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Russian Investigations and Deep Water Fishery on the Corner Rising

by

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INTRODUCTION

Sea mounts of the Corner Rising in the eastern Sargass Sea (34-37°N, 47-53°W) are of special importance among the areas of deep water fishery in the North Atlantic (Fig.1). The importance of this area is determined by its relative closeness to the countries with developed expeditionary fishery, free regime of fishery and high market value for fishing objects.

Commercial aggregations of deep water fish in the Corner Rising area were discovered for the first time by the Soviet research vessels in 1976. Further complex fisheries expeditions were repeatedly carried out on banks during which a considerable body of research and commercial data has been obtained. In separate years the commercial fishery was conducted in the area by results from research.

The aim of this paper is to submit to NAFO the results from research and commercial investigations conducted by the Soviet Union/Russia in the Corner Rising area.

MATERIAL AND METHODS

This publication has been prepared by results from analysis of materials for 1976-1995 collected during 26 cruises of research - scouting and commercial vessels.

Ichthyologic, meteorological and oceanographic observations were done in accordance with actual instructions and PINRO/VNIRO methods (Instructions and recommendations, 1980; Instructions for sampling ...., 1982). Catches of deepwater fish were taken by pelagic and bottom trawls (60-90mm minimum mesh size).

The following measurements have been done by the vessels belonging to PINRO, AtlantNIRO, SEVRYBPROMRAZVEDKA and ZAPRYBPROMRAZVEDKA during a whole period of the investigations:

- water temperature	- 6551
- salinity	- 6202
- length of fish body	- 66516
- maturity determination	- 13818
- studying on fish feeding	- 13818
- age reading	- 4147

Behaviour and distribution of fish on sea mounts were studied by results from hydroacoustic observations and ichthyological investigations.

## HISTORICAL REVIEW OF INVESTIGATIONS AND FISHERY

Soviet oceanographic observations in the Corner Rising area have been initiated since 1959 by RV "Mikhail Lomonosov" and in the 1960's they have been proceeded by RVs "Sedov", "Petr Lebedev", "Akademik Kurchatov", "Akademik Vernadsky" and other vessels from the Institute of Oceanography named after Shirshov. During these expeditions special attention was given to studying of topography and sediments of sea bottom.

Commercial aggregations of deepwater fish on the Corner Rising sea mounts were first found by exploratory vessel "Atlant" in 1976. Commercial fishing, in which 2 - 17 trawlers participated, was organized by results from investigations in the area. In total above 10 thou.t, mainly Alfonsino (Beryx splendens), were caught there per year.

In 1977 operations on the Corner Rising were performed by scouting-fishing expedition, comprising the exploratory vessels "Bakhchisarai", "Korifena" and 6 fishing trawlers. No stable fish aggregations were found on the banks during a whole period of investigations and fishery; it was resulted from an extreme withdroval of fish in previous year. The total catch made up about 0.8 thou.t.

No commercial fishing was carried out on the Corner Rising in subsequent decade. Only scouting and research operations were performed in that period (in total 14 cruises). Most of them have proved availability of deepwater fish of different density and stability on sea mounts. In total, about 2 thou.t of deepwater fish (mainly of Alfonsino) were taken by research and scouting trawlers on the Corner Rising from 1978 to 1986 (Table 1).

A set of special underwater observations (Zaferman, Sennikov, 1991) was also done in the same period, during which aggregations on sea mounts were revealed and a possibility of fishery on deepwater crab (*Gerion affinis*) with pots was determined.

In parallel with scouting-fishing operations most part of investigations were done on area oceanography, biology, behaviour and distribution of deepwater fish, conditions for their aggregations formation, including a use of "SEVER-2" autonomous underwater apparatus (Pshenichny, Kotlyar, Glukhov, 1986; Zaferman, Shestopal, 1991; Kukuev, 1991).

In 1987 a commercial fishing with 1-4 trawlers was arranged on the Corner Rising banks by results from research and scouting investigations carried out by exploratory vessel "Socrat"; total catch constituted 2.3 thou.t.

