



IRISH FISHERIES INVESTIGATIONS

SERIES B (Marine)

No. 2

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DUBLIN :

PUBLISHED BY THE STATIONERY OFFICE

TO BE PURCHASED FROM THE

GOVERNMENT PUBLICATIONS SALE OFFICE, G.P.O. ARCADE, DUBLIN

IRISH SPRATS AND SANDEELS

by

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In 1965 Ireland imported approximately 13,235 tons of fishmeal for animal feeding stuffs valued at £827,506. For some time now consideration has been given to the fish resources around our coasts and whether it would be possible to provide a constant source of supply of materials to the fishmeal industry and the growing number of mink and trout farms. Industrial landings of fish usually consist of sprats, young herrings, sandeels and a number of other species of fish which are not usually considered suitable for human consumption. Periodically, when "glut" conditions arise on markets, edible fish, usually whiting, herrings or mackerel, may also be utilised for fishmeal or other industrial purposes. Fishing for sprats in Ireland has fluctuated greatly from year to year as the annual landings from 1920 show

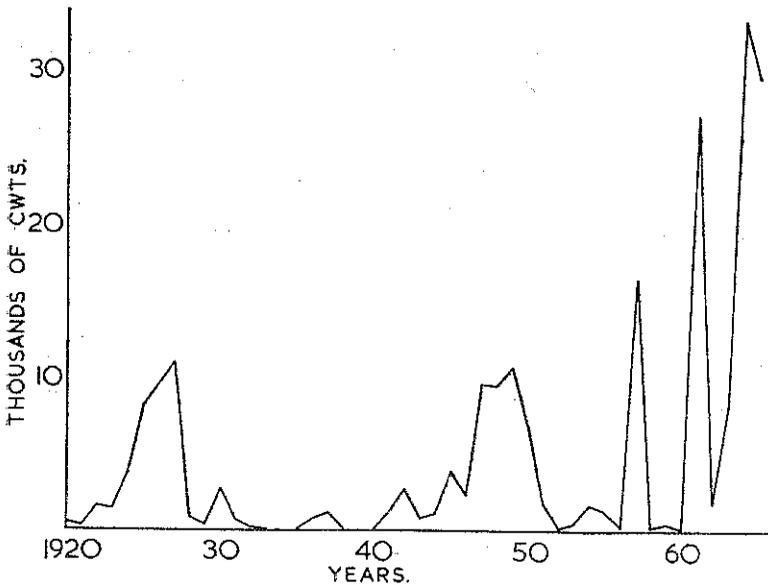


Figure 1.

(Fig. 1). In recent years landings have been very small but in July, 1964, active sprat fishing was revived on the east coast of Ireland at Clogherhead. Up to 1964 there was no Irish fishery for sandeels but in May of that year a small scale fishing began at Howth and lasted for a few months.

Fishing for sprats started in July, 1964, and was pursued by boats from Clogherhead. The results obtained encouraged boats from Skerries to take part in 1965. The pattern of fishing varied according to the demand and the prices of marketable fish but generally three pairs and one single boat, all using bottom trawls, fished for industrial purposes out of these two ports. During February, March and April, 1965, boats from Clogherhead fished over a large area extending from Benhead to Dundalk Bay out to about 20 fathoms. In May the main effort was concentrated between 15 and 25 fathoms off Clogherhead, and in June it shifted to 10 to 20 fathoms off the mouth of the Boyne. In July the main effort was again in this area and slightly more to the

south, i.e. 10 to 15 fathoms off Balbriggan. Skerries boats usually fished the area around the Rockabill and Skerries Islands. The monthly landings since July, 1964, were as follows :—

1964	cwts.	1965	cwts.	1965	cwts.	1966	cwts.
July	2470	Jan.	2620	July	6202	Jan.	560
Aug.	6240	Feb.	3820	Aug.	3140	Feb.	380
Sept.	5460	Mar.	560	Sept.	—	Mar.	1200
Oct.	2830	Apr.	50	Oct.	—	Apr.	220
Nov.	6340	May	3995	Nov.	440	May	3970
Dec.	3620	June	5570	Dec.	3770	June	8390

Sprats are obviously available nearly all the year. No fishing took place in September or October, 1965, due to lack of demand.

