Marine Mammals Studies Offshore North East Sakhalin in 2000
(Report)

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Introduction

The shelf of North East Sakhalin has been an object of great interest for scientists in recent years due to the active development of that area by the oil companies "Sakhalin Energy", "Exxon neftegaz" and "Sakhalinmorneftegaz. The leadership of those companies understands it well. For that reason, they have to financially support the studies on monitoring of marine mammals in the oil extraction areas. In recent years a number of studies on the distribution, number and some aspects of biology of gray whales (Eschrichtius gibbosus Erxl., 1777) of the Okhotsk-Korean population have been carried out (Berzin et al., 1986; Vladimirov, 1994; Blokhin, 1996; Browmell et al., 1997; Sobolevsky, 1998, 2000a; Wursig et al., 1998; Weller et al., 1999; Sobolevsky et al., 2000).

In 2000 the company "Sakhalin Energy" insisted on the necessity to continue the research of marine mammals offshore North East Sakhalin. In 200 the studies of the distribution of marine mammals offshore North East Sakhalin as well as the collection and analysis of acoustic data on noise background in the vicinity of the Molikpaq platform were continued. The research was conducted in accordance with the program of the studies of marine mammals offshore North East Sakhalin in 2000. The study area offshore North East Sakhalin covered several licensed sites including Piltun-Astokhsky and Lunsky ones, developed within the framework of the project "Sakhalin 2".

The program of surveys from a helicopter and small-sized vessels included monthly records of spatial distribution of marine mammals offshore North East Sakhalin.

The main goal of the aerial surveys was to conduct the monthly surveys for the identification of the main aggregations of gray whales on the shelf of North East Sakhalin and to determine their number. The main attention in the research program was paid to the scanty Okhotsk-Korean population of gray whales. The helicopter works were planned so that a full survey of other mammals and seals was conducted in addition to gray whales.

The aerial surveys were carried out once a month from June to November from a Mi-8 helicopter (MTV) of the Sakhalin Company Aviashelf.

The main goal of the acoustic studies conducted in 2000 offshore North East Sakhalin in the traditional summer-autumnal feeding area of gray whales was the study within the frequency range of 10 to 5000 Hz levels in standard set of1/3 octave frequency bands and spectra of natural and industrial noise. The measurements were taken in summer and autumnal hydrological conditions of the shelf of the Okhotsk Sea in both coastal zone – the area of aggregations of gray whales- and in the relatively deep-water part of the shelf – in the vicinity of the platform of the oil extraction complex Molikpaq. Apriori, it was known that the main sources of industrial acoustic noise in that aquatorium were the mechanisms working at the platforms "Molikpaq" and "Sakhalinskaya burovaya", bunkering tanker "Okha", as well as the noises generated by the moving or anchored tankers, responsible for the extracted oil transportation and the vessels responsible for the work of the whole oil extraction complex: "Smit Sibu", "Agat", "Rubin", "Trias", "Smit Sakhalin", "Neftegas 16", "Miss Sybil".

In the area of the whales' aggregations the source of the relatively short-term and high frequency noise were the suspended engines of the motorboats of "Zodiak" type. The group of whale observers based at the Piltun Lighthouse uses such boats, for example.

In accordance with the goal of the research the following tasks were determined:

1. In connection with difficult hydrological conditions in that aquatorium (for example, water flow rate can exceed 3 m/sec), to develop the methods of organization of acoustic measurements in nature and to design the necessary measuring and recording equipment.
2. To take the measurements of the acoustic background in the feeding area of gray whales in different hydrometeorological conditions: summer, autumn, rain, ripples, wind, still sea, as well as different works at «Molikpaq», which were accompanied by the generation of acoustic noise.

3. To study the temporal changeability of industrial acoustic background in the vicinity of the «Molikpaq» platform and to determine the levels and spectral characteristics of the noise generated by stationary and moving sources dominant in that aquatorium.
4. To study the losses during sound propagation from the «Molikpaq» platform to the feeding area of gray whales – the shallow water part of the shelf.
5. To take the measurements of natural acoustic signals generated by marine animals and to compare them with the noise level in that aquatorium.

Material and methods

The studies of marine mammals in 2000 were conducted by the researchers of IMB (Institute of Marine Biology), POI (Pacific Oceanological Institute), PRIFO-center and Sakhalinrybvod. The team «Piltun» which carried out the field study:

Sobolevsky Ye.I. – Dr.Sci., Head of the IMB laboratory (task manager)

1. Rutenko A.N. – Ph.D., Head of the PRIFO laboratory
2. Antonenko D.V. – Ph.D. IMB
3. Panchenko V.V. – junior research worker, IMB
4. Zemnukhov V.V. – post graduate, IMB
5. Blokhin S.A. – research worker. PRIFO-centre
6. Butyrin S.A. – Head of Noglinsky fishing inspection (Sakhalinrybvod)
7. Maslennikov Ye.A.. – engineer, POI
8. Borisov S.V. – research worker, POI
9. Gritsenko A.V. – research worker. POI

Antonenko D.V., Ruzhnikova N.P., Deridovich I.I., Pastukhov V.V., Zemnukhov V.V. and Gritsenko A.V. performed the cameral treatment of the materials. O.G. Kussakin, Ye.I.Sobolevsky and S.A.Blokhin wrote the literature review on the feeding base of gray whales and presented it separately to the company «Sakhalin Energy» in January. For that reason it was not included in this report.

The aerial survey of marine mammals was conducted from the helicopter MI-8MTV (Aviashelf company). The acoustic studies were carried out from the maintenance and small-sized vessels. The aerial helicopter surveys were carried out monthly at the extensive and intensive grid. The helicopter surveys were conducted on June 23 and 24, July 19, 20 and 24, August 25, 26 and 30, September 6-7, October 11, 13 and 14, November 18, 19 and 20 of 2000. The offshore aquatorium between 51˚10´ – 54˚00´north at a distance of 20 km from the shore was studied.

It is expedient to describe the survey technique in more detail.

The survey of the open waters and the offshore zone was carried out using the standard scheme of transects at the extensive and intensive grid. The survey of the coastal sites included the previously known to us areas of summer-autumn aggregations of seals (Chaivo, Lunsky, Piltunsky Bays and others).

The extensive grid survey covered the area of about 6000 km2 (20x300 km). The observation width at the transects was 2 km. The extensive grid included 32 transects covering the area of about 1280km2 (it comprised about 20% of the total area of the extensive survey). The transect lines were situated perpendicularly to the coast at approximately 5 miles from each other. The flights were conducted at a height of 150 m at the rate of 150 km/hour.

The intensive grid survey covered the area of 1000 km2 (20x50 km) around the Piltun-Astokhsky licensed site and included the areas, where the aggregations of gray whales in the previous years. If the weather conditions permitted, the survey at the intensive grid was conducted at the same day or within the next few days. The intensive grid included 26 transects with a length of 20 km each situated at a distance of one sea mile from each other. The intensive grid transects were directed from east to west and partly overlapped the extensive grid transects.

The aerial survey was conducted by the specialists with an experience of identification and fixation of the information on all kinds of marine mammals. During surveys, the standard equipment for data recording was used (GPS, headphones of external communication for all the observers, clinometers and dictaphones). Mi-8 MTV helicopter was equipped with all the necessary rescue equipment and each observer had a personal rescue suit. Before each flight the observers watched a film in Nogliki airport on the rules of behavior aboard helicopter and the necessary measures in case of an emergency landing of helicopter on water.

There were three observers aboard the helicopter. The main observer was in the helicopter cabin, two others on the right and left sides in the salon. Each observer

recorded the time of the beginning and finishing of the survey, time and coordinates of the animals registered, their number, behavior, movement direction, presence of mud spots. Aboard helicopter, there were 2 clinometers, with which help the measurements of the vertical angle in relation to each found whale and for the identification of the outer edge of transect band were conducted in order to establish whether the whales were within the observation band (2 km) or outside the transect.

During the flights, the weather changes, the state of the sea surface, waves, visibility conditions were constantly registered. In case of a sudden worsening of weather (heavy fog, strong wind) the flights were stopped and the helicopter returned to the base.

The aerial coastal surveys were conducted in the areas of seal aggregations (Piltun, Chaivo, Nyisky and Lunsky Bays). During the flights over the rookeries the seals were photographed from the helicopter for their additional calculation at the photographs.

1.1. Acoustic Data-Recording Equipment

The measurements of acoustic pressure, within the band of 10 Hz to 5 KHz, were carried out by use of stationary hydrophones of anchored autonomous sonar buoys (SB) installed off bottom. When making SB the rich practical experience obtained in 1999 during the exploitation of similar SB in that aquatorium was used. In the new buoys the standard disc hydrophones of the PR-1 type, having a titanic frame and a sensitivity of $\approx$300 mkV/Pa were used. The parameters of the electric amplifying tract of SB were changed. The coefficient of thorough amplification of electric tension (Ku) and the frequency band, in which Ku = const. increased significantly.

In order to solve the problems of autonomy during the works at the Piltun lighthouse and to exclude the electric interference to the registered signal, the

instruments were used in the new reception-registering complex, the power supply of which could be maintained for a long time (15-20 day) from the storage batteries with the voltage of 24 V.

The accumulation of acoustic data in digital form was carried out by the computer Notebook MITAC 6133 (Pentium II- 366) and rewritable laser discs with a capacity of 650 MGb. The electric signal (tension), which corresponds to the **conversed** acoustic pressure, from the **output** of frequency discriminator of radio-scanner AX-400 enters the **precise** module – analog-to-digital converter (ADC) LC-202. The module LC-202 has 4 independent analog channels with a permission of 16 bit. The module was designed for the signals of the frequency band from 0 Hz to 25,5 KHz. The discretization frequency is programmed from 0.8 Hz to 51.2 KHz. **The transection band** of antialiasing filters is automatically adjusted to the discretization frequency in order to restrict the band, starting approximately with half discretization frequency. The programmed instrumental amplifier together with attenuator 1/10 allows to change the entrance frequency band of the module from ± 10 V to ± 25 mV.

1.2. Specific of Experimental Data Digital processing

The program “LTCEnter” was developed, providing the entry and accumulation in real regime of data, arriving from the **crate system** LTC. The user’s interface allows to specify from one to four channels of data input from the module LC-202, to establish the discretization frequency of analog signal from 0.8 Hz to 51.2 KHz, to change the **entrance band** of the module from 10 V to 0.25 mV, to choose the folder on the disc, in which data files will be accumulated and to preset the entrance time interval. Before the beginning of the work “LTCEnter” loads the program into module and specifies its initial parameters. The real record regime, built with the use of the library functions of the processor ADSP-2184, established on the module board, providing the approach to the inner memory of

the module with a size of 2 Kb, works in the following way: the program, having waited for the filling of the first half of the FIFO buffer, having rolled in the internal variable, stores data in file, waits for the filling of the second half of the buffer, which is also recorded in the file. When the file reaches a certain size, it is closed and data is recoded in the file, which is next in order. For better information the name of each file includes month and day of the beginning of the experiment. The information on the beginning of the recording, discretization frequency and the number of specified channels is stored in the file with the add-in "*.inf".

1.3. Main Algorhythms and Terms

The level of the ambient noise is characterized by the intensity of the ambient noise background, which is expressed in decibels and measured by use of undirected hydrophone and the **flat** wave referred to the intensity, in which the root-mean-square pressure is 1 mkPa. Even though the level of the ambient noise is measured in different frequency bands, these levels are sometimes adjusted to the band with a width of 1 Hz, and in that case they are called *spectral levels of ambient noise*.

Let us introduce the main physical terms, which we will use for the analysis of the acoustic data. By definition the term spectral level refers to the level of the sound wave in the frequency band with a width of 1 Hz. This term is meaningful only for the signals with continuous spectrum, i.e. in those cases when the signal, even though small, is present in any point of the frequency band studied. The term *frequency band level* refers to the level in frequency band, which is wider or narrower than 1 Hz, for example in standard set of 1/3 – octave frequency bands.

As a result of the measurements, carried out by means of autonomous sonar buoys, the synchronous series of discretized data are obtained, which allow to study the temporal and spectral characteristics of the acoustic fields and signals (in

the limited frequency band). Normalization and correction of data were carried out by means of the following algorhythms:

- Nornalization of original data:

  A [mkPa] = $\mathrm{M} \times K_{TR}$, where $\mathrm{M}-$ is ADC value, and $K_{TR} = \dfrac{\Delta U}{K_g \cdot K_{U,M} \cdot K_{U,REC}\big|_{\max}}$,

  where $\Delta U -$is the quantization threshold of the analog-to-digital tension ADC [mV]; $K_{U,M}$ - is the gain on the scaling strengthener tension; $K_{u,REC}\big|_{\max}$ - is the maximal gain of a through «hydrophone – radio output» of the measuring tract in a given frequency band; K_g - is the hydrophone sensitivity [mV/mkPa].

- Normalization of the power spectrum*:*

$G_N(f) = G(f) \times (K_{TR})^2$

- Adjustment of the normalized power spectrum in accordance with the frequency response function of the through measuring tract:

$$G_{NA}(f) = \frac{G(f) \times (K_{TR})^2 \times (K_{U,REC}\big|_{\max})^2}{[K_{U,REC}(f)]^2}.$$

- Adjustment of the power spectrum to level *1 mkPa rms* in dB:

$$G_{1mkPa}(f) = 10 Log G_{NA}(f), \quad \text{[dB re 1 mkPa rms].}$$

- Development of the power spectrum estimate $\hat{G}(f)$ by way of averaging in consecutive realization without overlapping:

$$\hat{G}_{1mkPa}(f) = \frac{G_{1mkPa}(f)_1 + \ldots + G_{1mkPa}(f)_n}{n}, \quad \text{[dB re 1 mkPa rms].}$$

All programs for the normalization, adjustment and spectral and temporal analysis were verified by tests based on the application of calibrated noise and electric signaling tones, transmitted by the through «hydrophone – output of radio frequency discriminator» tract, as well directly entered in the computer by way of an analog-to digital coder..

1.4. Volume and Quality of Obtained Acoustic Data

In Fig. 1 the map of the area of the offshore zone of North East Sakhalin (Okhotsk Sea) is given, in which the acoustic measurements were taken. On the map the pints are shown (p.1, p.6), in which the stationary measurements of the background and tone (CW) acoustic signals, generated in the anchoring point of the rescue vessel «Agat» were taken at different time (see Table 1.1)

In June the measurements were taken of the acoustic background in the points p.1 and p.2 during the approach, mooring and oil transfer from the buffering tanker «Okha» to the transport tanker. The acoustic could arrive to the rescue vessel «Agat» only on June 23. The seismoacoustic studies on that aquatorium, carried out from the board of «Trias» were finished by that time. It was impossible to take the background acoustic measurements в Lunsky Bay during the seismoacoustic works there due to the lack of free place on «Trias», and the rescue vessel «Agat» had to stay within the 2-mile zone of «Molikpaq», because oil-transferring works were carried out at that time.

In July the synchronous measurements of the acoustic background and tone acoustic signals were carried out, which were carried out from the board of the rescue vessel «Agat», in two points p.4 and p.3 of the acoustic route «Molikpaq-Piltun» (directed first of all to the area of the traditional aggregation of gray whales), at a distance of 2.5 and 5.5 miles from «Molikpaq». In the period of the measurements in that aquatorium the works connected with the approach, mooring and oil transfer to the tanker «Amanskoye morye» were carried out.

In the period from July 27 to 30 the measurements of the acoustic background in the area of traditional aggregation of gray whales in the point p.5 were taken. The reception of radiotelemetric signal was carried out at the Piltun lighthouse. Unfortunately, the strong fog did not allow taking visual observations of the whales from the lighthouse.

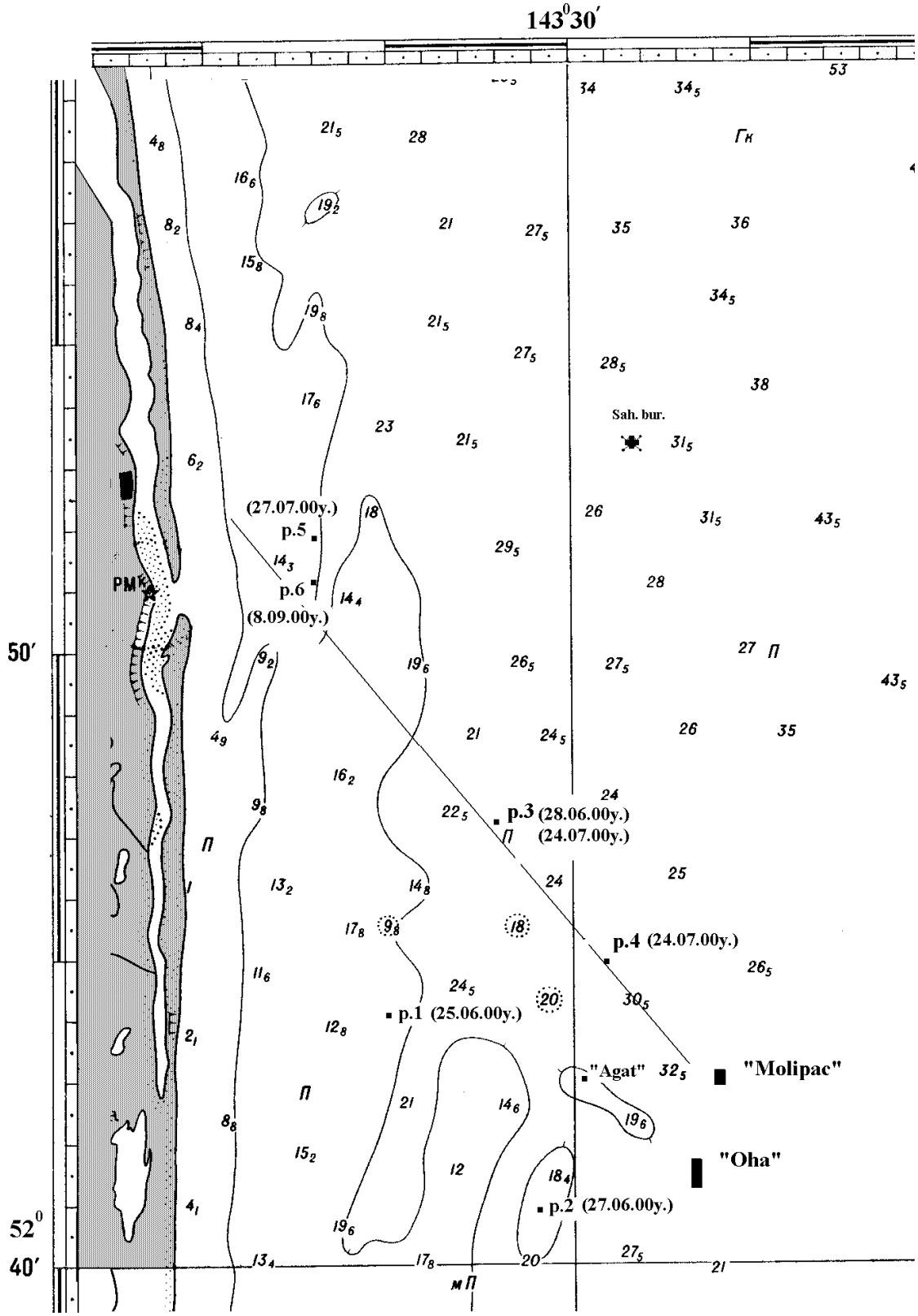


Fig. 1. Map of the experimental site with the locations of measuring devices and propagation path.

Table 1.1. Acoustical dates (information)

The beginning of measurements.	Finishing of measurements	Number coordinate of measuring point	Registering device	Additional measurements and observations of a whales	Comments notes
15h18min 25 June	8h25min 26 June	p.1 $52^0$44,17` $143^0$25.42`	Computer, Video tape recorder	The emission of the tone`s signals from the rescue vessel "Agat" in point: $52^0$43.093`, $143^0$30.479`.	Dates about vessels movements at the "Molikpaq"
16h55min 27 June	10h30min 29 June	p.2 $52^0$41.02` $143^0$29.6`	Computer, Video tape recorder		
13h43min 28 June	16h00min 28 June	p.3 $52^0$46.72` $143^0$28.56`	Computer, Video tape recorder		
11h00min 24 July	14h13min 26 July	p.4 $52^0$44,98` $143^0$31.07`	Computer, Video tape recorder	A works with the towing sound source.	Dates about vessels movements at the "Molikpaq"
11h00min 24 July	14h13min 26 July	p.3 $52^0$47,27` $143^0$27.89``			
19h37min 27 July	7h30min 30 July	p.5 $52^0$52.01` $143^0$22.98`	Computer, Video tape recorder	Receiving at the beacons.	Dolphin's acoustical signals.
17h00min 8 September	20h08min 13 September	p.6 $52^0$51.04.7` $143^0$23.01.8`	Computer	Receiving at the beacons.	Dolphin's acoustical signals.

On September 8 to 13 the stationary measurements of the acoustic background were carried out in the point p.6. The reception of the radiotelemetric signal was conducted at the Piltun lighthouse. The good, sunny weather during the acoustic measurements allowed carrying out the visual control of the movement of the vessels and whales on that aquatorium. Noteworthy, a test drilling was conducted at that time by means of «Sakhalinskaya burovaya» in the point (see Fig. 1.1), which was 6-7 miles away from the feeding area of gray whales. The distance from «Sakhalinskaya burovaya» to the acoustic background measuring point (p.6) was 5 miles. During the measurements a maintenance vessel was working near «Sakhalinskaya burovaya» and other vessels approached it from time to time. An anchored tanker was moored to «Okha» at 10 a.m. on September 10 northeast of «Molikpaq». A constantly working tugboat maintained the tanker and "Okha" during oil transfer, but twice a day due to the change in the direction of tidal flow their spatial position changes by 180^0. The tanker left early morning on September 11. At night on September 9 the acoustic signals of the marine animals were well heard.

Therefore, during the reported period on that aquatorium the long term measurements of the acoustic background and **опорных** tone acoustic signals, generated by the transmitter hanging from the board of the anchored rescue vessel «Agat» were carried out in specific points. The measurements were taken at low industrial background and during the approach, mooring and oil transfer from the buffering tanker «Okha» to the transportation tankers. The synchronous noise measurements in two points situated at a distance of 2.5 miles from each other on the «Molikpaq-Piltun» route, allow evaluating the extinction of the industrial acoustic noise during its propagation in the shallow-water part of the shelf.

2. Species Composition and Distribution of Marine Mammals Offshore North East Sakhalin

In the surveyed area in summer-autumnal period of 2000 seven species of marine mammals were observed. Among the whales, ***gray whales (Eschrichtius gibbosus Erxl. 1777)*** and ***killer whales (Orcinus orca***) were most abundant. On the coastal rookeries ***Larga seal (Phoca largha***) remained the most numerous species. At some seal rookeries ***bearded seals (Erignathus barbatus), ringed seals*** (***Pusa hispida), ribbon seals (Phoca fasciata***) and ***eared seals (Eumetopias jubatus***) were observed. From the helicopter several dolphins were recorded, but it was difficult to determine their species.

2.1. Results of Aerial Surveys in Feeding Areas of Gray Whales in June

The aerial surveys were conducted on June 23 and 24. On June 23 the flights were carried out on the extensive grid from Lunsky Bay to north in the direction of Piltun. 16 transects were surveyed (Fig. 1.1). North of Chaivo Bay the weather was foggy, and the aerial survey was stopped and continued on June 24. We observed the first whale at 4.04 p.m. at the coordinates of 52˚00´06´´north and 143˚31´16´´east (Table 1.1.). It happened approximately 20 km from the mouth of the Nyisky Bay (Fig.1.1). The whale moved to north in the direction of Piltun Bay. At the transects of Nyisky Bay to the mouth of Piltun Bay no more whales were found. Single whales were observed on June 24 at the coordinates of 52˚55´36´´north 143˚20´45´´east further north of Piltun Bay. The second group of whales was found closer to the shore. Mud spots were well seen around the whales. We observed the active feeding of the whales at 53˚13´42´´ – 53˚12´40´´north and 143˚15´20´´ – 143˚16´19´´east Seven gray whales were registered there. A female with calf was found in that group.

On June 24 the aerial survey of the whales was carried out from north to south on the intensive gridc. Eight whales were observed. The group of 6 whales stayed at almost the same coordinates further north of the mouth of Piltun Bay and 2 whales were encountered north of that group (Table 1.2 and Fig. 1.2) Therefore, in June 16 whales on the extensive grid and 8 whales on the intensive grid were observed (Table. 1.1. and 1.2.) The low occurrence of the gray whales in June in the traditional summer feeding area was probably connected with the fact that the majority of the whales stayed beyond the border of the Sakhalin shelf and did not come to the feeding area yet. In the traditional points of summer feeding whales formed two local groups north of the mouth of Piltun Bay. Occurrence of gray whales opposite to Nyisky Bay may indirectly testify of that the spring migration of the whales occurs along Sakhalin from south to north at a great distance from the shore but it needs additional proof.

Table 1.1

Occurrence of marine mammals offshore North East Sakhalin in June *(extensive grid, June 23-24)*

Time	Position	Species	Number of animals	Note
4:04 p.m.	52°00′06″ 143°31′16″	Gray whale	1	Moving to North
5:37 p.m.	52°19′26″ 143°10′52″	Seals	300-400	Lay on sandy spit
5:38 p.m.	52°19′18″ 143°11′00″	Seals	200-250	On sandy spit
June 24 (continuation of extensive grid)				
1:04 p.m.	52°55′36″ 143°20′45″	Gray whale	1+1+1	Whales stay aside each other
1:05 p.m.	52°55′06″ 143°20′00″	Gray whale	5	Milling, feeding
3:51 p.m.	53°13′42″ 143°15′20″	Gray whale	1+2+1+1	Behavior is calm, milling, diving, feeding. Two whales keep together (female + calf) active feeding, muddy spots
3:56 p.m.	53°12′40″ 143°16′19″	Gray whale	1+1	Active feeding, muddy spots

Table 1.2

Occurrence of marine mammals offshore North East Sakhalin in June *(intensive grid, June 24)*

Time	Position	Species	Number of animals	Note
4:21 p.m.	53°02′37″ 143°17′49″	Gray whale	1	Diving
5:09 p.m.	52°56′30′ 143°20′00″	Gray whale	1	Diving, the whale moving off shore
5:31 p.m.	52°53′00″ 143°20′12″	Gray whale	5+1	Group of 5 whales, 1 whale keeps apart

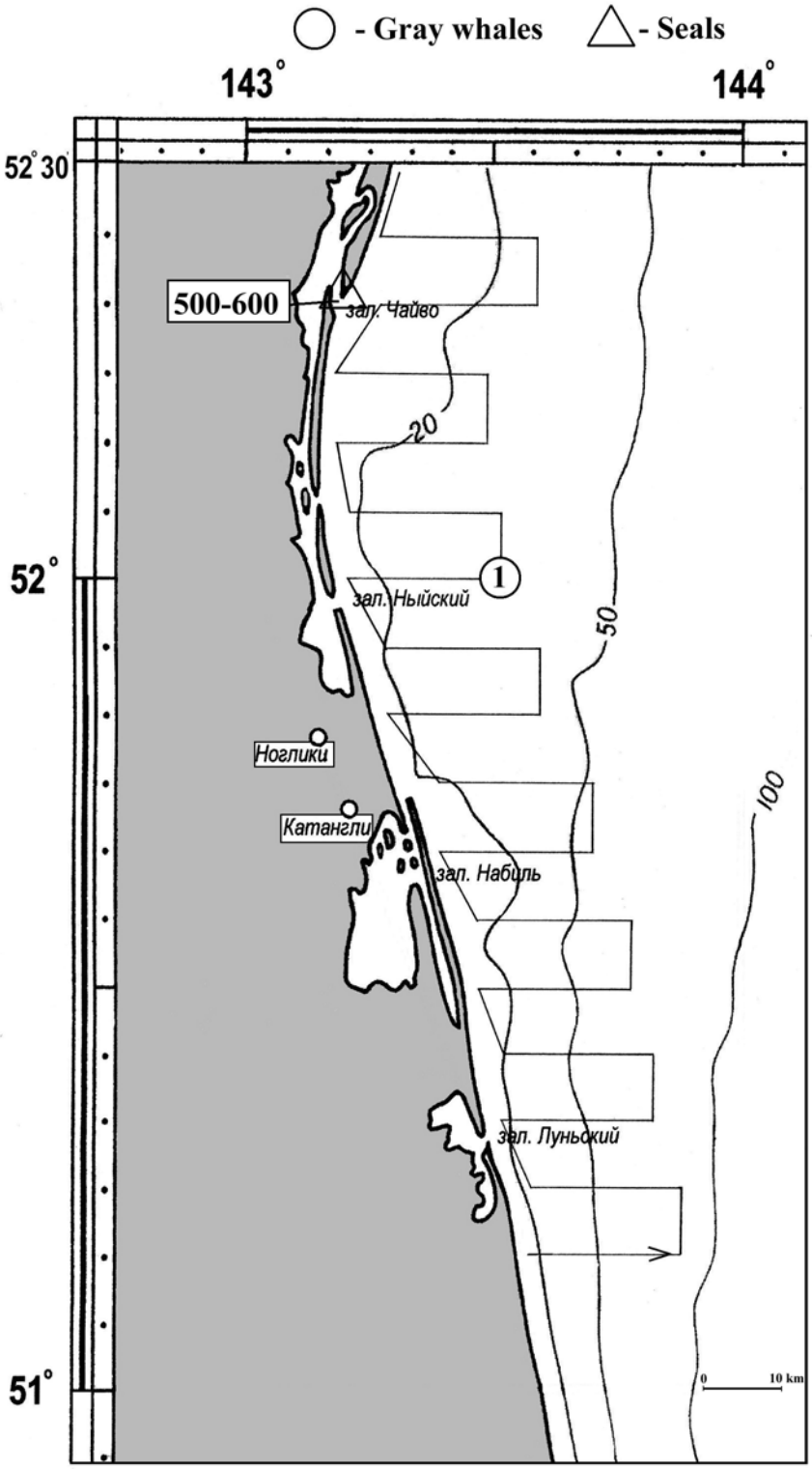
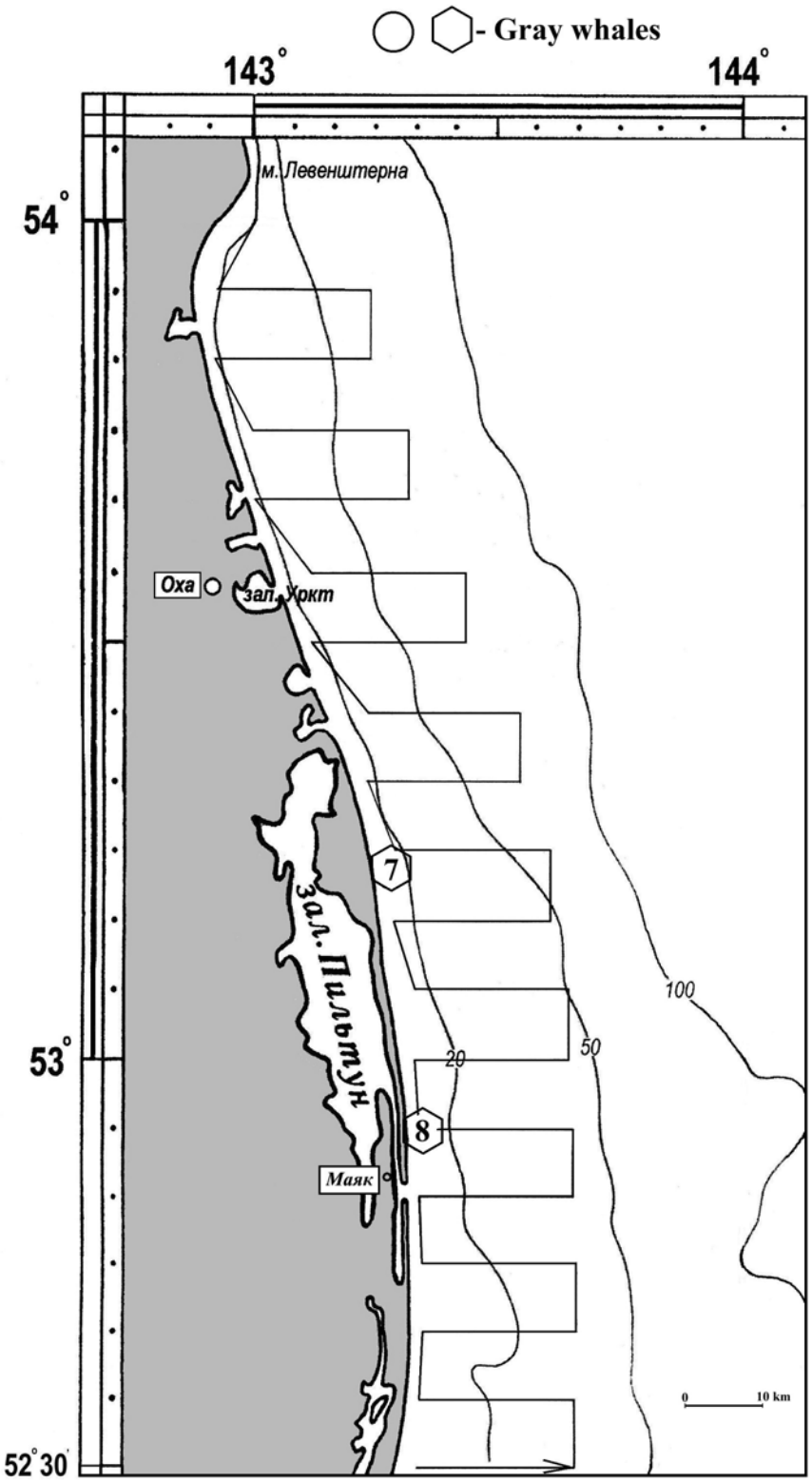


