	225.7	3.3	---	3.30	2.10	0.004
Date	Aug. 21, 1998							
12766	F	304	229.0	4.4	4.5	4.45	2.15	0.007
12767	M	299	245.5	4.6	4.6	4.60	2.40	0.006

Ratio FL/OL	Min. 65	Mean 78.94	Max. 94.18
Ratio OL/OH	Min. 1.5	Mean 2.05	Max. 2.07

Table 3

Species	***Clupea harengus***	Eng: Herring	Fr: Hareng atlantique
Location	St. Mary's Bay, Newfoundland		
Date	Sept. 3rd, 1954		

NSM#	Sex	FL(mm)	OL(mm) L	OL(mm) R	OL(mm) Mean	OH(mm) Mean	OW(g) Mean
11898		370	5.5	---	5.50	2.4	0.009

Location	St. Margaret's Bay, N. S.
Date	Aug. 6, 1998

NSM#	Sex	FL(mm)	OL(mm) L	OL(mm) R	OL(mm) Mean	OH(mm) Mean	OW(g) Mean
12775	F	253	4.1	4.1	4.10	1.85	0.005
12776	M	237	3.5	3.6	3.55	1.70	0.004
12777		215	3.3	3.2	3.25	1.60	0.003
12778		237	3.8	3.6	3.70	1.70	0.004
12779	F	249	4.2	4.4	4.30	1.80	0.004
12780		223	3.2	3.5	3.35	1.85	--------
12782		217	3.6	3.8	3.70	1.85	0.002
12783	M	251	4.0	-----	4.00	1.80	0.002
12784	M	248	4.0	4.0	4.00	1.90	0.001
12785	M	247	4.0	3.9	3.95	1.85	0.003
12786		246	4.0	3.9	4.95	1.80	0.004
12787		214	3.2	-----	3.20	1.60	0.001
12788	F	236	4.2	4.2	4.20	1.85	0.005

Sample Statistics	FL(mm)	OL(mm)	OH(mm)	OW(g)
Count	13	13	13	12
Max.	253	4.95	1.90	0.005
Min.	214	3.20	1.60	0.001
Mean	236.39	3.87	1.78	0.003
Stand. Deviation	14.44	0.48	0.10	0.001
Stand. Error of the Mean	4.01	0.13	0.03	0.0004
Coeff. of Variation	6.11	12.53	5.56	44.32

Ratio FL/OL	Min. 49.70	Mean 61.88	Max. 66.88
Ratio OL/OH	Min. 1.90	Mean 1.78	Max. 2.60

Regression and correlation coefficients

FL = 151.35 + 22 OL $\quad r = .738 \quad r^2 = .545$

Table 4

Species	***Dorosoma cepedianum***	Eng: Gizzard shad	Fr: Alose à gésier
Location	Lake Superior, Ontario		
Date	June 19, 1961		

NSM#	Sex	FL(mm)	FW(g)	OL(mm)			OH(mm)	OW(g)
				L	R	Mean		Mean
85011	F	330	680	5.7	-----	5.70	2.5	0.009

Ratio FL/OL = 57.89
Ratio OL/OH = 2.28

Table 5

Species	***Anguilla rostrata***		Eng: American eel	Fr: Anguille d'Amérique	
Location	N. S. [commercial purchase]				
Date	June 3rd, 1998				

NSM#	Sex	FL(mm)	OL(mm) L	OL(mm) R	OL(mm) Mean	OH(mm) Mean	OW(g) Mean
12497	M	552	4.1	4.0	4.15	2.30	0.010
12498		553	3.3	----	3.30	2.20	0.007

Location	East River (Hfx. Co.) N. S.
Date	July 14, 1998

	Sex	FL(mm)	FDW (1) FW(g)	OL(mm) L	OL(mm) R	OL(mm) Mean	OH(mm) Mean	OW(g) Mean
12829		363	82.5	2.5	2.4	2.45	1.25	0.003
12830		319	50.1	2.0	2.0	2.00	1.20	0.002
12832		394	102.5	2.5	2.8	2.65	1.80	0.004
12833	M	358	88.2(2)	2.2	----	2.20	1.80	0.002
12834		320	52.1	----	2.3	2.30	1.40	0.002
12835		353	56.5	2.3	2.4	2.35	1.90	0.001
12836		345	81.1	2.3	2.4	2.35	1.50	0.004
12837		326	49.2	2.4	2.5	2.45	1.55	0.004

(1) The weight of the fish dressed (= eviscerated)
(2) Fish total weight

Sample statistics	FL	OL	OH	OW
Count	10	10	10	10
Maximum	553	4.15	2.3	0.01
Minimum	319	2.00	1.20	0.001
Mean	388.3	2.62	1.69	0.004
Standard Deviation	89.433	0.639	0.376	0.003
Stand. Error of the Mean	28.281	0.202	0.119	0.001
Coeff. of Variation	23.032	24.376	22.263	69.98

Ratio FL/OL	Min. 133	Mean 148.89	Max. 168
Ratio OL/OH	Min. 1.22	Mean1.57	Max. 1.96

Regression and correlation coefficients

$FL = 48.37 + 129.74\ OL$ $r = .927$ $r^2 = .858$

Härkönen (1986) gives the following calculations:

OL/FL 1:150 --- 1:200

$FL = -44.211 + 189.57\ OL$ $r^2 = .985$
$FW = 4.052\ OL^{3.721}$ $r^2 = .986$

Table 6

Species	***Esox lucius***	Eng: Northern pike	Fr: Grand brochet
Location	Lake Erie, Ontario		
Date	May 1st, 1959		

NSM#	Sex	FL(mm)	FW(g)	OL(mm) L	OL(mm) R	OL(mm) Mean	OH(mm) Mean	OW(g) Mean
85023M		715		9.7	----	9.70	4.50	0.069

Location Lake Superior, Ontario
Date May 27, 1960

NSM#	Sex	FL(mm)	FW(g)	OL(mm) L	OL(mm) R	OL(mm) Mean	OH(mm) Mean	OW(g) Mean
85024	F	838	3,538	10.2	10.1	10.15	5.05	0.076
85025	F	787	3,062	8.9	-----	8.90	4.60	0.065

Ratio FL/OL Min. 73.71 Max. 82.56
Ratio OL/OH Min. 1.93 Max. 2.16

Härkönen (1986) gives the following calculations for fish between 281.5 and 890.02 mm.

OL/FL 1:50 --- 1:80
OL/OH

$FL = -153.0 + 87.02\ OL$ $r^2 = .993$
$FW = 40.0477\ OW^{4.686}$ $r^2 = .998$

Table 7

Species	***Umbra limi***	Eng: Central mudminnow	Fr: Umbre de vase
Location	Lake. Ontario. Ontario		
Date	Jan. 6, 1961		

NSM#	Sex	FL(mm)	OL(mm)			OH(mm)	OW(g)
			L	R	Mean	Mean	Mean
85026	F	88	----	2.2	2.20	1.20	0.002

Ratio FL/OL = 40.00
Ratio OL/OH = 1.83

Table 8

Species	***Coregonus hoyi***	Eng: Bloater	Fr: Corégone d'Hoy
Location	Rossport (Lake Superior) Ontario		
Date	June 7, 1960		

NSM#	Sex	FL(mm)	OL(mm)			OD(mm)	OW(g)
			L	R	Mean	Mean	Mean
85012	F	305	7.0	6.9	6.95	3.55	0.028
85013	-----	305	6.8	7.0	6.95	3.00	0.018
85014	F	-----	6.0	----	6.00	3.10	0.013

Ratio FL/OL 43.88 (both)
Ratio OL/OH Min. 1.93 Max. 1.96

Table 9

Species *Onchorhynchus mykiss* (*Salmo gairdneri*)

Eng: Rainbow trout Fr: Truite arc-en-ciel

Location Coldbrook Hatchery. N. S.
Date Feb. 10, 1977

NSM#	FL(mm)	OL(mm)			OH(mm)	OW(g
		L	R	Mean	Mean	Mean
85044	180	2.0	2.0	2.00	1.40	0.002

Location [Halifax market]
Date June 19, 1998

12496	332	3.2	----	3.20	2.10	0.004

Ratio FL/OL Min. 90.00 Max. 103.75
Ratio OL/OH Min. 1.43 Max. 1.52

Härkönen (1986) gives the following calculations:

OL/FL 1:100 --- 1:120
OL/OH 1.4 ---1.5

FL = 130.2 + 113.1 OL r^2 = .925
FW = 0.3286 $OL^{5.244}$ r^2 = .918

Table 10

Species	***Salmo salar***	Eng: Atlantic salmon	Fr: Saumon atlantique
Location	[Halifax market]		
Date	June 19, 1998		

NSM#	FL(mm)	OL (mm) L	R	Mean	OH(mm) Mean	OW(g) Mean
12499	475	4.5	4.4	4.45	2.25	0.006
Date July 3rd, 1998						
12713	576	4.2	-----	4.20	2.30	0.007
Date Jan. 25, 1999						
85009	452	4.1	4.5	4.30	2.45	0.010

Ratio FL/OL	Min. 105.12	Max. 137.14
Ratio L/OH	Min. 1.76	Max. 1.98

Härkönen (1986) gives the following calculations:

OL/FL = 1:80 --- 1:100
OL/OH = 1.90 --- 2.10

$FL = -45.1 + 88.4\ OL$ $r^2 = .768$
$FW = 16.78\ OL^{2.45}$ $r^2 = .783$

Table 11

Species	***Salvelinus namaycush***	Eng: Lake trout	Fr: Truite de lac
Location	**Otter Cove (Lake Superior) Ontario**		
Date	April 26, 1961		

NSM#	Sex	FL(mm)	FW (g)	OL(mm) L	OL(mm) R	OL(mm) Mean	OH(mm) Mean	OW(g) Mean
12291		343	363.8	3.7	3.7	3.70	2.70	0.006
12292		356	362.8	3.5	3.6	3.55	2.10	0.006
12293		281	453.6	4.0	3.7	3.85	1.95	0.005
12294		381	499.9	3.7	-----	3.70	2.00	0.003
12295		406	635.0	4.4	4.5	4.45	2.10	0.008
12296		432	725.8	3.8	4.1	3.95	2.80	0.007
12297		432	725.8	4.1	4.3	4.20	2.05	0.008
12298		457	816.5	4.6	4.7	4.65	2.35	0.008
Date:	April 27, 1961							
12284	M	279	226.8	3.3	3.4	3.35	1.95	0.005
12285		406	635.0	4.4	-----	4.40	2.10	0.009
12286	M	457	861.8	4.2	4.5	4.35	2.25	0.008
12287		368	453.6	3.9	-----	3.90	2.25	0.007
12288	M	419	725.8	4.1	4.2	4.15	2.40	0.006
12289	M	432	816.5	4.8	-----	4.80	2.30	0.005

Sample Statistics	FL(mm)	FW(g)	OL(mm)	OH(mm)	OW(g)
Count	14	14	14	14	14
Max.	457	861.50	4.80	2.12	0.009
Min.	279	226.80	3.35	1.37	0.003
Mean	389.28	593.05	4.07	1.84	0.007
Standard Deviation	57.991	199.102	0.428	0.242	0.002
Standard Error of the Mean	15.549	53.234	0.114	0.065	0.0004
Coeff. of Variation	14.897	33.586	10.506	13.187	25.423

Ratio Fl/OL	Min. 72.99	Mean 95.49	Max. 109.32
Ratio OL/OH	Min. 2.00	Mean 2.24	Max. 2.80

Regressions and correlation coefficients

FL = -36.35 + 104.54 OL	r = .771	r^2 = .595
Log FW = .755 + 3.276 log OL	r = .883	r^2 = .780

Table 12

Species	***Salvelinus namaycush***	Eng: Lake trout	Fr: Truite de lac
Location	**Superior Shoal (Lake Superior)**		
Date	June 20, 1960		

NSM#	Sex	FL(mm)	FW (g)	OL(mm)			OH(mm)	OW(g)
				L	R	Mean	Mean	Mean
12299	M	396	587.9	3.7	4.0	3.85	2.25	0.008
12300	F	452	907.2	4.1	3.2	3.65	2.15	0.010
12301	F	467	1,043.3	4.1	4.6	4.35	2.55	0.012
12302	F	478	1,043.3	4.7	5.0	4.85	2.35	0.011
12303	M	495	1,224.7	4.9	5.0	4.95	2.50	0.013
12304	F	503	1,043.3	4.5	4.7	4.60	2.50	0.011
12305	F	511	1,315.4	4.9	5.0	4.95	2.75	0.015
12306	F	533	1,451.5	4.7	4.9	4.80	2.65	0.013
12307	F	485	1,088.6	4.5	4.6	4.55	2.70	0.013
12308	M	508	1,224.7	4.9	5.0	4.95	2.85	0.015
12309	F	480	1,088.6	4.5	-----	4.50	2.70	0.011
12310	M	470	997.9	4.8	4.8	4.80	2.60	0.010
12311	M	472	1,043.3	4.7	-----	4.70	2.60	0.010
12312	M	506	1,360.8	4.8	4.9	4.85	2.45	0.011
12313	M	546	1,542.2	5.4	5.4	5.40	2.80	0.017
12314	F	546	1,542.2	4.9	-----	4.90	3.10	0.016
12315	M	406	680.4	3.7	3.8	3.75	2.20	0.008
12316	M	447	952.6	4.4	4.5	4.45	2.00	0.009
12317	M	442	1,043.3	4.0	4.2	4.10	2.75	0.009
12318	M	455	952.6	4.3	-----	4.30	2.35	0.009
12319	F	467	1,134.0	4.3	4.3	4.30	2.40	0.010
12320	F	480	1,179.4	4.6	4.6	4.60	2.45	0.012
12321	M	480	1,088.6	4.6	4.6	4.60	2.60	0.011
12322	F	482	1,088.6	4.6	4.7	4.65	2.30	0.011
12323	F	485	997.9	4.3	4.4	4.35	2.35	0.010
12324	F	493	907.2	5.0	-----	5.00	2.65	0.012
12325	F	503	1,315.4	4.0	4.0	4.00	2.55	0.011
12326	?	518	1,406.2	4.5	4.5	4.50	2.50	0.012
12327	F	434	907.2	4.6	4.6	4.60	2.35	0.009
12328	F	467	1,043.3	4.9	-----	4.90	2.40	0.014
12329	F	536	1,406.2	5.0	-----	5.00	2.70	0.015

Sample statistics	FL(mm)	FW(g)	OL(mm)	OH(mm)	OW(g)
Count31	31	31	31	30	31
Maximum	546	1542.20	5.40	3.10	0.017

Minimum	396	587.90	3.65	2.00	0.008
Mean	482.11	1116.38	4.57	2.518	0.012
Standard Deviation	36.06	225.62	0.40	0.232	0.002
Stand. Error of the Mean	6.48	40.52	0.07	0.042	0.0004
Coefficient of Variation	7.48	20.21	8.80	9.232	20.23

Ratio FL/OL	Min. 94	Mean 106.56	Max. 132
Ratio OL/OH	Min. 1.5	Mean 1.820	Max. 2.20

Regressions and correlation coefficients

FL = 189.878 + 63.893 OL $r = .711$ $r^2 = .505$

log. FW = 4.696 + 0.852 log. OW $r = .787$ $r^2 = .619$

Table 13

Species	***Salvelinus namaycush***	Eng: Lake trout	Fr: Truite de lac
Location	**Bateaux Rocks (Lake Superior) Ontario**		
Date	July 10, 1960		

NSM#	FL(mm)	FW (g)	OL(mm)			OH(mm)	OW(g)
			L	R	Mean	Mean	Mean
12330	333	362.8	4.1	-----	4.10	2.10	0.009
12331	345	272.2	3.5	3.7	3.60	2.00	0.007
12332	323	272.2	3.5	-----	3.50	2.00	0.008
12333	307	226.8	3.1	-----	3.10	2.00	0.004
12334	371	499.9	4.0	-----	4.00	2.25	0.007
12335	409	680.4	3.9	4.0	3.95	2.25	0.009
12336	366	408.2	4.6	-----	4.60	2.70	0.007
12337	338	362.8	4.4	-----	4.40	2.00	0.009
12338	475	1,043.3	5.0	-----	5.00	2.60	0.013
12339	737	4,672.1	5.8	-----	5.80	3.10	0.017
12340	386	499.9	3.9	4.0	3.95	2.10	0.009
12341	315	272.2	3.1	-----	3.10	2.10	0.006
12342	356	362.8	3.5	-----	3.50	2.10	0.008
12343	333	317.5	3.5	-----	3.50	2.20	0.008
12344	371	453.6	3.5	3.7	3.60	2.20	0.010
12345	635	2,721.6	5.4	-----	5.40	2.70	0.015
12346	338	317.5	3.5	-----	3.50	1.90	0.007
12347	399	635.0	3.8	3.9	3.85	2.30	0.007
12348	660	2,313.4	4.7	-----	4.70	2.70	0.017
12349	330	317.5	3.5	3.7	3.60	2.00	0.006
12350	348	408.2	4.1	4.4	4.25	2.10	0.008
12351	310	272.2	3.7	3.9	3.80	2.00	0.007

Sample statistics	FL(mm)	FW(g)	OL(mm)	OH(mm)	OW(g)
Count	22	22	22	22	22
Maximum	736	4672.1	5.80	3.1	0.017
Minimum	307	226.8	3.10	1.9	0.004
Mean	399.00	804.2	4.04	2.245	0.009
Stand. Deviation	120.38	1077.90	0.71	0.314	0.003
Stand. Error of the Mean	25.67	229.80	0.15	0.067	0.001
Coefficient of Variation	30.15	134.03	17.45	13.991	38.490

Ratio FL/OL	Min. 76.82	Mean 97.99	Max. 140.26
Ratio OL/OH	Min. 1.5	Mean 1.76	Max. 2

Regressions and correlation coefficients

FL = -179.031 + 143.264 OL	r = .838	r^2 = .703
FW = 522.24 + 843.46 OL	r = .819	r^2 = .671
Log FW = 0.193 + 4.199 log OL	r = .851	r^2 = .724
Log FW = 6.957 + 2.048 log OW	r = .875	r^2 = .765

Table 14

Species *__Salvelinus namaycush__* Eng: Lake trout Fr: Truite de lac
Location **Mamainse (Lake Superior) Ontario**

NSM#	FL(mm)	FW (g)	OL(mm)			OH(mm)	OW(g)
			L	R	Mean	Mean	Mean
Date	July 1st. 1956						
12355	432	997.9	4.4	-----	4.40	2.50	0.011
Date	July 20, 1956						
12356	432	1,950.5	4.1	-----	4.10	2.30	0.011
Date	July 25, 1956						
12357	457	1,950.5	4.1	-----	4.10	2.30	0.010
12358	508	---	5.1	-----	5.10	2.80	0.013
Date	July 27, 1956						
12359	394	---	4.1	4.2	4.15	2.15	0.008
12360	457	---	4.3	-----	4.30	2.25	0.007
12361	483	---	4.7	-----	4.70	2.45	0.011
12362	406	---	4.1	4.1	4.10	2.25	0.007
12363	487	---	4.6	-----	4.60	2.90	0.008
12364	457	---	4.1	4.3	4.15	2.45	0.006
12365	439	---	4.6	4.7	4.65	2.30	0.011
Date	July 28, 1956						
12366	508	---	4.8	-----	4.80	2.80	0.009

12367	432	---	4.5	4.7	4.60	2.30	0.010
12368	487	---	4.7	-----	4.70	2.50	0.014
12369	487	---	4.9	-----	4.90	2.50	0.013
12370	432	---	4.5	-----	4.50	2.35	0.011
12371	406	---	4.0	4.2	4.10	2.35	0.007
12372	457	---	4.5	4.6	4.55	2.45	0.011
12373	432	---	4.6	-----	4.60	2.50	0.008
12374	457	---	4.7	5.2	4.95	2.45	0.011
12275	483	---	4.4	4.4	4.40	2.30	0.008
12376	406	---	3.9	-----	3.9	-----	0.008
12377	432	---	4.7	-----	4.70	2.40	0.012
12378	508	---	5.1	-----	5.10	2.80	0.014
12379	457	---	4.7	-----	4.70	2.30	0.012
12380	432	---	4.5	-----	4.50	2.30	0.011
12381	432	---	4.4	4.5	4.45	2.30	0.009

Sample statistics	FL(mm)	OL(mm)	OH(mm)	OW(g)
Count	27	27	26	27
Maximum	508	5.10	2.04	0.014
Minimum	394	3.90	1.59	0.006
Mean	451.09	4.51	1.871	0.010
Stand. Deviation	32.50	0.32	0.114	0.002
Stand. Error of the Mean	6.26	0.06	0.022	-----
Coefficient of Variation	7.22	7.11	6.091	22.36

Ratio FL/OL	Min. 91.87	Mean 100.19	Max. 111.51
Ratio OL/OH	Min 4	Mean 4.51	Max. 5

Regression and correlation coefficients

FL = 130.615 + 71.069 OL   r = .700 r^2 = .491

Table 15

Species	***Salvelinus namaycush***	Eng: Lake trout	Fr: Truite de lac
Location	**South Baymouth (Lake Huron) Ontario**		
Date	May 24, 1960		

NSM#	FL(mm)	FW (g)	OL(mm) L	OL(mm) R	OL(mm) Mean	OH(mm) Mean	OW(g) Mean
12382	483	1,496.9	4.9	-----	4.90	3.20	0.012
12383	498	1,451.5	5.1	-----	5.10	-----	0.013
12384	540	1,859.8	4.8	4.8	4.80	2.80	0.013
12385	536	1,761.9	4.8	4.8	4.80	2.80	0.014

Date	May 30, 1960						
12386	564	1,995.8	4.5	4.7	4.60	2.95	0.012
12387	503	1,542.2	4.3	4.3	4.30	2.90	0.013
12388	533	1,678.3	5.0	-----	5.00	3.00	0.014
12389	561	2,313.4	5.2	-----	5.20	3.10	0.017
Date	June3, 1960						
12390	508	1,406.2	4.6	-----	4.60	2.70	0.012
12391	533	-----	4.8	4.9	4.85	2.90	0.012
12392	579	2,358.7	4.9	4.9	4.90	3.00	0.016
Date	June 6, 1960						
12393	549	---	4.9	4.9	4.90	2.95	0.014
12394	584	2,358.7	4.4	4.6	4.50	3.00	0.014
12395	556	1,814.4	4.6	4.6	4.60	2.70	0.013
12396	521	1,496.9	4.5	4.6	4.55	2.75	0.014
12397	511	1,451.5	4.4	4.3	4.35	2.60	0.013
12398	516	1,542.2	4.9	-----	4.90	2.90	0.014
Date	June 8, 1960						
12399	597	2,585.5	5.3	5.4	5.35	3.05	0.014
12400	544	1,723.7	5.0	5.2	5.10	3.15	0.015
12401	485	1,315.4	4.0	4.3	4.15	2.70	0.011
12402	483	1,224.7	4.3	4.2	4.25	2.80	0.010
12403	559	1,905.1	4.2	-----	4.20	3.00	0.012

Sample statistics	FL(mm)	FW(g)	OL(mm)	OH(mm)	OW(g)
Count	22	20	22	22	22
Maximum	596	2585.5	5.35	3.2	0.017
Minimum	482	1224.7	4.15	2.6	0.010
Mean	533	1764.1	4.72	2.90	0.013
Stand. Deviation	33.29	386.27	0.34	0.162	------
Stand. Error of the Mean	7.10	86.37	0.07	0.035	------
Coefficient of Variation	6.24	21.90	7.16	5.57	11.90

Ratio FL/OL	Min. 97.61	Mean 113.3	Max. 133.05
Ratio OL/OH	Min. 1.4	Mean 1.62	Max. 1.75

Regressions and correlation coefficients

FL = 357.482 + 37.223 OL	r = .378	r^2 = .143
Log FW = 5.3431 + 1.12 log. OW	r = .652	r^2 = .426

Table 16

Species *Salvelinus namaycush* Eng: Lake trout Fr: Truite de lac
Location **[Halifax market]**
Date Aug. 21st, 1999

NSM#	FL(mm)	OL(mm)			OH(mm)	OW(g)
		L	R	Mean	Mean	Mean
85010	558	5.0	5.1	5.05	2.80	0.012

Ratio FL/OL = 110.50
Ratio OL/OH = 1.80

Table 17

Species *Salvelinus fontinalis* Eng: Brook trout Fr: Omble de fontaine
Location Little Salmon River (Halifax Co.) N. S.
Date June 5-11, 1998

NSM#	Sex	FL(mm)	OL(mm)			OH(mm)	OW(g)
			L	R	Mean	Mean	Mean
12701		228	2.8	3.0	2.90	1.80	0.003
12702		267	-----	3.5	3.50	2.00	0.003
12703		254	-----	3.0	3.00	1.85	0.004
12704		254	3.2	3.3	3.25	2.05	0.005
12705		339	-----	3.6	3.60	2.00	0.003
12706		213	2.9	3.0	2.95	2.00	0.003

Location Porter’s Lake (Halifax Co.)
Date June 2nd, 1998

12493	M	280	-----	3.3	3.30	2.05	0.003
12494	F	330	2.9	3.1	3.00	2.05	0.003

Location East Brook (Hfx. Co.)
Date Aug. 25, 1998

12769	F	280	3.2	-----	3.20	2.00	------

Location Little Salmon River (Hfx. Co.)
Date Aug. 30, 1998

12770	F	282	-----	3.6	3.60	2.30	------

Location East Brook (Halifax Co.) N. S.
Date July 31st, 1998

12794		258	3.0	3.1	3.05	2.00	0.003

Sample statistics	FL(mm)	OL(mm)	OH(mm)	OW(g)
Count	11	11	11	9
Maximum	339	3.6	2.3	0.005
Minimum	213	2.9	1.8	0.003
Mean	271.36	3.214	2.01	0.003
Stand. Deviation	37.9	0.26	0.126	0.001
Stand. Error of the Mean	11.427	0.078	0.04	0.00024
Coefficient of Variability	13.97	0.087	6.28	21.213

Ratio FL/OL	Min. 72.20	Mean 84.49	Max. 110
Ratio OL/OH	Min. 1.5	Mean 1.60	Max. 1.8

Regression and correlation coefficients

FL = 27.08 + 76.02 OL $\quad$ r = .521 $\quad$ r^2 = .272

Härkönen (1986) gives the following calculations:

OL/FL !:120 ---1:150

FL = 157.44 + 148.3 OL $\quad$ r^2 = .970
FW = 0.491 $OL^{5.633}$ $\quad$ r^2 = .963

Table 18

Species	***Osmerus mordax***	Eng: Rainbow smelt	Fr: Éperlan d’Amérique

Location Lake Erie, Ontario
Date April. 14, 1959

NSM#	Sex	FL(mm)	OL(mm) L	OL(mm) R	OL(mm) Mean	OH(mm) Mean	OW(g) Mean
85015	M	155	---	4.4	4.40	2.60	0.012
85016	M	147	4.5	4.2	4.35	2.75	0.012
Date	Jan. 28, 1960						
11901		158	4.3	3.9	4.00	2.50	0.011
Location	L. Superior, Ontario						
Date	June 8, 1960						
85017	---	152	4.2	4.5	4.35	2.80	0.012
Location	Bowman’s Is. L. Superior, Ontario						
Date	June 10, 1961						
85018	---	229	5.0	5.0	5.00	3.25	0.017
Location	Glace Bay. L. Huron, Ontario						
Date	Oct. 11, 1974						
85019	--	175	-----	4.8	4.80	2.80	0.007
85020	--	115	4.6	4.8	4.70	2.65	0.014
85021	--	155	-----	4.5	4.50	2.80	0.008
85022	--	115	5.5	5.5	5.50	4.00	0.025

Location Bay of Fundy. N. B.
Date Dec. 14, 1998

			FW(g)					
12847	F	242	104	-----	6.1	6.10	3.90	0.030
12748	---	225	67	-----	5.5	5.50	3.60	0.024
12849	F	256	120	6.6	6.5	6.55	4.20	0.038
12850	F	285	194	7.1	7.2	7.15	4.15	0.039
12851	F	245	104	6.6	6.5	6.55	4.00	0.033

Ratio FL/OL Min. 20.91 Max. 45.08
Ratio OL/OH Min.1.37 Max. 1.77

Table 19

Species	***Argentina silus***	Eng: Atlantic argentine	Fr: Grande argentine
Place	Grand Banks (Division 3P)		
Date	Aug. 24, 1957		

NSM#	Sex	TL (mm)	OL(mm)			OH(mm)	OW(g)
			L	R	Mean	Mean	Mean
11913	F	330	8.4	9.3	8.45	4.90	0.038
11914	F	350	9.6	-----	9.60	5.10	0.046
11915	F	370	9.0	9.3	9.15	5.20	0.050
11916	F	370	8.9	-----	8.90	5.00	0.048
11917	F	380	10.0	10.0	10.00	6.00	0.062
11918	F	390	9.0	-----	9.00	5.50	0.061
11919	F	400	9.9	10.0	9.95	5.45	0.062
11920	F	410	9.0	10.0	9.50	6.00	0.076
11921	F	420	9.4	-----	9.40	6.50	0.069
11922	F	430	9.9	-----	9.90	6.60	0.078
11923	F	430	10.1	-----	10.10	5.60	0.068
11924	F	440	10.2	-----	10.20	7.00	0.078
11925	F	440	10.8	10.6	10.70	6.10	0.082
11926	F	440	9.8	-----	9.80	5.60	0.077
11927	F	440	8.8	9.0	9.85	6.05	0.073
11928	F	440	10.8	-----	10.80	5.90	0.076
11929	F	440	9.8	10.0	9.90	6.80	0.080
11930	F	450	10.9	10.9	10.90	6.20	0.066
11931	F	450	10.7	-----	10.70	5.60	0.072
11932	F	450	10.8	-----	10.80	6.30	0.087
11933	F	450	10.5	-----	10.50	6.30	0.085
11934	F	450	10.8	-----	10.80	5.70	0.082
11935	F	400	10.2	-----	10.20	6.00	0.072
11936	F	400	9.5	9.6	9.55	5.50	0.056

Sample statistics	FL (mm)	OL(mm)	OH(mm)	OW(g)
Count	24	24	24	24
Maximum	450	10.90	7.00	0.087
Minimum	330	8.45	4.9	0.038
Mean	415.42	9.935	5.871	0.069
Stand. Deviation	35.137	0.673	0.557	0.013
Stand. Error of the Mean	7.172	0.137	0.114	0.003
Coefficient of Variation	8.458	6.777	9.48	19.330

Ratio FL/OL	Min. 36	Mean 41.81	Max. 45
Ratio OL/OH	Min. 1.45	Mean 1.7	Max. 1.91

Regressions and correlation coefficients

$FL = -2.77 + 42.091\ OL$	$r = .807$	$r^2 = .651$
$FL = 251.199 + 2396.078\ OW$	$r = .903$	$r^2 = .816$
$\log FL = 3.059 + .377 \log OW$	$r = .921$	$r^2 = .848$

1. Härkönen's sample (1986) gives the OL/FL ratio of 1:38-48 for otolith length range between 2 and 11 mm. Using only otoliths ranging from 8 to11 mm from his sample, the ratio OL/FL is the same as in our own.

