CONTENTS

I. REPORT OF WORKSHOP ON AGEING TECHNIQUES IN BERGEN, 1962

At the ICNAF meeting in 1960 it was recommended that a Working Party on age-reading technique should be established with a view to resolve some of the difficulties in age determination. At the ICNAF meeting in 1961 this Working Party was urged in particular, to study (1) Techniques used in age-reading, (2) Interpretations of zone structures in otoliths, and (3) To decide on a uniform set of terms, definitions, and symbols for the study of otoliths. The final report of the Working Party should be presented at the meeting of the Commission in 1963.

These proposals were again considered at the 1962 annual ICNAF meeting in Moscow. There it was recommended that the Workshop should concentrate on the study of objective criteria for the age determination of cod, and methods of validation, with particular reference to the existing discrepancies in the age-reading of cod from Subareas 3 and 4. It was further recommended that the ICES Working Party on whiting age-reading should be invited to submit a report on their work to the Workshop.

After the conclusion of the 1962 annual ICNAF meeting, correspondence between the interested parties started. The main convenor of the Working Party, Dr. Rollefsen, became ill and was not able to participate in the preparations for the meeting. Other difficulties arose when some of the countries, who originally had intended to participate in the Workshop, withdrew for various reasons. It had previously been agreed that the main task of the Workshop was to resolve the present discrepancies in age determination of cod in Subareas 3 and 4. There were four countries most directly concerned, namely Canada, Portugal, Spain and USSR. It became clear rather late in the arrangements that from these countries only one expert, from Canada, would be present although several other people with wide experience of cod age determination problems would be present. The question of postponing the Workshop was raised with the ICNAF Secretariat, the Chairman of the Committee of Research and Statistics and others directly concerned with the outcome of the meeting. It was thought, however, that a postponement of the meeting would not guarantee the attendance of Portugal, Spain and the USSR at a later date. It was finally decided to hold the meeting on the dates originally chosen. It has been pointed out several times that it was most important to have the age determination problems cleared up as soon as possible because the discrepancies were delaying the use of the data by the ICNAF assessment group. The question was whether the rather small group of people who could finally assemble in Bergen would make a worthwhile contribution to the solution. It was decided that this group, although small, could dissect the problems, identify the sources of confusion and set out the possible explanations, in such a way that those countries not present could be expected to accept the group's findings, or, failing this, that they should be responsible for advancing very good reasons for rejecting them. It was also felt that to bring fresh ideas and wider experience to bear on these problems would be the most fruitful way of resolving them.

On November 19th, 1962, the following participants in the ageing techniques Workshop met in Bergen:

Dr.A.C.Kohler, Biological Station, St. Andrews, N.B., Canada
Dr. J. Messtorff, Institut für Seefischerei, Hamburg, Germany
Mr. S. Olsen, Havforskningsinstituttet, Bergen, Norway
Dr. Birger Rasmussen, Havforskningsinstituttet, Bergen, Norway
Mr. E. Bratberg, Havforskningsinstituttet, Bergen, Norway
Mr.B.D.Bedford, Fisheries Laboratory, Lowestoft, England
Mr.G.C.Trout, Fisheries Laboratory, Lowestoft, England
Mr.D.J.Symonds, Marine Laboratory, Aberdeen, Scotland
Mr.A.C.Jensen, Biological Laboratory, Woods Hole, Mass., USA.

In addition the following cod otolith technicians were present from the Institute of Marine Research in Bergen: Mr. A. Hansen, Mr. O. Annaniassen, Mr. A. Frøland, and Mrs. I. Sandrup.

The meeting opened at 10:00 a.m. on November 19th. Dr. Rollefsen welcomed the participants to the Workshop. He was sorry to declare that due to illness he could not participate further in the meeting. He would leave the chair to Dr. Birger Rasmussen, who would act in his place. Dr. Rasmussen took the chair and presented the preliminary agenda and timetable prepared for the meeting. He reviewed the problems to be discussed by the Workshop and the details of the meeting.

The following topics were discussed:

I. Otolith structure (G.C.Trout)

1. General and special variations.

2. Physiology of otolith formation.

3. Causal factors affecting normal change in internal otolith structure and zone formation.

4. Abnormal development as a result of tagging or disease.

5. Structural differences in different stocks and their validity.

6. Differences associated with long term changes.

II. Validation practise and the establishing of objective criteria for age reading (A.C.Kohler)

1. Review of exchange program data.

2. Examination of published age and growth data from Subareas 3 and 4.

3. Review of validation studies by Canada in Subarea 4.

4. Training and control of routine otolith reading.

5. Review of value of otolith exchange programs.

III. Standard terminology and notation for otolith age readers (A.C.Jensen)

1. Nomenclature and definitions of otolith structure.

2. Symbols and notations for laboratory use.

IV. Report on whiting age determination (Dr. Messtorff)

The following points and recommendations emerged from the discussion: It is evident that the crux of the problem which gives rise to the discrepancies in age determination from Subeareas 3 and 4 lies primarily in the complexity of the structures present in the first and second year's growth of the otoliths.

Part of the reason for this complexity results from (a) a long spawning period during the summer and early autumn, (b) the opaque material laid down during the first and second year (as evidenced by Canada's sampling of the group O and I fish) includes a varying number of hyaline zones (or checks) before the true hyaline zone is formed. (c) On the whole the earlier spawned fish are larger and have larger otoliths and more hyaline checks than the smaller later spawned fish. Juvenile material, illustrating these complex structures, and accessible only to research vessel sampling may not be available to some of the other countries working within the area. This material is available from Canada on loan.

It was stressed that ageing criteria should be based upon a sound and thorough knowledge of the juvenile otolith for each population, and should be kept under constant review. It was dangerous to apply criteria used to age one population to the age reading of another.

The Workshop was aware of the lack of evidence of what factors were involved in the changes seen in otolith structure and in particular those which occur in the first year's growth. Some current physiological and environmental studies were reported, but there is insufficient conclusive evidence available to support any particular theory on growth and differentiation in the otolith. Studies to determine cause and effect are desirable. The group also found that evidence of the effect of tagging, disease, etc. on otolith growth was inconclusive.

Discussion of the published data suggested that discrepancies might also arise from both age reading and sampling procedure, although length data available from ICNAF sources and discussed in this connection, were surprisingly consistent. In order to separate out any other factors, additional to age determination, involved in these discrepancies, the ICNAF Secretariat should request a specific and detailed note by member countries on the sampling procedures in current use. These notes should be published in conjunction with the ICNAF Sampling Yearbook. The Secretariat should finally stipulate the sampling method to be used.

In general, methods of training new staff to read otoliths, the checking of routine age reading and the periods over which checking was thought to be desirable, were relatively uniform in the countries represented at the Workshop. Transparencies of otolith photographs (35 mm) projected during the meeting by Dr. Messtorff confirmed the great value of this type of photograph for training and discussion, since it enables a large number of people to examine the same otolith and to discuss the same structure with certainty.

With regard to otolith exchange programmes, the group felt that the exchange of otoliths from countries not familiar with a particular population was of limited value. When cod otoliths are exchanged, the country supplying the sample should arrange to have them cut (not broken) in the approved position (i.e. at the interruption of the sulcus accusticus on the convex side - Rollefsen's method).

The reading of a sample of selected "difficult" otoliths, submitted by Portugal, and read by the majority of the participants, showed that the original age determinations were not biased in any particular direction. For this reason it is thought that countries interested in Subareas 3 and 4 should exchange whole samples of otoliths. Canada, Germany and the UK have already agreed to read the whole sample presented to the meeting by Portugal.

A.C.Jensen's paper "A Standard Terminology and Notation for Otolith Age Readers" was discussed, revised and adopted (a copy of the adopted paper is attached as Appendix I). This terminology and notation should be used by the readers in future otolith exchange programs. In connection with Jensen's annotation on readability of otoliths and the ICNAF General Secretary's letter of Oct.23rd, 1962, the Secretariat should state on the data sheet the form in which doubtful readings are to be reported.

A draft report on the findings of the whiting age reading group was presented by Dr. Messtorff. After discussion it was suggested by the Workshop that further clarification of some of the photographs and drawings should be made before publication. A copy of the draft report is attached as Appendix II.

APPENDIX I. A STANDARD TERMINOLOGY AND NOTATION FOR OTOLITH AGE READERS

by Albert C. Jensen
Bureau of Commercial Fisheries, Biological Laboratory, Woods Hole, Mass.

Results of the cod otolith exchange program (Anon., 1959), and the analysis of a questionnaire (Keir, 1960) distributed to biologists engaged in age determination of fishes, indicated some important disagreements between different workers, particularly in the terminology used to report their findings. Because of the fundamental importance of age data to the work of ICNAF the Standing Committee on Research and Statistics recommended at the 1960 Annual Meeting (Anon., 1960) that a working party on ageing techniques be set up to resolve these disagreements, and to draw up a uniform set of terms and symbols.

Dr. Gunnar Rollefsen was appointed Convenor of the working party that met in Bergen 19-24 November, 1962. During the meeting the working party discussed a preliminary listing of terms, definitions, and abbreviations prepared by the author. The present paper represents the consensus of the members of the working party and is prepared for use in the laboratories of ICNAF members, in otolith exchange reports, and in the preparation of papers dealing with otolith studies.

The terms have been kept as simple as possible. Preference has been given to terms that have precedence in the literature or have a valid historical basis. Quite often the oldest term is the best term.

Terms that deal with validity of methods (e.g., year-marks), and terms for which the dictionary definition has been replaced by a common usage definition (e.g., annulus) are not considered here. The proposed terms are intended to be descriptive and of a restricted nature. Also they are terms that will have a similar meaning when translated from English, the official language of ICNAF, into the various languages of the ICNAF members.

Otolith Marks

Term	Synonyms	Definition
Zones	Annuli, rings, year marks, bands, winter rings, summer rings, growth rings	Bands of concentric hyaline or opaque material seen in otoliths and counted for age determination.
Check	Check mark, check ring, false ring, secondary ring, secondary zone, split	Hyaline matter not counted in age determination. Checks are sometimes indistinct, discontinuous or, in the judgement of the reader, do not meet the criteria established for identification as a year mark.

Term	Synonyms	Definition
Nucleus	Focus, center, origin, kernel	The central area of the otolith bounded by the first check or zone. (In most laboratories the center of the otolith is not fully understood, thus many biologists have not yet developed a firm definition for this term.)
Opaque edge	Summer edge, fast-growth edge, dense edge	The otolith periphery composed primarily of opaque material.
Hyaline edge	Winter edge, slow-growth edge, translucent edge	The otolith periphery composed primarily of hyaline matèrial.
Spawning zones	Spawning marks, spawning rings	Hyaline and opaque zones formed in the otolith from the onset of sexual maturity. In general, both hyaline and opaque zones of spawners are uniform in size and form, and the opaque zones are distinctively narrower than those formed during the immature period of the fish's life. The hyaline spawning zones are clear and usually free of opaque material; in many species (e.g. cod) they are frequently broader than the subsquent opaque zones.

Readability of Otoliths

A system of number notations is proposed to grade the readability of the otoliths. Such notations will also serve as a guide to the reliability of the ages determined for each otolith. The numbers will permit use of these notations in IBM and similar machine systems.

Notation and term	Definition
0 - - Good	The zones are plainly visible with generally good definition between hyaline and opaque zones. Any check readily identifiable as such. The reader has a good decree of confidence in resulting age determination.
1 - - Fair	The zones are visible but not well defined. There are many checks present. The reader has fair degree of confidence in resulting age determination. In many otoliths the zones may form distinct patterns that make reliable age determinations feasible.

Term	Definition
2 - - Poor	The zones are vaguely marked.. Otoliths with zones so poorly defined as to be undecipherable, or where the age is merely estimated, are placed in this category.

Abbreviations and Symbols

It is desirable to keep abbreviations and symbols to a minimum and as simple as possible. Any lengthy comments on the appearance of the otolith and its markings, or on the degree of confidence of the determined age, are best made in an appropriate remarks' column on the form used to record the results of the otolith reading.

Asterisks, plus and minus signs, or other addenda to the age notation, serve only to clutter the data. When comparing the results of duplicate otolith readings, the reader's first concern is, "Do the ages agree?". After this, the question may be asked, "Why did the duplicate readings agree (or disagree)?" Symbols and remarks will serve to answer the second question, but they should not clutter the sheet such that, after the otolith has been studied and an age assigned, the data sheet must be studied to find the notation of age.

Type of edge growth

Determining the type of growth (hyaline or opaque) seen at the edge of the otolith can, at times, be difficult and sometimes depends upon the subjective judgement of the reader. Final determination of the type of edge growth is influenced by the manner in which the otolith is cut or broken for reading and usually the beginning of the new growth is best seen at the narrow tip of the long axis of the otolith. These factors must be taken into consideration by the reader when he records his observation of the type of edge growth. Since the type of edge growth is used to translate age determinations from zone counts, recognition of the edge type is essential to the otolith reading process. To help in this recording, the following abbreviations are proposed:

Hn	- narrow hyaline zone at edge	(1)
Hw	- wide hyaline zone at edge	(2)
On	- narrow opaque zone at edge	(3)
Ow	- wide opaque zone at edge	(4)

For card punch systems (IBM, Keysort, etc.), the numerical notation may be substituted for the abbreviation, but care should be exercised to avoid confusing the edge code number with the age or zone-count number.

