

The mapping of benthic biocenoses in the coastal zone of Latvia

Alexander Korolev

Marina Fetter

Latvian Fisheries Research Institute,
Daugavgrivas 8, LV-1007, Riga, Latvia
e-mail: korolevs@latfri.lv, fetter@latfri.lv

Abstract

The macro benthic communities of blue mussel (*Mytilus edulis*) and marine red algae (*Furcellaria lumbricalis*) are the most frequent biocenoses in the coastal zone of the Eastern Baltic. Blue mussel is a filter feeder, so these biocenoses exhibit high biofiltration and biosedimentation ability and thereby co-operate in the water **selfpurification** process. The spawning herring uses the **thalli** of *Furcellaria* for settling the eggs. Furthermore, the algae are valuable raw material for **agar-agar** production.

In the coastal zone of Latvia the investigations of distribution and abundance of *Furcellaria* were the main part of the benthic biocenoses monitoring which was carried out by the Latvian Fisheries Research Institute in 1980-1990 **from** Klaipeda to Ventspils. The monitoring was recommenced **in** 1998 and 1999 **after** interruption in 1991-1997. According to the previous assessment the total abundance **of** *Furcellaria* in the Klaipeda - Ventspils region decreased more than 2.5 times from 1980 to 1990 especially after two large oil accidents near the coast. The habitat of *Furcellaria* strongly diminished. The only relatively large stock of *Furcellaria* remained in the section between Pape and Liepaja where the four large herring spawning grounds were situated. This section is the most valuable as a protected marine area (it is included in the HELCOM list).

The results of surveys of 1998 and 1999 showed the restoration of *Furcellaria* stock. In the Pape-Ventspils region the biomass of *Furcellaria* was 3 times higher than it had been in 1990. In this area four large growths of algae were found with density of *Furcellaria* above 0.1 kg/m^2

Blue mussel biomass was also estimated for the Pape-Ventspils region. In comparison with the previous assessment (1982) blue mussel distribution and biomass changed inconsiderably in **1998- 1999**.

The results of surveys are presented as maps of distribution of *Furcellaria* and blue mussel along the Latvian coast for 1990, 1998 and 1999.

Introduction

Along the Latvian coast the sandy grounds predominate and they may be characterized with small specific biodiversity and comparatively low level of bioproductivity. On the contrary the stone bottom structures (hard bottom) play a significant role in the formation of coastal ecosystems. All main species of macrobenthos are concentrated in these areas. The macro benthic communities of blue mussel and *Furcellaria lumbricalis* are the most frequent biocenoses in the coastal zone along the coastline of Latvia. Blue mussel is a filter feeder, so these biocenoses exhibit high biofiltration and biosedimentation ability and thereby co-operate in the water selfpurification process. *Furcellaria* being the dominant species (by biomass) in such biocenoses serves as a spawning substratum for Baltic herring (*Clupea harengus membras*) and raw material for the agar-agar production.

Investigation of distribution and estimation of *Furcellaria* abundance at the Lithuanian coast was started by M. Kireeva in 1955 (Kireeva, 1960). The works were done by using at first the drags and later with the help of SCUBA divers sampling. The diving sampling was managed on the 2- 10 stations at 6- 15 m depth in the coastal zone of the Baltic Sea. The stations were situated in the sections that were perpendicular to the shoreline (Blinova, 1971, 1975). Within each station the average percent of projective covering of seaweeds and the value of average biomass of algae were determined. In 1973 the investigations were carried out at the Latvian coast and the biomass of *Furcellaria* in the Pape-Pavilosta region was estimated at the level of 73 000 t (Blinova, 1975). It was revealed that the productivity and abundance of the *Furcellaria* show annual and multiannual variability. The decrease of the biomass is caused by storms in autumn-winter season when some part of the algae (up to 50 %) are fragmented or totally destroyed. The annual increase of biomass can reach 50-150 percent. The water pollution especially with oil products is very harmful for algae. *Furcellaria* loses the capacity of attachment with natural substratum that is followed by a decrease of reproductivity and algae setting.

The examination of the whole stock distribution and abundance of *Furcellaria* in the Kaliningrad area, off the Lithuanian and Latvian coasts, Estonian islands Saaremaa and Hiiumaa was executed in the period from 1973 till 1980 by E.Prytkov, A. Korolev and H.Kukk (Korolev et al., 1983; Kukk, 1978).

In the coastal zone of Latvia the investigations of distribution and abundance of *Furcellaria* were the main part of the benthic biocenoses monitoring which was carried out by the Latvian Fisheries Research Institute in 1980-1990 from Klaipeda to Ventspils. The monitoring was recommenced in 1998 and 1999 after interruption in 1991-1997.