Fig. 1.1 . Occurrence of mammals offshore North-Eastern Sakhalin in June 2000 (extensive aerial survey, June 23-24)



Continuation of Fig. 1.1 (June 23-24)

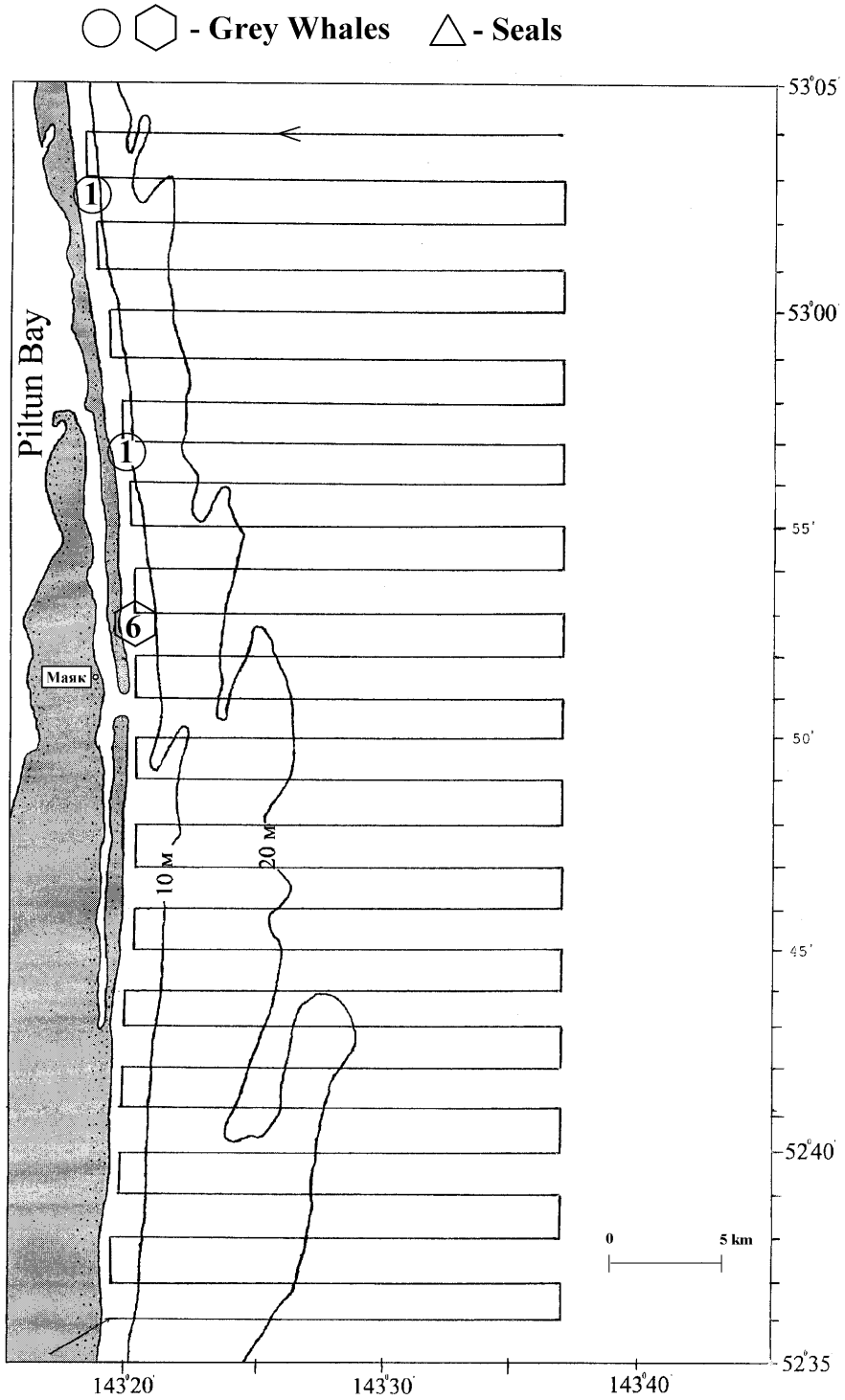


Fig. 1.2. Occurrence of mammals offshore Sakhalin in June 2000 (intensive aerial survey, June 24)

2.2. Results of Aerial Surveys in July

In July the aerial survey flights were carried out on July 19-20 on the extensive grid and on July 24 on the intensive grid. On July 19 and 20 the aerial survey was conducted in still sunny weather with a visibility over 10 km, sea was still (less 1 point). The aquatorium from Levenshtern Cape to Lunsky Bay was studied. On the first day of the survey (19 July) 17 transects were conducted and 36 gray whales and 13 killer whales were observed (Table2.1.). On the second day of the aerial survey no gray whales were observed south of 52˚30´north. Opposite to Lunsky Bay a single killer whale was observed, which stayed close to a group of seals. The majority of the encountered whales stayed close to the shore at 5-10 m isobaths. In July a significant number of the whales stayed opposite the mouth of Piltun Bay (8 whales) and south of Piltun Bay (9 whales). The majority of the whales were observed further north of 53˚north. Most often single whales and small groups were encountered at 53˚19´ – 53˚10´north at 6-12 m isobaths. Twelve whales were observed there (Fig.2.1.). In that area the active feeding of the whales was observed, in many places mud spots and mud tracks. Quite often groups of 2 whales and their synchronous swimming were recorded. However, half of the whales (18 specimens) stayed separated from each other.

From July 21 to 23 there was a fog over the sea, for which reason we could start the aerial surveys on the intensive grid only on July 24. The surveys were carried out from north to south, 30 transects were surveyed and 15 whales were encountered. The whales were mainly recorded north of the mouth of Piltun Bay (Fig.2.2.). Three whales were observed at a great distance from the shore (over 15 km) at the coordinates of 53˚00´north and 143˚36´east (2 whales) and52˚54´08´´north and 143˚36´06´´ east (1 whales). At the coordinates of 53˚06´18´´north and 147˚17´05´´east a female with calf was observed

Table 2.1

Occurrence of marine mammals offshore North East Sakhalin in July *(extensive grid, July 19)*

Time	Position	Species	Number of animals	Note
1:42 p.m.	54^0 00' 06" 142^0 57' 02"	Seals	4	Swimming, diving
1:43 p.m.	53^0 58' 57" 142^0 56' 09"	Seals	1+1+2+1+1	Swimming
2:05 p.m.	53^0 52' 28" 142^0 54' 01"	Seals	1+1	
2:19 p.m.	53^0 44' 53" 143^0 12' 31"	Killer whale	1	
2:46 p.m.	$53^0$34' 00" 143^0 03' 02"	Larga seal	1	Opposite mouth of Urkt Bay
3:05 p.m.	53^0 29' 52" 143^0 25' 42"	Killer whale	6	Group of killer whales are swimming together
3:07 p.m.	53^0 30' 17" 143^0 26' 23"	Killer whale	2+3	Killer whales are moving to the first group
3:21 p.m.	53^0 24' 03" 143^0 10' 00"	Killer whale	1	Moving to south-east
3:37 p.m.	53^0 19' 46" 143^0 24' 29"	Seal	1	Swimming
3:38 p.m.	53^0 19' 18" 143^0 13' 02"	Gray whale	2	Active feeding, muddy spots
3:40 p.m.	53^0 15' 02" 143^0 14' 46"	Gray whale	2	Feeding
4:10-4:28 p.m.		***Lending of helicopter on shore***		
4:30	53^0 14' 26" 143^0 14' 09"	Seals	6	Swimming near the shore
4:44 p.m.	53^0 12' 10" 143^0 15' 25"	Gray whale	1	Swimming, diving
4:45 p.m.	53^0 11' 12" 143^0 16' 05"	Gray whale	1	Feeding, diving
4:48 p.m.	53^0 09' 59" 143^0 15' 58"	Gray whale	2	Sticking together

Time	Position	Species	Number of animals	Note
4:49 p.m.	53^0 10' 37" 143^0 16' 09"	Gray whale	1+1+2	Active feeding, synchronous swimming of two whales, muddy spots
5:24 p.m.	53^0 02' 35" 143^0 17' 46"	Gray whale	1+2	Feeding, diving
5:38 p.m.	52^0 57' 38" 143^0 18' 39"	Gray whale	1	Diving
5:39 p.m.	52^0 57' 10" 143^0 18' 43"	Seals	6	Swimming, diving
5:40 p.m.	52^0 56' 54" 143^0 19' 01"	Gray whale	1	Diving, moving to north along the shore
5:41 p.m.	52^0 54' 58" 143^0 20' 56"	Gray whale	1+1	Feeding, muddy spots
5:42 p.m.	52^0 51' 02" 143^0 20' 44"	Gray whale	1+1+2	Swimming, milling
6:30-7:25 p.m.		***Fueling in Nogliky***		
8:28 p.m.	52^0 50' 45" 143^0 20' 19"	Gray whale	1+1+2	Diving near the shore, milling
8:43 p.m.	52^0 45' 00" 143^0 21' 06"	Gray whale	2+2	Swimming to south of Piltun Bay mouth
8:45 p.m.	52^0 45' 00" 143^0 20' 17"	Gray whale	1+1+1	Diving, active feeding, muddy spots
8:53 p.m.	52^0 44' 35" 143^0 20' 47"	Gray whale	1	Moving to north along the shore
8:57 p.m.	52^0 40' 08" 143^0 20' 20"	Gray whale	1	
July 20 (continuation of extensive grid)				
3:14 p.m.	52^0 35' 23" 143^0 21' 29"	**The beginning of survey**		
3:34 p.m.	52^0 30' 10" 143^0 11' 15"	Seals	2+4	Swimming
3:37 p.m.	52^0 28' 28" 143^0 17' 40"	Seals	3	Swimming

Time	Position	Species	Number of animals	Note
3:40 p.m.	52^0 26' 54" 143^0 17' 14"	Seal	1	
3:45 p.m.	52^0 25' 00" 143^0 26' 25"	Seal	1	Swimming
3:55 p.m.	52^0 19' 54" 143^0 09' 56"	Seals	600-800	3 large rookeries of seals at mouth of Chaivo Bay on sandy spit
4:26 p.m.	52^0 08' 01" 143^0 08' 50"	Seal	1	Swimming
4:35 p.m.	52^0 05' 34" 143^0 09' 10"	Seals	1+2+3	Swimming
4:37 p.m.	52^0 05' 45" 143^0 09' 04"	Seal	1	
4:56 p.m.	51^0 59' 01" 143^0 11' 00"	Seals	6	Swimming
4:59 p.m.	51^0 59' 40" 143^0 11' 00"	Seals	2	Swimming
5:02 p.m.	51^0 58' 28" 143^0 10' 00"	Seals	5	The seals lay on shore
5:06 p.m.	51^0 56' 25" 143^0 12' 27"	Seals	3	Swimming
5:08 p.m.	51^0 54' 59" 143^0 17' 33"	Seal	1	
5:25 p.m.	51^0 48' 25" 143^0 16' 52"	Seals	1+1	Swimming
5:26 p.m.	51^0 47' 50" 143^0 17' 15"	Seal	1	
5:27 p.m.	51^0 46' 52" 143^0 17' 47"	Seal	1	
5:29 p.m.	51^0 44' 17" 143^0 18' 55"	Seals	> 50	Swimming at mouth of Nabil Bay
5:53 p.m.	51^0 36' 03" 143^0 23' 38"	Seals	1+1+1	Swimming
5:59 p.m.	51^0 35' 01" 143^0 33' 38"	Seal	1	Swimming

Time	Position	Species	Number of animals	Note
6:15 p.m.	51^0 27' 56" 143^0 26' 58"	Seals	1+1+2	Swimming
6:16 p.m.	51^0 25' 17" 143^0 27' 45"	Seals	1+3	Diving
6:28 p.m.	51^0 20' 16" 143^0 48' 53"	Killer whale	1	Near the group of seals
6:28 p.m.	51^0 20' 14" 143^0 48' 52"	Seals	3	Swimming
6:45 p.m.	51^0 18' 58" 143^0 28' 53"	Seals	11+4+2+6+ 11+4	Swimming at mouth of Lunsky Bay
6:47 p.m.	51^0 17' 08" 143^0 30' 09"	Seals	2+1	

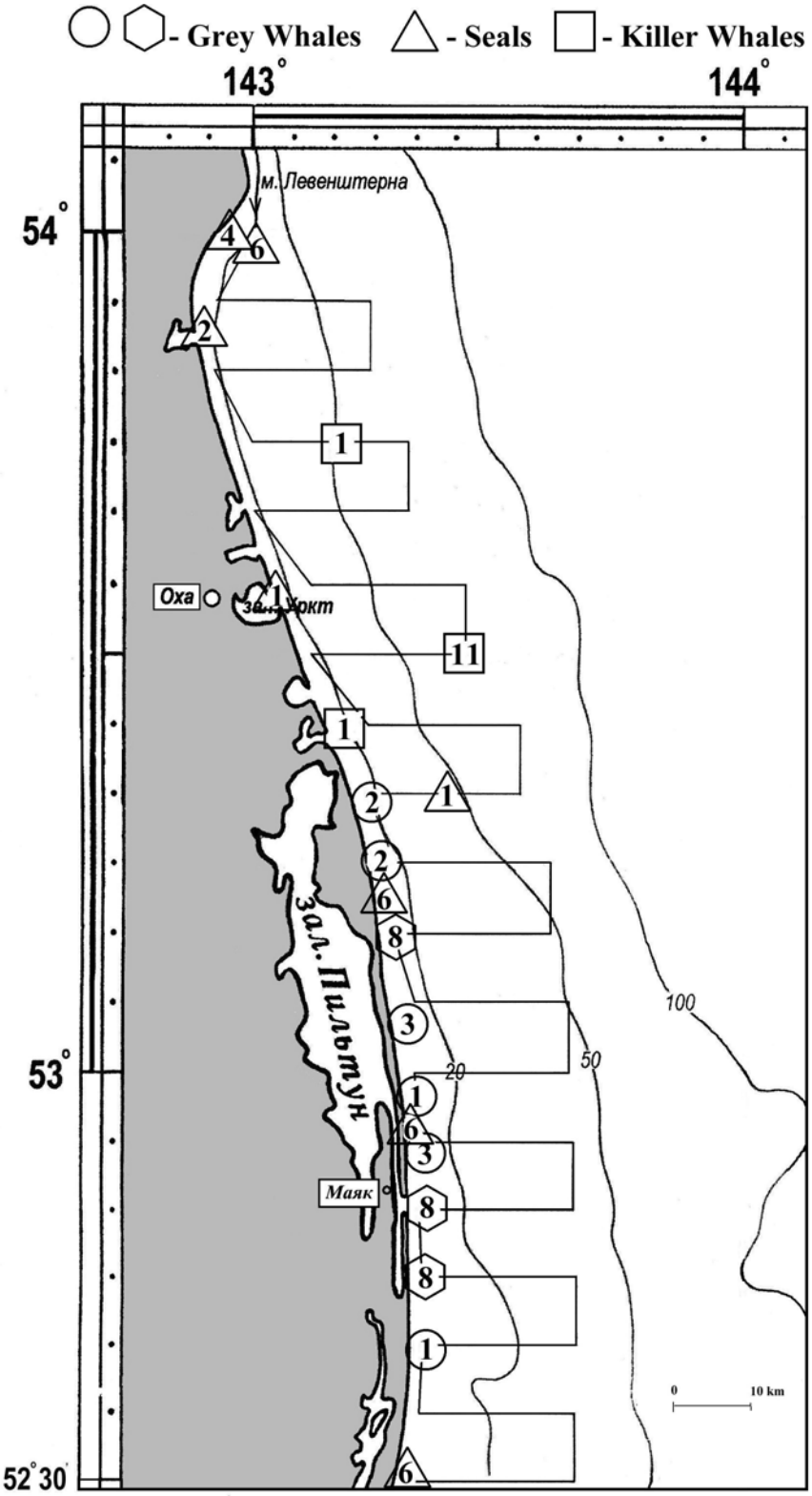
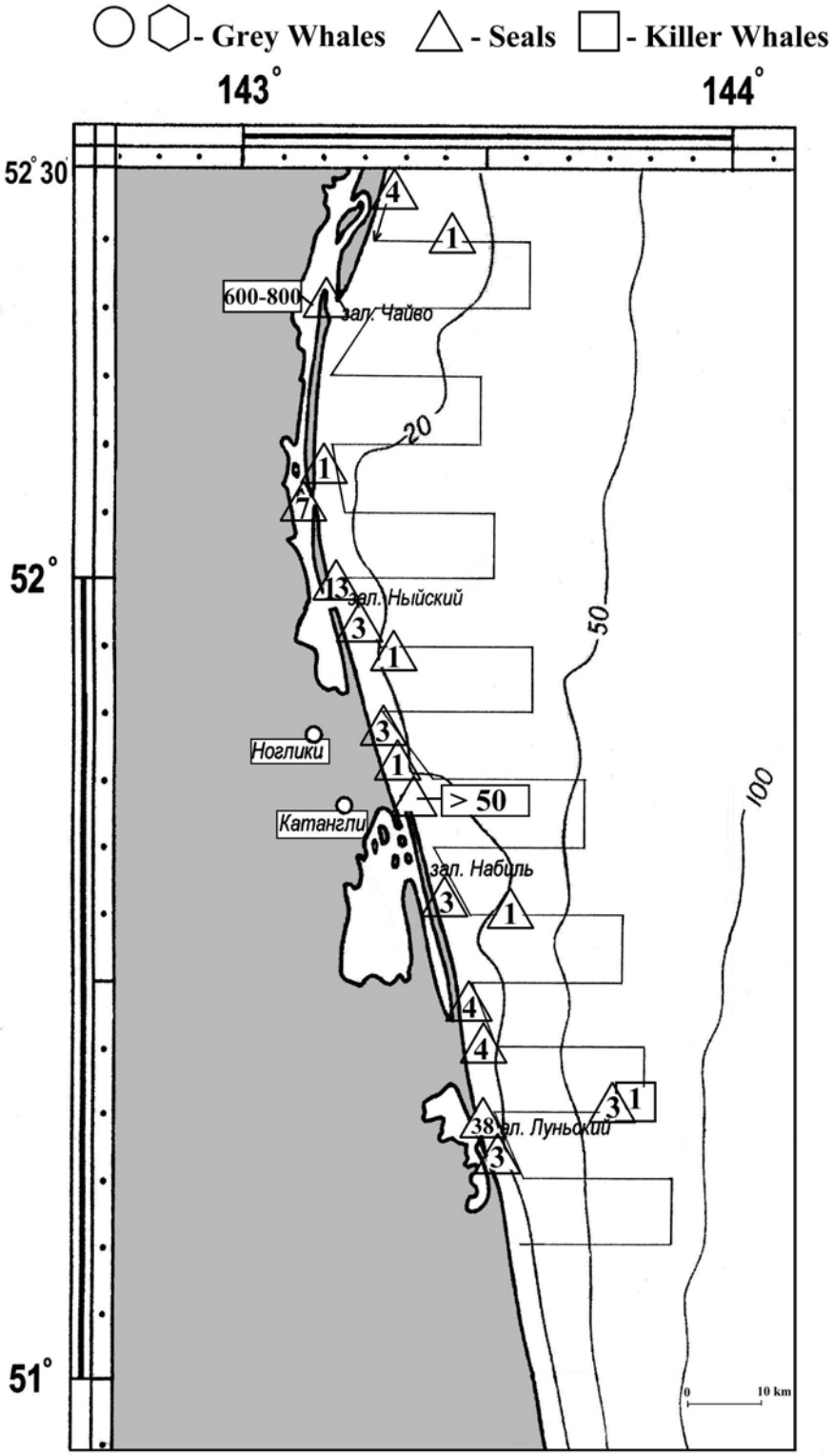


Fig. 2.1 . Occurrence of mammals offshore North-Eastern Sakhalin in July 2000 (extensive aerial survey, July 19 - 20)



Continuation of Fig. 2.1 (July 19 - 20)

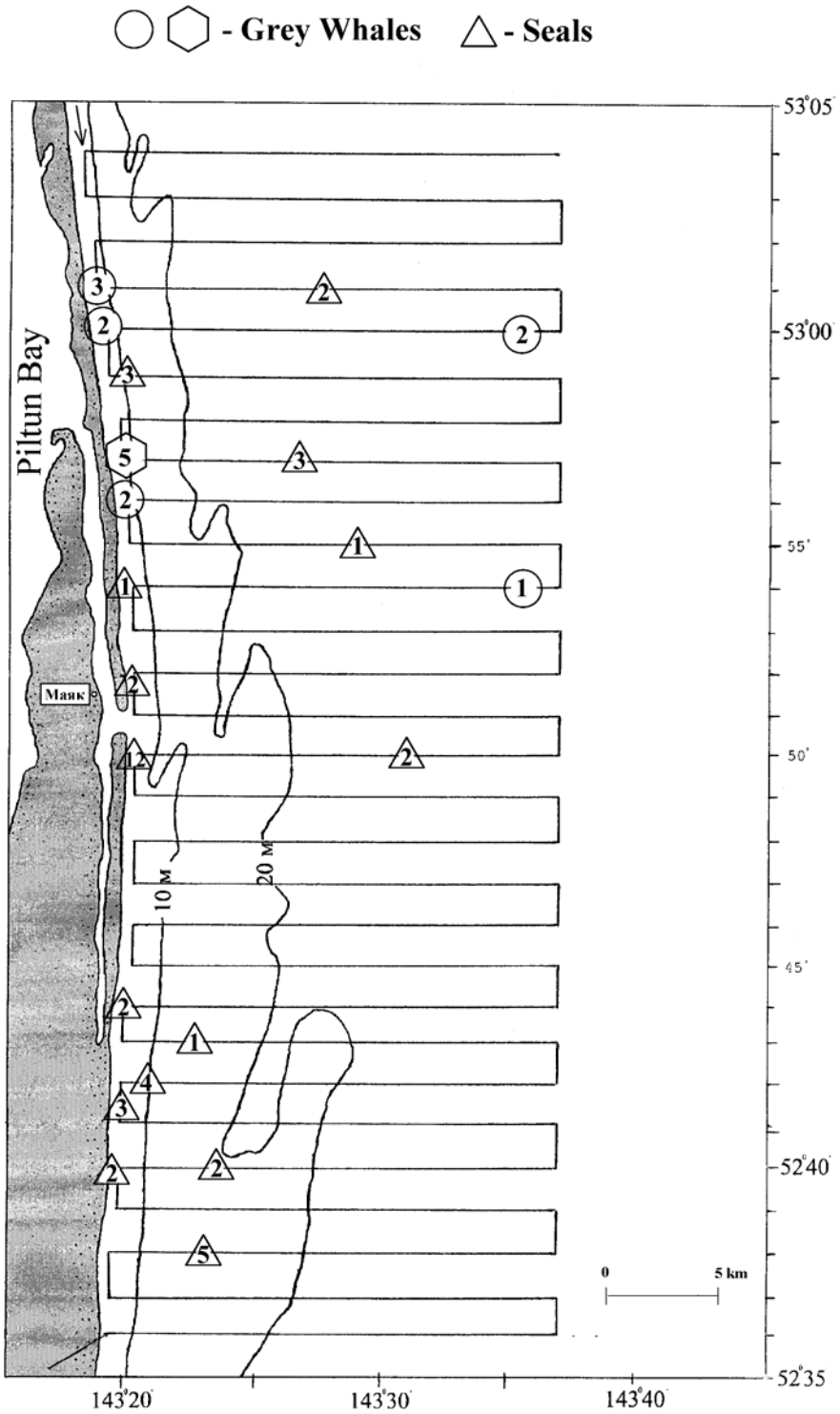


Fig. 2.2. Occurrence of mammals offshore Sakhalin in July 2000 (intensive aerial survey, July 24)

This group, like the other 4 whales, stayed somewhat further north of the intensive grid survey area (Table2.2.), for which reason they are not shown in Fig.2.2.

The flights on the intensive grid showed that the majority of the whales during four days moved from the mouth of Piltun Bay to north. On July 24 we observed no whales south of the Piltun lighthouse, even though on July 19 in that area 17 gray whales were recorded. When comparing the results of the aerial survey flights in 1999carried out approximately on the same dates (18 July on the extensive grid and 26 July on the intensive grid), the following fact attracts attention: the number of the whales observed in 1999 and 2000 on the extensive grid was approximately equal (34 and 36). However, their distribution pattern differed significantly (Fig.2.3. and 2.4.), which testifies that during the feeding period offshore North East Sakhalin the gray whales make continuous local migrations.

Table 2.2

Occurrence of marine mammals offshore North East Sakhalin in July *(intensive grid, July 24)*

Time	Position	Species	Number of animals	Note
11:20 a.m.	53^0 06' 29" 143^0 17' 42"	Gray whale*	2+1+1	Active feeding, many muddy spots, milling
11.22 a.m.	53^0 06' 18" 143^0 17' 05"	Gray whale*	2	Sticking together, female and calf. Active feeding, milling
11.53 a.m.	53^0 01' 03" 143^0 18' 34"	Gray whale	3	Behavior is calm, feeding, muddy spots
12.12 p.m.	53^0 00' 54" 143^0 26' 42"	Seals	2	Swimming
12.26 p.m.	53^0 00' 02" 143^0 36' 00"	Gray whale	2	
12.27 p.m.	52^0 59' 53" 143^0 18' 00"	Gray whale	1+1	The whales are swimming together near the shore
12.42 p.m.	52^0 59' 04" 143^0 20' 38"	Seals	1+2	
1.00 p.m.	52^0 57' 07" 143^0 19' 52"	Gray whale	2	Feeding, muddy trace
1.08 p.m.	52^0 56' 56" 143^0 27' 17"	Seals	3	
1.15 p.m.	52^0 56' 01" 143^0 19' 10"	Gray whale	2	Feeding, milling
1.16 p.m.	52^0 56' 48" 143^0 19' 21"	Gray whale	3	Group of large whales, active feeding
1:30 – 2:25 p.m.		***Landing of helicopter***		
2:33 p.m.	52^0 54' 53" 143^0 28' 30"	Seal	1	Swimming
2:37 p.m.	52^0 54' 08" 143^0 36' 06"	Gray whale	1	The whale is resting under water
2:45 p.m.	52^0 53' 447" 143^0 19' 17"	Larga	1	
3:00 p.m.	52^0 51' 45" 143^0 19' 51"	Seals	2	Swimming

Time	Position	Species	Number of animals	Note
3:10 p.m.	52^0 49' 59" 143^0 31' 06"	Seals	1+1	Swimming
3:14 p.m.	52^0 50' 21" 143^0 20' 43"	Seals	12	*Piltun Bay*
3:55 p.m.	52^0 43' 54" 143^0 19' 43"	Seals	1+1	
3:57 p.m.	52^0 43' 04" 143^0 22' 47"	Seal	1	Swimming
3:58 p.m.	52^0 42' 01" 143^0 21' 38"	Seals	1+1+2	Swimming
4:01 p.m.	52^0 41' 34" 143^0 19' 53"	Seals	3	Swimming
4:03 p.m.	52^0 40' 01" 143^0 23' 24"	Seals	1+1	
4:06 p.m.	52^0 39' 46" 143^0 19' 19"	Seals	2	
4:08 p.m.	52^0 38' 04" 143^0 22' 48"	Seals	5	Swimming

Note: * - whales observed beyond the border of the testing area

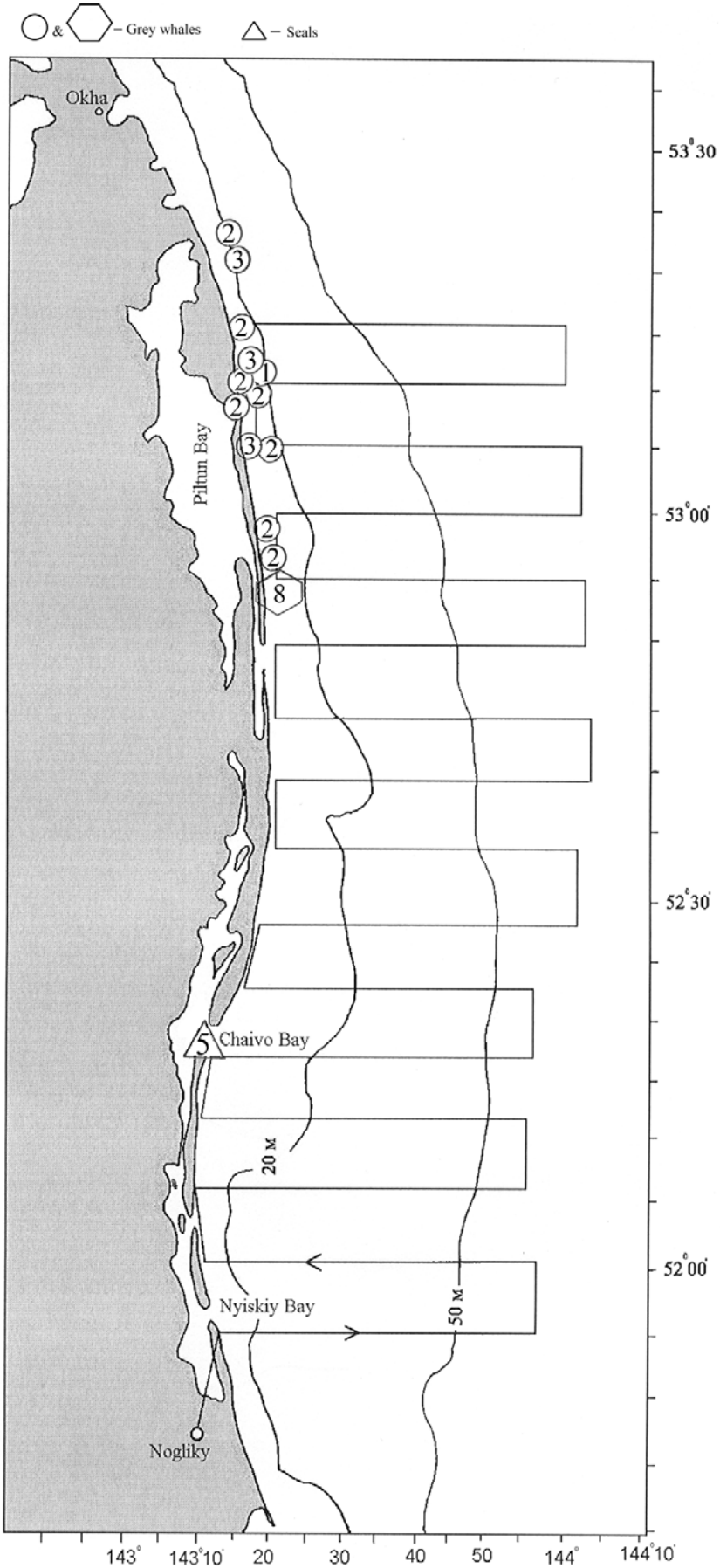


Fig. 2.3. Occurrence of mammals on shelf of Sakhalin by aerial survey at 18 July, 1999

