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Status of Skate Stocks in the Barents Sea
(Elasmobranch Fisheries – Poster)

by

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Abstract

The biomass and abundance of 6 species of skates (Thorny skate - *Raja radiata,* Northern skate – *R. hyperborea,* Round skate – *R. fyllae,* Blue skate – *R. batis,* Spinytail skate- *R. spinicauda* and Long-nosed skate – *R. oxyrhynchus*) have been assessed on the basis of data provided by trawl surveys conducted by PINRO in the Barents Sea annually from October to December.

Information on the distribution, conditions in the habitat, size distribution and sex composition of skates in the Barents Sea is presented.

Introduction

Assessment of bottom fish stocks in the Barents Sea has been done by the Polar Research Institute on a regular basis in autumn/winter season (Shevelev *et al*., 1990). Historically the status of stocks of major commercial fish species (cod, haddock, redfish, catfish etc.) has been assessed. However, the species (including skates) representing no interest for the fishery have not been adequately addressed. Meanwhile, a number of species, including skates, has for a long time already been examined as potential targets of commercial fisheries. From late 1980s-early 1990s data on the distribution and biology of skates started to be collected.

In this paper we attempted to review conditions in the habitat and distribution of various skate species in the Barents Sea, their size-sex composition and to assess abundance and biomass of each individual species.

Materials and Methods

This paper uses materials from trawl surveys in 1998-2001 conducted by the Polar Research Institute over a vast area of the Barents Sea from October to December. During surveys skates of all species were assessed, their length was measured to the nearest 1 cm, sex identified, in some cases fish were weighed and biological analysis was undertaken. Water temperature and salinity near the bottom were measured using a CTD system before or after each trawl haul.

The abundance of skates was estimated by applying the area method. To do this the average catch of skates of each species for each 5 cm length interval and for each fishing area (Map of fishing areas …, 1957) was estimated and then multiplied by the area of a given fishing area. In computations the fishing efficiency for all skate species and size groups was taken as 0.1. It was done so, because there were no specific studies to determine the fishing efficiency of trawls for skates. Before, to assess the biomass of skates the fishing efficiency derived for other fish

species, usually such as flatfish similar in body shape and behaviour to skates, was applied. For instance, Konstantinov (1977) assumed the fishing efficiency as 0.5. Vinter and Sparholt (1988) used the fishing efficiency estimated for plaice. However, they noted that only 1.33% of the total biomass of thorny skate was fished. According to T. B. Nikiforova and L. I. Serebrov (unpublished data), on the basis of underwater observations the fishing efficiency for thorny skate by research trawl was established to be 5 times less than for long rough dab for which the fishing efficiency was, on the average, about 0.2. The total abundance of a species was determined as a sum of estimates for each individual fishing area.

Biomass was estimated as a product of abundance of fish in each 5 cm length interval and mean weight of fish for this length group. To do this data on the mean weight of skates as provided by surveys averaged for the whole period of research were used.

Since the surveyed area differed slightly between years to derive comparable estimates of abundance and biomass selected locations which had been covered by all surveys were used. The total area surveyed was, on the average, about 200 000 miles^2.

Results

Species composition

There are 7 species of skates usually listed in the literature for the Barents Sea, they belong to the family *Rajidae* – Thorny skate - *Raja radiata,* Northern skate – *R. hyperborea,* Round skate – *R. fyllae,* Blue skate – *R. batis,* Spinytail skate- *R. spinicauda* and Long-nosed skate – *R. oxyrhynchus* and Shagreen ray *R. fullonica* (Andriyashev, 1954). Of them the most common are the first 5 species, while the latter two were not found (Dolgov, 2000). Despite repeated captures of Sail ray *R. lintea* (Ponomarenko, 1961; Poletaev and Shibanov, 1982; Dolgov and Igashev, 2001) this species was not included in the majority of reports from this area. Thornback ray *Raja.clavata*, a reference to a capture of which near the northern coast of Norway is available in one paper only (Hognestad and Vader, 1979), is likely to be scarce in this area or not found at all. So, the most typical of the Barents Sea are 6 species of skates, and reviewed below will be information relevant to these species.

Habitat

By hydrographic conditions in their habitat the skates can be divided into 3 groups (Fig. 1). The first group includes northern skate, which lives, mainly, at negative water temperatures, though it can also be found in areas with a higher water temperature. The second group comprises thorny skate for which a very wide range of temperatures (from - 1˚C to +7.5˚C) at which it occurs is typical, its aggregations were found at +0.5˚C to +3.5˚C. Round, blue, spinytail skate and sail ray live at higher water temperatures (above +2˚C), the most thermophilic skate (sail ray) was found at temperatures from +4˚C to +6˚C only. Salinity range was practically the same for all species of skates – 34.5-35.5‰.

Distribution

Thorny skate was found practically over the entire surveyed area of the Barents Sea and adjacent waters, all the way from the Novaya Zemplya in the east to the western coast of Spitsbergen in the north-west (Fig. 2). Average catch of this species was 3.1-4.1 fish per hour haul, maximum catch was as large as 110 fish per hour haul. The most large aggregations of thornback ray were noted for the central and coastal areas in the southern part of the Barents Sea, this species was less plentiful in western and eastern areas and Bear Island – Spitsbergen area.

Round skate was found mainly along the coast of Norway and Murman as far as the Bear Island (Fig. 3). Single individuals were fished near Spitsbergen. Average catch of this species was 0.02-0.03 fish per hour haul, maximum catch amounted up to 5 fish per hour haul.

Northern skate was found along the continental shelf slope between the coast of Norway and Bear Island as well as in the north of the eastern part of the surveyed area (Fig. 4). Average catch of this species was 0.1-1.0 fish per hour haul, maximum catch was as large as 187 fish per hour haul.

Blue, spinytail skate and sail ray were found as single individuals mainly along the continental shelf from the coast of Norway and Murman to the Bear Island (Figs. 5-7). Average catch of the first two species was 0.1-0.2 and 0.01-0.1 fish per hour haul, maximum catch was as large as 50and 29 fish per hour haul, respectively.

Size and sex composition

Catches contained thorny skate of 10-71 cm for males and 11-71 cm for females (Fig. 8). Mean length did not vary much, although it reduced slightly between 1998 and 2001 and was 36.4-37.6 cm in males and 36.3-38.5 cm in females. Females were slightly more plentiful than males, however, by 2001 males and females became equally represented in catch. Sex ratio changed from 1:1.2 (1998) to 1:1 (2001). Changes in the structure of size groups should also be noted – smaller number or nearly complete absence of fish in some size groups, besides, an overwhelming prevalence of one sex in some size groups.

The size of round skate in catch was 11-56 cm in males and 11-54 cm in females (Fig. 9). Mean length of both males and females tended to decrease between 1998 and 2001, however, it should not be ruled out that this could be a result of measuring a too small number of fish. Males and females were equally represented in catch, except in 2001 when sex ratio was 1:0.7.

The size of northern skate in catch was 20-86 cm in males and 26-91 cm in females (Fig. 10). No clear trend in variation of mean length was noted for both males and females. Sex ratio varied much between years from insignificant prevalence of females in 1999 (1:1.2) to practically complete dominance of males in 2001 (1:0.2).

The number of blue skate and spinytail skate measured was very small, therefore, it was not possible to identify any trends in the dynamics of their size and sex composition (Fig. 11-12).

Abundance and biomass

The abundance of thorny skate over the period of research varied from 130 x 10^6 fish in 1999 to 167 x 10^6 fish in 1998, and averaged 143 x 10^6 fish (Table 1). Biomass of thorny skate varied in the range of 88 000 to 106 000 tons, and averaged 95 500 tons. A decline in abundance and biomass of practically all size groups of thorny skate smaller than 45 cm should be noted, while the abundance and biomass of larger individuals (more than 46 cm) remained unchanged or increased slightly (Fig. 13).