The new effective methods with a high labor intensity have been elaborated in the Latvian Fisheries Research Institute since 1980. They include aerial-visual observations, aerial photography, the monitoring of the main regions of *Furcellaria* seaweeds based on the using TV-system, supplemented with the diving sampling (Muravsky et al., 1986).

Methods

In 1998 and 1999 the observations and sampling from hard bottom were carried out using colour underwater TV system **IBAK UF-23** and SCUBA diving. The sampling was performed on transects which were perpendicular to the shoreline (Fig. I). The distance between transects varied from 2 to 8 km for Pape-Liepaja region and from 8 to 20 km for Liepaja-Ventspils region. There were four stations on each of the transects on the depth of 7, 10, 15 and 20 m. On each station an area with the length 150-200m and width of 0.5-2.0 m was investigated. The method includes combination of underwater video recording with SCUBA diving at selected sites along the transects. Video signal from the bottom was recorded during the moving of vessel along the transect (Korolev, et al. 1993, Muravski, et al. 1986).

Location of the station was determined by GPS system.

Before sampling divers performed the visual observations of bottom communities in the 250 m² area. The test sample was taken at every stations in the place where the projective covering (%) of macrobenthos was the maximal. The samples of macrobenthos with small amount of soil were hand-picked by SCUBA divers using control frame 0.25 m² square and nylon fine-meshed net bag.

The underwater photography of the bottom area within the print-holder frame was made in each site of sampling to determine of projective covering .

Video records have been used for estimation of mean projective covering for each station.

The samples of macrobenthos were fixed in 4% of formalin.

The identification and analytical treatment of samples were made according to the standard techniques. Two main components of bottom biocenoses were under consideration - *Furcellaria* and blue mussels.

The weights of *Furcellaria* and blue mussels were determined in wet condition but before weighting *Furcellaria* and molluscs were exsiccated by blotting paper.

Projective covering of *Furcellaria* and blue mussels within the print-holder frame (p_f) was determined by photography.

Estimation of mean projective covering of *Furcellaria* and blue mussels for each station was made using video records. For each station accordant video record was divided into equal time intervals by freeze frame from which the projective covering was determined. The mean value of projective covering of all freeze frames was accepted as projective covering at the station (P_{st}).

Density of *Furcellaria* and blue mussels within the print-holder frame was re-calculated to 100 percent of projective covering because the samples were not always taken from the sites with 100 percent of projective covering due to drift of vessel.

Estimated density of *Furcellaria* and blue mussels at the station (D) was determined by the following formula:

$$D = \frac{WP_{st}}{P_f S}$$

where D is the density of a hydrobiont at the station (kg/m²);

W- is the biomass of the sample (kg);

P_{st} - is mean projective covering at the station

P_f - is projective covering within the control frame
 S - is the area of the control frame (m^2).

The data on a station coordinates and estimated density at the station was used to map the spatial distribution of *Furcellaria* and blue mussels (kg/m^2). Surfer Mapping System (Surfer Version 6.04) was used to map the density distribution of *Furcellaria* and blue mussels. Location of the monitoring stations in 1990 and 1998 is shown on Fig 1. In 1999 only the small part (from Pape to Liepaja) of Latvian coastal zone was surveyed with the stations arranged as in 1998.

Results and discussion

According to the previous assessment during the period from 1978 to 1990 the total stock of *Furcellaria* in the region Klaipeda - Ventspils decreased from 84 500 to 15 000 t. The dramatic decrease was determined after the accidents of the oil tankers "Antonio Gramsci" near Ventspils in 1979 and "Globe Asime" near Klaipeda in 1981 (Korolev, et al. 1991). Fig. 2 shows the distribution of *Furcellaria* in 1990. According to the data of survey in 1990 the habitat area of *Furcellaria* strongly diminished compared with the previous decade. Two relatively large spots of *Furcellaria* remained in the section between Pape and Liepaja (Fig.2). In 1990 the *Furcellaria* abundance was about 14000 t in the Pape-Pavilosta region (Korolev, et al. 1995).