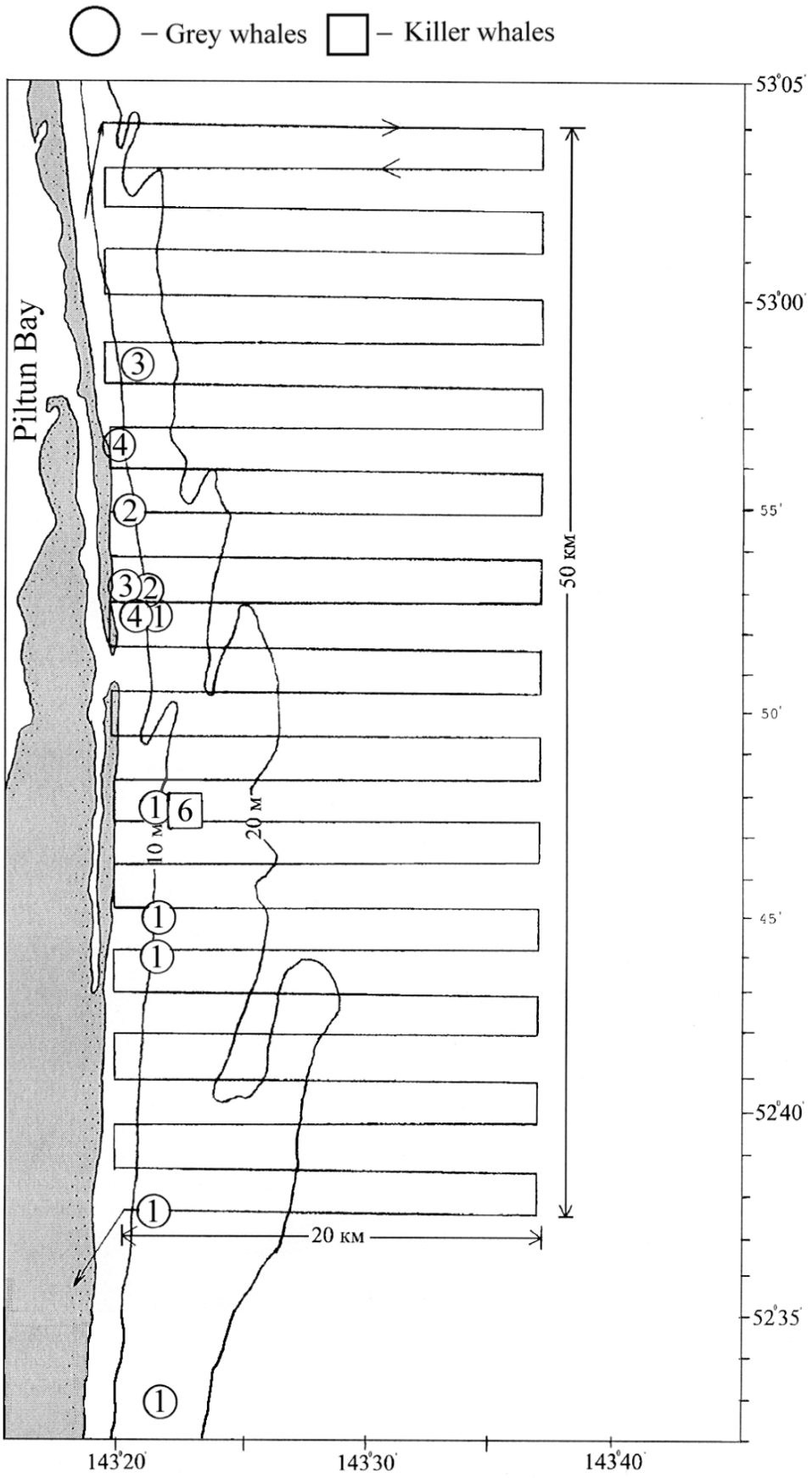


Fig. 2.4. Occurrence of mammals on shelf of Sakhalin by aerial survey at 26 July, 1999

2.3. Results of Aerial Surveys in August

In late August three aerial surveys of marine mammals from the helicopter were carried out. The survey on the intensive grid was conducted on August 25 in cloudy still weather, still sea (about 1 point). The flights were carried out in the second half of the day from south to north in the direction of Piltun Bay. 29 transects were covered by the survey. Twenty-four gray whales were recorded, which stayed close to the shore at a depth of 5-10 m. None of the observed whales was found at a depth over 20 m. The whales stayed quite scattered either individually or in pairs. Six groups of 2 whales and 12 single whales were found (Table3.1.). Out of the total number of the recorded whales approximately 33% (8 whales) were staying near the Piltun lighthouse south of the mouth of Piltun Bay (Fig.3.1.). Other whales were observed further north of 52˚55´north (Table 3.1.). 6 whales were observed during active feeding. At the coordinates of 53˚02´21´´north and 143˚17´29´´east a female with calf was recorded.

On August 26 the flights on the extensive grid were carried out. The aerial survey was conducted from north from Levenshtern Cape to south in still weather with a visibilitry over 10 km and still sea (approximately 1 point). The flights covered the aquatorium from Levenshtern Cape to the end of Lunsky Bay. Thirty-four transects were studied and 37 gray whales were observed (Table 3.2.). Three whales were observed somewhat further north of the mouth of Piltun Bay, other whales stayed close to the shore at 53˚14´ – 52˚51´north (Fig. 3.2.). Two whales were encountered north of Okha city. The first one was recorded at the coordinates of 53˚52´47´´ north and 143˚13´00´´east. The whale was moving to south and stayed at a distance of approximately 20 km from the shore. The second whale was staying offshore somewhat north of Urkt Bay (Fig. 3.2.). At the coordinates of 53˚07´28´´north and 143˚17´14´´east a female with calf was recorded.

Table 3.1

Occurrence of marine mammals offshore North East Sakhalin in August
(intensive grid, 25 August)

Time	Position	Species	Number of animals	Note
14.46	$52^0$35’31” $143^0$19’22”	Larga seal	1	Swimming close to the shore
15.36	$52^0$43’20” $143^0$20’41”	Gray whale	1	Swimming to north
16.21	$52^0$49’20” $143^0$20’46”	Gray whale	2	Diving
16.37	$52^0$51’49” $143^0$21’11”	Gray whale	2+1	Swimming, diving
16.39	$52^0$52’12” $143^0$20’57”	Gray whale	2	Swimming to the shore
17.17	$52^0$56’59” $143^0$19’14”	Gray whale	1	Feeding, mud spots
17.17	$52^0$56’58” $143^0$19’41”	Gray whale	1	Active feeding, mud spots
17.19	$52^0$57’18” $143^0$19’19”	Gray whale	1+1	Swimming from the shore
17.31	$52^0$59’01” $143^0$19’09”	Gray whale	1	Diving
17.32	$52^0$59’39” $143^0$19’38”	Gray whale	1	Diving
17.49	$53^0$01’01” $143^0$18’13”	Gray whale	1	
17.51	$53^0$02’13” $143^0$18’55”	Gray whale	1	Feeding, mud track
17.53	$53^0$02’21” $143^0$17’29”	Gray whale	2	A female with calf, diving
18.12	$53^0$02’23” $143^0$18’00”	Gray whale	1+2	Large whales, feeding, mud spots
18.13	$53^0$02’42” $143^0$18’22”	Gray whale	2+1	Swimming to north along the shore

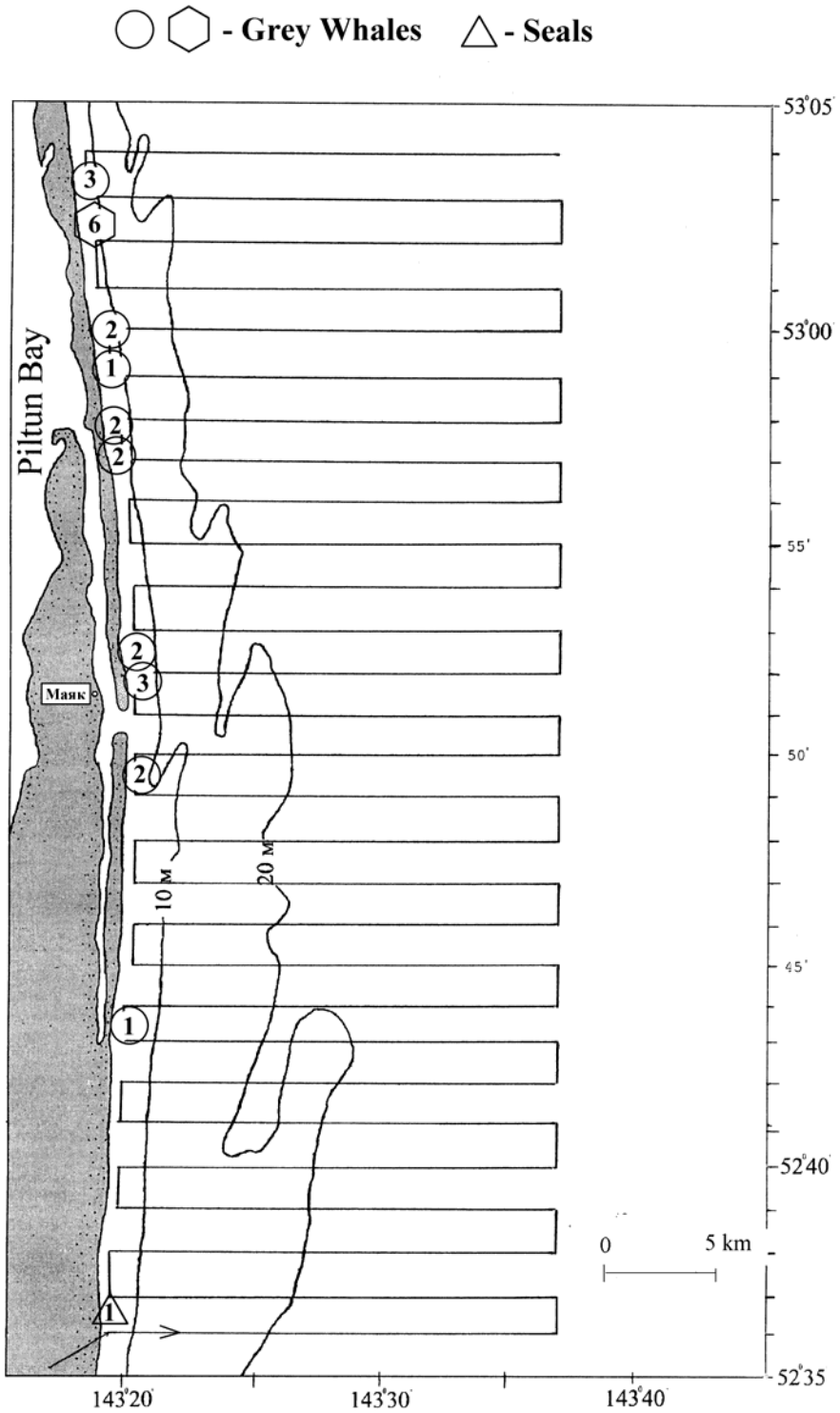


Fig. 3.1. Occurrence of mammals offshore Sakhalin in August 2000 (intensive aerial survey, August 25)

able 3.2

Occurrence of marine mammals offshore North East Sakhalin in August
(extensive grid, 26 August)

Time	Position	Species	Number of animals	Note
12.35	53^{0}52’47” 143^{0}13’00”	Gray whale	1	Swimming to south
12.45	53^{0}49’29” 142^{0}54’42”	Seals	1+1	Swimming
12.47	53^{0}45’40” 142^{0}56’50”	Larga seal	1	
13.05	53^{0}37’14” 143^{0}02’17”	Gray whale	1	Diving
13.41	53^{0}17’37” 143^{0}14’13”	Gray whale	1	Diving
13.43	53^{0}14’14” 143^{0}15’44”	Gray whale	2	
13.45	53^{0}13’19” 143^{0}15’39”	Gray whale	2	Feeding, mud spots
13.58	53^{0}09’34” 143^{0}16’51”	Gray whale	2	Feeding
13.59	53^{0}08’25” 143^{0}16’51”	Gray whale	2+1	
14.01	53^{0}07’28” 143^{0}17’14”	Gray whale	2	Female with calf
14.02	53^{0}06’40” 143^{0}18’03”	Gray whale	1	
14.05	53^{0}03’52” 143^{0}18’06”	Gray whale	3	Active feeding, mud spots
14.05	53^{0}03’21” 143^{0}18’33”	Gray whale	1	Diving
14.23	53^{0}01’45” 143^{0}18’56”	Gray whale	1	Feeding, mud spots
14.24	53^{0}00’22” 143^{0}18’31”	Gray whale	2	
14.24	52^{0}59’31” 143^{0}19’21”	Gray whale	1	
14.25	52^{0}58’30” 143^{0}18’57”	Gray whale	2	Feeding, mud spots
14.29	52^{0}57’18” 143^{0}19’19”	Gray whale	1+1	Swimming from the shore
14.29	52^{0}56’44” 143^{0}19’47”	Gray whale	2	Feeding, mud spots
14.30	52^{0}56’22”	Gray	3	Swimming from the shore

	143^{0}19’44”	whale		to east
Time	**Position**	**Species**	**Number of animals**	**Note**
14.30	52^{0}55’53” 143^{0}20’01”	Gray whale	1	
14.31	52^{0}54’35” 143^{0}20’05”	Gray whale	1	Feeding
14.57	52^{0}51’06” 143^{0}21’29”	Gray whale	1+1+1	Feeding, mud spots
14.59	52^{0}50’17” 143^{0}19’07”	Seals	Over 500	Rookery at the mouth of Piltun Bay
15.35 - 16.22	***Oil bunkerage***			
17.00	52^{0}19’02” 143^{0}11’10” 52^{0}19’46” 143^{0}10’23”	Seals	4000-5000	4 seals rookeries at sand spits at the mouth of Chaivo Bay
17.16	52^{0}09’33” 143^{0}09’04”	Seal	1	Swimming
17.20	52^{0}04’53” 143^{0}09’11”	Seals	Over 400	Seals are staying on sand island at the mouth of Nyisky Bay
18.57	51^{0}18’02” 143^{0}29’07”	Seals	Over 100	Swimming at the mouth of Lunsky Bay

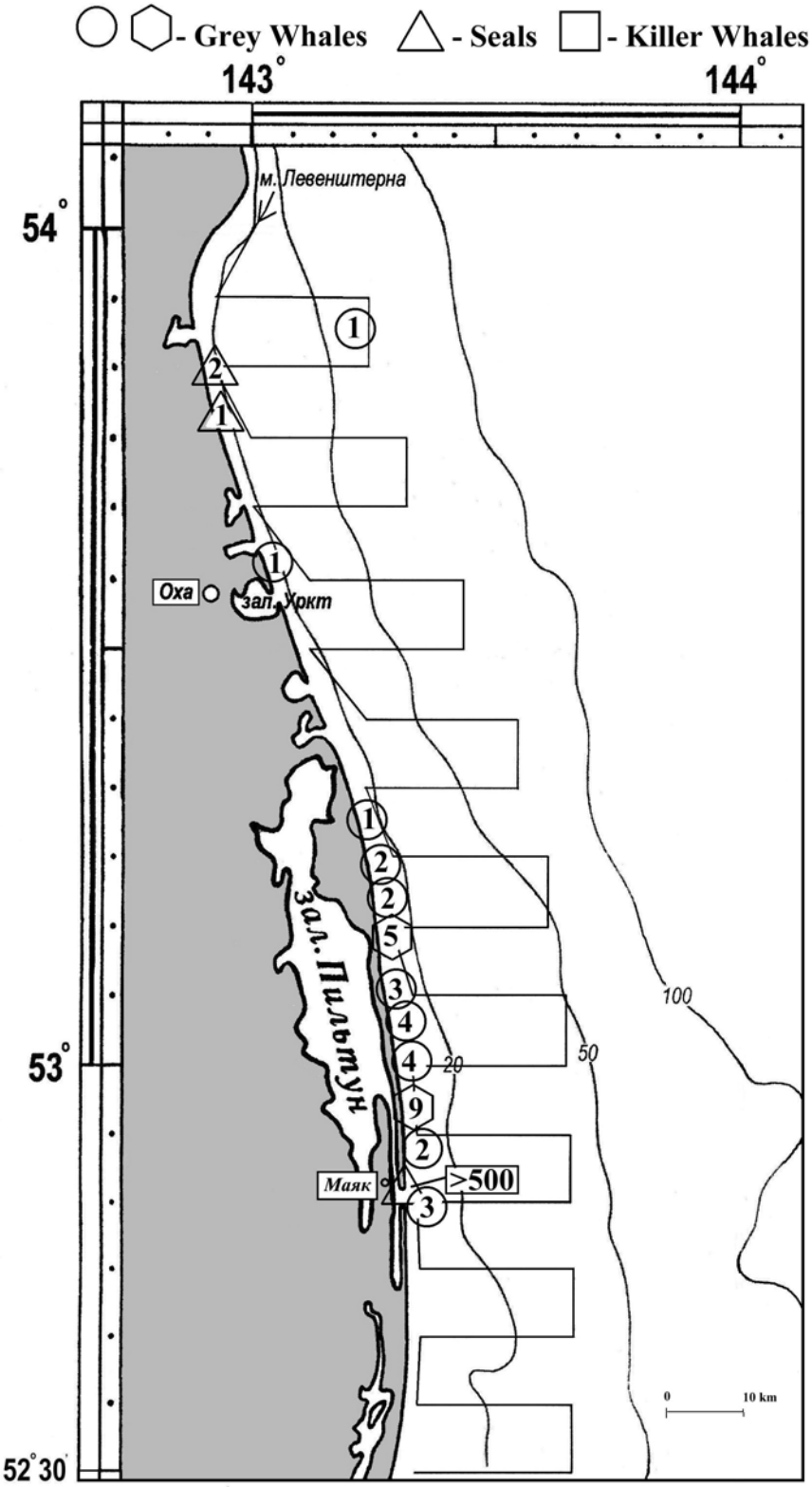
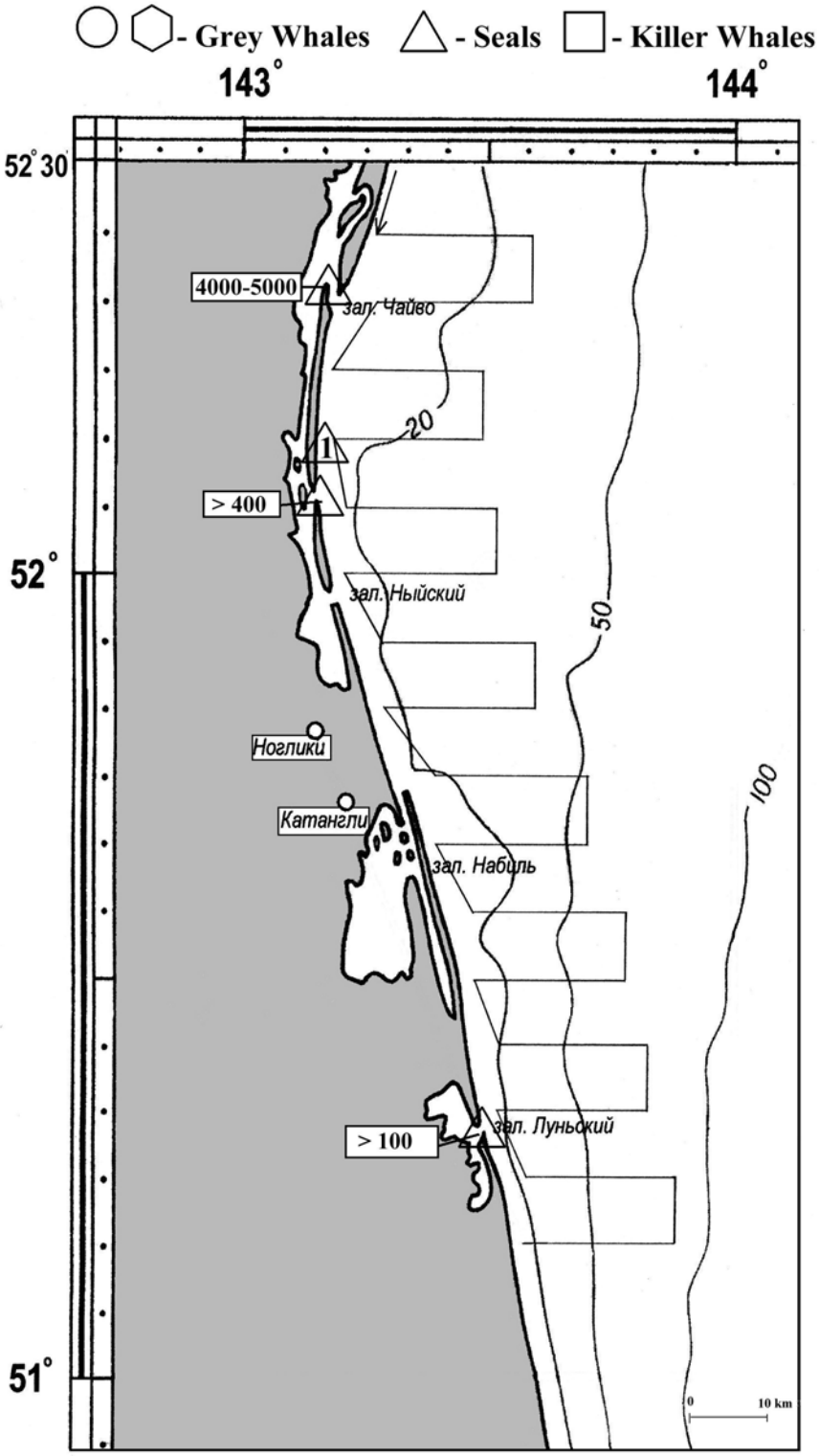


Fig. 3.2 . Occurrence of mammals offshore North-Eastern Sakhalin in August 2000 (extensive aerial survey, August 26)



Continuation of Fig. 3.2 (August 26)

The active feeding was well observed in 17 out of 37 whales recorded as well as the presence of the mud spots in their feeding areas.

Quite often groups of whales consisting of two specimens (8 groups) and more rarely of 3 specimens (2 groups) could be observed.

The results of the aerial surveys conducted on the intensive and extensive grids (25-26 August) make it possible to suggest that three whales still stayed south of the mouth of Piltun Bay, and almost in the same area there was a female with calf. The total number of the whales in the surveyed area remained almost the same.

In order to clarify the exact number and the migration pattern of gray whales on August 30 the flights were conducted from Nyisky Bay to north up to Okha city. The flight was carried out along the coastline. Thirty-nine 39 gray whales were surveyed (Table 3.3.). The whales were mainly observed at the limited area of the coastal shelf at 52˚51´-53˚18´north (Fig. 3.3.). Four whales were observed at the depth of 20 m. In two cases females with calves were encountered: the first one at the coordinates of 53˚14´13´´north and 143˚14´56´´east and the second one at the coordinates of 53˚17´33´´north and 143˚18´46´´east. In 7 cases the groups of 2 specimens were observed and twice the groups of 3 whales were recorded (Table 3.3.). The active feeding was observed in 7 whales by the presence of the mud spots in that area.

The flights carried out on August 26 and 30 revealed identical number of the whales (37 and 39 whales) and the similar distribution pattern of gray whales opposite to Piltun Bay.

Table 3.3.

Occurrence of marine mammals offshore North East Sakhalin in August (route survey along the coastline, August 30)

Time	**Position**	**Species**	**Number of animals**	**Note**
9.29	52°07′59″ 143°09′29″	Larga seal	1	**Swimming**
9.34	52°19′14″ 143°10′24″	Seals	> 500	Chaivo Bay, the survey conducted at full high tide, when most of the seals came to water
9.54	52°51′10″ 143°19′47″	Gray whale	1	
9.55	52°52′05″ 143°30′59″	Gray whale	1	
9.57	52°54′36″ 143°19′39″	Gray whale	1+1	Milling
9.59	52°57′16″ 143°20′15″	Gray whale	2	Swimming to north
9.59	52°58′25″ 143°19′34″	Gray whale	1	Swimming to north
10.00	52°58′15″ 143°20′48″	Gray whale	2+1	Whales are swimming
10.01	52°59′07″ 143°20′47″	Gray whale	1	Feeding
10.02	52°59′42″ 143°19′16″	Gray whale	2+1	Swimming to south along the coastline
10.02	53°00′21″ 143°19′20″	Gray whale	1	
10.03	53°01′25″ 143°18′55″	Gray whale	2	Whales are swimming to north
10.14	53°01′13″ 143°18′46″	Gray whale	1	Feeding, mud spots
10.16	53°02′19″ 143°20′30″	Gray whale	1	Feeding
10.20	53°03′08″ 14317′59″	Gray whale	1	
10.21	53°04′05″ 143°17′38″	Gray whale	1	Feeding, mud spots
10.27	53°10′52″ 143°16′01″	Gray whale	3+1	3 whales swimming together

Time	Position	Species	Number of animals	Note
10.30	53°12′25″ 143°16′17″	Gray whale	2	Feeding, mud spots
10.31	53°13′20″ 143°14′58″	Gray whale	3	Whales swimming together, synchronous diving
10.32	53°13′57″ 143°15′31″	Gray whale	1	
10.33	53°14′13″ 143°16′02″	Gray whale	1	Resting at one spot
10.34	53°14′13″ 143°14′56″	Gray whale	2	Female with calf
10.49	53°17′14″ 143°13′55″	Gray whale	1	Swimming to south along the coastline
10.53	53°17′33″ 143°18′46″	Gray whale	2+1	Female with calf are swimming together, swimming to south along the coastline
11.08	53°18′38″ 143°13′42″	Gray whale	1	Active feeding, mud spots

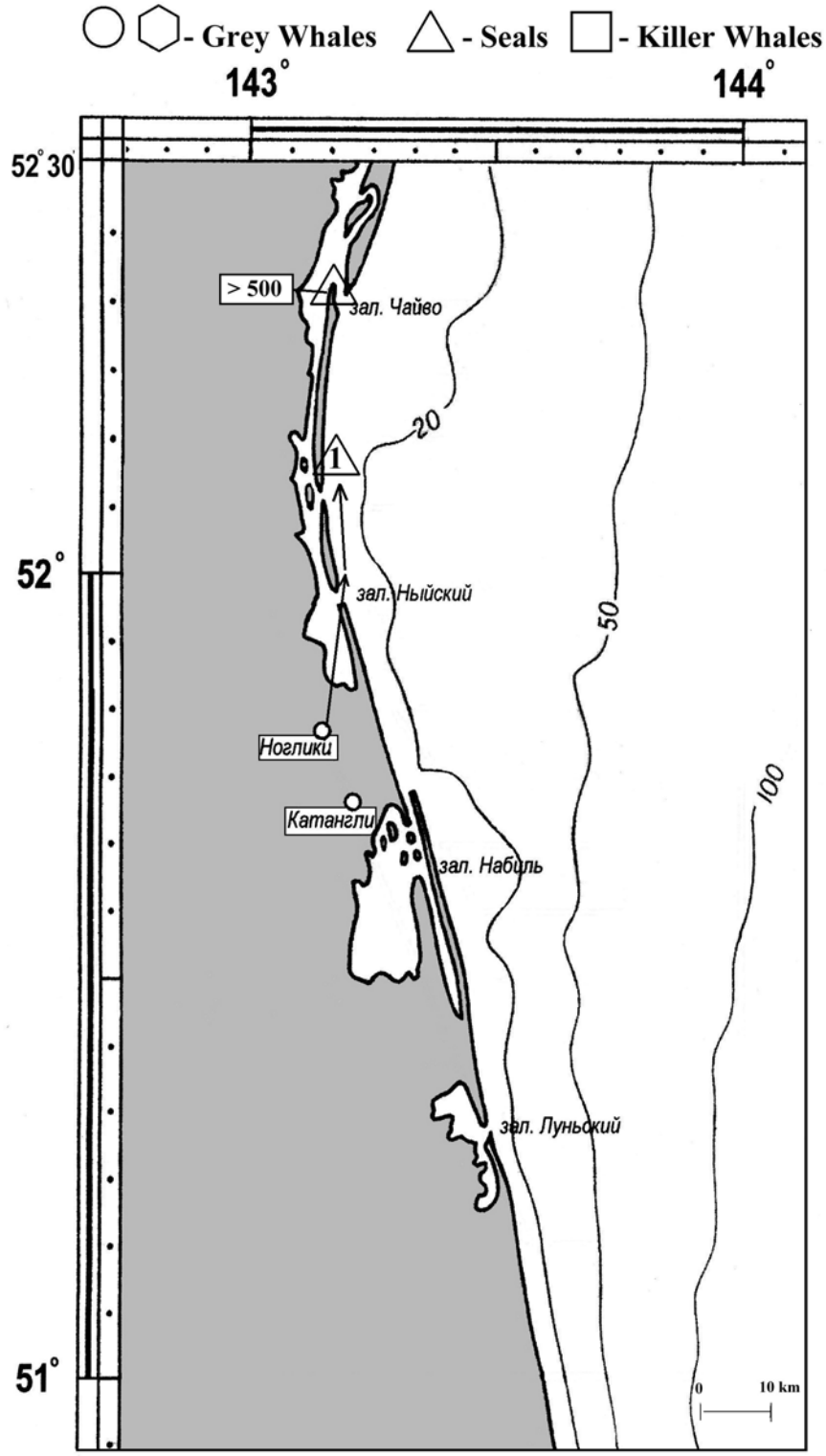
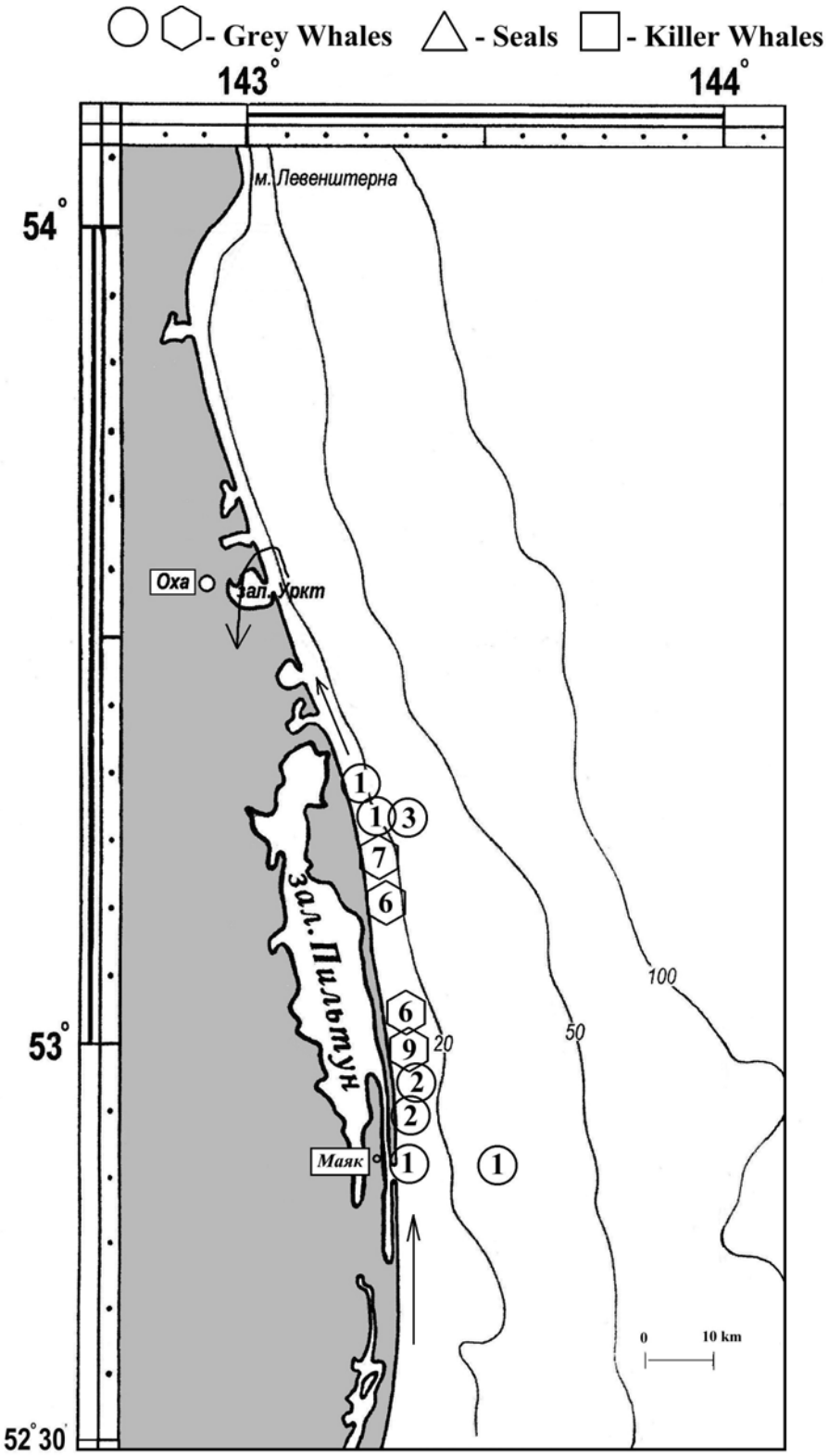


Fig. 3.3 . Occurrence of mammals offshore North-Eastern Sakhalin in August 2000 (aerial survey along the shore, August 30)



Continuation of Fig. 3.3 (August 30)

2.4. The results of aerial survey in September

The aerial survey of the whales on the extensive grid was carried out on September 6 in the second half of the day at clear sky, the visibility of over 20 km and still sea (1-2 points). The flights over the transects were carried out from Levenshtern Cape to Lunsky Bay. Forty gray whales and 2 dolphins were observed (Table 4.1.). All the whales were recorded offshore opposite to Piltun Bay. The whales were mainly staying at 5-10 m isobaths. Almost none of the whales were observed at a depth of 20 m and over. The gray whales were observed at a costal site the length of which was no more 60 km. The occurrence area of the whales was limited by the coordinates 53˚15´ - 52˚50´north and 143˚15´ – 143˚21´east (Fig. 4.1.). The whales were feeding actively; in the places of their recording we constantly observed mud spots and mud tracks. The active feeding was registered in 32 whales. In their feeding area the whales stayed in small groups (2-3 specimens), or single. From the helicopter 10 groups of whales consisting of 2 specimens and 2 groups of 3 specimens were observed. No groups of 4 and more whales were observed. At the coordinates of 53˚14´36´´north and 143˚15´19´´east the active feeding of a female was observed, a calf stayed close to her. During the helicopter survey flight most of the whales continued to feed actively and did not react to the noise produced by the helicopter.