Of other skate species the most plentiful were northern and round skate, their average abundance was 2.6 x 10^6 fish each, and average biomass 3 500 tons and 1 400 tons, respectively (Table 1). The abundance of blue and spinytail skate was even less (0.7 x 10^6 and 0.5 x 10^6 fish), however, the biomass of blue skate amounted up to 3 100 tons owing to a large size of fish, while the biomass of spinytail skate did not exceed 600 tons.

Overall, thorny skate was the most plentiful of all skate species and constituted 95.8% of catch in number and 91.8% by weight.

Discussion

The occurrence of various skate species in the Barents Sea is related to the presence of water temperatures they give preference to. Cold-water northern skate is spread in areas with low negative water temperatures, mainly, in northern and deepwater areas of the sea. The occurrence of warm-water species (round, blue, spinytail skate and sail ray) is limited by the areas of distribution of warm Atlantic water in the south-western part of the Barents Sea.

Data on the size and sex composition of skates, thorny skate in particular, are apparently indicative of some unfavourable changes in their populations associated with the fisheries. A somewhat reduced mean length, changes in the sex ratio and decreased number of smaller fish could be caused by selective impact of the fisheries on larger individuals and lower production of these species, which was noted in many cases for other areas where the pressure of fisheries on skate stocks was strong (Walker and Heessen, 1996; Walker and Hislop, 1998).

Estimates derived by us for thorny skate and round skate stocks practically remained unchanged over the whole period of research (1998-2001), which apparently suggests that their distribution area was covered rather well by

surveys, and these stocks are in stable condition. Estimates derived for the stock of thorny skate in 1990-1996 (Dolgov, 1997) differed several times (from 34 000 to 116 000 tons), because the area covered by surveys in different years was not the same. Estimates of stock size for other species of skate appeared to be less realistic and could not be used for comparison of abundance and biomass of various skate species. For northern skate this was related to incomplete coverage by the survey of its distribution area, since a fraction of this stock was distributed between Svalbard and Franz Jozef Land (Smirnov *et al*., 2000). For round and spinytail skate this was due to a too small number of individuals assessed by surveys. Besides, unlike the first three species, for which the Barents Sea is a spawning area, blue and spinytail skate and sail ray do not spawn in the Barents Sea at all or the extent of spawning is small and their stocks are sustained through migrations of fish from more southern areas.

So, of 8 skate species known for the Barents Sea, only 6 were found in the period from 1998 to 2001, of them the most plentiful were thorny skate, round and northern skate.

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TABLE 1. Abundance (x 10^6 fish) and biomass (x 10^3 t) of various skate species in the Barents Sea in 1998-2001

Species		Year				
		1998	1999	2000	2001	Average
Thorny skate	Abundance	167.00	130.57	135.62	140.32	143.4
	Biomass	106.32	88.68	91.56	95.42	95.5
Round skate	Abundance	2.50	0.33	4.18	3.21	2.6
	Biomass	1.34	1.26	1.89	1.22	1.4
Northern skate	Abundance	1.86	0.78	6.18	1.46	2.6
	Biomass	2.73	1.35	7.42	2.32	3.5
Blue skate	Abundance	1.41	0.30	0.75	0.27	0.7
	Biomass	1.25	3.99	1.88	5.17	3.1
Spinytail skate	Abundance		0.05	1.06	0.51	0.5
	Biomass		0.01	1.44	0.41	0.6
All skates	Abundance	172.78	132.03	147.79	145.76	149.72

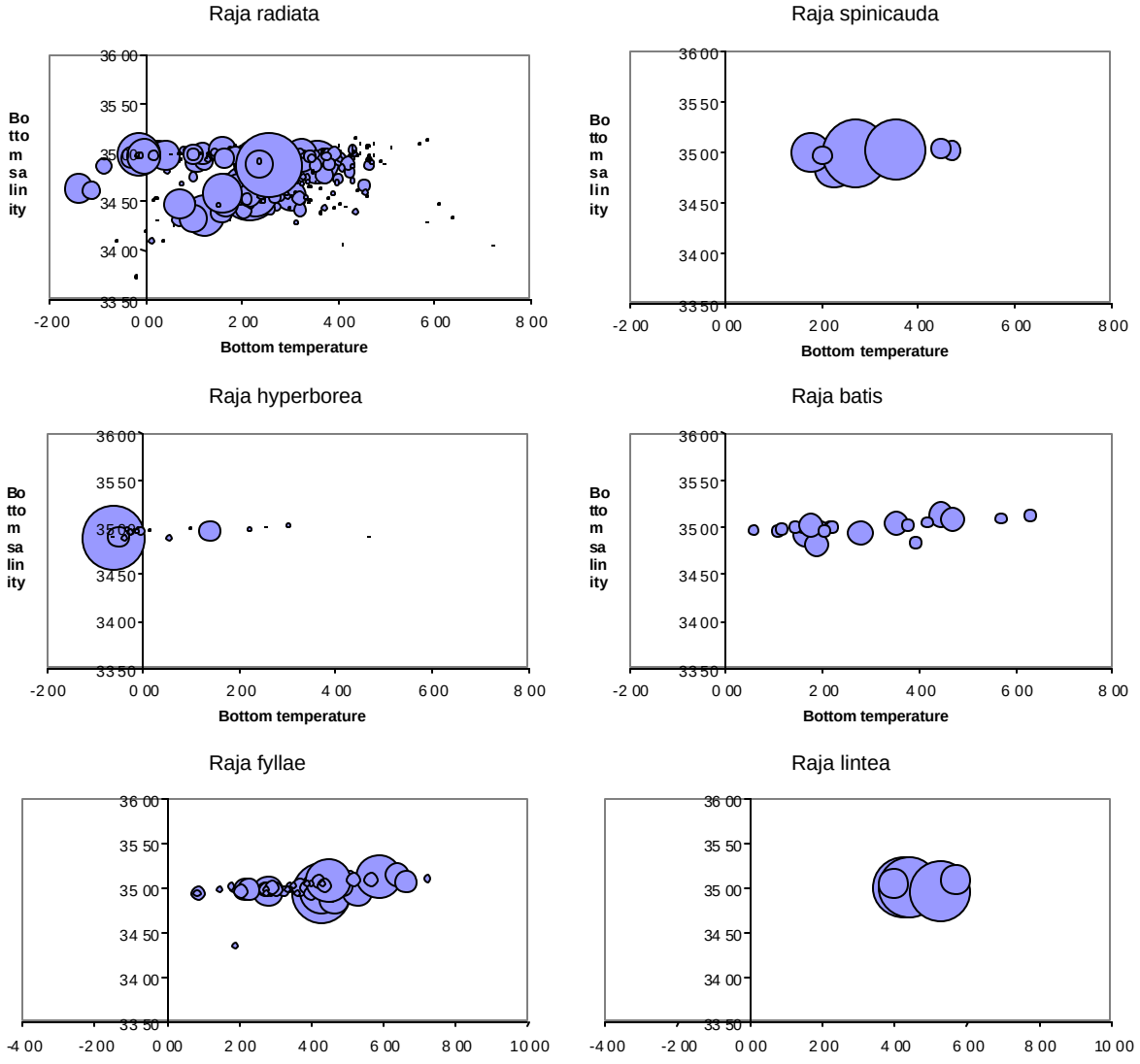


Fig. 1. Hydrographic conditions in the habitat of various skate species in the Barents Sea.