No investigations and fishery were carried out in the area in subsequent years. The operations were resumed in 1994-1995 when several scouting and fishing cruises were arranged on the Corner Rising by Russian Fishing Industry together with PINRO based on the experience obtained earlier. In 1994 about 0.4 thou.t of Alfonsino were taken there by trawler "Petr Petrov". In 1995 from 1 to 5 Russian trawlers operated on the Corner Rising banks and the total catch of which attained 3.5 thou.t.

In 1996 the fishery in the area was continued by 2 Russian vessels. In total 0.6 thou.t of Alfonsino were caught by them (information for February-April).

Thus, since the time of sea mounts discovery the total catch taken by the Soviet Union/Russia in the Corner Rising area has constituted above 19 thou.t (Table 1).

## BIOLOGICAL CHARACTERISTIC OF FISHERIES OBJECTS

As a result of investigations on ichthyofauna (Kukuev, 1991; Fisheries description . . . ., 1993) on the Corner Rising 175 fish species from 53 families have been revealed (Table 2).

Alfonsino is the main object of trawl fishing on sea mounts of the Corner Rising. Cardinal-fish (Epigonus telescopus), Black Scabbard fish (Aphanopus carbo) and wreckfish (Polyprion americanus), barrelfish (Hyperoglyphe perciforma) and flint-perch (Hoplostethus mediterraneus) are also of commercial importance.

### Alfonsino (Beryx splendens)

Alfonsino is presented in catches by specimens at 20-59cm fork length, mainly 34-43cm (Fig.2), and 1.2-1.7 kg mean weight. The fish caught were at age 2-11 (scale and otolith determinations).

Growth rate during the first years of life is relatively high. Mean length at age 1, 2, 3 makes up, respectively, 8, 15, 22cm. Maturation begins in the second year of life at 18cm mean length, and by age 5-6 all specimens become mature at 25-30cm length (Pshenichny, Kotlyar, Glukhov, 1986; Fisheries description . . . ., 1993).

Main spawning is observed in July-August in bottom layers at the water temperature 7-12°C. Spawning of Alfonsino is intermittent one, the number of batches is around 10-12. Duration of individual spawning period is to two months (Alekseeva, 1983). Young Alfonsino of 25-98mm long were caught by fry-sampling trawl in 0-600m layer in autumn where water temperatures were 14-26°C (Sherstyukov, Noskov, 1986). Alfonsino feed on different mesopelagic fish species (lanternfishes, hatchetfishes, viperfishes, etc.), squid and shrimp (Pshenichny, Kotlyar, Glukhov, 1986; Fisheries description, 1993).

### Black scabbard fish (Aphanopus carbo)

Specimens with total length of 70-144cm at age 3-13 (age was determined by otoliths) and with 1.1-2.4 kg weight occurred in catches. Fish at age 6-7 with 100-110cm length and 1.1-1.3 kg weight constituted the bulk of catches. Size of fish caught increases with a growing of depth. Weight of black scabbard fish females is higher than in males at the same length. Fish become mature at 80-85cm length and at 0.9-1.1 kg weight. Spawning takes place in mid-water in summer. Larvae and juveniles are registered in pelagial. Black scabbard fish feed on deepwater fish, squid and shrimp (Pshenichny, Kotlyar, Glukhov, 1986; Fisheries description . . . ., 1993).

### Barrelfish (Hyperoglyphe perciforma)

Total length of the fish caught was 22-108 (68-88cm mean length) and 0.4-18.0 kg weight. Barrelfish become mature at 55-60cm length at age 6-8 (age was determined by scale and otoliths). Spawning takes place in summer. Fish feed mainly on deepwater shrimp, squid, fish, holothurians (Pshenichny, Kotlyar, Glukhov, 1986; Fisheries description . . . ., 1993).

### Cardinal fish (Epigonus telescopus)

Catches of Cardinal-fish consist of fish with total length being 32-85cm, with the main portion of specimens having 38-47cm length. Fish become mature at age 7 (age was determined by scale and otoliths). Males were predominant in catches. Spawning takes place in spring-summer. It feeds on mesopelagic fish (lanternfishes, lightfishes, hatchetfishes), squid and shrimp (Pshenichny, Kotlyar, Glukhov, 1986; Fisheries description . . . ., 1993).

