

Fol. 41 H

This paper not to be cited without prior reference to the author

International Council for
the Exploration of the Sea

C.M. 1980/H: 60
Pelagic Fish Committee

Fisheridirektoratet
Biblioteket

The spurdogs in the North Sea area; the Norwegian
fishery and observations on changes in migration pattern

by

Per Otto Hjertenes
Institute of Marine Research ,
Bergen, Norway

ABSTRACT

The Norwegian fishery of spurdog (Squalus acanthias L.), which started in 1930, has played a dominant part in the fishery for this species in Europe. During 1963-1968 a change occurred in the behaviour of the spurdog stock. The spurdogs left the traditional fishing grounds, and this led to a depression in the Norwegian fishery. New concentrations were discovered in the southern North Sea during the autumn 1968. Several tagging experiments, 1975-1979, indicate that the spurdogs in this area migrate to the area north of Scotland during the spring. Recaptures from taggings 1959-1966 together with information on Scottish spurdog catches during 1947-1957, indicate that the spurdogs in the southern North Sea belong to the Scottish-Norwegian spurdog stock. During the last two years the Norwegian longline fishery for spurdogs has been greatly reduced. Length distributions indicate that maturing and mature females which constitute the main part of the Norwegian catch, were heavily reduced in numbers from 1975-1979. Research should be intensified to establish a basis for international regulation of the spurdog fishery.

I. INTRODUCTION

The little squaloid shark Squalus acanthias L. (spurdog or picked dogfish) has been caught commercially by Norwegian fishermen at least from 1930. The Norwegian catch steadily increased until 1963 when it reached 34 000 tons, amounting to 87% of the total European spurdog catch that year (Fig.1). Except for minor quantities delivered to fishmeal-plants, the total Norwegian spurdog catch has been exported fresh or frozen to the countries of central Europe.

The fishery was to a certain extent regulated by market conditions since the fishing fleet, by governmental control, was not allowed to land greater amounts of spurdogs than the exporters immediately managed to market abroad. This clearly inhibited the fishery until 1960 when the exporters were able to store the frozen fillets.

In 1964, when Aasen (1964) pointed out the danger of over-exploitation, a minimum legal size limit of 70 cm was introduced.

Unfortunately, the spurdog research was laid down during the following years, and was not taken up again until 1975. In the meantime, the fishery almost collapsed, but an increase in the landings occurred when new fishing grounds were discovered in 1968. During 1975-1979 several tagging experiments were carried out to investigate the migration of the spurdogs in the new fishing area. Because the Norwegian spurdog fleet follow the movements of the spurdogs most of the year, much could be learned from the movements of this fleet. However, the entire situation was not clearly understood as the fishermen for one period of the year, apparently lost the trail. In the following results, these tagging experiments will be presented together with a review of the Norwegian spurdog fishery with some remarks on the present situation.

II THE NORWEGIAN SPURDOG FISHERY

Earlier years

Traditionally the fishery for spurdogs was performed by small long liners, 30-60 feet, along the coast of Western Norway. The fishing-season lasted from late October to early March, and the appearance of the spurdogs along the coast, seemed to coincide with the appearance of the Norwegian springspawning herring in that area (Norstrand 1977). After 1945 the fishery was extended to the open sea and was prolonged to be all-season fishery. The shifts in fishing areas apparently followed the migration pattern of the spurdogs. The fish left the coast in March, moved westwards, passed the Norwegian furrow, and along the slopes of Tampen (Halibut grounds) to the shallow areas around the Orkneys and Shetlands. Here the spurdogs remained during summer and early autumn until they started the migration eastwards, to the Norwegian coast during September-October. This migration pattern was later confirmed by the tagging experiments of Aasen 1961, 1962, 1963, 1964 and Holden 1965.

Considering the rather stable fishing situation with a slowly increasing catch and the seasonal shift in fishing areas each year, the described migration-pattern must presumably have been the same since 1930 when the fishery started.

However, during the period 1960-1965 the situation changed markedly. The coastal fishery moved southwards and a new fishery developed outside Stavanger. In 1963-64 the spurdog fleet worked east of Lindesnes and the fishing area north of Scotland lost their importance compared to the catches taken along the coast (Fig.2).

The annual catch decreased rapidly until 1967. The confused migration system and low concentrations of spurdogs on the traditional grounds forced several boats to switch to other fisheries. The situation changed in August 1968 when a former spurdog vessel,

while working lines for porbeagle, came on high concentrations of spurdogs along the northern slope of the Doggerbank. A fishery soon developed, and later that autumn regulations were introduced to reduce the catches.

The spurdog fleet now started to follow the migration route of these new spurdogs-hoals, and after a few years it apparently had evolved a stable pattern: During January-April the fleet worked the shallow areas north of Scotland. In May, the best catches were taken around the Shetland islands. At that time the fleet lost contact with the spurdog, and this led to a period of two months with no fishing. From August the spurdog again could be caught with success south of 57°N in the North Sea, and the fleet worked the central part of this area until November when they moved against the English coast. The shoals of spurdogs seemed to move northwards along the British coast during the following period, and the fleet followed on until they reached the Orkneys in the middle of December.

The movements of the fleet during the year as summarized in Figure 3 have been stable until today.

The present situation

During the last years both vessels and gear have changed considerably in the Norwegian longline fishery. The lines are roughly the same, but the development of an automatic baiting and handling system has created a revolution in this fishery. This has made it possible to handle nearly twice the numbers of hooks compared to ordinary handbaiting. At present 46 vessels are using this system, and 22 of them have joined the spurdog fishery regularly the last years.