The following are his regression equations:

$FL = 10.466 + 40.03\ OL$ $r^2 = .993$

$FW = 0.5592\ OL^{3.173}$ $r^2 = .986$

Table 20

Species	***Arius sp*.**	Eng: Sea catfish	Fr:
Location	Florida, USA. [commercial specimen]		
Date	Summer 1967		

NSM#	Sex	FL(mm)	OL(mm) L	OL(mm) R	OL(mm) Mean	OH(mm) Mean	OW(g) Mean
11873	---	-------	9.1	9.1	9.10	7.45	0.249

Ratio OL/OH = 1.22

Table 21

Species	***Phycis chesteri***	Eng: Longfin hake	Fr: Merluche à longues nageoires
Location	Grand Bank (Division 3P)		
Date	Feb. 28, 1955		

NSM#	Sex	FL(mm)	OL(mm)			OH(mm)	OW(g)
			L	R	Mean	mean	Mean
11881	F	800	26.6	--	26.60	6.30	0.497

Location	Hermitage Bay, Newfoundland
Date	Sept. 7, 1954

NSM#	Sex	FL(mm)	OL(mm) L	OL(mm) R	OL(mm) Mean	OH(mm) mean	OW(g) Mean
85036	M	400	15.0	15.2	15.10	5.05	0.174
85037		330	11.5	11.7	11.60	3.95	0.079
85038		300	10.6	10.7	10.65	3.75	0.071
85039	F	370	13.9	14.0	13.95	4.60	0.063

Ratio FL/OL	Min. 26.49	Max. 36.52
Ratio OL/OH	Min. 2.84	Max. 2.93

Table 22

Species	***Urophycis chuss***	Eng: Red hake	Fr: Merluche-écureuil
Place	Hermitage Bay, Nfld.		
Date	Sept. 4, 1954		

NSM#	Sex	FL(mm)	OL(mm)			OH(mm)	OW(g)
			L	R	Mean	Mean	Mean
11906		330	14.6	---	14.60	3.60	0.1005
11907		490	21.7	---	21.70	4.50	0.2191
11908		430	18.0	---	18.00	4.20	0.1785
11909		420	16.4	16.6	16.50	4.10	0.1550

Location	Passamaquoddy Bay, N. B.
Date	Sept. 12, 1974

NSM#	Sex	FL(mm)	OL(mm) L	OL(mm) R	OL(mm) Mean	OH(mm) Mean	OW(g) Mean
11880	M	420	15.4	15.6	15.50	4.50	0.1810

Location St. Andrews, N. B.
Date Sept. 16, 1976

85040	F	374	13.5	---	13.50	3.80	0.1170

Date Sept. 8, 1980

11882	----	----	11.8	12.1	12.95	3.55	0.0980

Ratio FL/OL Min. 22.58 Max. 25.60
Ratio OL/OH Min. 3.44 Max. 4.82

Table 23

Species ***Urophycis tenuis*** Eng: White hake Fr: Merluche blanche
Location St. Pierre Bank (Division 3P)
Date Aug. 21st, 1957

NSM#	Sex	FL(mm)	OL(mm)			OH(mm)	OW(g)
			L	R	Mean	Mean	Mean
85041	F	1,200	37.1	38.2	38.15	9.35	1.437
Date	Aug, 22nd, 1957						
85042	F	640	21.5	24.6	24.60	5.50	0.340
Location	St. Andrew's, N. B.						
Date	Sept. 16, 1976						
85043	F	524	-----	19.2	19.20	4.80	0.198

Ratio FL/OL Min. 26.00 Max. 31.45
Ratio OL/OH Min. 4.00 Max. 4.07

Clay and Clay (1991) offer the following equation.

FL (fork length) = $1.5250(\text{OL, mm})^{1.1456}$

Table 24

Specie	***Brosme brosme***	Eng: Cusk	Fr: Brosme
Place	Bay of Fundy		
Date	July 1st, 1974		

NSM#	Sex	FL (mm)	OL(mm)			OH(mm)	OW(g)
			L	R	Mean	Mean	Mean
12050	F	568	12.1	12.0	12.05	6.20	0.1673
12051	F	490	10.5	10.5	10.50	5.40	0.1154
12052	M	538	11.5	11.6	11.55	6.00	0.1410
12053	--	540	11.4	11.3	11.35	5.85	0.1510
12054	F	541	11.9	11.6	11.75	5.65	0.1696
12055	M	485	10.5	10.7	10.60	5.45	0.1260
12056	F	532	11.2	11.1	11.15	5.45	0.1248
12057	M	604	12.1	12.5	12.30	5.45	0.1301
12058	M	580	11.4	11.1	11.25	5.60	0.1321
12059	F	639	12.5	12.3	12.40	6.10	0.1830
12060	F	682	14.7	14.8	14.75	7.90	0.2896
12061	M	734	16.2	16.7	16.45	8.30	0.4642
12062	F	555	11.5	11.3	11.40	5.60	0.1312
12063	--	620	14.7	15.1	14.90	7.25	0.3239
12064	M	565	12.5	12.4	12.45	5.85	0.1612
12065	F	605	13.2	13.5	13.35	5.85	0.2015
12066	M	594	13.3	13.4	13.35	6.05	0.1889
12067	M	711	13.7	-----	13.70	6.40	0.2143
12068	M	818	14.5	14.4	14.45	6.75	0.2664
12069	M	640	11.8	11.9	11.85	6.00	0.1590
12070	M	781	15.3	14.9	15.10	7.50	0.3061
12071	M	750	14.6	15.0	14.80	7.10	0.2635
12072	M	573	11.1	11.4	11.25	5.20	0.1350
12073	F	543	11.8	11.2	11.50	5.65	0.1337
12074	F	624	12.8	13.1	12.95	6.20	0.2363
12075	M	581	11.9	12.1	12.00	5.75	0.1468
12076	M	566	11.4	11.4	11.40	5.90	0.1399
12077	---	498	10.9	11.2	11.05	5.05	0.1067
12078	---	568	11.9	12.1	12.00	6.00	0.1654
12079	---	532	11.4	------	11.40	5.30	0.1254
12080	F	546	10.6	10.7	10.65	5.10	0.1144
12081	F	662	13.5	13.7	13.60	6.35	0.2753
12082	M	639	12.4	12.8	12.60	6.25	0.1774
12083	F	552	10.0	10.2	10.10	5.45	0.1000
12084	---	667	15.1	15.2	15.15	7.25	0.3868
12090	M	538	11.2	11.4	11.30	6.95	0.1421

12091	M	612	11.4	11.4	11.40	6.50	0.1575
12092	F	543	11.6	11.9	11.75	5.40	0.1427
12093	---	603	12.1	12.3	12.20	5.55	0.1975
12094	F	648	13.5	13.8	13.65	5.60	0.2791
12095	F	697	12.7	13.0	12.85	7.45	0.2494
12096	--	647	13.0	13.1	13.05	6.60	0.2169
12097	M	816	15.0	15.3	15.15	7.50	0.3614

Sample statistics	FL(mm)	OL(mm)	OH(mm)	OW(g)
Count	43	43	43	43
Maximum	818	16.45	8.3	0.464
Minimum	485	10.10	5.05	0.100
Mean	605.58	12.47	6.16	0.191
Stand. Deviation	82.37	1.50	0.804	0.080
Stand. Error of the Mean	11.75	.22	0.123	0.012
Coefficient of Variation	13.44	12.01	13.06	42.08

Ratio FL/OL	Min. 41.61	Mean 48.74	Max. 56.61
Ratio OL/OH	Min. 1.63	Mean 2.04	Max. 2.44

Regressions and correlation coefficients

FL = 30.274 + 46.14 OL	r = .849	r^2 = .721
FL = 451.521 + 805.737)W	r = .797	r^2 = .635
log. FL = 2.997 + .292 log. OW	r = .839	r^2 = .704

Table 25

Species	***Lota lota***	Eng: Burbot	Fr: Loche
Location	Bateau Rock (Lake Superior) Ont.		
Date	Sept. 10, 1960		

NSM#	FL(mm)	FW(g)	OL(mm) L	OL(mm) R	OL(mm) Mean	OH(mm) Mean	OW(g) Mean
12227	533	1,134.0	10.8	11.0	10.90	4.70	0.125
12228	533	1,179.4	10.8	11.0	10.90	4.70	0.144
12229	483	907.2	11.4	10.5	10.95	4.05	0.105
12230	508	1,020.6	11.5	-----	11.50	4.60	0.136
12231	584	1,389.1	-----	12.5	12.50	4.90	0.198
12232	533	1,088.6	10.9	11.0	10.95	4.55	0.154
12233	508	1,043.3	10.3	10.0	10.15	4.60	0.127
12234	533	1,134.0	11.5	11.2	11.35	4.60	0.123
12235	483	861.8	10.8	10.6	10.70	5.00	0.180
12236	533	1,270.1	12.2	12.6	12.40	4.60	0.144

Sample statistics	FL(mm)	FW(g)	OL(mm)	OH(mm)	OW(g)
Count	10	10	10	10	10
Max.	584	1,389.10	12.50	5.0	0.198
Min.	482	861.80	10.15	4.05	0.105
Mean	523.24	1,102.81	11.23	4.63	0.144
St. Deviation	29.81	157.98	0.737	0.251	0.003
St. Error of the Mean	9.43	49.96	0.233	0.079	0.009
Coeff. of Variation	5.70	14.33	6.560	5.42	19.40

Ratio FL/OL	Min. 43.10	Mean 46.67	Max. 50.05
Ratio OL/OH	Min. 2.14	Mean 2.43	Max. 2.7

Regressions and correlation coefficients

FL = 233.391 + 25.81 OL	r = .638	r^2 = .407
Log FW= -1.447 + 1.517 log OL	r = .680	r^2 = .463

Desse, Desse-Berset and Rocheteau (1990) give the following equations from 31 specimens

FL = 44.601 OL - 46.133	r^2 = .874
FW = 100.988 OW - 538.15	r^2 = .822

Table 26

Species	***Lota lota***	Eng:	Burbot Fr: Loche
Location	Boissoneau Bank (Lake Superior) Ontario		
Date	Apr. 24, 1961		

NSM#	FL(mm)	OL(mm)			OH(mm)	OW(g)
		L	R	Mean	Mean	Mean
12199	508	11.6	11.0	11.30	5.00	0.126

Ratio FL/OL = 44.96
Ratio OL/OH = 2.26

Table 27

Species	***Lota lota***	Eng: Burbot	Fr: Loche
Location	Brodeur I. (Lake Superior) Ont.		
Date	Apr. 26, 1961		

NSM#	Sex	FL(mm)	FW(g)	OL(mm) Mean	OH(mm) Mean	OW(g) Mean
12213	F	406	453.6	9.60	3.60	0.057
12214	M	406	544.3	8.45	3.95	0.075
12215	M	406	453.6	9.40	3.40	0.062
12216	M	483	1,134.0	11.70	4.70	0.133
12217	F	559	1,043.3	11.80	5.20	0.122
12218	M	406	499.9	9.00	3.60	0.063
12219	F	432	635.0	9.65	3.55	0.084
12220	F	406	499.9	9.30	3.70	0.068
12221	F	406	499.9	9.35	3.50	0.060
12222	F	432	589.7	10.00	3.70	0.065
12223	M	432	544.3	9.35	4.10	0.073
12224	M	406	408.2	10.55	3.80	0.085
12225	M	432	499.9	9.10	3.65	.060
12226	M	381	499.9	9.00	3.50	0.062

Sample statistics	FL(mm)	FW(mm)	OL(g)	OH(mm)	OW(g)
Count	14	14	14	14	14
Maximum	558	1,134	11.8	5.2	0.133
Minimum	381	408.2	8.45	3.4	0.057
Mean	428.17	593.25	9.73	3.85	0.076
Stand. Deviation	44.40	218.09	0.99	0.51	0.023
Stand. Error of the Mean	11.87	58.29	0.263	0.126	0.006
Coefficient of Variation	10.37	36.76	10.12	13.21	30.67

Ratio FL/OL	Min. 38.52	Mean 44.07	Max. 48.10
Ratio OL/OH	Min. 8.48	Mean 9.73	Max. 11.8

Regressions and correlation coefficients

FL = 71.34 + 36.665 OL	r = .814	r^2 = .662
FW = -1147.588 + 178.875 OL	r = .808	r^2 = .653
Log FW = 3.861 + .979 log OW	r = .862	r^2 = .743

Table 28

Species	***Lota lota***	Eng: Burbot	Fr: Loche
Location	Shesheeb Bay (Lake Superior) Ontario		
Date	Apr. 25, 1961		

NSM#	Sex	FL(mm)	FW(g)	OL(mm)			OH(mm)	OW(g)
				L	R	Mean	Mean	Mean
12245	F	356	362.8	8.4	8.3	8.35	3.70	0.050
12246	F	635	1,496.9	11.9	12.0	11.95	4.80	0.164
12247	F	432	499.9	10.4	-----	10.40	4.20	0.084
12248	---	381	362.8	8.6	8.2	8.40	3.60	0.055
12249	F	406	408.2	9.2	-----	9.20	3.90	0.059
12250	M	406	453.6	8.8	8.8	8.80	3.70	0.058
12251	M	381	408.2	8.7	8.7	8.70	3.70	0.056
12252	M	381	317.5	9.3	9.4	9.35	4.10	0.071
12253	---	496	408.2	9.4	-----	9.40	3.60	0.055
12254	F	406	453.6	8.3	-----	8.30	3.70	0.058
12255	F	406	453.6	8.4	8.9	8.65	3.60	0.062

12256	---	406	453.6	9.2	9.3	9.25	3.60	0.068
12257	M	381	362.8	8.3	-----	8.30	3.80	0.054
12258	M	432	589.7	10.3	-----	10.30	4.00	0.076
12259	F	508	1,088.6	9.3	10.0	9.65	4.15	0.103
12260	F	381	408.2	8.7	8.9	8.80	3.40	0.056
12261	F	406	453.6	9.9	10.2	10.05	3.65	0.086
12262	F	432	544.3	7.5	8.6	8.05	3.50	0.059
12263	M	457	635.0	8.7	9.0	8.85	3.50	0.061
12264	M	496	544.3	7.7	-----	7.70	3.90	0.061
12265	F	381	408.2	9.0	-----	9.00	3.60	0.060
12266	M	356	317.5	7.7	7.9	7.80	3.25	0.052
12267	---	457	544.3	9.0	-----	9.00	4.50	0.070
12268	F	381	317.5	7.7	8.1	7.90	3.15	0.047
12269	M	406	362.8	9.2	-----	9.20	3.60	0.064
12270	F	432	499.9	8.8	9.0	8.85	3.70	0.062
12271	F	356	317.5	8.8	-----	8.80	3.30	0.065
12272	F	406	453.6	9.7	-----	9.70	3.80	0.062
12273	M	432	408.2	8.7	9.0	8.85	3.60	0.051
12274	M	433	544.3	9.1	9.5	9.30	3.95	0.074
12275	F	381	453.6	8.8	-----	8.80	3.60	0.057

Sample statistics	FL(mm)	FW(g)	OL(mm)	OH(mm)	OW(g)
Count	31	31	31	31	31
Maximum	635	1496.90	11.95	4.8	0.164
Minimum	355	317.50	7.80	3.15	0.047
Mean	419.57	494.61	9.03	3.75	0.066
Stand. Deviation	56.37	234.35	0.858	0.34	0.022
Stand. Error of the Mean	10.13	42.09	0.154	0.062	0.004
Coefficient of Variation	13.44	47.38	9.502	9.20	32.47

Ratio FL/OL	Min. 40.40	Mean 46.61	Max. 64.42
Ratio OL/OH	Min. 1.97	Mean 2.41	Max. 2.15

Regressions and correlation coefficients

FL = 61.177 + 39.686 OL   r = .604 r^2 = .365

FW = -155.249 + 9779.382 OW   r = .900 r^2 = .811

Table 29

Species	***Lota lota***	Eng: Burbot	Fr: Loche
Location	Shesheeb Bay (Lake Superior) Ontario		
Date	Apr. 27, 1961		

NSM#	Sex	FL(mm)	FW(g)	OL(mm)			OH(mm)	OW(g)
				L	R	Mean	Mean	Mean
12276	M	457	816.5	8.8	9.1	8.95	3.65	0.082
12277	M	406	453.6	9.9-	-----	9.90	3.60	0.064
12278	F	381	408.2	8.8	9.3	9.05	3.55	0.052
12279	F	457	680.4	10.0	10.4	10.20	4.25	0.105
12280	M	406	408.2	8.7	8.9	8.80	3.90	0.063
12281	F	432	635.0	9.6	-----	9.60	4.20	0.033
12282	F	508	1,179.4	10.9	11.1	11.00	4.85	0.105
12283	F	432	453.6	9.8	10.9	10.35	4.30	0.204

Ratio FL/OL	Min. 41.01	Mean 44.75	Max. 51.05
Ratio OL/OH	Min. 3.60	Mean 4.00	Max. 4.90

Regression and correlation coefficients

FL = 33.98 + 104.28 OL　　　r = .667　　　r^2 = .445

Table 30

Species	***Lota lota***	Eng: Burbot	Fr: Loche
Location	Gros Cap Reef (Lake Superior) Ontario		
Date	July 14, 1961		

NSM#	FL(mm)	FW(g)	OL(mm)			OH(mm)	OW(g)
			L	R	Mean	Mean	Mean
12237	533	1,315.4	11.4	11.0	11.20	4.10	0.108
Date	July 19, 1961						
12238	559	1,315.4	12.3	11.2	11.75	4.55	0.125
12239	528	1,496.9	11.9	11.5	11.70	4.85	0.128

12240	478	1,043.3	11.2	11.5	11.35	4.50	0.129
12241	540	1,179.4	12.5	12.3	12.40	4.85	0.123

Date July 22nd, 1961

12242	546	1,315.4	11.9	11.8	11.85	4.95	0.155

Date Aug. 6, 1961

12243	521	1,134.0	10.6	10.8	10.70	4.40	0.103

Date Aug. 9, 1961

12244	533	1,270.1	11.8	11.7	11.75	4.30	0.124

Sample statistics	FL(mm)	FW(g)	OL(mm)	OH(mm)	OW(g)
Count	8	8	8	8	8
Maximum	559	149.9	12.4	4.95	0.155
Minimum	478	1,043.3	10.7.	4.10	0.103
Mean	528.64	1,258.74	11.59	4.56	0.125
Stand. Deviation	23.74	138.74	0.51	0.30	0.016
Stand. Error of the Mean	0.39	49.05	0.18	0.11	0.006
Coefficient of Variation	563.34	11.02	4.36	6.57	12.534

Ratio FL/OL	Min. 42.07	Mean 45.67	Max. 48.66
Ratio OL/OH	Min. 2.4	Mean 2.55	Max. 2.7

Regression equation and correlation coefficients

FL = 338.16 + 16.44 OL r = .350 r^2 = .123

Blacker (1974) provides a table on the relationship between Otolith width (mm) (Y) and Fish length (cm) (X) for various cod stocks: North Sea, Arctic, Irish Sea and Newfoundland.

Table 31

Species	***Lota lota***	Eng: Burbot	Fr: Loche
Location	Parisienne I. (Lake Superior) Ontario		
Date	Aug. 2nd, 1961		

NSM#	FL(mm)	FW(g)	OL(mm) L	OL(mm) R	OL(mm) Mean	OH(mm) Mean	OW(g) Mean
12210	559	1,134.0	13.5	13.5	13.50	4.55	0.170
Date	Aug. 5, 1961						
12211	572	1,496.9	12.6	12.3	12.45	5.05	0.156
12212	570	1,761.9	13.5	13.7	13.60	4.60	0.166

Ratio FL/OL Min. 41.40 Max. 45.94
Ratio OL/OH = Min. 2.46 Max. 2.97

Table 32

Species	***Lota lota***	Eng: Burbot	Fr: Loche
Location	Jackson I. (Lake Superior) Ontario		
Date	May 3, 1961		

NSM#	TL(mm)	TW(g)	OL(mm) L	OL(mm) R	OL(mm) Mean	OH(mm) Mean	OW(g) Mean
12202	533	1,179.4	13.0	13.0	13.00	5.55	0.199
12203	610	1,406.2	11.9	12.5	12.20	5.20	0.152
12204	610	1,451.5	12.6	12.7	12.65	5.00	0.149
12205	508	907.2	11.7	-----	11.70	4.40	0.105
12206	635	1,496.9	14.0	-----	14.00	6.10	0.266
12207	559	1,270.1	12.7	12.8	12.75	5.05	0.154
Date:	Aug.8, 1961						
12208	584	1,360.8	11.2	11.8	11.50	5.05	0.162
12209	559	1,542.2	10.9	11.2	11.05	4.95	0.126

Date March 6, 1962

12200	533	----	10.5	10.7	10.60	4.75	0.107
12201	533	----	12.1	12.0	12.05	4.10	0.143

Sample statistics	FL(mm)	FW(g)	OL(mm)	OH(mm)	OW(g)
Count	10	10	10	10	10
Maximum	635	1,542.2	14.00	6.10	0.266
Minimum	508	907.2	10.00	4.10	0.107
Mean	566.34	1,326.8	12.10	5.02	0.156
Stand. Deviation	41.64	206.79	1.115	0.557	0.047
Stand. Error of the Mean	13.17	73.11	0.353	0.176	0.015
Coefficient of Variation	7.35	15.59	9.22	11.103	30.254

Ratio FL/OL	Min. 41.03	Mean 47.07	Max. 53.30
Ratio OL/OH	Min. 2.11	Mean 2.43	Max. 2.94

Regression and correlation coefficients

FL = 332.68 + 19.33 OL r = .518 r^2 = .268

Table 33

Species ***Boreogadus saida*** Eng: Arctic cod Fr: Saida
Location Prince Leopold I. N. W. T.
Date Aug. 18, 1976

NSM	FL(mm)	OL(mm) L	R	Mean	OH(mm) Mean	OW(g) Mean
11876	143	5.3	----	5.30	2.20	0.30

Location Prince Leopold I. N. W. T.
Date Aug. 1st, 1976

11877	142	5.1	5.2	5.15	2.10	0.30

Ratio FL/OL	Min. 26.98	Max. 27.57
Ratio OL/OH	Min. 2.41	Max. 2.45

Frost and Lowry (1981) have calculated the Arctic cod total length using the otolith length with the following formula

FL = 1.588 + 2.198 OL (for fish between 70 and 210 mm) r = 0.981 N = 202 specimens

Their ratio OL/FL was 1:23-28.

Our specimens ratios fall within these limits.

Härkönen (1986) quotes the following regressions and correlation coefficients from Finley and Gibb (In press).

OL/FL 1:25 -- 1:36
OL/OH 2.0 – 2.4

$FL = 16.849 + 20.86\ OL$ $r^2 = .941$
$FW = 3.6\ (10^{-6})\ FL^{3.12}$ $r^2 = 1.00$

Table 34

Species	***Gadus morhua***	Eng: Atlantic cod	Fr: Morue franche
Place	**Grand Bank** (Division 3L)		
Time	August, 9 to Sept 22nd, 1957		

NSM#	FL (mm)	FW (g)	OL(mm)			OH(mm)	OW(g)	OL/OH
			L	R	Mean	Mean	Mean	
11848	1,240		22.6	22.8	22.70	12.95	1.7075	1.75
11849	990		24.0	22.4	23.20	11.14	1.3650	2.08
11863	1,260		22.9	23.7	22.30	12.50	1.8860	1.78
11864	1,320	23,000	22.1	22.9	22.50	12.80	1.6590	1.76
11865	1,160		21.3	-----	21.30	10.80	1.4039	1.97
11866	1,190		20.5	21.4	20.95	12.20	1.5283	1.72
11867	1,320		25.0	23.0	24.00	12.10	1.5370	1.98
11868	1,260	1,800	24.9	26.0	25.45	12.20	1.7350	2.09
11869	1,350		24.3	24.6	24.45	14.60	2.1324	1.67
11871	1,150		21.6	-----	21.60	12.70	1.5320	1.70
11870	230		9.2	9.2	9.20	4.10	0.0696	2.24
11872	220		8.9	9.0	8.95	3.70	0.0086	2.42

Ratio FL/OL	Min. 42.67	Mean 53.67	Max. 58.66	(excluding the last two small specimens)
Ratio OL/OH	Min. 1.68	Mean 1.85	Max. 2.10	(excluding the last two small specimens)

Regression and correlation coefficients

FL = 586.58 + 27.90 OL

Härkönen (1986) gives the following calculations:

OL/FL 1:20 -- 1:35
OL/OH 2.0 – 2.4

FL = -202.13 + 48.37OL r^2 = .916
FW = 0.006855 $OL^{4.435}$ r^2 = .949

Blacker (1974) provides a graph on the relationships of otolith width (Y) and the total fish length (X) for various stocks,

Hunt (1992) gives the following equation

Log n (Fork fish length) = 3.3138 + 1.6235 log n (OL, cm)

Table 35

Species *Gadus morhua* Eng: Atlantic cod Fr: Morue franche
Place **Bay of Fundy**
Date 1st July, 1984

NSM#	Sex	FL (mm)	OL (mm)			OH(mm)	OW (g)
			L	R	Mean	Mean	Mean
11987	M	702	18.1	---	18.10	8.50	0.5572
11988	F	639	17.0	17.3	17.15	7.65	0.4200
11989	M	826	20.0	20.0	20.00	9.35	0.6996
11990	F	554	15.4	15.3	15.35	7.00	0.3405
11991	M	514	14.4	---	14.40	6.80	0.2570
11992	M	637	16.8	17.1	16.95	9.05	0.5319
11993	F	438	13.4	13.5	13.45	6.10	0.2134
11994	M	489	16.1	16.1	16.10	7.00	0.3055
11995	M	557	16.4	---	16.40	7.20	0.3300
11996	F	572	15.6	15.8	15.70	7.15	0.3213

11997	M	534	15.1	15.0	15.05	7.15	0.3503
11998	M	601	18.2	18.1	18.15	8.45	0.5303
11999	F	474	14.2	14.2	14.20	6.60	0.2617
12000	F	497	15.7	16.0	15.85	7.05	0.3006
12001	M	664	17.4	16.8	17.10	8.10	0.4902
12002	M	409	14.0	13.7	13.85	5.65	0.1991
12003	M	695	17.8	18.8	18.30	9.05	0.6110
12004	M	613	17.2	17.7	17.45	8.75	0.5604
12005	F	644	16.8	16.5	16.65	8.00	0.5199
12006	F	524	16.3	16.3	16.30	7.20	0.3377
12007	M	615	16.5	16.4	16.45	7.50	0.4399
12008	M	690	17.1	17.2	17.15	9.05	0.6289
12009	F	594	16.7	16.9	16.80	8.70	0.5168
12010	M	672	18.4	18.8	18.60	8.60	0.6067
12011	M	527	16.1	16.0	16.05	7.05	0.3073
12012	M	457	14.0	14.1	14.05	6.50	0.2489
12013	M	427	12.6	12.7	12.65	5.85	0.1875
12014	F	530	13.7	14.2	13.95	6.60	0.2547
12015	M	449	13.7	14.1	13.90	6.00	0.2173
12016	M	658	16.3	16.4	16.35	7.35	0.3616
12017	M	534	15.7	15.9	15.80	7.30	0.3265
12018	M	568	16.1	15.4	15.75	7.00	0.3059
12019	M	589	15.6	15.6	15.60	7.75	0.3876
12020	F	586	16.7	16.8	16.75	8.00	0.4014
12021	M	662	18.4	18.5	18.45	9.05	0.5955
12022	M	667	16.2	16.4	16.30	8.00	0.4270
12023	M	627	17.5	18.0	17.75	8.70	0.5992
12024	M	541	16.6	16.6	16.60	7.80	0.3503
12025	F	566	15.8	16.0	15.90	7.60	0.3684
12026	M	474	13.8	14.1	13.95	6.15	0.2395
12026	M	363	13.1	13.2	13.15	5.50	0.1656
12028	F	472	14.7	15.1	14.90	6.60	0.2619
12029	F	432	14.4	14.4	14.40	6.10	0.2198
12030	M	410	13.5	13.6	13.55	6.25	0.2186
12031	M	758	18.3	18.3	18.30	9.65	0.6602
12032	M	712	17.5	17.5	17.50	9.10	0.5777
12033	M	715	19.2	18.3	18.75	9.15	0.6012
12034	F	611	17.2	17.2	17.20	8.00	0.4852
12035	M	620	16.3	16.2	16.25	8.35	0.4869
12036	M	749	17.9	18.5	18.20	9.00	0.6268
12037	M	575	17.0	16.6	16.80	7.40	0.5105
12038	M	652	17.3	16.5	16.90	8.35	0.5231
12039	F	503	15.0	15.1	15.05	7.15	0.3040
12040	M	650	19.1	19.9	19.50	8.45	0.5782

12041	M	707	19.3	19.9	19.60	8.50	0.5758
12042	M	609	18.4	18.4	18.40	8.10	0.5614
12945	M	712	19.1	20.1	19.60	9.35	0.7208
12044	F	445	13.8	14.2	14.00	6.00	0.1995
12045	F	601	16.5	17.0	16.75	7.20	0.4760
12046	M	515	15.4	16.1	15.75	7.50	0.4055
12047	F	345	11.4	12.0	11.70	5.35	0.1475
12048	M	757	18.4	18.6	18.50	9.00	0.6500
12049	F	649	16.4	16.4	16.40	8.80	0.5410

Sample statistics	FL(mm)	OL(mm)	OH(mm)	OW(g)
Count	63	63	63	63
Maximum	826	20	9.65	0.72
Minimum	345	11.70	5.35	0.15
Mean	580.44	16.29	7.62	0.42
Stand. Deviation	105.10	1.85	1.116	0.16
Stand. Error of the Mean	13.24	0.23	0.141	0.02
Coefficient of Variat	18.11	11.35	14.66	37.16

Ratio FL/OL	Min. 27.61	Mean 33.42	Max. 41.42
Ratio OL/OH	Min. 1.86	Mean 2.15	Max. 2.45

Regressions and correlation coefficients

FL = -257.98 +51.459 OL   r = .905 r^2 = .819
Log FL = 2.936 + .437 log OW   r = .947 r^2 = .896

Härkönen (1986) provides the following information

Ratio OL/FL 1:20-35

FL = -202.13 + 48.370 OL r^2 = .916
FW = 0.006855 $OL^{4.435}$ r^2 = .949

Hunt (1992) gives the following equation

Ln. FL (cm) = 3.3138 + 1.6235 ln.OL (cm)

Blacker (1974) provides a table on the relationship between the otolith width (mm)(Y) and the fish length (cm) (X) for various cod stocks: North Sea, Arctic, Irish Sea and Newfoundland.