On September 7 a survey was carried out on the intensive grid. The work was conducted in sunny weather, the visibility of over 10 km and still sea (1-2 Points). Twenty whales were recorded. All the whales were observed offshore opposite to Piltun Bay at the coordinates of 52˚49´-53˚04´north and 143˚22´-143˚17´east (Table 4.2; Fig.4.2.). A small group of whales was observed opposite to the Piltun lighthouse. South of Piltun Bay (from 52˚48´north) no whales were observed. Fourteen whales were observed during active feeding. The majority of the encountered whales stayed apart from others. When comparing the results of the aerial survey of gray whales in September 1999 (Sobolevsky, 2000) it is

possible to say that we see a rather similar distribution pattern (Fig.4.3. and 4.4.). Most of the gray whales in 1999-2000 were observed north of the Piltun lighthouse. The total number of the whales observed on the surveyed area was approximately similar.

Table 4.1

Occurrence of marine mammals offshore North East Sakhalin in September
(extensive grid, September 6)

Time	Position	Species	Number of animals	Note
14.12	53^{0}19’55” 143^{0}22’42”	Seal	1	
14.20	53^{0}15’19” 143^{0}14’36”	Gray whale	2+1	Feeding, mud spots
14.22	53^{0}14’36” 143^{0}15’19”	Gray whale	2	Female with calf, active feeding
14.23	53^{0}14’49” 143^{0}15’22”	Gray whale	2+2+1	Feeding
14.33	53^{0}10’01” 143^{0}28’20”	Seal	1	
14.37	53^{0}10’52” 143^{0}16’04”	Gray whale	2+1	Mud track, active feeding
14.46	53^{0}10’17” 143^{0}16’38”	Gray whale	3	Active feeding, mud spots
14.54	53^{0}05’14” 143^{0}18’05”	Gray whale	1	Swimming from the shore
14.56	53^{0}03’02” 143^{0}18’36”	Gray whale	2	Feeding, mud spots
14.58	53^{0}02’58” 143^{0}17’40”	Gray whale	2	Feeding, mud spots
15.08	53^{0}00’37” 143^{0}34’54”	Seals	2	
15.14	53^{0}00’00” 143^{0}18’47”	Gray whale	2+1	Whales swimming from the shore
15.18	52^{0}59’01” 143^{0}18’56”	Gray whale	1	Feeding, mud spots
15.20	52^{0}58’14” 143^{0}18’53”	Gray whale	1	Feeding
15.21	52^{0}58’36” 143^{0}19’40”	Gray whale	1	Swimming to north
15.24	52^{0}55’40” 143^{0}19’50”	Gray whale	1+1	Feeding, mud track
15.26	52^{0}55’15” 143^{0}19’49”	Gray whale	1+3	Active feeding, mud spots
15.44	52^{0}54’24” 143^{0}19’18”	Seal	1	
15.57	52^{0}50’04” 143^{0}21’55”	Gray whale	1+1	Feeding, mud spots
15.57	52^{0}51’22” 143^{0}20’59”	Gray whale	2	Feeding

Time	Position	Species	Number of animals	Note
16.01	$52^0$51’55” $143^0$20’52”	Gray whale	1	Swimming to north
16.05	$52^0$50’10” $143^0$21’18”	Gray whale	2	
16.30	$52^0$19’54” $143^0$09’56” $52^0$19’30” $143^0$11’31”	Seals	Over 2000	Two large rookeries of seals at the mouth of Chaivo Bay
17.06 - 17.45	***Oil bunkerage in Nogliki***			
19.18	$52^0$10’17” $143^0$24’33”	Dolphins	2	

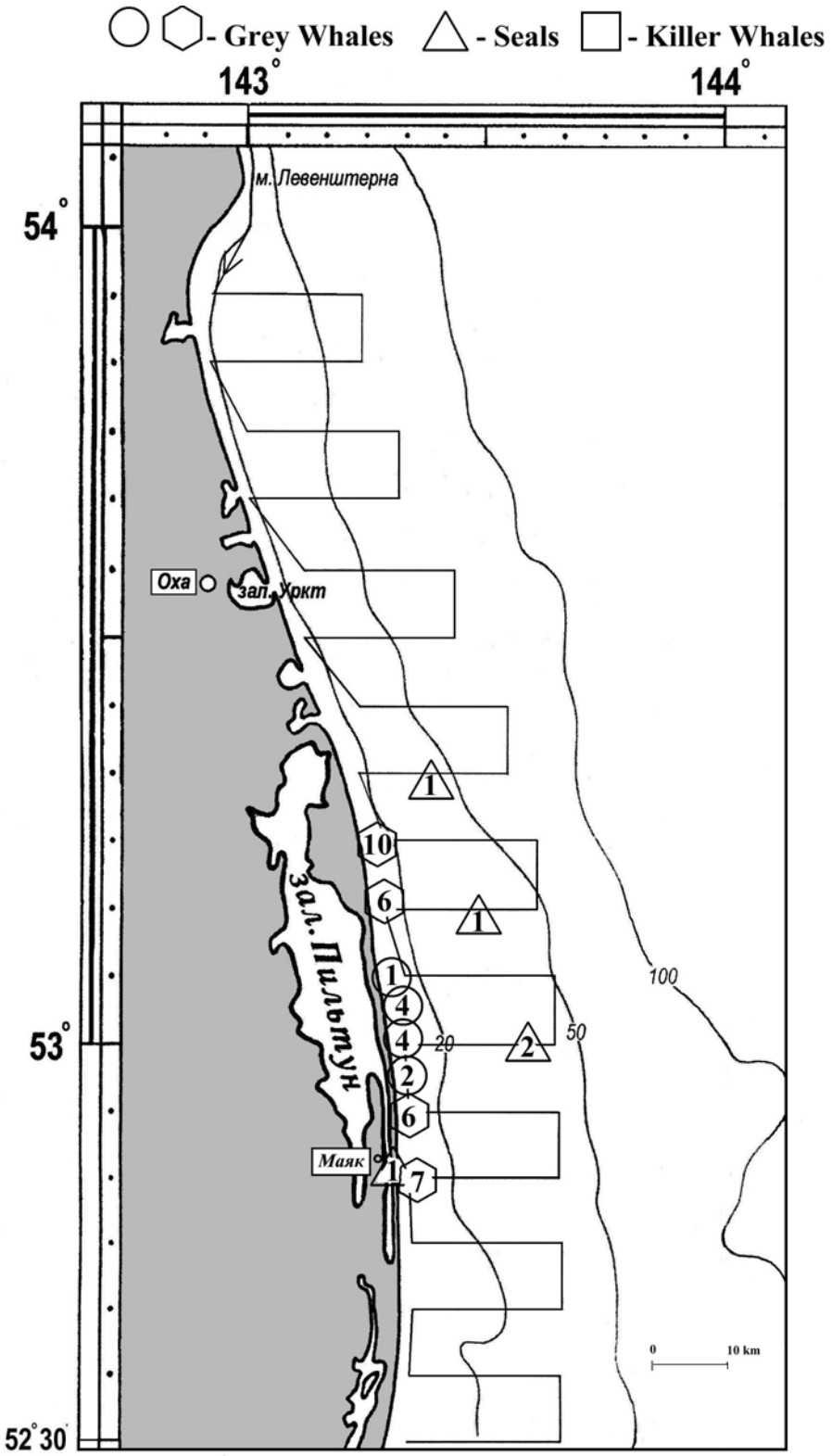
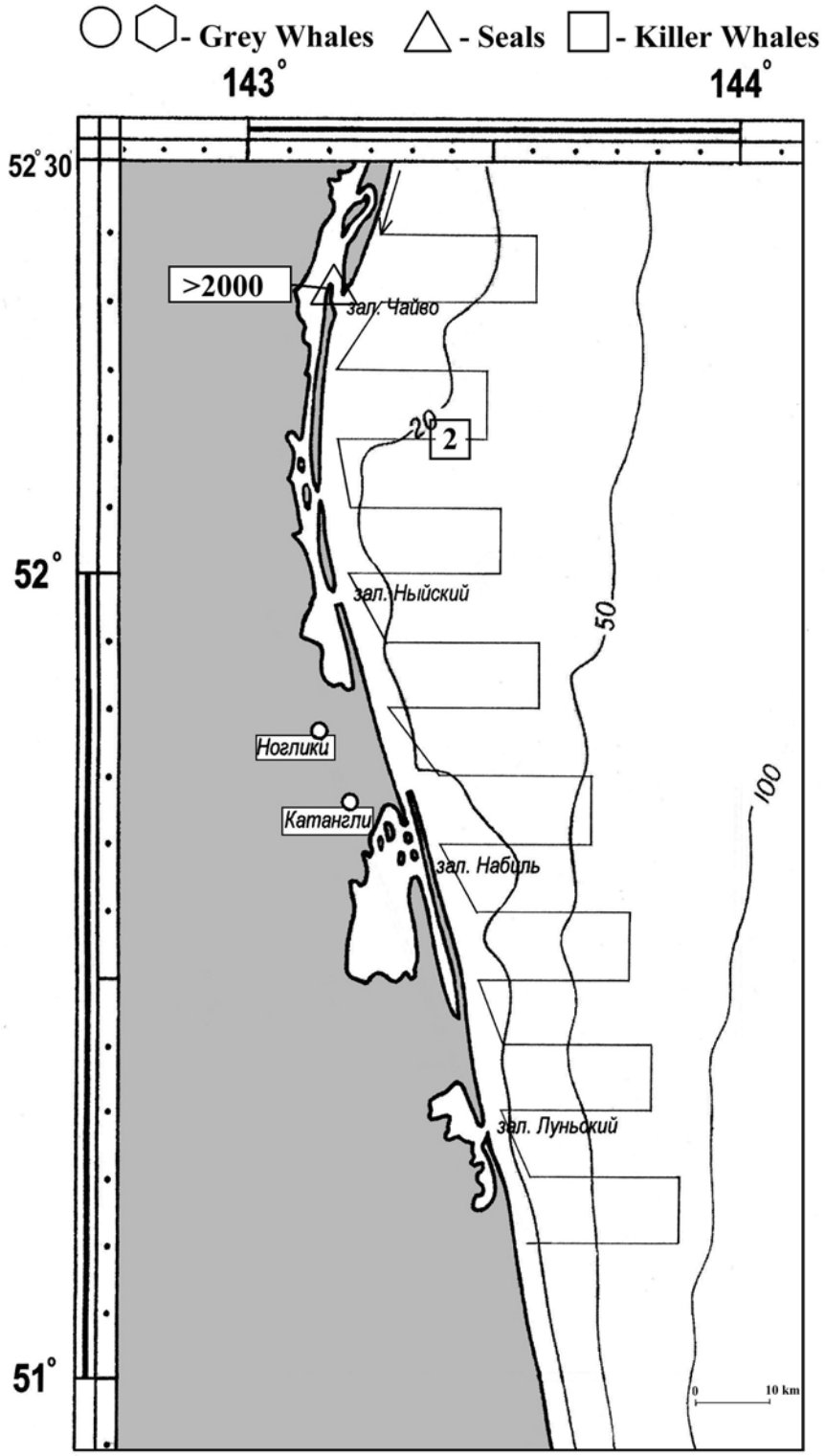


Fig. 4.1 . Occurrence of mammals offshore North-Eastern Sakhalin in September 2000 (extensive aerial survey, September 6)



Continuation of Fig. 4.1 (September 6)

Table 4.2

Occurrence of marine mammals offshore North East Sakhalin *(intensive grid, September 7)*

Time	Position	Species	Number of animals	Note
10.59	52^0 37' 00" 143^0 36' 50"	Dolphin	1	Resting, staying on the same place
12.22	52^0 49' 06" 143^0 21' 58"	Gray whale	1	Swimming to north
12.26	52^0 50' 03" 143^0 21' 35"	Gray whale	1	Milling
12.28	52^0 50' 29" 143^0 19' 14"	Seals	>500	A rookery at the mouth of Piltun Bay
12.39	52^0 51' 04" 143^0 21' 00"	Gray whale	1	Feeding, mud spots
12.40	52^0 51' 47" 143^0 21' 01"	Gray whale	1+1	Feeding, mud track
12.42	52^0 51' 52" 143^0 21' 38"	Gray whale	1	Swimming from the shore
12.54	52^0 53' 58" 143^0 20' 38"	Gray whale	2	Feeding
13.05	52^0 55' 50" 143^0 20' 16"	Gray whale	1	
13.05	52^0 55' 50" 143^0 20' 04"	Gray whale	2	Feeding, mud spots
13.12	52^0 55' 51" 143^0 19' 38"	Gray whale	1	
13.14	52^0 56' 26" 143^0 19' 04"	Gray whale	1	Active feeding
13.24	52^0 58' 55" 143^0 19' 58"	Killer whale	1	
13.26	52^0 59' 02" 143^0 18' 49"	Gray whale	1	
13.46	52^0 58' 59" 143^0 18' 58"	Gray whale	1	Feeding, mud spots
14.03	53^0 04' 30" 143^0 17' 43"	Gray whale	3+1+1	Active feeding, mud tracks

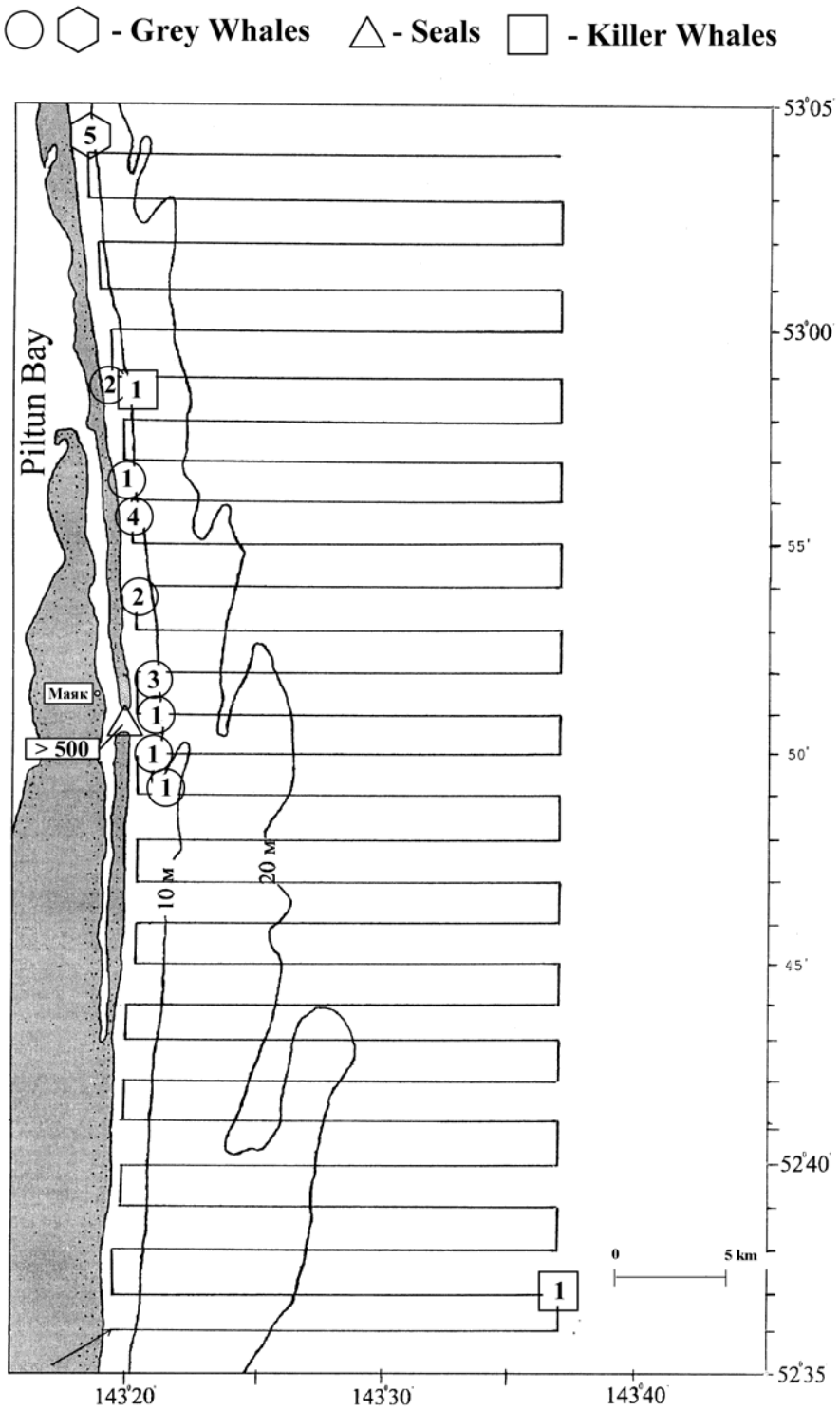


Fig. 4.2. Occurrence of mammals offshore Sakhalin in September 2000 (intensive aerial survey, September 7)

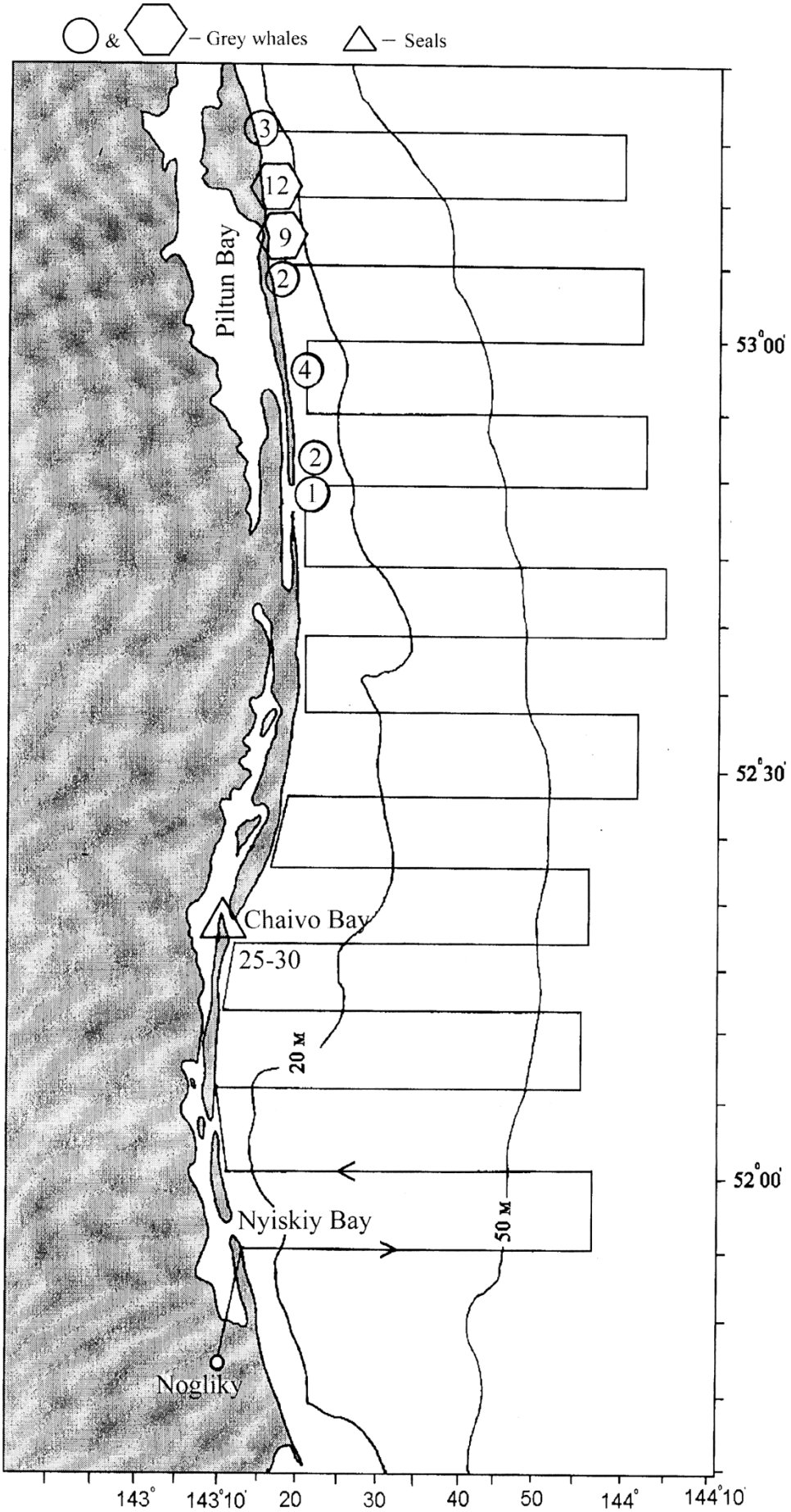


Fig.4.3. Occurrence of mammals on shelf of Sakhalin by aerial survey at 21 September, 1999

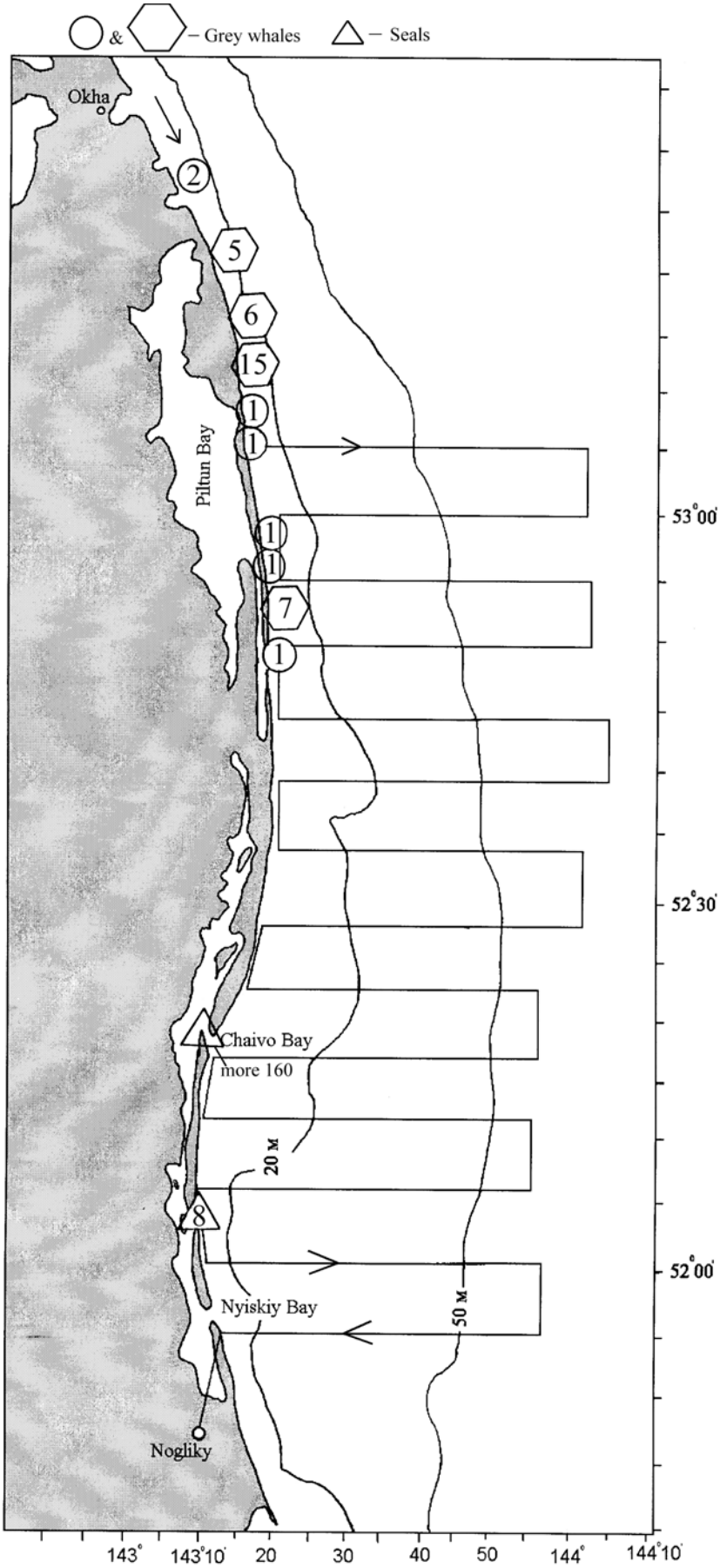


Fig. 4.4 Occurrence of mammals on shelf of Sakhalin by aerial survey at 22 September, 1999

2.5. Results of Aerial Surveys in October

The aerial survey was carried out on October 11 on the intensive grid and October 13-14 on the extensive grid. The survey on the intensive grid was conducted out in cloudy weather, still sea (up to 1 point). The survey was carried out from north to south. When the helicopter was approaching the testing area at the coordinates of 53˚15´32´´north and 143˚14´37´´east a group of whales of 3 specimens and 2 single whales near it were observed. The whales were feeding close to the shore. On the routes only 3 whales were observed (Fig. 5.1.), out of which one was staying at a significant distance from the shore at the coordinates of 52˚47´46´´north and 143˚32´46´´east (Table5.1.). The whale was swimming to north. Two whales found offshore at the coordinates of 53˚03´45´´north and 143˚17´43´´east were actively feeding.

On October 13 the offshore aquatorium from Rotmanova Cape (50˚40´north) to the northern extremity of Piltun Bay was studied. South of Piltun Bay no whales were observed. Gray whales were recorded opposite to the Piltun lighthouse (6 specimens) and at a small site of the offshore zone between 53˚08´and 53˚17´north (Table 5.2.; Fig. 5.2.). In total 25 whales were registered. Fourteen whales were observed during the feeding and there were mud spots in that area. The groups of whales and single whales were swimming quite actively along the coastal shelf in different directions. At the coordinates of 51˚55´30´north and 143˚13´56´east the hunting of killer whales for seals was observed. The killer whales managed to catch a seal and they ate it under water. On the surface a blood track was stretching behind them of about 10 m wide.

On October 14 a repeated survey was carried out. The survey was conducted in still, sunny weather. Sea was still (1-2 points). Visibility was over 10 km. The flight covered the coastal part of the shelf from Nogliki Village to north. Thirty-

eight gray whales and 7 killer whales were observed (Table 5.3.). On the aquatorium from Nabil Bay to the Piltun lighthouse no gray whales were found. All the whales were observed north of the mouth of Piltun Bay. As in September the majority of the whales were observed in shallow water areas of the shelf. In the vicinity of the Piltun lighthouse only 3 whales were observed (Fig.5.3.). North of 53˚20´north no whales were recorded (Table 5.3.). Twelve whales were observed during feeding (Table 5.3.). In 6 cases the groups of whales consisting of 2specimens, once the groups из 3 and 4 specimens were recorded. Other whales were staying apart. When comparing the results of the surveys conducted on October 8-9 in 1999 (Fig. 5.4. and 5.5.) with aerial survey data in October 2000 it is possible to say that in October the majority of the gray whales were staying north of the Piltun lighthouse and remained almost unavailable for the observations from the lighthouse.