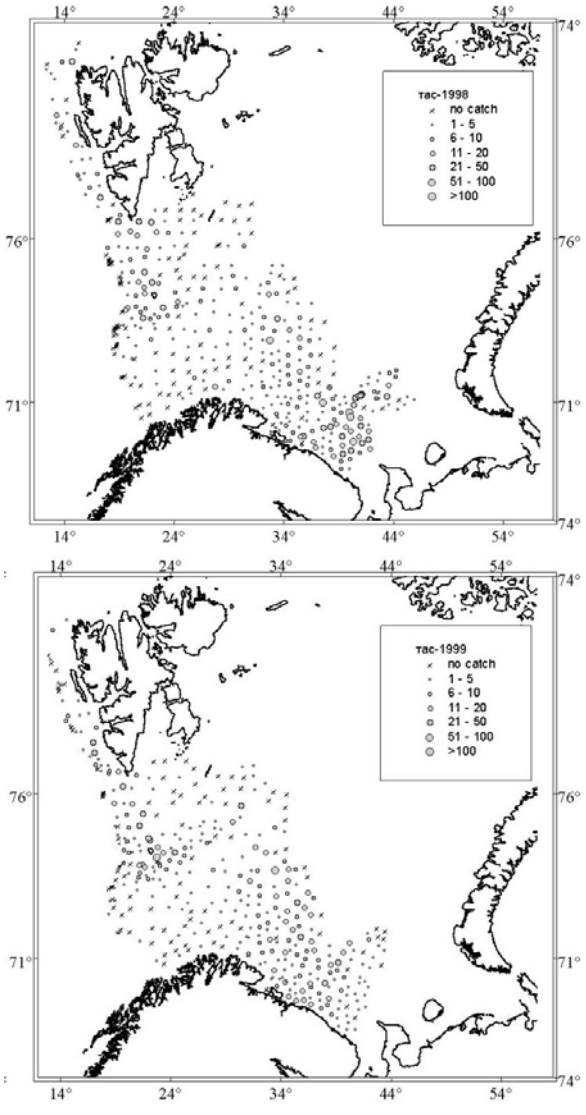


Fig. 2a. Distribution of thorny skate according to trawl surveys in 1998-1999.

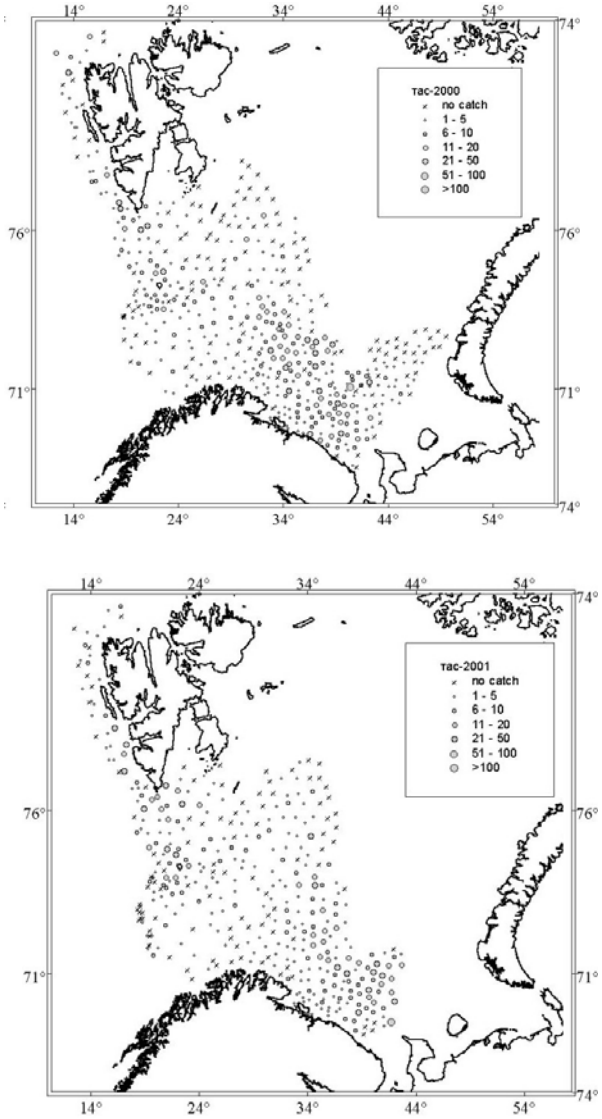
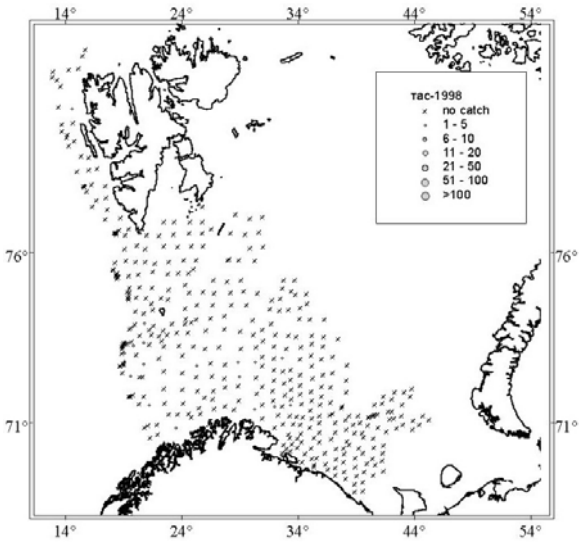


Fig. 2b. Distribution of thorny skate according to trawl surveys in 2000-2001



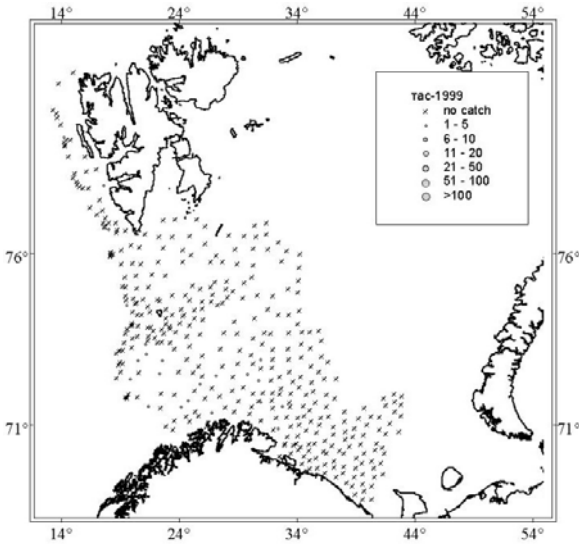
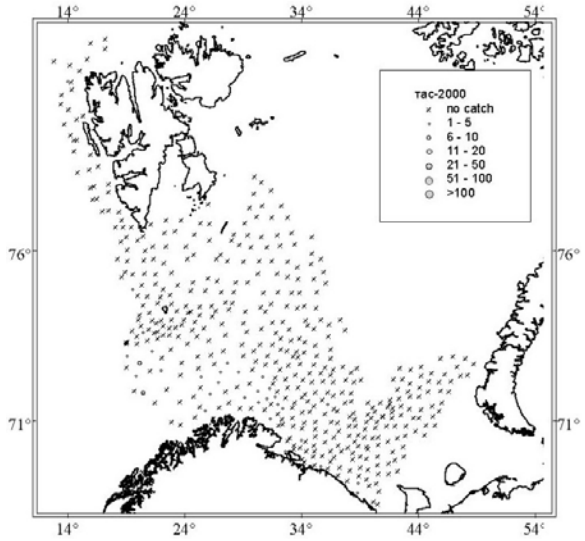


Fig. 3a. Distribution of round skate according to trawl surveys in 1998-1999.



