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Results of Ichthyological and Hydrological  
Investigations on the Shelf off Equatorial  
Guinea (Rio Muni)

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by

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SUMMARY

The investigations carried out in the area off Equatorial Guinea in August 1970 showed that the following fish predominated in the catches:- Lutjanus (16%), Vomer (14%), Drepane (10%), Sparidae (8%).

All the commercial species were found in the waters over the thermocline, that is up to the 50m contour line, and were in the pre-spawning state.

Frequent occurrence of Lutjanus, Sparidae and sea perches over hard ground (rocky ridges, uneven bottom, corals) may be the basis for the fishing of these valuable species by bottom long-line.

At 1°27'N-1°44'N commercial concentrations of P. duorarum were found at the depth range of 30-40 m (15-30 kgs per one-hour trawling). Maximum catches of shrimp should be expected in October-December and in March-May.

In the catches of control trawlings at the shallow depths high proportions of young cephalopods were constantly observed. In the catches taken from the depths over 250 m adult squids occurred. Cases were noted of the feeding of tunas taken by trawls upon large individuals of these molluscs.

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## Introduction

The first investigations on the shelf off Equatorial Guinea were carried out on board SRTM "Vikhma" in August 1970. The research included hydrographical, bottom and trawl surveys in the depth range of 20 to 70 metres of the area. Trawl and hydrographical sections with distances of 10-15 miles were located along the normal to the depth contours (Figures 1 and 2).

Each trawl catch was analysed as to species composition by weight proportions and as to biological characters of the main fish species. The total amounts of commercial invertebrates and cephalopod catches were estimated separately.

Hydrographical observations were made concerning the following parameters: temperature, salinity, oxygen, phosphates. Before trawling, bottom stations were made with the aid of a corer.

The ichthyological observations were carried out by S.T. Ptitsyn and the hydrographical ones by A.K. Sigaev.

### 1. Ichthyofauna of the Rio Muny Shelf Waters

Biological investigations were carried out on board 8004 SRTM "Vikhma" from 6 to 23 August, 1970. 38 trawlings were made at the depth of 20-70 m, and several trawlings were conducted at the depth of 150-250 m. More than 90 fish species were observed in the catches. Herrings (Clupeidae), horse-mackerels (Carangidae), Sparidae, Lutjanidae and Ephippidae appear to have commercial value.

Since local fish complexes are characteristic for some localities, the area investigated can be arbitrarily divided into 3 sub-areas:

- 1.a northern (1°44'N-2°17'N); Lutjanidae, Sparidae and Carangidae predominated in the catches;
- 2.a central (1°27'N-1°44'N); Ephippidae, Carangidae, Polynemidae and Otoperca were found;
- 3.a southern (1°07'N-1°27'N); Ephippidae and Lutjanidae predominated.

The most important commercial fish were:

#### Clupeidae

1. Sardinella aurita
2. S. eba
3. Ilisha africana

Sardinella aurita and S. eba were found in the catches at a depth of 20-70 m in the location of 1°40'N-2°00'N. The specimens were 18-21 cm long and the gonads were in the pre-spawning state. Some first-time-spawners, 10-12 cm long, were observed.

Albulidae

1. Albula vulpes

This species was found in all catches, its share being 20-40 kg per one-hour trawling. The sizes of 30-50 cm predominated. The fish were in the pre-spawning state.

Carangidae

1. Vomer setipinnis

2. Decapterus punctatus

3. Selar crumenophthalmus

4. Hynn timeriensis

5. Scyris alexandrinus

6. Caranx carangus

7. Chloroscombrus chrysurus

The most massive representative of this family, Vomer setipinnis, is a typical muddy-bottom dweller. It was found at the depths of 30-40 m in the northern and central areas, the catches were 1-3 cwt<sup>\*</sup> per one-hour trawling. Size frequency was 15-21 cm, the mode was 16 cm, and the gonads were in the pre-spawning and spawning state. At the location of 1°40'N-2°00'N different species of small horse-mackerels were observed as individual specimens.

Lutjanidae

1. Lutjanus agennes

2. L. maltzani

3. L. guineensis

4. Apsilus fuscus

Small blacktail Lutjanus maltzani had the widest distribution. It was found in the northern and southern localities; some hauls contained 3-4 cwt per one-hour trawling at the depths of 40 m. Size frequency was 18-30 cm, the mode was 23 cm. Feeding specimens of this species were observed in the southern area and more mature ones were found in the northern waters of the area. Together with this species large specimens of Lutjanus agennes and L. guineensis were caught. The sizes were 60-120 cm, and the weight was up to 10 kg. The specimens were feeding.

Sparidae

1. Dentex congolensis

2. Dentex angolensis

3. Dentex canariensis

4. Pagellus couplei

5. Pagrus ehrenbergii

6. Lethrinus atlanticus

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\* Here and below we use Russian hundredweights (1 cw = 100 kg).

Pagrus was widely distributed in the whole area, its share varying from individual specimens to 2 cwts. A maximum catch of 3.0 cwts per one-hour trawling was taken at the depth of 35 m in 1°40'N. Size frequency was 18-31 cm, the modal group was 24-26 cm. The average weight was 270 g, the gonads were in the pre-spawning state.

#### Ephipiidae

##### 1. Drepane africana

A typical representative of this family, Drepane africana, made up the bulk of the catches from the central and southern areas. At the depths of 20-45 m the catches contained 3 cwts per one-hour trawling. Size frequency was 16-32 cm, the mode was 19 cm. Feeding and pre-spawning individuals were found. Stable concentrations were observed at the location of 1°25'N-1°35'N.

#### Other species

1. Galeoides polydactylus, (Polynemidae), was the usual by-catch of shrimp landings and was found at the location of 1°27'N. Size frequency was 15-26 cm, the mode was 22 cm. Pre-spawning individuals were observed (hermaphrodite).