Checks

$C_{3,4}$ - check in third and fourth opaque zone

Spawning zones

12(4s) - total of 12 zones of type counted, 4 of which are spawning zones

Age notation

9 - clearly, nine completed zones of the type counted
9(10) - probably nine, possibly ten completed zones
(8)9(10) - probably nine but possibly eight or ten completed zones
12(?) - best estimate of count from ambiguously marked otolith

Literature Cited

Anon. 1959. Report of the ad hoc subcommittee on the ICNAF cod otolith exchange program. Report of the standing committee on Research and Statistics, ICNAF 1959 Annual Meeting. Appendix III, pp.48-50.

Anon. 1960. Report of subcommittee on Ageing Techniques. Report of the standing Committee on Research and Statistics, ICNAF 1960 Annual Meeting. Appendix X, p.37.

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APPENDIX II. AGE DETERMINATION IN THE WHITING (MERLANGIUS MERLANGUS (L.)) BY MEANS OF THE OTOLITHS

by

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and

J. Messtorff
Institut für Seefischerei, Bremerhaven

Introduction

In recent years interest in the whiting stocks of the North Sea and adjacent waters has increased considerably. This is due in part to the greater demand for the fish in certain countries (e.g. Scotland), and also because of the concern felt in some quarters about the possible effects on the whiting stocks of certain fisheries employing small mesh nets. This interest has heightened the need for a better understanding of the general biology of the whiting, and especially of aspects bearing particularly on population studies, including age and size composition of the stocks and possible stock separation and identification.

Age determinations have therefore been of great importance in the investigations into the whiting populations which have been carried out by workers in a number of European countries. In 1959 a programme of exchanges involving material, methods and readings was initiated between the whiting workers, and this programme was formally recognised and encouraged by ICES, in 1960, in setting up a working group to study age determination methods and to reach agreement on the results of age readings for whiting.

The members of the working group were:

R. Gambell (Scotland), convener
L. Hannerz (Sweden)
J.P. Hillis (Republic of Ireland)
H. Knudsen (Denmark)
J. Messtorff (German Federal Republic)
M. Roessingh (Netherlands)
D.W.R. Rout (England)
D. Sahrhage (German Federal Republic)

Meetings were held between members of this working group, in addition to the exchanges of material and results, and this paper deals with the conclusions reached as a result of these activities.

Methods of Age Determination

The ages of fish can be estimated, ideally, from the annual growth rings on the scales, the growth zones in the otolith or other skeletal structure, or by Petersen's (1895) method. For the whiting however, only the otolith provides a practical and reasonably reliable basis for age determination of older fish. The scales from young whiting are readable, but they become increasingly difficult in fish older than about four years of age. Petersen's method is difficult after the first year of life in most areas off north-western Europe, probably because of the long spawning season of whiting. This causes each year-class to have an extended length range, and consequently results in consecutive year-classes overlapping very considerably on a length scale. It is therefore not very reliable (Graham 1928). Vertebrae, spines and some bones of the head all show seasonal growth zones which can be interpreted to give the age of the fish, but as with the scales, they become increasingly difficult with age, and also suffer from the disadvantage of being difficult to collect in some cases.

This leaves the otolith, which gives an estimate of the age of the whiting over the whole life span of the fish. It is capable of interpretation for most fish from all the areas studied, and this paper provides the standards for interpretation arrived at by the working group.

The Structure of the Whiting Otolith

The otolith of the whiting has been described by Bowers (1954) from fish in the waters around the Isle of Man. This description applies equally well to the otoliths from the North Sea and adjacent areas. The important features of the structure of the otolith from the age determination point of view are the alternating opaque and hyaline zones, one of each zone being laid down at the edge of the otolith each year. There is no final proof that this is the case but observations of the edge of the otolith throughout the year provides strong evidence that it is so. Fig. 1 illustrates the type of edge found on the otoliths of northern North Sea whiting for each month of 1961. The data were obtained from monthly market samples, each containing 150 fish of all ages from one year old upwards, and all sizes from 25 cm and over. They demonstrate quite clearly the alternation of the two edge types, the opaque zone being formed in the summer and the hyaline zone in the winter.

Time of Zone Formation

From Fig. 1 it can be seen that in the northern North Sea the hyaline zone begins to appear on the edge of the otolith in September. During the following months it becomes broader, until by December-January the formation of the winter (hyaline) zone seems to be completed. The opaque zone starts in April, and continues on the edge of the otolith for the next four months. These timings appear to hold over the entire North Sea area, as Messtorff (1959) has shown, although there may be slight variations from one year to the next. Generally, the variations range over no more than one month

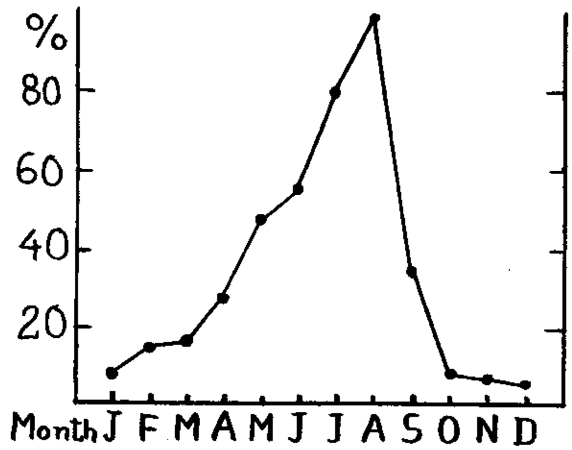


Fig. 1. Percentage of Northern North Sea whiting otoliths showing opaque edges in each month of 1961.

either way. Within these timings there is a relationship between the start of zone formation and the size and age of whiting. Immature fish start earlier than mature fish; for example, immature whiting at the end of their first or second year of life often have opaque edges to the otolith by March. Among mature fish also, the younger ones begin earlier than the older ones. When assessing the age of a whiting from the bands of growth in the otolith, considerations such as these of the time of zone formation and possible slight variations from the normal must be borne in mind in the interpretation. To avoid difficulties which may arise, for instance, when comparing age readings by different workers, the standard birth date for whiting of April 1st was adopted by the working group members for the interpretation of age-groups (Gambell et al., 1960).

Comparison of the more usual times of zone formation in the North Sea with those of whiting from the French Atlantic coast (Desbrosses, 1948), and the Isle of Man waters (Bowers, 1954), shows that the North Sea fish start to form both their zones rather earlier than do the other two. In the French Atlantic area the opaque growth starts in May, and in the Isle of Man area it appears in June. The hyaline zone in both these areas starts in January.

Further evidence that the growth zones are annual structures is provided by the catches of the good whiting broods of 1952 and 1955 in the North Sea over a number of years, as shown in the following table.

Annual percentage age composition of whiting caught by Scottish research vessels in the northern North Sea

Sampling year	1956	1957	1958	1959	1960
No. of hyaline zones in otolith	%	%	%	%	%
1	27	5	8	51	32
2	18	54	12	23	43
3	11	19	50	3	21
4	28	5	14	16	1
5	13	14	3	2	3
6	2	3	11	1	+
7+	1	+	2	4	+

These data show that there were peaks in the distributions corresponding to whiting with four hyaline zones in their otoliths in 1956, five hyaline zones in 1957 and six in 1958. It is reasonable to assume that these peaks can be attributed to the same brood each year, in which case an extra hyaline zone must have been added to the otoliths each year. This good brood corresponds with the 1952 year-class. Similarly, a peak in the distributions for whiting with two hyaline zones in 1957, three in 1958, four in 1959 and five in 1960 can be attributed to a single good year-class, that of 1955. This again suggests that a hyaline zone is added annually to the otolith.

Techniques of Otolith Reading

With some whiting otoliths the hyaline and translucent zones can be seen clearly in the whole otolith. By viewing the otolith in transmitted light, or in reflected light against a dark background, the alternating bands can be distinguished. This method of reading is not satisfactory for all otoliths however, since with increasing age the otoliths become thicker, and the growth zones are obscured. It is then necessary to view the otolith in section, and there are two main methods employed.

The quickest technique, and the one most generally used by members of the working group, is to break the otolith across transversely, and to mount the half otolith in plasticine, or a similar soft bed of material. The broken surface, which may be ground smooth to make it easier to read, is brushed with a clearing agent such as xylol or terpineol, and viewed under a binocular microscope by transmitted light. The extreme surface is shaded from the laterally directed light beam, and by altering the degree of shading, the growth zones can be made to stand out in sharp contrast to one another. This arrangement is illustrated in Fig. 2. By this method the translucent zones appear as bright bands and the opaque zones as dark ones. The otolith photographs shown in this paper were taken using this technique.

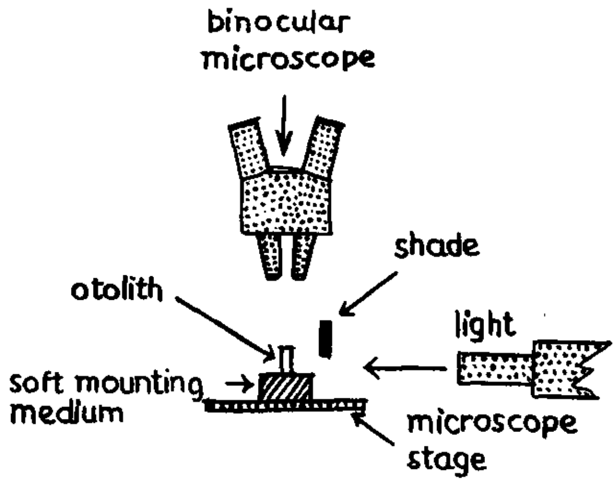


Fig. 2. Method of viewing otolith by transmitted light.

The second method of viewing the transversely broken otolith is by direct light against a black background. The otolith is submerged in xylol or alcohol in a black dish as in Fig. 3, and using this method the translucent zones appear dark and the opaque zones bright. Shading the broken surface to various degrees again increases the contrast between the light and dark bands. The photographs of otoliths published by Messtorff (1959) were taken by this method.

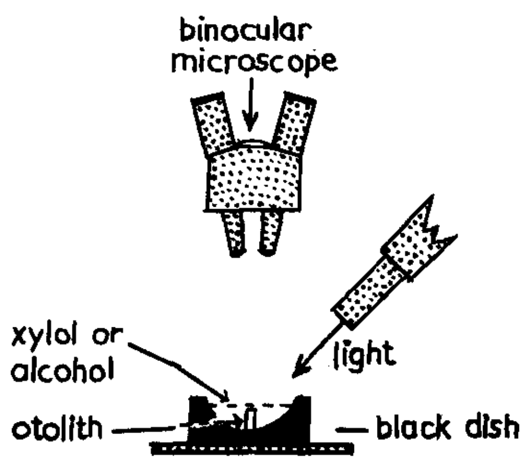


Fig. 3. Method of viewing otolith by direct light.

Interpretation of Zones in Whiting Otolith

As a basis for the standardisation of age readings from the otolith, material from whiting in the northern North Sea was selected. Otoliths from fish in this area are probably the least difficult to read of all those studied, the hyaline zones being generally quite compact bands, with a few or no false rings to confuse the picture.

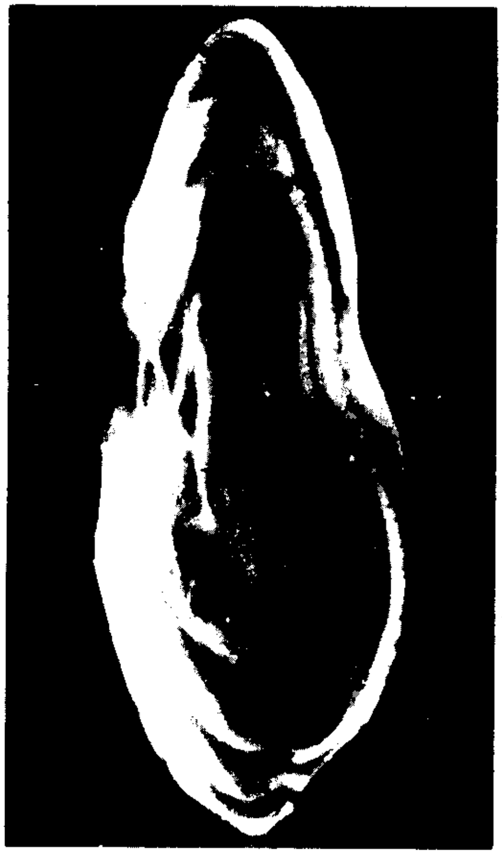
What might be called the 'standard' northern North Sea type of otolith is illustrated in Fig. 4. This shows an otolith with four fairly compact hyaline zones, corresponding to four winters' growth. The fourth hyaline zone is right on the edge of the otolith. This can be compared with an otolith showing a well formed opaque edge, for example, Fig. 5, taken from a fish caught in August. The most easily read sector of the otolith in the majority of fish is indicated in Fig. 4. This particular otolith also shows a hyaline central zone, or 'nucleus', which is not always found in the North Sea otolith. Fig. 5 is an example of the opaque type of centre.