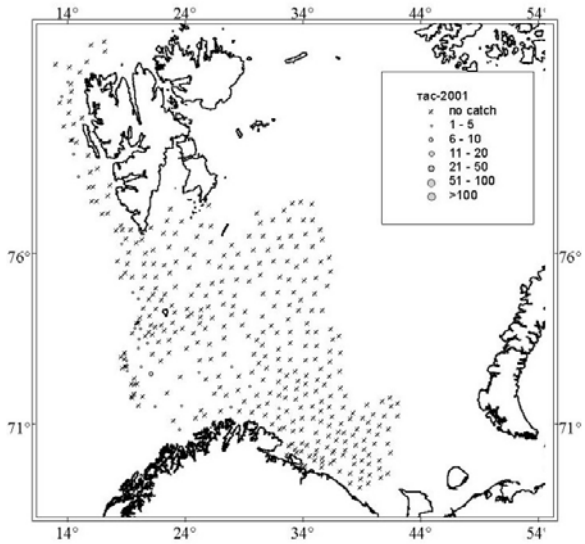
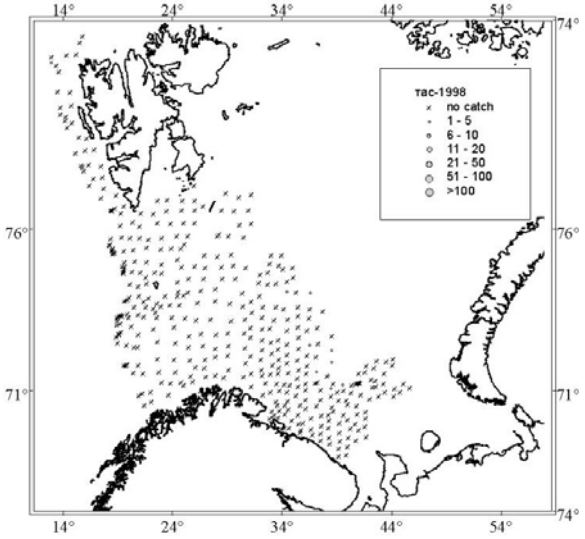


Fig. 3b. Distribution of round skate according to trawl surveys in 2000-2001.



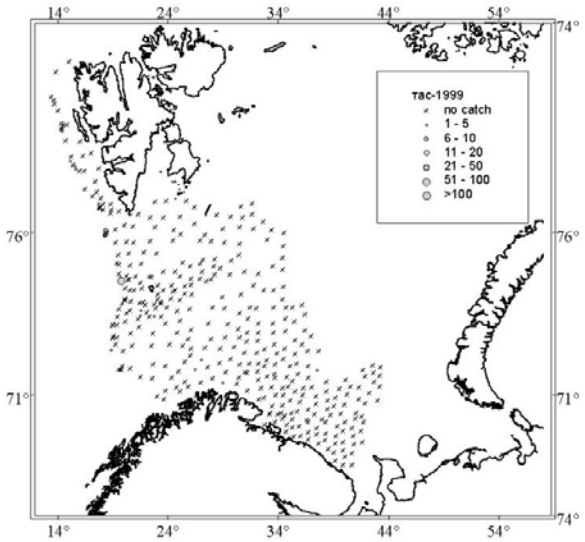
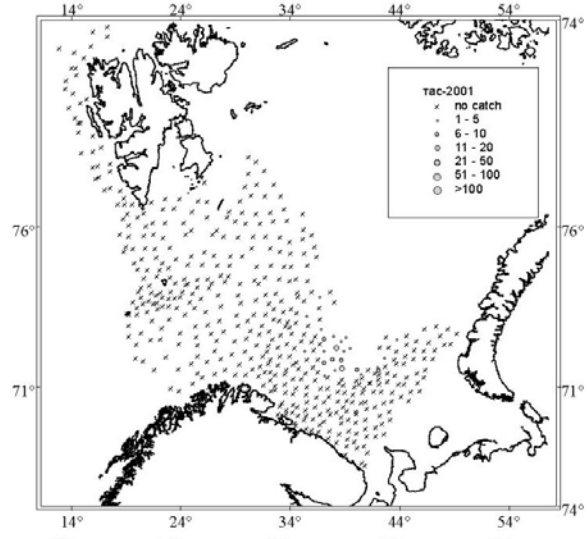


Fig. 4a. Distribution of northern skate according to trawl surveys in 1998-1999



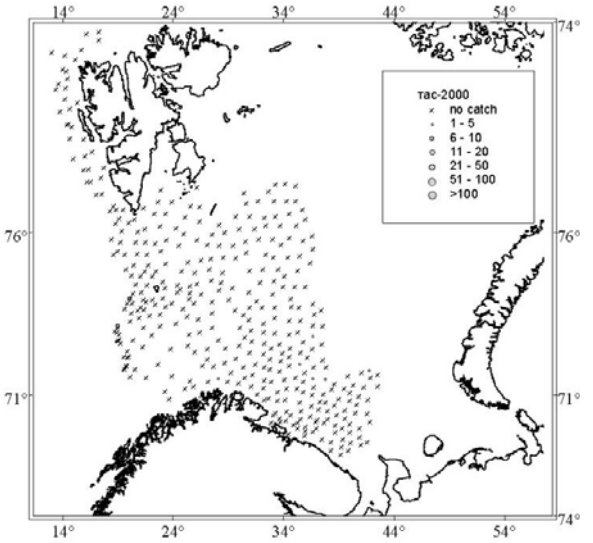


Fig. 4b. Distribution of northern skate according to trawl surveys in 2000-2001.

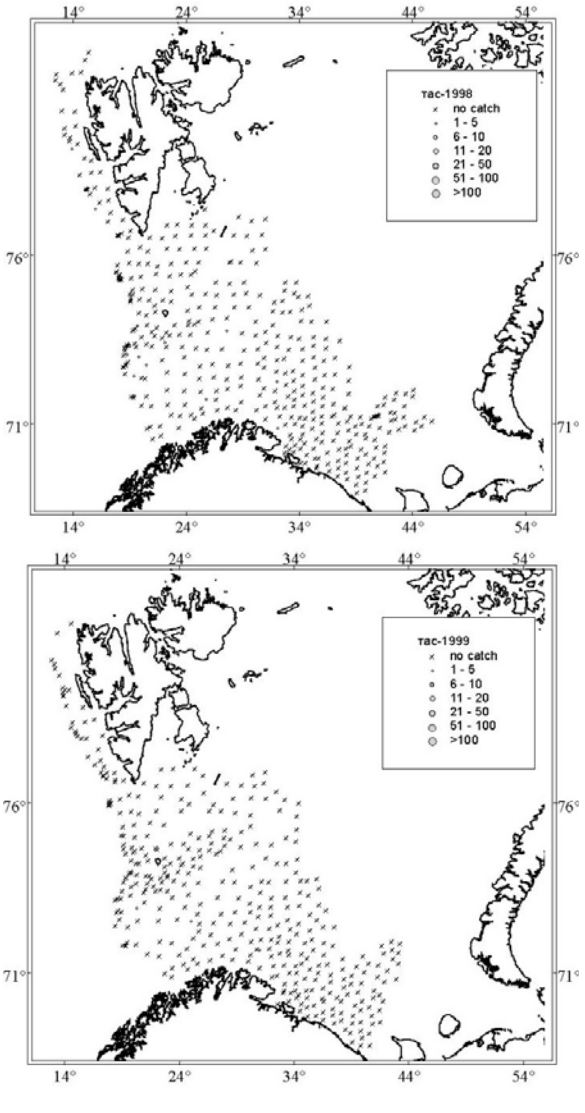


Fig. 5a. Distribution of blue skate according to trawl surveys in 1998-1999.