2. Otoperca aurita, (Pristipomatidae), was found everywhere. Size frequency was 14-19 cm, the mode was 16 cm. Gonads were in the pre-spawning state.

3. Gerres melanopterus, (Gerridae), with the size frequency of 10-19 cm and mode of 16 cm. The specimens had running sexual products.

4. Ilisha africana, (Clupeidae), with the size frequency of 12-15 cm and pre-spawning gonads.

These four species made up the bulk of catches taken from muddy grounds. However, their commercial value was not important. The above-mentioned species are characteristic of the central sub-area (01°27'N-01°44'N).

Epinephelus aeneus, (Serranidae), was found everywhere. 5-10 specimens were taken per haul. Size frequency was 27-56 cm, sexual maturity stages 2,4.

Sphyraena sphyraena was found everywhere. Size frequency was 29-55 cm, sexual maturity stages 3, 2, 4.

Priacanthus arenatus, (Priacanthidae), was observed everywhere. Size frequency was 20-28 cm, maturity stage 4.

Pristipoma jubelini, (Pristipomatidae), was observed at the depth of 40 m at 1°30'N. Size frequency was 22-37 cm, the mode was 32 cm, sexual maturity stage 4.

Lethrinus atlanticus, (Sparidae), was found everywhere. Size frequency was 21-35 cm, the mode was 23 cm, maturity stage 3-4.

Smaris macrophthalmus, (Maenidae), was found at the depth of 150 m. The catches were 2-3 cwts per one-hour trawling. Size frequency was 14-24 cm, the mode was 22 cm, sexual maturity stage 3.

Dentex congoensis, (Sparidae), was observed at the depth range of 20-150 m. Size frequency was 14-29 cm. The mode was 23-26 cm, maturity stage 3. The average size increased with the depth of trawling.

Synagrops microlepis, (Apogonidae), is a bottom dweller (more than 250 m), size frequency was 8-12 cm.

Euthynnus alliteratus, (Scombridae), was individually observed in the catches taken by a bottom trawl over the depth of 250 m. Sizes were 40-60 cm, maturity stage 4. Squids were found in the stomachs of tunas.

Young cephalopods (squids, sepias) were constant representatives in the catches. They constituted 1-5 kgs per one-hour trawling. Small squids with the mantle lengths of 6-12 cm dominated. Adult specimens were found in the offshore area over the depth of 250 m.

### Shrimp

Commercial concentrations of pink shrimp, Penaeus duorarum, were found off the Benito River mouth on muddy bottoms. The boundaries of the muddy area were located at 1°27'N-1°44'N, fishing depth being 20-55 m. Shrimp catches of 15-30 kgs wet weight per one-hour trawling were observed at the depth range 30-40 m. Shrimp was fished in the dark time only (19.00-05.00 GMT). Individuals of 60 to 170 mm in length were observed in the catches. Modal sizes of males were 90-100 mm, of females 110-120 mm. Individuals more than 130 mm in length made up 27% of the catches. Shrimps were measured from the base of the orbit to the end of the last body segment (telson). Half of the females were in the juvenile and first maturing stages. The shrimp population can be characterized on the whole as consisting of young ones and migrating from the shallows during the two previous months, intensively moulting and feeding upon juveniles of cephalopods.

Judging from the experience from the shrimp fishery, we may state that maximum shrimp catches will be expected in the rainy period, that is from October to December and from March to May.

## 2. Results of the Hydrographical Observations

### Temperature

Inshore waters of the area were characterized by high temperature (26°-28°) in August at the layer of 0-50 m, everywhere from Cape Campo to the San Juan Cape. The location of the upper and lower thermocline boundaries was found at the depth from 50 m to 70 m along the whole coast (Figure 3). The central sub-area was characterized by a thermocline with relatively smaller temperature gradients. The range of temperature at the depths of 75-100 m was 14.2°-14.8°. The marked sinking of the isotherms along the 100-m contour line is in the area near the Benito River (1°30'N-1°45'N). Temperature maximum of pre-bottom waters (Figure 4) and a depth less than 50 m was observed south of 1°30'N, and it reached 27°8 off Cape Udoba at the depth of 20 m.

### Salinity (Figures 5 and 6)

Surface waters in the layer 0-10 m were characterized by a salinity of  $30.0^{\circ}/\text{oo}$ - $33.0^{\circ}/\text{oo}$  in the whole area. Maximum values of surface salinity were found to the south in the area, and salinity minimum was observed at a location near the Campo and Bongola river mouths. However, pre-bottom waters at the depths of 30-70 m were the least saline ones in the central sub-area adjacent to the Benito River mouth. The  $35^{\circ}/\text{oo}$  isohaline descended here to a considerably lower depth, as compared with the northern and southern sections (Figure 5). Salinity variation in the layer of 30-50 m appeared to be most marked in the north of the area, off the Campo and Bongola rivers. The depths of 90-100 are occupied by waters with a high salinity ( $35.5^{\circ}/\text{oo}$ ).

### Oxygen and phosphates (Figure 7)

Oxygen content exceeding 100% saturation is found all over the diluted water column beyond the thermocline along the zone from the Ekuku River to Cape Udoba. To the north of Ekuku River, where increased content of phosphates (15-20 mg/l) was observed at the depths of 20-50 m, the oxygen content was less than 100% saturation. In the south of the area, off Cape San Juan, a somewhat decreased oxygen content at the depth of 20-35m may be attributed to the relatively high temperature and high salinity.