In 1998 the monitoring was recommenced after interruption of seven years. In 1998 in *Furcellaria* was distributed on the area of 265.9 km^2 occupying the depth interval from 7m to 20m (Fig.3). Four main concentration areas of *Furcellaria* were found. They were situated near Pape ($S=54.7km^2$), near Liepaja ($S=162.5 km^2$), near Akmenrags cape ($S=3.15 km^2$) and near Ventspils ($S=16.4 sq.km^2$). About 70 percent of *Furcellaria* total stock was situated between Pape and Liepaja. The station with the maximal density ($1.36 kg/m^2$) of *Furcellaria* was located in the area of Pape- Liepaja. The maximal projective covering was observed at the same station being 80 percent. The total biomass for the investigated area from Pape to Ventspils was estimated as 77 400 t. In 1999 the surveyed area was limited by Pape - Liepaja region (Fig.4). The distribution area of *Furcellaria* with the density of seaweeds of $0.1 kg/m^2$ was $162 km^2$ and situated in the depth interval of 7.5 - 18 m. Two spots of *Furcellaria* with the density more than $0.1 kg/m^2$ and one place with the density more than $1 kg/m^2$ were found. Total amount of *Furcellaria* was estimated as 36000 t. As regards the region from Pape to Liepaja it may be concluded that habitat area and average density of *Furcellaria* in 1999 has not changed essentially comparing with 1998.

Thus results of surveys of 1998 and 1999 showed the restoration of *Furcellaria* stock after its drastic decrease recorded in 1990.

Blue mussel distribution and abundance were also estimated for the Latvian coastal zone in 1998-1999. In comparison with the previous observations (1990) the blue mussel distribution changed inconsiderably in 1998- 1999 (Fig. 5-7). However the tendency to decreasing of the density of blue mussels is quite clearly seen for the region Pape-Liepaja during last two years (Fig.6 and 7). In 1998 blue mussels were observed on the total area of $1103.4 km^2$ occupying the depth interval from 6m to 30-35m. There were four places

with density of blue mussels above 0.5 kg/m^2 They are: near Ventspils (104.7 km^*), near Jurkalne (20.9 km^2), near Akmenrags (314.3 km^2) and between Pape and Liepaja (663.5 km^*). The maximal density of blue mussels was observed in the area of Pape-Liepaja reaching 4 kg/m^2 The total biomass of blue mussels for the whole investigated area was estimated as 1227900 t.

Density of blue mussels in 1999 was lower than in 1998 (Fig.7). The total stock of blue mussels was estimated 416000 t for the section Pape Liepaja.

Results of video-survey of the **soft** bottom between Pape and Liepaja show that sandy grounds strongly dominate at the depths up to 7 m. Sometimes a small amount of mud was observed between the sandy waves. The macrophytes were not found at all stations. Sometimes we observed the fragments of partly destroyed or unhurt *Furcellaria*.

Monitoring of sea algae and **molluscs** resources carried out by Latvian Fisheries Research Institute during 1980-1990 allows to evaluate the significance of separate sections in **self**-purification of the coastal zone. In this respect the Pape-Liepaja section is especially important because the maxima of blue mussel abundance and *Furcellaria* algae biomass were recorded there. Thanks to this fact the highest values of water transparency are observed in that place, testifying to the utmost intensity of water self-purification (Korolev et al., 1993).