In May, 1964, a commercial fishery for sandeels was started in the Irish Sea and lasted from May to July. Five boats took part and landed a total of 3,929 cwt. Due to various circumstances, however, no fishing took place in 1965 and it was impossible to examine any catches from commercial boats.

In an effort to assess the potential for sprats and sandeel fishing in the Irish Sea, investigations using the research boat, *Cú Feasa*, began in February, 1965 and continued until July, 1965. Further investigations were made in April and May, 1966. The four main objects of these cruises were to

- (1) Determine the extent and availability of sprats and sandeels.
- (2) Obtain samples for biological investigations.
- (3) Determine the nature of the bye-catch, and
- (4) Compare catching power of *Cú Feasa* with commercial boats.

A total of 204 hauls of one hour duration whenever possible were made in 1965 over a large area of the Irish Sea. Fifty seven hours were devoted to sprat fishing during February, March and April and 147 hours to sandeel fishing from May to the end of July. The gear used varied slightly for both species—a bottom trawl of 4 mm cod-end mesh was used for sandeels and a 9 mm cod-end mesh for sprats. The catch was classified into four categories :—

- (a) Sprat
- (b) Sandeels
- (c) Marketable fish, and
- (d) "Waste" fish.

This last category consisted of fish which, either because of their size or the species involved, were considered unfit for human consumption. It must be pointed out that the estimated quantities of marketable fish

are only approximate, as in most cases the numbers present and not the weights were taken. From the fishing log sheets the overall catch was distributed as follows:—

Catch	Using "Sprat" gear	Using "Sandeel" gear
(a) Sprat	27.0%	66.0%
(b) Sandeel	0.0	25.0
(c) Marketable fish	24.0	4.0
(d) Waste fish	49.0	5.0
	100.0	100.0

Thus waste fish formed the major portion of the catch (49.0%) when the primary species was sprat and only a small amount (5%) when the primary species was sandeels, even though the smaller meshed cod-end was in operation. In most cases the waste consisted of small whiting, norway pout, poor cod, with smaller amounts of small plaice, dabs, gurnards, etc. The decrease in the amount of "waste" fish taken when the sandeel net was used is probably due to the fact that whiting do not usually inhabit the type of sandy ground which sandeels prefer, while sprats may be found on both muddy and sandy ground. It can also be seen that the amount of sprat taken when the sandeel net was used was much greater than when the sprat net itself was used. This was undoubtedly due to the combination of the smaller meshed net and to a greater availability of sprats. Increased catches of sprats might have been taken had a mid-water trawl been used, as heavy markings were occasionally noticed below the surface.

A large area of the Irish Sea was covered during the investigations, but the main effort was concentrated in three areas which seemed most likely to yield good results and which, if fish meal plants were started along the coast, would be within reach of suitable harbours. These areas shown in Fig. 2 were A/ Squares 252 and 208 (off Clogherhead), B/ Squares 250, 251, 206 and 207 (Kish and Bennet Banks, Rockabill and Skerries) and C/ Squares 246 and 247 (off Wexford and Courtown). Both species were located over a wide area, but the quantities obtained, particularly in the case of sandeels were very variable. As had been thought, fishing for this species was very erratic—one haul yielding up to 12 crans while the following haul in exactly the same place may yield nothing. A possible reason for this may be that the shoals when disturbed bury themselves in the sand and take some time to regroup. Sprats were more evenly distributed and some good hauls were made. The availability of sandeels was greatest during May and June while catches were poor during July. Sprats were most plentiful during June and July. Consistently good catches of sprats were obtained from four statistical squares, namely 207 (maximum 10 crans per hour), 250 (max. 5 crans per hour), 251 (max. 9 crans per hour), and 246 (max. 12 crans per hour). (1 ton = 5.93 crans). The catch (stones per hour) for each week is shown in Table 1. The change from sprat