Wreckfish (Polyprion americanus)

Fish occur with the total length of 70-142cm. Mean length is 107.6cm, mean weight is 22.6 kg. Wreckfish spawning is observed in summer period. It feeds on different deepwater fish.

Flint-perch (Hoplostethus mediterraneus)

Fork length in catches varied from 11 to 32cm (100-900 g weight), with the fish 19-26cm long predominating. Females in catches made up 50-80%. Spawning occurs in spring-summer. Flint-perch feed mainly on shrimp and seldom on fish (lightfishes and lanternfishes).

BEHAVIOUR AND DISTRIBUTION, CONDITIONS OF FORMATION OF DEEPWATER FISH AGGREGATIONS

Behaviour and distribution of deepwater fish on sea mounts on the Corner Rising area are characterized by a considerable variability.

Alfonsino aggregations are distributed at 300-950m depth (mainly at 420-750m) both in bottom and mid-water layers (Fig.3). Specimens are fished off with pelagic and bottom trawls (Pshenichny, Kotlyar, Glukhov, 1986; Fisheries description..., 1993).

Accessibility of Alfonsino for fishery depends first of all on peculiarities of its vertical distribution and bottom conditions of sea mounts. The main factor, determining a pattern of Alfonsino vertical migrations, is a vertical shifting of its food organisms. The latter, in their turn, are closely related to variations in sea lightning (by the Sun and Moon) and hydrometeorological conditions in the area of sea mounts. By results from the investigations several types of Alfonsino vertical migrations have been revealed (Vinnichenko, in press).

Horizontal migrations of Alfonsino are limited by the area of sea mounts and their extension does not exceed several miles (Galaktionov, 1984; Vinnichenko, in press).

Unlike Alfonsino, other commercial deep water fish are mainly distributed at the bottom. Black scabbard fish, which sometimes form mixed aggregations with Alfonsino at 650-1200m, is an exclusion. This species is constantly occurs as by-catch during bottom and pelagic fishery on Alfonsino and it is the main fishing object deeper than 900m.

Cardinal-fish are caught from 780 to 900m depth together with Alfonsino. This species is mainly distributed in bottom layers, although sometimes perform vertical migrations to mid-water. Some catches taken by a bottom trawl consisted mainly of Cardinal fish.

Flint-perch occur in catches taken by a bottom trawl at 760-880m depth. Fish perform daily migrations related to feeding. In a bright time of day this species is distributed at the bottom and ascends the mid-water in the night, moving away at a distance of 90m from the bottom.

Wreckfish and barrelfish are frequently recorded in small quantities in catches from a bottom trawl, taken at 660-800m depth.

INTRASPECIFIC STRUCTURE OF DEEP WATER FISH

Until now studies on deep water intraspecific structure were effected only for Alfonsino.

As for Alfonsino intraspecific structure the two points of view exist. In opinion of most Russian investigators this species forms an independent population on each separate sea mount in the Atlantic open areas and all stages of its life cycle are developed within one sea mount (Titov, 1981; Klimenko, 1983; Vinnichenko, 1995). At the same time, some scientists support a hypothesis on availability of migrations between banks and on existence of Alfonsino single population in the North Atlantic (Alekseev et al., 1987).

#### CONCLUSIONS

1. The previous Soviet Union is a pioneer in the course of fisheries exploring of deep water fish stocks on the Corner Rising. The main contribution to studying the area and obtaining the most portion of deep water fish catch taken on sea mounts (around 19 thou.t) has been made by this state and its successor Russia.
2. The main fishing object on sea mounts is Alfonsino. Other deep water fishes, such as black scabbard fish, barrelfish, wreckfish, Cardinal fish and flint-fish are of minor commercial importance.
3. Limited stocks of deep water fish and free regime of fishery on the Corner Rising condition a necessity of fisheries management in the area on the international level.