Very often there is a tendency for the second hyaline zone to appear as a double structure, almost as though it was composed of two unusually thin hyaline bands separated by a very thin opaque band. An example of this type of otolith is shown in Fig. 6, where the double appearance also occurs in the third winter zone. That this sort of double band is in fact one winter's growth can be seen in the example given by the fact that the two bands of the second winter unite on the opposite side of the otolith. The spacing of the hyaline bands is also an indication that the true winter zones are double, as annual hyaline zones as thin and closely packed as these are not a feature of the whiting otolith. Further confirmation of the double zone as a single winter's growth is given in Fig. 7, where the formation of such a zone is shown taking place on the edge of the otolith. This otolith was undoubtedly from a fish in its second winter of life, both from its size (male, 23 cm) and from its scales, which showed two clear winter zones.

Fig. 7 also illustrates the narrower type of hyaline band found in the whiting otolith, which can be contrasted with the broader form in Fig. 4, and the components of the double bands in Fig. 6. This otolith also exhibits the opaque nucleus type found in the North Sea.

Bowers' Zone

Difficulties in interpretation of the zones of the otolith are caused not only by the formation of double bands, but also by hyaline bands which are not annual growth structures. One of these false bands is shown in Fig. 8. In the central part of this otolith there is a thin hyaline zone inside the first true winter zone. Such a formation has been described by Bowers (1954) as being laid down around the central core of the Isle of Man whiting otolith in August. It appears to be present in North Sea whiting when they take up the bottom-living habit, in about July or August of their first summer of life. It may be



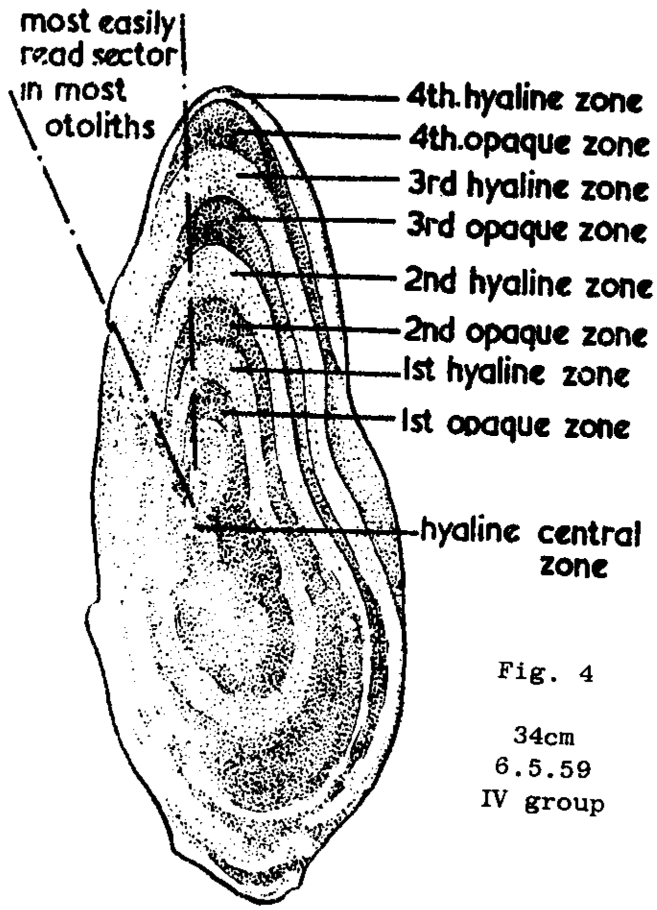


Fig. 4

34cm
6.5.59
IV group

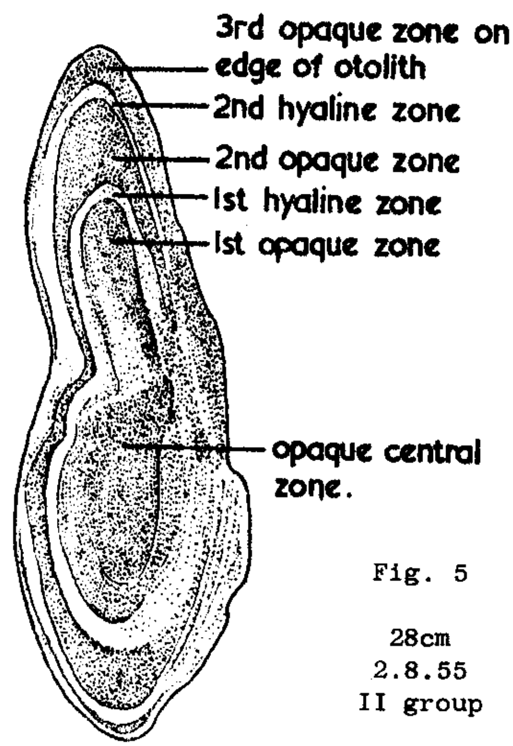


Fig. 5

28cm
2.8.55
II group

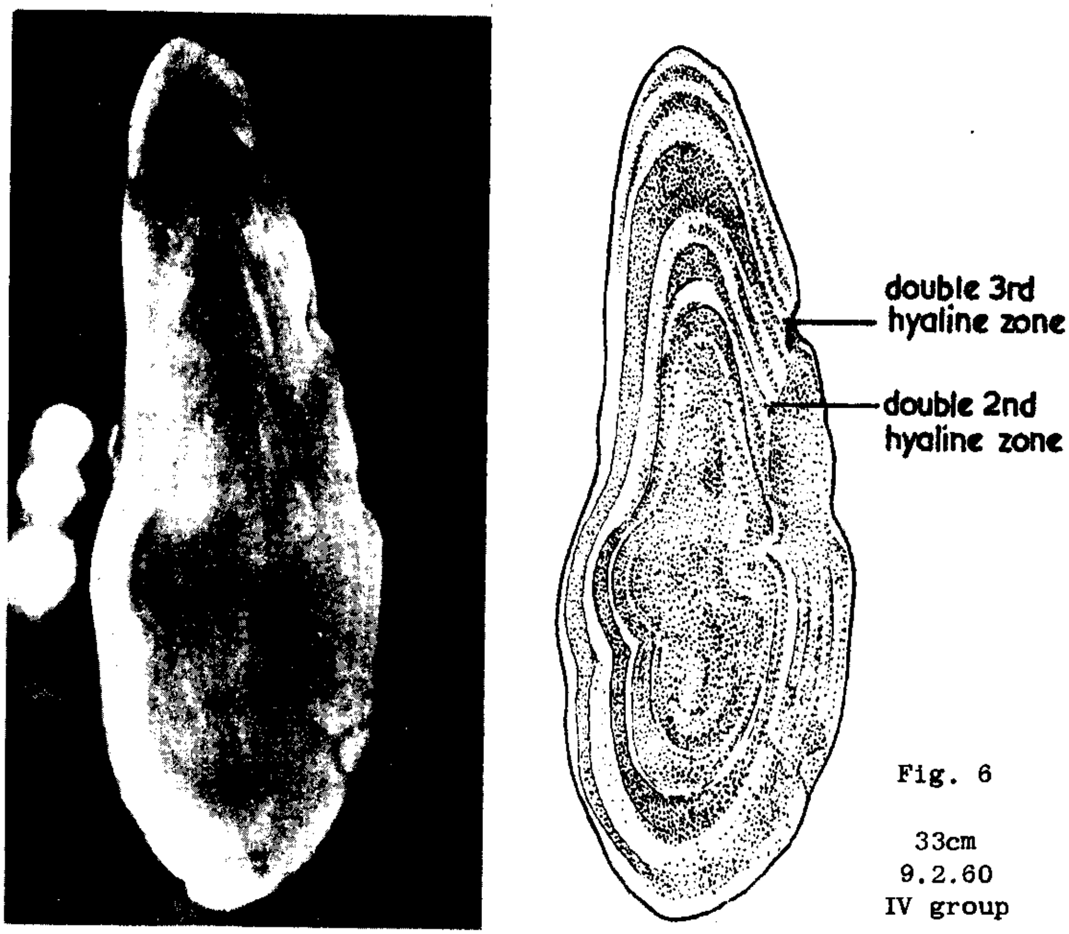


Fig. 6

33cm
9.2.60
IV group

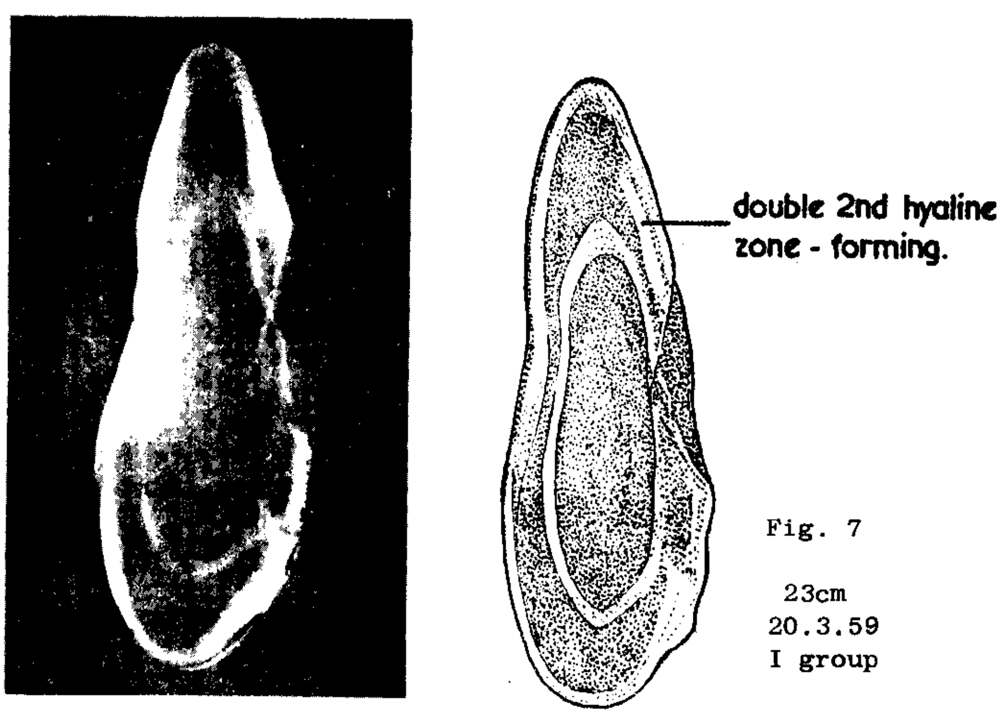


Fig. 7

23cm
20.3.59
I group

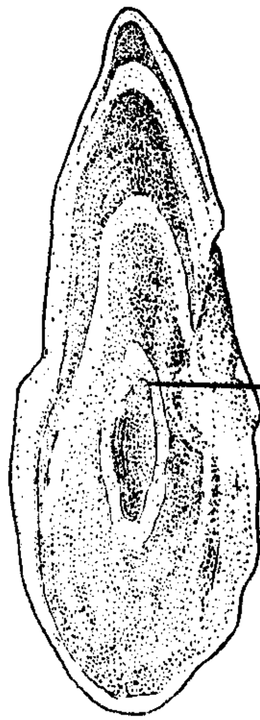


Fig. 8

32cm
9.2.60
II group

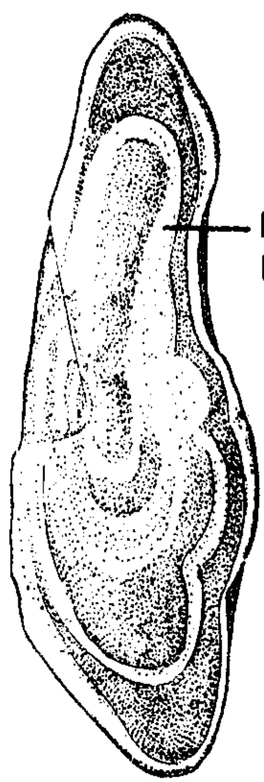


Fig. 9

31cm
6.5.59
II group

that the "Bowers' zone" is connected with this change from the pelagic to the demersal habitat, together with the associated change in feeding.

Broad First Hyaline Zone Type

Some North Sea otoliths present the appearance shown in Fig. 9, where the first annual hyaline zone is much larger than normal, and the centre of the otolith is composed of a confused mass of hyaline and opaque bands. In the example given, it is considered that there is not a true annual hyaline zone in this central area, and that the otolith was from a whiting in its second winter.

A possible explanation for this phenomenon lies in the very crenulated appearance of the otolith of a whiting during its first year of life (Fig. 10). When the otolith is broken across, the break may occur at any position on the crenulations. If the break happens to fall across two projections on opposite sides of the first hyaline zone, then this zone will appear rather larger than usual in cross-section.

Otoliths which show crenulations in the first hyaline zone are illustrated in Figs. 11 and 12, where the indentations in this zone can be clearly seen. The otolith in Fig. 12 also shows a double second hyaline zone.