### Bottom (Figure 8)

Sand predominated at the depth of 20 m along the whole coastline. The depths of 20-50 m were characterized by various bottoms: sand, silty sand, sandy silt. According to the data of the ground survey, silty sediments were mainly in the traverse of Cape San Juan at the depths of 50-75 m between the Benito river mouth and the Cape Gegin where a pitch of silt was observed at the shortest distance from the shore and reached the depth of 20m, as well as between Cape Mbonda and Cape Campo at the depths of 30-70 m.

Sand and silty sand dominated south of  $1^{\circ}30'N$ ; sandy silt prevailed north of Cape Mbode at the depth of 50 m. It is characteristic of sandy bottoms that the presence of numerous rocky ridges and corals interfered with the trawling.

Based on the data of the ground survey, as well as on the echo-recordings made during the trawling, the whole area should be divided into locations suitable for trawl fishing and those suitable for long-lining (Figure 2).

### Currents

Preliminary analysis of some data on current observations has shown that the main flow with the speed range of 0.4-1.0 knots in the layer beyond the thermocline off Cape Mbonda was directed towards the south, and the pre-bottom currents were also weak.

The direction of surface currents recorded during our observations appeared to coincide with the known geostrophic scheme plotted on the basis of data by the research vessels "Calypso" and "Ombango" (1). However, the shelf water dynamics over shallow depths in the inshore zone is probably of a more complicated nature. Judging from indirect observations, such as the distribution of temperature, salinity, phosphates and bottom features, the current over the shallow areas along the coast from Mosquitos Point towards Cape San Juan is directed towards the north; and the inshore current in shallow waters from Cape Gegin to Cape Campo was also directed towards the north. With the presence of a stable southwards current over the

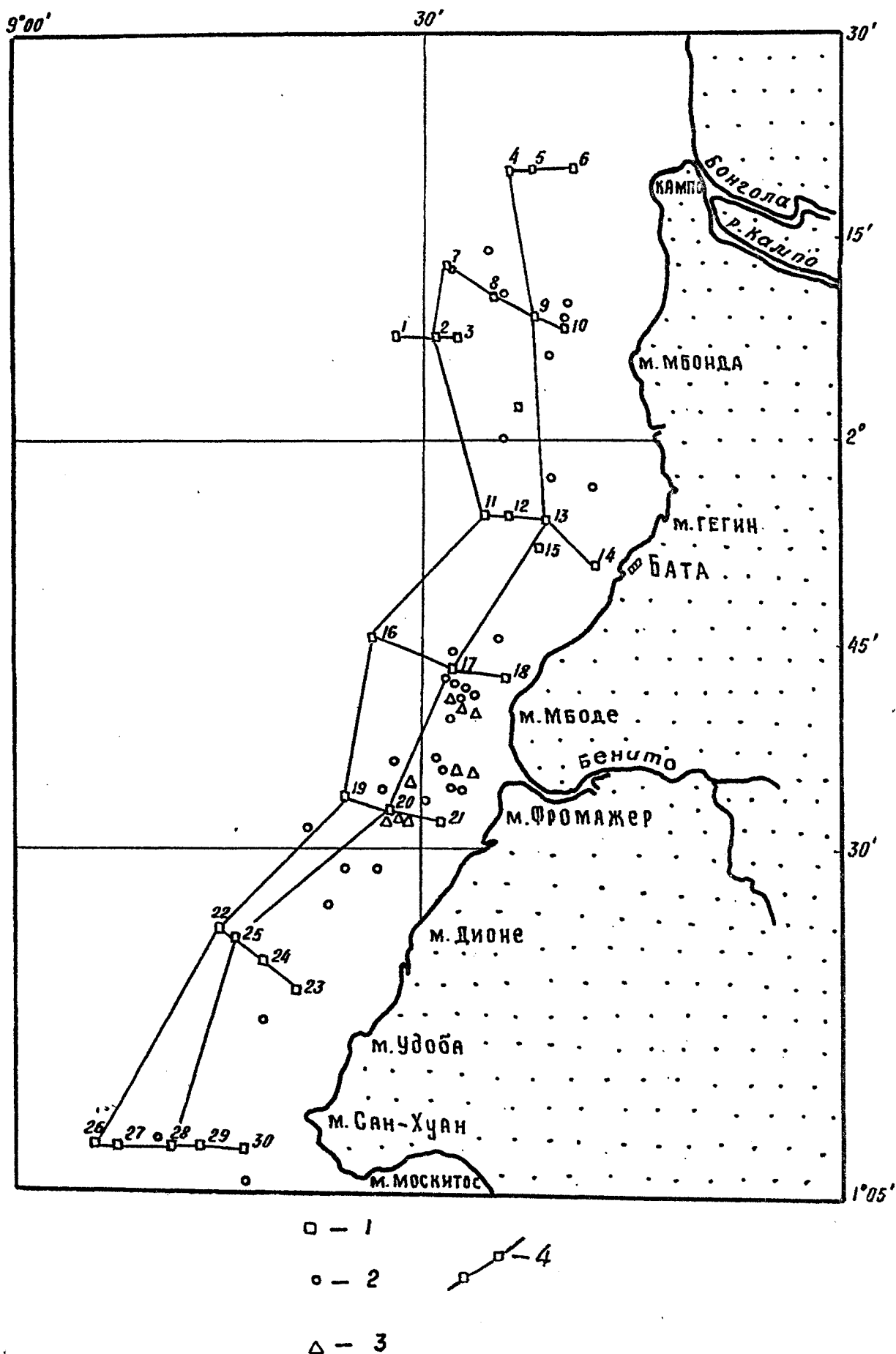
continental slope and of the observed inshore northwards currents, it is very likely that the waters of the northern and southern areas are influenced by cyclonic gyres. The result of such gyres is the formation of upwelling zones.

In this connection, the central area adjacent to the Benue river should be located in the zone of convergence which is in the periphery of the northern and southern zones of upwelling.