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TABLE 1  
Investigations and fishery of the USSR /Russia in the  
Corner Rising area

Year	Vessel	Total catch, thou.t
1976	EV "Atlant"	10,2*
	EV "Bakhchisarai"	
	EV "Spectr"	
1977	EV "Korifena"	0,8*
	EV "Bakhchisarai"	
1978	RV "Evrika" "	0,13
1979	EV "Atlant"	0,53
	EV "Andrei Markin"	
1980	EV "Pavel Kaikov"	0,2
1981	EV "Kapitan Demidov"	0,26
1981	EV "Mikhail Verbitsky"	0,13
1982	EV "Evrika"	0,01
1982	EV "Efim Krivosheev"	0,2
1983	EV "Mikhail Verbitsky"	0,14
	EV "Nikolai Kuropatkin"	0,02
	EV "Odisei"	-
1984	EV "Nikolai Kuropatkin"	0,24
1985	RV "Genichesk"	0,01
1986	EV "Nikolai Kononov"	0,11
1987	EV "Sokrat"	2,3*
	EV "Ekliptika"	
	EV "Obva"	
1987	RV "Kapitan Shaitanov"	-
1994	EV "Petr Petrov"	0,4
1995	EV "Petr Petrov"	3,5*
	EV "Olenitsa"	
1996	1-2 fishing vessels	0,3

\* - with allowance for catch by fishing vessels

TABLE 2.

Composition of ichthyofauna of Corner Rising sea mounts  
(Fisheries description ..., 1993)

No.	Family, species
	Scapnorhynchidae
1.	Mitsukurina owstoni Jordan
	Scyliorhynidae
2.	Parmaturus manis Springer
	Squalidae
3.	Centroscymnus coelolepis Bocage et Capello
4.	Squaliolus laticandus Smith et Radcliffe
	Bathylagidae
5.	Bathylagus longirostris Maul
6.	B. berycoides (Borodin)
7.	B. euryops Goode et Bean
	Argentinidae
8.	Microstoma microstoma (Risso)
	Opisthoproctidae
9.	Opisthoproctus soleatus Vaillant
10.	O. grimaldii Zagmayer
11.	Rhynchohyalus natalensis Gilchrist et von Bonde
12.	Dolichopteryx longipes (Vaillant)
	Gonostomatidae
13.	Gonostoma denudatus Kafinesque
14.	G. clanqatus Gunther
15.	G. bathyphilum (Vaillant)
16.	Banapartia pedaliota Goode et Bean
17.	Margrethia obtusirostra Jespersen et Taning
18.	Ichthyococcus ovatus (Cocco)
19.	Vinciguerria attenuata (Cocco)
20.	V. poweriae (Cocco)
21.	Diplophos taenia Yunther
	Sternoptychidae
22.	Sternoptyx diaphana Harmann
23.	Argyropelecus aculeatus Valenciennes
24.	A. hemigymnus Cocco
	Chauliodontidae
25.	Chauliodus sloani Schneides
26.	Ch. danae Regan et Trewavas



- 
- | No. | Family, species |
|-----|-----------------|
|-----|-----------------|
- 
- Astronesthidae
- |     |  |
|-----|--|
| 27. | Astronesthes gemmifer Goode et Bean          |
| 28. | A. macropogon Goodyear et Yibbs              |
| 29. | A. leucopogon Regan et Trewavas              |
| 30. | Neonesthes capensis (Gilchrist et Von Boude) |
| 31. | Borostomias antarcticus (Lonnberg)           |

- Stomiatidae
- |     |                                 |
|-----|---------------------------------|
| 32. | Stomias brevibarbatus Ege       |
| 33. | S. boa ferox Reinhardt          |
| 34. | Macrostomias Congibarbus Brauer |