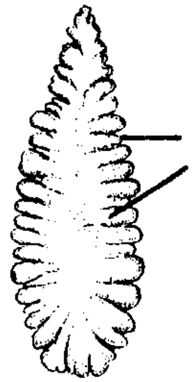
Spacing of Zones

Some otoliths are difficult to read because there are many hyaline zones which cannot be easily followed round the entire otolith. In places it may even seem as if they run into one another, and the whole picture is quite confused. An example of this is shown in Fig. 13. The two inside hyaline zones are close together and the outer zones tend to be double. It may be thought that the two inside bands are really the two parts of a double zone also, but they are not interpreted in this way as each of these bands has the appearance of a normal hyaline zone, despite the relatively close positioning of the two zones.

An example of an otolith with two hyaline bands in the centre which are not regarded as separate years' growth zones is shown in Fig. 14. Here the outer of the two central hyaline bands is very thin and unlike a normal annual zone. The spacing of the bands also indicates that it is not a true zone. Generally, the distance between the first and second annual hyaline bands is greater than that between any other two adjacent zones. From the second annual hyaline zone outwards the spacing is regular with the alternating opaque and translucent bands gradually becoming narrower towards the edge of the otolith (Fig. 15). This is not true for the otolith in Fig. 14 unless the first two hyaline bands are interpreted as a single zone or the second band is regarded as a false band. The two inside hyaline bands of the otolith in Fig. 13 can be interpreted as separate annual zones without upsetting the usual spacing pattern, and so these two otoliths are interpreted differently from one another.

Fig. 10

Whole otolith,
o-group
(by reflected
light)
12cm
2.8.55



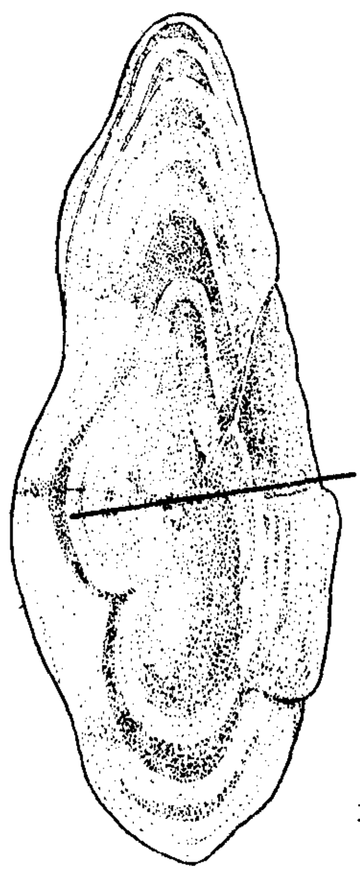


Fig. 11

34cm
9.2.60
IV group

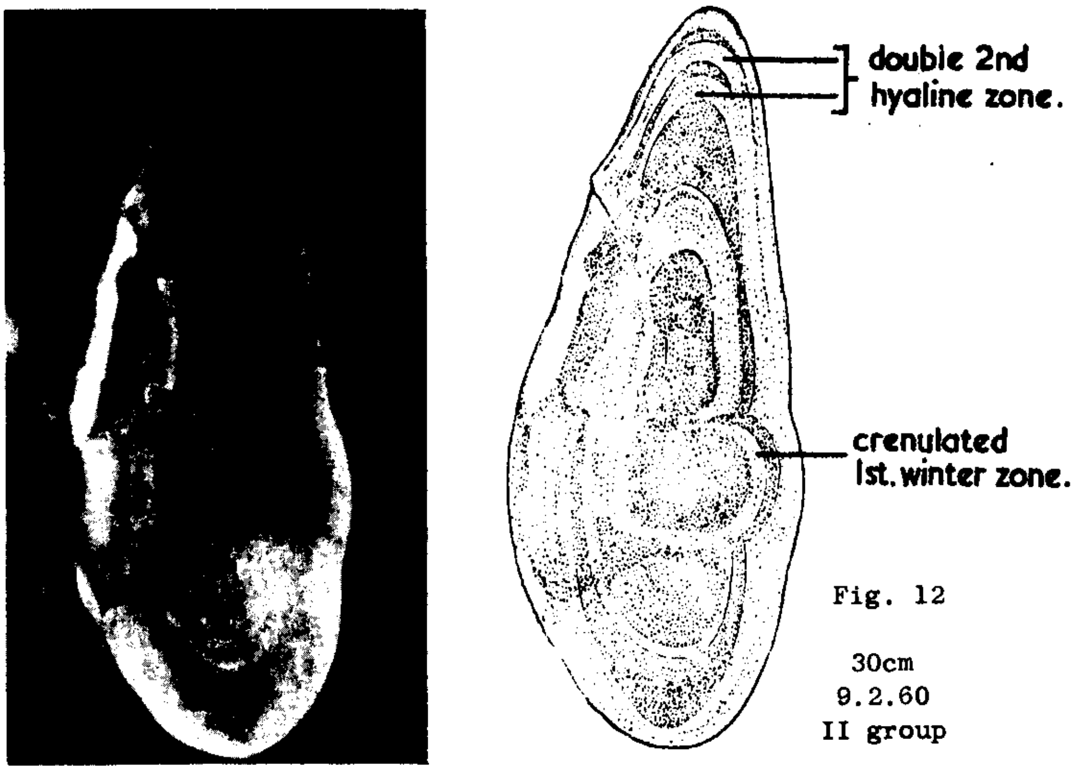


Fig. 12

30cm
9.2.60
II group

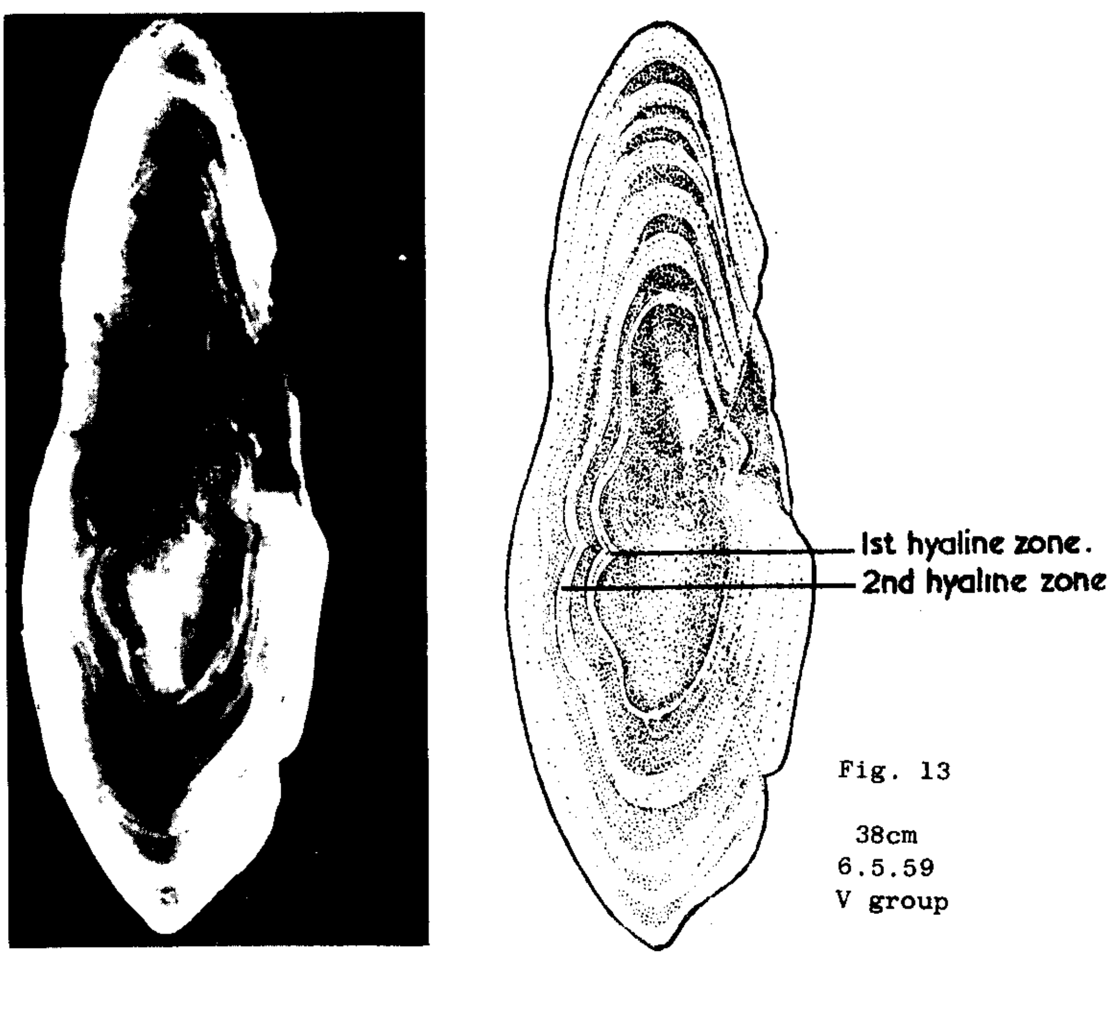


Fig. 13

38cm
6.5.59
V group

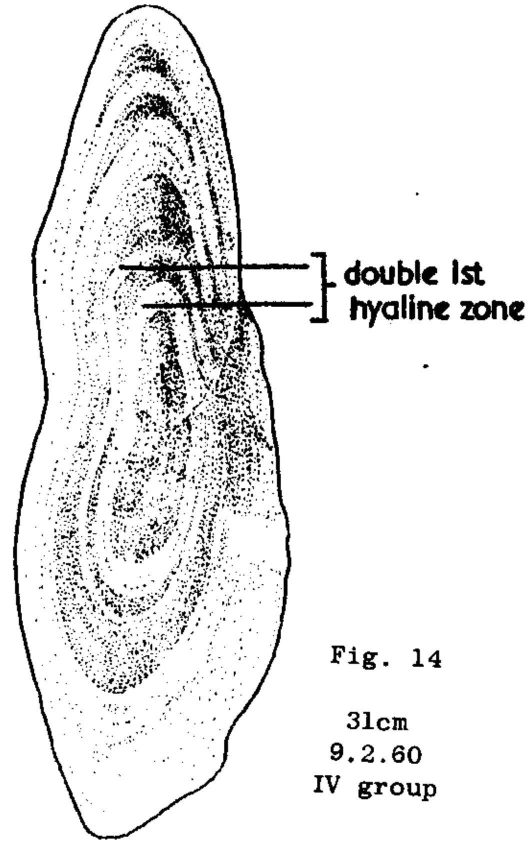


Fig. 14

31cm
9.2.60
IV group

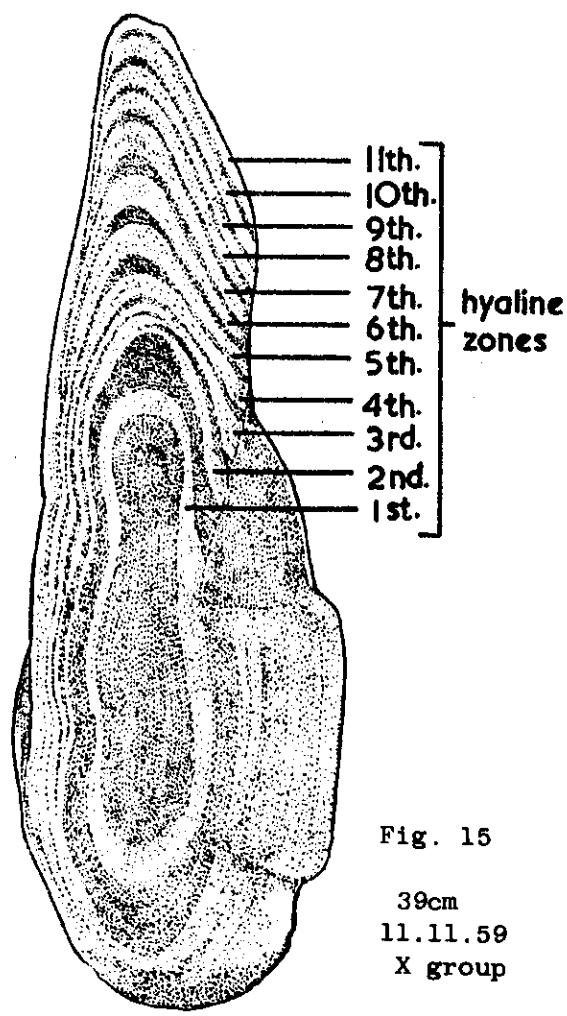


Fig. 15

39cm
11.11.59
X group

Otoliths from Other Areas

The methods of interpretation outlined for otoliths from the northern North Sea apply equally well to otoliths from whiting caught in other areas. Some differences in the appearance of the otoliths from these areas can be mentioned however. As has been said already, the northern North Sea type of otolith is probably the clearest and most straightforward of all those examined. In other areas the hyaline bands are not always such compact structures as those illustrated from the northern North Sea, but tend to be made up of many fine hyaline lines which can be distinguished from one another in the annual band. This results in the alternating opaque and hyaline zones being less sharply differentiated when the otolith is seen in transverse section. This diffuse otolith type is found in the Clyde, Irish Sea and Skagerak areas, and is illustrated in Fig. 16. The otoliths from southern North Sea whiting are not so diffuse as this, but even so, are less clear than the northern North Sea type.