It is of interest that the analysis of the ichthyofauna composition of the northern, southern and central parts of the area show some analogy between the northern and southern ones. For example, Lutjanidae were found in the southern and northern areas only. It is noteworthy that the hydrographical situation observed by us in the central area corresponds well with the optimum conditions for the pink shrimp, Penaeus duorarum.

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**Figure 1.** Chart of position of hydrographical stations and sections on the Equatorial Guinea shelf.

- Legend:**
- 1 - Stations on the sections
  - 2 - Bathythermographic and bottom stations
  - 3 - Separate bathythermographic stations
  - 4 - Position lines of hydrographical sections.



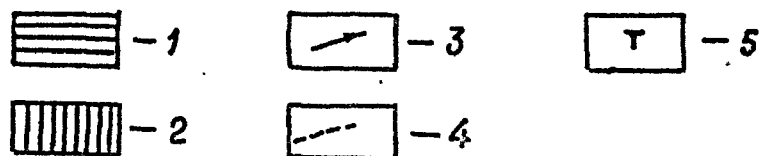
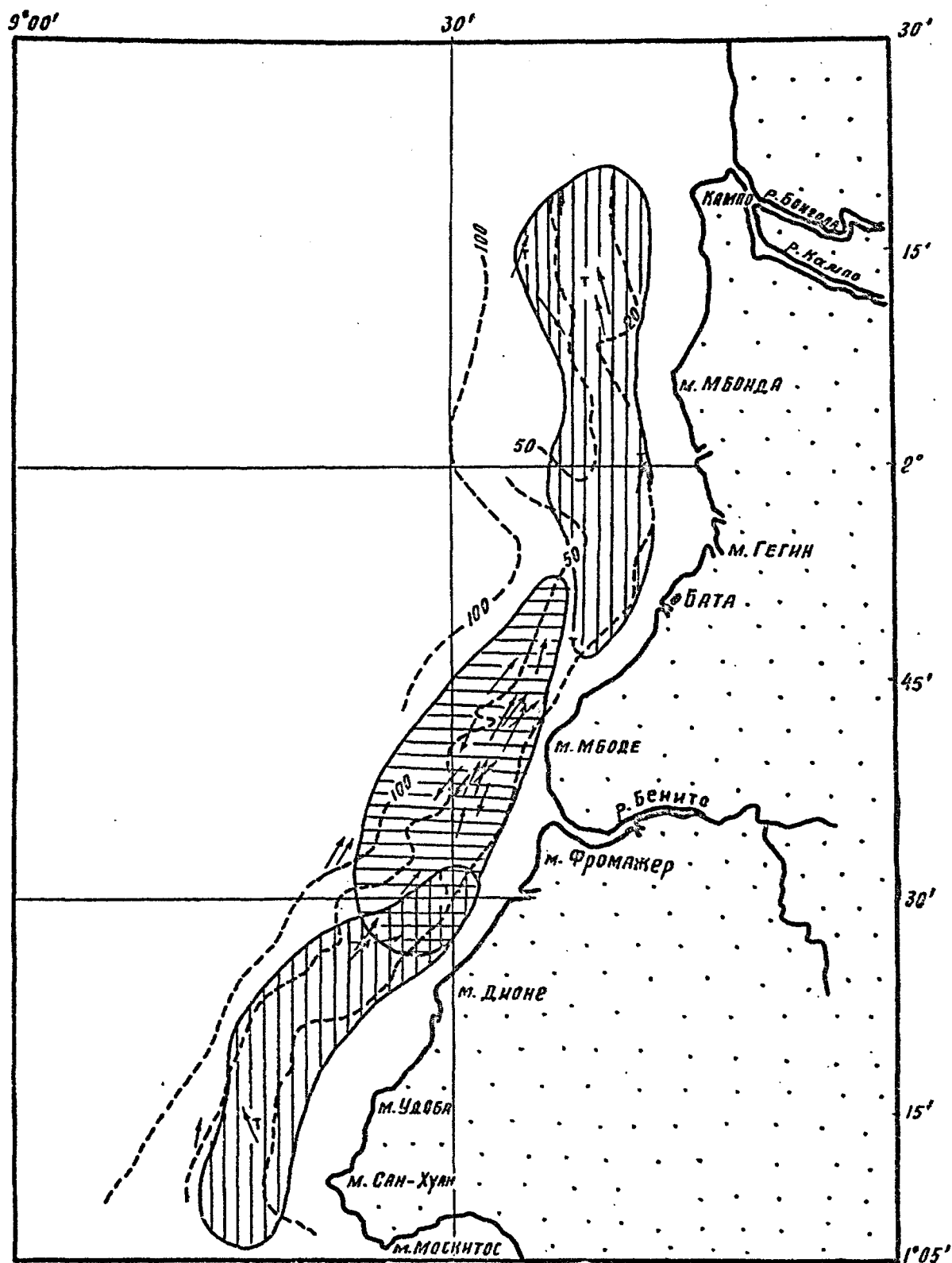


Figure 2. Fishing areas.

Legend

- 1 - Locations for trawl fishing
- 2 - Locations for long-line fishing
- 3 - Control trawlings by SRTM "Vykhma"
- 4 - Contour lines
- 5 - Locations of trawl touching the bottom.