Table 36

Species	***Gadus morhua***	Eng: Atlantic cod	Fr: Morue franche
Place	**St. Margaret's Bay**		
Time	18 June 1987		

NSM#	FL (mm)	FW (g)	OL(mm) Mean	OH(mm) Mean	OW(g) Mean
11530	212	74.3	9.00	4.70	0.064
11531	366	399.4	11.30	5.20	0.132
11532	232	96.6	9.25	4.50	0.064
11533	284	------	10.70	4.25	0.088
Date	Aug. 21st, 1998				
12771	410	------	18.70	9.85	0.793

Ratio FL/OL	Min. 23.56	Max. 32.39
Ratio OL/OH	Min. 1.90	Max. 2.52

Table 37

Species	***Melanogrammus aeglefinus***	Eng: Haddock	Fr: Aiglefin
Place	St. Margaret's Bay. N. S.		
Date	Sept. 1987		

NSM#	Sex	FL (mm)	FW (g)	OL(mm) Mean	OH(mm) Mean	OW(g) Mean
11556	-----	591	1,445.9	19.55	6.65	0.483
Place	Offshore waters of N. S.					
Date	Aug. 8, 1998					
12845	-----	543	-----	18.70	6.60	0.413
Date	Dec. 10, 1998					
12846	M	455	------	16.80	6.25	0.184

Ratio FL/OL Min. 27.08 Max. 30.23
Ratio OL/OH Min. 2.69 Max. 2.83
Hunt (1992) gives the following equation

Log n (Fork fish length) = 2.9775 + 1.5846 (OL, cm)

Table 38

Species	***Melanogrammus aeglefinus***	Eng: Haddock	Fr: Aiglefin
Place	Bay of Fundy		
Date	July, 1st. 1974		

NSM#	Sex	FL(mm)	OL (mm)			OH(mm)	OW (g)
			L	R	Mean	Mean	Mean
12106	---	710	20.8	21.1	20.95	7.50	0.5633
12107	---	439	16.4	16.7	16.55	6.10	0.3019
12108	M	546	19.4	-----	19.40	6.00	0.4554
12109	M	597	18.8	19.4	19.10	6.40	0.4367
12110	M	584	17.2	17.7	17.45	6.50	0.4077
12111	F	592	19.6	20.0	19.80	6.80	0.5228
12112	---	617	22.3	22.2	22.25	7.80	0.7256
12113	M	585	19.1	-----	19.10	7.20	0.5176
12114	---	651	21.1	20.6	20.85	7.60	0.7184
11215	F	725	21.6	21.2	21.40	8.20	0.8077
12116	F	452	17.4	17.4	17.40	6.20	0.3018
12117	---	587	20.0	20.0	20.00	7.00	0.5233
12118	M	576	20.1	21.2	20.65	7.50	0.5028
12119	---	485	17.6	17.1	17.35	6.50	0.3664
12120	M	600	19.3	19.3	19.30	7.25	0.5891
12121	M	617	18.2	18.2	18.20	7.05	0.4477
12122	F	628	18.4	-----	18.40	7.60	0.5281
12123	--	699	20.4	20.2	20.30	7.65	0.5906
12124	--	736	23.3	23.1	23.20	9.05	1.0436
12125	--	642	22.0	22.2	22.10	8.00	0.7735
12126	--	634	19.0	19.0	19.10	6.50	0.5184
12127	--	711	21.2	21.2	21.20	8.25	0.7390
12128	--	693	21.1	21.6	21.35	7.80	0.6915
12129	M	614	19.3	19.6	19.45	6.90	0.5212
12130	--	752	22.1	22.2	22.15	8.60	0.8620
12131	M	690	21.2	21.4	21.30	7.75	0.7787
12132	--	601	19.2	19.0	19.10	7.15	0.4589
12133	M	580	19.3	19.2	19.25	6.85	0.4929
12134	--	529	18.1	18.0	18.05	7.20	0.3903

12135	--	562	19.5	19.4	19.45	8.15	0.4645
12136	--	565	20.1	20.3	20.20	7.30	0.6061
12137	M	649	20.0	20.0	20.20	7.15	0.5925
12138	M	619	19.3	19.4	19.35	7.00	0.4882
12139	M	604	19.3	19.7	19.50	6.90	0.4432
12140	--	616	17.8	18.1	17.95	6.85	0.4119
12141	F	652	21.9	21.8	21.85	7.85	0.6217
12142	--	578	18.9	19.7	19.30	7.25	0.4691
12143	--	667	22.5	21.5	22.00	9.20	0.9030
12144	--	569	18.5	17.5	17.75	6.50	0.4090
12145	M	653	21.3	21.6	21.45	7.45	0.5858
12146	--	592	19.3	19.3	19.30	7.70	0.5180
12147		552	17.6	17.7	17.65	6.20	0.3684
12148	--	662	21.3	22.1	21.70	7.85	0.7519
12149	--	600	21.4	21.8	21.60	7.40	0.6936
12150	--	463	17.3	17.0	17.15	6.15	0.3179
12151	--	593	18.0	17.6	17.80	7.30	0.4531
12152	--	547	17.5	----	17.50	6.60	0.3955
12153	--	466	17.0	17.0	17.00	6.25	0.3344
12154	--	581	18.3	19.0	18.65	6.15	0.4881
12155	--	704	23.5	22.5	23.00	8.20	0.7691

Sample statistics	FL(mm)	OL(mm)	OH(mm)	OW(g)
Count	50	50	50	50
Maximum	752	23.20	9.20	1.04
Minimum	439	16.55	6.00	0.30
Mean	607.32	19.77	7.25	0.55
Stand. Deviation	73.48	1.73	0.76	0.17
Stand. Error of the Mean	10.25	0.24	0.107	0.02
Coefficient of Variation	11.94	8.74	10.49	30.18

Ratio FL/OL	Min. 25.98	Mean 30.6	Max. 34.43	9
Ratio OL/OH	Min. 2.41	Mean 2.74	Max. 3.23	

Regression and correlation coefficients

FL = -58.019 + 33.651 OL   r = .802 r^2 = .644

Härkönen (1986) gives the following results:

OL/FL 1 : 20-30
OL/OH 2.35 --- 2.50

$FL = 8.785\ OL^{1.38}$ r^2 = .964
$FW = .0002096\ OL^{4.58}$ r^2 = .971

Table 39

Species	***Microgadus tomcod***	Eng: Atlantic tomcod	Fr: Poulamon atlantique
Location	King Creek (Hans. Co.) N. S.		
Date	Dec. 1st, 1998		

NSM#	FL(mm)	FW(g)	OL(mm)			OH(mm)	OW(g)
			L	R	Mean	Mean	Mean
12839	M	198	10.1	10.3	10.20	4.25	0.090
12840	F	192	9.6	10.0	9.80	3.50	0.070
12841	F	186	9.6	9.6	9.60	3.70	0.074
12842	F	174	9.0	9.1	9.05	3.45	0.054

Ratio FL/OL	Min. 19.12	Max. 19.59
Ratio OL/OH	Min. 2.40	Max. 2.80

Hunt (1992) gives the following equation

Ln FL(cm) = 2.9775 + 1.5846 ln OL(cm)

Table 40

Species	***Pollachius virens***	Eng: Pollock	Fr: Goberge
Location	Grand Bank (Division 3 L)		
Date	Sept. 7, 1956		

NSM#	Sex	FL(mm)	OL (mm)			OH(mm)	OW (g)
			L	R	Mean	Mean	Mean
11850		1,060	21.0	20.4	20.70	8.60	0.981
11851	M	850	20.2	20.3	20.25	6.75	0.545

Ratio FL/OL	Min. 41.98	Max. 51.21
Ratio OL/OH	Min. 2.41	Max. 3.00

Table 41

Species	***Pollachius virens***	Eng: Pollock	Fr: Goberge
Place	Bay of Fundy, N. S.		
Time	July 1st, 1974		

NSM#	Sex	FL(mm)	OL (mm)			OH(mm)	OW (g)
			L	R	Mean	Mean	Mean
11938	F	672	20.1	19.2	19.65	6.00	0.3437
11939	F	767	18.2	-----	18.20	6.70	0.3792
11940	--	871	19.7	20.0	19.85	6.60	0.5824
11941	F	682	18.1	17.5	17.80	5.75	0.3042
11942	M	643	16.7	16.9	16.80	5.85	0.3050
11943	--	601	15.8	15.8	15.80	5.30	0.2258
11944	F	608	16.9	16.8	16.85	5.15	0.2950
11945	F	632	16.2	16.5	16.35	5.00	0.2678
11946	M	829	18.5	18.8	18.65	6.45	0.4178
11947	M	651	18.7	18.8	18.75	5.65	0.3041
11948	F	705	19.3	18.8	19.05	6.10	0.3512
11949	--	676	17.3	17.1	17.20	5.90	0.3016
11950	F	848	19.2	19.8	19.50	6.20	0.4822
11951	--	709	19.4	19.2	19.30	6.05	0.3529
11952	F	786	17.5	17.8	17.65	6.10	0.3729
11953	M	677	17.4	17.1	17.25	6.05	0.3304
11954	--	754	17.2	17.5	17.35	6.00	0.3568
11955	M	530	14.7	14.6	14.65	4.75	0.1841
11956	M	828	20.6	19.6	20.10	7.45	0.5873
11957	M	728	17.4	17.4	17.40	5.70	0.3063
11958	--	907	20.3	-----	20.30	7.00	0.5962
11959	--	903	20.7	-----	20.70	7.30	0.6018
11960	F	690	17.2	17.4	17.30	5.50	0.3151
11961	M	811	20.1	18.9	19.50	6.40	0.4362
11962	M	864	18.9	19.1	19.00	6.75	0.5175
11963	--	695	17.2	17.4	17.30	6.00	0.3325
11964	M	619	16.5	16.8	16.65	5.40	0.2825
11965	M	674	17.5	17.5	17.50	5.00	0.3029
11966	F	692	17.7	17.3	17.50	5.50	0.3793
11967	--	701	17.4	17.3	17.35	5.75	0.3075
11968	M	848	18.4	18.9	18.65	6.55	0.4197
11969	F	583	17.1	16.8	16.95	5.70	0.2883
11970	M	614	16.3	16.4	16.35	5.35	0.2500
11971	F	637	15.3	15.3	15.30	5.20	0.2242
11972	M	572	15.7	15.7	15.70	5.60	0.2299

11973	F	581	15.7	16.2	15.95	4.75	0.2253
11974	--	585	16.1	16.3	16.20	5.40	0.2625
11975	F	687	18.2	18.2	18.20	6.20	0.3457
11976	--	865	19.3	19.4	19.35	6.45	0.4728
11977	F	777	18.3	19.0	18.65	5.70	0.3855
11978	F	928	20.1	20.5	20.30	7.90	0.5912
11979	M	668	16.1	16.2	16.15	5.40	0.2698
11980	M	645	17.6	17.6	17.60	6.00	0.3120
11981	M	913	22.7	22.8	22.75	8.00	0.7455
11982	M	646	16.5	17.0	16.75	5.55	0.2811
11983	M	736	17.3	17.6	17.45	6.15	0.3550
11984	F	606	16.3	16.7	16.50	5.35	0.2549
11985	M	790	20.3	21.0	20.65	5.85	0.4234
11986	--	750	18.1	18.1	18.10	6.35	0.3604

Sample statistics	FL(mm)	OL(mm)	OH(mm)	OW(g)
Count	49	49	49	49
Maximum	928	22.75	8.00	0.75
Minimum	530	14.65	4.75	0.18
Mean	718.04	17.96	6.00	0.36
Stand. Deviation	104.42	1.62	0.721	0.12
Stand. Error of the Mean	14.92	.23	0.103	0.017
Coefficient of Variation	14.54	9.03	12.029	32.95

Ratio FL/OL	Min. 34.39	Mean 39.85	Max. 45.71
Ratio OL/OH	Min. 2.56	Mean 3.08	Max. 3.50

Regression and correlation coefficients

FL = -268.373 + 54.932 OL   r = .853 r^2 = .727

Härkönen (1986) gives the following equations:

OL/FL 1 :25-45
OL/OH 2.9 --- 3.2 (in specimens > 200mm)

FL = 8.97297 $OL^{1.53}$ r^2 = .966
FW = .007288 $OL^{4.501}$ r^2 = .958

Hunt (1992) gives the following equation

Ln. FL (fork length;cm) = 3.2510 + 1.6251 ln. OL (cm)   N = 19

Table 42

Species	***Pollachius virens***	Eng: Pollock	Fr: Goberge
Location	St. Margaret's Bay, N. S.		

NSM#	Sex	FL(mm)	OL(mm) L	OL(mm) R	OL(mm) Mean	OH(mm) Mean	OW(g) Mean
Date	July 2nd, 1981						
11237		349	11.8	11.8	11.80	4.30	0.117
11238		306	10.5	10.6	10.55	4.15	0.086
11239		335	11.5	12.0	11.75	4.15	0.114
11240		237	8.5	8.7	8.60	3.15	0.050
11241		251	----	8.9	8.90	3.20	0.057
Date	July 17, 1987						
11242		943	22.0	21.6	21.80	6.95	0.594
Date	Aug. 10, 1987						
11243	M	397	12.3	12.2	12.25	4.20	0.120
Date	Oct. 15, 1987						
11259	F	410	13.2	13.3	13.25	4.25	0.129
Date	Aug. 20, 1998						
12789	F	428	14.1	13.7	14.10	4.65	0.175
Date	Aug. 21st, 1998						
12772	F	509	14.9	15.2	15.05	5.10	0.208
12773	M	475	14.6	15.1	14.85	5.30	0.210
12774	M	466	15.0	14.7	14.85	5.00	0.199

Ratio FL/OL	Min. 27.56	Max. 43.26
Ratio OL/OH	Min. 2.54	Max. 3.14

Table 43

Species	***Pollachius virens***	Eng: Pollock	Fr: Goberge
Place	Purcell's Cove, N. S.		
Date	Oct. 12, 1981		

NSM#	FL(mm)	OL (mm)			OH(mm)	OW (g)
		L	R	Mean	Mean	Mean
11262	179	6.8	6.8	6.80	2.55	0.036
11263	178	7.0	7.1	7.05	2.65	0.028
11264	167	6.8	6.8	6.80	2.25	0.027
11265	162	6.8	6.8	6.80	2.25	0.024

Ratio FL/OL Min. 23.32 Max. 23.32
Ratio OH Min. 2.67 Max. 3.02

Table 44

Species	***Merluccius albidus***	Eng: Offshore hake	Fr: Merlu blanc
Place	Passamaquoddy Bay, N. B.		
Date	Dec. 13, 1977		

NSM#	FL (mm)	OL(mm)			OH(mm)	OW(g)
		L	R	Mean	Mean	Mean
11575	378	20.5	20.7	20.60	9.60	0.340

Ratio FL/OL = 18.35
Ratio OL/OH = 2.15

Table 45

Species	***Merluccius australis***	Eng: Australian hake	Fr: Merlu d'Australie
Place	New Zealand		
Date	May 7, 1967		

NSM#	FL (mm)	OL(mm) Mean	OH(mm) Mean	OW(g) Mean
11535	770	29.00	9.20	0.572

Ratio FL/OL = 26.55
Ratio OL/OH = 3.15

Table 46

Species	***Merluccius bilinearis***	Eng: Silver hake	Fr: Merlu argenté
Place	Grand Bank (Division 3N)		
Date	July 21st ,1955		

NSM#	Sex	FL (mm)	OL(mm)			OH(mm)	OW(g)
			L	R	Mean	Mean	Mean
85049		440	20.2	20.4	20.30	5.95	0.198
85050		440	20.6	20.2	20.40	5.50	0.184
85051		390	--	17.8	17.80	5.45	0.154
85052		460	--	21.6	21.60	6.60	0.243

Date Sept. 8, 1956

NSM#	Sex	FL (mm)	L	R	Mean	OH(mm) Mean	OW(g) Mean
11905	F	390	19.0	--	19.00	5.20	0.158

Ratio FL/OL	Min. 20.53	Max. 21.90
Ratio OL/OH	Min. 3.27	Max. 3.71

Nichy (1969) provides a graph of the relationship between the otolith length (Y) and the fish fork length (X) for 8,522 hakes between 7 and 62 cm. From this curve fish length can easily be estimated using the otolith length.

Table 47

Species *Merluccius bilinearis* Eng: Silver hake Fr: Merlu argenté
Place Pagan Point, Passamaquoddy Bay. N. B.
Date April 15, 1977

NSM	Sex	FL (mm)	OL(mm)			OH(mm)	OW(g)
			L	R	Mean	Mean	Mean
11558	-----	300	13.7	13.8	13.75	5.00	0.0775

Date Aug. 15, 1977

NSM	Sex	FL (mm)	L	R	Mean	OH Mean	OW Mean
11854	F	304	14.4	14.4	14.40	4.55	0.0780

Date Sept. 8, 1980

NSM	Sex	FL (mm)	L	R	Mean	OH Mean	OW Mean
12156	M	250	11.9	11.8	11.85	4.40	0.0593
12157	M	285	12.7	-----	12.70	4.40	0.0678
12158	F	310	13.5	13.5	13.50	4.70	0.0765
12159	M	288	13.2	13.2	13.20	4.85	0.0758
12160	M	283	13.1	-----	13.10	4.50	0.0742
12161	M	274	11.9	12.3	12.20	4.35	0.0627
12162	M	283	12.7	12.7	12.70	4.30	0.0678
12163	---	293	13.2	13.2	13.20	4.70	0.0688
12164	M	287	13.2	12.9	13.05	4.45	0.0733
12165	M	302	12.9	12.9	12.90	4.50	0.0693
12166	M	280	12.3	12.7	12.50	4.55	0.0639
12167	M	276	12.5	12.5	12.50	4.50	0.0670
12168	F	300	12.9	12.8	12.85	4.35	0.0684
12169	M	270	11.7	11.5	11.60	4.25	0.0538
12170	M	280	13.2	------	13.20	4.40	0.0733
12171	F	267	11.7	11.8	11.75	4.10	0.0583
12172	F	313	14.6	------	14.60	5.00	0.0910
12173	M	283	13.0	12.8	12.90	4.45	0.0620
12174	M	295	14.0	14.3	14.15	4.35	0.0735
12175	F	274	12.5	12.3	12.40	4.15	0.0619
12176	M	300	13.4	13.5	13.45	4.10	0.0651
12177	F	308	14.0	14.1	14.05	4.65	0.0845
12178	F	290	12.1	12.2	12.15	4.60	0.0710
12179	F	300	14.1	14.0	14.05	4.45	0.0752
12180	M	285	13.1	13.0	13.05	4.10	0.0650
12181	M	270	12.3	12.2	12.25	4.15	0.0562

12182	F	265	12.0	-----	12.00	4.40	0.0640
12183	F	245	9.8	10.1	9.95	3.95	0.0371
12184	F	308	14.1	14.7	14.40	4.65	0.0822
12185	F	302	13.6	-----	13.60	4.90	0.0835
12186	M	233	10.1	10.3	10.20	3.65	0.0347
12187	F	279	12.9	12.9	12.90	4.60	0.0750
12188	F	279	12.7	12.3	12.50	4.55	0.0716
12189	M	308	13.4	13.3	13.35	4.75	0.0841
12190	M	277	12.5	12.3	12.40	4.20	0.0568
12191	F	280	12.3	12.2	12.25	4.70	0.0678
12192	M	377	18.8	-----	18.80	5.00	0.1442
12193	F	268	12.8	13.0	12.90	5.45	0.0692
12194	M	267	12.2	-----	12.20	4.20	0.0578
12195	M	263	12.7	12.5	12.60	4.20	0.0644
12196	F	294	14.3	14.1	14.20	4.80	0.0915
12197	M	233	10.9	10.9	10.90	4.00	0.0497
12198	M	257	11.8	11.7	11.75	4.00	0.0553

Sample statistics	FL(mm)	OL(mm)	OH(mm)	OW(g)
Count	43	43	43	43
Maximum	371	18.80	5.45	0.144
Minimum	233	9.95	3.65	0.029
Mean	283.28	12.86	4.45	0.69
Stand. Deviation	24.25	1.37	0.333	0.02
Stand. Error of the Mean	3.70	0.21	0.051	0.003
Coefficient of Variation	8.56	10.62	7.481	25.81

Ratio FL/OL	Min. 20.05	Mean 22.05	Max. 24.62
Ratio OL/OH	Min. 2.34	Mean 2.9	0Max. 3.76

Regression and correlation coefficients

FL = 72.194 + 16.409 OL $\quad r = .924 \quad r^2 = .854$

Hunt (1992) gives the following formula.

Ln FL = 3.0111 + 1.0276 Ln OL

Table 48

Species	***Merluccius bilinearis***	Eng: Silver hake	Fr: Merlu argenté
Place	Chebucto Head, N. S.		
Date	Dec. 3rd, 1974		

NSM#	Sex	FL (mm)	OL(mm)			OH(mm)	OW(g)
			L	R	Mean	Mean	Mean
11910		448	22.3	21.9	22.10	5.45	0.1924 (1)

Place Offshore N. S. waters
Date Unknown

NSM#	Sex	FL (mm)	L	R	Mean	OH Mean	OW Mean
11559		----	24.1	24.6	24.35	6.55	0.2340 (1)

Place St. Margaret's Bay
Date 10 Aug. 1987

NSM#	Sex	FL (mm)	L	R	Mean	OH Mean	OW Mean
11545	F	392	-----	21.1	21.10	5.50	0.178

Date Sept. 22, 1987

NSM#	Sex	FL (mm)	L	R	Mean	OH Mean	OW Mean
11546	F	366	17.1	17.2	17.15	4.80	0.137
11547	F	384	18.4	17.3	17.85	5.35	0.129
11548	F	368	14.7	-----	14.70	5.00	0.129
11549	F	371	19.0	19.0	19.00	5.25	0.147
11550	F	391	19.0	18.5	18.75	5.00	0.178

Date Sept. 29, 1987

NSM#	Sex	FL (mm)	L	R	Mean	OH Mean	OW Mean
11551	F	407	-----	-----	19.60	-----	0.147
11552	F	381	19.1	19.8	19.45	5.50	0.144
11553	F	365	17.5	-----	17.50	5.00	0.130

Date Sept. 30, 1987

NSM#	Sex	FL (mm)	L	R	Mean	OH Mean	OW Mean
11569	F	459	----	-----	-----	5.40	0.160
11570	F	375	16.2	-----	16.20	5.40	0.131
11571	F	364	17.2	17.1	17.15	5.35	0.127

Sample statistics	FL(mm)	OL(mm)	OH(mm)	OW(g)
Count	12	11	11	12
Maximum	407	21.10	5.5	1.78
Minimum	364	14.70	4.8	1.13
Mean	377.42	18.04	5.23	0.15
Stand. Deviation	13.76	1.78	0.24	0.020
Stand. Error of the Mean	3.97	0.54	0.072	0.005
Coefficient of Variation	3.65	9.86	4.59	12.72

Ratio FL/OL	Min. 18.58	Mean 21.13	Max. 25.03
Ratio OL/OH	Min. 2.94	Mean 3.43	Max. 3.84

Regression and correlation coefficients

FL = 285.815 + 5.14 OL $\quad$ $r = .661$ $\quad$ $r^2 = .437$

(1) Not included in the calculations.

Table 49

Species *Merluccius hubbsi* Eng: Argentinean hake Fr: Merlu d'Argentine
Place Argentinean Shelf, South Atlantic
Date March 7, 1970

NSM#	Sex	FL (mm)	OL(mm) L	OL(mm) R	OL(mm) Mean	OH(mm) Mean	OW(g) Mean	OL/OH Mean
11878	F	334	13.7	13.7	13.70	5.45	0.081	2.51
11879	M	430	18.1	-----	18.10	7.05	0.378	2.57
85161	F	477	20.0	19.6	19.80	7.70	0.219	2.57
85162	M	363	-----	16.0	16.00	6.40	0.129	2.50
85163	F	509	-----	21.9	21.90	8.60	0.269	2.55
85164	M	416	16.6	16.7	16.65	6.50	0.179	2.56
85165	F	506	21.4	21.5	21.45	8.00	0.232	2.68
85166	F	478	17.4	------	17.40	7.55	0.187	2.30
85167	M	519	22.4	22.1	22.25	7.85	0.258	2.83
85168	--	470	19.5	19.2	19.35	7.30	0.178	2.65
85169	F	406	17.4	17.3	17.35	6.70	0.153	2.89
85170	F	415	18.3	-----	18.30	6.90	0.162	2.65
85171	M	352	15.1	15.1	15.10	7.00	0.104	2.16
85172	F	641	23.0	22.8	22.90	8.65	0.296	2.65
85173	M	438	19.0	19.2	19.10	7.15	0.178	2.67
85174	M	418	18.2	17.9	18.05	7.55	0.156	2.39
85175	M	428	18.1	18.1	18.10	7.55	0.175	2.39
95176	F	530	28.5	28.5	28.50	10.00	0.525	2.85
85177	M	302	12.6	12.7	12.65	5.35	0.074	2.36
85178	M	437	-----	18.1	18.10	7.00	0.172	2.59

No statistics calculated because it is not a random sample

Table 50

Species	***Merluccius productus***	Eng: Pacific hake	Fr: Merlu du Pacifique
Place	Stuart Channel, B. C.		
Date	Dec. 13, 1976		

NSM#	Sex	FL(mm)	OL (mm) L	OL (mm) R	OL (mm) Mean	OH(mm) Mean	OW (g) Mean
11560	F	340	15.2	15.0	15.10	6.40	0.121
11561	M	410	18.2	17.6	17.90	6.65	0.248
11562	--	311	14.8	13.7	14.25	5.05	0.081
11563	M	445	20.0	20.4	20.20	7.00	0.310
11564	M	465	20.4	20.5	20.55	7.05	0.249
11565	M	359	16.1	15.8	15.95	6.20	0.133
11566	M	414	18.8	19.0	18.90	6.65	0.206
11567	F	445	19.6	18.5	19.05	7.10	0.279
11578	F	454	19.5	19.3	19.40	7.00	0.301
11601	--	301	13.0	-----	13.00	5.25	0.069

Sample statistics	FL(mm)	OL(mm)	OH(mm)	OW(g)
Number	10	10	10	10
Maximum	465	20.6	7.10	0.31
Minimum	301	13	5.05	0.07
Mean	394.4	17.44	6.44	0.20
Stand. Deviation	61.62	2.67	0.74	0.09
Stand. Error of the mean	19.49	7.11	0.234	0.03
Coefficient of Variation	15.62	15.29	11.502	45.81

Ratio FL/OL	Min. 21.82	Mean 22.55	Max. 23.28
Ratio OL/OH	Min. 2.36	Mean 2.70	Max. 2.92

Regression and correlation coefficients

FL = -2.901 + 22.788 OL $\quad$ r = .986 $\quad$ r^2 = .972

Table 51

Species	***Macrourus bairdii***	Eng: Marlin-spike	Fr: Grenadier de Baird
Location	Grand Bank (Division 3N)		
Date	Sept. 7, 1954		

NSM#	FL (mm)	OL(mm)			OH(mm)	OW(g)
		L	R	Mean	Mean	Mean
85045	290	7.6	7.9	7.75	4.85	0.055
85046	320	9.2	9.4	9.30	5.00	0.083
85047	350	8.6	8.6	8.60	4.60	0.062

Location St. Pierre Bank (Division 3P)
Time Aug. 23rd, 1957

85048	315	9.1	9.4	9.15	5.00	0.064

Ratio FL/OL Min. 34.41 Max. 40.70
Ratio OL/OH Min. 1.60 Max. 1.87

Table 52

Species	***Lycodes reticulates***	Eng: Arctic eelpout	Fr: Lycode arctique
Location	Grand Bank (Division 3L)		
Date	Aug. 12, 1957		

NSM#	Sex	FL(mm)	OL(mm)			OH(mm)	OW(g)
			L	R	Mean	Mean	Mean
85066 F	520	5.2	5.3	5.25	3.65	0.031	

Ratio FL/OL = 99.05
Ratio OL/OH = 1.44

Table 53

Species *Opsanus tau* Eng: Oyster toadfish Fr:
Location Grand Banks (Division 3N)
Date June 28, 1954

NSM#	Sex	FL(mm)	OL(mm) L	OL(mm) R	OL(mm) Mean	OH(mm) Mean	OW(g) Mean
85029	F	510	4.0	-----	4.00	2.80	0.013
Date	Aug. 3rd, 1955						
85030	-----	660	5.1	-----	5.10	2.65	0.019
Date	Sep. 9, 1957						
85031	M	530	4.7	-----	4.70	2.80	0.011
Date	Sept. 20, 1957						
85032	F	470	4.0	4.2	4.10	2.65	0.013
Date	Sept. 22, 1957						
85033	-----	540	4.7	4.6	4.65	2.65	0.017

Ratio FL/OL Min. 11.77 Max. 129.41
Ratio OL/OH Min. 1.43 Max. 1.92

Table 54

Species	***Lophius americanus***	Eng: Goosefish	Fr: Baudroie d'Amérique
Location	St. Pierre Bank (Division 3P)		
Date	Aug. 22nd, 1957		

NSM#	Sex	FL(mm)	OL(mm)			OH(mm)	OW(g)
			L	R	Mean	Mean	Mean
85034		470	6.4	6.6	6.50	4.45	0.032
Date	Aug, 25, 1957						
85035		230	3.5	3.6	3.55	2.40	0.009 (1)
Location	St. Margaret's Bay. N. S.						
Date	Aug. 10, 1987						
11257	M	710	8.0	8.2	8.10	5.45	0.065
11258	---	540	5.7	5.9	5.80	4.55	0.042

(1) Otoliths lost

Ratio FL/OL	Min. 64.80	Max. 93.10
Ratio OL/OH	Nin. 1.27	Max. 1.49

Table 55

Species	***Sebastes marinus***	Eng: Redfish	Fr: Sébaste atlantique
Location	St. Pierre Bank (Division 3P)		
Date	Feb.28, 1955		

NSM#	FL(mm)	OL(mm)			HO(mm)	OW(g)
		L	R	Mean	Mean	Mean
85080	110	5.4	5.4	5.40	3.55	0.057
85081	116	5.7	5.7	6.70	3.35	0.058

Location	Passamaquoddy Bay, N. B.
Date	Sept. 16, 1976

11290	290	13.0	12.6	12.80	3.50	0.209
11853	338	13.6	14.2	13.90	3.40	0.371

Ratio FL/OL Min. 17.33 Max. 24.32
Ratio OL/OH Min. 1.52 Max. 4.09

Härkönen (1986) gives the following values and regressions

Ratio OL/FL 1 : 20 ---1: 31
Ratio OL/OH 1.30 --- 1.90
.