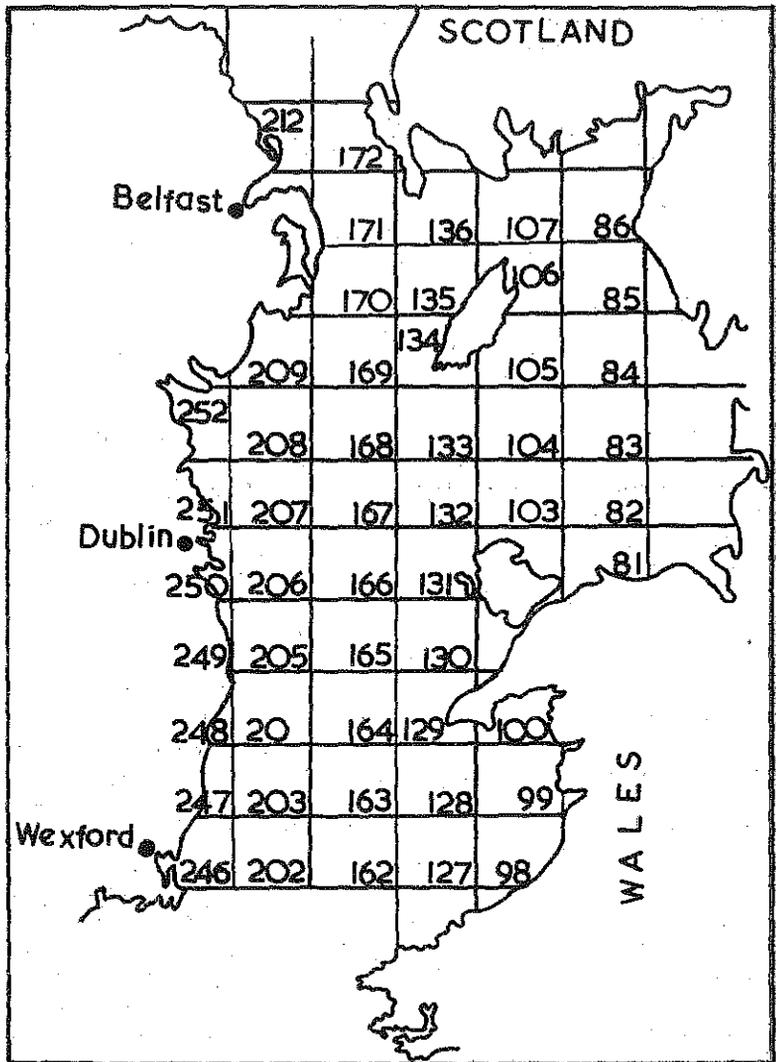


Figure 2.

fishing to the smaller meshed sandeel net can be clearly seen after the week ending 24/4, with the increased catches of sprats, the presence of sandeels and the decreased catches of "waste" fish. A decrease in the catch is shown at the end of July, a fact borne out by the commercial boats who were to undergo a period of slack fishing from this until December.

A further study of the "waste" fish revealed that the most important species involved were the "smalls" of whiting and plaice. Over the whole period from February to July 333 baskets of whiting were taken of which 242 baskets or 72% (of this total) were undersized. Similarly out of 46 baskets of plaice taken, 25 baskets or 55% were undersized.

The presence of the young of these two species in large quantities must cause some concern and further investigations at present being carried out will throw light on this aspect in the event of intensive fishing by commercial boats.

Two short cruises were made in April and May, 1966. The areas covered were those which gave best results in 1965. Twenty hauls were made but the results were disappointing and very few sprats were taken. Weather conditions at the time were not favourable and followed a long period of easterly winds. Of the total catches taken, 66% was considered to be "waste" and suitable for fishmeal, 8% was marketable and 26% were "smalls" of protected species (of which whiting made up the dominant group).