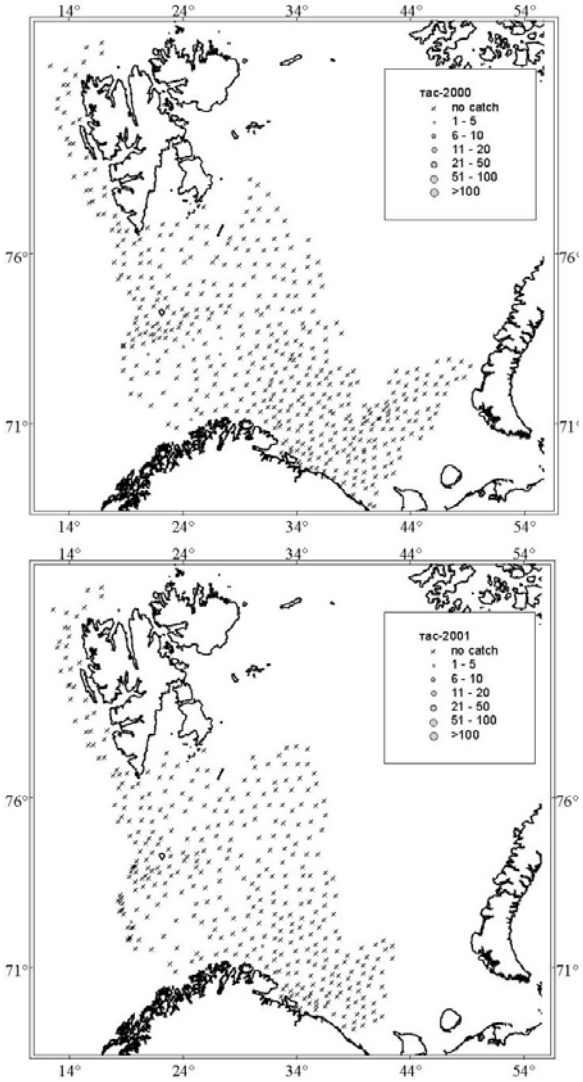


Fig. 5b. Distribution of blue skate according to trawl surveys in 2000-2001

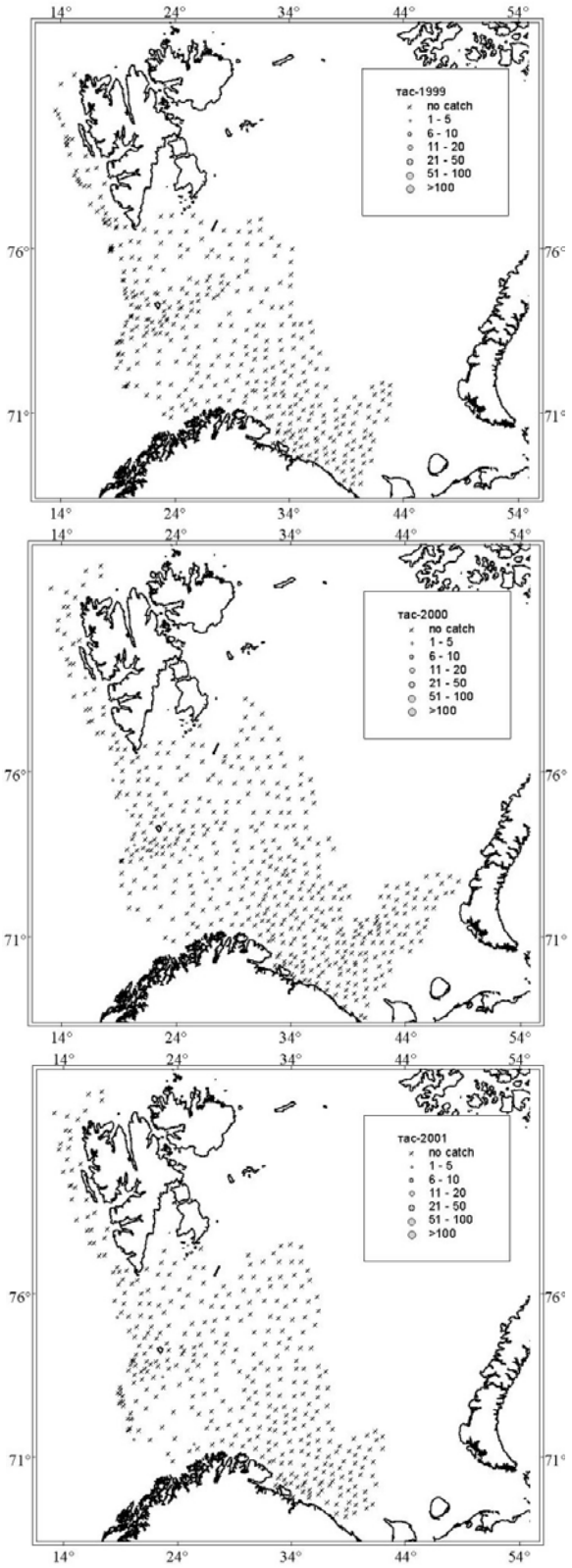


Fig. 6. Distribution of spinytail skate according to trawl surveys in 1999-2001.

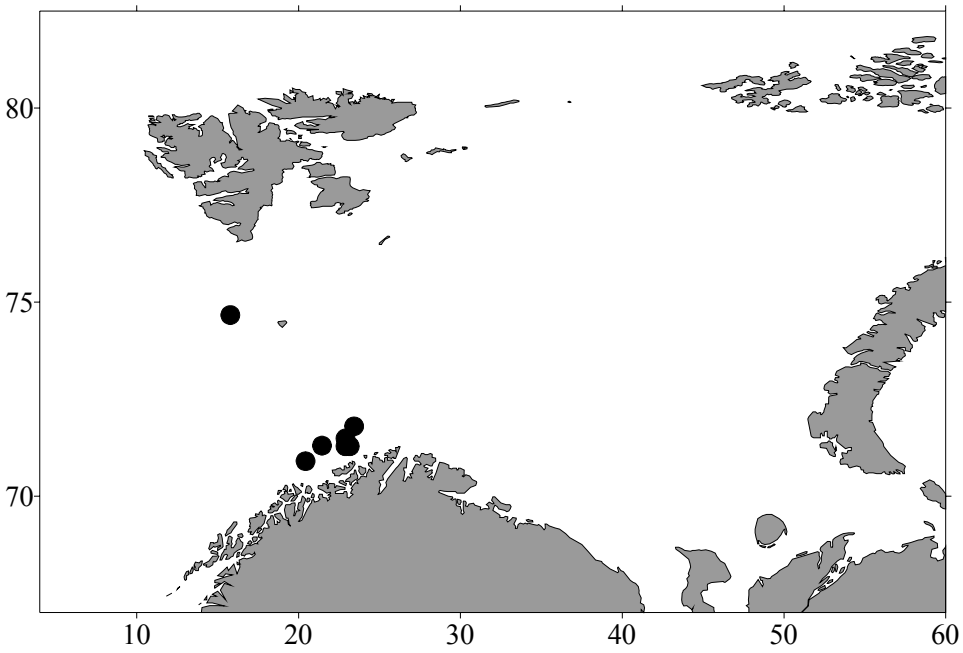


Fig. 7. Capture sites of sail ray in 1998-2001.