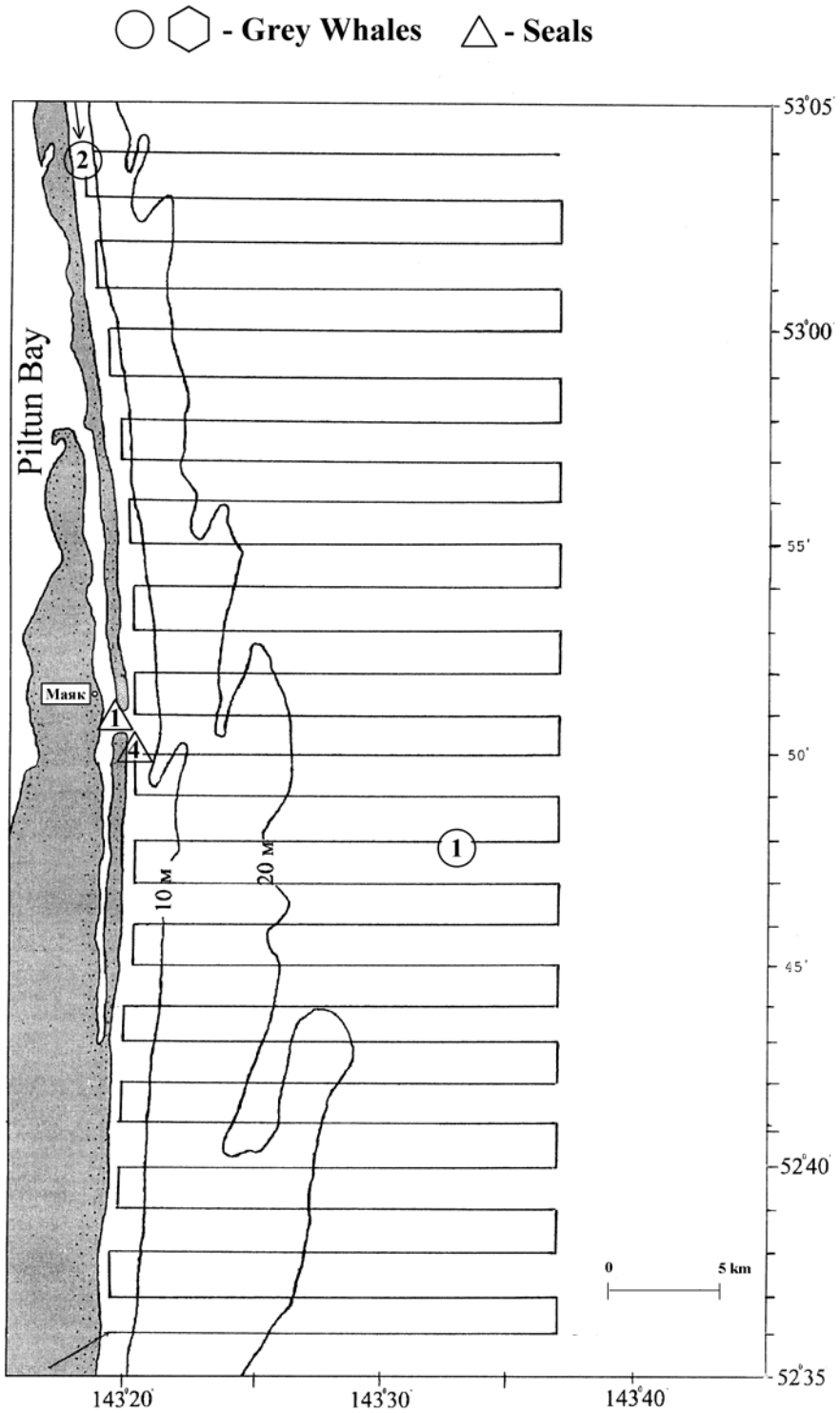


Fig. 5.1. Occurrence of mammals offshore Sakhalin in October 2000 (intensive aerial survey, October 11)

Table 5.1

Occurrence of marine mammals offshore North East Sakhalin in October
(intensive grid, 11 October)

Time	Position	Species	Number of animals	Note
11.44	$53^0$03’45” $143^0$17’43”	Gray whale	1+1	Feeding in the ashore zone
14.45	$52^0$51’12” $143^0$19’17”	Seal	1	Swimming
14.47	$52^0$50’00” $143^0$21’13”	Seals	1+2+1	Swimming
15.07	$52^0$47’46” $143^0$32’46”	Gray whale	1	Swimming to north

Table 5.2

Occurrence marine mammals offshore North East Sakhalin in October
(extensive grid, 13 October)

Time	Position	Species	Number of animals	Note
09.34	51^{0}18’03” 143^{0}29’06”	Seals	2	
9.36	51^{0}20’57” 143^{0}30’00”	Seals	2	Swimming
10.42	51^{0}55’30” 143^{0}13’56”	Killer whales	2+3	A bloody track stretches behind the killer whales with a length of 50 m, and the width of over 10 m
11.30	52^{0}19’06” 143^{0}10’52”	Seals	800-1000	A large rookery of seals on a sand bar at the mouth of Chaivo Bay
12.28	52^{0}50’51” 143^{0}20’59”	Gray whale	1+1	
12.30	52^{0}52’51” 143^{0}19’30”	Gray whale	1+1+1	Feeding, mud spots
12.42	52^{0}55’41” 143^{0}19’56”	Gray whale	1	
13.05	53^{0}08’28” 143^{0}17’14”	Gray whale	2+1	Swimming to the shore
13.08	53^{0}08’29” 143^{0}17’43”	Gray whale	1	
13.13	53^{0}10’00” 143^{0}16’42”	Gray whale	2	Feeding, swimming to north
13.22	53^{0}10’13” 143^{0}18’38”	Gray whale	3+1	Feeding, mud spots
13.24	53^{0}14’14” 143^{0}15’38”	Gray whale	1	Swimming to south
13.31	53^{0}15’47” 143^{0}14’27”	Gray whale	1+2	Feeding
13.33	53^{0}15’52” 143^{0}16’57”	Gray whale	2	Swimming to south along the coastline
13.34	53^{0}16’45” 143^{0}15’58”	Gray whale	1	
13.36	53^{0}17’12” 143^{0}15’23”	Gray whale	1+1	Feeding

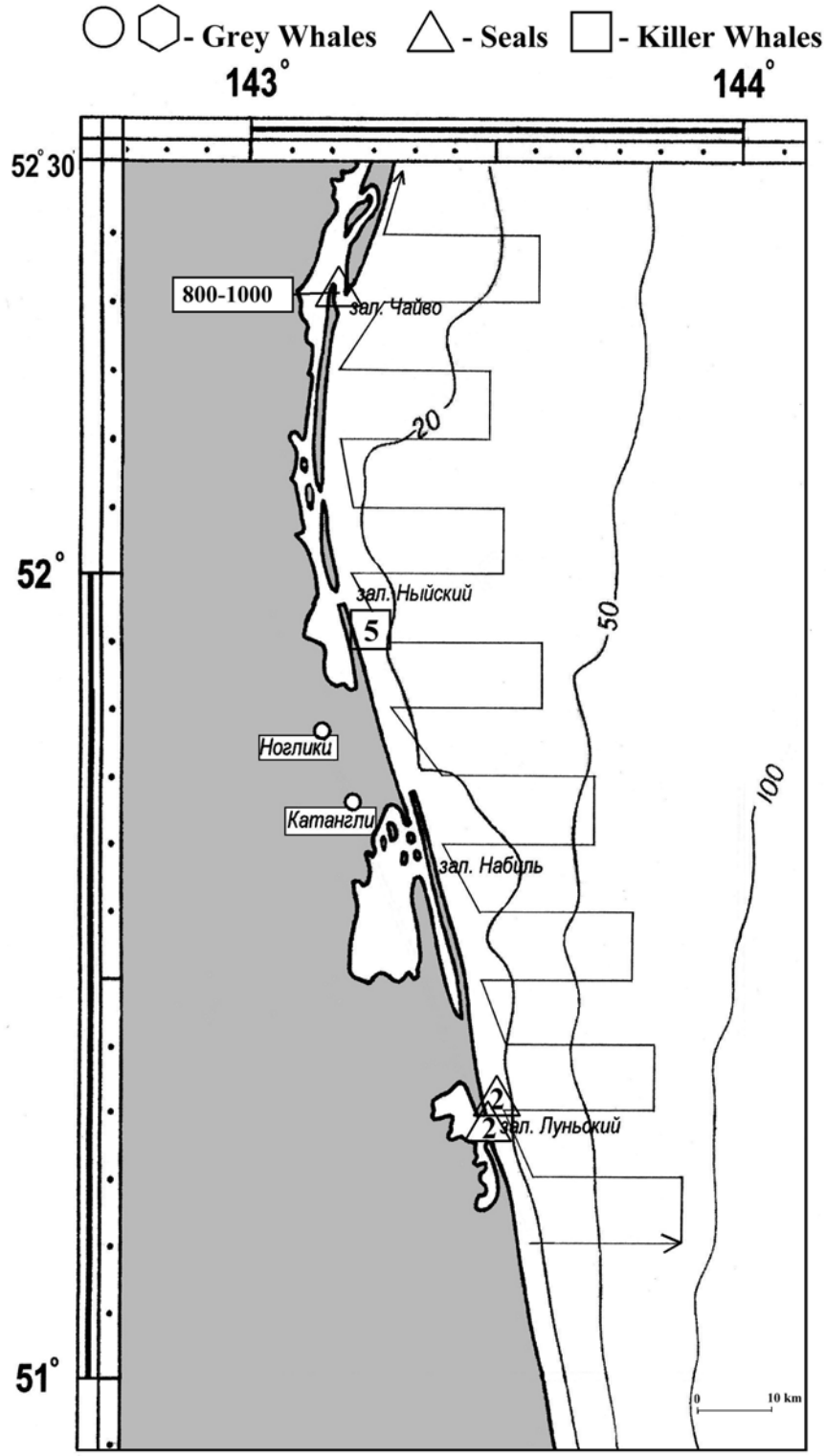
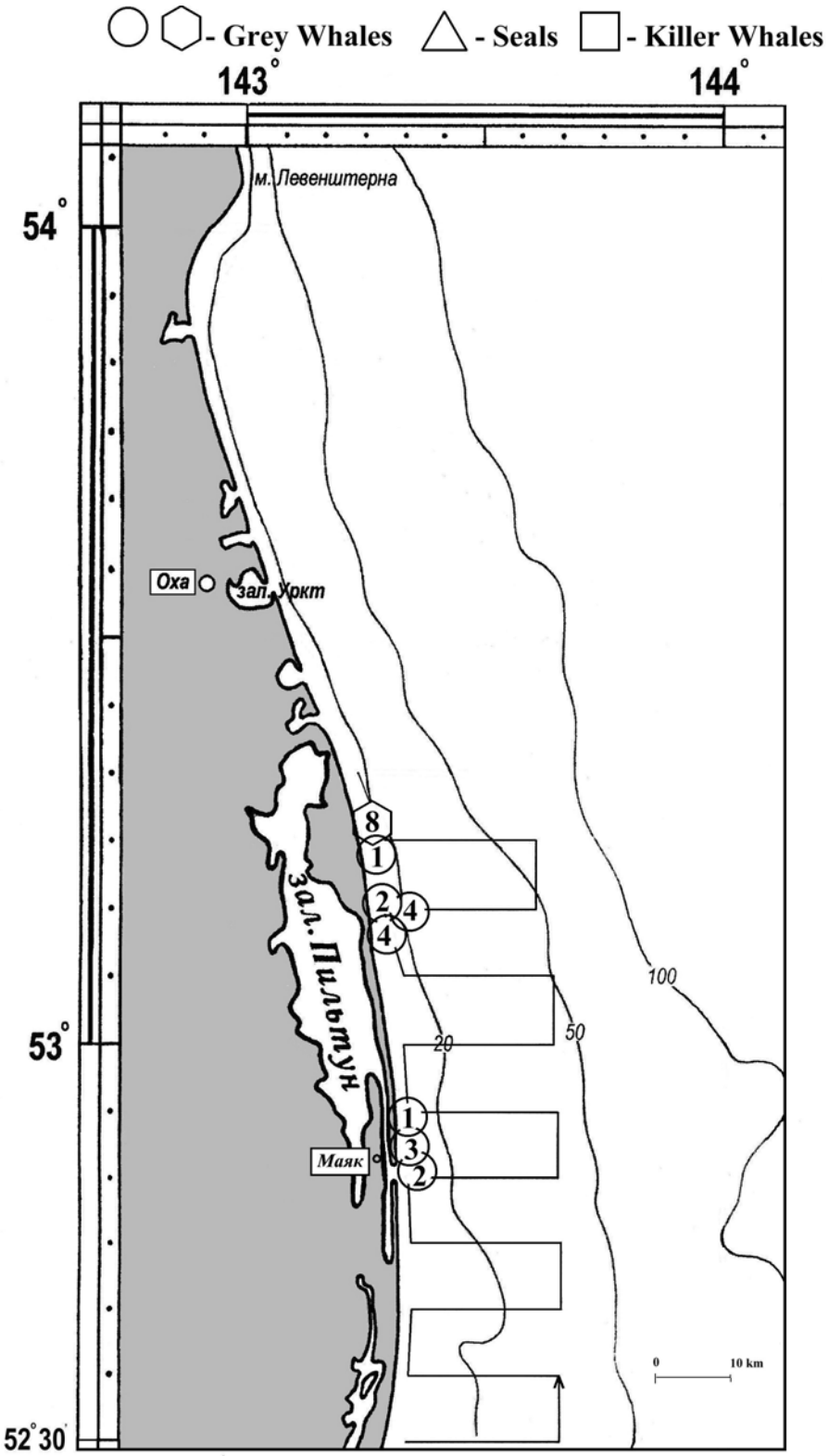


Fig. 5.2 . Occurrence of mammals offshore North-Eastern Sakhalin in October 2000 (extensive aerial survey, October 13)



Continuation of Fig. 5.2 (October 13)

Table 5.3

Occurrence of marine mammals offshore North East Sakhalin in October
(survey along the coastline on October 14)

Time	Position	Species	Number of animals	Note
9.45	$51^0$55'33" $143^0$13'18"	Killer whales	2*	Swimming to south
10.00	Chaivo Bay $52^0$19'13" $143^0$10'54"	Seals	200-250*	The survey was conducted during high tide
10.36	$52^0$52'03" $143^0$19'55"	Gray whale	1+1	Swimming to north
10.37	$52^0$53'12" $143^0$19'31"	Gray whale	1	Diving
10.56	$52^0$57'46" $143^0$19'08"	Gray whale	4	Active feeding
11.02	$52^0$58'10" $143^0$19'40"	Gray whale	1+1	Swimming to north
11.04	$52^0$58'48" $143^0$18'36"	Gray whale	1	Diving, swimming to north
11.07	$53^0$00'41" $143^0$20'07"	Gray whale	1+2	Milling
11.08	$53^0$01'33" $143^0$20'04"	Gray whale	2	Diving
11.12	$53^0$02'50" $143^0$20'27"	Gray whale	2	Whales resting under water, periodically appearing on the surface at the same place
11.22	$53^0$05'42" $143^0$16'59"	Gray whale	1	The whale is actively feeding ashore; many mud spots around the whale
11.25	$53^0$06'35" $143^0$17'41"	Gray whale	1+1	Feeding
11.26	$53^0$07'12" $143^0$17'08"	Gray whale	1+1	Feeding, mud spots
11.28	$53^0$09'56" $143^0$16'24"	Gray whale	1	
11.29	$53^0$11'12" $143^0$17'06"	Gray whale	1	Swimming to north

Time	Position	Species	Number of animals	Note
11.31	$53^0$12’01” $143^0$16’16”	Gray whale	2+1	Swimming to north along the coatline
11.34	$53^0$13’04” $143^0$16’32”	Gray whale	3	Swimming to north
11.35	$53^0$13’10” $143^0$16’44”	Gray whale	2	Resting
11.37	$53^0$16’59” $143^0$13’41”	Gray whale	2	Feeding
11.38	$53^0$17’37” $143^0$14’50”	Gray whale	1+1	Diving
11.41	$53^0$19’24” $143^0$13’04”	Gray whale	1	
11.45	$53^0$19’50” $143^0$12’13”	Gray whale	1	Feeding, mud track
12.26	$53^0$45’01” $142^0$56’56”	Seals	1+2	Swimming ashore
Landing in the airport of Okha city. Oil bunkerage				
15.58	Piltun Bay $52^0$50’27” $143^0$19’23”	Seals	800-900	A large rookery at the mouth of Piltun Bay
16.15	$52^0$39’12” $143^0$19’56”	Killer whales	3+1+1	Three killer whales stay in a dense group (large male, female and a young specimen)
16.45	Chaivo Bay $52^0$20’21” $143^0$10’23”	Seals	80-100	A rookery at the left shore of Chaivo Bay
16.45	Chaivo Bay $52^0$19’19” $143^0$10’30”	Seals	1000-1200	2 large rookeries at the mouth of Chaivo Bay (the survey was carried out at full low tide)

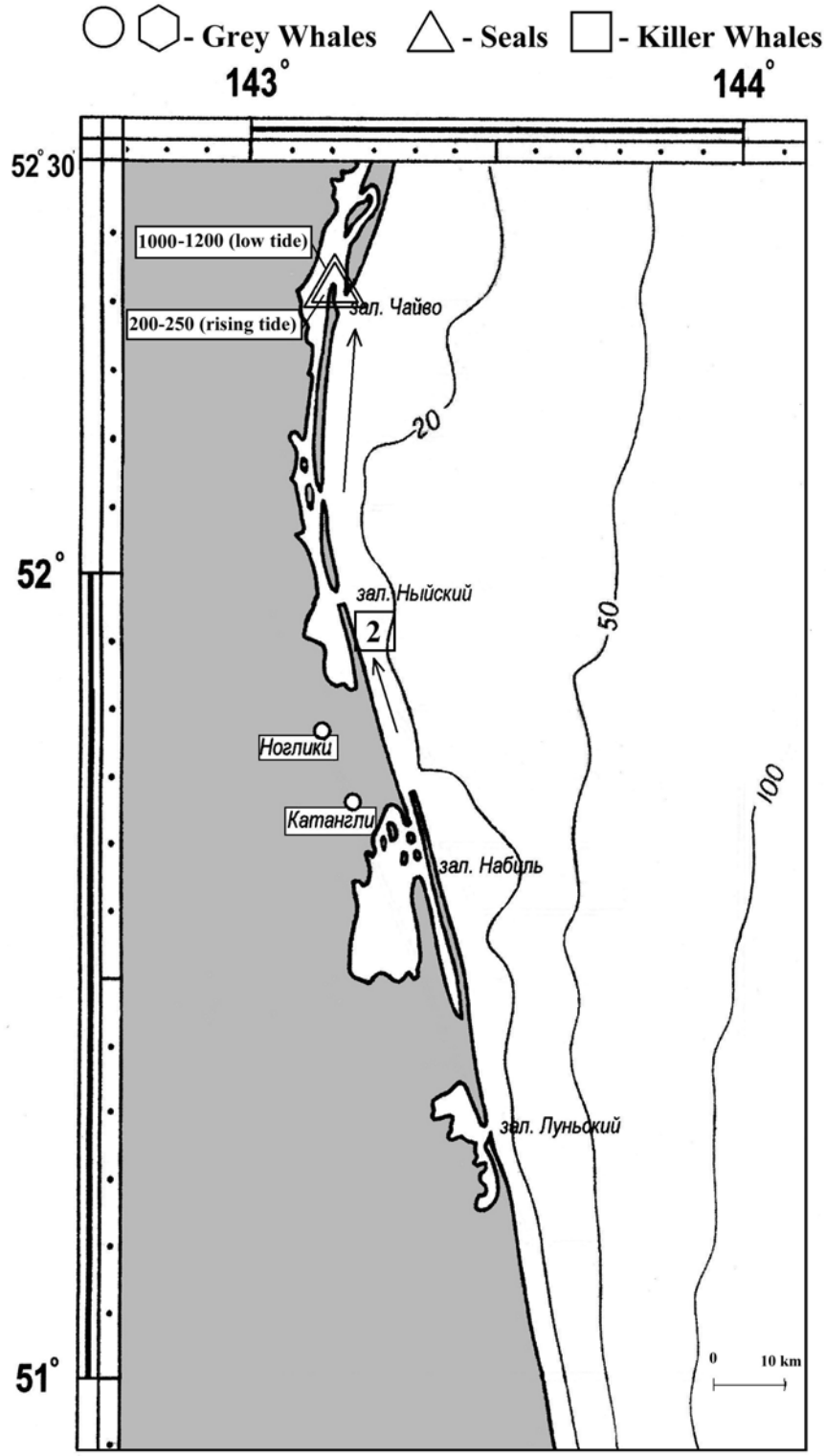
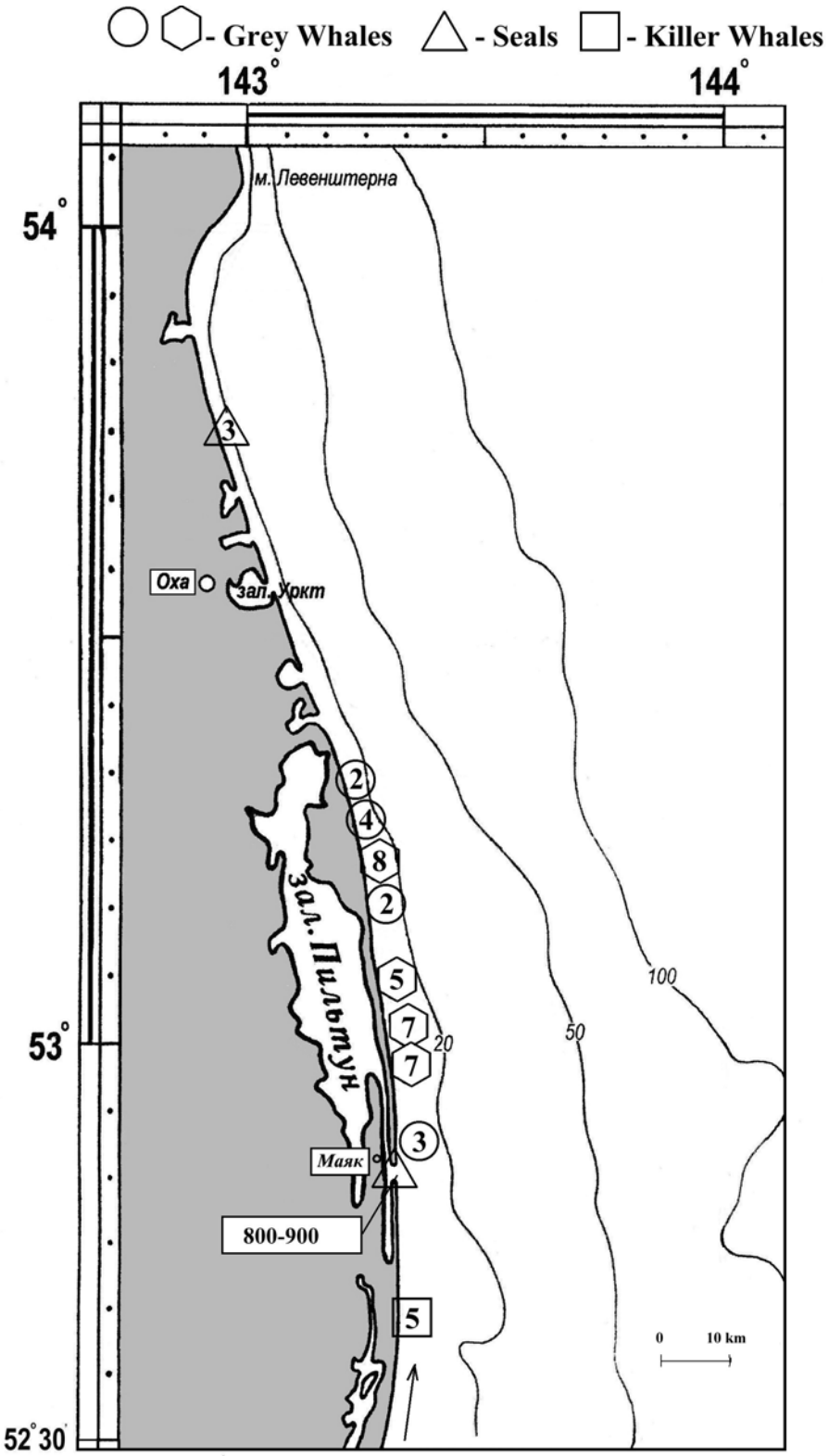


Fig. 5.3. Occurrence of mammals offshore North-Eastern Sakhalin in October 2000 (aerial survey along the shore, October 14)



Continuation of Fig. 5.3. (October 14)

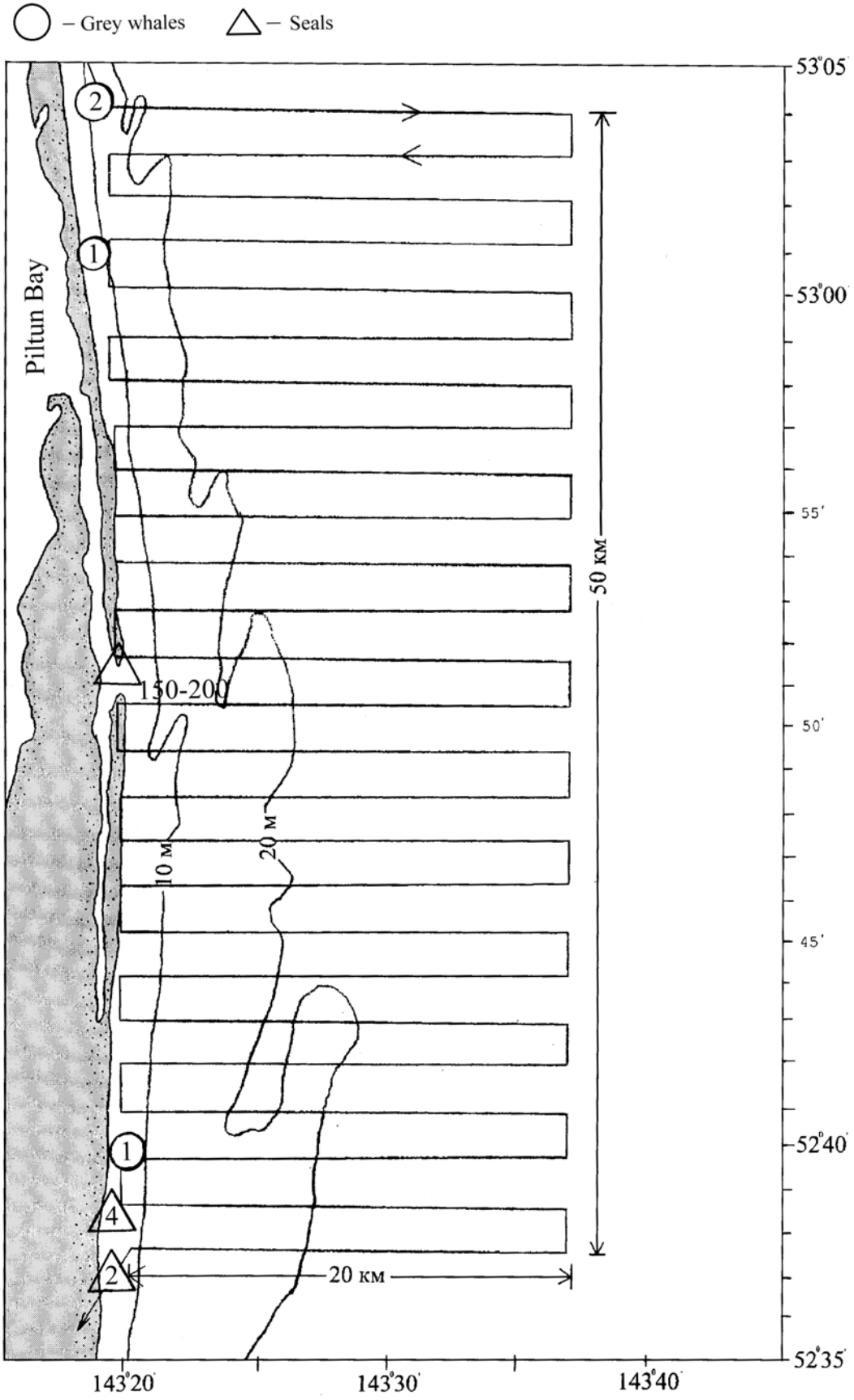


Fig. 5.4 Occurrence of mammals on shelf of Sakhalin by aerial survey at 8 October, 1999

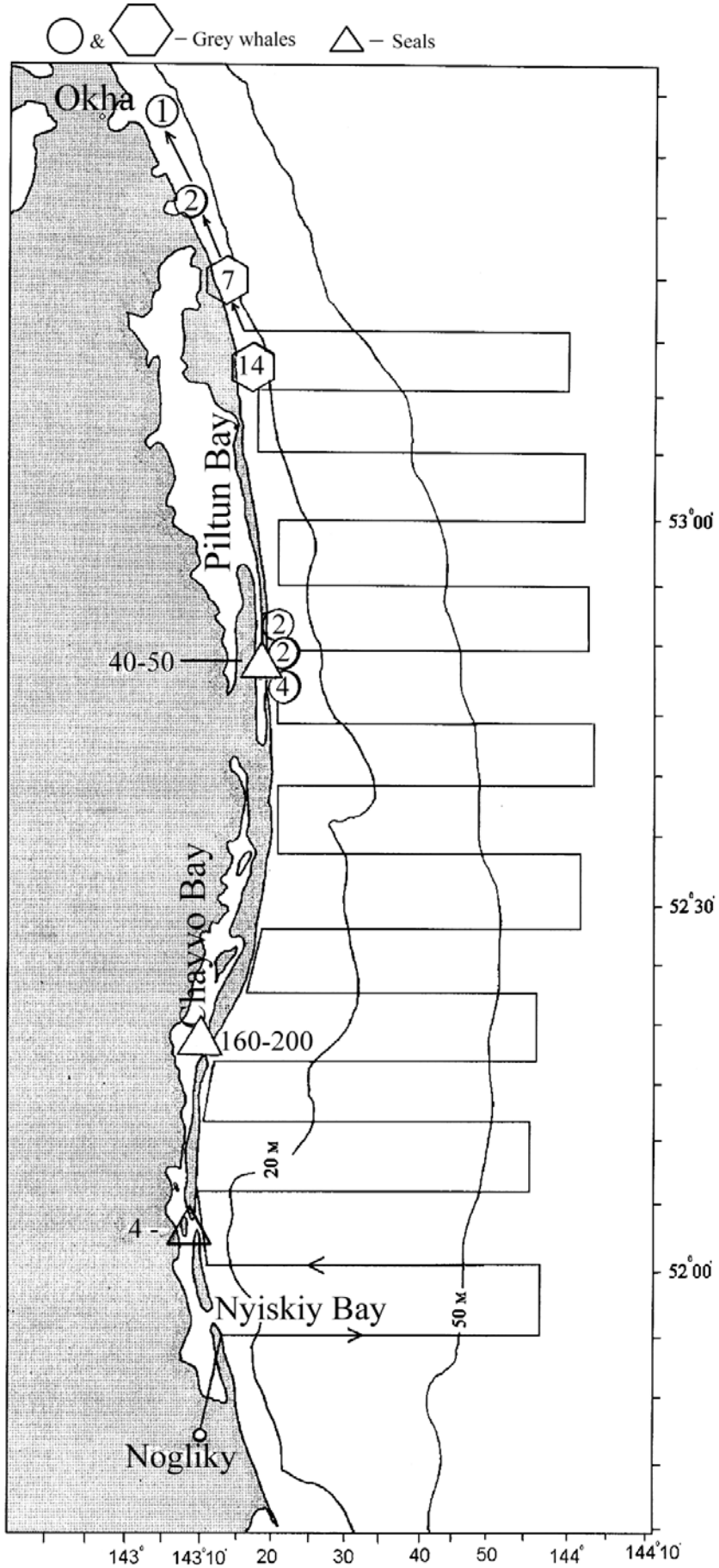


Fig. 5.5 Occurrence of mammals on shelf of Sakhalin by aerial survey at 9 October, 1999

2.6. Results of Aerial Surveys in November

In November two aerial surveys of marine mammals were conducted. On November 18 a survey on the intensive grid was carried out after a heavy sea storm, for which reason the water in the shallow-water part of the shelf was of dirty-gray color, which made it impossible to see mud spots. On the day of the survey the weather was frosty (-18˚ C) and windy. In the fields of the pancake ice sea was still (to 1 point), in the open water sites it was 2-3 points. On the survey day 6 whales were observed, out of which 2 whales were found north of the survey area during the helicopter's arrival to that area (Table 6.1.). All the whales were observed north of the Piltun lighthouse (Fig. 6.1.) close to the shore, in the fields of young pancake ice and in thinly broken ice. The animals rarely came to the surface for 2-5 sec. and stayed under water for 3-5 minutes. The fountains of the whales were well seen due to the low surface temperature of water. It was impossible to see the feeding of the whales because of the high turbidity.