- Melanostomiatidae
- |     |   |
|-----|---|
| 35. | Melanostomias valdiviae Brauer            |
| 36. | M. melanoporoda Regan et Trewavas         |
| 37. | M. spilorhynchus Regan et Trewavas        |
| 38. | M. tentocolatus (Regan et Trewavas)       |
| 39. | M. melapos Brauer                         |
| 40. | Bathophilus metallicus (Welsh)            |
| 41. | Chirostomias pliopterus Regan et Trewavas |
| 42. | Flagellostomias boureli (Zugmayer)        |
| 43. | Grammatostomias circularis Morrow         |
| 44. | G. flagellibarba Holt et Byrne            |
| 45. | G. dentatus Goode et Bean                 |
| 46. | Pachystomias microdon Gunther             |
| 47. | Trigonolampa miriceps Regan et Trewavas   |
| 48. | Photonectes braneri (Zugmayer)            |
| 49. | P. margerita (Goode et Bean)              |
| 50. | P. bifilifer Beebe                        |
| 51. | Echiostoma barbatum Lowe                  |
| 52. | Eustomias obscurus Vaillant               |
| 53. | E. bigelowi Welsh                         |
| 54. | E. dubius Parr                            |
| 55. | E. parri Regan et Trewavas                |
| 56. | E. filifer (Gilchrist)                    |
| 57. | E. schidti Regan et Trewavas              |
| 58. | E. braure Zugmayer                        |
| 59. | E. tetranema Zugmayer                     |
| 60. | E. bibulbosuas Parr                       |
| 61. | E. radicifilis Borodin                    |
| 62. | E. achirus Parin et Pokhilskaya           |
| 63. | Leptostomias gladiator (Zugmayer)         |
| 64. | L. analis Regan et Trewavas               |
| 65. | L. leptobolus Regan et Trewavas           |
| 66. | L. bermydensis Beede                      |

- Malacosteidae
- |     |                              |
|-----|------------------------------|
| 67. | Malacosteus niger Ayres      |
| 68. | Photostomias guernei Collett |
| 69. | Aristostomias tittmani Welsh |
| 70. | A. lunifer Regan et Trewavas |

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No.	Family, species
	Idiacanthidae
71.	Idiacanthus fasciola Peters
	Alepocephalidae
72.	Einara macrolepis (Koefoed)
73.	Xenodermichthys copei (Gill)
	Platytroctidae
74.	Maulisia maui Parr
75.	Sagamichthys schnakenbecki Krefft
	Notosudidae
76.	Anliesaurus berryi Bertelsen, Krefft, Marchall
77.	Scopelosaurus maui Krefft, Marshall
78.	S. lepidus (Krefft et Maul)
79.	S. smithii Bean
	Evermannellidae
80.	Coccorella atlantica (Parr)
81.	Evermannella indica Brauer
	Paralepididae
82.	Paralepis coregonoides Ricco
83.	P.harryi (Maul)
84.	P. elongatys (Brauer)
85.	Notolepis rissoi (Bonaparte)
86.	Lestidiops jayakari (Boulenger)
87.	L.affinis (Ege)
88.	Lestidium atlanticus Borodin
89.	Stemosudis intermedia (Ege)
90.	S. gracile (Ege)
91.	Sudis hialina Rafinesque
92.	S. atrox Harri
	Omosudidae
93.	Omosudis lowei Gunther
	Alepisauridae
94.	Alepisaurus ferox Lowe
95.	A. brevirostris Gibbs
	Myctophidae
96.	H.macrochir (Gunther)
97.	M. selenops Taning
98.	L.gemmellari (Cocco)
99.	Diaphus metopoclampus (Cocco)
100.	D. effulgens (Goode et Bean)
101.	D. taningi Norman
102.	Lampadena speculigera Goode et Bean
103.	L. urophaos atlantica Maul

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No.	Family, species
104.	L. anomala Parr
105.	L. chavesi Collett
106.	L. macdonaldi (Goode et Bean)
107.	L. festivus Taning
108.	L. ater Taning
109.	L. lineatus Taning
110.	L. teniformes Brauer
111.	Lepidophanes guentheri (Goode et Bean)
112.	C. warmingi (Lutken)
113.	Bolinichthys supralateralis (Parr)
114.	B. indicus Nafpactitis
115.	Notoscopelus resplendens (Richardson)
116.	N. sandispinosus (Johnson)
	Neoscopelidae
117.	Neoscopelus macrolepidotus Johnson
	Eurypharyngidae
118.	Eurypharynx pelecanoioides Vaillant
	Derichthyidae
119.	Derichthys serpentinus Gill
	Serrivomeridae
120.	Serrivomer beani Gill
121.	S. parabeani Bertin
122.	S. brevidentatus Roule et Bertin
	Nemichthyidae
123.	Nemichthys scolopaceus Richardson
124.	Nessorhamphus ingolfianus (Schmidt)
	Moridae
125.	Physiculus dalwigki Kaup
	Melanonidae
126.	Melanonus zugmayeri Norman
	Macrouridae
127.	Nezumia sclerorhynchus (Valenciennes)
128.	N. lingibarba (Goode et Bean)
129.	N. longibarba (Goode et Bean)
130.	Malacocephalus laevis (Lowe)
131.	Odontomacrurus murrayi
132.	Coryphaenoides rupestris Gunnerus
	Regalecidae
133.	Regalecus glesne Ascanius
	Trachipteridae
134.	Iu cristatus (Bonelli)