Besides the vessels are larger (100-130 feet) and nearly all of them have closed working decks where the lines are operated through hatchways fore and aft. Freezing and storing capacity are greatly enlarged, and better insulation of storing rooms have prolonged the time at sea.

Despite all these improvements, the landings of spurdogs have decreased considerably the latest years. The reason for this is that the boats have difficulties in finding schools containing spurdogs greater than the legal size limit.

Much of time at sea is now used for searching, and as the cost of fuel has risen considerably, the Norwegian fishermen loose interest in this fishery. During 1978, the winter fishery north of Scotland collapsed, and during the autumn season 1979, more than half of the fleet left the fishery. This year only 5-10 boats are expected to join the autumn fishery for a shorter period. This rapid decline in the landings have not been so marked in England and Scotland. The reason for this is that these fleets traditionally catch smaller spurdogs (Holden 1965) and besides: they have no size limit.

Certain factors indicate that a size limit not only conserves the smaller fish, but that it also concentrates the fishing pressure on the females. The reason for this is that the male spurdogs nearly stop growing when they reach 70 cm, and since the spurdogs is known to school by sex and size (Ford 1921), the long liners will search for schools with low percentage of undersized spurdogs. Undersized fish have to be sorted out by hand and hamper the fishing operation considerably. From experience, these schools mostly contain mature and maturing females, which also is consistent with Ford's investigations (Ford.op.cit.).

This condition suggests that the percentage of mature females (greater than 80 cm) in the stock, have been affected by the Norwegian longline fishery. The length distribution from a fishery searching service performed during 1975-1978 and some samples taken during the autumn 1979, emphasizes this particular problem (Fig.4). Here we can see that the length distribution of the males have not been affected by the fishery over the last years while the percentage of mature females is gradually reduced. In this connection it should be stressed that the length distribution from the searching cruises gives a more true picture in relation to the gear which is used. The reason for

this is that during these cruises the whole fishing area would be sought through while the fishermen go specifically for the concentrations of large fish. In this way 1978 should give a more true picture of the length distribution in the stock than 1979 which solely is based on samples from landings.

III TAGGING EXPERIMENTS PERFORMED DURING 1975-1979

From 1974 special searching cruises were organized once or twice a year, mostly to cover well known fishing grounds for spurdogs outside the main fishing season.

These cruises gave little information on the general distribution of spurdogs during the year, and from 1975 some preliminary tagging experiments were started. The taggings were extended during 1977, and covered all major fishing grounds during 1977 and 1978.

Below a description will be given of the tagging experiments and the recoveries during the period 1975-1979.

The tags used

During 1975 and 1976 a special shark-tag designed by O.Aasen was used for the spurdog (Aasen 1961).

This tag has a serious draw-back. After some years at liberty the plastic film is worn against the rough shark-skin, and will in the end drop off and be lost.

When the taggings were extended in 1977 a "Petersen-tag" was chosen. This tag consists of one white and one orange plastic-disc, each with a thickness of 0.1 cm and a diameter of 1.8 cm. The discs are placed on each side of the second dorsal fin and secured by a stainless steel string which pierces the fin and both of the discs. It is important that the string is lanced through the cartilaginous part of the fin (below the ceratotrichia). If not, there is a substantial risk of shedding.

In that way the second dorsal fin would give the best hold for a tag.

Both Jensen (1969) and Holden (1965, 1968) conclude that the Petersen tag is well applicable on spurdogs. However, our experience indicate that the tag is not appropriate for dogfish less than 60 cm. The area of the fin where a tag can be placed is then too small, and the tag will come in contact with the dorsal part of the fish and cause irritation and probably infections.

The tagging experiments

Most taggings were carried out during searching cruises which mainly lasted for 20-30 days, and offered a good opportunity to spread the tags over most of the fishing grounds (Fig.5).

Spurdogs for tagging were caught on long-lines of the same type as used in Norwegian spurdog fishery. The lines, baited with frozen mackerel, were mainly worked at the bottom down to 250 m. In the southern North Sea floating lines also were used, especially during August-September.

The lines were fairly short, 360 m - 350 hooks, and the fishing time was normally kept within one hour. The fish were kept in a 2 m³ tank with running water, and were usually tagged immediately when we had finished operating the lines. Tagging, sexing and measuring (total length to nearest cm) was mostly finished 2-4 hours after the lines had been set.

In the text-table below is given a detailed account of all tagging experiments, and the recoveries from each experiment until January 1980.

Experi- ment	Area	RELEASE		Number of stations	♀ Number tagged	RECOVERY Number
		Time				
1	C	Sep.75		2	37+ 263	51
2	C	Aug.76		23	23+ 252	50
3	A	Mar.77		23	879+1320	96
4	D	Apr.77		2	120+ 36	3
5	C	Aug./Sep.77		39	912+2129	167
6	D	Okt./Nov.77		9	191 328	16
7	A	Feb./Mar.78		11	165	13
8	C	Aug.78		77	747+2571	207
9	D	Nov.78		14	132+1000	37
10	A	Jan.79		6	1064+ 47	57
TOTAL	-			146	4378+8111	687

Results and discussion

689 tags were recovered during September 1975 - January 1980. Of these, 153 tags were received with insufficient information on the recapture. The rest of the tags were sorted according to time of recapture (year and month) and to area for recapture. For the analyses four areas were defined (Fig.4). The seasonal pattern of recoveries for the areas A, B and C seemed so rigid that the recoveries taken in one particular month and one particular area could be summarized for all the years 1975 to 1980. The result is presented in Figure 6. Area D will be discussed later.