On November 19-20 the flights were carried out on the extensive grid. The survey covered the aquatorium from Levenshtern Cape to Lunsky Bay. In the days of the survey the weather was frosty and windy. Air temperature in Nogliki was -22˚C, in the Piltun area–15-18˚C. The process of active ice formation was observed in the sea. The outcasts of young ice and lolly ice at some sites of the survey area from Chaivo Bay to Piltun Bay stretched for 8-15 km. In most of the survey area the coastal zone at the distance of 2-3 km was covered with lolly ice, joined by the fields of young pancake ice. A sharp cooling of the surface water masses and the active process of ice formation made most of the whales leave their summer feeding areas in November. During the two days of the flights we observed 3 whales (Table 6.2.; Fig. 6.2.). All the whales were observed north of the Piltun lighthouse. The whales were staying at a depth of 5-12 m and were swimming in pancake ice. The analysis of the survey data during the last two years

(1999-2000) allows suggesting that in November most of the whales leave their summer feeding areas. The date and pattern of migration, probably, depends very much on the climatic factors, including the intensity of ice formation. In 1999 the shelf zone from Yelizavety Cape to Lunsky Bay was free from ice and November 20 in the offshore zone opposite Lunsky Bay a significantly greater number of gray whales was observed (Sobolevsky, 2000) (Fig. 6.3.), which, probably, stayed offshore North East Sakhalin till December.

Table 6.1

Occurrence of marine mammals offshore North East Sakhalin in November
(intensive grid, 18 November)

Time	Position	Species	Number of animals	Note
10.04	Departure from the airport of Nogliki			
11.28	53^{0}10'44" 143^{0}16'30"	Gray whale*	1	Diving in pancake ice
11.41	53^{0}09'03" 143^{0}17'02"	Gray whale*	1	Diving in pancake ice
11.47	53^{0}04'00" 143^{0}20'01"	Gray whale	1	Diving in pancake ice
12.03	53^{0}03'03" 143^{0}17'40"	Gray whale	1	Diving in thinly broken ice
12.27	52^{0}59'04" 143^{0}20'02"	Gray whale	1	
13.05	52^{0}55'00" 143^{0}19'31"	Gray whale	1	Diving in thinly broken ice
14.04	52^{0}54'00" 143^{0}25'05"	Seal	1	
14.14	52^{0}52'54" 143^{0}19'33"	Seals	1+1+1	Swimming
14.29	52^{0}50'21" 143^{0}20'32"	Seals	2+1+3	Swimming at the mouth of Piltun Bay
14.37	52^{0}48'03" 143^{0}20'21"	Seals	1+1	Swimming
14.48	52^{0}47'15" 143^{0}19'32"	Seals	4+1	Swimming
15.09	52^{0}45'22" 143^{0}22'28"	Seal	1	Staying on ice
15.55	52^{0}37'00" 143^{0}19'33"	Bearded seal	1	Staying on ice
15.56	52^{0}37'02" 143^{0}21'29"	Seal	1	Staying on ice
16.06	52^{0}36'00" 143^{0}22'11"	Seals	1+1	Staying on ice
16.10	52^{0}36'02" 143^{0}19'30"	Seals	2+1+1	Swimming in the midst of pancake ice
16.22	52^{0}35'00" 143^{0}20'00"	Seals	5	On ice

- whales recorded above the area of the intensive grid survey

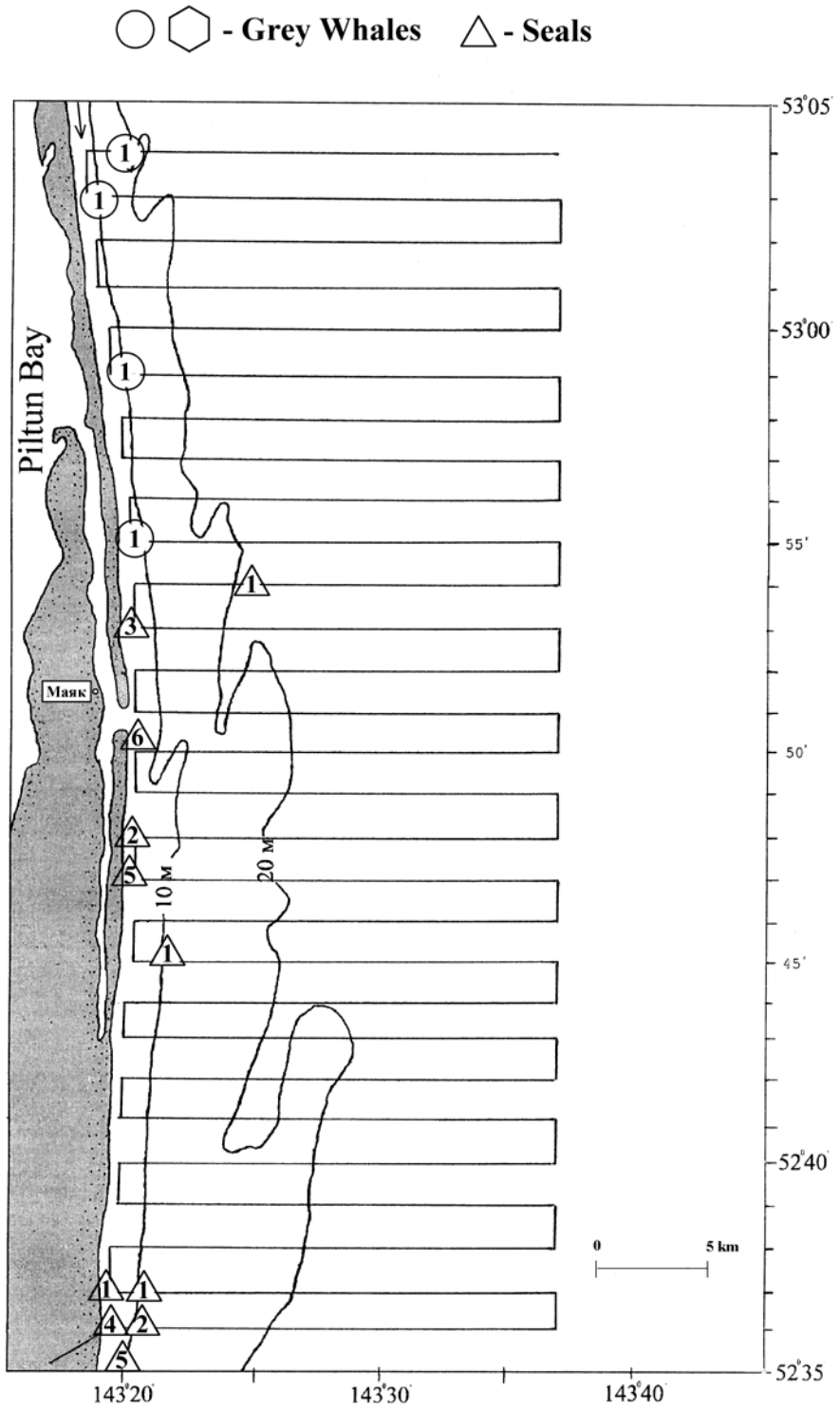


Fig. 6.1. Occurrence of mammals offshore Sakhalin in November 2000 (intensive aerial survey, November 18)

- **Table 6.2**

Occurrence of marine mammals offshore North East Sakhalin in November
(extensive grid, 19 November)

Time	Position	Species	Number of animals	Note
10.46	53^{0}50'10" 142^{0}55'11"	Seal	1	Swimming
11.04	53^{0}47'01" 142^{0}56'06"	Seals	2	Swimming
11.06	53^{0}45'37" 142^{0}57'58"	Seals	2	Offshore in the tidal area
11.22	53^{0}37'21" 143^{0}02'11"	Seal	1	Swimming
11.37	53^{0}28'11" 143^{0}07'32"	Seals	1+1	Swimming in the midst of pancake ice
11.50	53^{0}20'02" 143^{0}11'02"	Seals	1+2	Swimming in lolly ice
11.51	53^{0}20'44" 143^{0}12'06"	Seals	1+1	Swimming in pancake ice
11.52	53^{0}17'46" 143^{0}14'21"	Gray whale	1	Diving in pancake ice and lolly ice
11.56	53^{0}16'10" 143^{0}14'42"	Seals	2	Swimming among pancake ice
12.05	53^{0}14'41" 143^{0}16'42"	Gray whale	1+1	Swimming in pancake ice
12.15	53^{0}10'17" 143^{0}16'15"	Seals	1+2+1	Swimming in lolly ice
12.20	53^{0}06'52" 143^{0}17'20"	Seals	1+1	Swimming in lolly ice
12.40	53^{0}00'07" 143^{0}19'44"	Seals	2+4	Swimming in lolly ice
12.43	52^{0}59'37" 143^{0}18'40"	Seal	1	Swimming in lolly ice
12.47	52^{0}58'19" 143^{0}19'02"	Seals	3+2+1	Swimming in lolly ice
12.49	52^{0}57'50" 143^{0}19'43"	Seals	1+2	Swimming in lolly ice
13.02-13.40		**Landing at Piltune**		
14.00	52^{0}50'35" 143^{0}19'10"	Seals	40-50	Seals staying on ice near ice holes at the mouth of Piltun Bay
14.03	52^{0}50'30" 143^{0}21'28"	Seals	2+1+2+4	Swimming in pancake ice
14.07	52^{0}49'31" 143^{0}20'12"	Seals	1+2+1+3	Swimming in young pancake ice

Time	Position	Species	Number of animals	Note
14.09	$52^0$48’09” $143^0$20’53”	Seals	1+2	Swimming in lolly ice
14.12	$52^0$47’14” $143^0$22’00”	Seal	1	Staying on ice
14.32	$52^0$40’21” $143^0$24’03”	Seals	2+6+5	Swimming in pancake ice
14.35	$52^0$40’38” $143^0$21’20”	Seals	3+4+2	Swimming in pancake ice
14.40	$52^0$39’44” $143^0$21’58”	Seals	2+3+5+4	Staying on ice floes
14.43	$52^0$37’51” $143^0$22’24”	Bearded seals	3+1+5	Staying on small ice floes
14.44	$52^0$36’17” $143^0$22’12”	Bearded seals	4+3+12	Staying on ice floes
14.45	$52^0$35’09” $143^0$21’50”	Bearded seals	2+3+8	Staying on ice floes
14.46	$52^0$34’47” $143^0$22’08”	Seals	2+5+2	Swimming in free spaces between pancake ice
14.59	$52^0$30’47” $143^0$24’58”	Seals	12+6+8	Staying on ice floes in the fields of
15.02	$52^0$30’11” $143^0$19’37”	Seals	2	Staying on ice floes
15.22	$52^0$19’34” $143^0$10’36”	Seals	2+1	Staying on ice floes in Chaivo Bay
15.23	$52^0$18’54” $143^0$11’12”	Seals	2	Swimming in lolly ice
15.26	$52^0$15’12” $143^0$12’34”	Seals	3+4+5	Staying on ice floes
15.47	$52^0$07’02” $143^0$09’25”	Seals	2	Staying on ice floes in Nyisky Bay
16.13	$51^0$59’47” $143^0$10’36”	Seals	3+6	Swimming

November 20 **staying on ice floes** (continuation of survey on the extensive grid)

Time	Position	Species	Number of animals	Note
9.20	51°55′20″ 143°17′17″	Seals	1+1	Swimming
9.41	51°46′55″ 143°18′29″	Seals	1+3	Swimming
9.43	51°45′58″ 143°18′58″	Seal	1	Swimming
9.47	51°44′35″ 143°19′12″	Seals	1+1+2+2	In the mouth of Nabil Bay
9.48	51°44′32″ 143°21′55″	Seals	9	Swimming in lolly ice
10.05	51°41′40″ 143°22′00″	Seal	1	Swimming in pancake ice
10.06	51°40′24″ 143°22′18″	Seals	2+2+3+6	Swimming
10.15	51°40′06″ 143°22′13″	Seals	2	Swimming
10.20	51°35′34″ 143°24′17″	Seals	1+1	Staying on ice floe
10.36	51°34′57″ 143°26′02″	Seals	1+2	Staying on ice floes
10.38	51°35′00″ 143°26′10″	Seals	2	Staying on ice floe
11.00	51°29′43″ 143°31′49″	Seals	4	Swimming
11.02	51°30′28″ 143°26′34″	Seal	1	Swimming in lolly ice
11.07	51°25′46″ 143°28′55″	Seal	1	Swimming in pancake ice
11.22	51°20′33″ 143°29′44″	Seals	1+1	Swimming
11.22	51°20′16″ 143°29′56″	Seals	2	Staying on ice floes
11.29	51°15′31″ 143°31′46″	Seals	2	Staying on ice floes in the fields of pancake ice

Time	Position	Species	Number of animals	Note
11.31	51°14′36″ 143°32′27″	Seals	2+1	Swimming in the open water space between icefloes
11.53	51°10′26″ 143°32′40″	Seals	1+1+3	Staying on ice floes
11.53	51°10′22″ 143°33′47″	Seals	1+2	Staying on ice floes
11.54	51°09′44″ 143°35′07″	Seals	1+2	Swimming in pancake ice
11.55	51°09′33″ 143°34′39″	Seal	1	Swimming in pancake ice
11.59	51°05′31″ 143°36′01″	Seal	1	Swimming

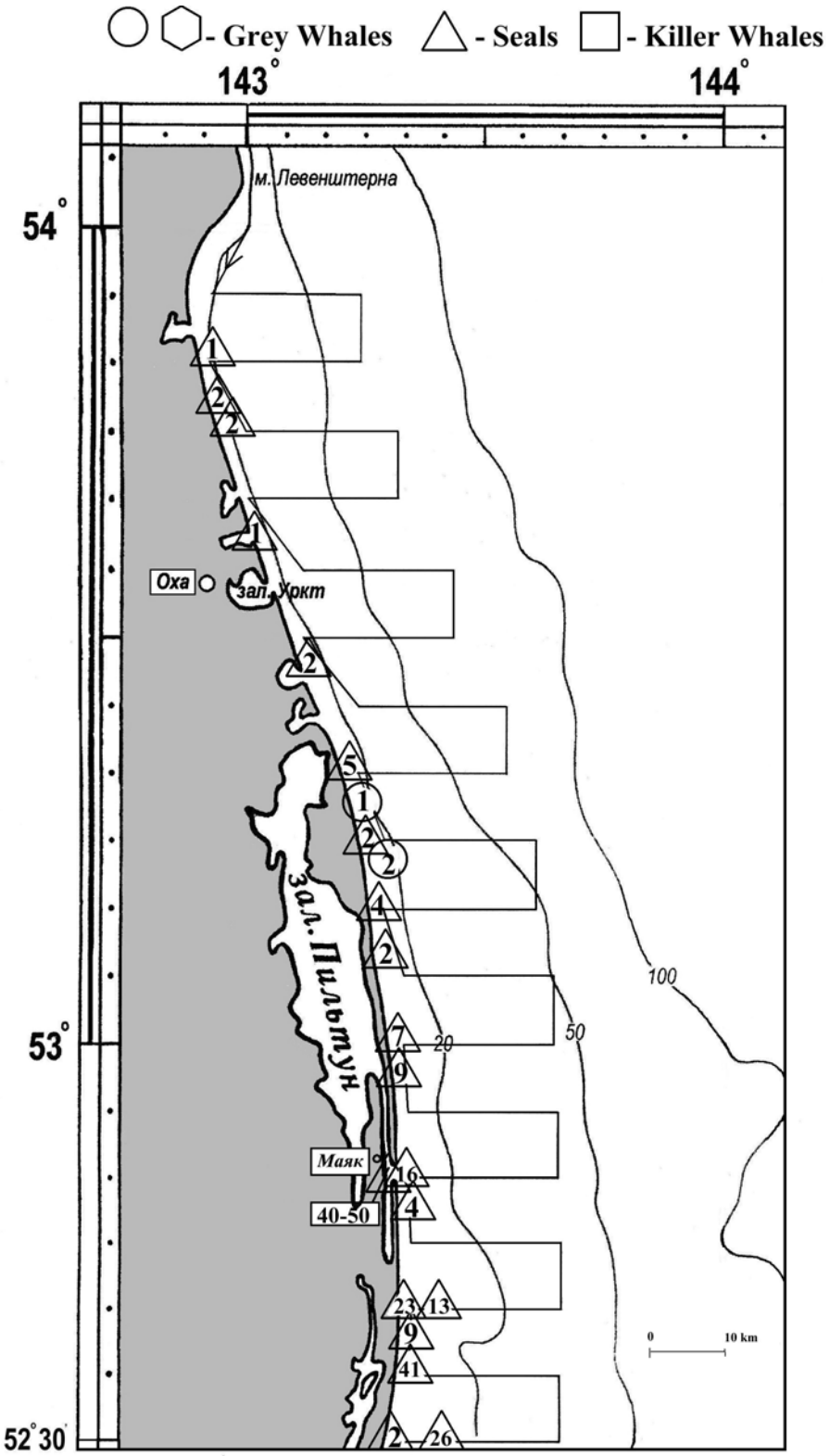
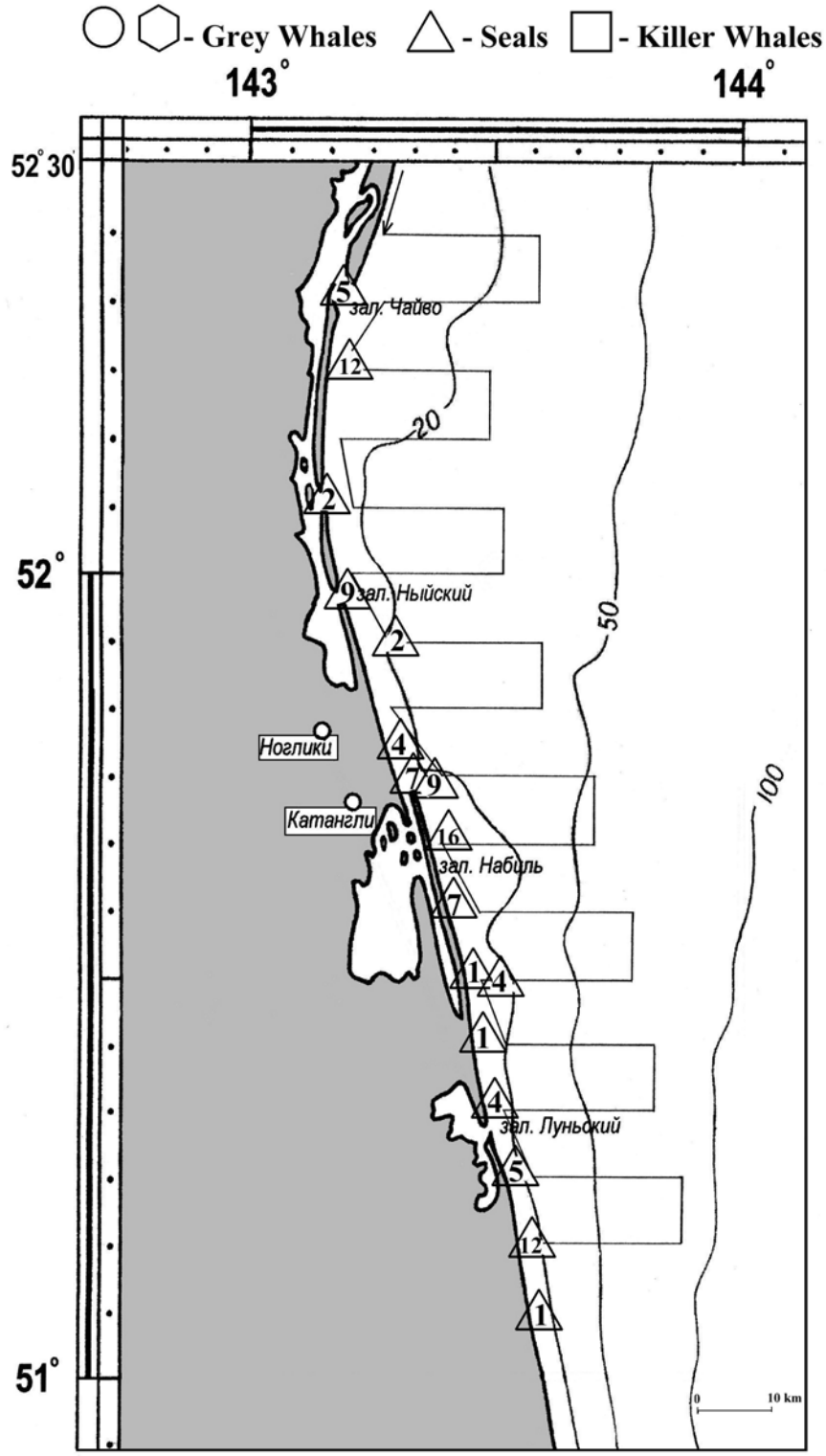


Fig. 6 .2 . Occurrence of mammals offshore North-Eastern Sakhalin in November 2000 (extensive aerial survey, November 19 -20)



Continuation of Fig. 6.2 (November 19-20)

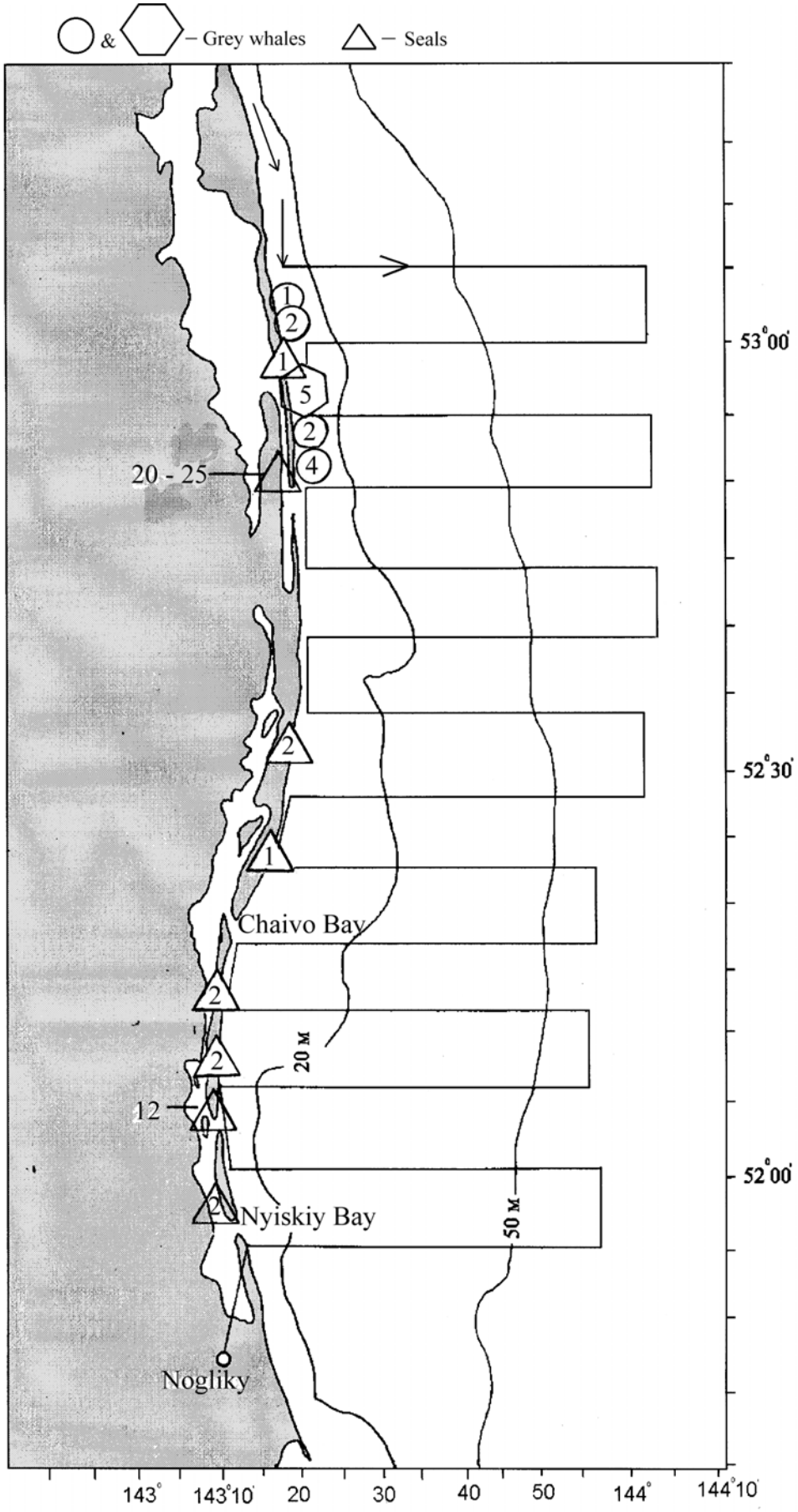


Fig. 6.3 Occurrence of mammals on shelf of Sakhalin by aerial survey at 20 November, 1999

3. Distribution and Number of Seals Offshore North East Sakhalin in June-November 2000.

The aerial survey works conducted in June-November 1999 allowed for the first time to obtain data on the distribution of the pinnipeds in summer autumnal period offshore North East Sakhalin (Sobolevsky, 2000 b). The previous aerial surveys and land observations due to their remoteness (Fedoseyev, 1970; Fedoseyev et al., 1970; Kosygyn et al., 1986; Sobolevsky, 1983, 1988) cannot reflect the distribution pattern of the seals in the studied area at present.

In June 2000 the studies were continued in order to get the accurate information on the seasonal dynamics of the seals number and to determine the main rookeries in their summer habitat areas. The studies mostly confirmed the results of the observations of 1999 that in early summer (June-July) the seals are mainly scattered along the whole offshore zone of North East Sakhalin (Sobolevsky, 2000 b). We observed a similar picture in the vicinity of the Shantar Islands (Sobolevsky, 1999). In that period the seals form rookeries mainly in their traditional habitat areas–Piltun, Chaivo, Lunsky bays and others. The number of the seals on the rookeries in early summer to a great extent depends on the availability of food and the degree of the anthropogenic disturbances. In early summer the greatest abundance of seals was observed in the mouth of Chaivo Bay at the coordinates of 52˚19´north and 143˚11´east. Over 500 seals were recorded there (Table1.1.). In July with the approach of pink salmon to the shores of Sakhalin the number of the seals in Chaivo Bay started to increase (to 800 specimens). In the mouth of Chaivo Bay the seals formed 3 large rookeries. At that time in Lunsky, Nabil and Nyisky Bays the seals were mainly staying at the mouth of the bays, however, they did not form large rookeries. In Piltun Bay in late July 2 seals rookeries were observed: at the mouth of Piltun Bay and at the mouth of Astokh Bay. The total number of the seals according to coastal observations varied within the range of 230-350 specimens.

In August the large rookeries of the seals were observed in Chaivo Bay (4000-5000 specimens). During low tide the seals formed 4 large rookeries on the sand bars there. During the survey helicopter flights most of the seals did not show any anxiety and stayed on the shore. The number of the seals in Piltun, Nyisky and Lunsky bays increased significantly (from 100 to 500 specimens) (Table 3.2.). The number of the seals remained low in Nabil Bay, which is possibly connected with the continuous presence of fishermen there and the disturbance of the seals.

In September the seals aggregations were observed in Chaivo and Piltun Bays. In Chaivo Bay over 2 thousand seals and over 500 seals in Piltun Bay were observed (Fig. 4.1. and 4.2.; Table 4.1. and 4.2.). In Lunsky, Nabil and Nyisky Bays there were no seals rookeries. In September 2000 the number of the seals was approximately twice as much in Chaivo and Piltun Bays as compared with the similar period in 1999.

In October the number of seals increased significantly in Piltun Bay (Table 5.3) and comprised 800-900 specimens. In Chaivo Bay, on the opposite, it decreased approximately twice (Table 5.3.) In October there were 2 large rookeries in Chaivo Bay: the first one was on the sand island that appeared after a strong storm, the second one was situated approximately 500 m from the mouth of Chaivo Bay on the coast of a large channel. In summer there was no that rookery there and the seals were staying at the mouth Chaivo Bay. In October almost no seals were found at the mouth of Lunsky Bay and Nabil and Nyisky Bays.

In November most of the seals left the bays and stayed close to the shore in the fields of young pancake ice. In late November Piltun, Chaivo, Nyisky, Nabil and Lunsky Bays were covered with snow. In the mouth of Piltun Bay on 40-50- seals were observed. Individual seals were observed in Chaivo and Nyisky Bays (Table 6.2.). During the two days of the flights (19-20) over 300 seals were observed in the offshore aquatorium (Table 6.1; 6.2 and Fig. 6.2.), out of which about bearded seals comprised 15%, which were laying individually and in small groups on ice floes and were easily distinguished from other seals.

When analyzing the seals distribution in 1999-2000 it is noteworthy that there was a significant increase in seals number in summer autumnal period in 2000 offshore North East Sakhalin. It was especially typical of Chaivo and Piltun Bays, where the maximal abundance increased approximately twice. The coastal observation showed that in 2000 in Piltun and Chaivo Bays the number of bearded seals and ringed seals increased significantly. In 1999 only individual bearded seals were observed (Sobolevsky, 2000), but in summer 2000 the groups of bearded seals consisting of 5-10 and more specimens were continuously observed in the coastal rookeries. Young bearded seals were quite often observed in Piltun Bay and in November on small ice foes north of Chaivo Bay. The increase in the number of seals and especially of bearded seals is probably connected with the cessation of commercial fisheries offshore Sakhalin and testifies of the restoration of the seals stocks in the Okhotsk Sea.

4. Results of Acoustic Studies in situ

In this section of the Report the results of spectral analysis of the acoustic background, measured near the «Molikpaq» and in the traditional feeding area of gray whales, are presented. In sections 1.4 a short description of the works was presented, which were carried out at the studied aquatorium of the shelf of the Okhotsk Sea during the acoustic measurements, the results of which are considered in detail in this section.