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No.	Family, species
	Radiicephalidae
135.	Radiicephalus elongatus Osorio
	Berycidae
136.	Beryx splendens Lowe
137.	B. decadactylus Cuvier
	Diretmidae
138.	Diretmus argenteus Johnson
139.	Diretmoides parini Post et Quero
	Trachichthyidae
140.	Hoplostethus atlanticus Collett
141.	H. mediterraneus Cuvier
	Melamphaidae
142.	Melamphaes suborbitalis (Gill)
143.	Scopelogadus mizolepis (Gunther)
144.	Paromitra capito Goode et Bean
145.	P. crassiceps (Gunther)
	Anoplogasteridae
146.	Anoplogaster corunta Valenciennes
	Oreosomatidae
147.	Neocyttus helgae Holt et Byrne
	Grammicolepididae
148.	Xenolepidichthys dalgleishi Gilbert
	Serranidae
149.	Polyprion americanus Schneider
	Apogonidae
150.	Epigonus telescopus (Risso)
	Cheilodipteridae
151.	Howella brodiei Ogilby
	Chiasmodontidae
152.	Chiasmodon niger Johnson
153.	Ch. microcephalus Osorio
154.	Pseudoscopelus altipinnis Parr
155.	P. scriptus Lutken
156.	Kali macrura (Parr)
	Ophidiidae, Brotulidae
157.	Brotulotaenia crassa Parr

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No.	Family, species
Gempylidae	
158.	<i>Gempylus serpens</i> Guvier
159.	<i>Diplospinus multistriatus</i> Maul
160.	<i>Neolotus tripes</i> Johnson
161.	<i>Lepidocybium flavobrunneus</i> (Smith)
162.	<i>Ruvettus pretiosus</i> Cocco
Scombrobracidae	
163.	<i>Scombrobraca heterolepis</i> Roule
Trichiuridae	
164.	<i>Aphanopus carbo</i> Lowe
Centrolophidae	
165.	<i>Centrolophus niger</i> Gmelin
166.	<i>Schedophilus medusophagus</i> Cocco
167.	<i>Hyperoglyphe perciforma</i> (Mitchill)
Nomeidae	
168.	<i>Cubiceps gracilis</i> Lowe
169.	<i>C. baxteri</i> Mculloch
170.	<i>Psenes pellucidus</i> Lutken
171.	<i>P. maculatus</i> (Lutken)
Lophiidae	
172.	<i>Sladenia shafersi</i> Caruso et Bullis
Chaunacidae	
173.	<i>Chaunax pictus</i> Lowe
174.	<i>Ch. nuttingi</i> Garman
Ceratiidae	
175.	<i>Cryptopsaras couesi</i> Gill