Summary and Conclusions

The whiting otolith is a convenient and reliable structure from which the age of a fish can be estimated. The main methods of reading the otolith, by transmitted or direct light, are described, while the chief difficulties met in the interpretation of the otolith are illustrated. These include the presence of double bands and other zones which are not annual structures. The size and spacing of the growth zones are considered, and it is concluded that by taking into account the general appearance of the otolith, the normal spacing and form of the zones, and the time of zone formation, a reliable age determination is possible for whiting from all sea areas off northwestern Europe.

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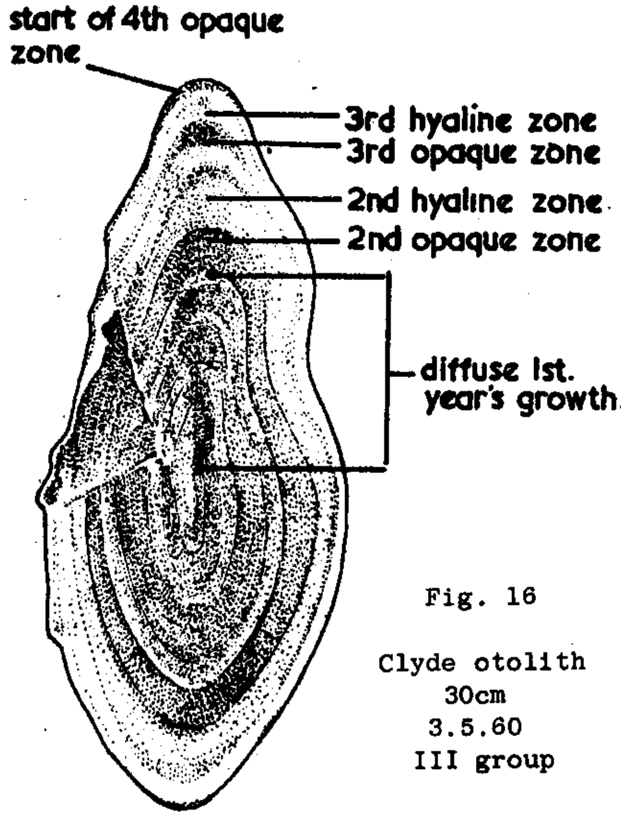

Fig. 16

Clyde otolith
30cm
3.5.60
III group

II. SELECTIVITY DIFFERENCES BETWEEN CODENDS MADE OF NATURAL AND SYNTHETIC FIBRES, IN THE ICNAF AREA

by B.B.Parrish
Marine Laboratory, Aberdeen

Introduction

At the meeting of the Standing Committee on Research and Statistics in 1962, it was agreed that an analysis should be made of the available experimental data for the ICNAF area, on the differences in selectivity between codends made from different materials, with special reference to the heavier, natural fibre twines (e.g. manila) and the "lighter", synthetic fibre ones now in common use in the commercial fisheries. This report summarises the results of an analysis of such data available to the author. A comparison is also made with experimental data for the north-east Atlantic, as contained in relevant ICES documents, especially the "Report of the Mesh Selection Working Group".

Experimental Data

As shown in the 1962 Meeting document No.6 most of the reported codend selectivity data for the ICNAF area are from experiments with codends made from manila twines of various runnages and mesh sizes. Only for cod in Subarea 4 (Canadian experiments), haddock in Subareas 4 and 5 (Canadian and U.S. experiments), silver hake in Subarea 5 (U.S. experiments) and American plaice in Subarea 4 (Canadian experiments) have selectivity data for synthetic codend materials also been reported. Furthermore, in very few of these experiments were direct comparisons made between the selectivities of codends of different materials at the same place and time. Therefore, an estimation of the differences in selectivity between materials has to be made from comparisons of data from experiments made mostly in different localities (divisions or subdivisions) and at different times (months or years). Also, the catch size and composition, the runnages of the materials and the mesh sizes of the codends were not the same for all materials. However, an inspection of the selectivity data for cod and haddock, in the mesh size range 100-168 mm (cod) and 73-167 mm (haddock) for manila and nylon (single and double) shows no clear relation between selection factor (SF = $\frac{\text{50\% retention length}}{\text{Mesh size}}$) and either runnage, mesh size or catch size. Therefore, in this analysis no account has been taken of differences in catch size, and the selection factors have been used as indices for comparing the selective properties of the different materials. The selection ranges have also been compared.

In all cases, the selectivity data were obtained from "covered codend" experiments.

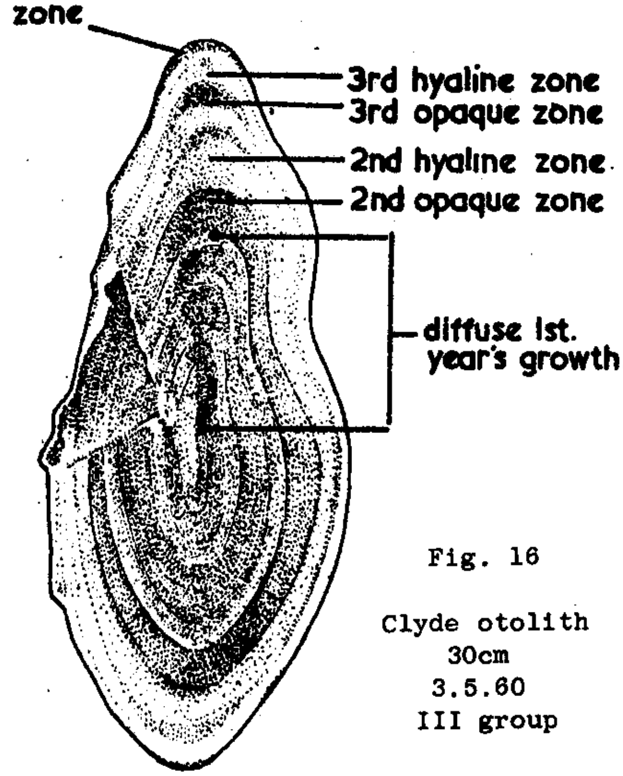

Fig. 16

Clyde otolith
30cm
3.5.60
III group

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In all cases, the selectivity data were obtained from "covered codend" experiments.

Differences Between Selection Factors

(a) Cod

The only ICNAF region for which cod selectivity data are available for a range of codend materials is Subarea 4 (Canadian experiments). The selection factors for experiments made in divisions 4T, and 4V-W, over the period 1953-1960 are given in Table 1. These results show that, despite many fewer data for cotton and the synthetic fibres than for manila, in all cases, the selection factors for them were higher, and outside the range of values for manila. The percentage differences between the mean value for each material and the overall mean for manila in all experiments are as follows:-

Single Cotton	- D. Manila;	8.0%
Single Nylon	- D. Manila;	13.6%
Double Nylon	- D. Manila;	12.4%
Single Terylene	- D. Manila;	21.0%
Courlene	- D. Manila;	15.4%

(b) Haddock

Haddock selectivity data for manila and other materials are available for Subareas 4 (Canadian experiments) and 5 (U.S. experiments). The selection factors for these experiments (excluding those in which topside chafers were used) are given in Table 2. With the exception of the one experiment with single, braided "dacron", these results although exhibiting greater variability, show, as with cod, higher selection factors for the experiments with cotton and the synthetic fibres than for those with manila. The corresponding percentage differences between the mean values for each of these materials and the overall mean for manila are as follows:-

Single Cotton	- D. Manila;	5.6%
Single Nylon	- D. Manila;	14.3%
Double Nylon	- D. Manila;	12.7%
Single Terylene	- D. Manila;	14.9%
Single Dacron	- D. Manila;	-3.7%

(c) Silver Hake

Selection data for silver hake with manila and other materials are available from U.S. experiments in Subarea 5. The selection factors for these experiments (excluding two made with the very small mesh sizes, 35 and 40 mm), are given in Table 3. As pointed out by Clark (1957), the selection factors for this species are substantially lower and more variable than are those for other roundfish species, having similar length/girth relationships. Also, the selection factors appear to increase with increase in mesh size. However, the above results agree with those for other species in showing higher selectivities for nylon and cotton (compared with the overall mean value) than for manila (both double and single braided). The percentage differences between the overall means for all experiments are as follows:-

Single Cotton	- D. Manila;	7.0%
Single Nylon	- D. Manila;	21.4%

(d) American Plaice

Data for American Plaice, from Canadian experiments in Subarea 4, with codends made from double manila, single cotton, single nylon and courlene are given in Table 4. Again, with the exception of the one experiment with courlene, the selection factors for single cotton and single nylon are substantially higher than those for double manila. The percentage differences between the overall means are as follows:-

Single Cotton	- D. Manila;	19.6%
Single Nylon	- D. Manila;	10.1%
Courlene	- D. Manila;	-

Differences Between Selection Ranges

In addition to the selection factors for the different materials, data are also available for their "selection ranges" (the 75% retention length - 25% retention length). The mean values for cod, haddock, silver hake and American plaice, from experiments in which approximately the same mesh sizes were used, are given in Table 5. These results indicate that in the Canadian experiments on cod and haddock in Subarea 4, the selection ranges for the double manila codends were, on average, 2-4 cm larger than for the cotton and synthetic fibre ones (except courlene). However in the American experiments for haddock in Subarea 5, the ranges for double manila and single nylon were approximately the same. As with the selection factors, the selection range for silver hake varied widely between experiments, but in contrast to cod and haddock, they were larger for cotton and single nylon than for double manila. For American plaice also, they tended to be higher for the synthetic fibres than for manila (but lower for single cotton).

Discussion

With the exception of single experiments with courlene (American plaice) and dacron (haddock) the above results of experiments carried out in the ICNAF area show substantially higher average selection factors for cotton and the synthetic fibre codends than for the manila ones. Since these results are from experiments conducted at different places and times and for a range of mesh and catch sizes only rough estimates of the differentials between materials can be made, but for the two major roundfish species, cod and haddock, it seems that, on average, the 50% retention lengths are, for single cotton, 5-10% and for the main polyamide and polyester synthetic fibres 12-20% greater than those for double manila codends of the same mesh size. These results are broadly the same as those for experiments carried out in the north-East Atlantic (see ICES, "Report of Mesh Selection Working Group Meetings in Copenhagen, December 1959 and 1960"). For example, the results of experiments carried out in the north-eastern part of the ICES area show average differences, for cod, of 10-12% between the selection factors for double nylon and double terylene, and that for double manila. Results for other parts of the ICES area (e.g. North Sea) show similar differences for other roundfish species (e.g. haddock and whiting).

The selectivity differentials for the ICNAF area are based on the differences between the average selection factors for the experiments made with each material. For some of these, twines of different runnages were used; thus, the double manila twines had runnages ranging between 45-75 yds/lb; and there were differences between the constructions and runnages of the double and single nylon twines. An examination of the selectivity data for cod and haddock from the experiments with different runnages of manila show a very small and non-significant increase in average selection factor with increase in runnage, over the range 45-75 yds/lb. Also, the selection factors for these runnages are within the range of those obtained in the north-east Atlantic with manila twines of much higher runnages (112-150 yds/lb). Therefore, the selective properties of double manila twines can be treated as independent of runnage, within the range of twines used in the main commercial fisheries. On the other hand, as the results for haddock in Table 2 show, there were large differences between the selection factors in different experiments with both single and double nylon twines, which might be associated with differences in runnage. However, it is not possible from the data available to determine whether these were associated with runnage and/or construction, or with differences due to times and locality. Further experiments, with nylon twines of a range of runnages, conducted at the same place and time are required.

Another feature of the results was the small differences between the selectivities of single and double braided codends of the same material. This is shown for both cod and haddock with single and double nylon codends and for silver hake for single and double manila. This is again in general conformity with results of experiments in the north-east Atlantic.

The results for cod with a courlene (polyethylene fibre) codend are of interest in showing comparable selectivity with the polyamide and polyester fibres. This is in marked contrast with the results of experiments in the north-east Atlantic, which show courlene to have selective properties similar to manila rather than to the synthetic fibres. However, the results for American plaice in the ICNAF experiments are of this nature.

Although the selection ranges varied widely for the different species and materials, and for different experiments with one material, the results show that, for the two main species, cod and haddock, selection was, on average, sharper with the synthetic fibres than with double manila.

Summary

The published results of codend selectivity experiments with trawl codends of different materials were compared. These show substantially higher selection factors for single and double nylon, (polyamide fibre), single terylene (polyester fibre) and single cotton codends than for double manila ones. Courlene (polyethylene) gave variable results. Average differences of 5-10% for single cotton and 12-20% for single and double nylon and single terylene were obtained for the principal roundfish species, cod and haddock.

No significant differences were detected between single and double braided nylon and manila twines or between double manila twines of different runnages.

The selection ranges for cod and haddock tended to be 2-4 cms smaller with the synthetic fibres (nylon and terylene) codends than with double manila ones.