The described recovery-pattern (Fig.5) reflects the migrations of the spurdogs. The main part of the stock in the North Sea migrates from a winter-area north of Scotland (A), through area B to a summer/autumn-area in the southern North Sea (C) (spring migration), and back again to the winter area also through area B (late autumn migration).

This explanation assumes that a) there have to be a considerable exchange of tagged fish between area A and B from releases in these two areas, and b) that the fishing effort on spurdogs is evenly distributed over the entire area (A+B+C) through the year.

An investigation of the recoveries from releases in area A and from releases in area B satisfies the first of these two conditions:

Recoveries from 3887 spurdogs released in area A:

Area:	A	B	C	Other	Total
Rec.	53	17	49	7	126

Recoveries from 6934 spurdog released in area B:

Area:	A	B	C	Other	Total
Rec:	44	39	248	52	383

There have been taken 49 recoveries in area C from releases in A, and 44 recoveries in area A from releases in C. However, the returnrate in A from releases in C is rather low compared to the number of releases. This is explained by the distribution of the fishing effort. During the unstable weather months December to March, the fishing effort in the areas north of Scotland where just a few nations are working, must be low compared to the stable summer and autumn months in the southern North Sea where several nations perform a great activity during this period. This fact also explains the very high return rate in C from releases in the same area. All the releases were performed prior to a period of high fishing intensity. The tagged spurdogs were then concentrated during this period which resulted in a high recatch percentage the first month after the tagging.

The second condition is not so readily acceptable. The recatches have been taken by totally 10 different countries. The most important contributors are:

England:	41%
Scotland:	19%
Norway:	16%
Other countries:	24% (mostly Denmark and France)

No records of fishing effort are available from any of these contributors. Only Norway performs a special spurdog fishery. The other mainly catch spurdogs as a bycatch in connection with the trawl and sein fishery for cod and haddock. Regarding this trawl/seine fishery, there seems to be no conspicuous transference of fishing fleets between the different area during the year. Therefore, most of the North Sea, and likewise the areas north of Scotland, would be exposed to a continuous fishing effort from trawl and seine throughout the year only affected by the weather-conditions and the general fishing situation within the particular areas.

Besides this, Norwegian fishing authorities have carried out an extensive searching service for spurdogs since 1974. Personal experience from searchings during 1976-1979 indicates that outside the different areas where the Norwegian spurdog fleet works during the year, only smaller concentrations of immature spurdogs exist. From experience obtained during these cruises and from the results of the tagging experiments, maps indicating the distribution of spurdogs during an early autumn and a late winter situation have been drawn (Fig. 7, a,b). The distribution of mature females in the southern North Sea during the summer has been statistically verified from recatches, while the corresponding distribution in the winter area is based on communication with Norwegian fishermen and personal knowledge.

Area D (Norwegian coast and Skagerrak)

From 1666 spurdogs released in the Norwegian fjords 56 tags have been recovered. Only one of the tags was recovered outside the area. 29 tags, however, have been recovered in area D from releases in area C, mainly in Skagerrak. Further, there is one recovery from releases in area A.

The results indicate that the spurdogs in the Norwegian fjords are isolated from the North Sea spurdogs.

Somehow, there seems also to be seasonal migrations inside this area, but the recoveries are too few to describe the situation exactly.

The recaptures taken in Skagerrak from releases in C, are taken outside the fjord areas and mostly during the autumn. The number taken each year is variable, and do not describe any stable migration pattern.

The described pattern of recoveries for all areas is not consistent with the results obtained by Aasen (1961, 1962) and Holden (1965). They both found that the areas north of Scotland mainly were inhabited by the spurdog stock during the summer, and that there was an extensive migration to the Norwegian coast during the late autumn and winter. However, Aasen (1963) pointed out the first signs of a change in this migration pattern. Unfortunately, the research was reduced during the following period. At present, there have been no spurdog fishery off the Norwegian coast since 1970.

It seems clear that the Scottish-Norwegian spurdog stock has changed its migration pattern. This is supported by the fact that there are tags still recovered from Aasens taggings which coincides with the existing recovery pattern. Further, Rae (1961), points out that the time when the former migration pattern existed, most of the spurdogs were distributed north of 57°N throughout the year. Spurdogs were only occasionally taken along the northern slopes of the Doggerbank which now is the most important spurdog ground.

IV CONCLUSION

The Scottish-Norwegian spurdogs stock have changed their migration pattern during 1962-1968 and established a new migration pattern.

The stability of this migration pattern is not yet proved, and a future regulation of the fishery for this species should cover both the North Sea, the areas north of Scotland and the Norwegian coast.

Decreasing landings, inspite of increasing effort by each single boat, together with the series of length distributions presented, indicate that the reproducing part of the spurdog stock is heavily reduced.

Further regulation of the fishery may be needed as the minimum landing size of spurdogs introduced by the Norwegian authorities has apparently been insufficient to avoid overfishing.

The consequence of a minimum landing size large enough to protect females, would be that males remained totally unexploited. Possibly, international catch quotas together with some kind of protection of the older females being the best producers of progeny, should be established. The research on the spurdog stock ought to be intensified to establish a more firm basis for the management of the fishery.