In an effort to show how efficient the *Cú Feasa* is, the average catch per hours fishing was worked out, and compared with similar figures for single and paired boats from Clogherhead and Skerries. When making comparisons of this sort a number of points must be borne in mind which render accurate estimates difficult to make. The *Cú Feasa* was not always fishing in the same area as commercial boats, the type of gear varied slightly, and when good hauls were made the *Cú Feasa* did not always remain in the same place but continued searching for fish in other areas. The average catch over the period February to July, 1964, was :—

Paired Boats	Single Boats	<i>Cú Feasa</i>
81.5 stones	33.8 stones	92.6 stones

SPRATS

(a) From the east coast fishery.

Investigations of sprats (*Clupea sprattus*) began in August, 1964, from samples obtained from Clogherhead and have continued, with some interruptions, up to 1966. The samples were taken from landings made up at this port and were forwarded to Dublin preserved in 70% alcohol. Smaller samples of fresh sprats in water tight jars were also forwarded for fat analyses. All fish were measured and placed in $\frac{1}{2}$ cm groups e.g. 6.0—6.49, 6.50—6.99, etc. They were also examined for sex and maturity of the gonads and the number of vertebrae were counted as a possible useful meristic character. Otoliths were removed and retained for age determination.

Length and age : Age was determined by counting the number of winter rings formed on the otolith, which are, in the case of sprats, well defined and easy to read. Marginal growth on the otoliths was just beginning to show about early May, after the recommencement of the feeding season, and in samples obtained prior to this period the outer edge of the otolith must be considered as a winter ring. According to Isles and Johnson (1962) the fact that the sprat has a prolonged spawning season may mean that the number of winter rings present on the otolith may not be indicative of the true age. Sprats

spawned late in the year may still be in the larval state at the commencement of the first winter and in this state cannot lay down a winter ring, i.e. the first winter ring will not be laid down until two winters after the period in which the fish have been spawned. The mean length in cms per age class and percentage age distribution for 1964, 1965 and 1966 were as follows :—

Age in years	1964	%	1965	%	1966	%
1	6.92	36.9	7.38	6.5	5.72	0.8
2	9.44	57.6	9.91	63.1	8.87	84.0
3	10.77	5.1	10.43	27.4	10.44	13.4
4	11.25	0.4	11.06	2.9	11.21	1.7
5			14.25	0.1	12.75	0.1
TOTAL		100.0		100.0		100.0

The age distribution per length shows much over-lapping on account of the prolonged spawning as can be seen in Table 2. The scarcity of older fish when compared with samples from Killybegs and the disappearance of the large numbers of 2 years old fish present in 1964 which were not represented as 3 year old fish in the 1965 season seems to suggest that the boats are not fishing the main shoals but are relying more on the potential recruits. Samples taken from the *Cú Feasa* failed to show any significant difference between the lengths of fish taken from different depths of water. Over the period August to November, 1964, the mean lengths per age class showed an average increase of 0.37 cm, while from May to October, 1965 the average increase was 1.48 cm. A large influx of small O-group fish join the adult stocks about June each year.

Sex and Maturity. The state of sexual maturity was classified according to a modified scale derived by Johnson (pers Comm). The annual maturity cycle suggests that spawning takes place during May and June. Before these months most fish were either developing or full. During the period July to November the majority of the fish present were the immature O-group already mentioned. The fact that very few running fish in the actual process of spawning or recent spents were found indicates that the boats do not fish the actual spawning stock which must migrate to some other area for this purpose.

Vertebral Counts. On comparison with the vertebral counts obtained from Killybegs and Youghal, it was observed that the differences were very slight, ranging from 47.57 to 47.68. Johnson (Pers Comm) expressed his doubts about the validity of vertebral counts as a useful

meristic character in the case of sprats. Johansen (1929) found appreciable differences between vertebral counts obtained in the North Sea, but as this was not observed in the Irish Sea, this method of determining meristic characters was discontinued.