4.1. Specifics of Acoustic Background in the Vicinity of Molikpaq Platform

In Fig. 4.1-4.3 the plots of the power density spectral values $G(f)$, and their sonograms $G(f,t)$, obtained from the results of the stationary measurements of the acoustic field in the point p.2, carried out in June, 2000, are presented. The colored (spectral density value is shown by color) illustration $G(f,t)$ in Fig. 4.1 shows the variations of spectral density of the acoustic field 2.5 miles from «Okha» at night. During those measurements there were the maintenance vessels on the aquatorium: «Smit Sibu», «Agat», «Trias», and to «Okha» a tanker was moored that was maintained by the tugboat «Smit Sakhalin» and oil transfer was carried out. At night on June 28 the chain: «tank», «Okha», the tanker, the working tugboat «Smit Sakhalin» - stretched from south to north, and in the morning on June 29 the changed tidal flow turned it by 180^0. From the board of the rescue vessel «Agat» a transmitter was suspended and the sound was generated in water with a frequency of about 3068 Hz. In Fig. 4.1 it is seen, that the peak of spectral density of the measured acoustic field at that frequency is well expressed and its level exceeds the level of the background by over 5 dB. In the plots $G(f,t)$ the stationary (during twelve hours) frequency interferential structure

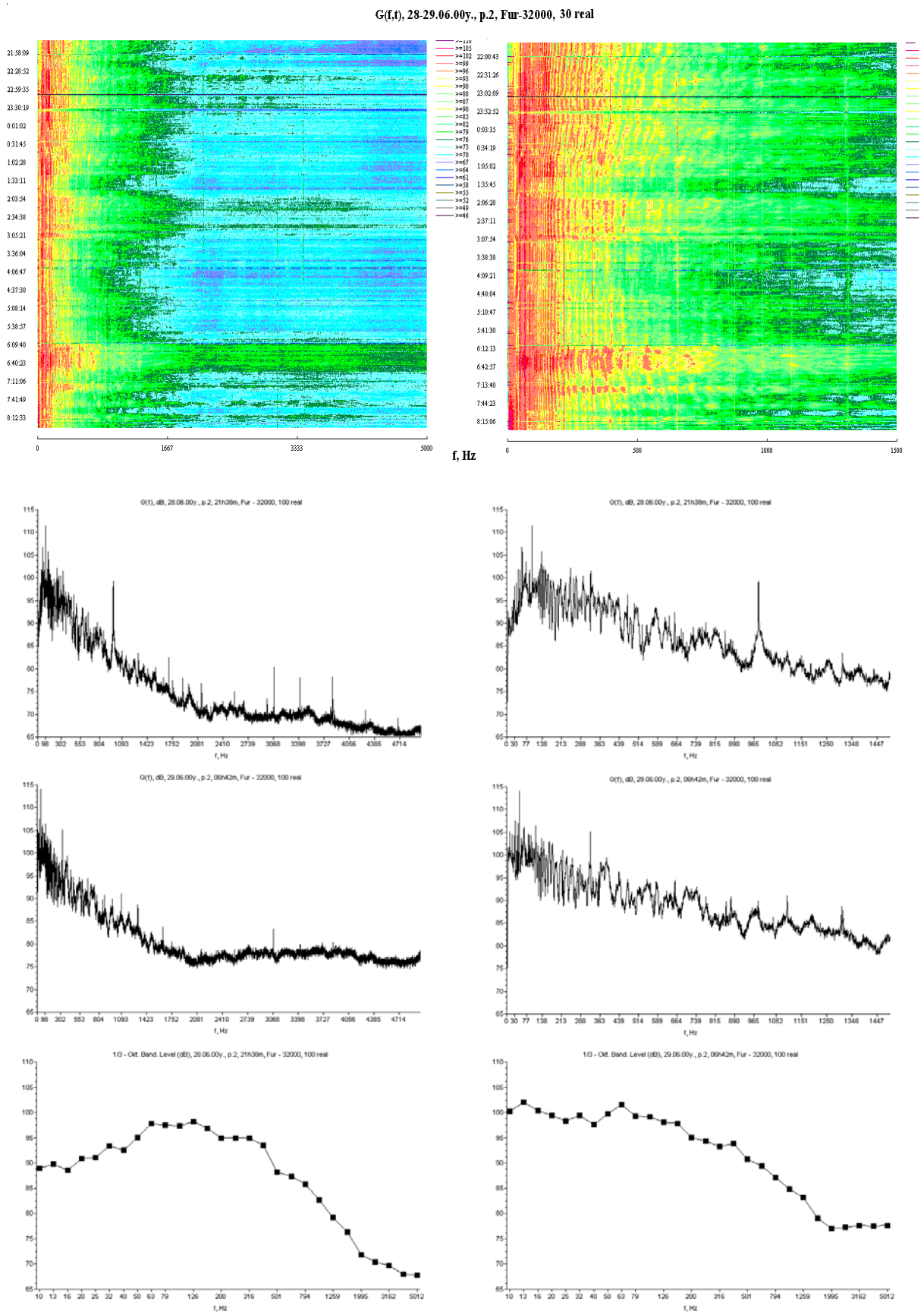


Fig. 4.1. Results of acoustic measurements, carried out on June 28-29, 2000, in the point p.2.

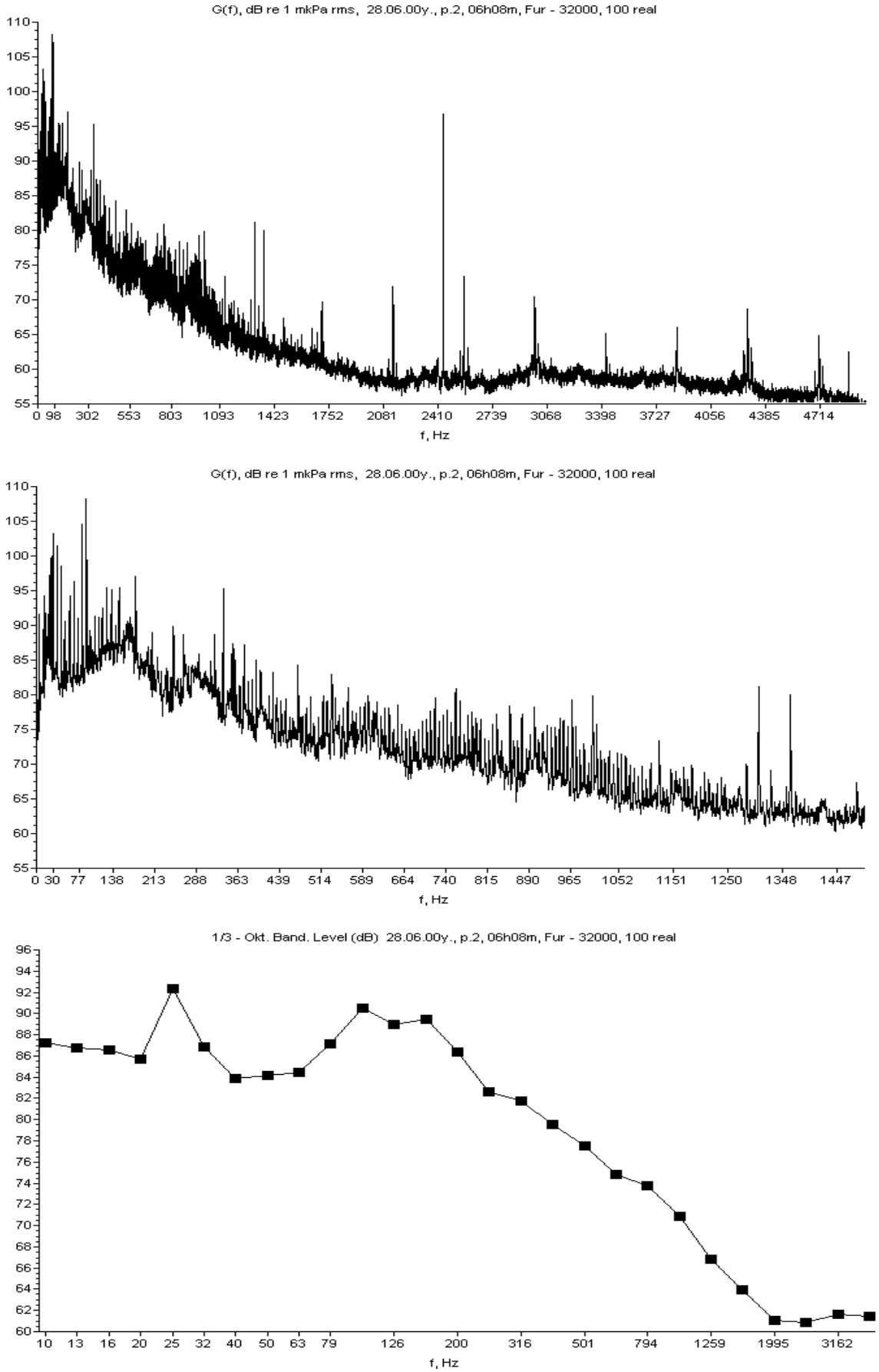


Fig. 4.2. Results of acoustic measurements, carried out on June 28, 2000, in the point p.2.

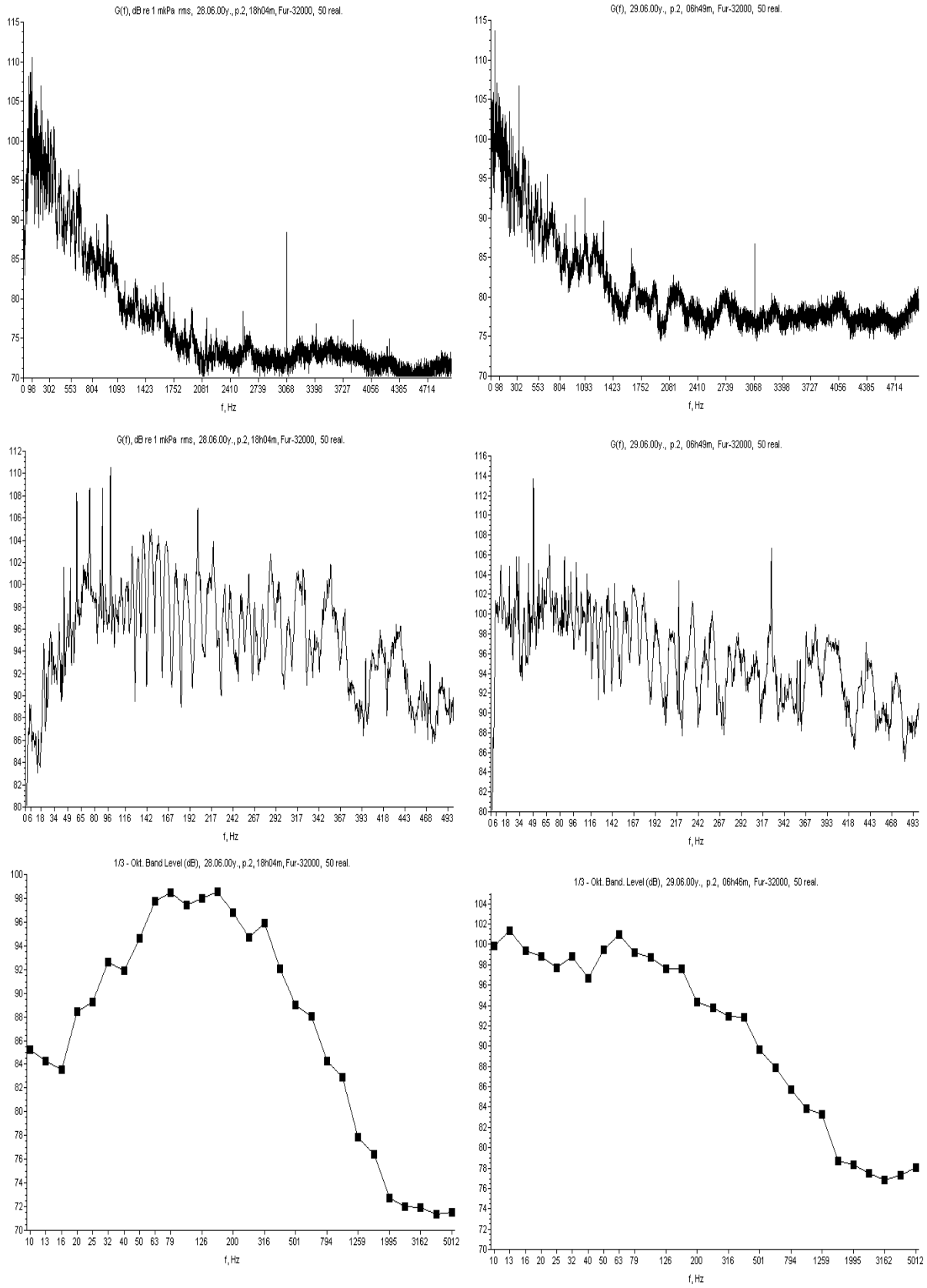


Fig. 4.3. Results of acoustic measurements carried out on June 28 and 29 in the point p.2.

of the acoustic field within the band to 600 Hz, generated in the point p.2 by wide-band noise sources is well expressed, which testifies of their relative motionlessness, the vessels were anchored. A sharp increase in the noise intensity at some time intervals, for example, at 6.12 a.m. – June 29 (see Fig. 4.1) is due to the change in the working regime of the maintenance tugboat. In Fig. 4.1 in the plots $G(f)$ the tonal components, corresponding to the acoustic noise generated by the working machines and mechanisms both on the vessels and at the «Molikpaq» platform, are also well expressed. It is known that there are following sources of machine vibrations:

1. Rotation of disbalanced parts of machines, for example, eccentric shafts or motor armatures;
2. Repeated bumps and collisions;
3. Reciprocating motion of some parts of mechanisms such as internal combustion engines;
4. Cavitations and turbulence of fluid flow in the pumps, pipes, valves and condensers;
5. Mechanical friction in bearings and journals.

The first three sources produce *line spectrum* where tonal components as the main harmonics of the vibration-generating process dominate; the two other sources generate noise with a *continuous spectrum* with superimposed discrete components when resonance vibration occurs in the structural elements. That is why the machinery noise spectrum of a moving object can be presented as a superposition of a low-level continuous spectrum and strong discrete components.

The plots $G(f)$ presented in Fig. 4.2 correspond to a relatively calm level of the acoustic background in that aquatorium, when the maintenance vessels were anchored and there was no tanker near «Okha» and on the roadstead. In that case the level of the acoustic tonal signal with a frequency of 2,5 kHz, generated from the board of the rescue vessel «Agat», exceeded the background level by over 35 dB.

The curves $G(f)$ in Fig. 4.3 show the quantitative changes of the industrial acoustic background in the point p.2, which correspond to the turn of the chain by 180^0: «tank», «Okha», tanker, the tugboat. On July 28 at 6 p.m. this chain was directed northward, which corresponded to the maximal distance of the working tugboat from the point p.2 (see Fig. 1.1), in which the acoustic measurements were taken, and at 7 p.m. on July 29 (see Fig. 4.3) it was directed southward. In Fig. 4.3 it is seen, that the arrival of the working tugboat to the point p.2 resulted in the increase of the level of spectral density of acoustic noise in almost all studied frequency band. It should be noted that on June 27-29 the vessel «Neftegaz-16» joined the maintenance vessels.

The results of spectral analysis of the acoustic background, synchronously measured at two points (p.4 and p.3) of the «Molikpaq-Piltun» route (see map in Fig. 1.1), are presented in Fig. 4.4 - Fig. 4.8. During those acoustic measurements there were the following maintenance vessels at the aquatorium: «Smit Sibu», «Agat», «Trias», «Smit Sakhalin». In Fig. 4.4 and Fig. 4.5 the plots $G(f,t)$ and $G(f)$ are given, which illustrate spectral and frequency-temporal characteristics of the acoustic noise, generated near the «Molikpaq», as well as the losses (attenuation) during its propagation in the area of aggregations of gray whales. For the quantitative comparison during those measurements from the board of the anchored rescue vessel «Agat» a tonal signal with the frequency of $\approx$4 kHz was generated. In Fig. 1.1 it is seen, that the distance from «Agat» to the point p.4 was 2 miles, and to the point p.3 – 4.3 miles. This testifies of a relatively low background level in the studied aquatorium, corresponding to the drift at a significant distance (north-east) from the «Molikpaq» of the tanker «Andaman Sea» and the calm position of the maintenance vessels. The changes in the acoustic noise level in the aquatorium during the movement of any vessel are illustrated by the sonograms $G(f,t)$ presented in Fig. 4.6. Till 1.32 p.m. between «Molikpaq» and«Okha» the vessel «Smit Sakhalin» was maneuvering. Afdter 2.07 p.m. the vessel «Smit Sakhalin» started to move again near «Molikpaq» and till 4.30 p.m.

this vessel was maneuvering between «Molikpaq» and «Okha». At 5.58 p.m. the roadstead vessel «Miss Sybil» approached «Okha» from north and after the people transfer at 5.23 p.m. it approached the tanker «Andaman Sea». At 5.56 p.m. the vessel «Miss Sybil» left the tanker and at 6.14 p.m. it approached «Molikpaq».

The plots $G(f)$ in Fig. 4.4 and Fig. 4.5 show the spectral composition of the acoustic noise, generated near the «Molikpaq» platform and the specifics of its propagation in the shallow water part of the shelf, approximately along the «Molikpaq – Piltun» route. The low-frequency part of the noise spectrum to 1 kHz, in accordance with the plots $G(f)$ in Fig. 4.4 and Fig. 4.5, can be presented as a superposition of line and continuous spectra. In Fig. 4.5 it is seen, that the tonal components of line spectrum are well expressed in the noise acoustic background, measured both in the point p.4, and the point p.3. It is noteworthy that there was an increase in the losses during the propagation of the noise along the route, which was approximately proportional to its frequency (see Fig. 4.5, plots $G(f)$ p.4, p.3). At the frequencies above 1 kHz, according to Fig. 4.4, the tonal noise signals are well expressed, which are probably the harmonics and the components of the powerful tonal acoustic noise sources, operating in that aquatorium. First of all, it is important to distinguish the signal at the frequency of ≈ 1.6 kHz, which was easily registered in almost all experiments. The typical characteristic of those tonal noise signals is that they are repeated at approximately 440 Hz.

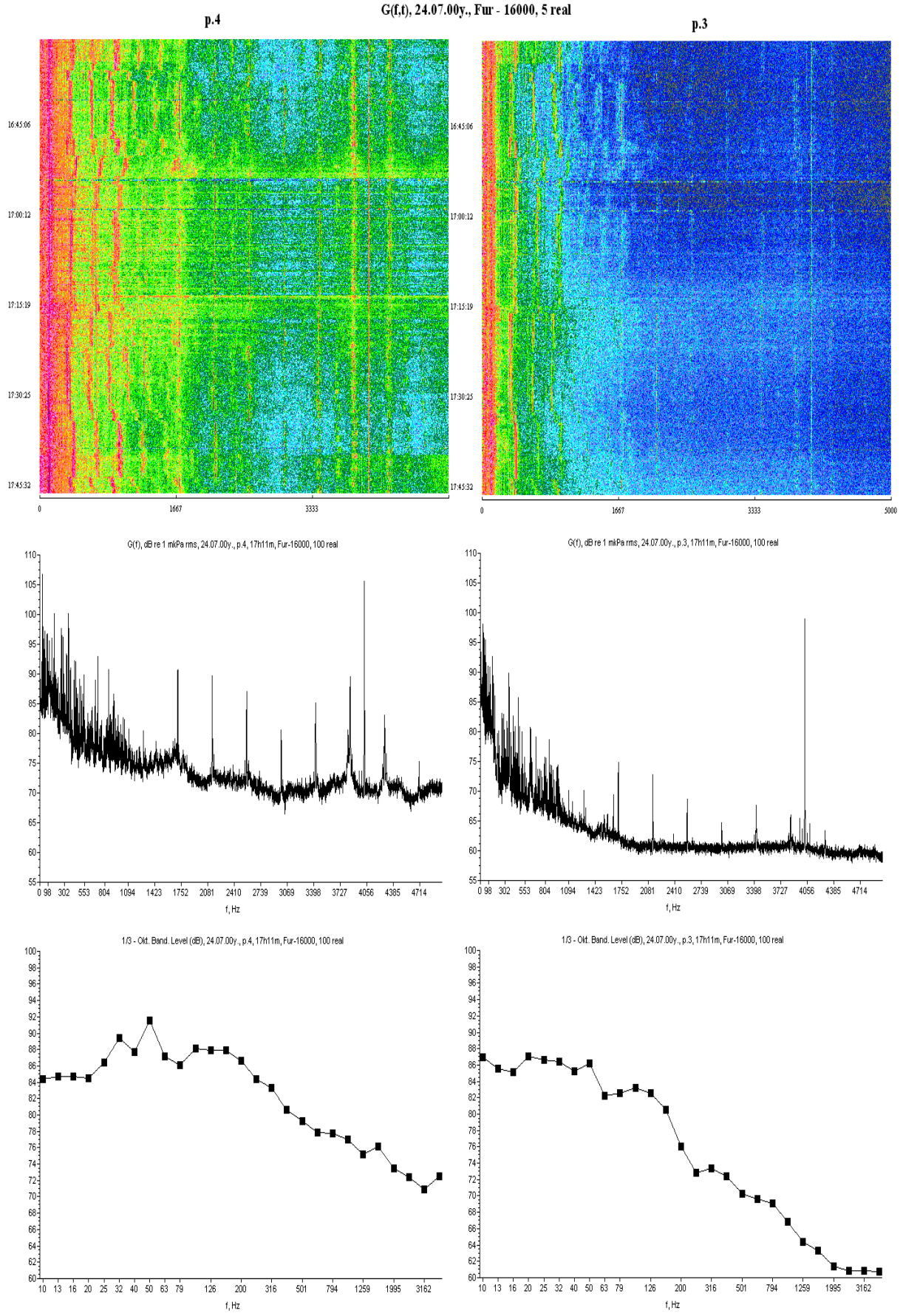


Fig. 4.4. Results of spectral analysis of the acoustic signals synchronously measured on July 24, 2000 at the «Molikpaq – Piltun» route in the points p.4 and p.3 (see Fig. 1).

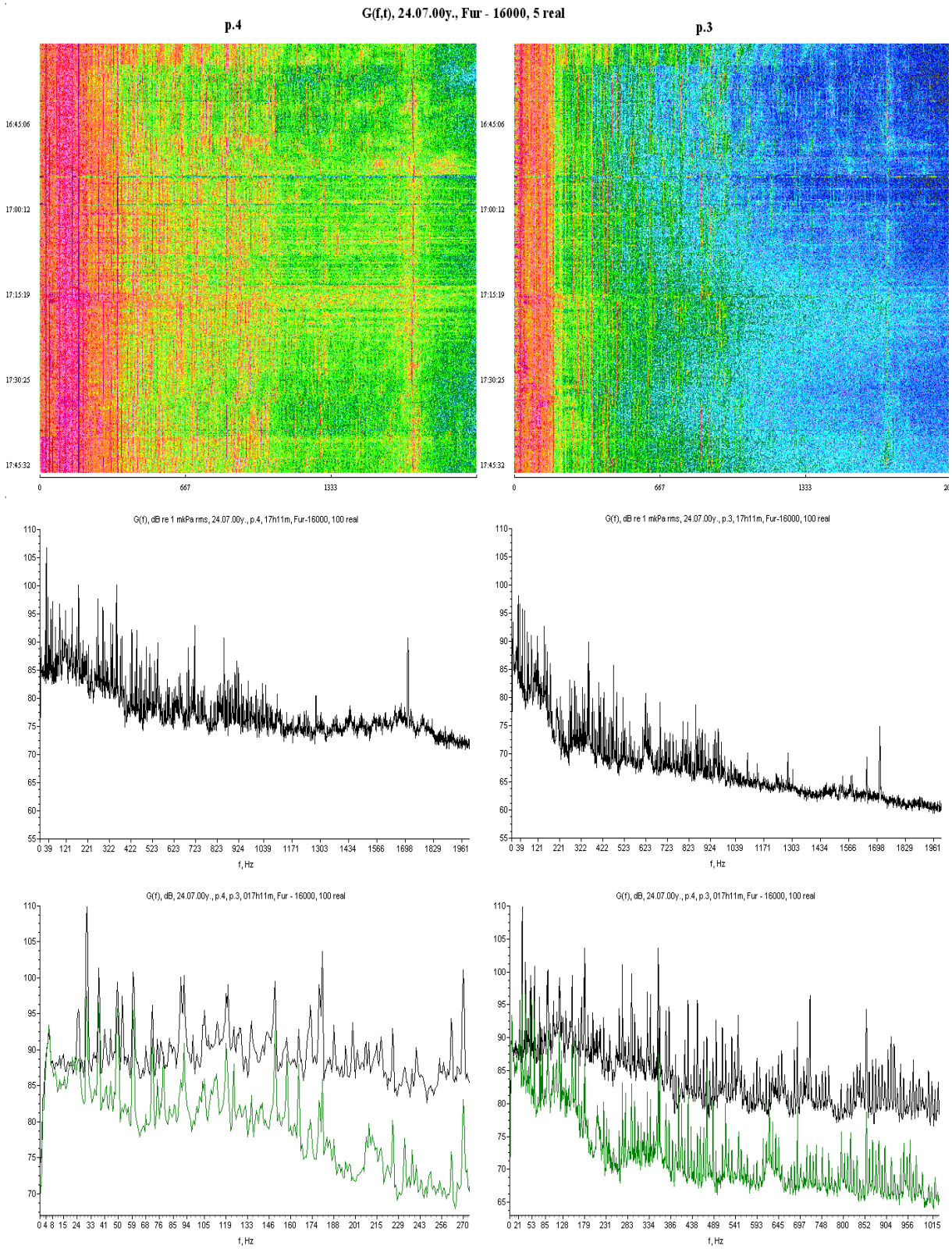


Fig. 4.5. The same as in Fig. 4.4, but the low-frequency parts of spectra are shown with more detail. For visual analysis of the low-frequency tonal components of industrial acoustic noise the plots $G(f)$ are given in the same axes. Black curves correspond to the signals measured in the point p.4, and the green ones – in the point p3.

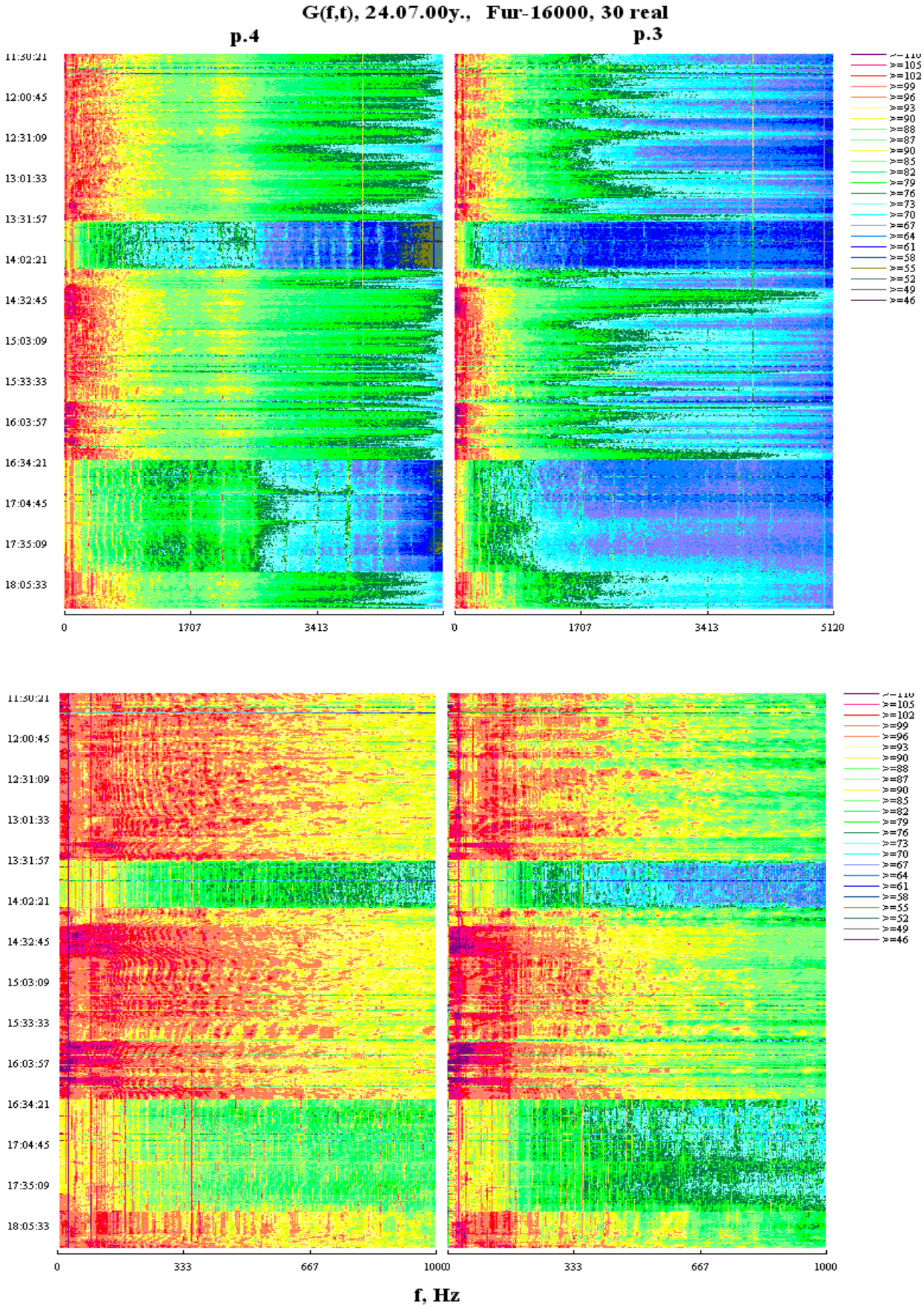


Fig. 4.6. Sonogram power density spectra of the acoustic signals synchronously measured in the points p.4 and p3 (see Fig. 1.1) July 24, 2000.

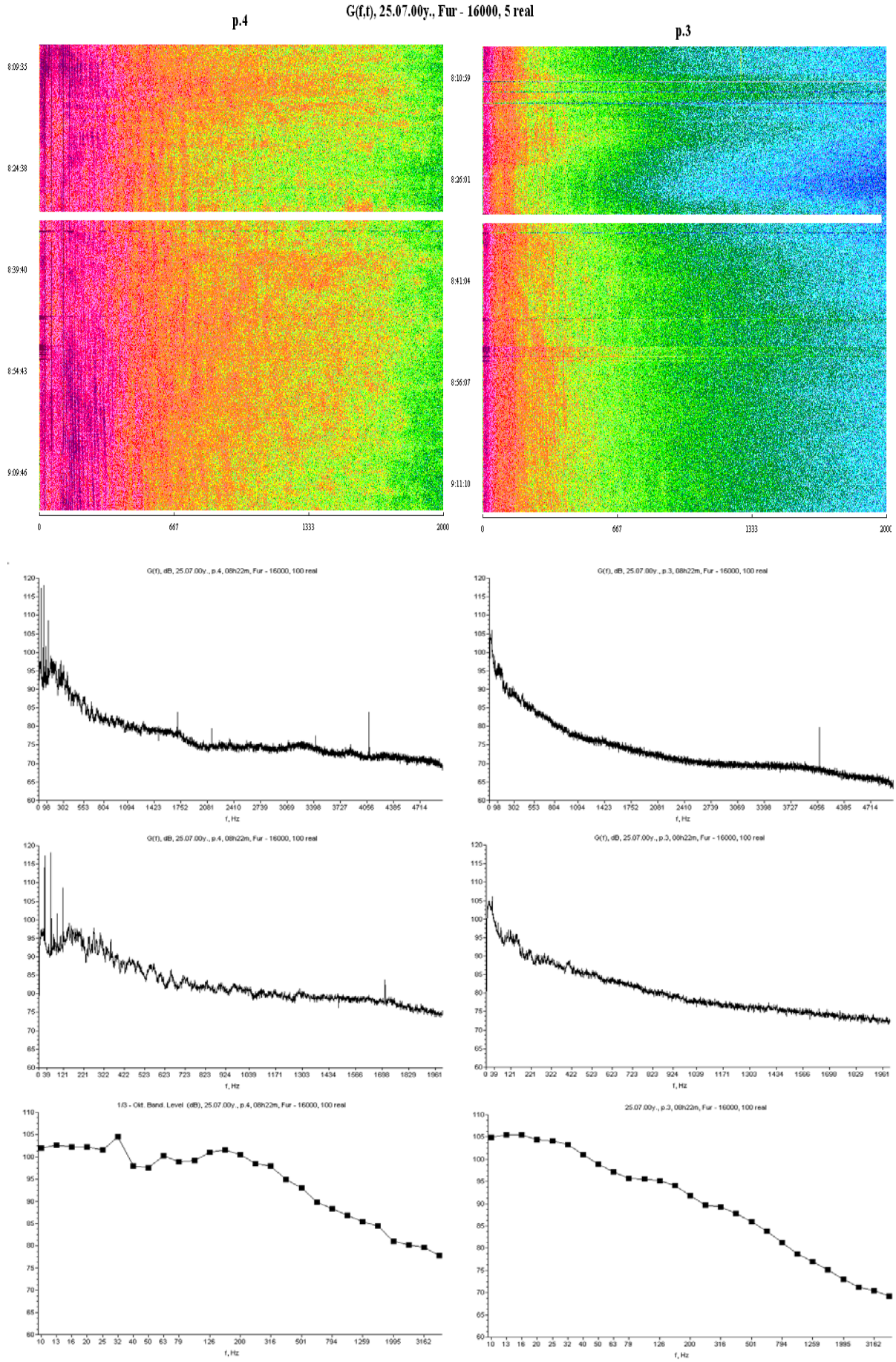


Fig. 4.7. The results of spectral analysis of the acoustic signals synchronously measured in the points p.4 and p.3 (see map in Fig.1.1) July 25, 2000.