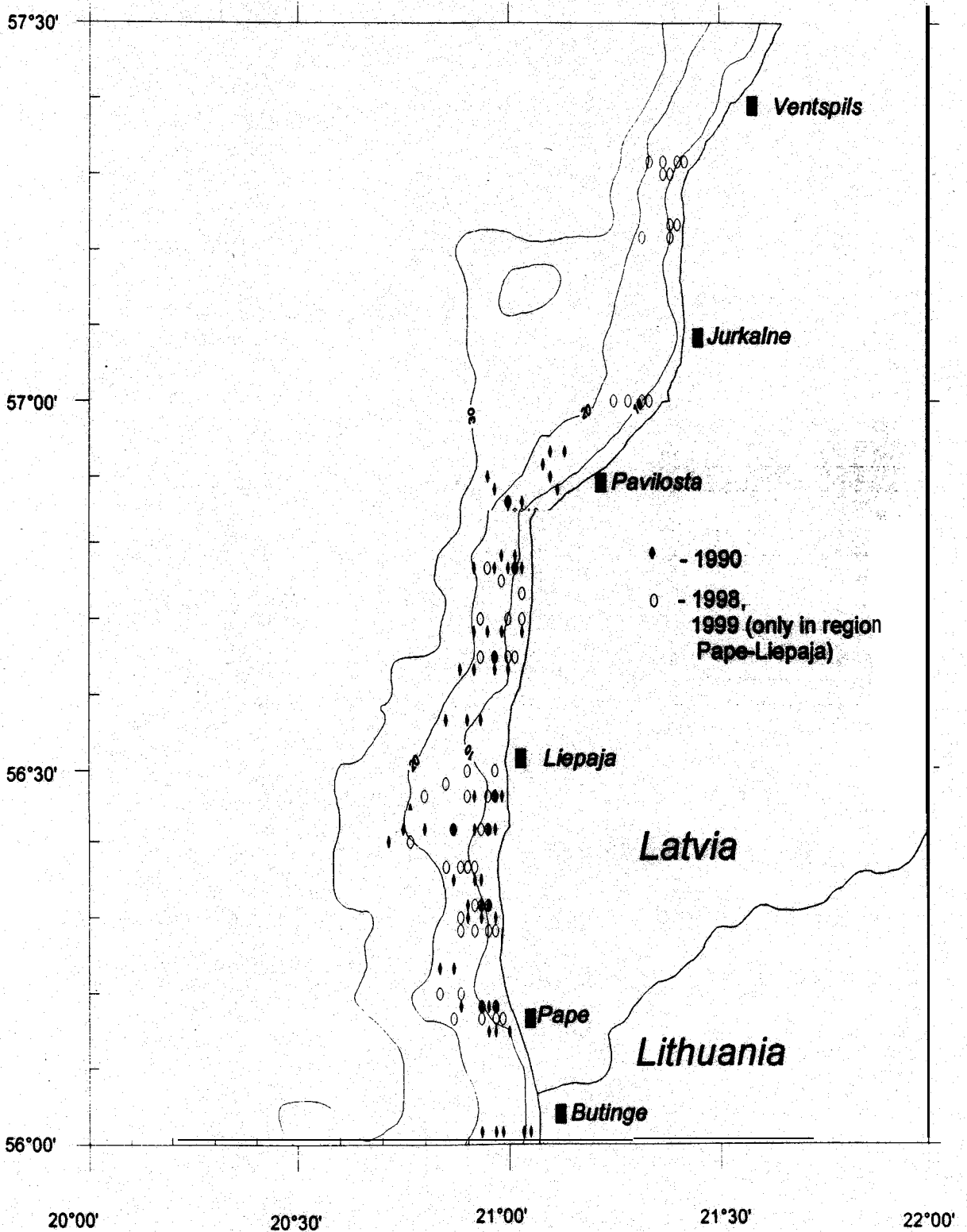
Taking into account the estimation of 1998 we may conclude that during the period **from** 1990 till 1998 the stable tendency of *Furcellaria* biomass increase is observed for the region Pape-Ventspils. Nowadays the total biomass of *Furcellaria* is approximately 3 times higher than it was in 1990.

References:

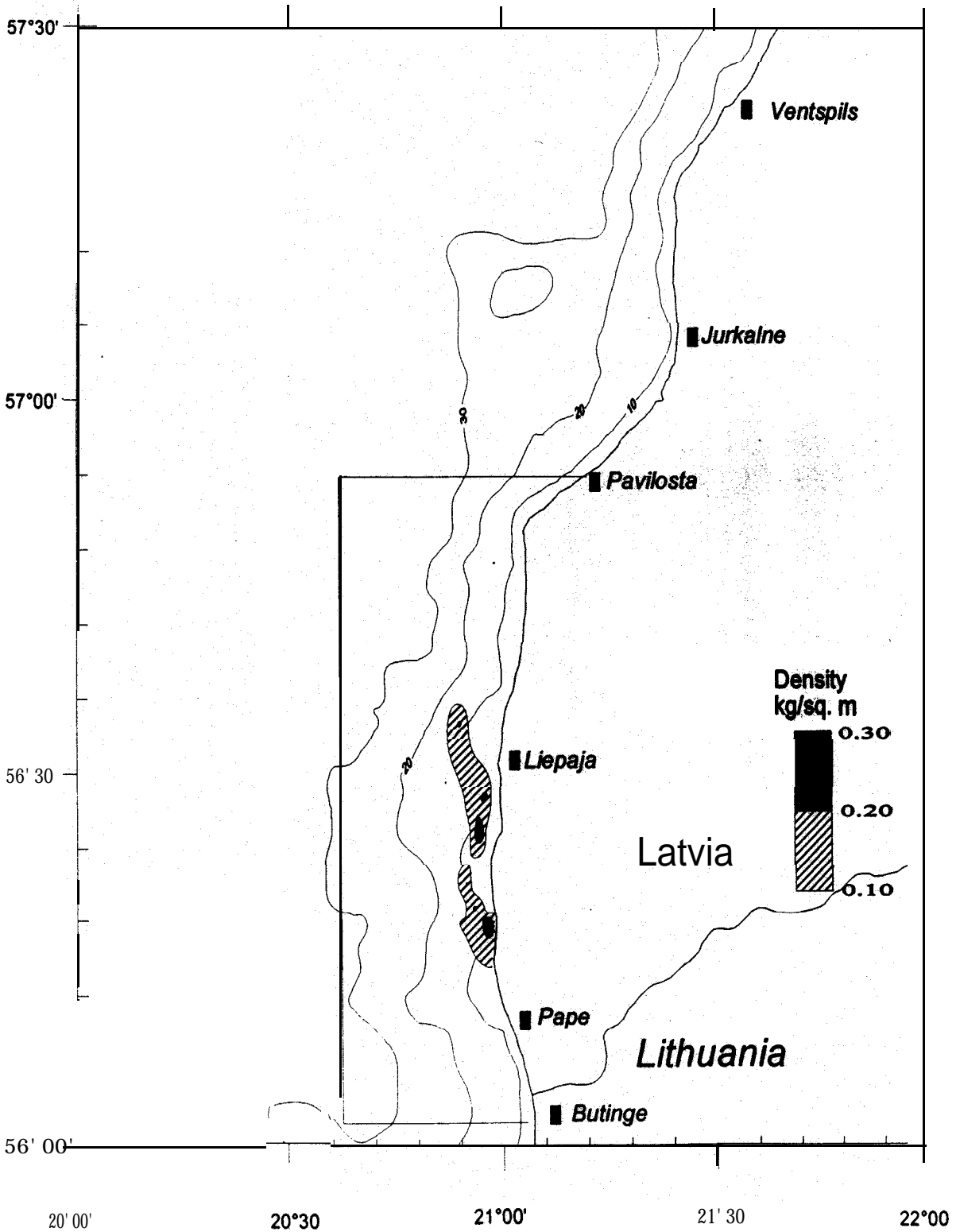
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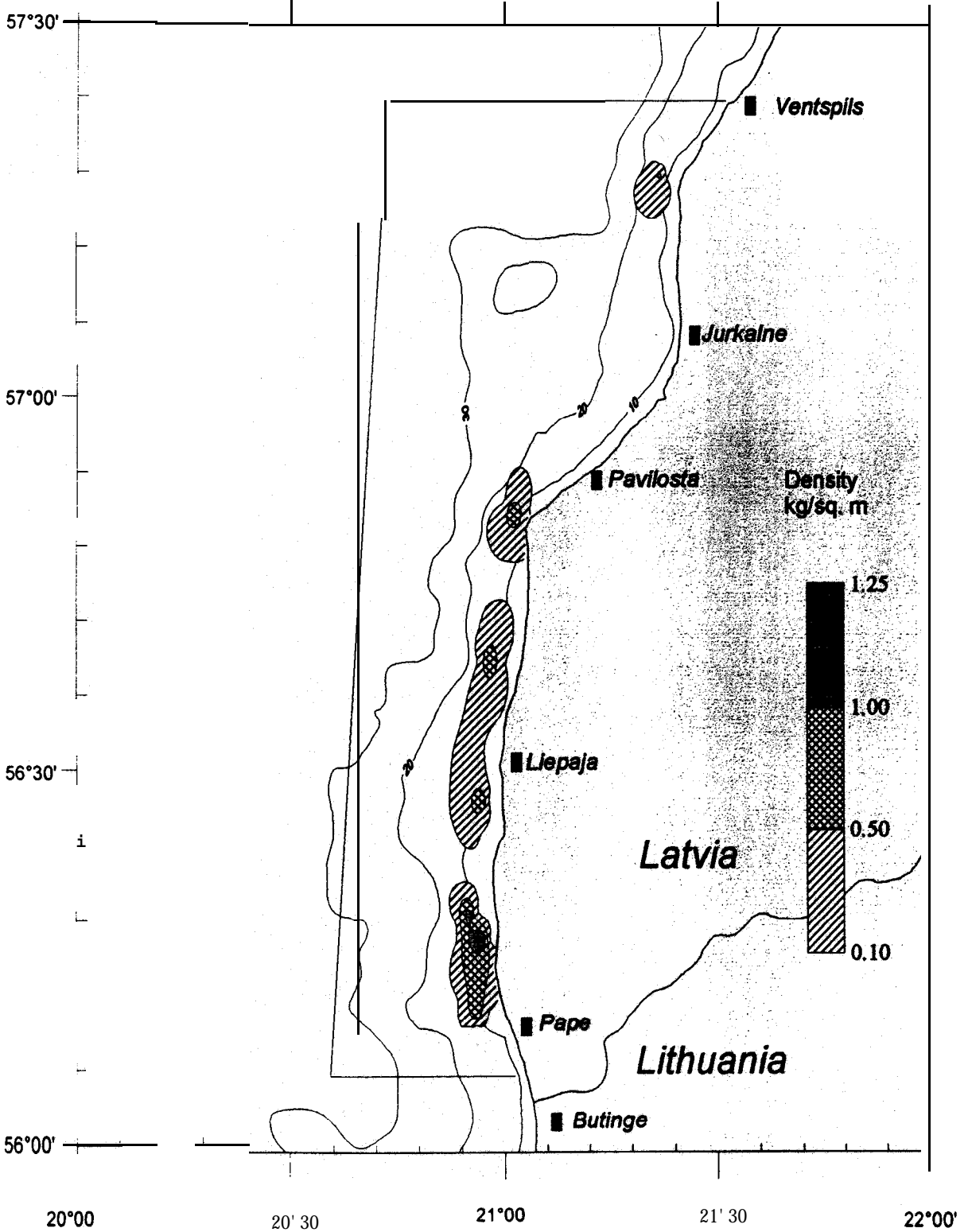
Fig. 1 Location of the monitoring stations