Fat Analyses. Samples of sprats were first obtained for fat analyses in May, 1965. An indirect method was used by determining the moisture percentage, and the fat content was calculated on the basis of 81—moisture content. Sprats are at their peak fat level when they cease feeding; usually at the end of October, but during the winter these reserves built up are progressively diminished until during the February/March period when they are down to a minimum. It was not possible to obtain samples during the September/November period, 1965, so that the fat level when sprats in the Irish Sea should be at their maximum is not yet known. According to Johnson there is a progressive increase in fat content with the size of the fish, the small immature fish possessing a relatively low amount while the largest fish have the most. The following are the mean fat contents (as %) per month since May, 1965 :—

1965		1966	
May	7.1	February	2.8
June	9.8	March	3.0
July	9.9	May	5.3
August	9.7	June	9.9
December	6.0	July	10.2

(b) **From other areas.**

Youghal : Samples of a mixture of sprats and young herrings were obtained from Youghal from August to November, 1964. These samples were taken from a sprat weir situated in Youghal Harbour. Altogether 3,634 sprats were measured during the period and otoliths retained from 569. The length distribution over the period of examination ranged from 3.5 cm to 13.0 cm, the dominant length group being 5.0 to 5.4 cm. Approximately 95% of all the fish were considered to be in their first year of life. The 0— group fish increased in size from 5.76 cm in August to 6.46 cm in October, while 1 group increased from 8.76 to 9.60 over the corresponding period.

Killybegs : One sample of sprats from Killybegs was obtained in July, 1964. It consisted of 224 fish which ranged in size from 5.0 to 14.4 cm. The percentage age distribution and mean lengths were:—

Age in Years	% distribution	Mean length
1	10.3	6.34
2	33.9	11.74
3	51.8	12.10
4	4.0	11.03

A further sample was obtained in May, 1966. These were large sprats ranging from 9.0 cm to 15.4 cm. The age distribution and mean lengths were:—

Age in Years	% distribution	Mean length
2	4.0	10.19
3	73.6	12.99
4	15.4	13.69
5	7.0	14.54

All these sprats were in maturity stages III and III-IV, i.e. nearly full. Killybegs sprats seem to be much larger and grow faster than sprats from the Irish Sea and Youghal areas.