$FL = 16.165\ OL^{1.224}$ r^2 = .979
$FW = .0741\ OL^{3.295}$ r^2 = .989

Hunt (1992) gives the following equation

Ln.FL (cm) = 3.1273 + 1.1436 ln.L(cm)

Saborido-Rey (1998) All measurements in mm. (Personal communication)

FL(standard) = .6283 + 28.89 OL r^2 = .910 N = 217
OW = .286 + 1.82 FL(standard) r^2 = .900

Table 56

Species ***Sebastes mentella*** Eng: Deepwater redfish Fr: Sébaste d'eau profonde
Location Lunenburg, N. S. (commercial)
Date March 25, 1976

NSM#	FL(mm)	OL(mm)			OH(mm)	OW(g)
		L	R	Mean	Mean	Mean
11895	298	12.3	12.9	12.60	7.70	0.217
11896	306	12.9	13.5	13.20	7.65	0.232
11897	310	10.3	11.7	11.00	7.45	0.183
85082	280	11.8	11.8	11.80	7.50	0.166

Ratio FL/OL Min. 23.18 Max. 28.18
Ratio OL/OH Min. 1.52 Max. 1.70

Saborido-Rey (1998) All measurements in mm. (Personal communication)

FL(standard) = 11.72 + 19.72 OL r^2 = .890 N = 374
OW = .546 + 2.36 FL (standard) r^2 = .980

Table 57

Species	***Triglops ommatistius***	Eng: Mailed sculpin	Fr: Faux-trigle maillé
Location	Grand Bank (Division 3L)		
Date	Aug. 2nd, 1957		

NSM#	Sex	FL(mm) (1)	OL(mm)			OH(mm)	OW(g)
			L	R	Mean	Mean	Mean
85092	F	126	3.7	3.7	3.70	1.75	0.006

(1) Fork length

Ratio FL/OL = 34.05
Ratio OL/OH = 2.11

Table 58

Species	***Artediellus uncinatus***	Eng: Arctic hookbear sculpin	Fr: Crochet arctique
Location	Grand Bank (Division 3L)		
Date	Aug. 12, 1957		

NSM	FL(mm)	OL(mm)			OH(mm)	OW(g)
		L	R	Mean	Mean	Mean
85083	80	4.7	4.8	4.75	2.25	0.011

Ratio FL/OL = 16.84
Ratio OL/OH = 1.11

Table 59

Species	***Myoxocephalus octodecimspinosus***	Eng: Longhorn sculpin	Fr: Chaboisseau à dix-huit épines
Location	Grand Bank (Division 3N)		
Date	June 27, 1954		

NSM#	Sex	FL(mm)	OL(mm) L	OL(mm) R	OL(mm) Mean	OH(mm) Mean	OW(g) Mean
11902	F	280	7.4	7.5	7.45	3.25	0.015
Date	July , 1954						
85084	F	280	6.4	-----	6.40	3.00	0.021
85085	F	290	5.6	6.0	5.80	2.75	0.027
85086	F	210	8.0	8.0	8.00	3.20	0.055
Date	Sept. 6, 1956						
85087	F	330	8.9	9.1	9.00	3.15	0.045
Date	Aug. 18, 1957						
11904		380	7.4	-----	7.40	3.70	0.043
Date	Sept 20, 1957						
85088	F	320	7.6	7.7	7.65	3.45	0.057
85089	F	370	7.6	7.7	7.65	3.25	0.061
Date	Sept. 21st, 1957						
11903	F	360	7.1	7.2	7.15	3.45	0.061

Sample statistics	FL(mm)	OL(mm)	OH(mm)	OW(g)
Count	9	9	9	9
Maximum	380	9.00	3.7	0.061
Minimum	210	5.8	2.8	0.015
Mean	313.33	7.39	3.24	0.043
Stand. Deviation	54.31	0.913	0.28	0.018
Stand. Error of the Mean	18.11	0.304	0.09	0.006
Coefficient of Variation	17.33	12.36	8.49	41.45

Ratio FL/OL	Min. 26.25	Mean 42.91	Max. 51.35
Ratio OL/OH	Min. 2.00	Mean 2.28	Max. 2.86

Regression and correlation coefficients

FL = 26.25 - 51.35 OL

Table 60

Species *Myoxocephalus octodecimspinosus* Eng: Longhorn sculpin Fr: Chaboisseau à dix-huit épines
Location Passamaquoddy Bay, N. B
Date Oct. 8, 1980

NSM#	Sex	FL(mm)	FW(g)	OL(mm) L	OL(mm) R	OL(mm) Mean	OH(mm) Mean	OW(g) Mean
11593		----		6.4	----	6.40	3.70	0.033

Location St. Margaret's Bay, N. S.
Date June 18, 1987

NSM#	Sex	FL(mm)	FW(g)	OL(mm) L	OL(mm) R	OL(mm) Mean	OH(mm) Mean	OW(g) Mean
11541		205		-----	----	6.00	2.30	0.021

Date July 2nd, 1987

NSM#	Sex	FL(mm)	FW(g)	OL(mm) L	OL(mm) R	OL(mm) Mean	OH(mm) Mean	OW(g) Mean
11536		275		7.2	7.1	7.15	3.30	0.028
11537		189		-----	5.5	5.50	2.20	0.019

Location St. Margaret’s Bay, N. S.
Date Aug.21st, 1998

NSM#	Sex	FL(mm)	FW(g)	OL(mm) L	OL(mm) R	OL(mm) Mean	OH(mm) Mean	OW(g) Mean
12760 ---		280	211	8.1	8.1	8.10	2.75	0.039
12761	---	242	152	7.3	7.5	7.40	2.70	0.030
12762	F	273	231	6.8	7.1	6.95	3.05	0.035
12763	---	256	180	6.6	6.7	6.65	3.05	0.033
12764	---	276	227	6.7	6.4	6.55	3.00	0.035
12765	F	286	248	7.1	7.0	7.05	3.00	0.038

Ratio FL/OL	Min. 32.70	Mean 37.19	Max. 42.14
Ratio OL/OH	Min. 2.13	Mean 2.44	Max. 2.95

Table 61

Species	***Myoxocephalus scorpius***	Eng: Shorthorn sculpin	Fr: Chaboisseau à épines courtes
Location	St. Margaret's Bay, N. S.		
Date	Sept. 22nd, 1987		

NSM	Sex	FL(mm)	FW(g)	OL(mm)			OH(mm)	OW(g)
				L	R	Mean	Mean	Mean
12408	F	355	840	8.6	8.8	8.70	4.50	0.063

Ratio FL/OL = 40.80
Ratio OL/OH = 1.93

Harkönen (1986) gives the following values and regressions

Ratio OL/FL 1:26 --- 1:35
Ratio OL/OH 2.00 --- 2.70
.

FL = -9.95 + 34.84OL r^2 = .859
FW = 0.2261 $OL^{3.496}$ r^2 = .873

Table 62

Species	***Hemitripterus americanus***	Eng:Sea raven	Fr: Hémiptriptère atlantique
Location	Sandy Cove, Terence Bay, N. S.		
Date	Sept. 11, 1993		

NSM#	Sex	FL(mm)	OL(mm)			OH(mm)	OW(g)
			L	R	Mean	Mean	Mean
11269	-----	340	4.3	5.0	4.65	2.35	0.012

Location Passamaquoddy Bay, N. B.
Date Sept. 16, 1993

NSM#	Sex	FL(mm)	L	R	Mean	OH Mean	OW Mean
11840		472	5.4	5.5	5.45	2.85	0.019
11841		456	6.8	7.0	6.90	3.10	0.028

Ratio FL/OL	Min. 73.12	Max. 86.60
Ratio OL/OH	Min. 1.91	Max. 2.23

Table 63

Species	**Morone chrysops**	Eng: White bass	Fr: Bar blanc
Location	Lake Erie. Ontario		
Date	June 30, 1959		

NSM#	FL(mm)	OL(mm)			OH(mm)	OW(g)
		L	R	Mean	Mean	Mean
85067	------	9.2	9.0	9.10	5.05	0.056

Ratio OL/OH = 1.80

Table 64

Species	***Micropteus dolomieu***	Eng: Smallmouth bass	Fr: Achigan à petite bouche
Location	Thames R. (London, Ontario)		
Date	1960		

NSM#	FL(mm)	OL(mm)			OH(mm)	OW(g)
		L	R	Mean	Mean	Mean
12405	-----	4.7	4.5	4.60	2.20	0.007

Ratio OL/OH 2.09

Table 65

Species	***Perca flavescens***	Eng: Yellow perch	Fr: Perchaude
Location	Lake Erie. Ontario		
Date	June 7, 1957		

NSM#	Sex	FL(mm)	OL(mm)			OH(mm)	OW(g)
			L	R	Mean	Mean	Mean
12100		204	5.5	5.6	5.55	2.80	0.017
12101		218	6.3	----	6.30	3.50	0.023
12102		196	-----	5.6	5.60	3.10	0.019
12103		204	5.0	5.5	5.25	2.80	0.016
12104		188	5.8	5.9	5.85	2.95	0.016

Location	Lake St. Claire. Ontario
Date	Jan. 1st, 1961

NSM#	Sex	FL(mm)	L	R	Mean	OH Mean	OW Mean
12098		144	-----	4.6	4.60	2.00	0.009
12099	F	224	6.3	6.4	6.35	3.30	0.021

Ratio FL/OL	Min. 31.30	Mean 34.89	Max. 38.86
Ratio OL/OH	Min. 1.80	Mean 1.95	Max. 2.30

Table 66

Species	***Stizostedion vitreum***	Eng: Walleye	Fr: Doré jaune
Location	Lake Superior. Ontario		
Date	Oct. 6, 1959		

NSM#	FL(mm)	OL (mm)			OH(mm)	OW(g)
		L	R	Mean	Mean	Mean
85068	457	11.0	10.6	10.80	4.00	0.057

Ratio FL/OL = 42.31
Ratio OL/OH = 2.70

Table 67

Species	***Aplodinotus grunniens***	Eng: Freshwater drum	Fr: Malachigan		
Location	Lake Erie, Ontario				

NSM#	Sex	FL(mm)	OL(mm)O L	R	Mean	OD(mm) Mean	OW(g) Mean
Date	April 29, 1959						
85069		381	15.2	15.0	15.15	14.55	0.965
Date	April 30, 1959						
11852	M	533	19.1	19.3	19.25	16.10	2.105
85070	M	483	14.5	14.6	14.55	13.80	1.323

Ratio FL/OL	Min. 25.15	Max. 33.20
Ratio OL/OH	Min. 1.04	Max. 1.20

Witt (1960) provides the following equation

FL(body, mm) = -70.3253 + 29.8974 OL(mm)
Log. OW = -3.1286 + 2.3534 log. FL(body length mm) N = 172

Priegel (1983) gives the following equation

FL(body, mm) = -37.77 + 28.26 OL N = 983

Table 68

Species	***Lumpenus lumpretaeformis***	Eng: Snakeblenny	Fr: Lompénie-serpent
Location	Grand Bank (Division 3L)		
Date	Aug. 26, 1957		

NSM#	FL(mm)	OL(mm) L	R	Mean	OH(mm) Mean	OW(g) Mean
85072	340	2.8	2.9	2.85	1.70	0.010

Ratio FL/OL = 119.30
Ratio OL/OH = 1.68

Table 69

Species	***Lumpenus maculatus***	Eng: Daubed shanny	Fr: Lompénie tachetée
Location	St. Mary's Bay, Newfoundland		
Date	Sep. 3rd, 1954		

NSM#	FL(mm)	OL(mm)			OH(mm)	OW(g)
		L	R	Mean	Mean	Mean
85071	270	2.6	2.6	2.60	1.50	0.045

Ratio FL/OL = 103.85
Ratio OL/OH = 1.73

Table 70

Species	***Anarhychas latifrons***	Eng: Northern wolffish	Fr: Loup à tête large
Location	Grand Bank (Division 3N)		
Date	Sep.19, 1957		

NSM#	Sex	FL(mm)	OL(mm)			OH(mm)	Mean
			L	R	Mean	Mean	Mean
85077	F	----	4.8	5.1	4.95	2.05	0.007

Ratio OL/OH = 2.41

Nijssen (1964) gives a table with fish length (cm), sex, age, and otolith length (mm) height (mm), and weight for five individuals

Table 71

Species *Anarhichas lupus* Eng: Atlantic wolffish Fr: Loup atlantique
Location Grand Bank (Division 3L)

NSM#	Sex	FL(mm)	OL(mm)			OH(mm)	OW(g)
			L	R	Mean	Mean	Mean
Date	Aug. 9, 1957						
11894	--	1,000	5.0	----	5.00.	2.80	0.015
Date	Aug. 12, 1958						
11893	F	890	5.0	5.2	5.10	2.50	0.013
Location	Grand Bank (Division 3K)						
Date	Aug. 19, 1957						
11889	F	400	3.0	3.0	3.00	2.00	0.005
11890	F	830	4.0	-----	4.00	-----	0.007
11891	F	920	4.6	4.7	4.65	2.30	0.012
11892	F	1,080	5.0	5.8	5.40	2.70	0.016
Location	Shoal Bay, N. S.						
Date	Jan. 14, 1999						
85001	F	624	4.5	4.6	4.55	2.15	0.007

Ratio FL/OL Min. 133.33 Max. 200.00
Ratio OL/OH Min. 1.50 Max. 2.12

Härkönen (1986) gave the following data:

OL/FL 1 : 110 - 1:160
OL/OH 1.50 -- 1/80

FL = -242.27 + 216.51 OL $r^2 = .903$
FW = 1.000 $OL^{5.595}$ r2 = .899

Nijssen (1964) gives a table with fish length (cm), sex, age, and otolith length (mm) height (mm), and weight for 11 specimens.

Table 72

Species	***Anarhichas minor***	Eng: Spotted wolffish	Fr: Loup tacheté
Location	Gran Bank (Division 3L)		
Date	Aug. 12, 1957		

NSM#	Sex	FL(mm)	OL(mm) L	OL(mm) R	OL(mm) Mean	OH(mm) Mean	OW(g) Mean
11888	F	960	6.5	6.6	6.55	4.30	0.033

Location Greenland Bank (Division 1B)
Date Sept. 14, 1957

NSM#	Sex	FL(mm)	OL(mm) L	OL(mm) R	OL(mm) Mean	OH(mm) Mean	OW(g) Mean
11886	F	530	3.3	3.3	3.30	1.80	0.005
11887	--	630	4.9	----	4.90	2.00	0.011
85073	F	520	3.3	3.4	3.35	1.65	0.009

Date Sept. 24, 1957

NSM#	Sex	FL(mm)	OL(mm) L	OL(mm) R	OL(mm) Mean	OH(mm) Mean	OW(g) Mean
85090	F	950	5.7	5.8	5.75	3.35	0.025
85091	M	1,210	6.0	6.2	6.10	3.70	0.042

Date Oct. 13, 1957

NSM#	Sex	FL(mm)	OL(mm) L	OL(mm) R	OL(mm) Mean	OH(mm) Mean	OW(g) Mean
85074	F	790	4.6	----	4.60	3.10	0.020
85075	F	100	4.8	----	4.80	3.70	0.024
85076	F	108	5.6	5.8	5.70	3.70	0.033

Location Shoal Bay, N. S.
Date Jan. 14, 1999

NSM#	Sex	FL(mm)	OL(mm) L	OL(mm) R	OL(mm) Mean	OH(mm) Mean	OW(g) Mean
85002		-----	4.8	4.5	4.65	------	-----

Sample statistics	FL(mm)	OL(mm)	OH(mm)	OW(g)
Count	9	9	9	9
Maximum	1210	6.55	4.30	0.042
Minimum	520	3.30	1.65	0.005
Mean	852.22	5.01	3.03	0.22
Stand. Deviation	247.58	1.15	0.971	0.012
Stand. Error of the Mean	82.53	0.382	0.324	0.004
Coefficient of Variation	29.05	1.311	32.02	55.39

Ratio FL/OL	Min.128.57	Mean 169.34	Max. 208.33
Ratio OL/OH	Min. 1.30	Mean 1.73	Max. 2.45

FL = -57.94 + 181.83 OL   r = .841 r^2 = 707

Regression and correlation coefficients

FL =-57.94 +181.83 OL   r = .841 r^2 = .707

Härkönen (1986) gave the following formulae

OL/FL	1 : 100 --- 1:150
OL/OH	1.5 --- 1.9

FL = -196.00 + 177.41 OL r^2 = .917

FW = 5.290 $OL^{4.08}$ r^2 = .986

Nijssen (1964) gives a table with fish length (cm), sex, age, and otolith length (mm), height (mm) and weight for 11 specimens.

Table 73

Species	***Ammodytes americanus***	Eng: American sand lance	Fr: Lançon d'Amérique
Location	Grand Bank (Division 3N)		
Date	Set**.** 15, 1957		

NSM#		FL(mm)	OL(mm)			OH (mm)	OW(g)
			L	R	Mean	Mean	Mean
85078	F	230	2.8	2.9	2.85	1.55	0.004
85079	F	280	3.2	---	3.20	1.80	0.004

Ratio FL/OL	Min. 80.70	Max. 85.50
Ratio OL/OH	Min. 1.78 –	Max. 1.84

Table 74

Species	***Scomber scombrus***	Eng: Atlantic mackerel	Fr: Maquereau bleu
Location	N.S. offshore waters		
Time	Nov. 20, 1997		

NSM#	Sex	FL(mm)	OL(mm) L	OL(mm) R	OL(mm) Mean	OH(mm) Mean	OW(g) Mean
12750		393	4.6	-----	4.60	1.60	-----

Location St. Margaret's Bay, N. S.
Date Aug. 6, 1998

NSM#	Sex	FL(mm)	OL(mm) L	OL(mm) R	OL(mm) Mean	OH(mm) Mean	OW(g) Mean
12806		242	----	2.1	2.10	1.00	----
12808		283	3.4	3.3	3.35	1.20	----
12810		306	3.9	----	3.90	1.20	----
12813		304	3.9	----	3.90	1.30	----
12814		310	-----	4.0	4.00	1.40	----
12815	F	392	4.6	----	4.60	1.50	----
12818		244	3.6	----	3.60	1.10	----
12821		319	----	3.7	3.70	1.40	----

Location Mahone Bay, N. S.
Time Sept. 26, 1998

NSM#	Sex	FL(mm)	OL(mm) L	OL(mm) R	OL(mm) Mean	OH(mm) Mean	OW(g) Mean
12757		288	3.5	3.4	3.45	1.20	0.001
12759		325	3.6	----	3.60	1.40	0.004

Sample statistics	FL(mm)	OL(mm)	OH(mm)
Count	11	11	11
Maximum	393	4.6	1.60
Minimum	242	2.1	1.00
Mean	309.64	3.71	1.30
Stand. Deviation	49.16	0.675	0.179
Stand. Error of the Mean	14.82	0.203	0.54
Coefficient of Variation	15.88	18.194	13.76

Ratio FL/OL	Min. 67.78	Mean 84.73	Max. 115.24
Ratio OL/OH	Min. 2.10	Mean 2.85	Max. 3.25

Regression and correlation coefficients

$FL = 85.35 + 60.47\ OL$ $r = .830$ $r^2 = .689$

Härkönen (1986) gives the following formulae

OL/FL	1:68 --- 1:93
OL/OH	2.50 --- 3.10

$FL = -20.41 + 87.59\ OL$ $r^2 = .906$

$FW = 1.094\ OL^{4.039}$ $r^2 = .897$

Table 75

Species	***Scophthalmus aquosus***	Eng: Windowpane	Fr: Turbot de sable
Location	Passamaquoddy Bay, N. B.		
Date	Sept. 13, 1974		

NSM#	FL(mm)	OL(mm)			OH(mm)	OW(g)
		L	R	Mean	Mean	Mean
85094	302	3.6	3.7	3.65	2.45	0.009
85095	243	4.0	4.0	4.00	2.85	0.013
Date	Sept. 8, 1980					
11847	327	4.0	----	4.00	2.50	0.013
85093	302	4.0	4.1	4.05	2.40	0.011

Ratio FL/OL	Min. 85.26	Max. 130.80
Ratio OL/OH	Min. 1.40	Max. 1.69

Table 76

Species	***Hippoglossoides platessoides***	Eng: American plaice	Fr: Plie canadienne
Location	Passamaquoddy Bay, N. B.		
Date	Sept. 13, 1971		

NSM#		FL(mm)	OL(mm)			OH(mm)	OW(g)
			L	R	Mean	Mean	Mean
85096		222	---	---	2.65	2.20	0.004
85097		175	---	---	2.40	1.65	0.003
85098		268	---	---	5.25	3.30	0.015
85099		280	---	---	5.00	4.00	0.024

Location Shoal Bay, N. S.
Date Jan. 14, 1979

12852	M	436	7.3	7.3	7.30	5.65	0.069
12853	F	441	7.6	7.2	7.40	5.65	0.064

Location St. Margaret's Bay, N. S.
Date Aug. 21st, 1998

12792	F	410	6.7	6.7	6.70	5.60	0.060
12793		414	7.6	7.9	7.75	5.15	0.069

Location Offshore waters of N. S.
Date Nov. 20, 1998

12828	F	312	6.9	6.8	6.85	4.85	0.049

Location Bay of Fundy
Date Dec. 1st, 1998

12843		336	7.3	7.2	7.25	4.95 1.	0.057
12844		385	5.8	5.8	5.80	4.60	0.044

Ratio FL/OL	Min. 45.55	Mean 59.63	Max. 83.77
Ratio OL/OH	Min. 1.20	Mean 1.44	Max. 1.97

Harkönen (1986) gives the following values and regressions

OL/FL 1:38 --- 1:50
OL/OH 1.10 --- 1.50

FL = -24.52 + 48.35 OL r^2 = .966
FW = 0.166 $OL^{3.788}$

Table 77

Species: ***Hippoglossus hippoglossus*** Eng: Atlantic halibut Fr: Flétan atlantique

Location Grand Bank (Division 3N)
Date Aug. 22nd, 1957

NSM#	Sex	TL(mm)	OL(mm)			OH(mm)	OW(g)
			L	R	Mean	Mean	Mean
11883		980	11.7	12.4	12.05	8.10	0.183
11884		760	10.0	10.7	10.35	6.40	0.102
11885		820	11.7	12.3	12.00	6.80	0.105

Date Sept. 21st, 1957

NSM#	Sex	TL(mm)	L	R	OL Mean	OH Mean	OW Mean
85109	M	800	11.1	11.3	11.20	6.25	0.129
85110	M	840	11.2	10.8	11.00	6.10	0.108
85111	M	950	-----	----	12.00	7.30	0.174
85112	F	960	12.3	12.6	12.45	7.70	0.165
85113	M	980	14.2	13.9	14.05	7.90	0.191
85114	F	1,670	14.8	15.0	14.90	9.95	0.333
85115	F	1,770	12.2	13.9	13.05	9.60	0.282

Location Grand Bank (Division 3L)
Date Aug. 13, 1957

NSM#	Sex	TL(mm)	L	R	OL Mean	OH Mean	OW Mean
85116	F	1,400	14.6	15.9	15.25	9.00	0.371

Location Greenland (Division 1B)
Date Sept. 1957

NSM#	Sex	TL(mm)	L	R	OL Mean	OH Mean	OW Mean
85100	F	610	-----	10.4	10.50	5.20	0.085
85101	F	690	10.0	-----	10.30	6.10	0.101
85102	F	810	-----	11.0	11.00	6.40	0.117
85103	F	810	11.0	11.5	11.25	7.00	0.195
85104	F	810	-----	-----	11.70	7.30	0.143
85105	M	820	-----	12.6	12.90	6.50	0.128
85106	F	970	12.4	13.0	12.70	7.65	0.194
85107	F	1,010	-----	13.3	13.60	8.55	0.191

Location Greenland (Division 1J)
Date Sept. 20, 1957

NSM#	Sex	TL(mm)	L	R	OL Mean	OH Mean	OW Mean
85108	F	900	11.8	12.8	12.20	6.85	0.148

Location	Offshore waters of N. S.
Date	Unknown

11529	-----	10.3	10.5	10.40	6.05	0.105

Ratio FL/OL	Min. 58.10	Mean 78.45	Max. 135.63
Ratio OL/OH	Min. 1.36	Mean 1.68	Max. 2.00

Sample statistics	FL(mm)	OL(mm)	OH(mm)	OW(g)
Count	19	19	19	19
Maximum	1,770	15.25	9.95	0.371
Minimum	610	10.30	5.20	0.085
Mean	971.58	12.22	7.36	0.174
Stand. Deviation	310.63	1.46	1.27	0.079
Stand. Error of the Mean	71.26	0.34	0.291	0.018
Coefficient of Variation	31.97	11.97	17.24	45.71

Regression and correlation coefficients

$FL = -982.72 + 159.88\ OL$ $\quad r = .753 \quad r^2 = .567$

Harkönen (1986) gives the following values and regressions

OL/FL	1:50 --- 1:60
OL/OH	1.60 --- 2.10

$FL = -413.93 + 105.79\ OL$ $\quad r^2 = .949$

$FW = 0.01867\ OL^{5.056}$ $\quad r^2 = .929$

Table 78

Species *Reinhardtius hippoglossoides* Eng: Greenland halibut Fr: Flétan de Groenland

Location Grand Bank (Division 3L)
Date Aug. 12, 1957

NSM#	Sex	FL(mm)	OL(mm)			OH(mm)	OW(g)
			L	R	Mean	Mean	Mean
11861	F	450	8.3	9.5	8.90	6.15	0.046

Ratio FL/OL = 50.56
Ratio OL/OH = 1.45

Härkönen (1986) gives the following values and regressions

OL/FL 1:40 --- 1:74
OL/OH 1.00 --- 1.50
.

$FL = 39.454\ OL^{1.142}$ (Power function) r^2 = .982
$FW = 0.2748\ OL^{3.717}$ r^2 = .978

Table 79

Species *Glyptocephalus cynoglossus* Eng: Witch flounder Fr: Plie frise

Location Grand Bank (Division 3L)
Date April 13, 1955

NSM#	FL(mm)	OL(mm) L	OL(mm) R	OL(mm) Mean	OH(mm) Mean	OW(g) Mean
11899	630	8.2	8.3	8.25	6.65	0.155
85125	470	7.1	7.4	7.25	5.80	0.090
85126	550	7.0	7.6	7.30	6.90	0.108
85127	570	8.2	8.8	8.50	6.20	0.098
85128	590	9.3	9.6	9.45	7.05	0.210

Location Offshore N. S. waters
Date Nov. 20, 1998

NSM#	FL(mm)	OL(mm) L	OL(mm) R	OL(mm) Mean	OH(mm) Mean	OW(g) Mean
12826	403	6.8	6.1	6.45	5.10	0.054
12827	354	5.8	5.9	5.85	5.45	0.042

Ratio FL/OL Min. 60.50 Max. 75.34
Ratio OL//OH Min. 1.06 Max. 1.37

Härkönen (1986) gives the following values and regressions

OL/FL 1:38 --- 1:73
OL/OH 1.10 --- 1.50
.