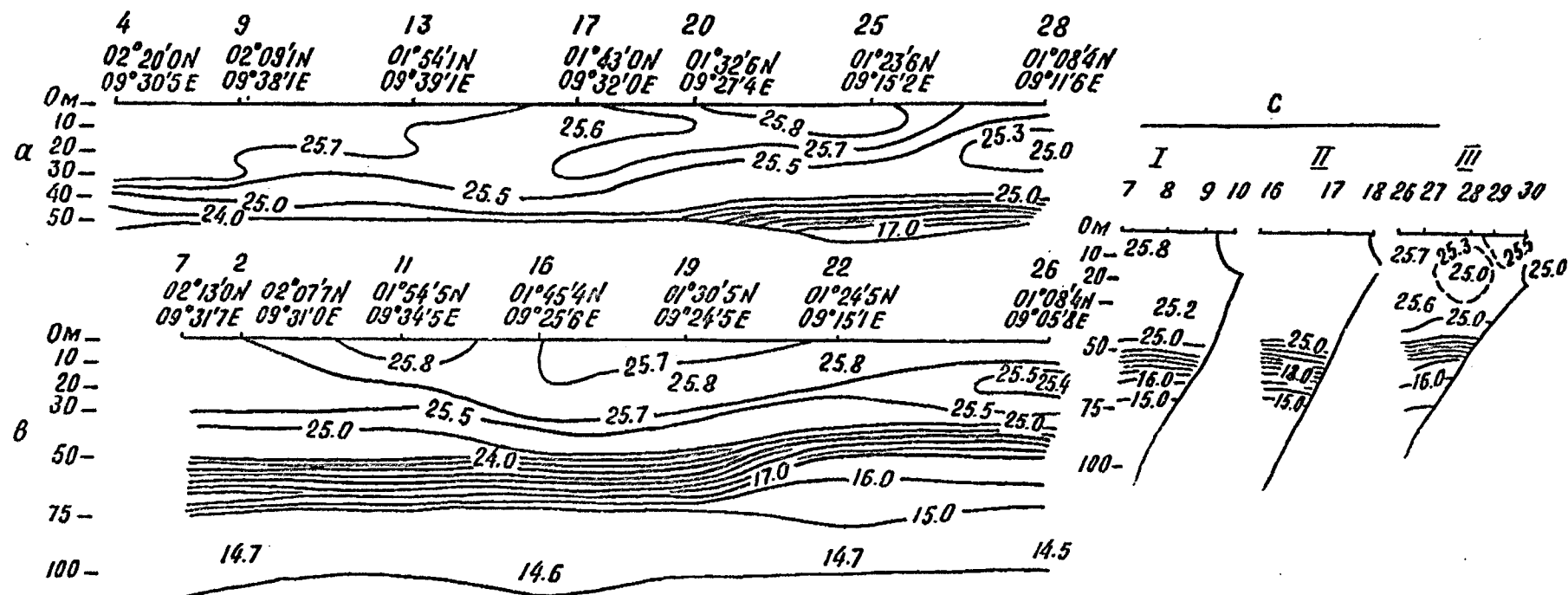


Figure 3. Vertical temperature distribution on the Equatorial Guinea shelf, 3-4 August 1970.

**Legend**

- a - Section along the 50 m contour line
- b - Section along the 100 m contour line
- c - Sections normal to the contour lines:

- I - northern, off Cape of Mbonda
- II - central, off Cape of Mbode
- III - southern, off San Juan Cape.