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Clark, J.R. 1957. Escapement of silver hake through codends. Summary of US experiments. Doc. no. S.26, ICNAF-ICES-FAO Joint Scientific Meeting. Lisbon.

TABLE 1. MEAN SELECTION FACTORS FOR COD. SUBAREA 4. 1953-60. RANGE OF MESH SIZE 102-168 MM (4"-6 5/8")

SUB-AREA	DIV.	YEAR	MANILA 1) DOUBLE MEAN* S.F.	MANILA 1) DOUBLE RANGE OF VALUES	COTTON SINGLE MEAN* S.F.	COTTON SINGLE RANGE OF VALUES	NYLON SINGLE MEAN* S.F.	NYLON SINGLE RANGE OF VALUES	NYLON DOUBLE MEAN* S.F.	NYLON DOUBLE RANGE OF VALUES	TERYLENE SINGLE MEAN* S.F.	TERYLENE SINGLE RANGE OF VALUES	COURLENE ? MEAN* S.F.	COURLENE ? RANGE OF VALUES
4	V-W	1953	3.3	3.1-3.5(7)	-	-	-	-	-	-	-	-	-	-
	"	1956	3.5	(3)	-	-	-	-	3.8	(19)	-	-	-	-
	"	1959	-	-	-	-	-	-	-	-	4.1	(8)	-	-
4	T	1954	3.4	3.2-3.5(50)	3.65	3.6-3.7(20)	-	-	-	-	-	-	-	-
	"	1955	3.45	3.4-3.5(23)	-	-	3.88	3.8-3.9(85)	-	-	-	-	-	-
	"	1958	3.3	(26)	-	-	-	-	-	-	-	-	-	-
	"	1959	3.3	(11)	-	-	-	-	-	-	-	-	-	-
	"	1960	-	-	-	-	-	-	-	-	-	-	3.9	(28)
ALL EXPERIMENTS			3.38	3.1-3.5(120)	3.65	3.6-3.7(20)	3.88	3.8-3.9(85)	3.8	(19)	4.1	(8)	3.9	(28)

TOTAL NUMBER OF HAULS IN BRACKETS

1) RUNNAGE OF TWINES 45-75 YDS/LB

* ARITHMETIC MEANS OF VALUES FOR SEPARATE EXPERIMENTS, UNWEIGHTED BY NUMBERS OF HAULS OR SIZE OF CATCH

TABLE 2. MEAN SELECTION FACTORS FOR HADDOCK. 1952-60. SUBAREAS 4 AND 5. RANGE OF MESH SIZE 73-167 MM (2 7/8"-6½")

SUB-AREA	DIV.	YEAR	MANILA 1) DOUBLE MEAN* S.F.	MANILA 1) DOUBLE RANGE OF VALUES	COTTON SINGLE MEAN* S.F.	COTTON SINGLE RANGE OF VALUES	NYLON SINGLE MEAN* S.F.	NYLON SINGLE RANGE OF VALUES	NYLON DOUBLE MEAN* S.F.	NYLON DOUBLE RANGE OF VALUES	TERYLENE SINGLE MEAN* S.F.	TERYLENE SINGLE RANGE OF VALUES	DACRON (BRAIDED) SINGLE MEAN* S.F.	DACRON (BRAIDED) SINGLE RANGE OF VALUES
4	V-W	1953	3.2	3.1-3.3(13)	-	-	-	-	-	-	-	-	-	-
	"	1956	3.0	(2)	-	-	-	-	3.35	3.3-3.4(25)	-	-	-	-
	"	1959	-	-	-	-	-	-	-	-	3.7	(24)	-	-
4	T	1954	-	-	3.4	(16)	-	-	-	-	-	-	-	-
4	X	1955	3.2	(12)	-	-	3.9	3.8-4.0(42)	-	-	-	-	-	-
4	W	1958	3.1	(15)	-	-	-	-	3.9	(29)	-	-	-	-
	"	1960	3.4	(14)	-	-	-	-	-	-	-	-	-	-
5	"	1952	3.22	3.1-3.3(55)	-	-	-	-	-	-	-	-	-	-
	"	1953	3.25	3.0-3.5(88)	-	-	-	-	-	-	-	-	-	-
	"	1955	3.40	3.3-3.5(30)	-	-	-	-	-	-	-	-	-	-
	"	1956	-	-	-	-	3.45	3.1-3.8(47)	-	-	-	-	3.1	(15)
ALL EXPERIMENTS			3.22	3.0-3.5(229)	3.4	(16)	3.68	3.1-4.0(89)	3.63	3.3-3.9(54)	3.7	(24)	3.1	(15)

TOTAL NUMBER OF HAULS IN BRACKETS

1) RUNNAGE OF TWINE 45-75 YDS/LB

* ARITHMETIC MEANS OF VALUES FOR SEPARATE EXPERIMENTS

TABLE 3. MEAN SELECTION FACTORS FOR SILVER HAKE. SUBAREA 5. 1954-1961. RANGE OF MESH SIZE 60-103 MM

SUB-AREA	YEAR	MANILA DOUBLE 1) MEAN* S.F.	MANILA DOUBLE 1) RANGE OF VALUES	MANILA SINGLE MEAN* S.F.	MANILA SINGLE RANGE OF VALUES	COTTON SINGLE MEAN* S.F.	COTTON SINGLE RANGE OF VALUES	NYLON SINGLE MEAN* S.F.	NYLON SINGLE RANGE OF VALUES
5	1954	3.4	-(4)	2.8	2.6-3.0(11)	3.1	2.7-3.4(13)	3.52	3.2-3.7(30)
"	1961	2.41	2.2-2.6(34)	-	-	-	-	-	-
ALL EXPERIMENTS		2.9	2.2-3.4(38)	2.8	2.6-3.0(11)	3.1	2.7-3.4(13)	3.52	3.2-3.7(30)

TOTAL NUMBER OF HAULS IN BRACKETS

1) RUNNAGE 45 YDS/LB
* ARITHMETIC MEANS OF VALUES FOR SEPARATE EXPERIMENTS

TABLE 4. MEAN SELECTION FACTORS FOR AMERICAN PLAICE. SUBAREA 4. 1954-1960. RANGE OF MESH SIZE 113-146 MM

SUB-AREA	DIV.	YEAR	MANILA 1) DOUBLE MEAN* S.F.	MANILA 1) DOUBLE RANGE OF VALUES	COTTON SINGLE MEAN* S.F.	COTTON SINGLE RANGE OF VALUES	NYLON SINGLE MEAN* S.F.	NYLON SINGLE RANGE OF VALUES	COURLENE ? MEAN* S.F.	COURLENE ? RANGE OF VALUES
4	4T	1954	2.07	2.0-2.2(32)	2.5	(17)	-	-	-	-
	"	1955	-	-	-	-	2.3	2.2-2.4(29)	-	-
	"	1958	2.1	(7)	-	-	-	-	-	-
	"	1960	-	-	-	-	-	-	2.1	(14)
ALL EXPERIMENTS			2.09	2.0-2.2(39)	2.5	(17)	2.3	2.2-2.4(29)	2.1	(14)

TOTAL NUMBER OF HAULS IN BRACKETS

1) RANGE OF RUNNAGES 45-125 YDS/LB
* ARITHMETIC MEANS OF SEPARATE EXPERIMENTS

TABLE 5. MEAN SELECTION RANGES FOR ALL EXPERIMENTS WITH THE SAME RANGES OF MESH SIZE. 1952-1960

SUB-AREA	SPECIES	MANILA DOUBLE MEAN S. RANGE (CM)	MANILA DOUBLE RANGE OF VALUES	COTTON SINGLE MEAN S. RANGE (CM)	COTTON SINGLE RANGE OF VALUES	NYLON SINGLE MEAN S. RANGE (CM)	NYLON SINGLE RANGE OF VALUES	NYLON DOUBLE MEAN S. RANGE (CM)	NYLON DOUBLE RANGE OF VALUES	TERYLENE SINGLE MEAN S. RANGE (CM)	TERYLENE SINGLE RANGE OF VALUES	COURLENE MEAN S. RANGE (CM)	COURLENE RANGE OF VALUES	DACRON MEAN S. RANGE (CM)	DACRON RANGE OF VALUES
4	COD	10.0	6-12	8.0	-	6.5	6-8	8.0	7-9	6.0	-	10.0	-	-	-
4	HADDOCK	9.0	6-11	?	-	7.5	7-8	6.7	4-9	7.0	-	-	-	-	-
5	"	8.0	4-14	-	-	8.3	5-11	-	-	-	-	-	-	6.1	-
5	SILVER HAKE	8.6	8-9	10.3	7-15	12.6	7-16	-	-	-	-	-	-	-	-
4	AMERICAN PLAICE	7.0	5-11	4.0	-	7.5	7-8	-	-	-	-	9.0	-	-	-

III. ANNOTATED LIST OF PAPERS PERTINENT TO ICNAF compiled in the Secretariat[1]

I. HYDROGRAPHY

Breslan, Lloyd R., J.B.Hersey, Harold E. Edgerton and Frances S. Birch. 1962. A precisely timed submersible pinger for tracking instruments in the sea. Deep-Sea Res. 9: 137-144.

The inclusion of a miniaturized precision time source in a standard Edgerton submersible pinger and used in conjunction with a Precision Graphic Recorder or similar device, permits the measurement of direct acoustic travel time as well as the difference in acoustic travel time between the ping and its echo.

Bumpus, Dean F. 1962. Investigations of climate and oceanographic factors influencing the environment of fish. Woods Hole Ocean. Inst. unpublished ms. No.62-1, 5 pp. (as per title).

1962. Investigations of climate and oceanographic factors influencing the environment of fish. Woods Hole Ocean. Inst. unpublished ms. No.62-24, 4 pp. (as per title).

Craig, R.E. and Lawrie, R.G. 1962. An underwater light intensity meter. Limnol. Oceanogr., 7, 259-261.

Describes an instrument to measure underwater light from 0.00001 to 100 lux on a single scale.

Dietrich, G. 1962. Fischereihydrographie im Rahmen der internationalen Meeresforschung (Fishery Hydrography within the Scope of International Oceanography). - Ber. Dt. Wiss. Komm. Meeresforsch., 17(1): 21-26, Stuttgart, Dec. 1962.

A lecture given on occasion of the 60th Anniversary of the DWK.

Harvey, J.G. 1962. Hydrographic conditions in Greenland waters during August, 1960. Ann. biol., 17, 14-17.

As title.

Jordan, G.F. 1962. Large submarine sand waves. Science 136, 839-848.

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[1] Papers published in ICNAF publications are not included.

Their orientation and form are influenced by some of the same factors that shape desert sand dunes.

Lauzier, L.M. and J.H.Hull. 1962. Sea temperatures along the Canadian Atlantic coast, 1958-1960. Fish. Res. Bd. Canada, Atlantic Progress Rept., no. 73, 11-15.

During the years 1958 and 1959 the cooling trend has generally continued along the outer coast of Nova Scotia and in the Bay of Fundy area. Quarterly deviations from long-term averages are plotted in Figure 1 for each one of the monitoring stations for the period 1950-1960. All curves indicate a cooling trend starting at the beginning of the fifties, and relatively warm waters observed in 1960. At Lurcher Lightship the temperature variations of the bottom waters are remarkably similar to those of the surface waters, but they seem to indicate a slightly more pronounced cooling trend than that of the surface waters.

Lee, A.J. 1962. The effect of wind on water movements in the Norwegian and Greenland Seas. Proc. Symp. on Mathematical-hydrodynamical methods of physical oceanography, Sept. 1961.

Institut für Meereskunde der Universität, Hamburg.

Correlations are found between wind and water transport at Bear Island (in summer only) and off South Greenland. No such correlations were found in the winter at Bear Island, or in the Faroe-Shetland Channel.

Mertins, H.-O. 1962. Nordostorkan bei Kap Farvel (North-East Hurricane off Cape Farvel). - Der Wetterlotse, 14 (187): 145-149.

" " 1962. Die Sturmhäufigkeit auf den Fischfangplätzen im Jahre 1961 (The frequency of gales on the fishing grounds in 1961). Der Wetterlotse, 14 (187): 155-157.

Rodewald, M. 1962. Die Anomalie der Luftzirkulation über den nördlichen Meeren des atlantischen Bereiches im Jahre 1960 (Atmospheric Circulation Anomalies in the Northern Part of the Atlantic Region). Der Wetterlotse, 14 (185): 121-123.

Worthington, L.V. 1962. Evidence of a two gyre circulation system in the North Atlantic. Deep Sea Res., 9, 51-67.

Data presented suggest that the Gulf Stream does not turn to the northward after passing the Grand Banks, but continues to flow in a southeasterly direction, and that the currents which pass the Flemish Cap are part of a separate, northerly gyre. Evidence is produceded for the existence of a nearly permanent trough of low pressure separating the two gyres. A water budget consistent with the distribution of oxygen is presented.

II. PLANKTON

Be, Allen W.H. 1962. Quantitative multiple opening- and- closing plankton samplers. Deep-Sea Res., 9, 144-151.