LITERATURE

- AASEN, O. 1961. Pigghåundersøkelsene. Fiskets Gang, 47: 36-44, 2 fotogr., 5 fig., 6 tab.
- 1962. Norske pigghåmerkinger 1958-61. Fiskets Gang, 48: 507-511, 6 fig., 2 tab.
 - 1963. Norske pigghåmerkinger 1962. Fiskets Gang, 49: 455-460, 7 fig., 5 tab.
 - 1964. The exploitation of the spiny dogfish (Squalus acanthias L.) in European waters. Fiskeridir.Skr.Fisk., 13(7): 5-16, 4 fig., 4 tab.
- FORD, E. 1921. A contribution to our knowledge of the life-histories of the dogfishes landed at Plymouth. J.Mar.Biol.Assoc.U.K., N.S. 12(3): 468-505, 19 fig.
- HOLDEN, M.J. 1965. The stocks of spurdog (Squalus acanthias L.) in British waters, and their migrations. Min.Agr.Fish.Fd. (U.K.), Fish.Invest., Ser.II, 24(4): 1-20, 3 fig., 19 tab.
- 1968. The rational exploitation of the Scottish-Norwegian stocks of spurdogs (Squalus acanthias L.) Min.Agr.Fish.Fd. (U.K.), Fish.Invest., Ser II, 25(8): 1-28, 4 fig., 18 tab.
- JENSEN, A.C. 1969. Spiny dogfish tagging and migration in North America and Europe. Int.Coun.NW Atl.Fish., Res.Bull. No.6: 72-78, 3 tab.
- NORSTRAND, F. 1977. Fiske etter og marknadsføring av pigghå fra Måløy, 1925-1975. Thesis from the Norwegian Institute of Commerce. pp.161 (Not published).
- RAE, B.B. 1961. Dogfish, species occurring in the Scottish area. Scott.Fis.Bull. 4: 14-19, 4 fig.

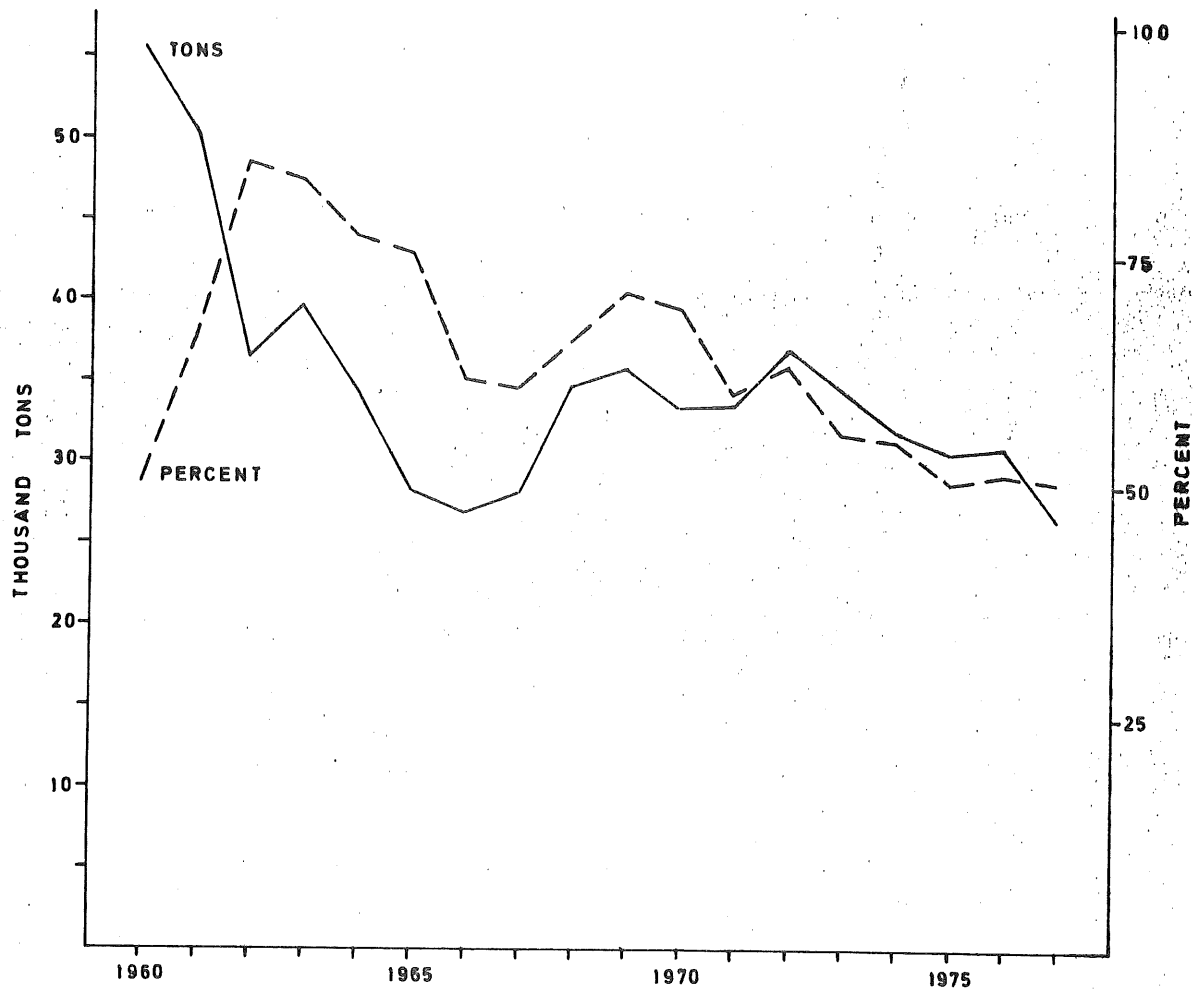


Fig.1 European catches in thousand tons during 1960-1970, and the Norwegian share in percent.