FL = -100.65 + 78.29 OL r^2 = .894
FW = 0.0770 $OL^{4.633}$ r^2 = .927

Table 80

Species	***Limanda ferruginea***	Eng: Yellowtail flounder	Fr: Limande à queu jaune

Location Grand Bank (Division 3N)
Date July, 1954

NSM#	Sex	FL(mm)	OL(mm) L	OL(mm) R	OL(mm) Mean	OH(mm) Mean	OW(g) Mean
85124	M	420	5.8	5.6	5.75	4.60	0.045

Date Sept. 1st, 1957

NSM#	Sex	FL(mm)	OL(mm) L	OL(mm) R	OL(mm) Mean	OH(mm) Mean	OW(g) Mean
11859	F	400	5.9	6.0	5.95	4.45	0.041
11860	F	470	6.9	7.0	6.85	5.20	0.060

Date Sept. 9, 1957

NSM#	Sex	FL(mm)	OL(mm) L	OL(mm) R	OL(mm) Mean	OH(mm) Mean	OW(g) Mean
85117	F	150	2.7	2.8	2.75	2.25	0.007
85118	M	290	4.8	5.0	4.90	3.30	0.023
85119	---	330	4.6	4.6	4.60	3.55	0.021
85120	F	400	5.4	5.7	5.55	4.95	0.054
85121	F	410	6.9	-----	6.00	5.00	0.062
85122	M	420	5.6	5.7	5.65	4.30	0.044
85123	F	430	5.5	6.0	5.75	4.25	0.033

Sample statistics	FL(mm)	OL(mm)	OH(mm)	OW(g)
Count	10	10	10	10
Maximum	470	6.85	5.20	0.062
Minimum	150	2.75	2.25	0.007
Mean	372.00	5.38	4.19	0.039
Stand. Deviation	93.31	1.106	0.911	0.018
Stand. Error of the Mean	29.51	0.35	0.288	0.006
Coefficient of Variation	25.08	20.57	21.77	46.03

Ratio FL/OL	Min. 54.55	Mean 68.39	Max. 74.78
Ratio OL/OH	Min. 1.12	Mean 1.29	Max. 1.48

Regression and correlation coefficients

FL = -66.013 + 81.49 OL $\quad$ r = .996 $\quad$ r^2 = .932

Table 82

Species *Gadus morhua* Eng: Atlantic cod Fr: Morue franche

Place 3 - 4 miles South of Prospect Bay (Halifax. Co.) N. S.
Dates 5, 9, 12, 40 August and 1st, September 1982

#	Sex	FL(mm)	FW (g)	OL (mm) Mean	OW (g) Mean
1	M	540	1,474	16.45	0.3474
2	M	740	3,942	18.95	0.6460
3	F	390	635	13.50	0.1960
4	F	425	780	13.65	0.1849
5	F	448	839	13.90	0.2238
6	F	514	1,148	15.90	0.3504
7	F	367	454	12.20	0.1656
8	F	445	907	13.85	0.2467
9	M	405	680	12.90	0.1796
10	M	390	680	11.80	0.1721
11	M	590	1,814	16.40	0.4057
12	M	645	2,472	12.05	0.4567
13	M	630	2,041	11.75	0.3743
14	F	585	1,901	12.15	0.4272
15	M	495	1,047	16.90	0.3401
16	F	475	966	14.15	0.3059
17	F	460	907	14.20	0.2335
18	F	571	1,674	15.80	0.3679
19	F	558	1,560	16.55	0.3782
20	F	631	2,381	15.05	0.4171
21	M	629	2,409	17.85	0.4325
22	M	596	1,288	14.75	0.2964
23	M	559	1,601	16.20	0.3644
24	F	436	816	13.70	0.2321
25	M	510	1,275	15.05	0.2999
26	F	500	1,769	15.25	0.2973
27	F	508	1,220	15.45	0.3601
28	F	470	1,107	14.00	0.2410
29	M	464	1,047	15.30	0.2736
30	F	500	1,134	15.20	0.2784
31	M	465	994	15.35	0.3264
32	F	478	966	14.35	0.2695
33	M	443	748	15.05	0.2660
34	F	505	1,134	14.85	0.2821
35	F	430	821	13.55	0.2325

36	M	395	540	12.25	0.1656
37	M	374	567	12.90	0.1732
38	M	364	540	13.75	0.1938
39	F	550	1,529	16.10	0.4071
40	F	500	1,193	15.30	0.2995
41	F	563	1,647	16.60	0.3623
42	F	470	966	14.60	0.2415
43	F	514	1,193	16.80	0.2994
44	F	520	1,110	14.70	0.2820
45	F	505	1,207	14.90	0.2845
46	M	490	1,157	15.45	0.2923
47	M	420	739	13.40	0.1768
48	M	645	2,222	18.25	0.4523
49	M	455	907	15.10	0.2513
50	F	570	1,647	16.15	0.3410
51	F	427	907	13.04	0.2434
52	F	462	870	13.95	0.2245
53	M	615	2,182	17.05	0.4561
54	M	514	1,361	15.00	0.3039
55	M	539	1,259	16.05	0.3438
56	F	730	2,948	19.00	0.4697
57	F	591	1,728	15.30	0.3166
58	F	638	2,214	14.85	0.3246
59	M	835	4,903	19.65	0.7082
60	F	1,122	12,500	23.55	0.6250
61	F	574	1,701	14.65	0.2718
62	F	540	1,542	15.50	0.3262
63	F	1,000	9,662	18.75	0.6386
64	M	510	1,193	15.75	0.2875
65	M	505	1,474	14.90	0.2827
66	F	496	1,320	16.00	0.3048
67	F	508	1,220	14.20	0.2951
68	F	476	1,048	15.50	0.3081
69	M	510	1,193	14.30	0.3267
70	M	488	1,134	14.85	0.3013
71	F	490	1,075	16.40	0.3260
72	F	442	780	14.25	0.2289
73	M	515	1,247	14.75	0.3031
74	M	487	980	13.85	0.2567
75	F	397	680	14.55	0.2455
76	M	375	540	13.35	0.1608
77	F	530	1,560	15.50	0.3224

78	M	526	1,528	15.95	0.3149
79	F	563	1,615	15.50	0.3295
80	F	575	2,100	16.95	0.4084
81	M	540	1,107	15.35	0.3260
82	F	488	1,202	15.15	0.3043
83	F	500	1,220	15.30	0.2977
84	M	494	1,220	14.05	0.2454
85	F	482	1,021	13.10	0.2313
86	F	1,026	10,945	20.90	0.9446
87	M	692	3,062	17.30	0.4657
88	F	831	5,543	20.50	0.7633
89	M	820	6,464	18.45	0.4713
90	F	859	5,842	20.10	0.7070
91	M	702	3,402	16.35	0.4897
92	M	740	4,055	17.70	0.6729
93	F	660	2,649	14.70	0.3978
94	M	609	2,409	16.50	0.3811
95	M	601	1,928	16.80	0.4245
96	F	589	1,447	15.85	0.3721
97	F	479	1,275	16.65	0.3465
98	M	544	1,814	13.95	0.3093
99	M	600	1,887	16.55	0.4036
100	M	510	1,588	13.95	0.2710
101	M	515	1,134	14.85	0.3015
102	F	418	794	13.75	0.2061
103	F	441	1,247	14.10	0.2394
104	F	446	907	14.00	0.2321
105	M	480	1,048	15.85	0.2326
106	F	410	658	13.95	0.2102

Sample statistics	FL(mm)	FW (g)	OL(mm)	OW(g)
Count	106	106	106	106
Maximum	1,122	12,500	23.55	0.945
Minimum	364	454	11.71	0.161
Mean	543.28	1,831.39	15.37	0.340
Stand. deviation	133.91	1,913.79	1.98	0.14
Stand. error of the mean	13.01	185.89	0.19	0.13
Coefficient of variation	24.65	104.5	12.90	40.29

Ratio OL/FL Min. 26.47 Mean 35.10 Max. 55.62

Regressions and correlation coefficients

FL = -301.603 + 54.957 OL	r = .814	r^2 = .662
Log FW = -1.496 + 3.927 log OL	r = .773	r^2 = .598
Log FW = 3.984 + 1.657 log OW	r = .923	r^2 = .851

Table 83

Species *Merluccius bilinearis* Eng: Silver hake Fr: Merlu argenté

Place Chebucto Head (Off Halifax)
Date Dec. 3rd, 1974

NSM#	Sex	FL (mm)	OL (mm) Left	OL (mm) Right	OL (mm) Mean	OW (g) Mean
1	F	365	17.6	-----	17.60	0.1337
2	M	357	18.3	18.2	18.25	0.1485
3	F	349	16.6	16.7	16.65	0.1079
4	F	357	15.9	16.0	15.95	0.1060
5	F	361	17.3	17.3	17.30	0.1479
85166	M	345	16.2	16.2	16.20	0.1164
85167	F	397	18.5		18.50	0.1712
85168	F	294	15.2	15.2	15.20	0.1036
85169	F	362	17.2	17.1	17.15	0.1120
85170	F	372	17.9	18.1	18.00	0.1272
85171	F	407	19.1	19.1	19.10	0.1114
85172	F	344	16.4	16.4	16.40	0.1199
85173	F	344	16.1	16.0	16.05	0.1037
85174	M	327	16.0	15.8	15.90	0.1099
85175	M	329	---	16.4	16.40	0.1183
85176	F	342	17.2	17.2	17.20	0.1242
85177	F	385	18.1	18.1	18.10	0.1440
85178	F	525	25.2	25.0	25.10	0.2463
85179	F	448	22.3	21.9	22.10	0.1924
85180	F	373	17.8	17.8	17.80	0.1401
85181	F	348	16.3	16.4	16.35	0.1047
85182	M	383	18.3	18.5	18.40	0.1433
85183	F	375	17.6	17.8	17.70	0.1200
85184	F	364	17.7	17.3	17.50	0.1243
85185	F	365	17.9	18.0	17.85	0.1238
85186	F	354	16.6	16.7	16.65	0.1156

85187	F	364	---	17.1	17.10	0.1225
85188	F	336	15.8	16.1	15.95	0.0988
85189	F	567	25.0	---	25.00	0.2295
85190	F	498	23.2	23.1	23.15	0.2025
85191	F	368	---	17.4	17.40	0.1204
85192	F	354	16.5	16.4	16.45	0.1142
95193	F	333	17.2	17.0	17.10	0.1098
85194	F	364	16.3	16.5	16.40	0.1131
85195	F	381	19.0	19.0	19.00	0.1630
85196	F	348	17.2	17.2	17.20	0.1166
85197	F	403	19.2	19.6	19.40	0.1375
85198	F	357	---	16.3	16.3	0.0999
85199	F	342	16.3	16.3	16.3	0.1185
85200	F	396	18.1	18.1	18.1	0.1390
85201	F	373	18.8	18.8	18.80	0.1319
85202	--	354	18.2	18.1	18.15	0.1222
85203	F	367	16.8	16.9	16.85	0.1062
85204	F	340	15.7	15.8	15.75	0.1030
85205	F	372	18.9	19.1	19.00	0.1027
85206	--	352	18.1	17.8	17.95	0.1260
85207	M	318	15.0	15.0	15.00	0.0949
85208	--	301	14.5	-----	14.50	0.0906
85209	F	470	23.4	-----	23.40	-----
85210	F	398	19.1	19.1	19.10	0.1597
11910		448	22.3	21.9	22.10	0.1924

Place Offshore waters of N. S.
Date

11559	24.1	24.6	24.35	0.234

Sample statistics	FL(mm)	OL(mm)	OW(g)
Count	50	50	50
Maximum	567	25.1	0.25
Minimum	294	14.5	0.09
Mean	372.19	17.86	0.13
Stand. Deviation	50.96	2.31	0.03
Stand. Error of the mean	6.02	12.93	0.001
Coefficient of Variation	11.54	12.93	26.15

Ratio FL/OL Min. 19.34 Mean 20.86 Max. 22.19

Regression and correlation coefficients

FL = -5.401 + 21.01 OL r = .959 r^2 = .919

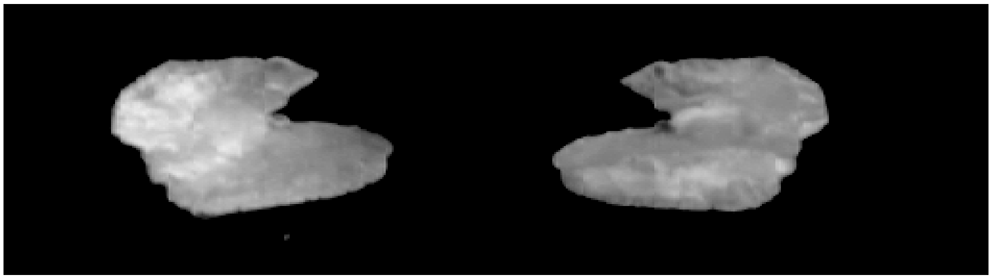
APPENDIX II

The following 62 tables present graphic, taxonomic, and morphometric information about the otoliths in the collection of the Nova Scotia Museum of Natural History. Table numbers correspond to those of tables in Appendix I.

Sections A to D give information on the shape and features of the otolith of each species. Section E, dealing with ratios, provide a feeling of the relationships of the otolith length with that of the fish and with its own width. The data provided here can be supplemented with information given on the tables of Appendix I.

In most cases, the pictures presented on each table represent both otoliths from the same fish. The picture on the left shows the lateral (outer) side of the left otolith, while the right picture represent the medial (inner) side of the right otolith. Both otoliths are oriented with their anterior end towards the fish head, i.e. to the left of the reader. When there was only one otolith available, its both sides were scanned. If it was the left otolith, as in Table 7, the left image is oriented as mentioned above, but the right image is oriented towards the right. On the contrary, if only the right otolith was used, as in Table 1, both images are facing each other; then, the right image only is oriented towards the fish head.

Since otoliths increase their size and change their shape from juvenile to adulthood, otoliths of a medium size fish in each sample were used to avoid extreme features. For cod, an important fish in modern and earlier cultures of the Atlantic region, three pairs of otoliths have been chosen to give some idea of their variability.



Species: *Alosa aestivalis* **Family:** Clupeidae
Eng. name: Blueback herring **Fr. name:** Alose d'été
NSM#: 12721 **Table 1** **FL (mm) = 295** **OL (mm)$_x$ = 3.15 (1)**

OTOLITH MORPHOLOGY

A. GENERAL FEATURES
Shape: two-pronged
Relative size: small**,** thin, fragile

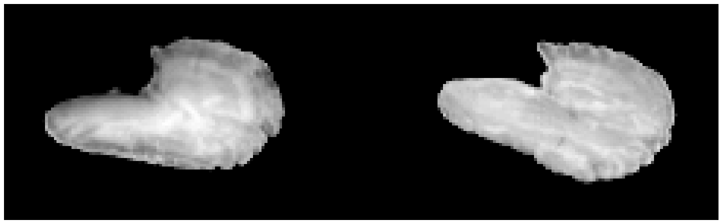
B. MARGINS
Dorsal: slightly convex
Ventral: mostly linear

C. ROSTRA
Rostrum: massive, round, more than 1/3 of OL length
Antirostrum: prominent, pointed
Pararostrum:small, pointed
Postrostrum: absent
Rostrum/antirostrum angle: ~ 45^o

D. SCULPTURES
Sulcus: deep
Ostium: open
Cauda: shallow, closed

E. RATIOS [F=fish; O=otolith; L=total length; H=height or width]
FL/OL = 87.08 – 93.65 **N = 2** **OL/OH = 2.60** **N = 1**

(1) Right otolith used for both pictures



Species: *Alosa pseudoharengus* **Family:** Clupeidae
Eng. name: Alewife **Fr. name:** Gaspereau
NSM#: 12800 **Table 2** **FL (mm) = 259** **OL (mm)$_x$ = 2.75**

OTOLITH MORPHOLOGY

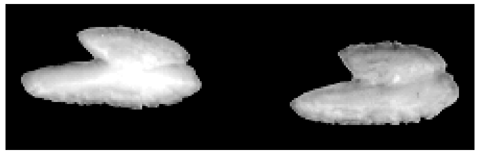
A. GENERAL FEATURES
Shape: two-pronged
Relative size: small**;** thin, fragile

C. MARGINS
Dorsal: convex scalloped
Ventral: almost linear

C. ROSTRA
Rostrum: massive, round, more than 1/2 OL length
Antirostrum: short pinted
Pararostrum: absent
Postrostrum: absent
Rostrum/antirostrum angle: ~ 90^o

F. SCULPTURES
Sulcus: long
Ostium: open
Cauda: closed

G. RATIOS [F=fish; O=otolith; L=total length; H=height or width]
FL/OL = 65 – 94.18 **N = 8** **OL/OH = 1.5 – 2 07** **N** = 8



Species: *Clupea harengus* **Family:** Clupeidae
Eng. name: Herring **Fr. name:** Hareng atlantique
NSM#: 12785 Table 3 FL (mm) = 247 OL (mm)$_x$ = 3.95

OTOLITH MORPHOLOGY

A. GENERAL FEATURES
Shape: elongate, two-prong
Relative size: medium**;** thin, fragile

D. MARGINS
Dorsal: slightly convex, small crenulations
Ventral: almost linear, small crenulations

C. ROSTRA
Rostrum: massive, round, more than 1/3 OL length
Antirostrum: long, pointed
Pararostrum: insinuated, small
Postrostrum: massive, round
Rostrum/antirostrum angle: > 45°

H. SCULPTURES
Sulcus: deep, long
Ostium: open
Cauda: closed

I. RATIOS [F=fish; O=otolith; L=total length; H=height or width]
FL/OL = 49.70 – 66.88 N = 13 OL/OH = 1.90 – 2.60 N = 13

Species: *Dorosoma cepedianum* **Family:** Clupeidae
Eng. name: Gizzard shad **Fr. name:** Alose à gésier
NSM#: 85011 **Table 4** **FL (mm) = 330** **OL (mm)$_x$ = 5.70 (1)**

OTOLITH MORPHOLOGY

A. GENERAL FEATURES
Shape: two-pronged, elongated
Relative size: medium**;** thin, fragile

E. MARGINS
Dorsal: slightly convex, small crenulations
Ventral: mostly linear

C. ROSTRA
Rostrum: massive, round, around 1/3 of OL length
Antirostrum: pointed, prominent
Pararostrum: round, wide arched
Postrostrum: round, small
Rostrum/antirostrum angle: < 45º

J. SCULPTURES
Sulcus: wide, deep, long
Ostium: open, narrow
Cauda: closed

K. RATIOS [F=fish; O=otolith; L=total length; H=height or width]
FL/OL = 57.89 **N = 1** **OL/OH = 2.28** **N = 1**

(1) Right otolith used for both pictures

Species: *Anguilla rostrata* **Family:** Anguillidae
Eng. name: : American eel **Fr. name:** Anguille d'Amérique
NSM#: 12832 **Table 5** **FL (mm) = 394** **OL (mm)$_x$ = 2.65**

OTOLITH MORPHOLOGY

A. GENERAL FEATURES

Shape: oblong
Relative size: small**;** medium thickness

F. MARGINS

Dorsal: convex
Ventral: mostly linear

C. ROSTRA

Rostrum: round, massive
Antirostrum: small, round
Pararostrum: small or insinuated, round
Postrostrum: small

L. SCULPTURES

Sulcus: wide
Ostium: open
Cauda: closed

M. RATIOS [F=fish; O=otolith; L=total length; H=height or width]

FL/OL = 133 - 168 **N = 10** **OL/OH = 1.22 – 1.96** **N** = 10

Species: *Esox lucius* **Family:** Esocidae
Eng. name: Northern pike **Fr. name:** Grand brochet
NSM#: 85024 Table 6 FL (mm) = 838 OL (mm)$_x$ = 10.15

OTOLITH MORPHOLOGY

A. GENERAL FEATURES
Shape: arrow-like
Relative size: medium**,** thick in the center, margins thin
:

G. MARGINS
Dorsal: convex, with large lobes
Ventral: curved, crenulations of various sizes

C. ROSTRA
Rostrum: long, pointed, more than 1/3 OL length
Antirostrum: small, round
Pararostrum: round, distinct
Postrostrum: distinct
Rostrum/antirostrum angle: acute and deep

N. SCULPTURES
Sulcus: deep. wide
Ostium: open
Cauda: open

O. RATIOS [F=fish; O=otolith; L=total length; H=height or width]
FL/OL = 73.71 – 82.56 N = 3 OL/OH = 1.93 – 2.16 N = 3

Species: *Umbra limi* **Family:** Umbridae
Eng. name: Central mudminnow **Fr. name:** Umbre de vase
NSM#: 85026 **Table 7** **FL (mm) = 88** **OL (mm)$_x$ = 2.20 (1)**

OTOLITH MORPHOLOGY

A. GENERAL FEATURES
Shape: arrow-like
Relative size: medium**;** thin
:

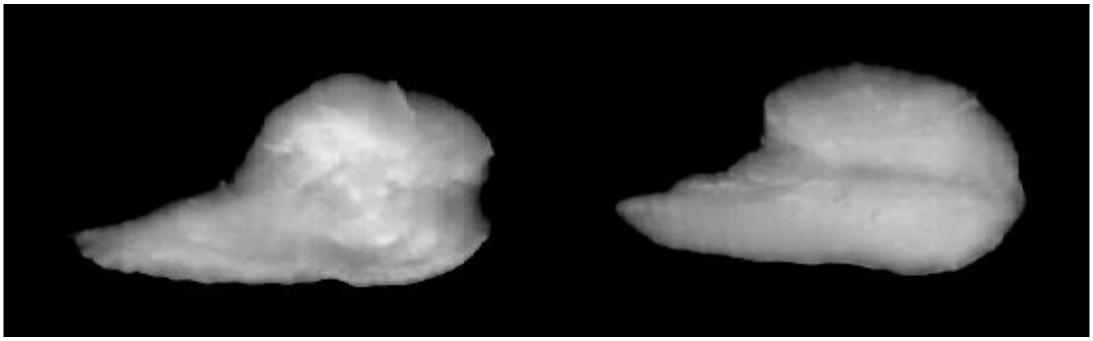
H. MARGINS
Dorsal: highly domed, irregularly lobate
Ventral: straight

C. ROSTRA
Rostrum: long, round
Antirostrum: absent
Pararostrum: absent
Postrostrum: insinuated

INENR SURFACE
Sulcus: long
Ostium: open
Cauda: open

P. RATIOS [F=fish; O=otolith; L=total length; H=height or width]
FL/OL = 40.00 **N = 1** **OL/OH = 1.83** **N = 1**

(1) Left otolith used for both pictures



Species: *Coregonus hoyi* **Family:** Salmonidae
Eng. name: Bloater **Fr. name:** Corégone d'Hoy
NSM#: 85013 **Table 8** **FL (mm) = 305** **OL (mm)$_x$ = 6.95**

OTOLITH MORPHOLOGY

A. GENERAL FEATURES
Shape: almond-shaped
Relative size: medium**;** body relatively thick

I. MARGINS

Dorsal: convex, smooth
Ventral: almost rectilinear, small indentations

C. ROSTRA
Rostrum: long, pointed
Antirostrum: absent
Pararostrum: insinuated
Postrostrum: insinuated

Q. SCULPTURES
Sulcus: long
Ostium: open, wide
Cauda: open

R. RATIOS [F=fish; O=otolith; L=total length; H=height or width]
FL/OL = 43.88 **N = 2** **OL/OH = 1.93 – 1.96** **N = 2**

Species: *Onchorhynchus mykiss* **Family:** Salmonidae
Eng. name: Rainbow trout **Fr. name:** Truite arc-en-ciel
NSM#: 12496 **Table 9** **FL (mm) = 332** **OL (mm)$_x$ = 3.20 (1)**

OTOLITH MORPHOLOGY

A. GENERAL FEATURES
Shape: almond-like
Relative size: small; thick in the centre

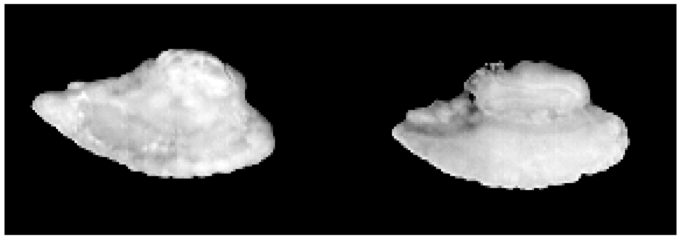
J. MARGINS
Dorsal: convex with irregular lobes
Ventral: amply arched, rather smooth

C. ROSTRA
Rostrum: pointed, short
Antirostrum: absent
Pararostrum: insinuated
Postrostrum: insinuated

S. SCULPTURES
Sulcus: narrow, long
Ostium: open
Cauda: open

T. RATIOS [F=fish; O=otolith; L=total length; H=height or width]
FL/OL = 90 – 103.75 **N = 2** **OL/OH = 1.43 – 1.5** **N = 2**

(1) Left otolith used for both pictures



Species: *Salmo salar* **Family:**
Eng. name: Atlantic salmon **Fr. name:** Saumon atlantique
NSM#: 12499 **Table 10** **FL (mm) = 475** **OL (mm)$_x$ = 4.45**

OTOLITH MORPHOLOGY

A. GENERAL FEATURES

Shape: almond-like
Relative size: small**;** posterior part thick

K. MARGINS

Dorsal: convex, elevated, irregularly lobate or smooth
Ventral: arched, scalloped

C. ROSTRA

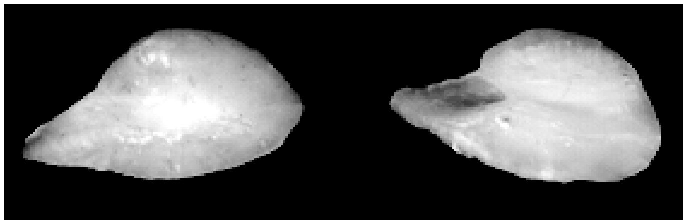
Rostrum: robust, long, pointed
Antirostrum: small
Pararostrum: insinuated, round
Postrostrum: round

U. SCULPTURES

Sulcus: short, deep
Ostium: open, wide
Cauda: open

V. RATIOS [F=fish; O=otolith; L=total length; H=height or width]

FL/OL = 105.12 – 137.14 N = 3 **OL/OH = 1.76 – 1.98 N = 3**



Species: *Salvelinus namaycush* **Family:** Salmonidae
Eng. name: Lake trout **Fr. name:** Truite de lac
NSM#: 12305 **Table 12** **FL (mm) = 511** **OL (mm)$_x$ = 4.95**

OTOLITH MORPHOLOGY

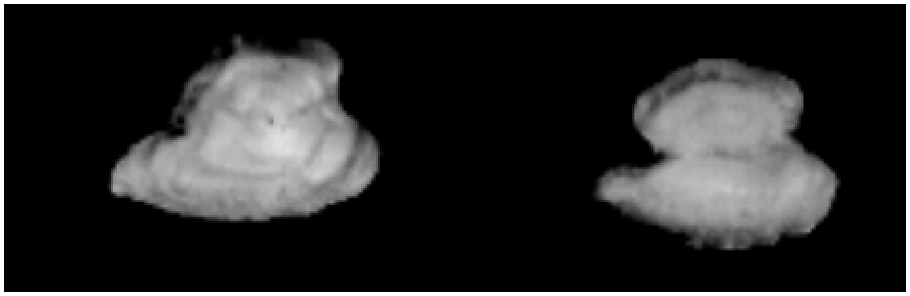
A. GENERAL FEATURES
Shape: almond-like
Relative size: small**;** anterior part thick

L. MARGINS
Dorsal: convex, irregularly lobate or smooth
Ventral: arched, scalloped

C. ROSTRA
Rostrum: thick, pointed
Antirostrum: insinuated
Pararostrum: absent
Postrostrum: absent

W. SCULPTURES
Sulcus: short, deep
Ostium: open, wide
Cauda: open

X. RATIOS [F=fish; O=otolith; L=total length; H=height or width]
FL/OL = 94 -106.56 **N = 31** **OL/OH = 1.50 – 2.20** **N = 31**



Species: *Salvelinus fontinalis* **Family:** Salmonidae
Eng. name: Brook trout **Fr. name:** Omble de fontaine
NSM#: 12794 **Table 17** **FL (mm) = 330** **OL (mm)$_x$ = 3.00**

OTOLITH MORPHOLOGY

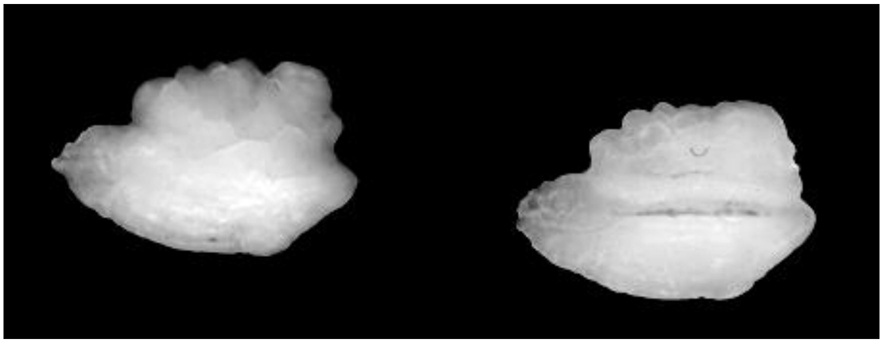
A. GENERAL FEATURES
Shape: almond-like
Relative size: small**;** thick

M. MARGINS
Dorsal: convex
Ventral: slightly arched, lobulate

C. ROSTRA
Rostrum: massive, pointed, round
Antirostrum: short, insinuated
Pararostrum: round
Postrostrum: round, slightly pointed
Rostrum/antirostrum angle : ~ 45°

Y. SCULPTURES
Sulcus: short
Ostium: open, wide
Cauda: open, wide

Z. RATIOS [F=fish; O=otolith; L=total length; H=height or width]
FL/OL = 72.2 - 110 **N = 11** **OL/OH = 1.5 – 1.8** **N =11**



Species: *Osmerus mordax* **Family:** Osmeridae
Eng. name: Rainbow smelt **Fr. name:** Éperlan d'Amérique
NSM#: 12849 **Table 18.** **FL (mm) = 256** **OL (mm)$_x$ = 6.55**

OTOLITH MORPHOLOGY

A. GENERAL FEATURES

Shape: almond-like
Relative size: medium, large**;** medium thickness

N. MARGINS

Dorsal: convex, deep and irregular crenulations
Ventral: arched, almost smooth

C. ROSTRA

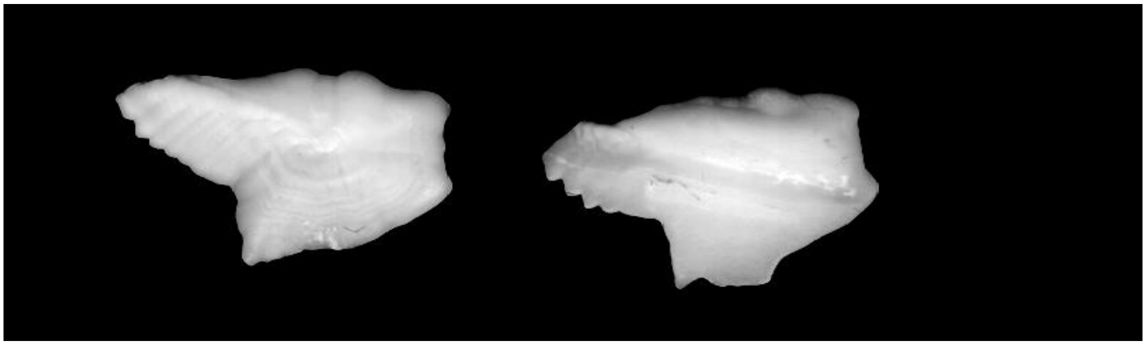
Rostrum: massive, pointed, ~ 1/3 OL length
Antirostrum: insinuated
Pararostrum: absent
Postrostrum: prominent, round