Two quantitative plankton samplers, incorporating identical opening-and-closing principles, have been constructed for serial sampling of zooplankton in the upper 1000 m of water. A pressure-sensitive release mechanizm allows horizontal or oblique towing in pre-selected depth intervals. No messingers are needed. The designs are flexible and may be modified for size of frame opening, number of nets and depth ranges to be sampled.

Brunel, Jules 1962. Le phytoplancton de la Baie des Chaleurs. Contr. du Min. Chasse et Pech., No.91.

Colton, John B., Jr. and Robert R. Marak. 1962. Use of the Hardy Continuous Plankton Recorder in a fishery research programme. Bull. Mar. Eco., 5(49), 231-246.

Investigations of the drift of haddock eggs and larvae at Georges Bank and an evaluation of the use of the Recorder for research.

Grainger, E.H. 1962. Zooplankton of Foxe Basin in the Canadian Arctic. J. Fish. Res. Bd. Canada, 19, 377-400.

Zooplankton collections from 100 stations in Foxe Basin and immediately adjacent waters of the eastern Canadian Arctic, made in 1955, 1956 and 1957, are considered. Available information on physical oceanography of the region is discussed, especially factors with apparent direct relationship to plankton distribution. Zooplankton standing crop on the two sides of Foxe Basin is estimated, and related to water movement, depth, ice cover and turbidity. Zooplankton quantity within the upper 50 m of the basin is estimated as about 50 mg/m^3, the western section

showing approximately twice the standing crop of the eastern area. Forty-eight species of zooplankton are recorded, dominated numerically by amphipods (12), copepods (10) and medusae (9). Copepods exceed all other groups in biomass, and are represented principally by the species Pseudolibrotus minutus, Calanus glacialis and Calanus hyperboreus. Other especially abundant and widely spread species are Aglantha digitale and Halitholus cirratus (medusae), Sagitta elegans (chaetognath) and Themisto libellula (amphipod). From the occurrence of plankton species and apparent water movements, it is concluded that Foxe Basin is a region of opposed Arctic (polar water) and sub-Arctic (mixed polar and Atlantic water) elements, the former entering the basin from the north and dominating most of the north and central parts of the region, the latter entering from the south and influencing chiefly the southernmost part of the basin but probably extending as a minor element up the east side to the northern limits of Foxe Basin. Differences in the zooplankton development in different years are related in part to variations in duration of ice cover.

Marak, R.R. and J.B.Colton, Jr. 1962. Distribution of fish eggs and larvae, temperature and salinity in the Georges Bank-Gulf of Maine area 1953. U.S. Fish and Wildl. Service, Special Sci. Rept., Fisheries No.398: 61 pp. (as per title).

Marak, Robert R., John B. Colton, Jr., and Donald B. Foster. 1962. Distribution of fish eggs and larvae, temperature, and salinity in the Georges Bank-Gulf of Maine area, 1955. U.S. Fish and Wildl. Service, Spec. Sc. Rept. Fisheries No. 411, 66 pp.

Basic data on the distribution of fish eggs and larvae in the Georges Bank-Gulf of Maine area were collected on surveys made by the Bureau of Commercial Fisheries research vessel ALBATROSS III during the spring of 1955. The data are presented in tabular and graphic form. Plots and tables of surface temperature and salinity are also included.

Marak, Robert R., John B. Colton, Jr., Donald B. Foster, and David Miller. 1962. Distribution of fish eggs and larvae, temperature, and salinity in the Georges Bank-Gulf of Maine area, 1956. U.S. Fish and Wildl. Service, Spec. Sc. Rep. Fisheries No. 412, 95 pp.

Basic data on the distribution of fish eggs and larvae in the Georges Bank-Gulf of Maine area were collected on surveys made by the Bureau of Commercial Fisheries research vessel

ALBATROSS III during the spring of 1956. The data are presented in tabular and graphic form. Plots and tables of surface temperature and salinity are also included.

Steele, J.H. and Menzel, D.W. 1962. Conditions for maximum primary production in the mixed layer. Deep Sea Res. 9, 39-49.

Theoretical relations are developed which determine primary production in terms of the depth of the mixed layer and of nutrient limitation.

Wood, E.J. Ferguson. 1962. A method for phytoplankton study. Limnol. Oceanogr. 7, 32-35.

A method for quantitative and qualitative investigations of phytoplankton which can be employed at sea on fresh material is described.

III. FISHES

A. Cod Group

Anon. 1962. Die deutschen Kabel jauuntersuchungen bei Gronland 1960 (The German Cod Investigations off Greenland in 1960). AFZ, 14 (24): 18-19, Bremerhaven, June 16.

As per title.

Anon. 1962. Wanderungen gronlandischer Kabeljau (Migrations of Greenlandic Cod). - AFZ, 14 (10): 15-16, Bremerhaven, March 10.

A short review of Dr. Meyer's tagging experiments.

Fritz, Raymond L. 1962. Silver hake. U.S. Fish and Wildl. Service, Fishery Leaflet No. 538, 7 pp.

Discusses distribution and movements, spawning, tagging, growth, feeding and the fishery for silver hake.

Gulland, J.A. 1962. Trans-Atlantic journey of a tagged cod. Nature, 195, 921.

A cod tagged in the North Sea in June 1957 was recaptured by a Polish factory trawler off Newfoundland in December, 1961.

Hoberman, John M. and Albert C. Jensen. 1962. The growth rate of New England pollock. Trans. Amer. Fish. Soc. 91, 227-228.

The scales and fork lengths of 299 American pollock from seven locations in the Gulf of Maine were analyzed to determine the growth rate.

Jean, Yves 1962. Discards of cod at sea. Fish. Res. Bd. Canada, Biological Station, St. Andrews, N.B., General Series Circular No.37, 3 pp. (Also printed in French)

The quantity of small cod discarded at sea by fishermen in the southwestern Gulf of St. Lawrence has changed. Prior to 1947 cod were taken by hook and line, and wasteage of cod was small. By 1956 otter trawling was an important fishing method in this area, and in that year about 7 million cod were discarded at sea because small-mesh nets were used and small fish were not marketable. By 1961 discarded cod were reduced to about 1 million fish because fishermen were required to use large-mesh nets and smaller cod became acceptable to fish buyers.

Jensen, Albert C. and John P. Wise. 1962. Determining age of young haddock from their scales. U.S. Dept. Interior, Fish and Wildl. Service, Fish.Bull. 195, 61: 439-450.

The history of age determinations of haddock from various areas is discussed, with a resumé of the previous work in New England and adjacent areas. Various methods of validation of age determination of haddock in New England waters are considered and evaluated. It is concluded that scales provide a satisfactory indication of the age of these fish, particularly for their first 5 years.

Jones, R. 1962. Haddock bionomics. 2. The growth of haddock in the North Sea and at Faroe. Mar. Res. Scot., 1962, no.2, pp. 19.

The growth of haddock in the North Sea and at Faroe, with particular reference to growth differences between different subareas and years.

Livingstone, Robert, Jr. 1962. Underwater television observations of haddock (Melanogrammus aeglefinus (Linnaeus)) in the cod-end. J. Cons. int. Explor. Mer, 27: 43-48.

In general, haddock entered the cod-end near the top in loose groups numbering between 3 to 26 individuals, rather than continuously, at an average rate of one fish every 1.6 seconds. Two distinct swimming patterns were recorded; one in which individuals swam from side to side and generally avoided the meshes, and another in which individuals headed downstream to the end of the cod-end. Approximately 58% of the haddock responded to the moving cod-end meshes by keeping pace with the net.

Meyer, A. 1962. Bisher 3.7% Ruckmeldungen der Kabeljaumarkierungen von Gronland (Up till now 3.7% Returns of Tagged Greenlandic Cod). AFZ, 14:22, Bremerhaven, June 1.

As per title.

O'Brien, John J. 1962. New England whiting fishery, and marketing of whiting products, 1946-61. U.S. Fish and Wildl. Service, Bur. of Comm. Fish., Market News Service, Spec. Rep. 39 pp (Mimeo).

A special report of landings and ex-vessel precies of the whiting fishery in New England; primary wholesale prices, stocks, market trends, and receipts on some wholesale markets.

Templeman, Wilfred and A.M.Fleming. 1962. Cod tagging in the Newfoundland area during 1947 and 1948. J. Fish. Res. Bd. Canada, 19, 445-487.

Cod were tagged in the Newfoundland and Labrador inshore areas and on the Grand Bank and St.Pierre Bank. Most cod tagged in the inshore areas were recaptured close to the tagging areas with a gradual increase with time in the average minimal distance moved.

Following the tagging year, the greatest number of recaptures of cod tagged inshore was in shallow inshore waters from June to September. Through late summer to winter and early spring there were more recaptures from the deeper water.

Cod were tagged either with an internal bachelor button tag through the opercular bone or with an internal 2-inch flat tag inserted through a slit in the body wall. Injuries at the point of insertion were often quite severe for the external tag but generally mild for the internal tag. The internal tags gave fewer returns than the external in the tagging year but the opposite was generally true for the years following.

Although cod were recaptured almost immediately after being tagged from traps, those tagged from handlines and longlines were not caught by baited hooks for 7-10 days afterwards. An inverse relationship exists between the length of otter-trawl drags from which fish were tagged and the percentage recaptured.

B. Flat Fishes

Miller, David and Robert R. Marak. 1962. Early larval stages of the fourspot flounder, *Paralichthys oblongus*. *Copeia* 1962, 454-455.

As per title.

C. Redfish

Anon. 1962. Über das Vorkommen von Jugendstadien des Rotbarsches (On the Distribution of Redfish Larvae). *AFZ*, 14 (24): 19-20, Bremerhaven, June 16.

A short review of the Icelandic-German Redfish Larvae Survey in the North Atlantic.

Henderson, G.T.D. 1962. *Sebastes* in continuous plankton records in 1960. *Ann. biol.*, Copenhague, 17 (1960), 81-83, 1962.

Samples at monthly intervals in the Iceland-Irminger Sea/Greenland area to the Newfoundland Banks give average numbers of young *S. marinus* per $10m^3$ in statistical rectangles, and percentage size frequency composition of the Recorder catches. (This paper was published in Denmark by the International Council for the Exploration of the Sea).

Seydlitz, H. von 1962. Untersuchungen über die Tagesperiodizitat des Rotbarsches, *Sebastes marinus*, auf Grund von Fanganalysen (Investigations on the Daily Periodicity of the Redfish according to analyses of catches). *Kurze Mitteil. Inst. Fischereibiol. Univ. Hamburg*, Nr. 12: 27-35, Hamburg, Dec.

Analyses of the redfish catches of German exploring trawlers in 1958-1960 showed that catches in the waters off Labrador and West Greenland by day were better than at night. Catches off East Greenland did not show such a periodicity.

D. Others

Bevelander, Gerrit and Richard J. Goss. 1962. Influence of tetracycline on calcification in normal and regenerating teleost scales. Nature, 1098-1099.

Tetracyclines administered to biological systems have an affinity for calcified tissues, inhibit calcification, and fluoresce under ultra-violet illumination. These properties facilitate the investigation of growth and regeneration of scales in Fundulus heteroclitus.

Boyar, H.C. 1962. Blood cell types and differential cell counts in Atlantic herring, Clupea harengus harengus. Copeia 1962, 463-465.

The various blood cell types and their frequency of occurrence in herring of three length groups are described.

Brawn, Vivien M. 1962. Physical properties and hydrostatic function of the swim-bladder of herring (Clupea harengus L.). J. Fish. Res. Bd. Canada, 19, 635-656.

Living herring at the depth of adjustment had a mean sinking factor of 1003, density of 1.026 g/ml, relative sensitivity of 0.8 and percentage swim-bladder volume of 4.2. Neutral buoyancy was attained at a mean pressure reduction of 5.5% from the adjusted pressure. Swim-bladder gas was under an average excess pressure of 1 cm Hg. Gas was released through the posterior swim-bladder duct during pressure reduction in 105 out of 109 herring observed. Gas release occurred at a mean pressure decrease of 6% in rapidly swimming herring, at 32% in moderately swimming fish and brought the herring to within 19% of perfect adjustment to a new reduced pressure within half an hour. Herring could compensate for their increased buoyancy during pressure decrease until this was reduced by gas release. Decompression at rates up to 123 cm Hg/sec was not fatal after 16 hours at the greater pressure. No recovery of buoyancy after gas loss occurred in herring held 24 hours in running sea water even if fine air bubbles were present. Recovery occurred if these fish had access to the surface. Gas production by bacterial activity as a means of restoring buoyancy was not established.

Herring responded to rapid pressure increases by swimming upwards. They could compensate for their increased density following pressure increase of 300% and survive increases of 430%. Herring from 10 to 25 feet depth at sea were positively buoyant at surface pressure when anaesthetized. Thus in nature herring are adjusted to pressures greater than surface pressure. It is suggested that they take in air when feeding at the surface at night and slowly pass this to the swim-bladder on returning to greater depths by day.

Das, Naresh and S.N.Tibbo. 1962. On the feeding and growth of young herring (Clupea harengus L.) in captivity. J. Fish. Res. Bd. Canada, 19, 981-983.

Results of a preliminary study of young herring in captivity show that they can be kept alive with a steady increase in body length.