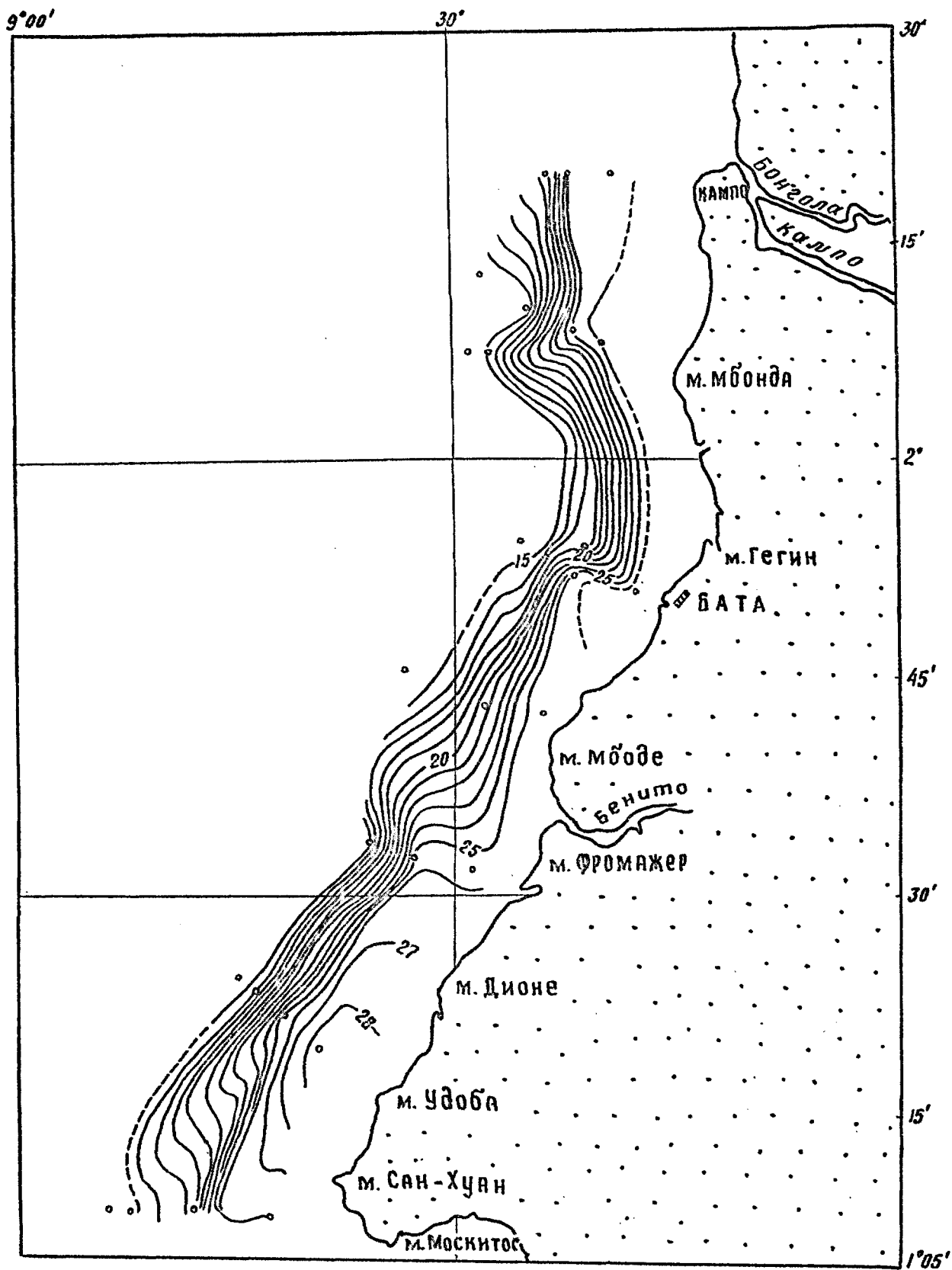
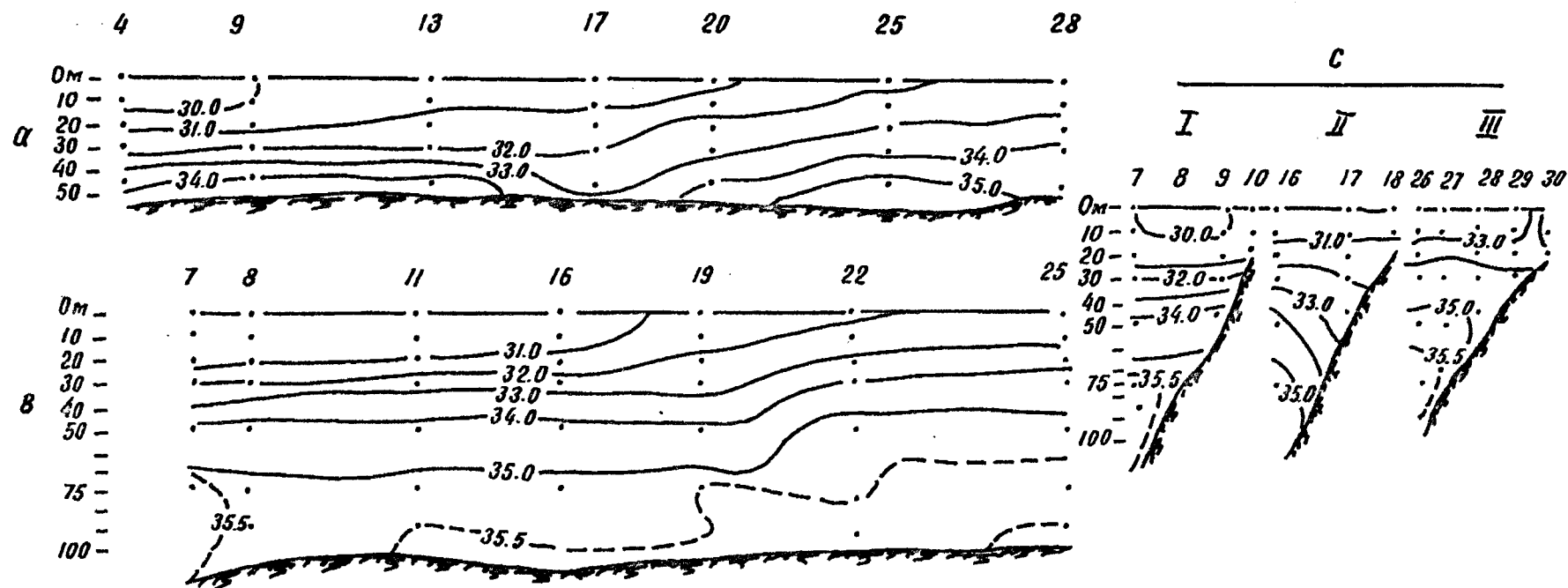


Figure 4. Chart of temperature distribution near the bottom, 3-4 August 1970.



**Figure 5.** Vertical distribution of salinity on the Equatorial Guinea shelf, 3-4 August 1970.

**Legend**

- a - Section along the 50 m contour line
- b - Section along the 100 m contour line
- c - Sections normal to the contour lines:
  - I - northern, off Cape of Mbonda
  - II - central, off Cape of Mbode
  - III - southern, off San Juan Cape.