AA. SCULPTURES

Sulcus: deep
Ostium: open, wide
Cauda: open

BB. RATIOS [F=fish; O=otolith; L=total length; H=height or width]

FL/OL = 20.91 – 45.08 **N = 14** **OL/OH = 1.37 – 1.77** **N = 14**



Species: *Argentina silus* **Family:** Argentinidae
Eng. name: Atlantic argentine **Fr. name:** Grande argentine
NSM#: 11933 **Table 19** **FL (mm) = 450** **OL (mm)$_x$ = 10.50**

OTOLITH MORPHOLOGY

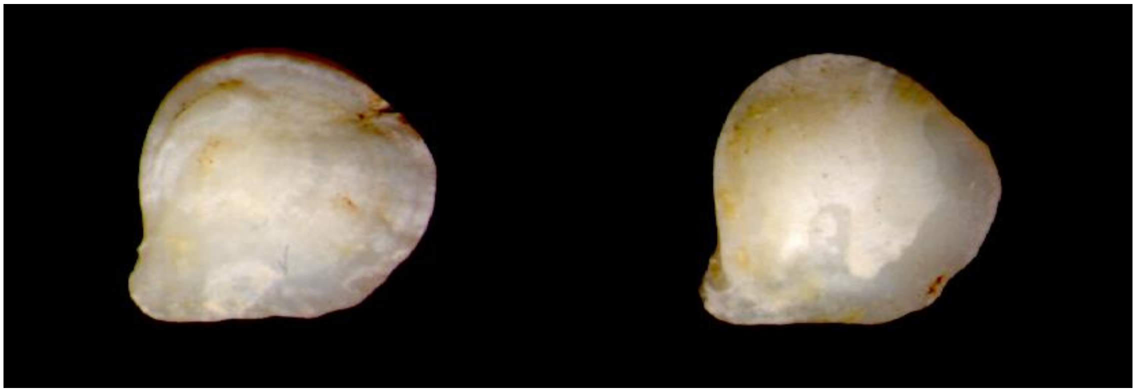
A. GENERAL FEATURES
Shape: arrowhead-like
Relative size: large**;** thick

O. MARGINS
Dorsal: almost straight, lobate
Ventral: with a large keel-like expansion

C. ROSTRA
Rostrum: massive, lower margin lobate, pointed, ~ 1/3 OL length
Antirostrum: absent or pointed
Pararostrum: pointed
Postrostrum: absent

CC. SCULPTURES
Sulcus: long, deep
Ostium: open, wide and long
Cauda: open

DD. RATIOS [F=fish; O=otolith; L=total length; H=height or width]
FL/OL = 36 - 45 **N = 24** **OL/OH = 1.45 – 1.91** **N = 24**



Species: *Arius sp.* **Family:** Ariidae
Eng. name: Sea catfish **Fr. name:**
NSM#: 12404 **Table 20** **FL (mm) = N/A** **OL (mm)$_x$ = 9.10**

OTOLITH MORPHOLOGY

A. GENERAL FEATURES

Shape: rectangular with round corners; small spur in front
Relative size: N/A; thick**,** bulbous

P. MARGINS

Dorsal: convex
Ventral: slightly arched

C. ROSTRA

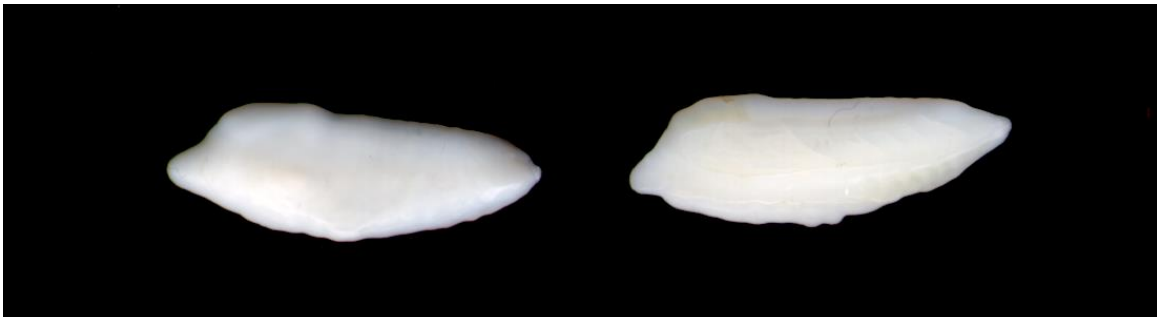
Rostrum: small, protruding
Antirostrum: absent
Pararostrum: absent
Postrostrum: absent

EE. SCULPTURES

Sulcus: curved
Ostium: open
Cauda: closed

FF. RATIOS [F=fish; O=otolith; L=total length; H=height or width]

FL/OL = N/A **OL/OH = 1.22** **N** = 1



Species: *Phycis chesteri* **Family:** Gadidae
Eng. name: Longfin hake **Fr. name:** Merluche à longues nageoires
NSM#: 85036 **Table 21** **FL (mm) = 400** **OL (mm)$_x$ = 15.10**

OTOLITH MORPHOLOGY

A. GENERAL FEATURES

Shape: lanceolate
Relative size: medium**;** massive

Q. MARGINS

Dorsal: almost straight, smooth
Ventral: curved, smooth or with small lobes

C. ROSTRA

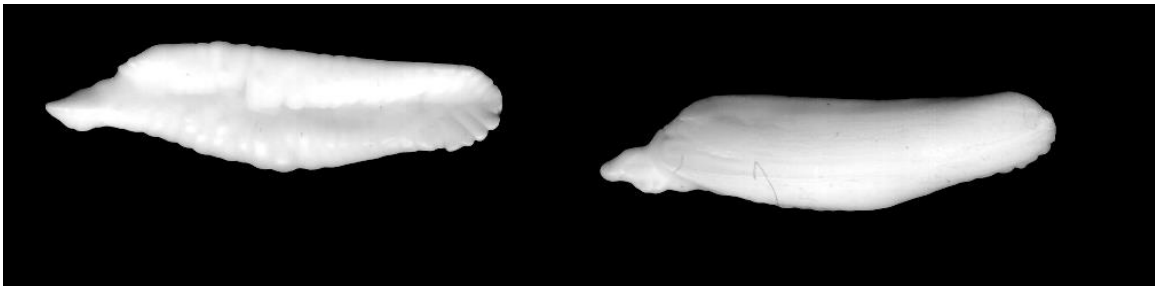
Rostrum: long
Antirostrum: absent
Pararostrum: pointed
Postrostrum: absent

GG. SCULPTURES

Sulcus: shallow, long
Ostium: closed
Cauda: closed

HH. RATIOS [F=fish; O=otolith; L=total length; H=height or width]

FL/OL = 26.49 – 36.52 **N = 4** **OL/OH = 2.84 – 2.93** **N = 4**



Species: *Urophycis chuss* **Family:** Gadidae
Eng. name: Red hake **Fr. name:** Merluche-écureuil
NSM#: 11909 **Table 22** **FL (mm) = 420** **OL (mm)$_x$ = 16.50**

OTOLITH MORPHOLOGY

A. GENERAL FEATURES

Shape: elongated, anteriorly pointed; posteriorly round
Relative size: medium**;** massive

R. MARGINS

Dorsal: straight, small lobes
Ventral: arched, lobulate

C. ROSTRA

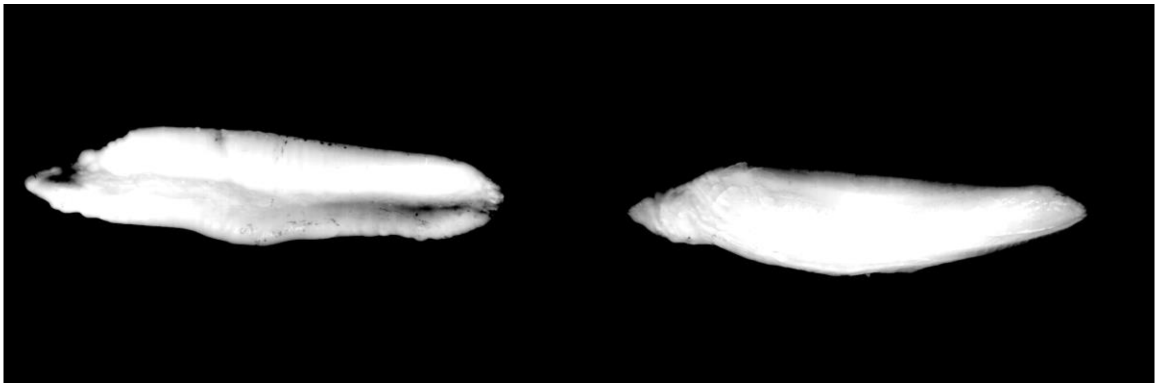
Rostrum: strong, pointed
Antirostrum: absent
Pararostrum: absent
Postrostrum: absent

II. SCULPTURES

Sulcus: shallow
Ostium: closed
Cauda: closed

JJ. RATIOS [F=fish; O=otolith; L=total length; H=height or width]

FL/OL = 22.58 – 25.60 **N = 7** **OL/OH = 3.44 – 4.82** **N = 7**



Species: *Urophycis tenuis* **Family:** Gadidae
Eng. name: White hake **Fr. name:** Merluche blanche
NSM#: 85041 **Table 23** **FL (mm) = 1,200** **OL (mm)$_x$ = 38.15**

OTOLITH MORPHOLOGY

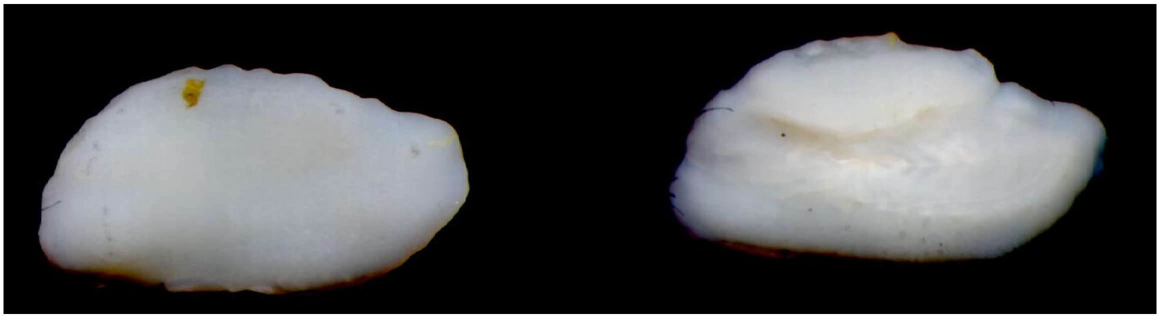
A. GENERAL FEATURES
Shape: elongated, pointed in front; posterior margin round
Relative size: medium**;** massive
:

S. MARGINS
Dorsal: mostly straight, smooth
Ventral: slightltly curved, small lobes

C. ROSTRA
Rostrum: pointed
Antirostrum: absent
Pararostrum: absent
Postrostrum: absent

KK. SCULPTURES
Sulcus: shallow
Ostium: closed
Cauda: closed

LL. RATIOS [F=fish; O=otolith; L=total length; H=height or width]
FL/OL = 26.00 – 31.45 N = 3 **OL/OH = 4.00 – 4.07 N = 3**



Species: *Brosme brosme* **Family:** Gadidae
Eng. name: Cusk **Fr. name:** Brosme
NSM#: 12057 **Table 24** **FL (mm) = 604** **OL (mm)$_x$ = 12.3**

OTOLITH MORPHOLOGY

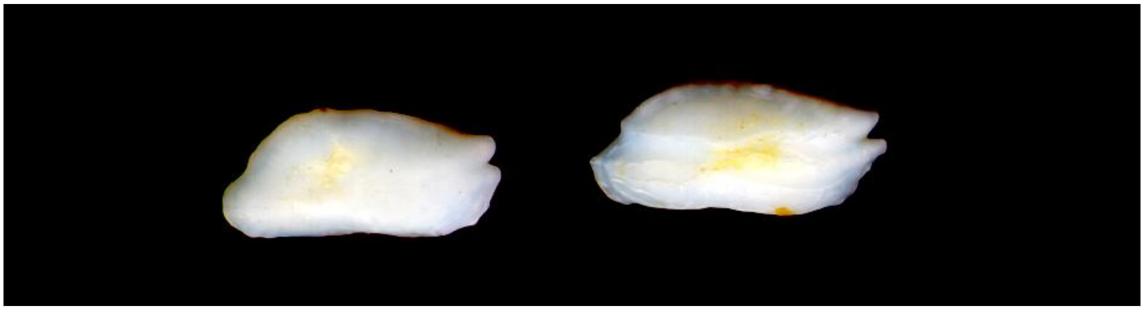
A. GENERAL FEATURES
Shape: rectangular with curved corners
Relative size: medium**;** massive

T. MARGINS
Dorsal: convex, irregularly scalloped
Ventral: curved, smooth

C. ROSTRA
Rostrum: round, wide
Antirostrum: absent
Pararostrum: insinuated
Postrostrum: round, wide

MM. SCULPTURES
Sulcus: wide, curved
Ostium: open
Cauda: open

NN. RATIOS [F=fish; O=otolith; L=total length; H=height or width]
FL/OL = 41.61 – 56.61 **N = 43** **OL/OH = 1.63 – 2.44** **N = 43**



Species: *Lota lota* **Family:** Gadidae
Eng. name: Burbot **Fr. name:** Loche
NSM#: 12259 **Table 28** **FL (mm) = 508** **OL (mm)$_x$ = 9.65**

OTOLITH MORPHOLOGY

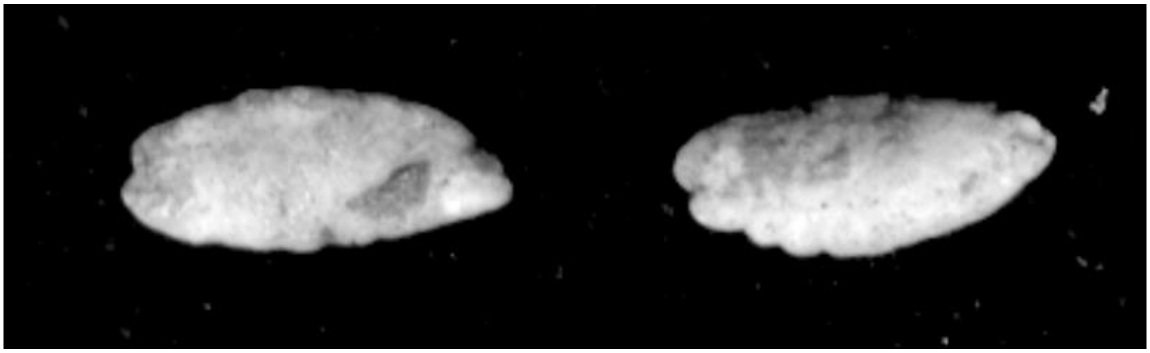
A. GENERAL FEATURES
Shape: rectangular
Relative size: medium**;** thick

U. MARGINS
Dorsal: convex, mostly smooth
Ventral: concave, smooth

C. ROSTRA
Rostrum: strong, round
Antirostrum: absent or insinuated
Pararostrum: pointed
Postrostrum: pointed

OO. SCULPTURES
Sulcus: long, deep
Ostium: open
Cauda: open

PP. RATIOS [F=fish; O=otolith; L=total length; H=height or width]
FL/OL = 40.40 – 64.42 **N = 31** **OL/OH = 1.97 – 2.15** **N = 31**



Species: *Boreogadus saida* **Family:** Gadidae
Eng. name: Arctic cod **Fr. name:** Saida
NSM#: 11877 **Table 33** **FL (mm) = 142** **OL (mm)$_x$ = 5.15**

OTOLITH MORPHOLOGY

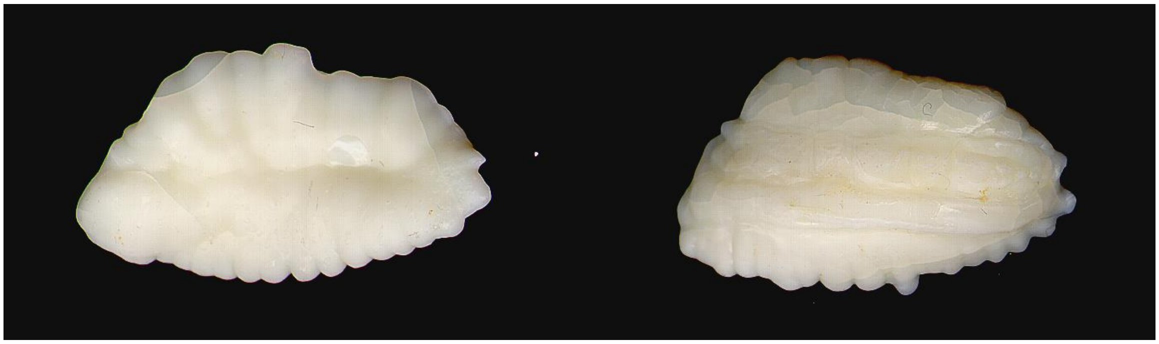
A. GENERAL FEATURES
Shape: lanceolate, elliptical
Relative size: medium; thick

V. MARGINS
Dorsal: convex, small lobes
Ventral: arched, scalloped

C. ROSTRA
Rostrum: distinct, round
Antirostrum: small, round
Pararostrum: insinuated
Postrostrum: round

QQ. SCULPTURES
Sulcus: short
Ostium: closed
Cauda: closed

RR. RATIOS [F=fish; O=otolith; L=total length; H=height or width]
FL/OL = 26.98 – 27.57 **N = 2** **OL/OH = 2.41 – 2.45** **N = 2**



Species: *Gadus morhua* **Family:** Gadidae
Eng. name: Atlantic cod **Fr. name:** Morue franche
NSM#: 11866 Table 34 FL (mm) = 1,190 OL (mm)$_x$ = 20.95

OTOLITH MORPHOLOGY

A. GENERAL FEATURES
Shape: oval, anterior cut across, posterior round
Relative size: medium; thick

W. MARGINS
Dorsal: convex, irregularly scalloped
Ventral :arched, regularly scalloped

C. ROSTRA
Rostrum: prominent, massive, round
Antirostrum: absent
Pararostrum: absent
Postrostrum: insinuated

SS. SCULPTURES
Sulcus: shallow, wide
Ostium: closed
Cauda: closed

TT. RATIOS [F=fish; O=otolith; L=total length; H=height or width]
FL/OL = 42.67 – 55.66 N = 12 OL/OH = 1.68 – 2.10 N = 12

Species: *Gadus morhua* **Family:** Gadidae
Eng. name: Atlantic cod **Fr. name:** Morue franche
NSM#: 12042 **Table 35** **FL (mm) = 609** **OL (mm)$_x$ = 18.40**

OTOLITH MORPHOLOGY

A. GENERAL FEATURES

Shape: oval, elliptical, anterior cut across, posterior round
Relative size: medium; very thick

X. MARGINS

Dorsal: slightly convex, regularly scalloped
Ventral: slightly convex, regularly scalloped

C. ROSTRA

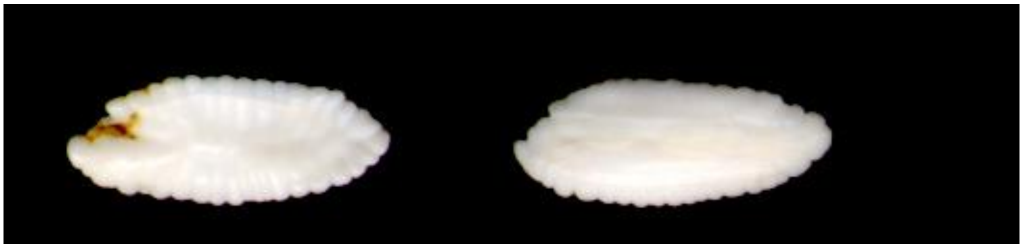
Rostrum: massive, round
Antirostrum: insinuated
Pararostrum: insinuated
Postrostrum: absent

UU. SCULPTURES

Sulcus: shallow, wide
Ostium: closed
Cauda: closed

VV. RATIOS [F=fish; O=otolith; L=total length; H=height or width]

FL/OL = 27.61 – 41.42 N = 63 OL/OH = 1.86 – 2.45 N = 63



Species: Gadus morhua **Family:** Gadidae
Eng. name: cod **Fr. name:** Morue
NSM#: 11533 **Table 36** **FL (mm) = 284** **OL (mm)$_x$ = 10.70**

OTOLITH MORPHOLOGY

A. GENERAL FEATURES

Shape: elliptical, anterior cut across, posterior pointed
Relative size: medium; thick

Y. MARGINS

Dorsal: convex, regularly scalloped
Ventral: arched, regularly scalloped

C. ROSTRA

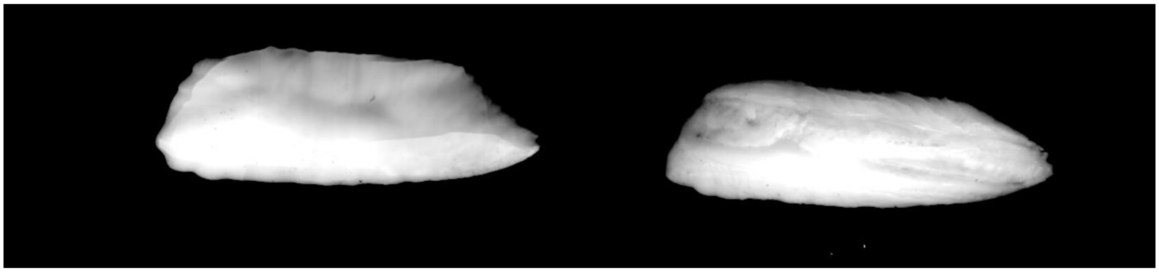
Rostrum: prominent, round
Antirostrum: small, pointed
Pararostrum: insinuated
Postrostrum: absent

WW. SCULPTURES

Sulcus: shallow, wide
Ostium: closed
Cauda: closed

XX. RATIOS [F=fish; O=otolith; L=total length; H=height or width]

FL/OL = 23.56 – 32.39 **N = 4** **OL/OH = 1.90 – 2.52**



Species: *Melanogrammus aeglefinus* **Family:** Gadidae
Eng. name: Haddock **Fr. name:** Aiglefin
NSM#: 12129 **Table 38** **FL (mm) = 614** **OL (mm)$_x$ = 19.45**

OTOLITH MORPHOLOGY

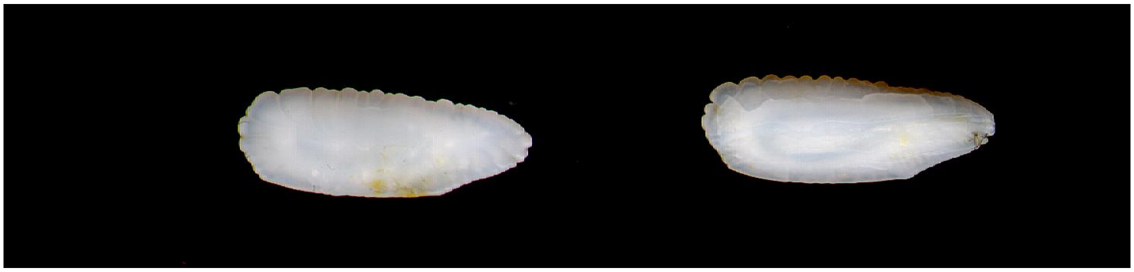
A. GENERAL FEATURES
Shape: lanceolate, anterior cut across, posterior pointed
Relative size: medium; very thick

Z. MARGINS
Dorsal: almost straight
Ventral: almost straight

C. ROSTRA
Rostrum: round
Antirostrum: absent
Pararostrum: absent
Postrostrum: prominent

YY. SCULPTURES
Sulcus: shallow, wide
Ostium: closed
Cauda: closed

ZZ. RATIOS [F=fish; O=otolith; L=total length; H=height or width]
FL/OL = 25.98 – 34.43 **N = 50** **OL/OH = 2.41 – 3.23** **N = 50**



Species: *Microgadus tomcod* **Family:** Gadidae
Eng. name: Atlantic tomcod **Fr. name:** Poulamon atlantique
NSM#: 12840 **Table 39** **FL (mm) = 192** **OL (mm)$_x$ = 9.80**

OTOLITH MORPHOLOGY

A. GENERAL FEATURES
Shape: lanceolate, anterior cut across, posterior pointed
Relative size: small; thin

AA. MARGINS
Dorsal: almost straight, smooth
Ventral: almost straight, regularly scalloped

C. ROSTRA
Rostrum: absent
Antirostrum: absent
Pararostrum: absent
Postrostrum: round

AAA. SCULPTURES
Sulcus: shallow, wide
Ostium: closed
Cauda: closed

BBB. RATIOS [F=fish; O=otolith; L=total length; H=height or width]
FL/OL = 19.12 – 19.54 **N = 4** **OL/OH = 2.40 – 2.80** **N = 4**

Species: *Pollachius virens* **Family:** Gadidae
Eng. name: Pollock **Fr. name:** Goberge

NSM#: 11965	**Table 41**	**FL (mm) = 674**	**OL (mm) = 17.50**
NSM#: 11962	**Table 41**	**FL (mm) = 864**	**OL (mm) = 19.00**

OTOLITH MORPHOLOGY

A. GENERAL FEATURES

Shape: lanceolate, subquadrangular, anterior cut across, posterior pointed, round
Relative size: medium; thick

BB. MARGINS

Dorsal: convex, irregularly lobate
Ventral: mainly straight, posterior curved, irregularly lobate

C. ROSTRA

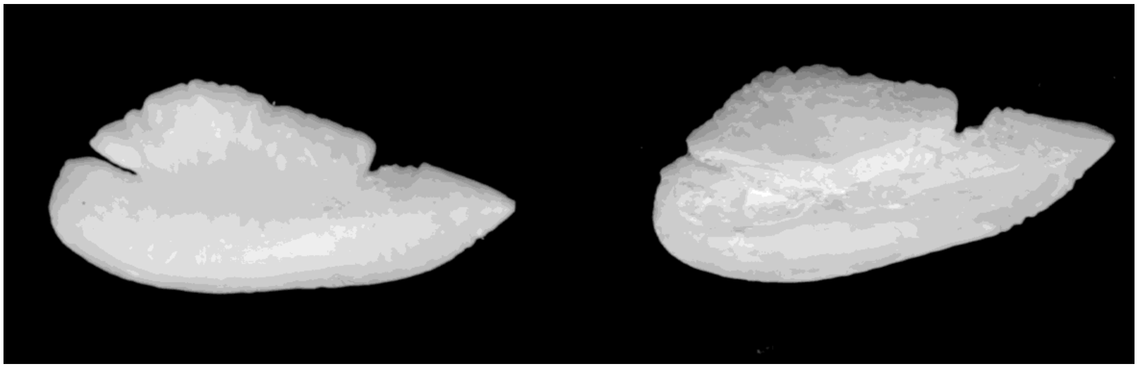
Rostrum: distinct, pointed
Antirostrum: absent
Pararostrum: absent
Postrostrum: distinct, round

CCC. SCULPTURES

Sulcus: shallow, wide
Ostium: closed
Cauda: closed

DDD. RATIOS [F=fish; O=otolith; L=total length; H=height or width]

FL/OL = 34.39 – 45.71 N = 49 OL/OH = 2.56 – 3.50 N = 49



Species: *Merluccius albidus* **Family:** Merlucciidae
Eng. name: Offshore hake **Fr. name:** Merlu blanc
NSM#: 11575 **Table 44** **FL (mm) = 378** **OL (mm)$_x$ = 9.60**

OTOLITH MORPHOLOGY

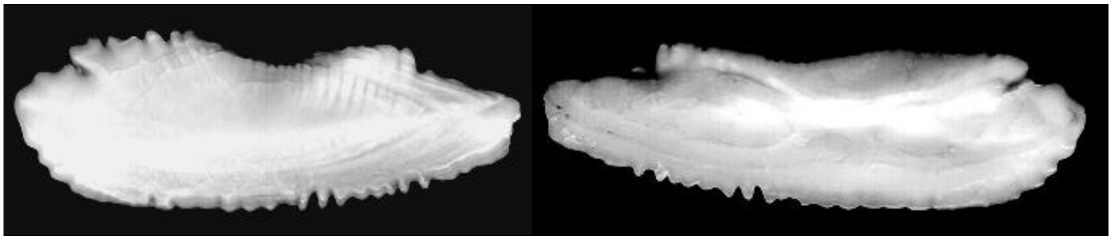
A. GENERAL FEATURES
Shape: almond-like
Relative size: large; fragile

CC. MARGINS
Dorsal: highly convex, deep indentations, irregularly festooned
Ventral: convex, smooth, wavy

C. ROSTRA
Rostrum: large, round
Antirostrum: absent
Pararostrum: absent
Postrostrum: pointed

EEE. SCULPTURES
Sulcus: wide, long, shallow
Ostium: closed
Cauda: closed

FFF. RATIOS [F=fish; O=otolith; L=total length; H=height or width]
FL/OL = 18.35 **N = 1** **OL/OH = 2.15** **N = 1**



Species *Merluccius australis* **Family:** Merlucciidae
Eng. name: Australian hake **Fr. name:** Merlu d'Australie
NSM#: 11535 **Table 45** **FL (mm) = 770** **OL (mm)$_x$ = 29.00**

OTOLITH MORPHOLOGY

A. GENERAL FEATURES

Shape: elongated
Relative size: large; fragile

DD. MARGINS

Dorsal: irregularly sinuous, large concavity in the middle
Ventral: concave, regularly lobate