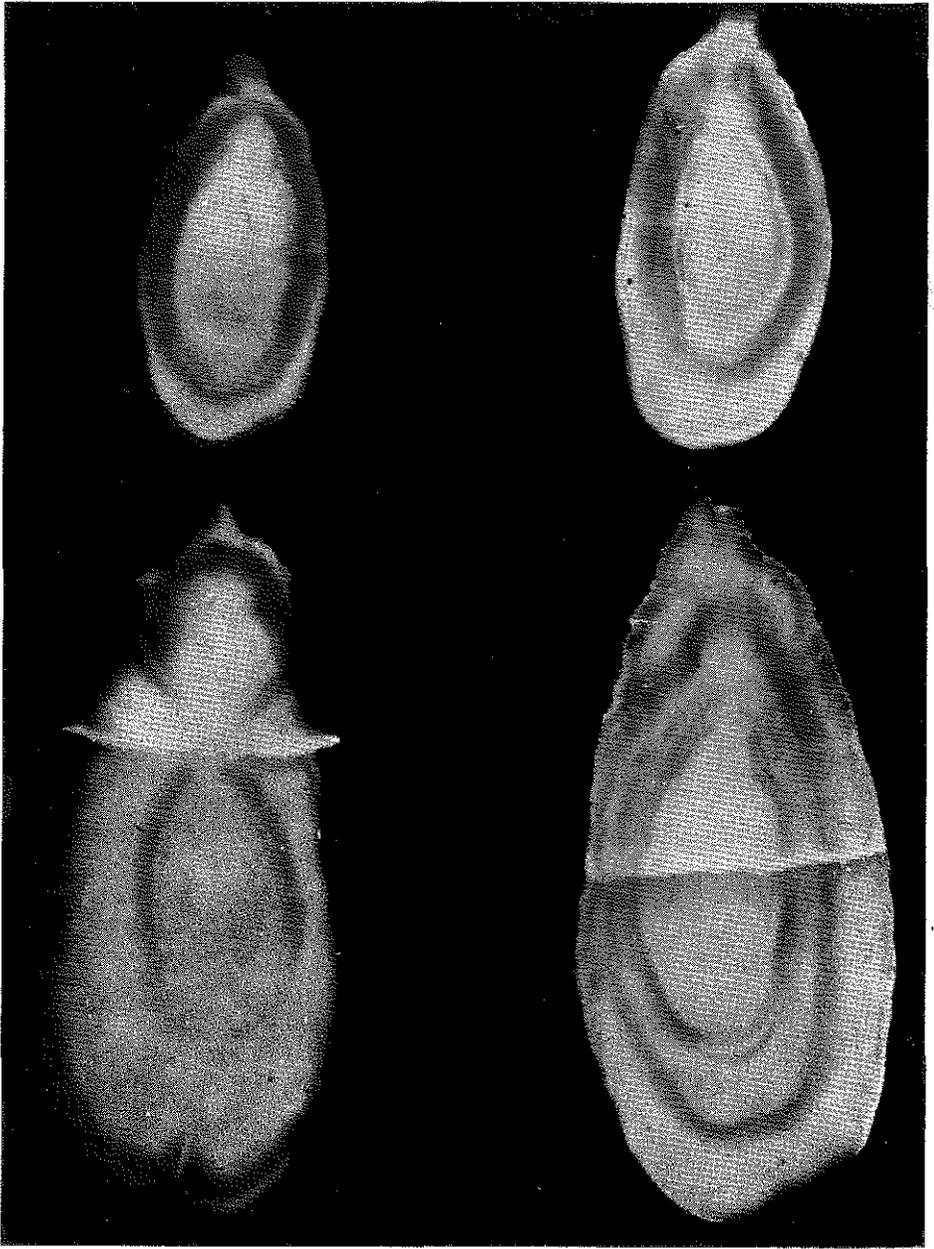
Dunmore East. A sample of 492 fish were examined from Dunmore East in February, 1965. These were again large fish and ranged from 10.0 to 15.9 cm in length. An examination of the gonads showed that they were in stage III (developing). The age distribution and mean lengths were:—

Age in Years	% distribution	Mean length
3	59.3	12.16
4	34.5	13.54
5	6.2	14.61

SANDEELS

Samples of sandeels for biological examination were obtained during May, June and July, 1965. Each sample was separated into the species present and then preserved in 70% alcohol. Afterwards they were examined for length ($\frac{1}{2}$ cm groups) sex maturity, vertebral count and age (otolith readings). Due to shrinkage which occurs after preservation in alcohol fish were moved up a half centimeter group—thus fish whose length placed them in the 10.0—10.4 cm group would in reality be in the 10.5—10.9 cm group.

Sandeels belong to the family *Ammodytidae*. Four species were identified from the Irish Sea—*Ammodytes marinus*, *Ammodytes lancea*, *Ammodytes lanceolatus* and *Ammodytes immaculatus* (Molloy, 1966). *A. lanceolatus* is the most easily identified of the four species being the largest in size and having a dark spot on either side of the snout. *A. immaculatus* has a uniformly dark snout and head and is usually pigmented along the back. Both these species have two small teeth in the roof of the mouth and their upper jaw cannot be extended. The upper jaw of *A. marinus* and *A. lancea* can be extended so that the jaws form a tubelike structure when open and they lack the two small teeth. They can be identified from each other by the arrangement of their ventral scales which are in the form of chevrons (< shaped with the point towards the head) in *A. lancea* and are unevenly distributed in *A. marinus*. The position of the scales show up best when the skin is dry. The species may also be distinguished by differences in meristic characters, e.g. size and shape of otolith and vertebral counts.