During the first 42 days of the experiment the increase in mean body length was only 0.4 cm. This small amount of growth can be attributed to the fact that the fish passed through a period of starvation during that time. During the whole 89-day period, however, mean length increased by 3.0 cm. The table shows that there was a decrease in growth rate between mid August and mid September. This was probably the result of an observed decrease in food intake during September. During the same period there was a significant rise in the water temperature which was not controlled during the experiment.

Graham, T.R. 1962. A relationship between growth, hatching and spawning season in Canadian Atlantic herring. (Clupea harengus L.). J. Fish. Res. Bd. Canada, 19, 985-987.

Evidence is presented to show that the season at which Chaleur Bay herring spawn is not necessarily the same as the hatching season, and is influenced or determined by the rate of growth in the first year, as shown by scales and otoliths. An increase in the relative amount of autumn-hatching and spawning has taken place, and mean length has also increased. There appears to be a definite relationship between growth, hatching and spawning season in the Chaleur Bay herring stock.

Major, Richard L. and Donovan R. Craddock. 1962. Marking sockeye salmon scales by short periods of starvation. U.S. Fish and Wildl. Service, Spec. Sci. Rep. Fisheries No. 416, 12 pp.

Experiments conducted at the Leavenworth, Washington, national fish hatchery in 1959 and 1960 demonstrated that the scale pattern of Columbia River sockeye salmon Oncorhynchus nerka can be recognizably modified by a short period of starvation. Modification was obtained with little mortality.

Mather, Frank J., III, and Martin R. Bartlett. 1962. Bluefin tuna concentration found during a long-line exploration of the northwestern Atlantic slope. Comm. Fisheries Rev. 24(2): 1-7.

Results are given for fishing 14 exploratory long-line sets during November 1960, in or near the slope water between Cape Hatteras, North Carolina, and the Nova Scotia Banks. Water temperatures and salinities are listed for each station.

Parrish, B.B. 1962. Problems concerning the population dynamics of the Atlantic herring (Clupea harengus L.) with special reference to the North Sea. Brit. Ecol. Soc. Symp., No.2, 3-28.

Discussion of the complex changes in the composition of herring stocks coinciding with the decline in the British drift net fishery and of the problems involved in assessing the effects of fishing.

Southward, G. Morris. 1962. Photographing halibut otoliths for measuring growth zones. J. Fish. Res. Bd. Canada, 19, 335-338.

Apparatus is described for clearing and photographing halibut otoliths for use in growth studies.

Steele, J.H. 1961. The environment of a herring fishery. Mar. Res. Scot., 1961, no. 6, pp.19.

Plankton and herring distributions are studied in relation to the sharp boundary between Atlantic and Baltic water masses in the North Sea.

IV. SHELLFISH

Bourne, N. and A. McIver. 1962. Gulf of St. Lawrence scallop explorations -- 1961. Fish. Res. Bd. Canada, Biological Station, St. Andrews, N.B., General Series Circular, No.35, 4 pp. (Also published in Canadian Fisherman, 49, 17-19, 1962 as "Gulf Survey for Sea Scallops")

Five beds in the southern Gulf of St. Lawrence are sufficiently well stocked with commercial-size scallops to make small-boat scallop fishing worthwhile in 1962. On 4 of these beds there were also large numbers of small scallops, indicating that profitable fishing might be continued into 1963.

Dow, Robert L. 1962. A method of predicting fluctuations in the sea scallop populations of Maine. *Comm. Fisheries Rev.* 24(10), 1-4.

During the past 80 years the inshore sea scallop fishery in Maine has alternated at about decade intervals between extremes of high and low landings. Trends of sea water temperature closely parallel declines and increase in the relative abundance of sea scallops as indicated by landings and suggest an optimum range as well as unfavorable high and low temperatures.

Hughes, John T. and George C. Mathiessen. 1962. Observations on the biology of the American lobster, *Homerus americanus*. *Limnol. Oceanogr.* 7, 414-421.

Presents data from records of the Massachusetts State Lobster Hatchery, Oak Bluffs, Massachusetts, on seasonal occurrence of hatching, duration of larval period, occurrence of moulting with age and season, and rates of growth.

Shaw, William N. 1962. Raft culture of oysters in Massachusetts. *U.S. Dept. Interior, Fish and Wildl. Service, Fish. Bull.* 197, vol. 61: 481-495.

The possibility of growing oysters attached to rafts was tested and found commercially feasible as a method of culture that might be useful in reviving the declining oyster industry in Massachusetts.

Squires, H.J. 1962. Giant scallops in Newfoundland coastal waters. *Bull. Fish. Res. Bd. Canada*, 135, 29 pp.

Exploratory fishing in 1957 and 1958 around Newfoundland showed several promising areas on the west coast but fewer and smaller areas on the southwest coast, and no areas on the northeast and east coast where beds of giant scallops (*Placopecten magellanicus* Gmelin) were present.

V. OTHER MARINE ORGANISMS

Colton, John B., Jr., Robert F. Temple, and Kenneth A. Honey. 1962. The occurrence of oceanic copepods in the Gulf of Maine-Georges Bank area. Ecology 43, 166-171.

Lists species, frequency of occurrence, relative abundance, and distribution of oceanic copepods in the Gulf of Maine-Georges Bank area. The distribution and abundance of the various copepod species yield direct evidence of an intrusion of oceanic water across the southern edge of Georges Bank and into the Gulf of Maine.

Dow, Robert L. 1962. Use of environmental and economic factors to check biological fluctuations in Maine lobster population. Comm. Fisheries Rev. 24(8), 6-8.

Average April-May sea water temperature is associated with the number of lobsters available to the post-moult July-August fishery. The July-August supply regulates the summer price, which, in turn, influences fishing intensity during both the lobster seasonal year (July-June) and the calendar years following.

Since it is possible to predict landings, and, by inference, available abundance,by the measurable variables: temperature, landed value, and fishing intensity, any significant (± 10 percent) deviation from prediction is indicative of probable biological changes: i.e. frequency of moult, natural mortality, or year class survival.

Hoffman, Glenn L. and Carl J. Sindermann. 1962. Common parasites of fishes. U.S. Fish and Wildl. Service, Circular No.144, 17 pp.

Discusses different parasites of marine and freshwater fish separately. Each category is organized into parasites of the body surfaces and gills, parasites of the body muscles and parasites of the viscera.

Kabatz, Z. 1962. The mouth and the mouth-parts of *Lernaeocera branchialis* (L.), a parasitic copepod. Crustaceana, 3, 311-317.

Prefontaine, Georges et Pierre Brunel. 1962. Liste d'invertébrés marins recueillis dans l'estuaire du Saint-Laurent de 1929 à 1934. Contr. Min. Chasse et Pêch., Québec, No.86. Le Naturaliste canadien, Vol. 89, nos. 8-9.

A list of invertebrates collected in the St. Lawrence estuary.

Rae, B.B. 1962. The effect of seal stocks on the Scottish marine fisheries. Brit. Ecol. Soc. Symp., No.2, 306-311.

Describes kinds of damage to fisheries and quantity of fish eaten by seals. Refers to the spread of nematode infestation of cod due to seals.

Sindermann, Carl J. and Alva E. Farrin. 1962. Ecological studies of Cryptocotyle lingua (Trematoda: Heterophyidae) whose larvae cause "pitment spots" of marine fish. Ecology 43, 69-75.

Examination was made of seasonal variations in incidence of larval Cryptocotyle lingua in the snail Littorina litorea. Experimental studies of factors that might influence emergence of infective cercariae from the snail host are included.

Squires, H.J. 1962. Decapod crustacea of the Calanus expeditions in Frobisher Bay, Baffin Island, 1951. J. Fish. Res. Bd. Canada, 19, 677-686.

Specimens collected by trawl and dredge on the Calanus Shelf and by plankton net at Potter Island were mostly of the family Hippolytidae; especially abundant was Lebbeus groenlandicus. Their size distribution was similar to those from Ungava Bay but maturity was apparently later and at a somewhat larger size. Stations at the shallower parts of the shelf yielded the greater number of specimens of decapods, those on the outer slope few decapods and a deeper station shoreward from the shelf no decapods at all.

Teal, J.M. and K. Halcrow. 1962. A technique for measurement of respiration of single copepods at sea. J. Cons. int. Explor. Mer, 27, 125-128.

The method involves the use of polarographic oxygen electrodes and has yielded results comparable to those obtained by other workers, using similar experimental material.

VI. FISHERIES AND FISHING INDUSTRY

Anon. 1962. Fischerei in NW-Atlantik (Fishery in the NW Atlantic). AFZ, 14(13): 35-36, March 31.

As per title.

Anon. 1962. Die Zukunft der Hochseefischerei (The Future of the Deep Sea Fishery). AFZ, 14(13): 33-34, March 31.

As per title.

Anon. 1962. Die Fischerei im NW-Atlantik (The Fisheries in the NW Atlantic) AFZ, 14(49): 17-18, Bremerhaven, Dec. 8.

Deals with the catches of Cod, Haddock and Redfish by different countries in the ICNAF Area.

Anon. 1962. Starke Expansion der grönlandischen Fischerei (The Fisheries off Greenland heavily expanded). AFZ, 14(22/23): 15, Bremerhaven, June 8.

As per title.

Beverton, R.J.H. 1962. Long-term dynamics of certain North Sea fish populations. Brit. Ecol. Soc. Symp. 2.

Examines the trends in North Sea catches of cod, plaice and turbot (steady), sole (increasing) and haddock (decreasing). The possible controlling factors of the plaice population are examined and the most likely control is density-dependent mortality in the young larvae.

Buttner, S. 1962. Die deutsche Hochseefischerei im Jahre 1961 (The German Deep Sea Fishery in 1961). - Jahresber. Dt. Fischwirtschaft 1961/62: 250-256, Berlin, Oct.

As per title.

Dickie, L.M. 1962. Effects of fishery regulations on the catch of fish. Economic Effects of Fishery Regulations, FAO Fish. Rept. No. 5, 102-133, Rome.

The biological theories or "models" underlying fisheries regulations are classed here into two major types, termed the logistic and the dynamic-pool type models. They postulate a different relationship between population size and rate of natural production, hence may sometimes lead to a different diagnosis of fishery conditions, a different judgment of the need for and best kind of regulation, and predicted different effects of regulation. There are no fully satisfactory objective criteria for making choices between the models. A review of

past applications suggests that choice has depended largely on investigator's judgment of the fishery complexity, and the state of data collection concerning it. The logistic-type model has generally been fitted to the more complex or less well known situations. Where data are available, the dynamic-pool model has often been preferred because of its inherently more analytic approach.

Comparison of the two models suggests that in fisheries where size at first capture can be manipulated, the simple logistic model may describe too limited a range of population and production relationships. However, experience with some fisheries suggests that interactions among forces controlling population size lead to fewer possible equilibrium states than are predicted by the simple dynamic-pool models.

Differences between the two types of models are not as great as appears from comparison of their simplest forms. They reflect a difference in the relative importance that investigators ascribe to forces controlling population size rather than fundamental disagreement about the nature of population control. However, pending their further development, there remains the possibility of conflicting results from the two models applied to the same fishery. This is illustrated by reference to published studies of the Pacific halibut fishery. Where there are such differences, there would appear to be particular obligations for thorough testing of the consequences of regulation.

Lundbeck, J. 1962. Biologisch-statistischer Bericht über die deutsche Hochseefischerei im Jahre 1961 (Biological-statistical Report on the German Deep Sea Fishery in 1961). Jahresber. Dt. Fischwirtschaft 1961/62: 119-150, Berlin, Oct.

Lundbeck, J. 1962. Biologisch-statistische Untersuchungen über die Deutsche Hochseefischerei. IV Die Entwicklung der Hochseefischerei in fangtechnischer, raumlicher und biologischer Hinsicht. 6. Die Fernfischerei (Biological-statistical Investigations on the German Deep Sea Fisheries. IV The Development of the Deep Sea Fisheries with Respect to Techniques, Space and Biology. 6. The Distant Fisheries). Ber. Dt. Wiss. Komm. Meeresforsch., 16 (4): 251-338, Stuttgart, Nov.

This is another part of the author's well-known contribution to the knowledge of the history of the German Deep Sea Fisheries by aids of biologic-statistical investigations. It deals with the development of the fisheries in the distant waters including those of the ICNAF Area.

Meseck, G. 1962. Die fischwirtschaftspolitik im Jahre 1961/62 (Fishery Policy in 1961/62). - Jahresber. Dt. Fischwirtschaft 1961/62: 7-17, Berlin, Oct.

As per title.

Meseck, G. 1962. Bedeutung und weitere Entwicklung der Fischerei (Importance and further Development of the Fisheries). - Ber. Dt. Wiss. Komm. Meeresforsch., 17(1): 3-8, Stuttgart, Dec.

A lecture given on the occasion of the 60th anniversary of the DWK.

Messtorff, J. 1962. Zur Fischerei von morgen (Fisheries of Tomorrow). - AFZ, 14(47): 24-25, Bremerhaven, Nov. 24.

A discussion of the future development and possibilities of the deep sea fisheries.

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VII. GEAR

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