**Fig. 2 Distribution of red algae *Furcellaria lumbricalis* in May 1990
(survey area - from Butinge to Pavilosta)**



**Fig. 3 Distribution of red algae *Furcellaria lumbricalis* in July 1998
(survey area - from Pape to Ventspils)**



**Fig. 4 Distribution of red algae *Furcellaria lumbricalis* in July 1999
(survey area - from Pape to Liepaja)**

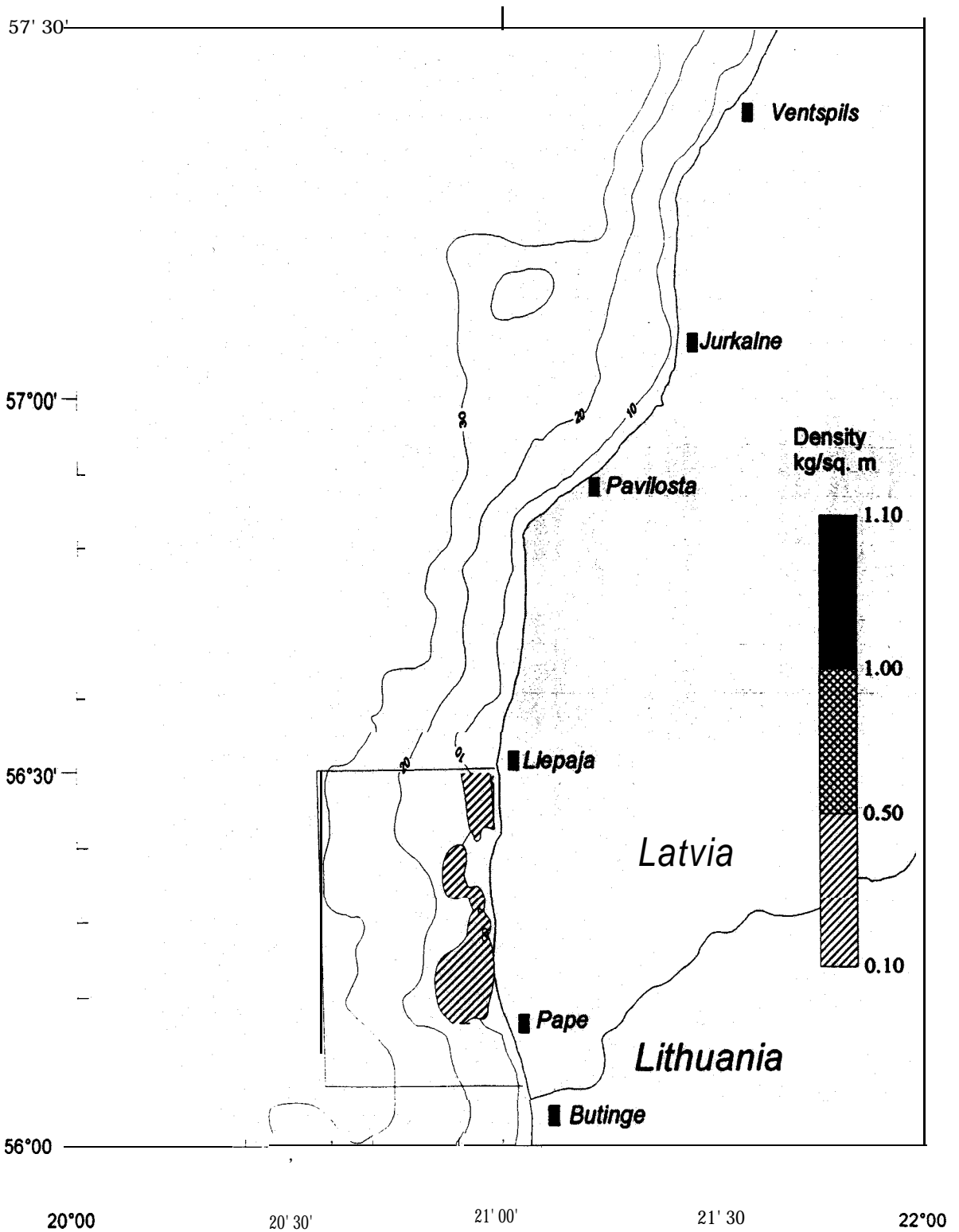


Fig. 5 Distribution of blue mussels (*Mytilus edulis*) in May 1990
(survey area - from Butinge to Pavilosta)