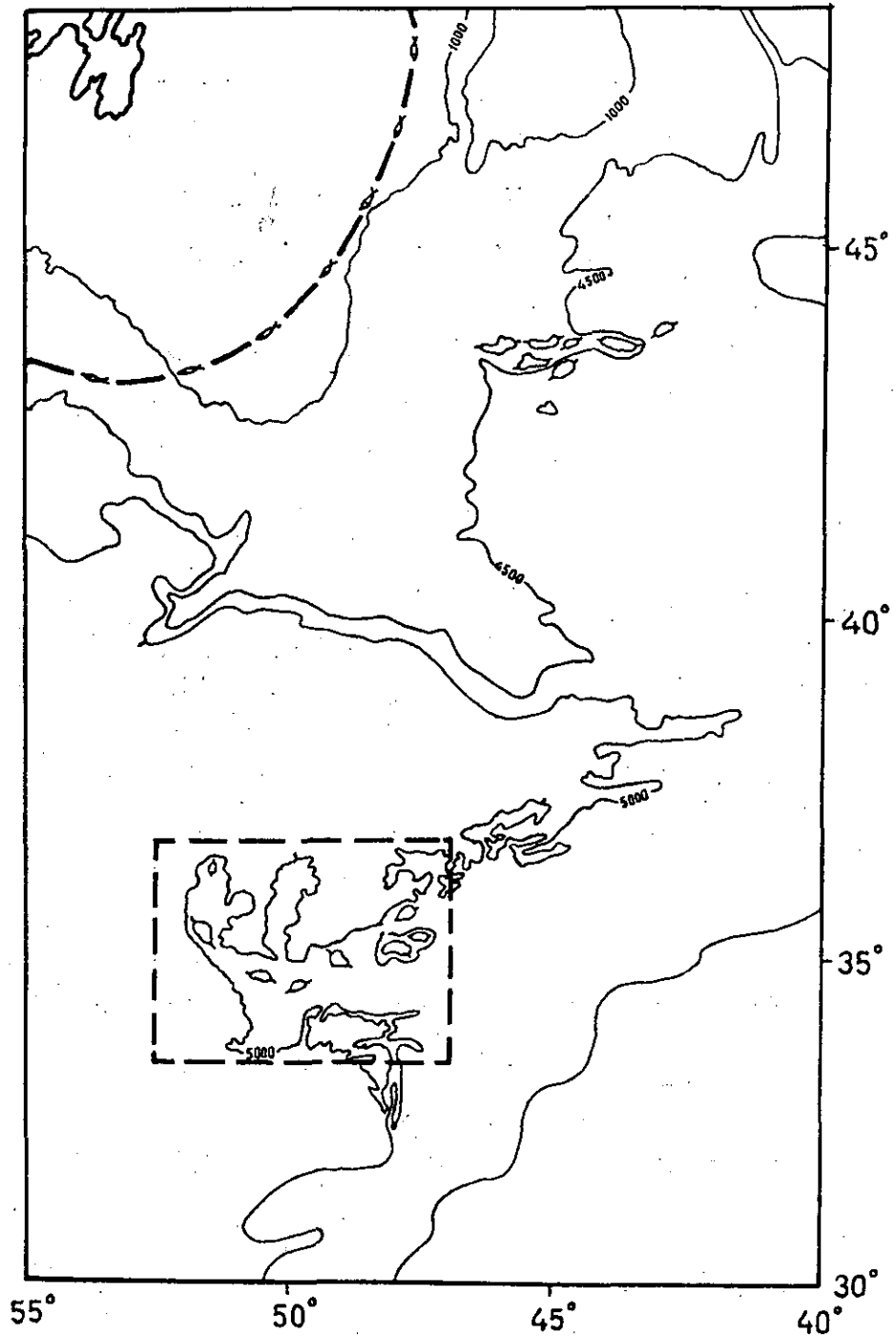


Fig.1. Area of deepwater investigations on the Corner Rising

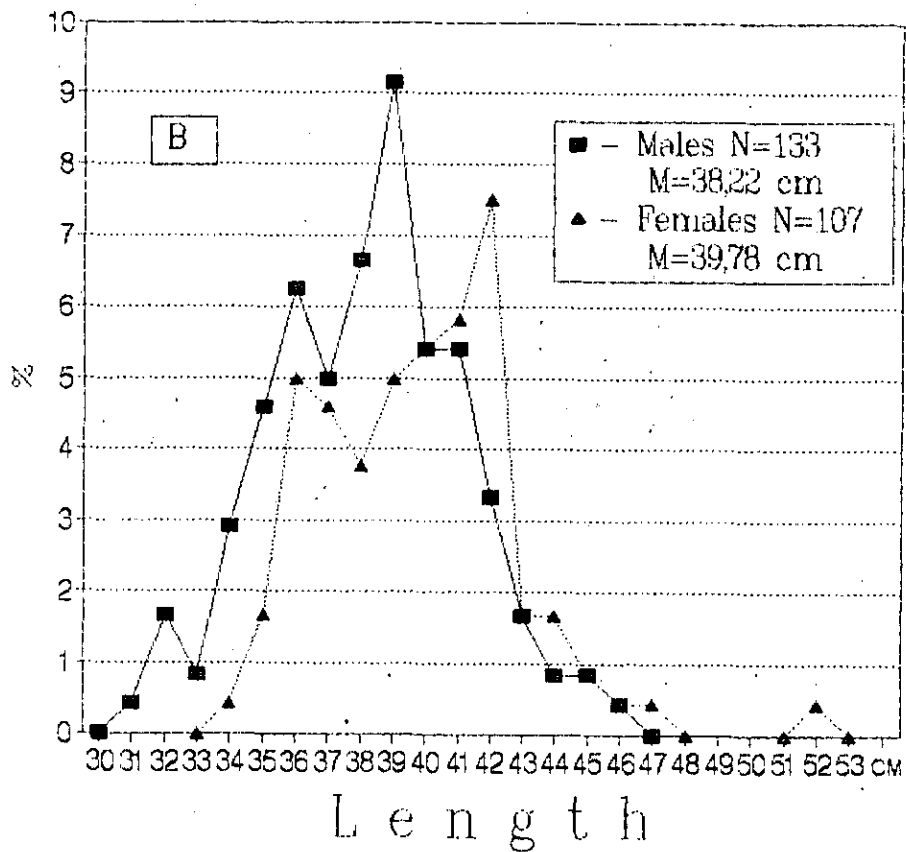