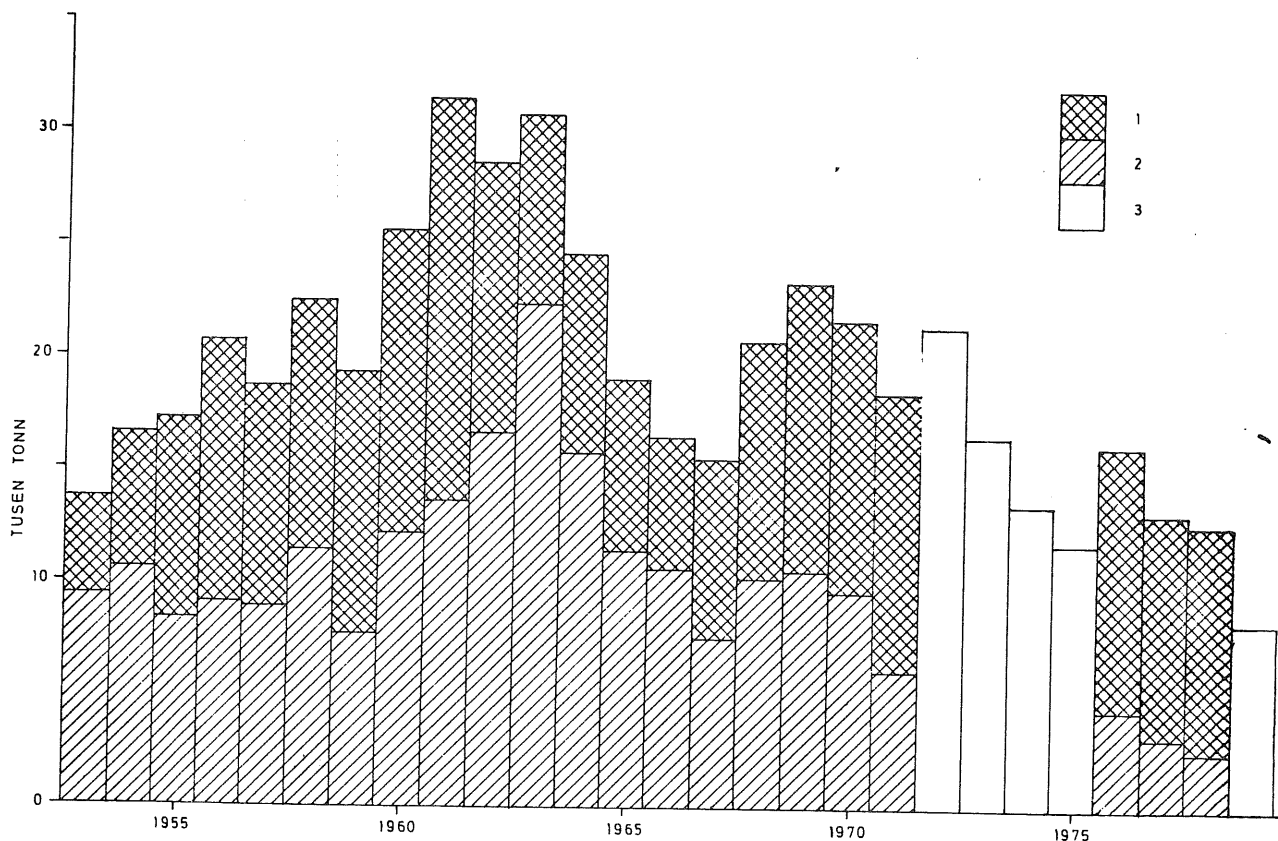


Fig.2 Norwegian catch in thousand tons during the years 1953-1979.
 1) Catches taken on far seas, 2) Catches taken outside the coast
 3) Data not available.