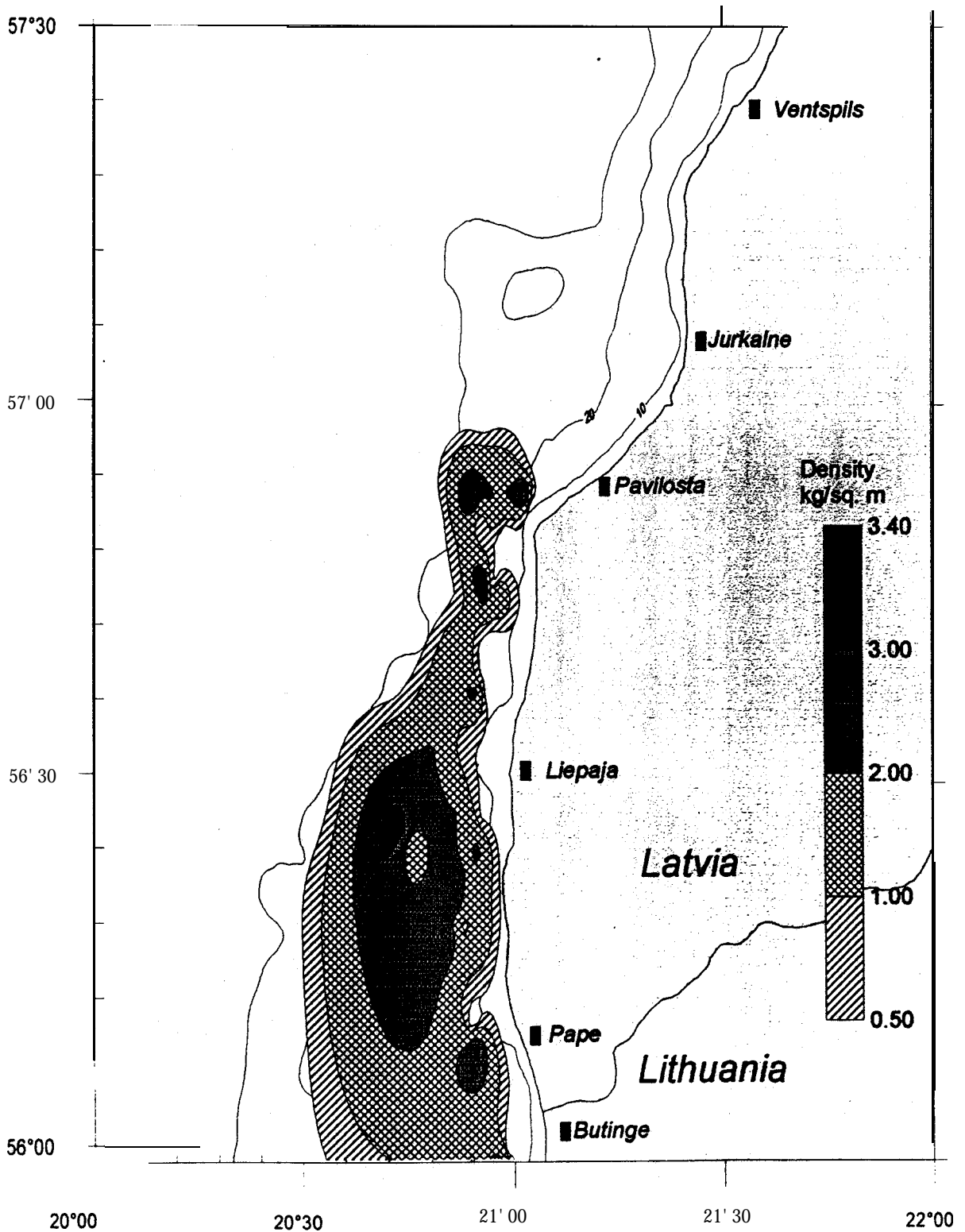
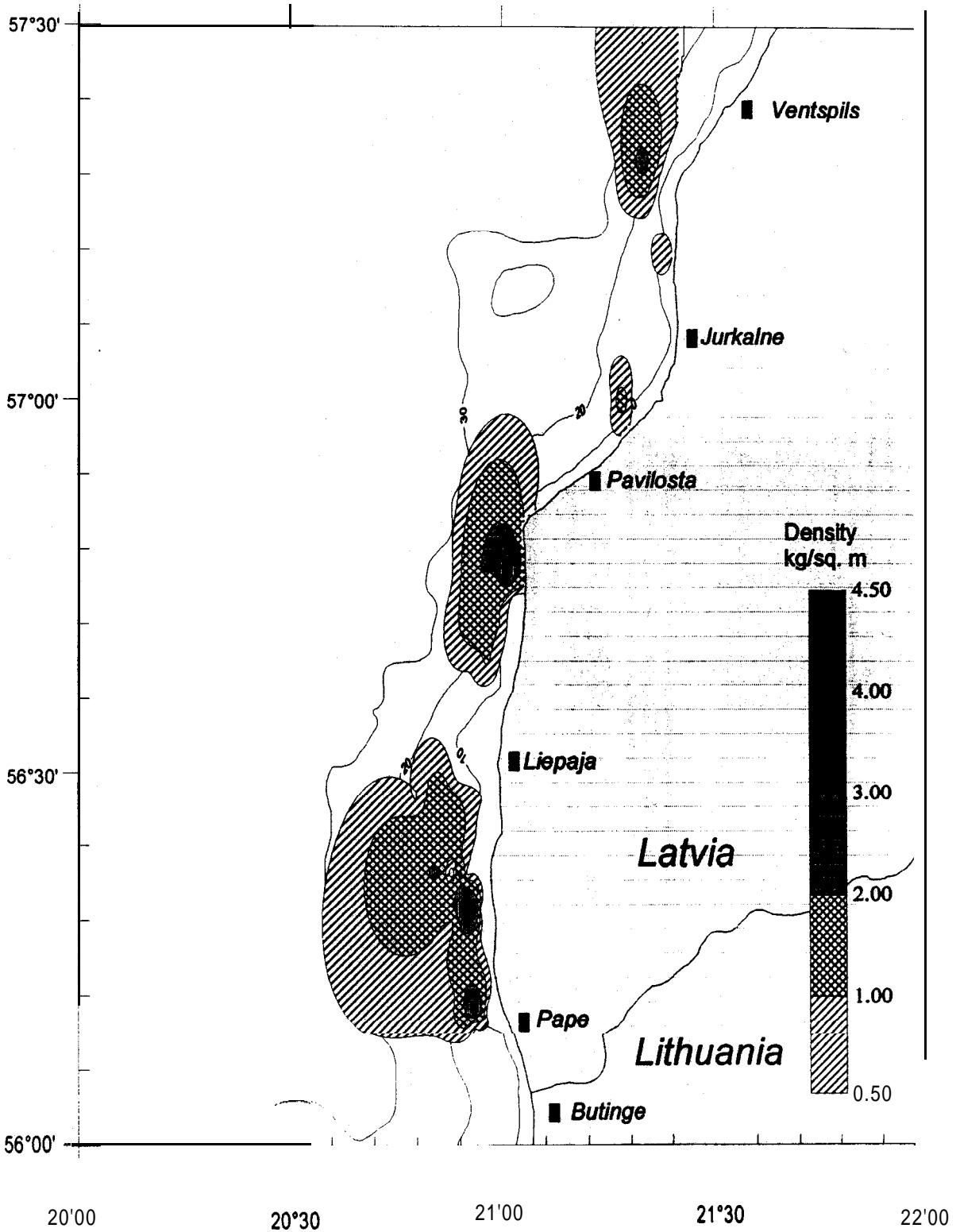


Fig.6 Distribution of blue mussels (*Mytilus edulis*) in July 1998
(survey area - from Pape to Ventspils)



**Fig. 7 Distribution of blue mussels (*Mytilus edulis*) in July 1999.
(survey area -from Pape to Liepaja)**