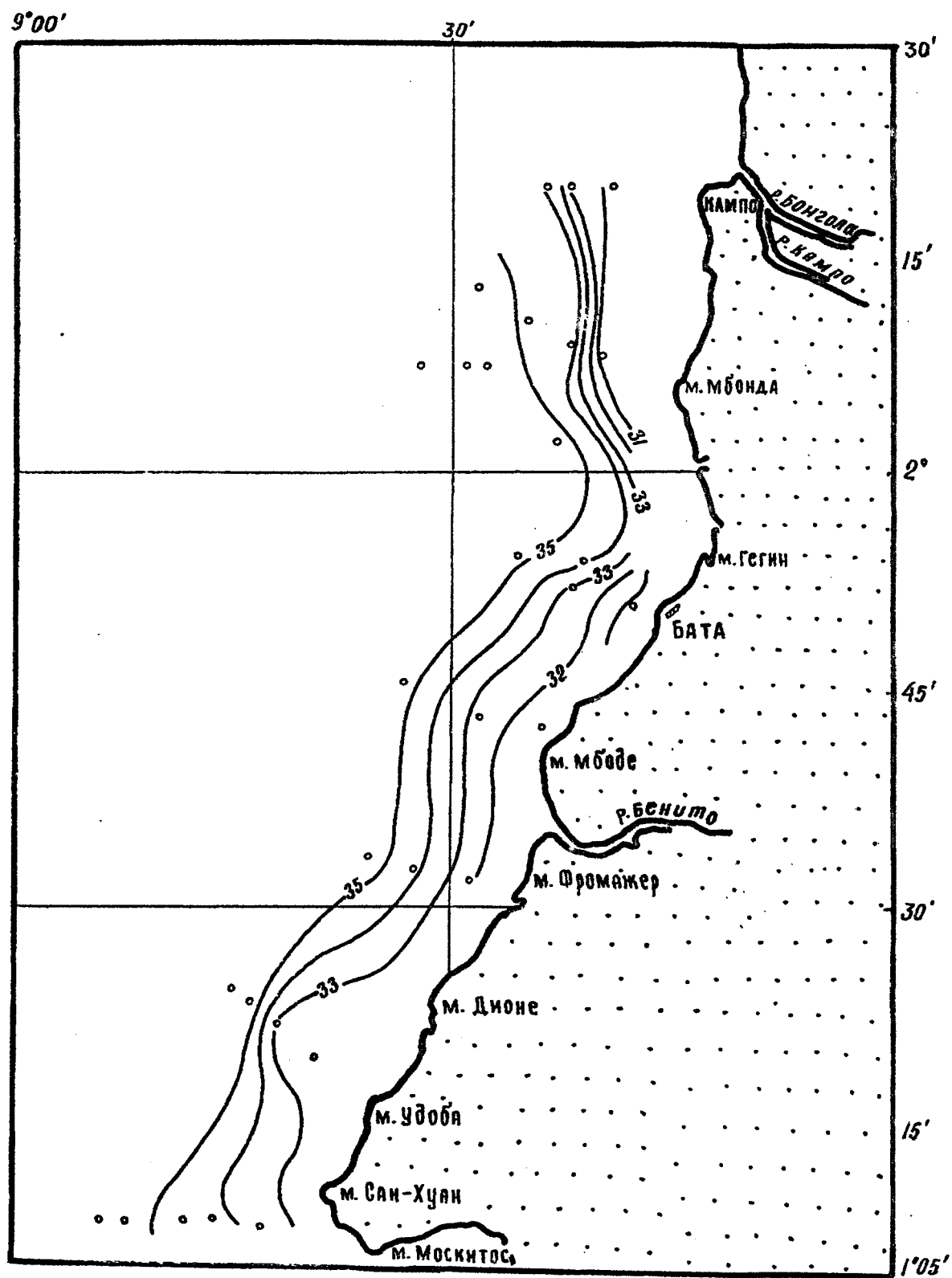


Figure 6. Chart of salinity distribution near the bottom,  
3-4 August 1970.