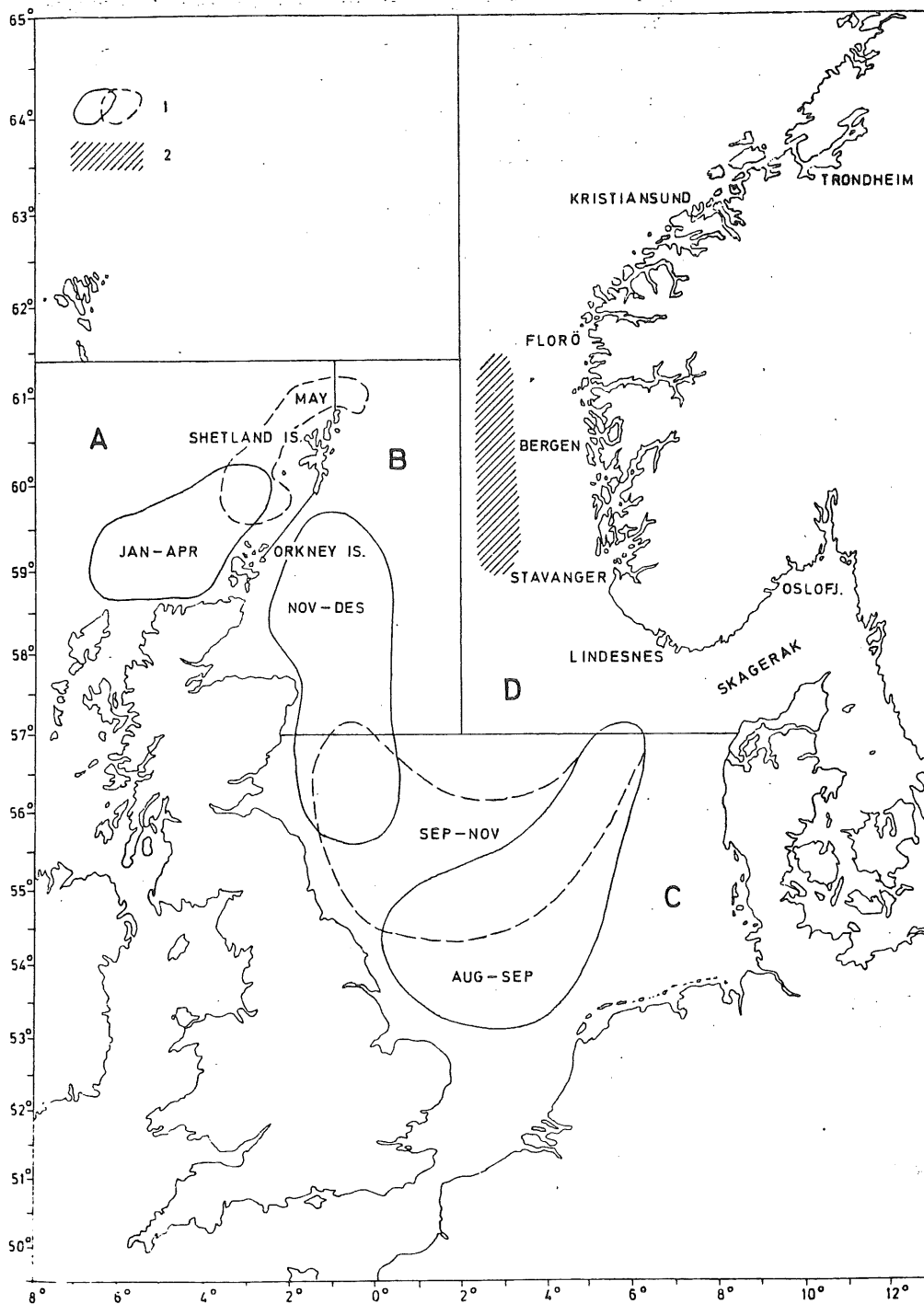


Fig.3 Areas for the Norwegian spurdog fishery
 1) Longline, 2) Trawl

n = number(♀ + ♂) s = sample f = fishingstations

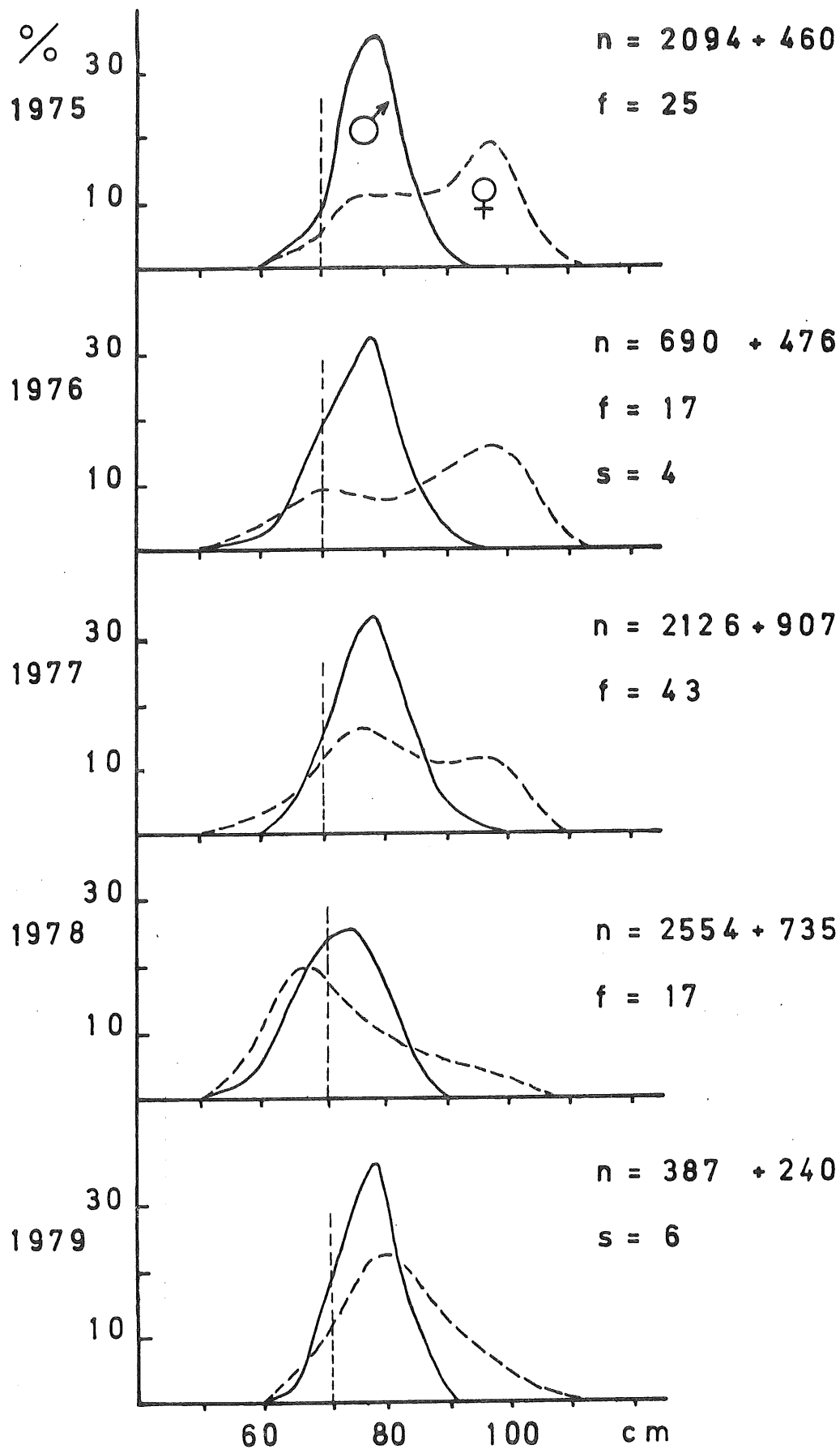


Fig. 4 Length distribution of spurdogs (percentage - 5 cm groups) from samples taken on shore(s) and from searching cruises(f). The Norwegian minimum size limit is indicated.