C. ROSTRA

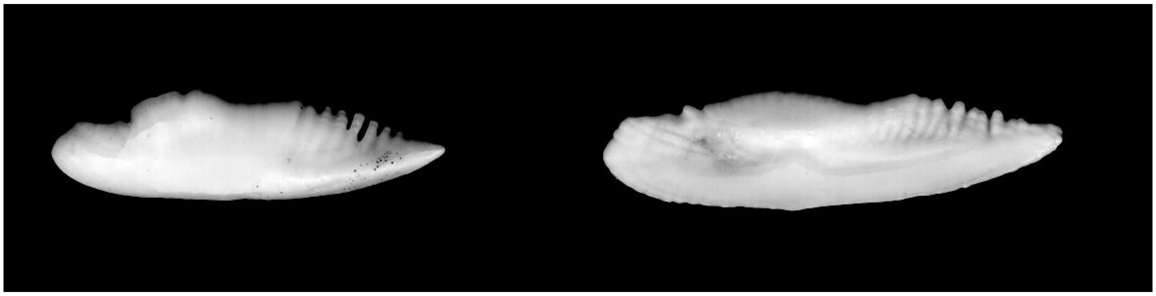
Rostrum: massive, round
Antirostrum: absent
Pararostrum: absent
Postrostrum: pointed, more or less round

GGG. SCULPTURES

Sulcus: long, wide, shallow
Ostium: closed
Cauda: closed

HHH. RATIOS [F=fish; O=otolith; L=total length; H=height or width]

FL/OL = 26.55 **N = 1** **OL/OH = 3.15** **N = 1**



Species: *Merluccius bilinearis* **Family:** Merlucciidae
Eng. name: : Silver hake **Fr. name:** Merlu argenté
NSM#: 85050 Table 46 FL (mm) = 440 OL (mm)$_x$ = 20.40
NSM#: 11546 Table 48 FL (mm) = 366 OL (mm)$_x$ = 17.15

OTOLITH MORPHOLOGY

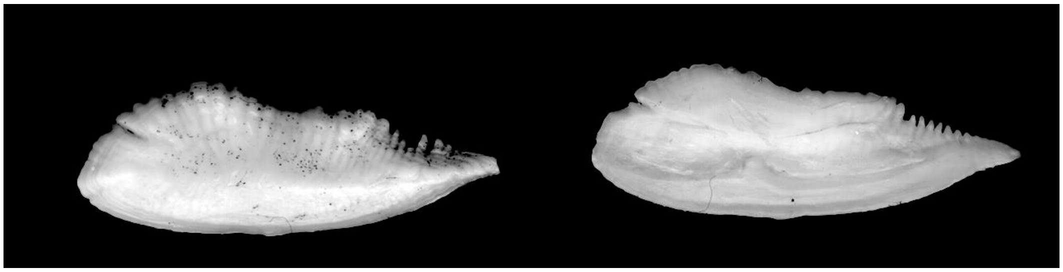
A. GENERAL FEATURES
Shape: elongated, anterior rim round, posterior pointed
Relative size: long; fragile

EE. MARGINS
Dorsal: irregularly wavy, long and thin lobes
Ventral: concave, smooth

C. ROSTRA
Rostrum: round, large
Antirostrum: absent or insinuated
Pararostrum: absent
Postrostrum: pointed, round

III. SCULPTURES
Sulcus: long, irregularly wide, shallow
Ostium: closed
Cauda: closed

JJJ. RATIOS [F=fish; O=otolith; L=total length; H=height or width]
FL/OL = 18.58 – 25.03 N = 12 OL/OH = 2.94 – 2.84 N = 12



Species: *Merluccius hubbsi* **Family:** Merlucciidae
Eng. name: Argentinean hake **Fr. name:** Merlu d'Argentine
NSM#: 85167 **Table 49** **FL (mm) = 519** **OL (mm)$_x$ = 22.25**

OTOLITH MORPHOLOGY

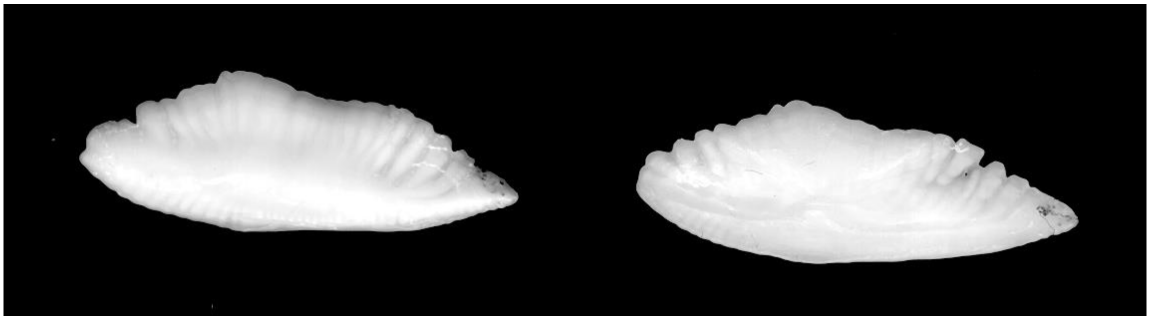
A. GENERAL FEATURES
Shape: almond-like
Relative size: large; fragile

FF.MARGINS
Dorsal: irregularly sinuous, long and thin lobes
Ventral: convex**,** smooth

C. ROSTRA
Rostrum: massive**,** round
Antirostrum: absent
Pararostrum: absent
Postrostrum: pointed

KKK. SCULPTURES
Sulcus: wide, shallow, long
Ostium: closed
Cauda: closed

LLL. RATIOS [F=fish; O=otolith; L=total length; H=height or width]
FL/OL = 23.22 **N = 1** **OL/OH = 2.83** **N = 1**



Species *Merluccius productus* **Family:** Merlucciidae
Eng. name: Pacific hake **Fr. name:** Merlu du Pacifique
NSM#: 11566 Table 50 FL (mm) = 414 OL (mm)$_x$ = 18.90

OTOLITH MORPHOLOGY

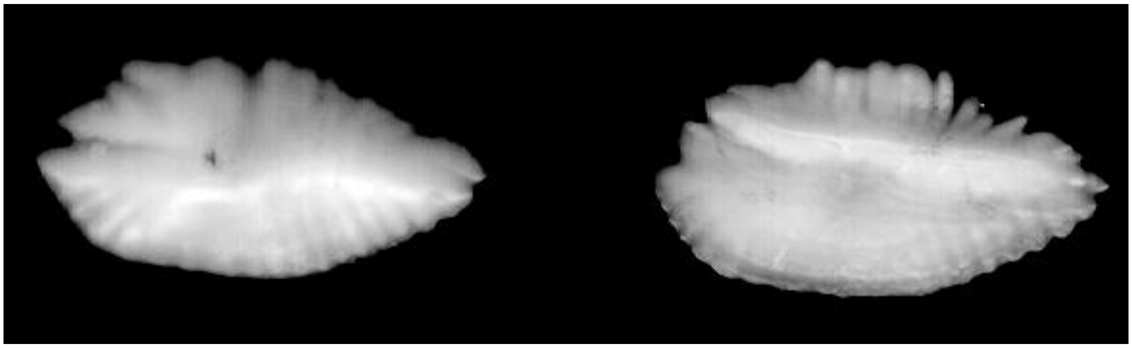
A. GENERAL FEATURES
Shape: almond-like
Relative size: large; fragile

GG. MARGINS
Dorsal: irregularly sinuous, distinct small lobes
Ventral: convex, smooth

C. ROSTRA
Rostrum: massive**,** round
Antirostrum: insinuated
Pararostrum: absent
Postrostrum: pointed, round

MMM. SCULPTURES
Sulcus: wide, long, shallow
Ostium: closed
Cauda: closed

NNN. RATIOS [F=fish; O=otolith; L=total length; H=height or width]
FL/OL = 21.82 – 23.41 N = 10 OL/OH = 2.36 – 2.92 N = 10



Species: *Macrourus bairdii* **Family:** Macrouridae
Eng. name: Marlin-spike **Fr. name:** Grenadier de Baird
NSM#: 85048 **Table 51** **FL (mm) = 315** **OL (mm)$_x$ = 9.15**

OTOLITH MORPHOLOGY

A. GENERAL FEATURES

Shape: oval, lenticular
Relative size: medium; anterior and posterior rims round

HH. MARGINS

Dorsal: highly concave, well-defined narrow lobes, surface plated
Ventral: convex, regularly scalloped

C. ROSTRA

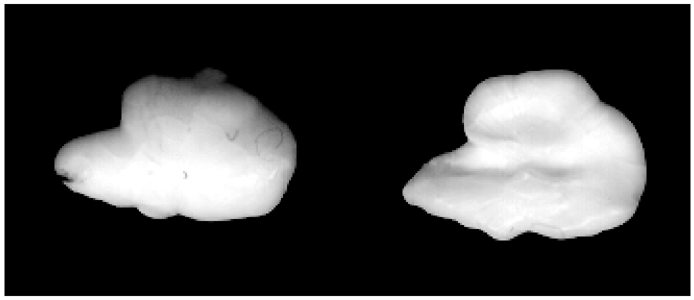
Rostrum: pointed, distinct
Antirostrum: pointed
Pararostrum: insinuated
Postrostrum: insinuated

OOO. SCULPTURES

Sulcus: wide, long, shallow
Ostium: closed
Cauda: closed

PPP. RATIOS [F=fish; O=otolith; L=total length; H=height or width]

FL/OL = 34.41 – 40.70 **N = 4** **OL/OH = 1.60 – 1.87** **N = 4**



Species *Lycodes reticulates* **Family:** Zoarcidae
Eng. name: Arctic eelpout **Fr. name:** Lycode arctique
NSM#: 85066 **Table 52** **FL (mm) =520** **OL (mm)$_x$ = 3.65**

OTOLITH MORPHOLOGY

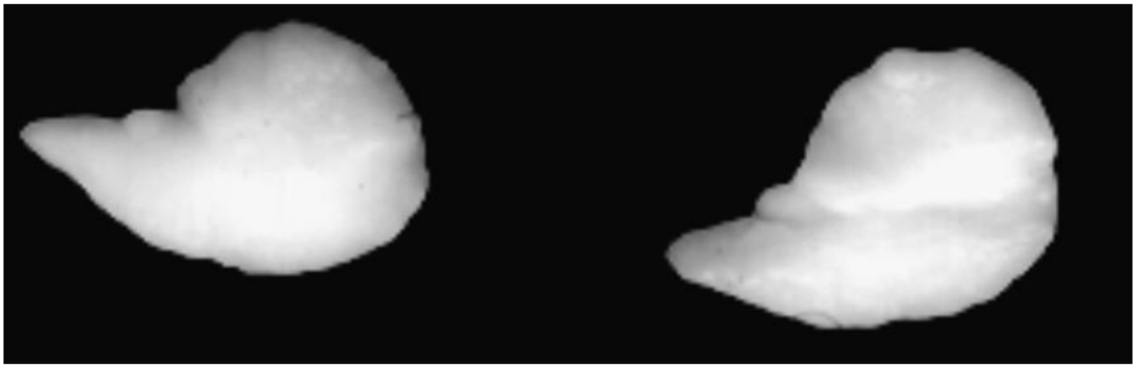
A. GENERAL FEATURES
Shape: oval, with anterior margin pointed; posterior round
Relative size: small; thick

II. MARGINS
Dorsal: highly arched, smooth
Ventral: slightly arched, sinuous

C. ROSTRA
Rostrum: strong, pointed
Antirostrum: strong, pointed
Pararostrum: absent
Postrostrum: absent
Rostrum/antirostrum angle: ~ 90º

QQQ. SCULPTURES
Sulcus: deep, narrow
Ostium: open
Cauda: closed

RRR. RATIOS [F=fish; O=otolith; L=total length; H=height or width]
FL/OL = 99.05 **N = 1** **OL/OH = 1.44** **N = 1**



Species: *Opsanus tau* **Family:** Batrachoididae
Eng. name: Oyster toadfish **Fr. name: N/A**
NSM#: 85032 **Table 53** **FL (mm) = 470** **OL (mm)$_x$ = 4.10**

OTOLITH MORPHOLOGY

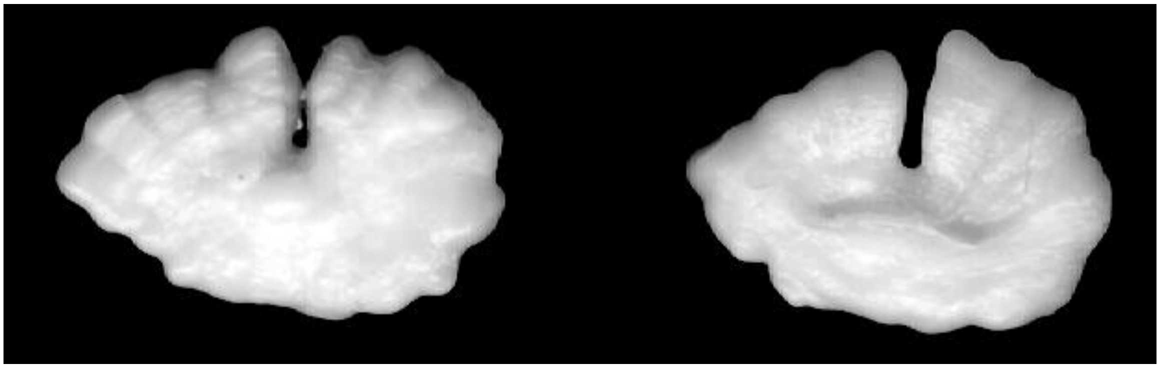
A. GENERAL FEATURES
Shape: almond-like, posterior round
Relative size: small; thick

JJ. MARGINS
Dorsal: highly arched, smooth, slightly scalloped
Ventral: convex, slightly scalloped

C. ROSTRA
Rostrum: pointed, long
Antirostrum: insinuated
Pararostrum: absent
Postrostrum: absent

SSS. SCULPTURES
Sulcus: deep
Ostium: open
Cauda: open

TTT. RATIOS [F=fish; O=otolith; L=total length; H=height or width]
FL/OL = 112.77 – 129.41 N = 5 **OL/OH = 1.43 – 1.92 N = 5**



Species: *Lophius americanus* **Family:** Lophiidae
Eng. name: Goosefish **Fr. name:** Baudroie d'Amérique
NSM#: 11257 **Table 54** **FL (mm) = 710 OL (mm)$_x$ = 8.10**

OTOLITH MORPHOLOGY

A. GENERAL FEATURES

Shape: oval, variable number of expansions and deep creases
Relative size: medium; thick

MARGINS

Dorsal: concave, large lobes and depressions
Ventral: convex, irregularly scalloped

C. ROSTRA

Rostrum: short, round
Antirostrum: absent
Pararostrum: absent
Postrostrum: absent

D. SCULPTURES

Sulcus: deep, short
Ostium: closed
Cauda: closed

RATIOS [F=fish; O=otolith; L=total length; H=height or width]
FL/OL = 64.80 – 93.10 N = 4 OL/OH = 1.27 – 1.49 N = 4

Species: *Sebastes marinus* **Family:** Scorpaenidae
Eng. name: Redfish **Fr. name:** Sébaste atlantique
NSM#: 11853 **Table 55** **FL (mm) = 338** **OL (mm)$_x$ = 13.90**

OTOLITH MORPHOLOGY

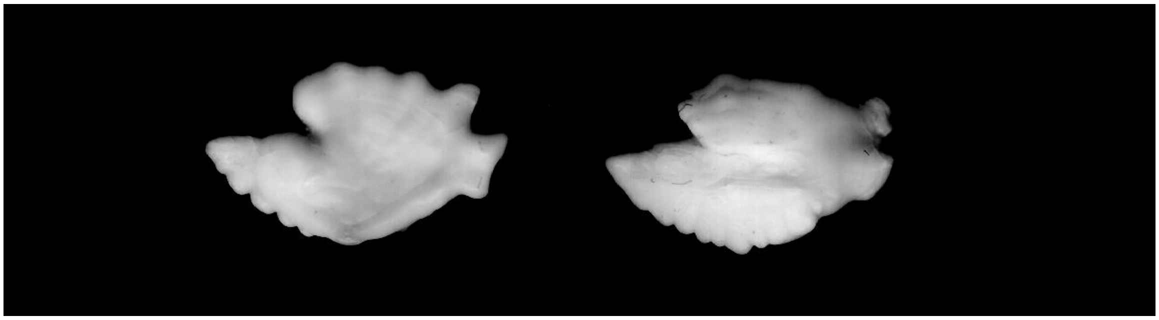
A. GENERAL FEATURES
Shape: oval
Size: large**;** massive

KK. MARGINS
Dorsal: highly arched, irregular lobes
Ventral: curved, smooth, very small lobes

C. ROSTRA
Rostrum: strong, pointed, long. Length ~1/4 OL
Antirostrum: strong, round
Pararostrum: strong
Postrostrum: absent

UUU. INNER SURFACE
Sulcus: wide
Ostium: open
Cauda: closed

VVV. RATIOS [F=fish; O=otolith; L=total length; H=height or width]
FL/OL = 17.33 – 24.32 **N = 4** **OL/OH = 1.52 – 4.09** **N = 4**



Species: *Sebastes mentella* **Family:** Scorpaenidae
Eng. name: Deepwater redfish **Fr. name:** Sébaste d'eau profonde
NSM#: 11986 **Table 56** **FL (mm) = 306** **OL (mm)$_x$ = 13.20**

OTOLITH MORPHOLOGY

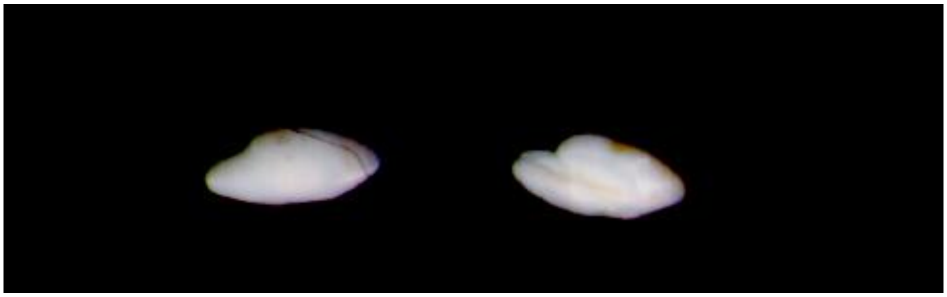
A. GENERAL FEATURES
Shape: oval
Relative size: large; thick

LL. MARGINS
Dorsal: highly arched, irregular lobes
Ventral: curved, smooth, more regular lobes

C. ROSTRA
Rostrum: strong, pointed, long
Antirostrum: strong, short, round
Pararostrum: strong
Postrostrum: absent
Rostrum/antirostrum angle: < 90^o

WWW. SCULPTURES
Sulcus: wide
Ostium: open
Cauda: closed

XXX. RATIOS [F=fish; O=otolith; L=total length; H=height or width]
FL/OL = 23.18 – 28.18 **N = 4** **OL/OH = 1.52 – 1.70** **N = 4**



Species: *Triglops ommatistius* **Family:** Triglidae
Eng. name: Mailed sculpin **Fr. name:** Faux-trigle maillé
NSM#: 85092 **Table 57** **FL (mm) = 126 OL (mm)$_x$ = 3.70**

OTOLITH MORPHOLOGY

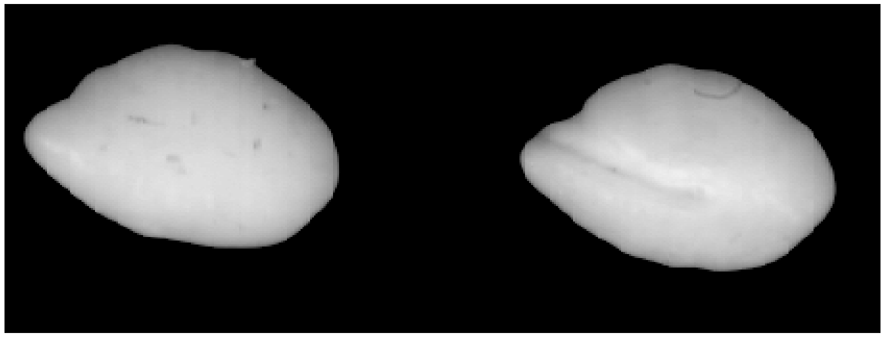
A. GENERAL FEATURES
Shape: lanceolate
Relative size: medium; thick

MM. MARGINS
Dorsal: arched, sinuous with low lobes
Ventral: smooth, slightly curved

C. ROSTRA
Rostrum: prominent, pointed
Antirostrum: insinuated or short
Pararostrum: absent
Postrostrum: absent

YYY. SCULPTURES
Sulcus: short
Ostium: open
Cauda: closed

ZZZ. RATIOS [F=fish; O=otolith; L=total length; H=height or width]
FL/OL = 34.05 **N = 1** **OL/OH = 2.11** **N = 1**



Species: *Artediellus uncinatus* **Family:** Cottidae
Eng. name: hookbear sculpin **Fr. name:** Crochet arctique
NSM#: 85083 **Table 58** **FL (mm) = 80** **OL (mm)$_x$ = 4.75**

OTOLITH MORPHOLOGY

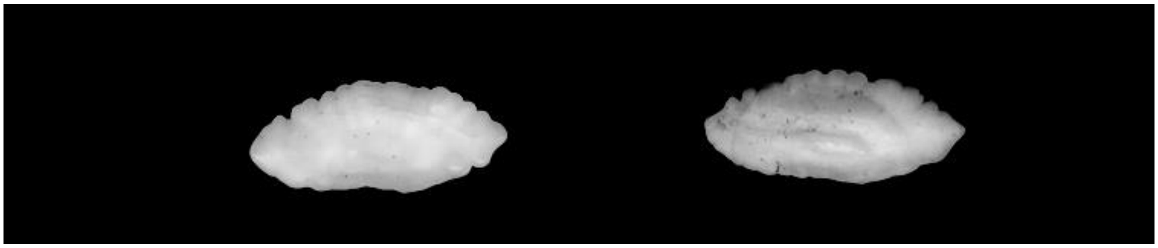
A. GENERAL FEATURES
Shape: oval
Relative size: large; thick

NN. MARGINS
Dorsal: smooth
Ventral: smooth, slightly curved

C. ROSTRA
Rostrum: prominent, round, short
Antirostrum: insinuated
Pararostrum: absent
Postrostrum: absent

AAAA. SCULPTURES
Sulcus: short, deep, straight
Ostium: open
Cauda: closed

BBBB. RATIOS [F=fish; O=otolith; L=total length; H=height or width]
FL/OL = 16.84 **N = 1** **OL/OH = 1.11** **N = 1**



Species *Myoxocephalus octodecimspinosus* **Family:** Cottidae
Eng. name: Longhorn sculpin **Fr. name:** Chaboisseau à dix-huit épines
NSM#: 11536 Table 59 FL (mm) = 275 OL (mm)$_x$ = 7.15

OTOLITH MORPHOLOGY

A. GENERAL FEATURES

Shape: oval
Relative size: medium; thin

OO. MARGINS

Dorsal: convex, scalloped
Ventral: slightly curved, smooth or with small lobes

C. ROSTRA

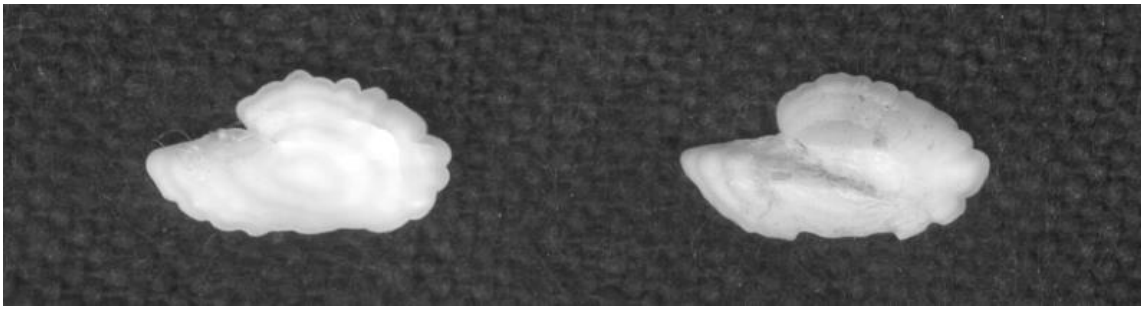
Rostrum: distinct, round
Antirostrum: insinuated or absent
Pararostrum: distinct
Postrostrum: absent

CCCC. SCULPTURES

Sulcus: shallow, length ~ 1/2 of OL
Ostium: open
Cauda: closed

DDDD. RATIOS [F=fish; O=otolith; L=total length; H=height or width]

FL/OL = 32.70 – 42.14 N = 10 OL/OH = 2.13 – 2.95 N = 10



Species *Myoxocephalus scorpius* **Family:** Cottidae
Eng. name: Shorthorn sculpin **Fr. name:** Chaboisseau à épines courtes
NSM#: 12408 **Table 61** **FL (mm) = 355** **OL (mm)$_x$ = 8.70**

OTOLITH MORPHOLOGY

A. GENERAL FEATURES

Shape: oval
Relative size: large; thick

PP.MARGINS

Dorsal: highly arched, regularly scalloped
Ventral: slightly arched, sinuous

C. ROSTRA

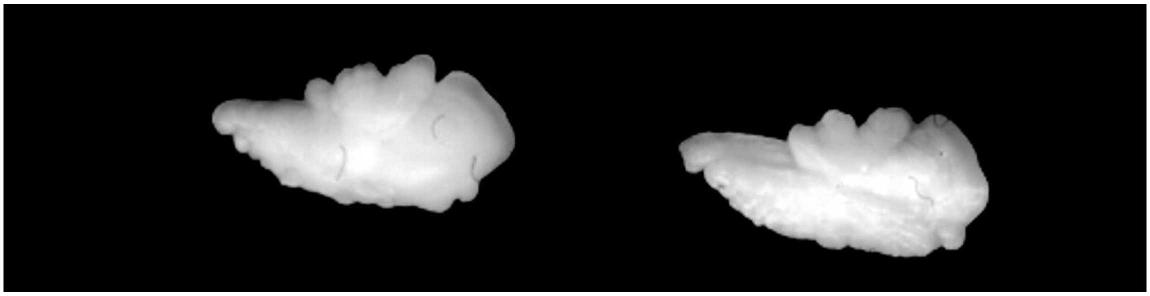
Rostrum: large, pointed**,**
Antirostrum: length ~ 1/3 OL
Pararostrum: absent
Postrostrum: absent
Rostrum/Antirostrum angle: <90^o

EEEE. SCULPTURES

Sulcus: deep, straight, short
Ostium: open
Cauda: closed

FFFF. RATIOS [F=fish; O=otolith; L=total length; H=height or width]

FL/OL = 40.80 **N = 1** **OL/OH = 1.93** **N = 1**



Species: *Hemitripterus americanus* **Family:** Cottidae
Eng. name: Sea raven **Fr. name:** Hémiptriptère atlantique
NSM#: 11840 **Table 62** **FL (mm) = 472** **OL (mm)$_x$ = 5.45**

OTOLITH MORPHOLOGY

A. GENERAL FEATURES

Shape: lanceolate
Relative size: medium; thick

QQ. MARGINS

Dorsal: irregularly lobed, large lobes
Ventral: slightly curved, small lobes

C. ROSTRA

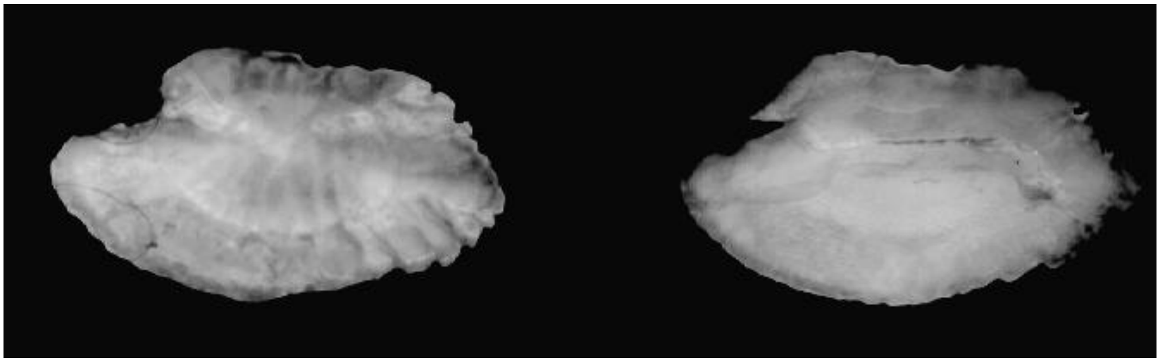
Rostrum: prominent, round
Antirostrum: distinct, round
Pararostrum: insinuated
Postrostrum: insinuated

GGGG. SCULPTURES

Sulcus: straight
Ostium: open
Cauda: closed

HHHH. RATIOS [F=fish; O=otolith; L=total length; H=height or width]

FL/OL = 73.12 – 86.60 N = 3 OL/OH = 1.91 – 2.23 N = 3



Species: *Morone chrysops* **Family:** Percichthyidae
Eng. name: White bass **Fr. name:** Bar blanc
NSM#: 85067 **Table 63** **FL (mm) = N/A** **OL (mm)$_x$ = 9.10**

OTOLITH MORPHOLOGY

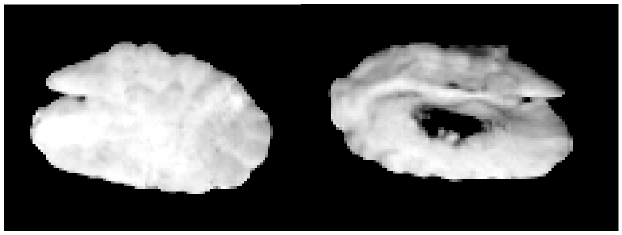
A. GENERAL FEATURES
Shape: oval
Relative size: N/A; thin

RR. MARGINS
Dorsal: slightly curved, irregular lobes
Ventral: highly concave, posterior rim scalloped

C. ROSTRA
Rostrum: massive, round
Antirostrum: distinct
Pararostrum: insinuated
Postrostrum: absent

IIII. SCULPTURES
Sulcus: deep, curved
Ostium: open
Cauda: closed

JJJJ. RATIOS [F=fish; O=otolith; L=total length; H=height or width]
FL/OL = N/A **N = 1** **OL/OH = 1.80** **N = 1**



Species: *Micropteus dolomieu* **Family:** Centrarchidae
Eng. name: Smallmouth bass **Fr. name:** Achigan à petite bouche
NSM#: 12405 **Table 64** **FL (mm) = N/A** **OL (mm)$_x$ = 4.60**