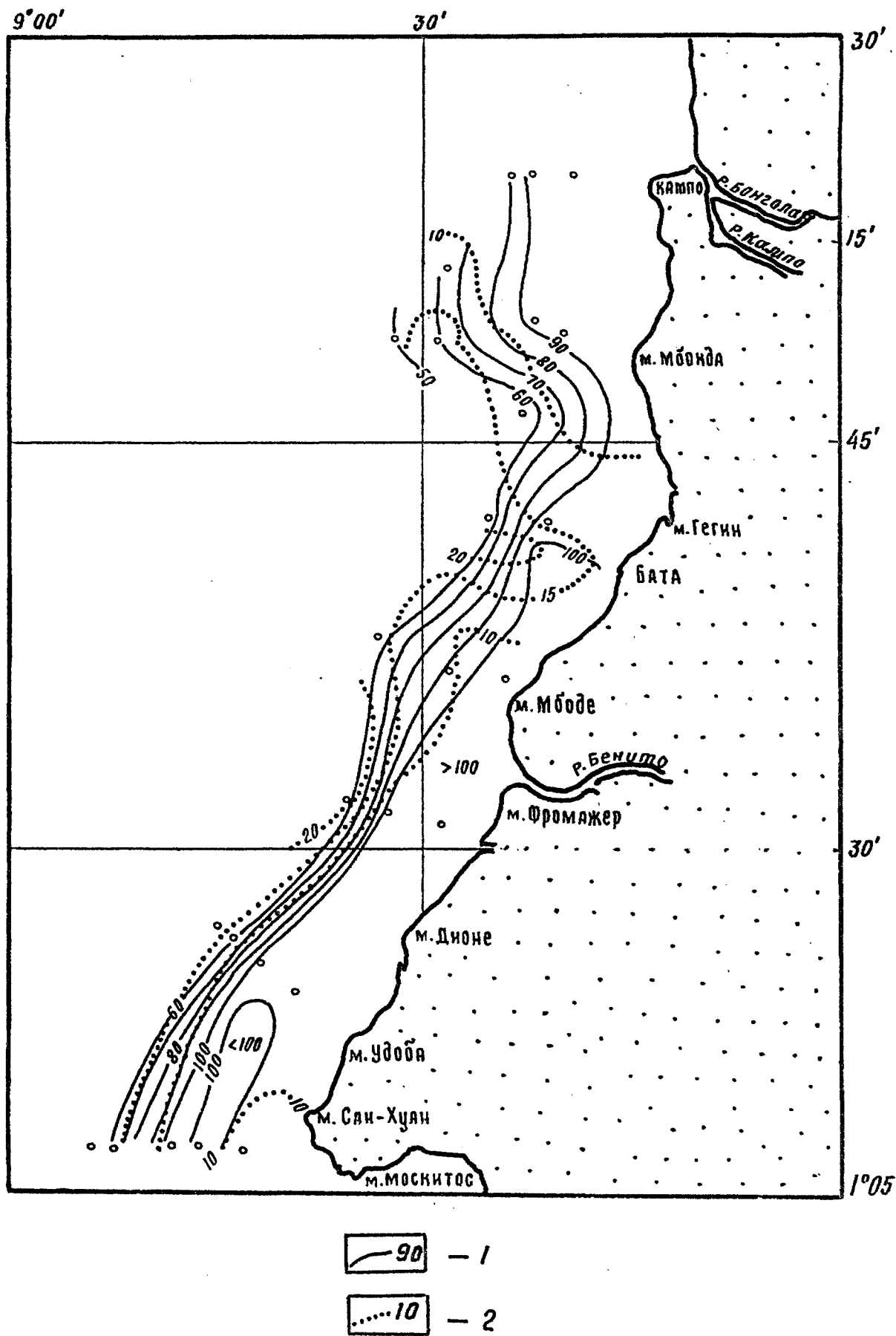
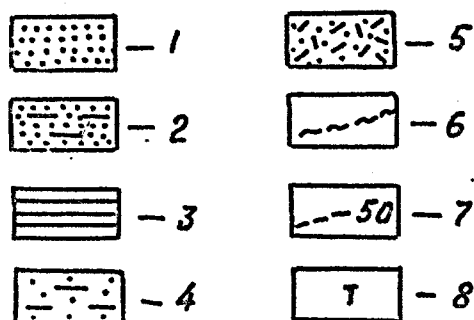
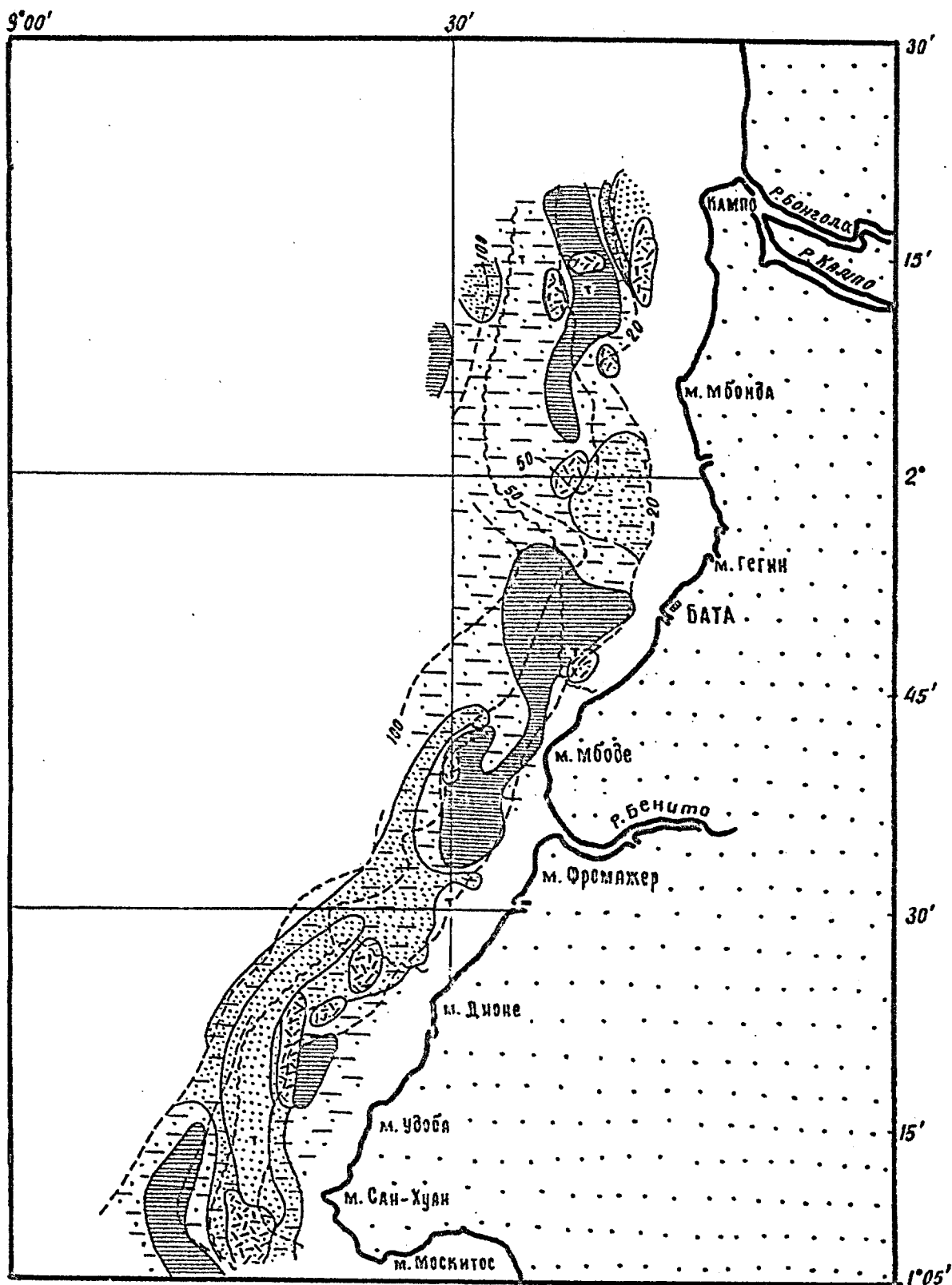


Figure 7. Chart of oxygen (%) and phosphates (mg/l) distribution near the bottom, 3-4 August 1970.

Legend:

- 1 - Isoxygens                      2 - Isophosphates



**Figure 8.** Chart of bottom sediments distribution on the Equatorial Guinea shelf.

**Legend:**

- 1 - sand
- 2 - silty sand
- 3 - silt
- 4 - sandy silt
- 5 - rocky ridges, corals, uneven bottoms
- 6 - boundaries of locations which are hazardous for trawling
- 7 - contour lines
- 8 - locations of trawl touching the bottom.