Top left. *A. marinus*, 1 winter ring.
Top right. *A. lancea*, 1 winter ring.
Bottom left. *A. lanceolatus*, 2 winter rings.
Bottom right. *A. immaculatus*, 2 winter rings.

Plate 1.

A. marinus. As in the North Sea this species made up the bulk of the catch and is easily the most important part of the catch. It is considered a winter spawner and all the specimens examined were either virgin or resting fish. The main growing period is between January and August. "Summer" growth became obvious on the otolith about the beginning of May. The otoliths show well defined winter rings and are easy to read. (see Plate 1). The length ranged from 6.0 to 14.5 cm but according to Macer (1966) the maximum length may reach 23.5 cm. Mean lengths per age groups were as follows:—

Kish and Bennet Banks			Off Wexford		
W. Rings	Mean length (cm)	Nos.	W. Rings	Mean length (cm)	Nos.
0	7.9	57	0	—	—
1	9.6	344	1	10.2	22
2	11.1	376	2	11.5	42
3	12.6	119	3	12.8	26
4	13.3	34	4	13.3	2
5	13.6	4	5	14.0	6

According to Macer (1966) the fish may grow to 10 years of age. It would appear that most of the growth takes place in the first year of life and thereafter the fish grow very slowly. The Irish Sea stock seem to grow much slower than the North Sea fish—this may be due to overcrowded conditions and intense competition for food. The mean vertebral count was 68.76 based on 50 specimens. Post larvae from the Celtic Sea had a count of 68.56 (Corbin and Vati 1949).

A. marinus was found over a wide area of the Irish Sea, the greatest concentrations being on the Kish and Bennet Banks, and off Wexford and Courtown. It was usually found in association with *A. lanceolatus* which feeds on it. It, itself, is a plankton feeder.

A. lancea. This species, primarily an inshore one, is unimportant in the fishery and is very seldom found with *A. marinus*. It was located off Gormanstown and Balbriggan. It exists in two varieties—a winter spawner and summer spawner (Kandler, 1941). All the specimens obtained were again either virgins or resting so it may be assumed that they belonged to the winter spawning variety. The otoliths were difficult to read because of numerous secondary rings and because the winter rings themselves were badly defined (Plate 1). Lengths ranged from 10.0 to 17.0 cm. No 0— group fish were found so that the young from the last spawning period had not yet joined the stock. The mean length per age group was as follows:—

W. Rings	Mean length (cm)	Nos.
1	12.1	49
2	13.7	58
3	14.5	69
4	16.0	13
5	17.3	2

A. lancea thus seems to grow considerably faster than *A. marinus*. The vertebral count for 21 specimens was 64.14. The North Sea count for summer spawners was 63.09 and for winter spawners, 64.08 (Kandler, 1941).

Some 41 specimens were examined which seemed identical with *A. lancea* in outward appearance and in vertebral count, but their otolith structure was different. While it was first thought that these fish may have been of the summer spawning variety the maturities did not substantiate this assumption and the fish must be considered as of doubtful identity. Their mean length per age class was as follows:—

W. Rings	Mean length (cm)	Nos.
1	12.0	5
2	14.0	31
3	15.6	5

A. lanceolatus. This is by far the largest species and may attain a length of 38 cm. It is the only predator and its chief food is *A. marinus*. The spawning period is very prolonged. Full and running fish were found from May to the end of July. Lengths ranged from 10.5 to 32.0 cm. They seem to reach sexual maturity around 21.0 cm, i.e. in their second year. Otoliths are shown in Plate 1. The mean lengths per age group were as follows:—

W. Rings	Mean length (cm)	Nos.
1	16.7	85
2	24.1	70
3	28.1	13
4	29.8	14
5	31.5	2

The mean vertebral count for 78 specimens was 66.22 compared with 66.73 and 66.85 for the Baltic and North Sea (Kandler, 1951).