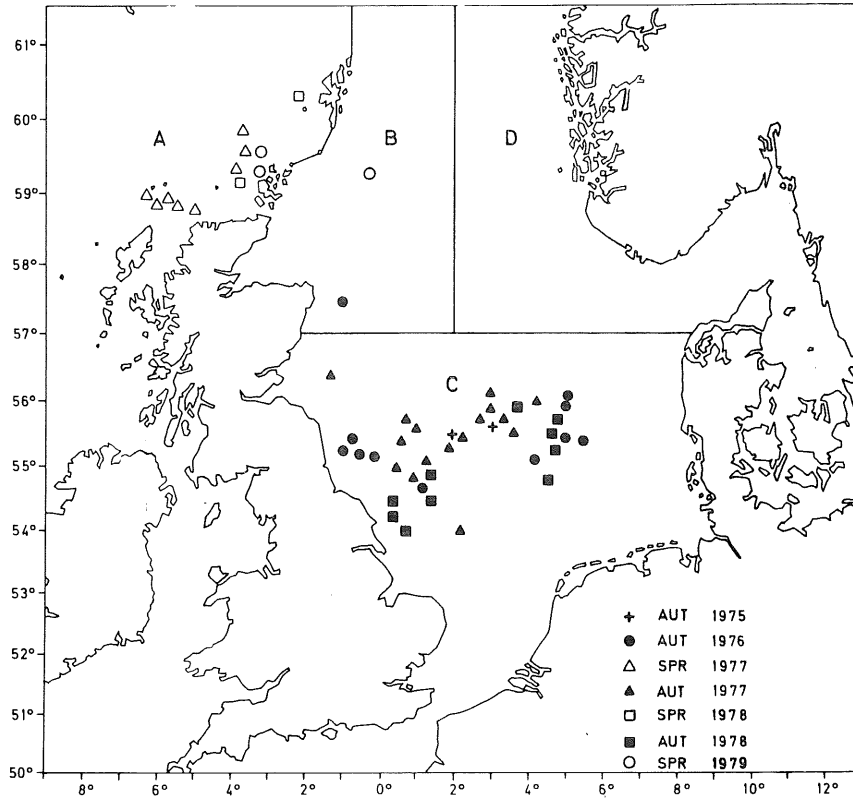


Fig.5 Releases of spurdogs in area A, B and C

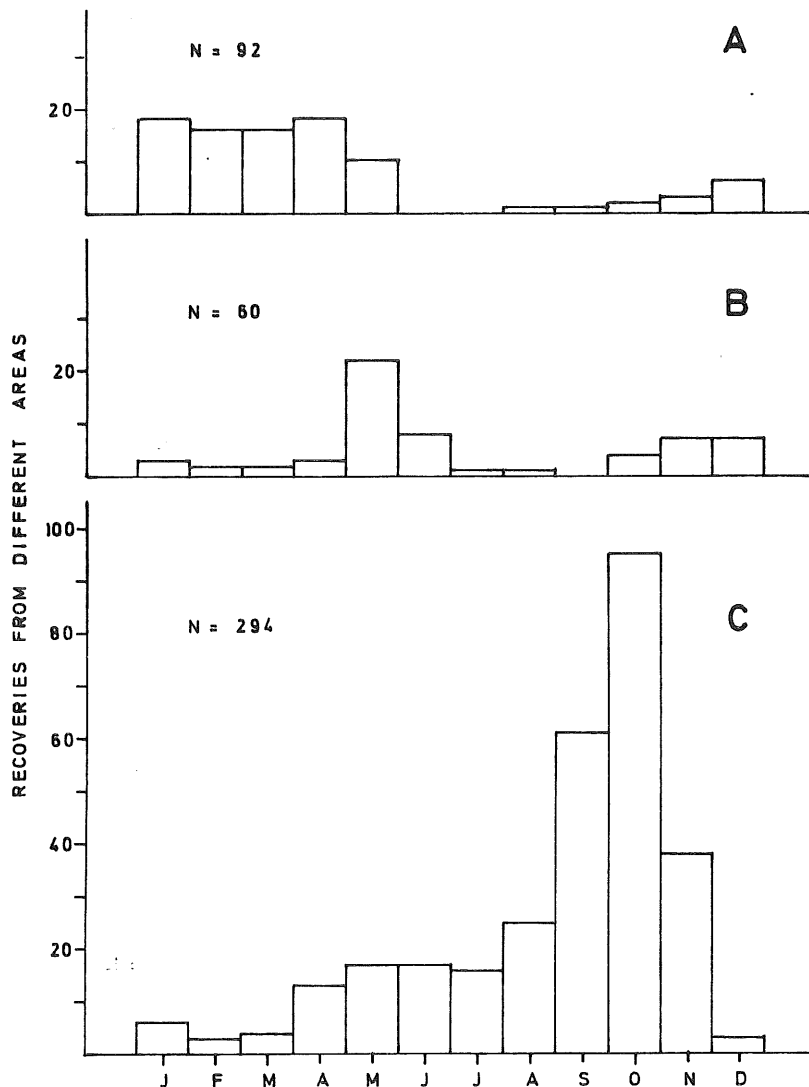


Fig.6 Number of recoveries taken in relation to month and area during 1975-1979.