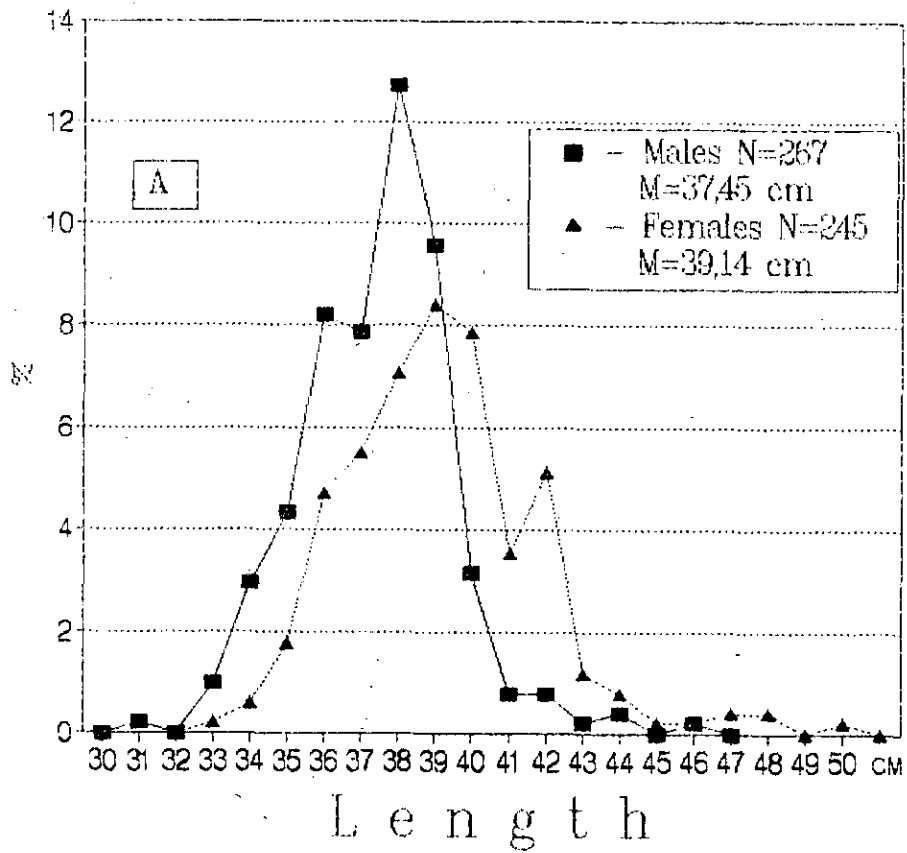


Fig.2. Length composition of Alfonsino in the Corner Rising area in May 1995.



Fig.3. Aggregations on Alfonsino on the "Vybornaya" Bank