A. immaculatus. This was the rarest species encountered, only having been taken on one occasion. All the specimens were 2 winter ring fish and probably resting. Otoliths were very difficult to read (Plate 1). The first winter ring is well defined in the small specimens but when the second ring is formed the following years growth seems to obscure the first ring and may make it practically invisible. Lengths ranged from 16.5 to 22.5 cm. The mean length for the 2 winter ring specimens was 20.5 cm and the mean vertebral count for 47 specimens was 71.04.

SUMMARY

- (1) As a result of an increased demand for fish for industrial purposes landings of sprats and sandeels have increased considerably over the last few years.
- (2) Sprats are available all the year round while sandeels are most plentiful during the summer months.
- (3) Investigations using the research boat, *Cú Feasa*, showed that consistently good catches were taken off Wexford, Kish and Bennet Banks and off Clogherhead.
- (4) The presence of large quantities of small plaice and whiting taken when fishing for sprat was viewed with considerable alarm.
- (5) The catching power of the *Cú Feasa* compared very favourably with commercial boats.
- (6) Scientific investigations were initiated on sprat and sandeels.
- (7) Irish sea sprats are composed mainly of one and two year old fish indicating that boats are not fishing the main portion of the stocks.
- (8) Samples of sprats obtained from other areas were composed of larger and older fish.
- (9) The mean fat content of sprats per month was investigated.
- (10) Four species of sandeels were identified from the Irish Sea. As in the North Sea fishery *A. marinus* constituted the most important part of the catch.

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TABLE 1. Showing the total catches of the listed categories in stones per hour from February to July, 1965, by *Cú Feasa*

Week ending	Sprats	Sandeels	Marketable	Waste	Total
20/2	11.0		2.2	7.1	20.3
27/2	5.4		0.3	11.5	17.2
6/3			5.0	14.1	19.1
27/3	22.4		16.7	48.1	87.2
3/4	25.4		29.8	70.5	125.7
24/4	2.9		32.1	39.3	74.3
15/5	10.0	38.8	4.1	5.3	58.2
22/5	44.1	20.3	0.4	1.3	66.1
29/5	57.6	37.8	1.2	1.1	97.7
5/6	65.6	26.6	4.5	1.3	98.0
12/6	54.9	24.2	11.8	4.4	95.3
19/6	58.1	90.0	1.7	2.5	152.3
3/7	174.1	3.4	1.9	10.7	190.1
10/7	227.5	14.5	12.1	9.6	263.7
24/7	22.5	10.1	9.6	13.2	55.4
31/7	38.8	9.3	6.7	6.0	60.8

TABLE 2. Length distributions of sprats per age class and their mean lengths

groups $\frac{1}{2}$ Cm.	1964					Age in Years					1965	
	1	2	3	4	Total	1	2	3	4	5	Total	
4.0—4.4						1					1	
4.5—4.9	3				3	2					2	
5.0—5.4	37				37	7					7	
5.5—5.9	133				133	14					14	
6.0—6.4	316				316	23					23	
6.5—6.9	233				233	18					18	
7.0—7.4	245				250	30					30	
7.5—7.9	144	5			178	43	7				50	
8.0—8.4	124	34			272	27	39				68	
8.5—8.9	42	148			458	31	112				153	
9.0—9.4	16	416			584	3	382				467	
9.5—9.9		543	22	3	450		555	10		3	736	
10.0—10.4		431	19		305		450	79		7	682	
10.5—10.9		258	42	5	150		272	174		14	462	
11.0—11.4		116	34		73		272	218		17	226	
11.5—11.9		51	22		40		90	173		22	74	
12.0—12.4		19	20	1	19		23	40		11	34	
12.5—12.9		3	12	4	3		5	23		5	7	
13.0—13.4			3		4			4		3	2	
13.5—13.9			2	2	4			2			6	
14.0—14.4			3	1	4			4		2	1	
15.0—15.4			2		2				1		2	
TOTAL	1293	2024	181	16	3514	199	1935	843	85	3	3065	
Mean length	6.92	9.44	10.77	11.25		7.38	9.91	10.43	11.06	14.25		

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