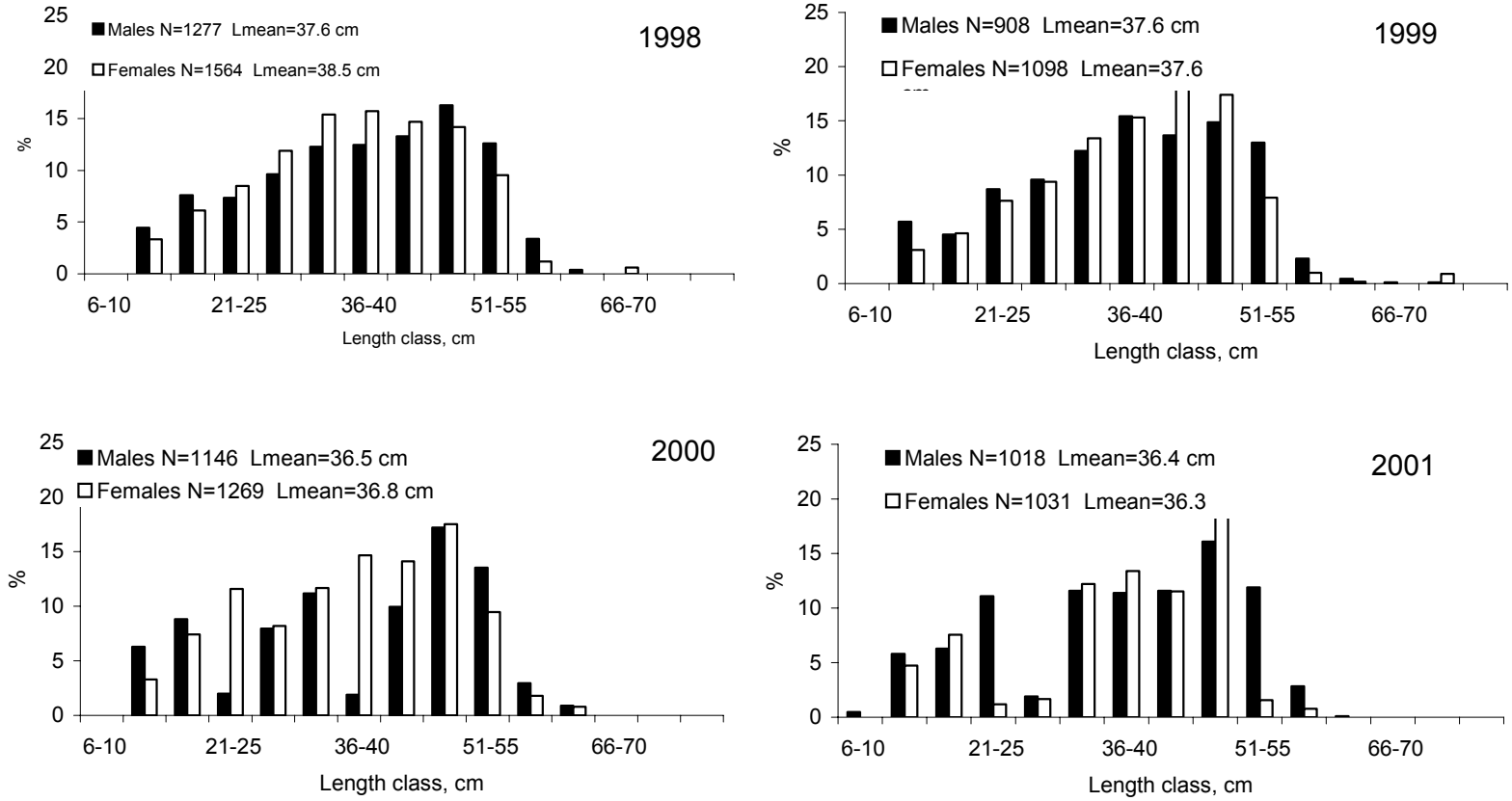


Fig. 8. Size distribution of thorny skate in 1998-2001.