OTOLITH MORPHOLOGY

A. GENERAL FEATURES

Shape: oval
Relative size: N/A; thin
:

SS. MARGINS

Dorsal: convex, regularly scalloped
Ventral: almost straight, small lobes

C. ROSTRA

Rostrum: massive, round
Antirostrum: pointed, distinct
Pararostrum: absent
Postrostrum: absent
Rostrun/Antirostrum angle: acute

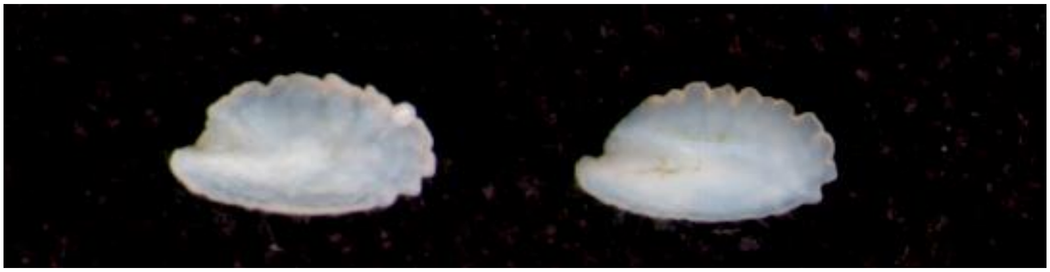
KKKK. SCULPTURES

Sulcus: deep, curved
Ostium: open
Cauda: closed

LLLL. RATIOS [F=fish; O=otolith; L=total length; H=height or width]

FL/OL = N/A **N =** **OL/OH = 2.09** **N = 1**

The dark spot is dirt that couldn't be cleaned



Species *Perca flavescens* **Family:** Percidae
Eng. name: Yellow perch **Fr. name:** Perchaude
NSM#: 12103 **Table 65** **FL (mm) = 204** **OL (mm)$_x$ = 5.25**

OTOLITH MORPHOLOGY

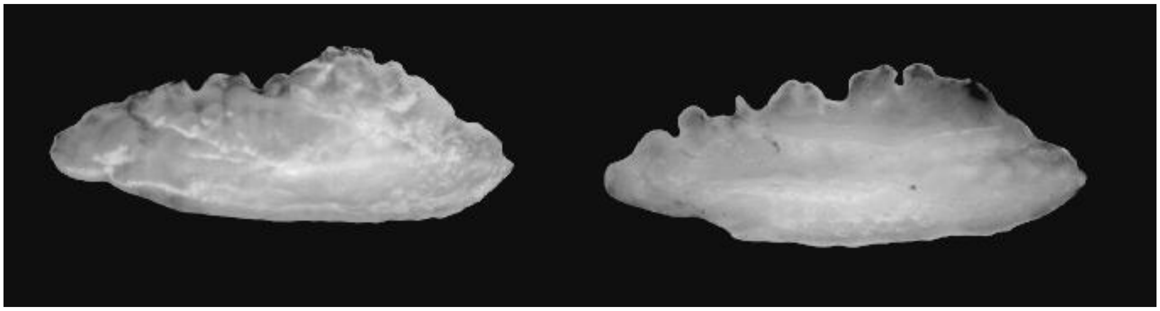
A. GENERAL FEATURES
Shape: oval
Relative size: large; thin

TT. MARGINS
Dorsal: convex, regularly scalloped
Ventral: almost straight, small lobes

C. ROSTRA
Rostrum: large, round
Antirostrum: insinuated
Pararostrum: absent
Postrostrum: absent

MMMM. SCULPTURES
Sulcus: straight, deep
Ostium: open
Cauda: closed

NNNN. RATIOS [F=fish; O=otolith; L=total length; H=height or width]
FL/OL = 31.30 – 38.86 N = 7 OL/OH = 1.80 – 2.30 N = 7



Species: *Stizostedion vitreum* **Family:** Percidae
Eng. name: Walleye **Fr. name:** : Doré jaune
NSM#: 85068 **Table 66** **FL (mm) = 457** **OL (mm)$_x$ = 10.80**

OTOLITH MORPHOLOGY

A. GENERAL FEATURES
Shape: lanceolate
Relative size: large; thin, fragile

UU. MARGINS
Dorsal: moderately convex, irregularly lobate
Ventral: slightly arched, smooth,

C. ROSTRA
Rostrum: prominent, round
Antirostrum: absent or insinuated
Pararostrum: absent
Postrostrum: prominent, round

OOOO. SCULPTURES
Sulcus: long**,** wide
Ostium: open
Cauda: closed

PPPP. RATIOS [F=fish; O=otolith; L=total length; H=height or width]
FL/OL = 42.31 **N = 1** **OL/OH = 2.70** **N = 1**

Species: *Aplodinotus grunniens* **Family:** Sciaenidae
Eng. name: Freshwater drum **Fr. name:** Malachigan
NSM#: 85069 **Table 67** **FL (mm) = 381** **OL (mm)$_x$ = 15.15**

OTOLITH MORPHOLOGY

A. GENERAL FEATURES

Shape: quadrangular with round angles
Relative size: large; thick,

VV. MARGINS

Dorsal: straight, small irregularities
Ventral: highly arched, small indentations

C. ROSTRA

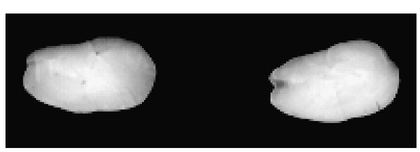
Rostrum: insinuated
Antirostrum: insinuated
Pararostrum: absent
Postrostrum: absent

QQQQ. SCULPTURES

Sulcus: shallow, wide, curved
Ostium: open
Cauda: closed

RRRR. RATIOS [F=fish; O=otolith; L=total length; H=height or width]

FL/OL = 25.15 – 33.20 **N = 3** **OL/OH = 1.04 – 1.20** **N = 3**



Species: *Lumpenus lumpretaeformis* **Family:** Stichaeidae
Eng. name: Snakeblenny **Fr. name:** Lompénie-serpent
NSM#: 85072 **Table 68** **FL (mm) = 340** **OL (mm)$_x$ = 2.85**

OTOLITH MORPHOLOGY

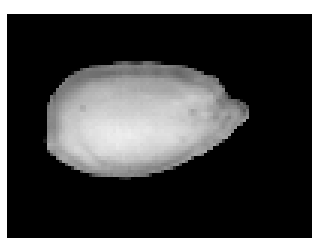
A. GENERAL FEATURES
Shape: lenticular
Relative size: small; thick

WW. MARGINS
Dorsal: convex, smooth
Ventral: almost rectilinear, smooth; posterior rim round

C. ROSTRA
Rostrum: prominent in large specimens
Antirostrum: small, pointed, round
Pararostrum: absent
Postrostrum: absent

SSSS. SCULPTURES
Sulcus: shallow
Ostium: open
Cauda: closed

TTTT. RATIOS [F=fish; O=otolith; L=total length; H=height or width]
FL/OL = 119.30 **N = 1** **OL/OH = 1.63** **N = 1**



Species: *Lumpenus maculatus* **Family:** Stichaeidae
Eng. name: Daubed shanny **Fr. name:** Lompénie tachetée
NSM#: 85071 **Table 69** **FL (mm) = 270** **OL (mm)$_x$ = 2.60**

OTOLITH MORPHOLOGY

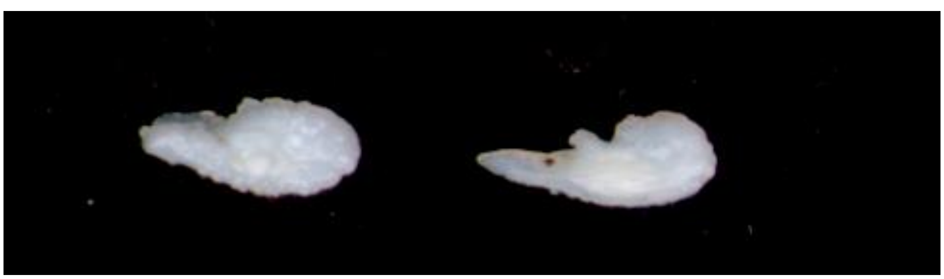
A. GENERAL FEATURES
Shape: oval
Relative size: small; thick

XX. MARGINS
Dorsal: slightly convex, smooth
Ventral: concave, smooth

C. ROSTRA
Rostrum: prominent
Antirostrum: insinuated
Pararostrum: absent
Postrostrum: absent

UUUU. SCULPTURES
Sulcus: shallow
Ostium: open
Cauda: closed

VVVV. RATIOS [F=fish; O=otolith; L=total length; H=height or width]
FL/OL = 103.85 **N = 1** **OL/OH = 1.73** **N = 1**



Species: *Anarhychas latifrons* **Family:** Anarhichadidae
Eng. name: Northern wolffish **Fr. name:** Loup à tête large
NSM#: 85077 **Table 70** **FL (mm) = N/A** **OL (mm)$_x$ = 4.75**

OTOLITH MORPHOLOGY

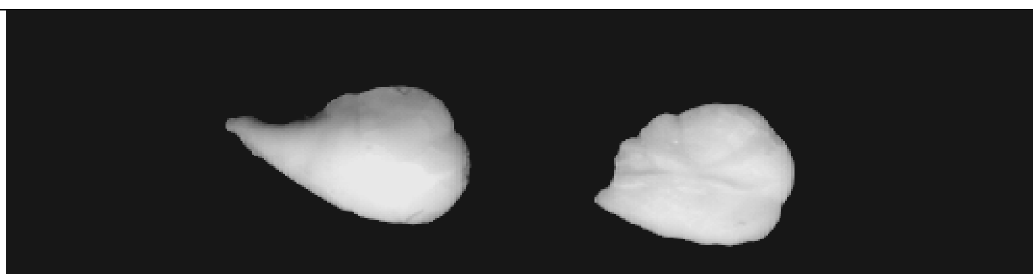
A. GENERAL FEATURES
Shape: arrow-like
Relative size: small; fragile

YY. MARGINS
Dorsal: convex, irregularly lobed
Ventral: moderately concave, smoother than dorsal margin

C. ROSTRA
Rostrum: prominent, long; length > 1/3 OL
Antirostrum: insinuated
Pararostrum: absent
Postrostrum: absent

WWWW. SCULPTURES
Sulcus: short
Ostium: open
Cauda: closed

XXXX. RATIOS [F=fish; O=otolith; L=total length; H=height or width]
FL/OL = N/A **OL/OH = 2.41** **N = 1**



Species: *Anarhichas lupus* **Family:** Anarhichadidae
Eng. name: Atlantic wolffish **Fr. name:** Loup atlantique
NSM#: 11891 Table 71 FL (mm) = 920 OL (mm)$_x$ = 4.65

OTOLITH MORPHOLOGY

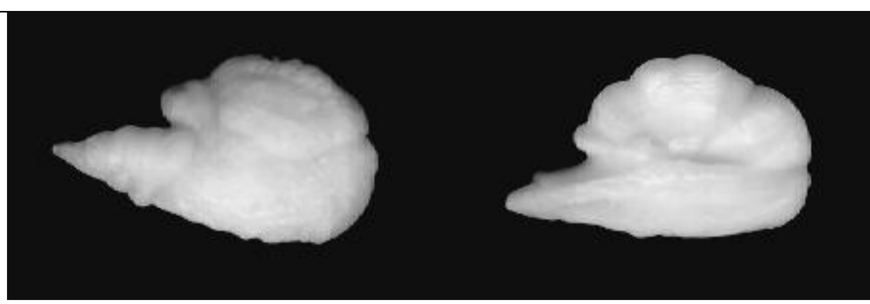
A. GENERAL FEATURES
Shape: almond-like
Relative size: small; fragile

ZZ. MARGINS
Dorsal: highly convex, irregularly lobate
Ventral: concave, smooth, posterior rim round

C. ROSTRA
Rostrum: prominent, pointed; length > 1/3 OL
Antirostrum: insinuated
Pararostrum: insinuated
Postrostrum: insinuated

YYYY. SCULPTURES
Sulcus: deep, straight
Ostium: open
Cauda: closed

ZZZZ. RATIOS [F=fish; O=otolith; L=total length; H=height or width]
FL/OL = 133.33 – 200.00 N = 6 OL/OH = 1.50 – 2.12 N = 6



Species: *Anarhichas minor* **Family:** Anarhichadidae
Eng. name: Spotted wolffish **Fr. name:** Loup tacheté
NSM#: 85090 **Table 72** **FL (mm) = 950** **OL (mm)$_x$ = 5.75**

OTOLITH MORPHOLOGY

A. GENERAL FEATURES

Shape: almond-like
Realtive size: small; thick

AAA. MARGINS

Dorsal: highly convex, lobate
Ventral: concave or rectilinear, small irregularities

C. ROSTRA

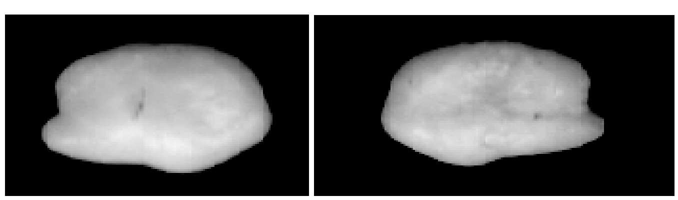
Rostrum: prominent, long; length ~ 1/3 OL
Antirostrum: round, short
Pararostrum: absent
Postrostrum: absent

AAAAA. SCULPTURES

Sulcus: short
Ostium: open
Cauda: closed

BBBBB. RATIOS [F=fish; O=otolith; L=total length; H=height or width]

FL/OL = 128.57 – 208.33 N = 9 **OL/OH = 1.30 – 2.45 N = 9**



Species: *Ammodytes americanus* **Family:** Ammodytidae
Eng. name: American sand lance **Fr. name:** Lançon d'Amérique
NSM#: 85078 **Table 73** **FL (mm) = 230** **OL (mm)$_x$ = 2.85 (1)**

OTOLITH MORPHOLOGY

A. GENERAL FEATURES
Shape: oval to lanceolate
Relative size: medium; thick

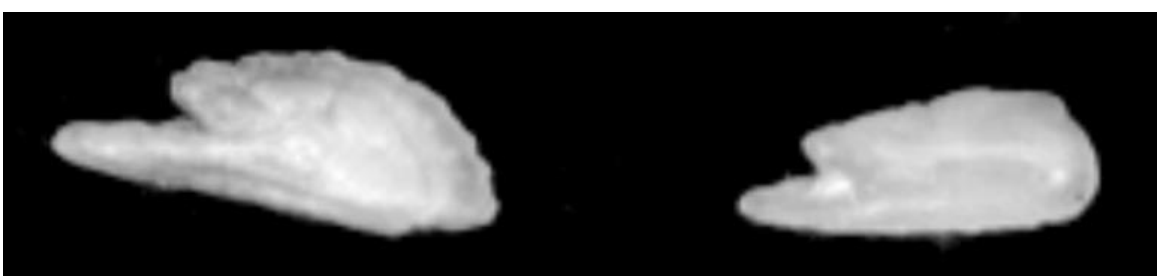
BBB. MARGINS
Dorsal: convex, smooth
Ventral: concave, smooth, a median depression

C. ROSTRA
Rostrum: prominent, round
Antirostrum: insinuated
Pararostrum: absent
Postrostrum: absent

CCCCC. SCULPTURES
Sulcus: small
Ostium: open
Cauda: closed

DDDDD. RATIOS [F=fish; O=otolith; L=total length; H=height or width]
FL/OL = 80.70 – 85.50 **N = 2** **OL/OH = 1.77 – 1.80** **N = 2**

(1) Left otolith used for both pictures



Species: *Scomber scombrus* **Family:** Scombridae
Eng. name: Atlantic mackerel **Fr. name:** Maquereau bleu
NSM#: 12759 (L) Table 74 FL (mm) = 325 OL (mm)$_x$ = 2.10 Left
NSM#: 12086 (R) Table 74 FL (mm) = 242 OL (mm)$_x$ = 3.6 Right

OTOLITH MORPHOLOGY

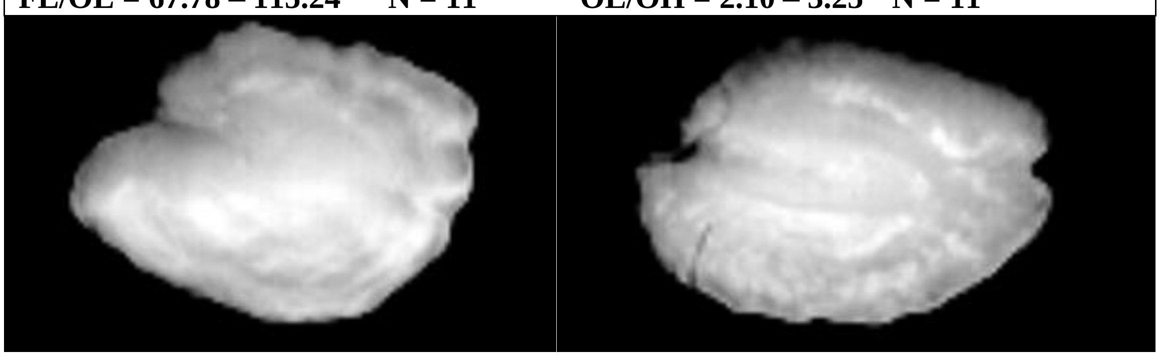
A. GENERAL FEATURES
Shape: lanceolate
Relative size: medium; thin, fragile

CCC. MARGINS
Dorsal: convex or almost straight, deep depressions
Ventral: straight, smooth

C. ROSTRA
Rostrum: prominent, pointed, length ~ 1/3 or 1/4 OL
Antirostrum: prominent, round
Pararostrum: absent
Postrostrum: absent

EEEEE. SCULPTURES
Sulcus: long, curved
Ostium: open
Cauda: closed

FFFFF. RATIOS [F=fish; O=otolith; L=total length; H=height or width]
FL/OL = 67.78 – 115.24 N = 11 OL/OH = 2.10 – 3.25 N = 11



Species: *Scophthalmus aquosus* **Family:** Bothidae
Eng. name: Windowpane **Fr. name:** Turbot de sable
NSM#: 85094 **Table 75** **FL (mm) = 302** **OL (mm)$_x$ = 3.65**

OTOLITH MORPHOLOGY

A. GENERAL FEATURES

Shape: lenticular
Relative size: medium to small; thick

DDD. MARGINS

Dorsal: convex, small irregularities
Ventral: concave, smooth

C. ROSTRA

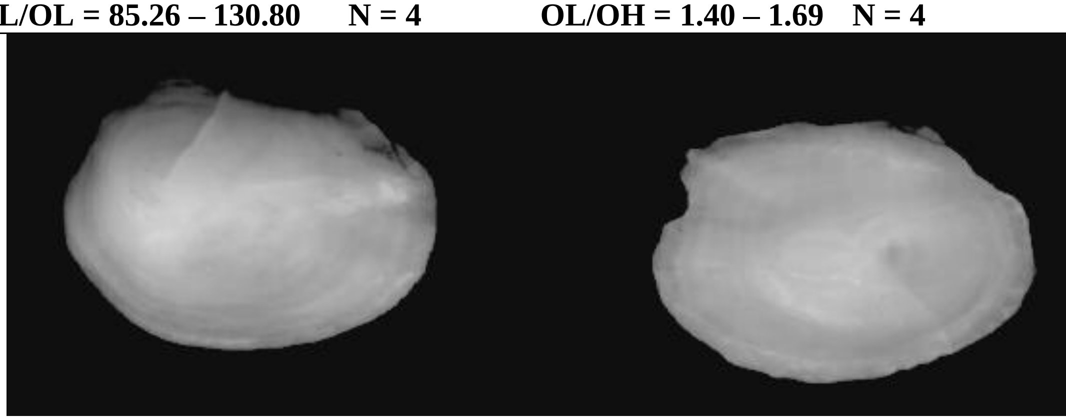
Rostrum: prominent, round
Antirostrum: small or insinuated
Pararostrum: insinuated
Postrostrum: insinuated

GGGGG. SCULPTURES

Sulcus: long, deep
Ostium: open
Cauda: closed

HHHHH. RATIOS [F=fish; O=otolith; L=total length; H=height or width]

FL/OL = 85.26 – 130.80 N = 4 **OL/OH = 1.40 – 1.69 N = 4**



Species: *Hippoglossoides platessoides* **Family:** Pleuronectidae
Eng. name: American plaice **Fr. name:** Plie canadienne
NSM#: 123.43 **Table 76.** **FL (mm) = 336** **OL (mm)$_x$ = 7.25**

OTOLITH MORPHOLOGY

A. GENERAL FEATURES

Shape: lenticular
Relative size: medium

EEE. MARGINS

Dorsal: slightly convex, smooth
Ventral: medium or strongly arched, smooth

C. ROSTRA

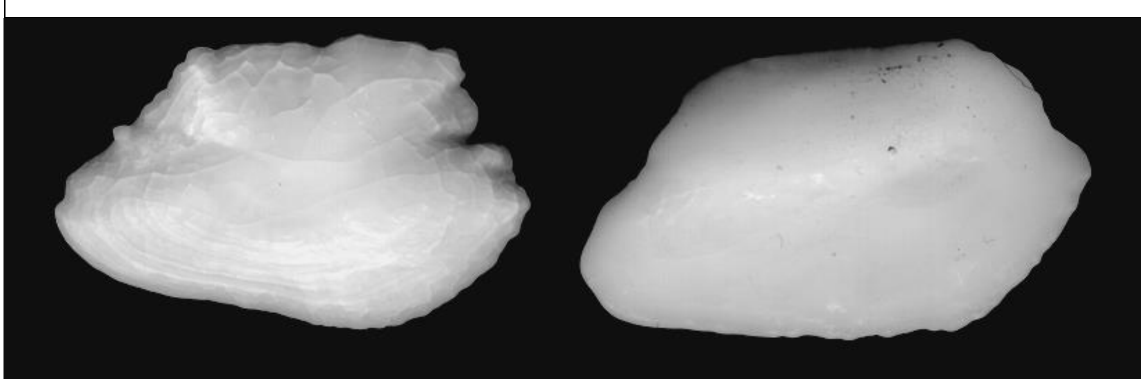
Rostrum: prominent, round
Antirostrum: small or insinuated
Pararostrum: absent
Postrostrum: absent

IIIII. SCULPTURES

Sulcus: short
Ostium: closed
Cauda: closed

JJJJJ. RATIOS [F=fish; O=otolith; L=total length; H=height or width]

FL/OL = 45.55 – 83.77 **N = 11** **OL/OH = 1.20 – 1.97** **N = 11**



Species: *Hippoglossus hippoglossus* **Family:** Pleuronectidae
Eng. name: Atlantic halibut **Fr. name:** Flétan atlantique
NSM#: 85116 **Table 77** **FL (mm) = 1,400** **OL (mm)$_x$ = 15.25**

OTOLITH MORPHOLOGY

A. GENERAL FEATURES

Shape: oval to quadrangular, round angles
Relative size: medium to small; thick

FFF. MARGINS

Dorsal: slightly convex, irregularly lobate
Ventral: slightly concave, smooth

C. ROSTRA

Rostrum: prominent, round
Antirostrum: absent
Pararostrum: absent
Postrostrum: absent

KKKKK. SCULPTURES

Sulcus: long, shallow
Ostium: closed
Cauda: closed

LLLLL. RATIOS [F=fish; O=otolith; L=total length; H=height or width]

FL/OL = 58.10 – 135..63 N = 19 **OL/OH = 1.36 – 2.00 N = 19**

Species: *Reinhardtius hippoglossoides* **Family:** Pleuronectidae
Eng. name: Greenland halibut **Fr. name:** Flétan de Groenland
NSM#: 11861 Table 78 FL (mm) = 450 OL (mm)$_x$ = 8.90

OTOLITH MORPHOLOGY

A. GENERAL FEATURES

Shape: very irregular with arched and straight sides
Relative size: medium; thick

GGG. MARGINS

Dorsal: almost straight, anterior section with long, narrow lobes and deep creases
Ventral: arched, with long, narrow lobes and deep creases

C. ROSTRA

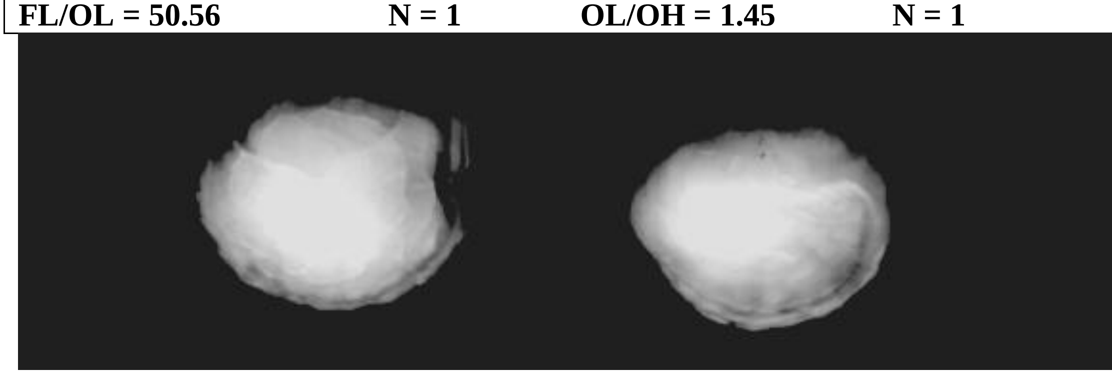
Rostrum: prominent, difficult to recognize
Antirostrum: prominent, difficult to recognize
Pararostrum: absent
Postrostrum: absent

MMMMM. SCULPTURES

Sulcus: short
Ostium: closed
Cauda: closed

NNNNN. RATIOS [F=fish; O=otolith; L=total length; H=height or width]

FL/OL = 50.56 N = 1 OL/OH = 1.45 N = 1



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Species: *Glyptocephalus cynoglossus* **Family:** Pleuronectidae
Eng. name: Witch flounder **Fr. name:** Plie frise
NSM#: 12827 **Table 79** **FL (mm) = 354** **OL (mm)$_x$ = 5.85**

OTOLITH MORPHOLOGY

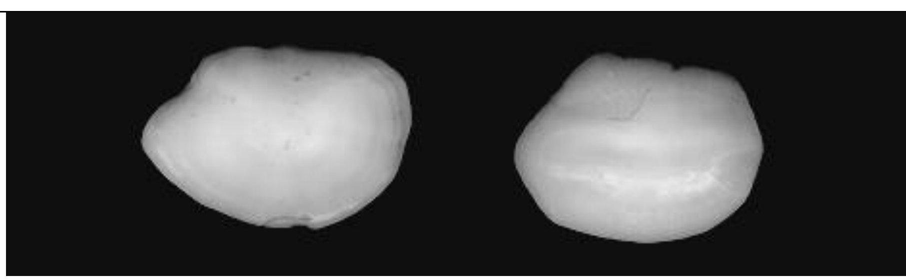
A. GENERAL FEATURES
Shape: round
Relative size: medium; thick

HHH. MARGINS
Dorsal: slightly convex, smooth
Ventral: concave or semicircular, smooth

C. ROSTRA
Rostrum: round
Antirostrum: absent or insinuated
Pararostrum: absent
Postrostrum: absent

OOOOO. SCULPTURES
Sulcus: short
Ostium: closed
Cauda: closed

PPPPP. RATIOS [F=fish; O=otolith; L=total length; H=height or width]
FL/OL = 60.50 – 75.34 N = 7 **OL/OH = 1.06 – 1.37 N = 7**



Species: *Limanda ferruginea* **Family:** Pleuronectidae
Eng. name: Yellowtail flounder **Fr. name:** Limande à queu jaune
NSM#: 85123 **Table 80** **FL (mm) = 430** **OL (mm)$_x$ = 5.75**

OTOLITH MORPHOLOGY

A. GENERAL FEATURES

Shape: lenticular
Relative size: medium; thick

III. MARGINS

Dorsal: almost straight, smooth
Ventral: concave, smooth

C. ROSTRA

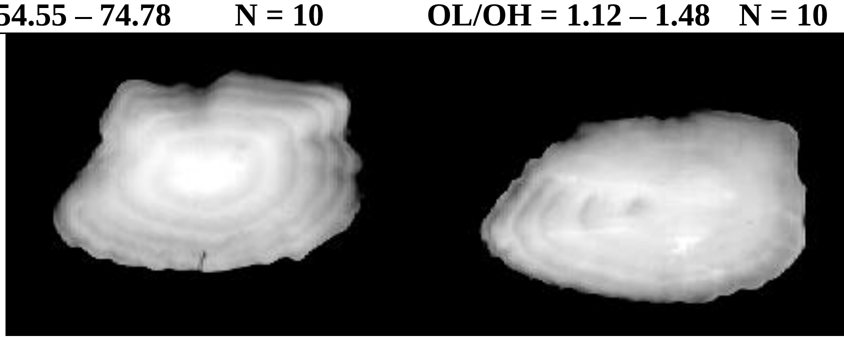
Rostrum: prominent, round
Antirostrum: insinuated
Pararostrum: absent
Postrostrum: absent

QQQQQ. SCULPTURES

Sulcus: short, shallow
Ostium: closed
Cauda: closed

RRRRR. RATIOS [F=fish; O=otolith; L=total length; H=height or width]

FL/OL = 54.55 – 74.78 **N = 10** **OL/OH = 1.12 – 1.48** **N = 10**



Species: *Pseudopleuronectes americanus* **Family:** Pleuronectidae
Eng. name: Winter flounder **Fr. name:** Plie rouge
NSM#: 85057 **Table 81** **FL (mm) = 305** **OL (mm)$_x$ = 5.20**

OTOLITH MORPHOLOGY

A. GENERAL FEATURES
Shape: lenticular
Relative size: medium to large; thick

JJJ. MARGINS
Dorsal: straight or convex, irregular outline
Ventral: slightly concave; smooth or scalloped

C. ROSTRA
Rostrum: prominent, round
Antirostrum: insinuated
Pararostrum: absent
Postrostrum: absent

SSSSS. SCULPTURES
Sulcus: long, deep
Ostium: closed
Cauda: closed

TTTTT. RATIOS [F=fish; O=otolith; L=total length; H=height or width]
FL/OL = 75.67 – 117.63 **N = 13** **OL/OH = 1.43 – 1.95** **N = 13**