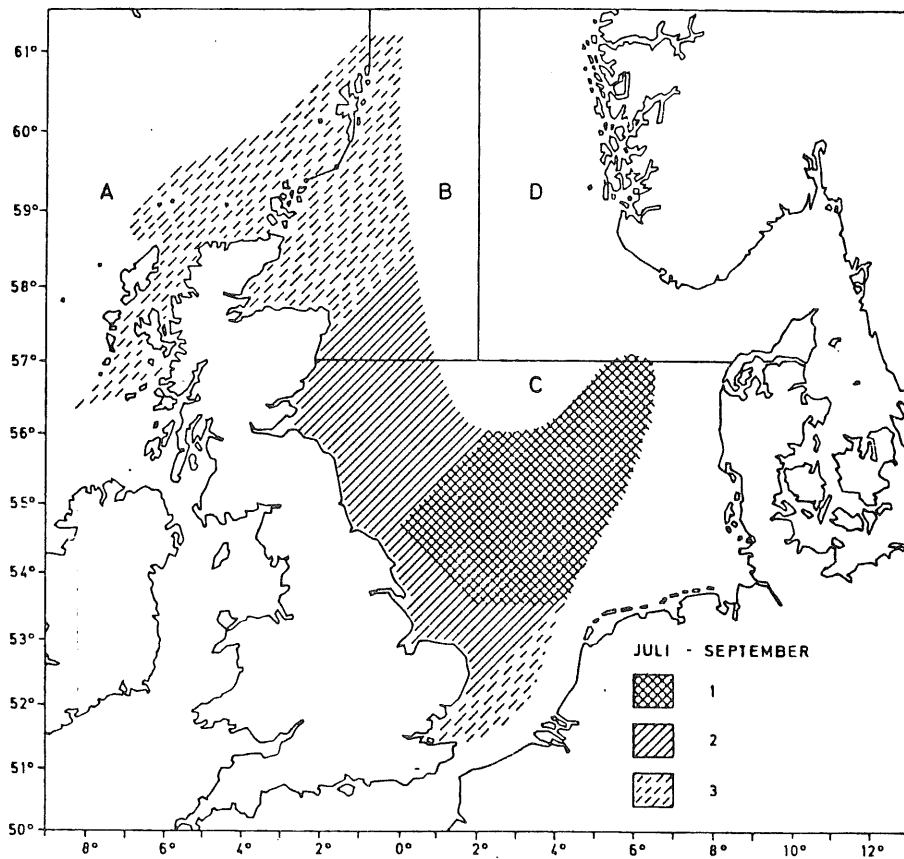
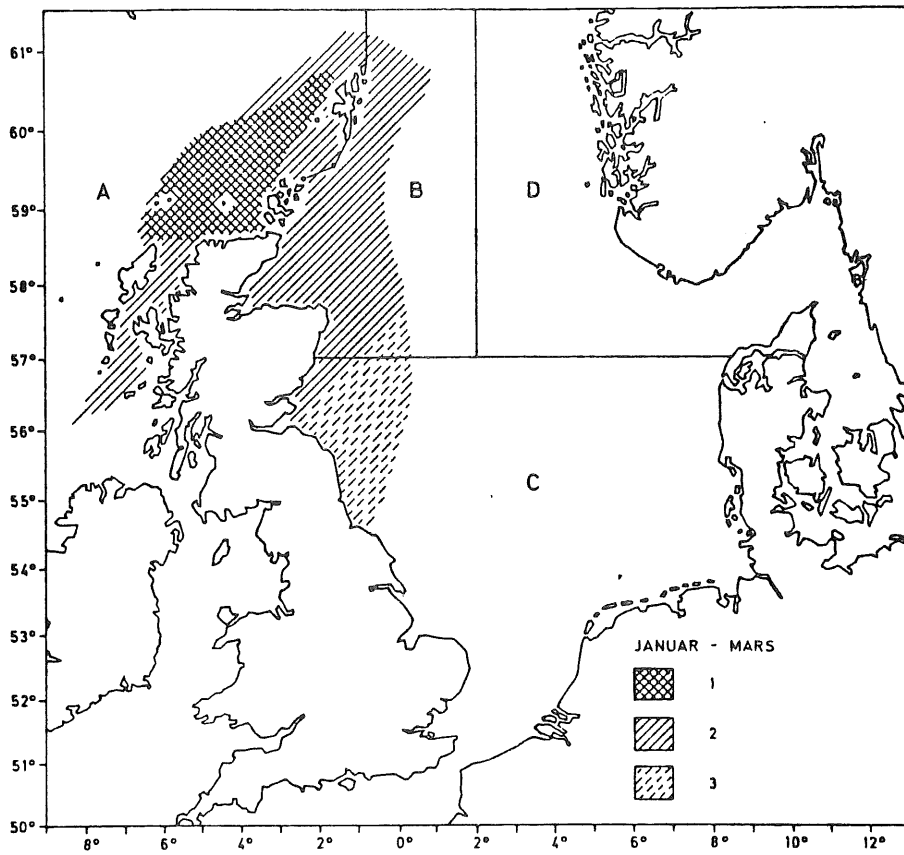


Fig.7 Distribution of spurdogs during winter (top) and summer (below). 1) Mature females, 2) Immature spurdogs, 3) Scattered distribution.