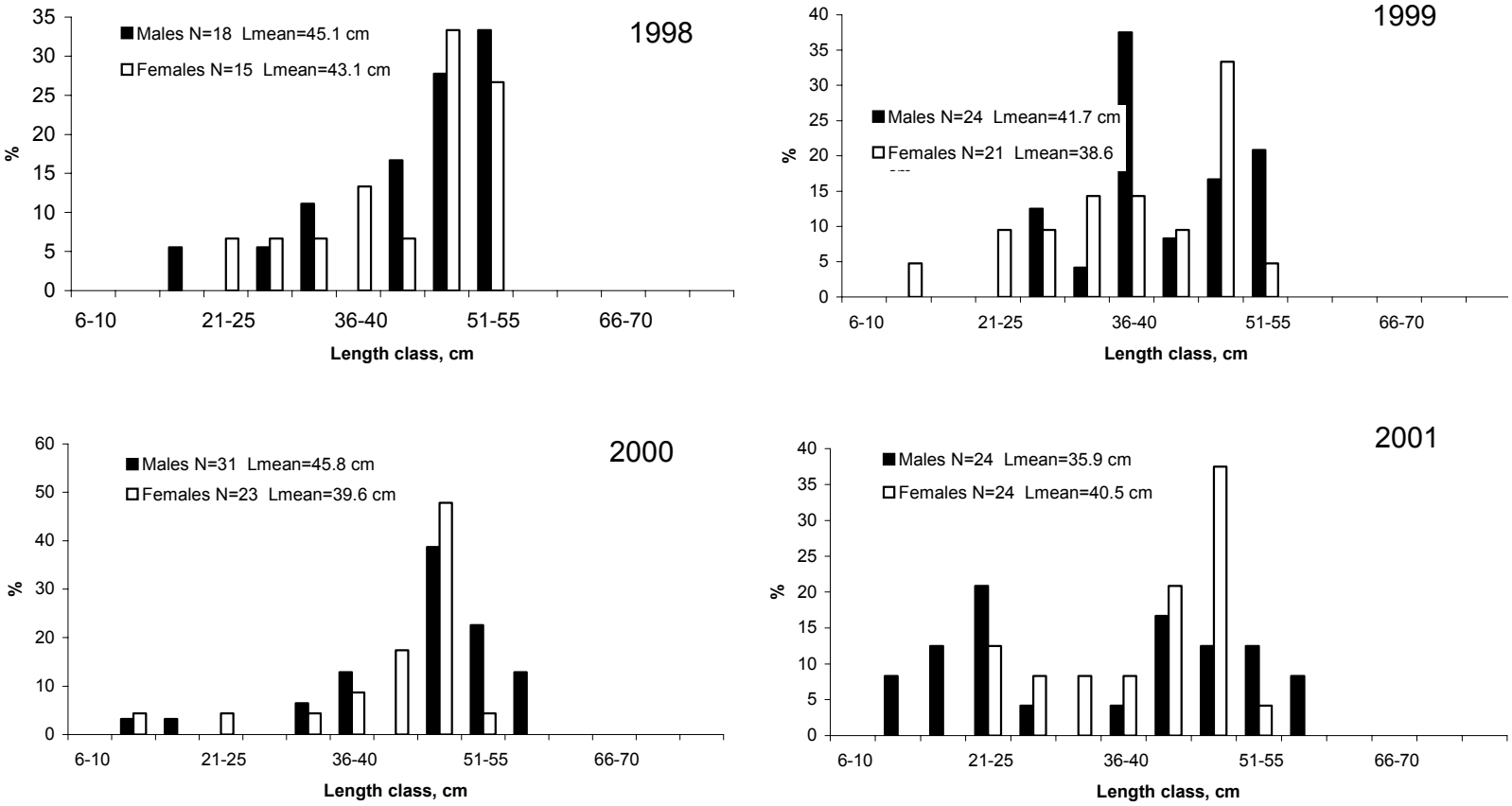


Fig. 9. Size distribution of round skate in 1998-2001

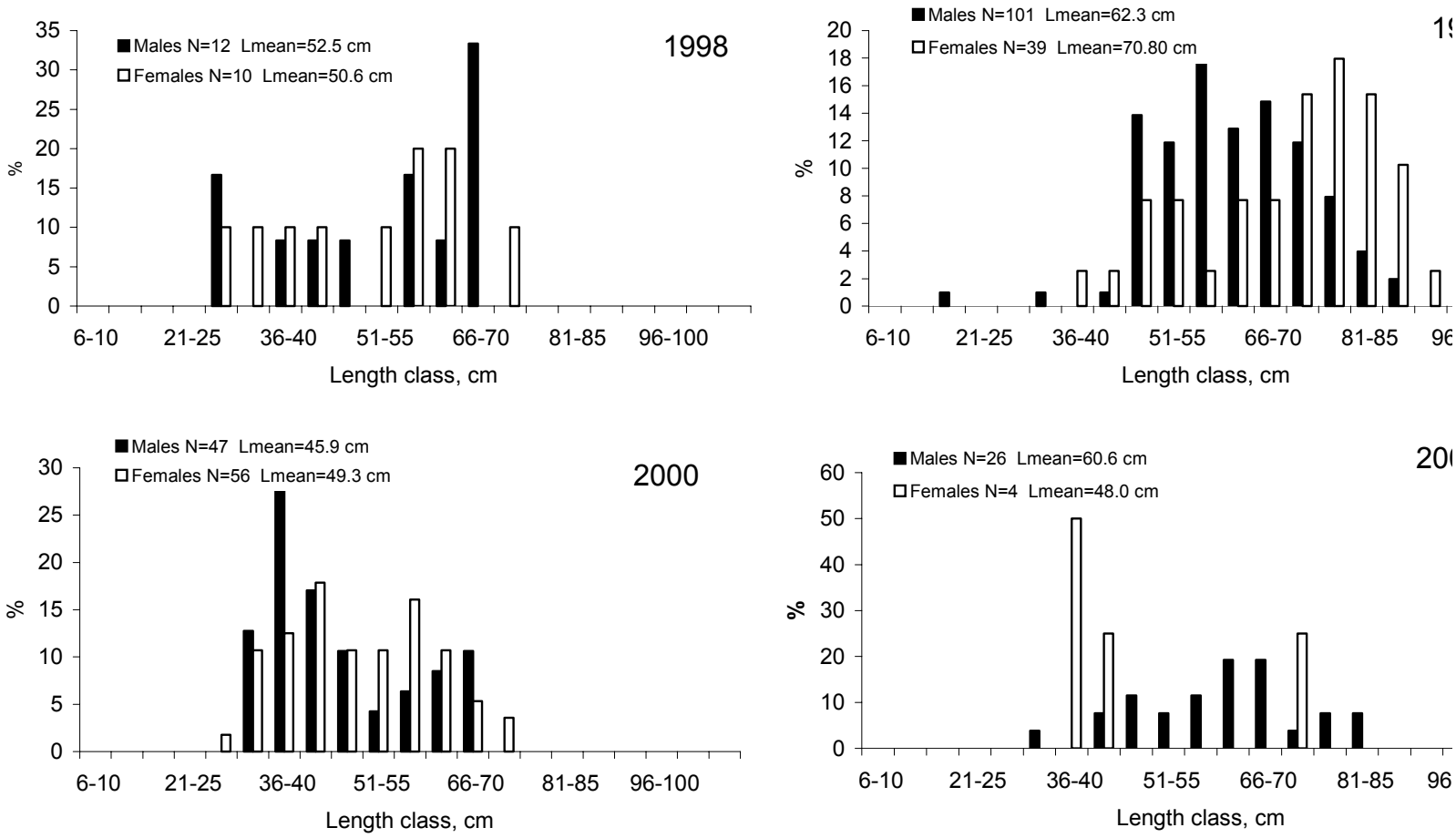


Fig.10. Size distribution of northern skate in 1998-2001

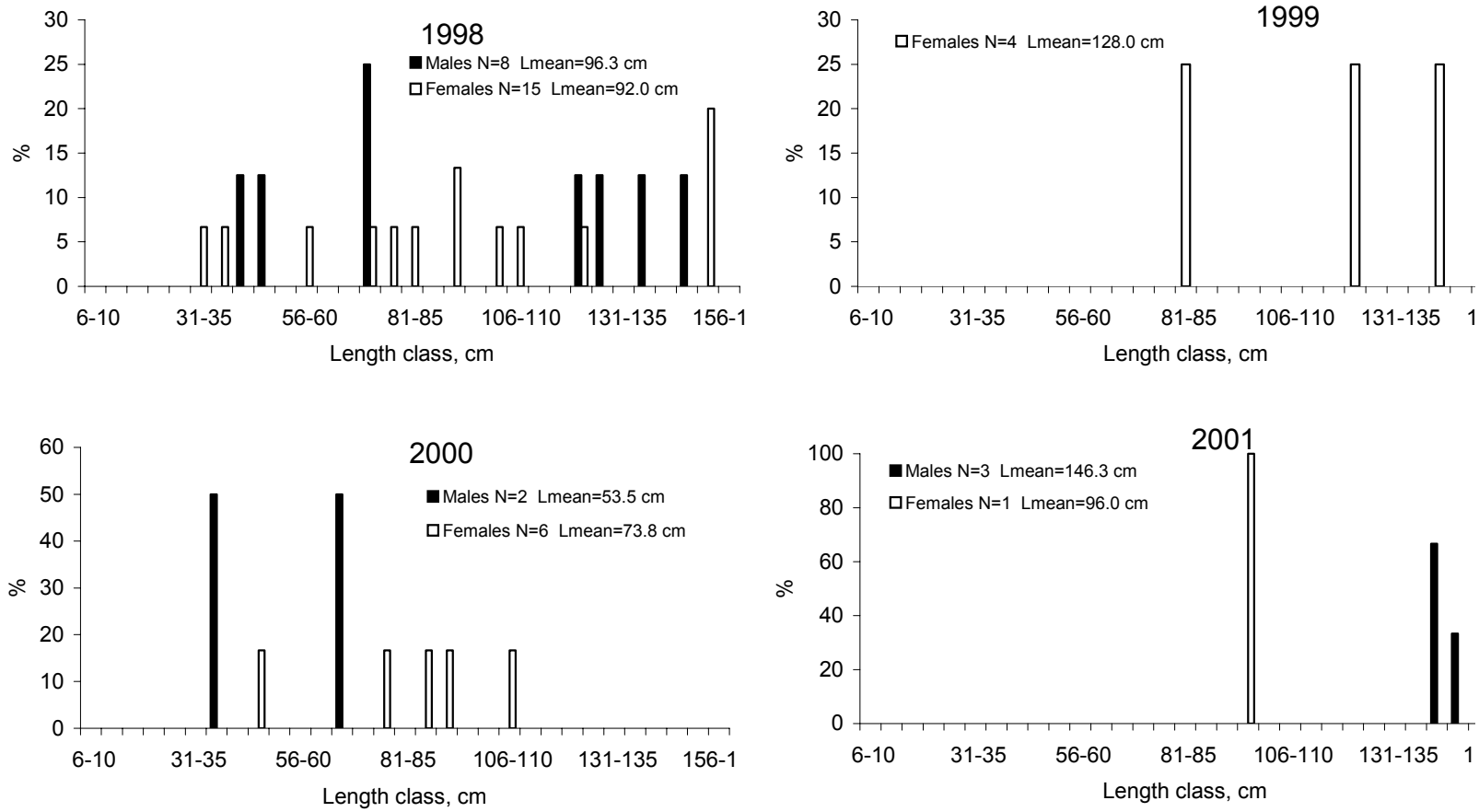
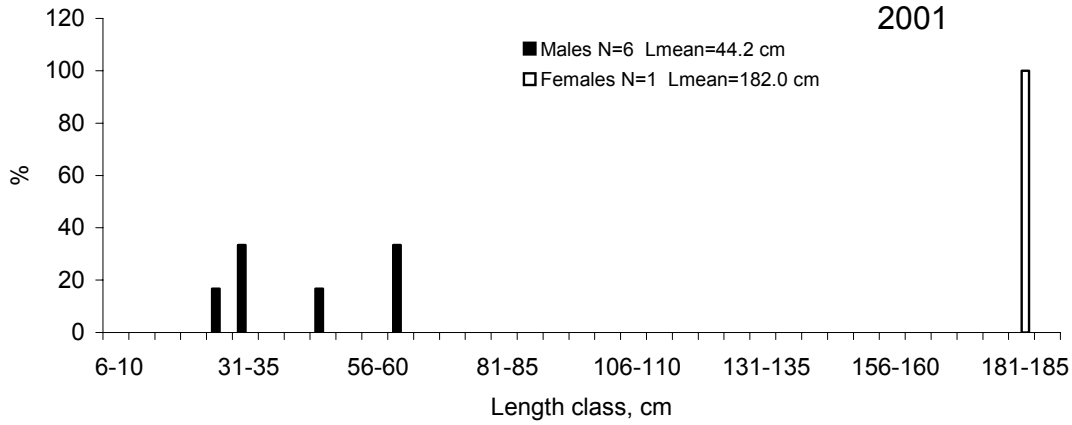
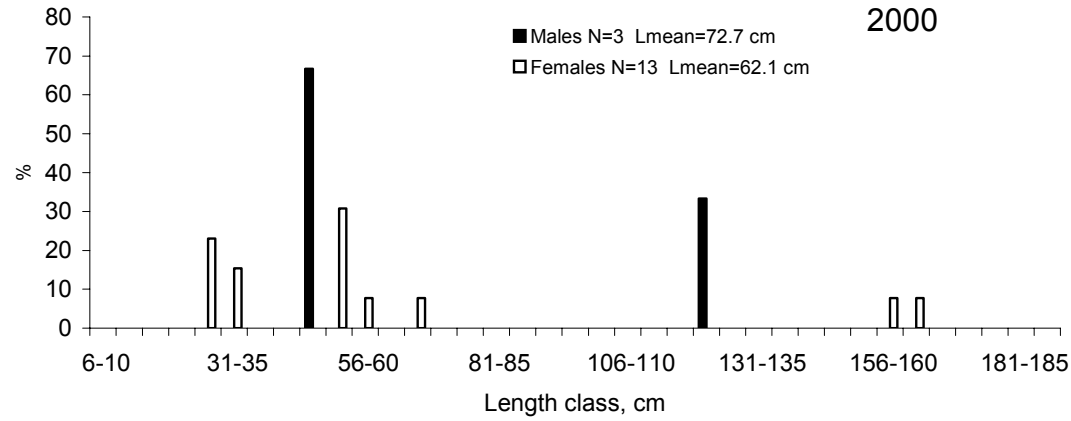


Fig.11. Size distribution of blue skate in 1998-2001.





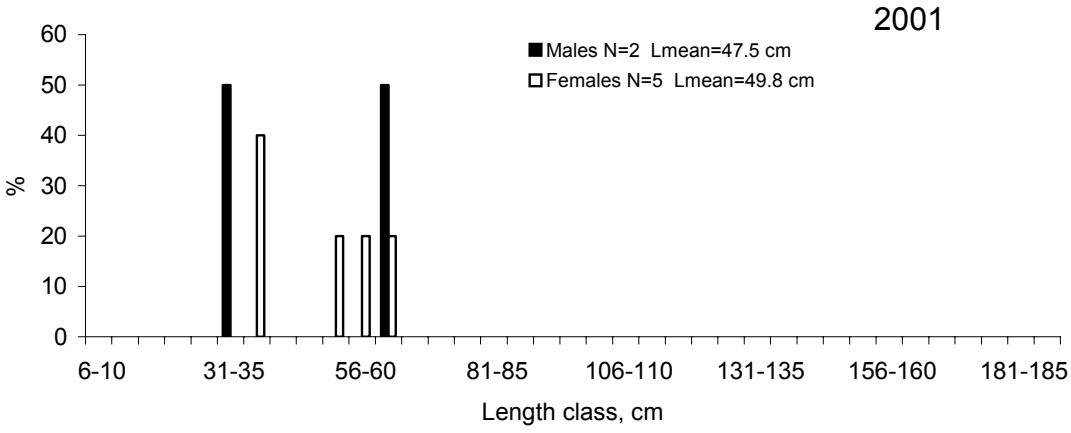


Fig.12. Size distribution of spinytail skate in 1998-2001.

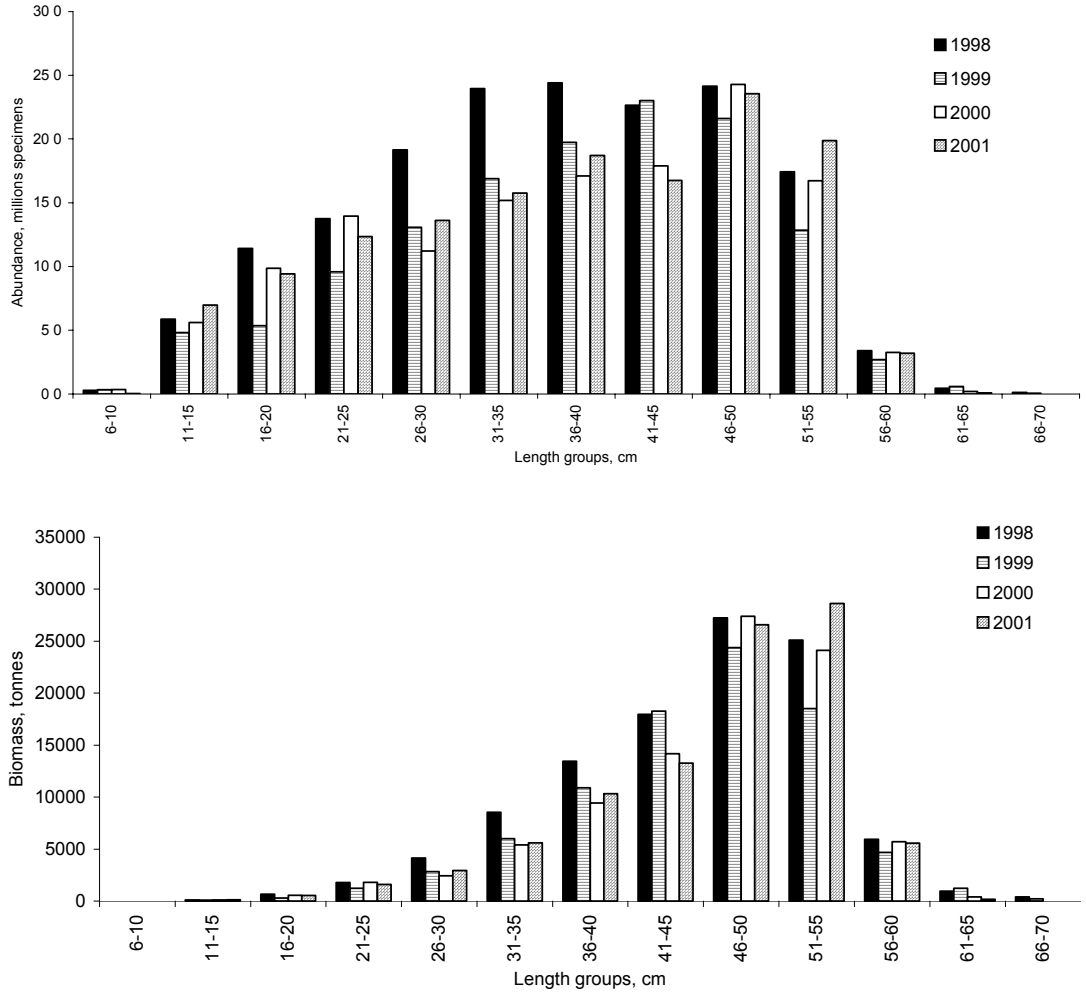


Fig.13. Dynamics of abundance and biomass of thorny skate by size groups.