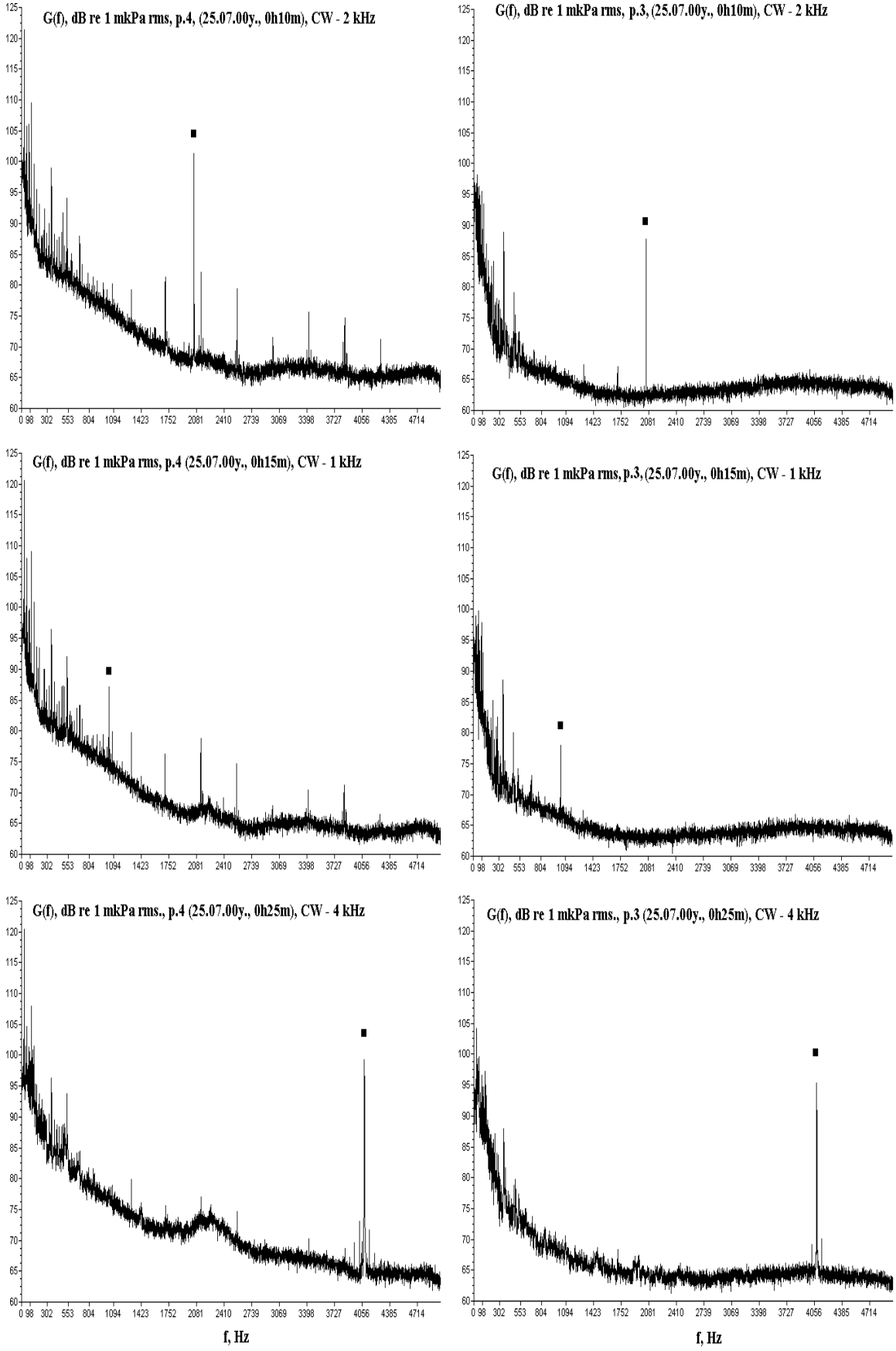


Fig. 4.8. Results of synchronous measurements in the points p.4 and p.3 of the acoustic tonal signals generated in the anchorage point of the rescue vessel «Agat» (see map in Fig.1.1).

The noise level with continuous spectrum in the points p.4 and p.3 (see in Fig. 4.4 the plots in 1/3 – okt band) in the frequency band to 126 Hz, are approximately similar, within the band from 200 to 794 Hz they differ by 8-10 dB, and at the frequencies above 1 kHz by over 12 dB.

The results of spectral analysis of the acoustic background, synchronously measured in the points p.4 and p.3 in the morning on July 25 are presented in Fig. 4.7. The level of low-frequency narrow-band noise generated by the vessels gathered around «Molikpaq» increased to such an extent that the acoustic reception systems entered the restriction by the level of the coming signal (especially during their movement), for which reason we give a short realization corresponding to the measurements taken with maximal accuracy.

The results of the sound propagation with a frequency of 1, 2 and 4 kHz from the anchorage point of the rescue vessel «Agat» to the points p.3 and p.4 (see Fig. 1.1), are presented in Fig. 4.8. The distance from «Agat» to the point p.3 was approximately twice as much as that to the point p.4. In Fig. 4.8 it is seen that the levels of the acoustic signals synchronously measured in those points differ by the level for CW - 1 kHz by 9 dB, CW – 2kHz by 13 dB and CW – 4 kHz by 6 dB.

4.2 Results of Acoustic Background Measurements in the Traditional Feeding Area of Gray Whales

The measurements of the acoustic noise in the offshore zone in the traditional feeding area of gray whales were conducted in July – point p.5 and September – point p.6 (see map in Fig. 1.1). In those experiments the reception of the radiotelemetric signal was conducted at the Piltun lighthouse. The uniqueness of those measurements is caused by the lack of any electromagnetic disturbances that can interfere with the acoustic measurements as far as the diesel-generator**,** supplying the illumination and power of the electric equipment, worked at specific and relatively short time intervals. The accumulative batteries provided the power supply of the receiving-registering equipment**.**

The temporal variability of the acoustic background in the point p.5, situated at a distance of over 11 miles from the «Molikpaq» (see Fig. 1.1), is shown in Fig. 4.9. In this sonogram $G(f,t)$ the low-frequency tonal and relatively wide-band episodically occurring noise components generated by stationary sources are well expressed. In Fig. 4.10 a sonogram $G(f,t)$ is presented, which corresponds to the acoustic background, measured near the «Molikpaq» in September 1999. This figure illustrates the changes in the intensity of the acoustic noise (after 10.30 p.m.) in that aquatorium after anchoring of the moving vessel; the spectra of the acoustic signals, generated by marine animals– a group of killer whales (time interval from 0.30 a.m. to 2 a.m.), but the main thing is that, in Fig. 4.10 (see the plots $G(f,t)$ after 2 a.m.) similar to Fig. 4.9 (see time interval till 1 a.m.), the relatively low-frequency and wide-band noise generated by a periodically switched on mechanism is well expressed.

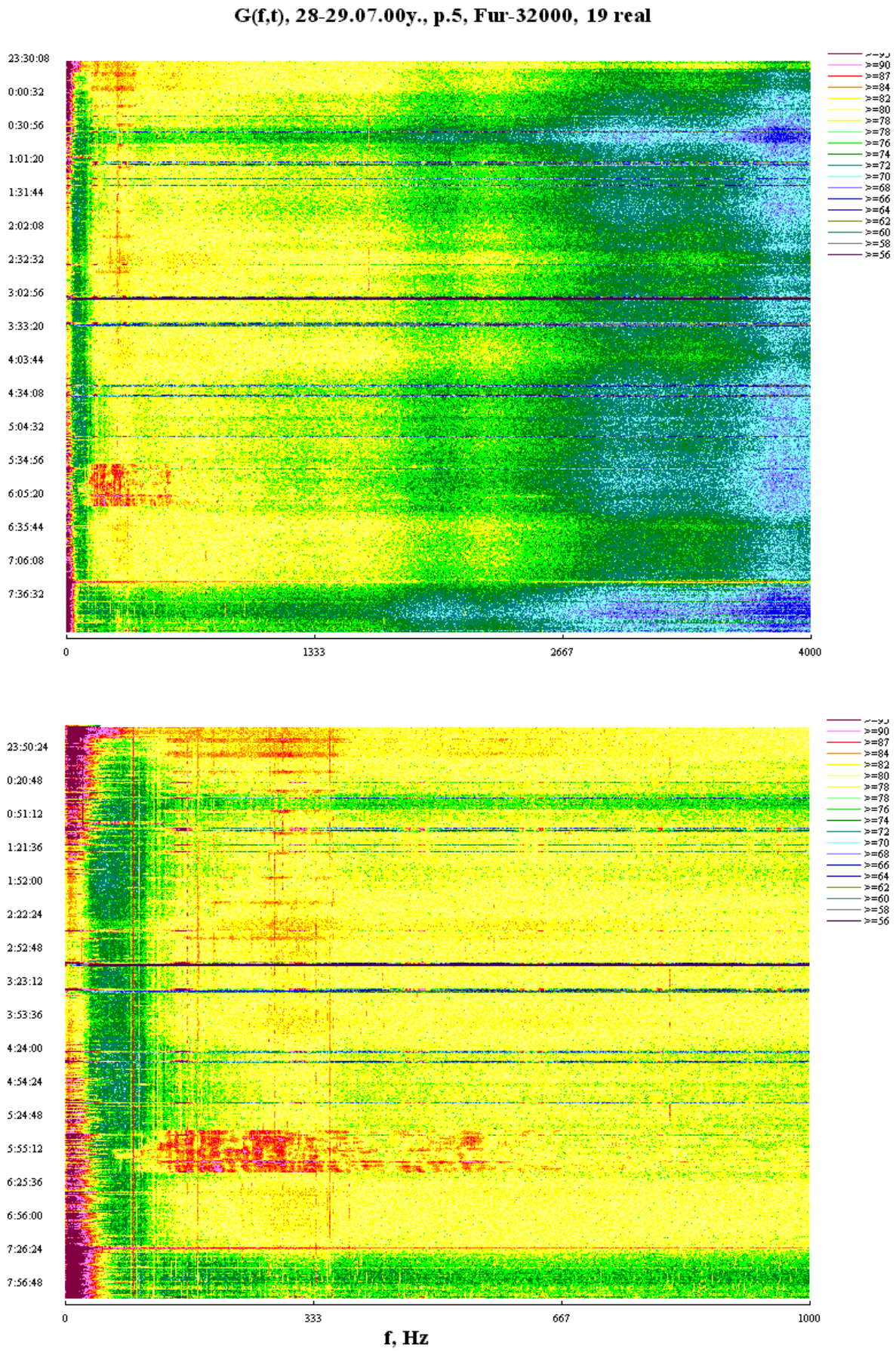


Fig. 4.9. Results of measurements of acoustic background in the point p.5 (see map in Fig.1.1).

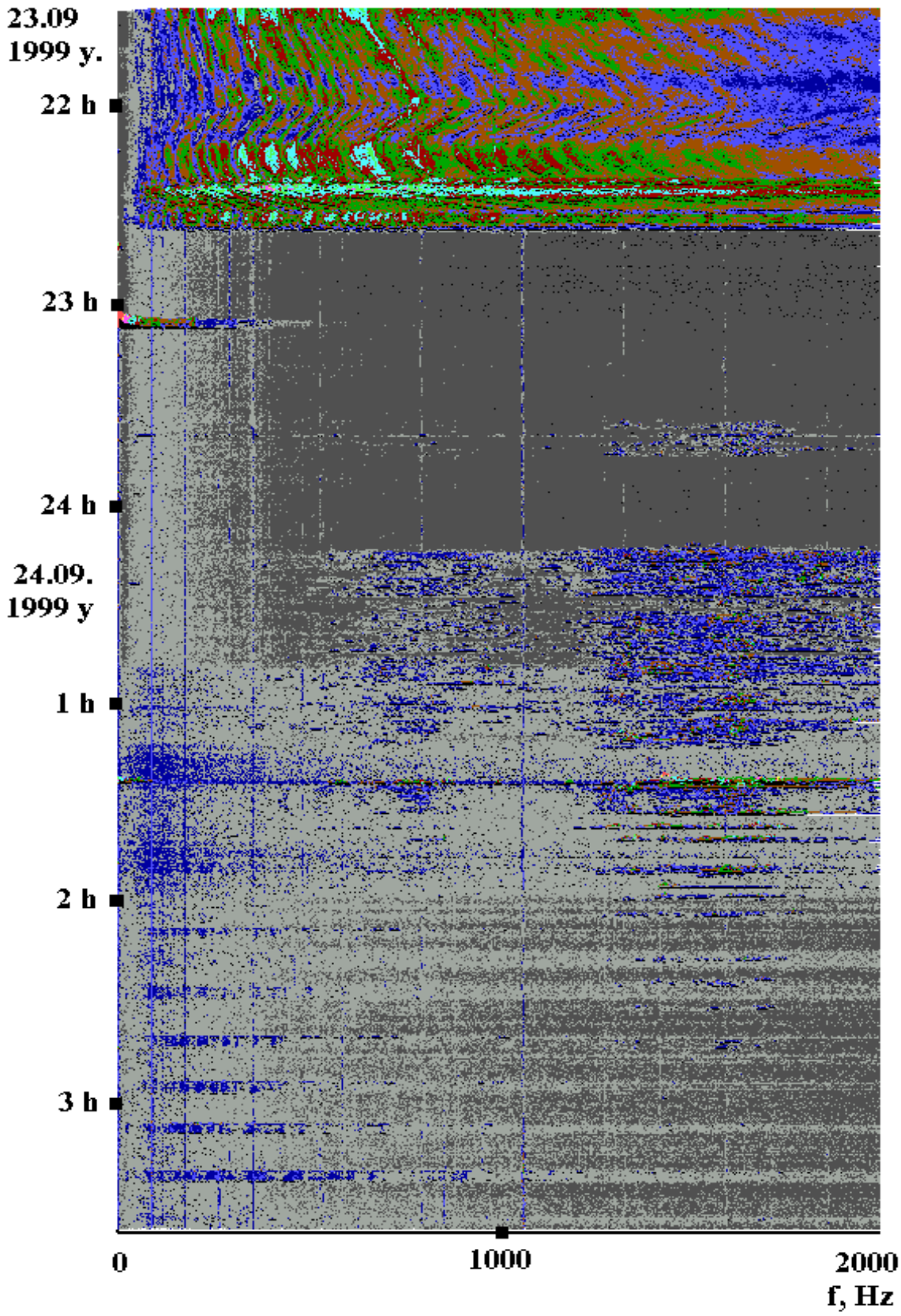


Fig. 4.10. Sonogram $G(f,t)$ of the acoustic background, measured at night on September 23-24 in 1999 near the “Molikpaq”.

A sharp increase in the noise level within the band of 100 to 600 Hz after 5.30 a.m. (see Fig. 4.9) is connected with the movement of the vessel. In Fig. 4.11 the power density spectrum values $G(f)$ of the acoustic background in the point p.5 are presented, corresponding to that time interval. In the plot $G(f)$ the relatively narrow-band power peaks are well expressed at low frequencies, which are common for the frequency interferential structure of the noise field, generated by a moving vessel. The noise spectra, generated by the stationary sources are shown in Fig. 4.12. In all the plots $G(f)$ in these figures the spectral density peak is well expressed at the frequencies less 40 Hz, which is caused by the flow noise of the measuring hydrophone and the sonar buoy. The buoy was situated at over 70 m from the hydrophone. In the acoustic background spectra the tonal components are well expressed, the level of which far exceeds the level of the wide-band noise. For example, the level of the tone with a frequency of 1.6 kHz exceeds the level of the «white» noise by over 6 dB (see Fig. 4.11). In Fig. 4.13 the plots $G(f)$ corresponding to the high level of the industrial noise in the point p.5 are presented. From that figure it is obvious that during the mooring and oil transfer works from the tanker near the «Molikpaq» швартовых и перегрузочных работ с the level of noise tonal components in the feeding area of whales at the frequencies less 200 Hz can reach 96 dB. However, in the afternoon on July 29 from c 3.30 p.m to 4.20 p.m. in the point p.5 the acoustic signals, presumably, generated by a group of killer whales were well heard. In Fig. 4.14 the sonograms $G(f,t)$ of the noise background and the spectrum $G(f)$ of the acoustic signals, generated by marine animals are presented. A heavy fog made it impossible to take visual observations of the sea surface near the buoy, that is why we cannot say how many animals were there in the group.

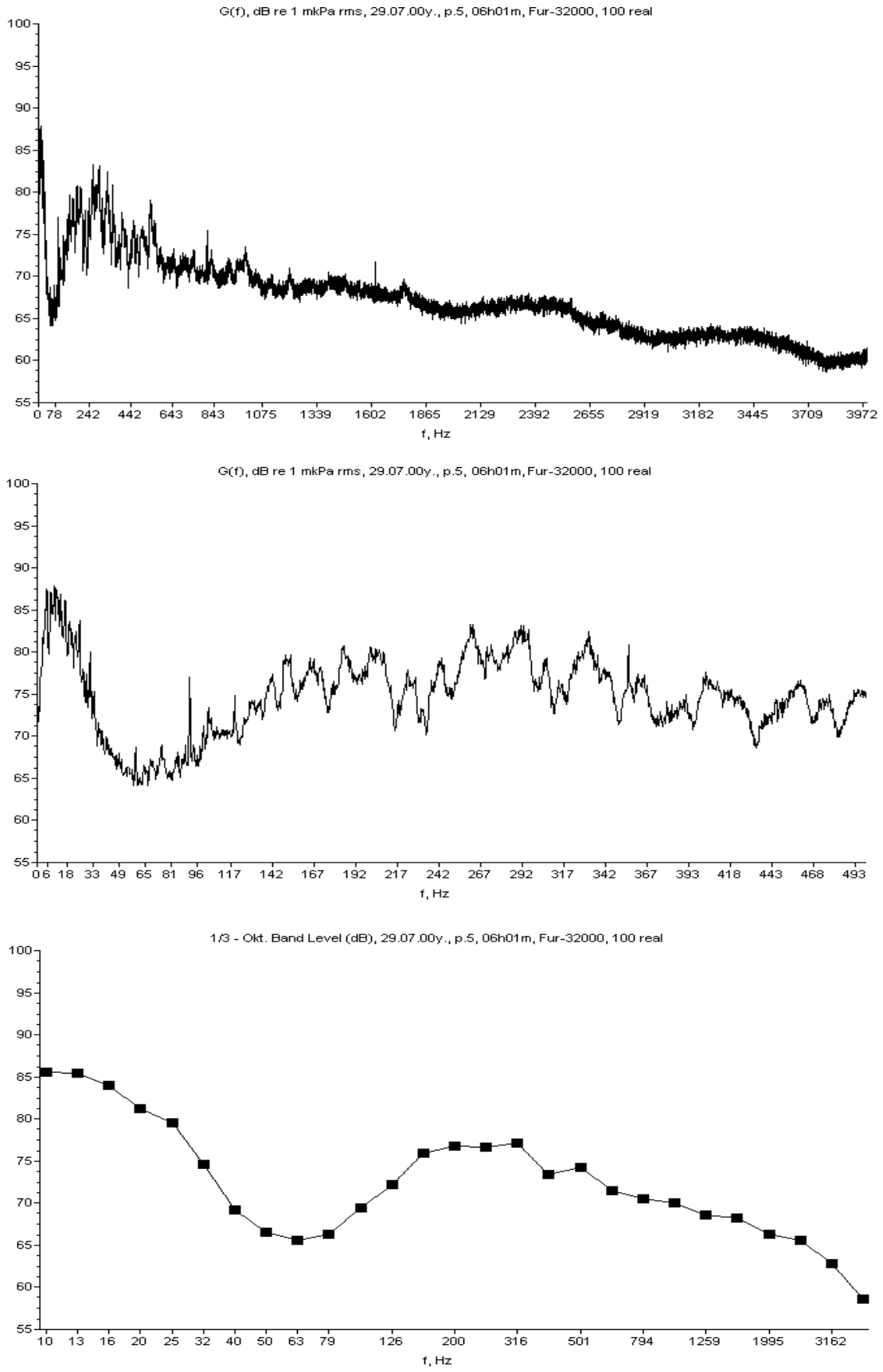


Fig. 4.11. Power density spectral values of the acoustic background measured in the point p.5 during the vessel movement near the «Molikpaq».

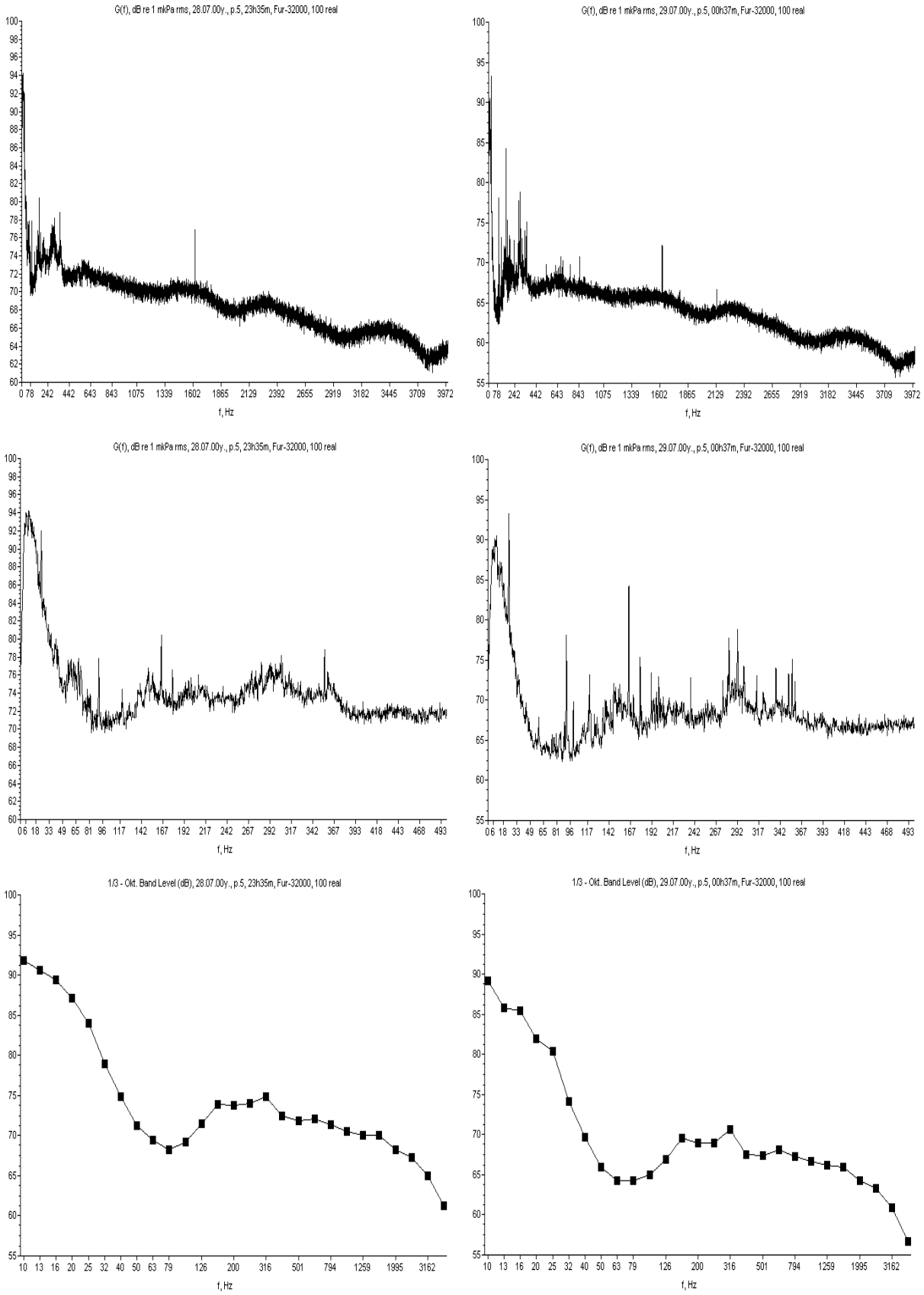


Fig. 4.12. Power density spectral values of the acoustic background measured in the point p.5.

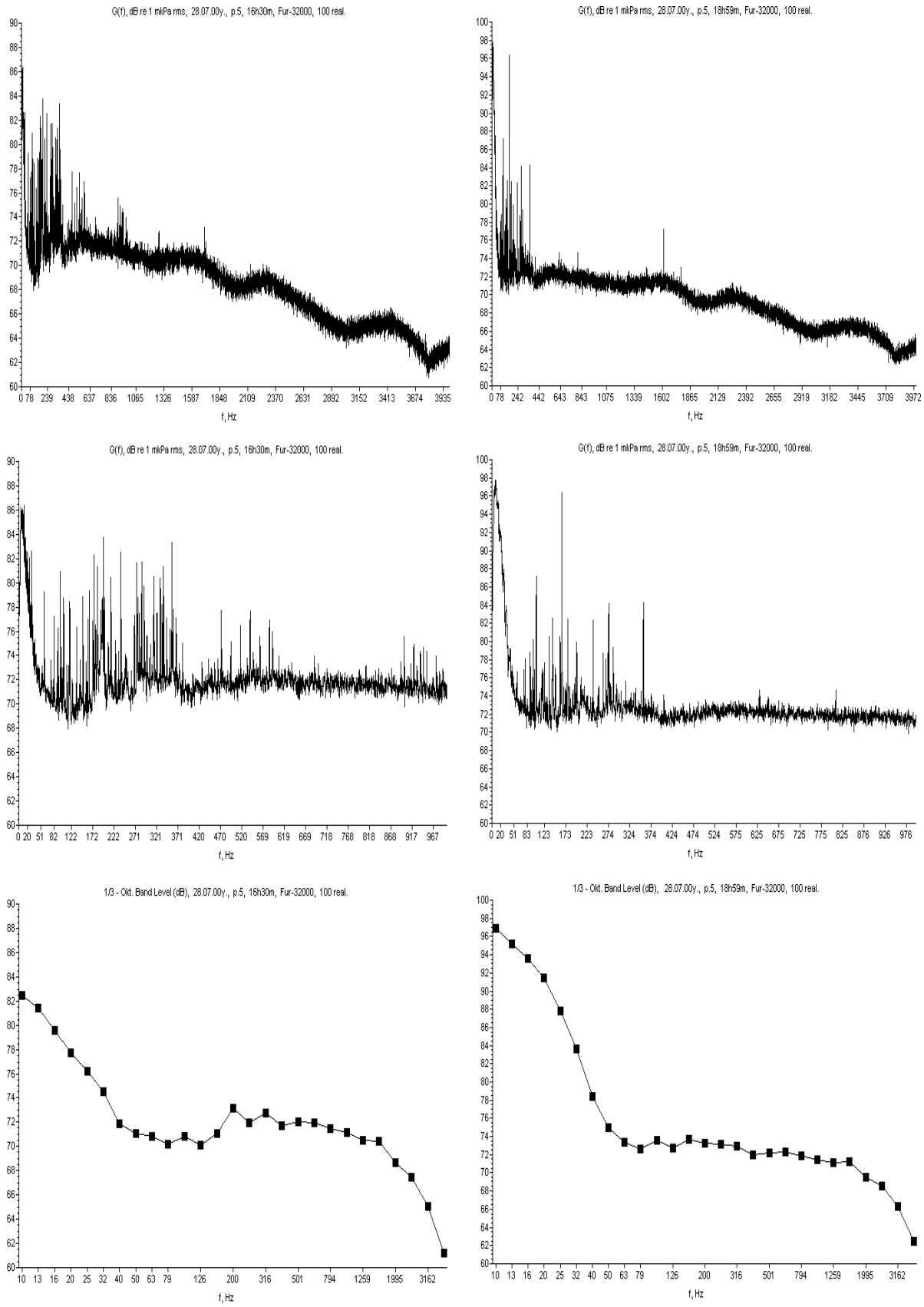


Fig. 4.13. Power density spectral values of the acoustic background measured on July 28 in 2000 in the point p.5.

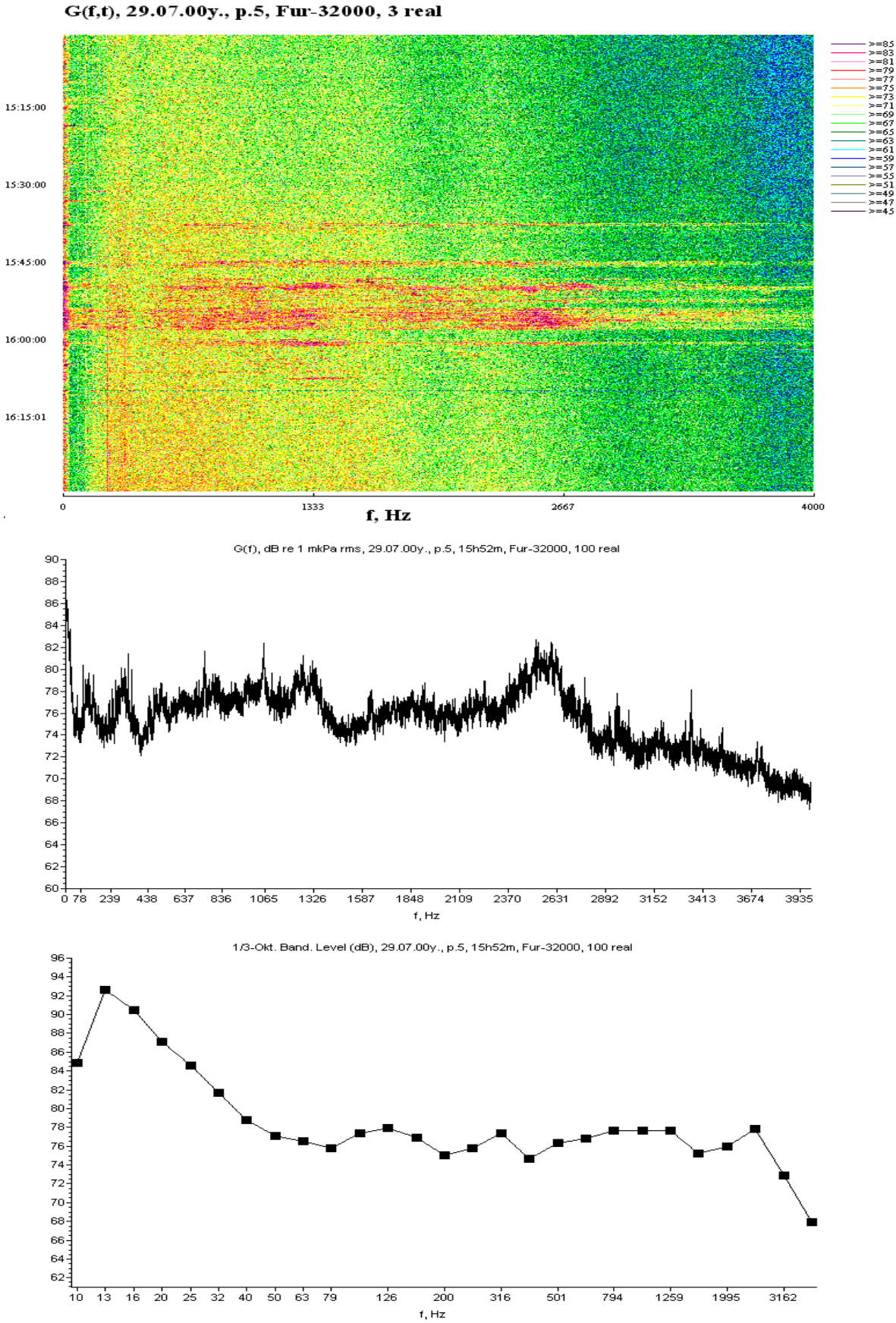


Fig. 4.14. Sonogram $G(f,t)$ of the noise background and spectrum $G(f)$ of the acoustic signals, generated by a group of killer whales. The measurements were taken on July 29 in the point p.5.

The results of the spectral analysis of acoustic data, corresponding to small wave action and almost no ripples, and as a result, the low level of the flow noise by the surface waves of the buoy, are shown in Fig. 4.15. In that case, in the plots $G(f)$ the acoustic noise within the band to 3 kHz is well expressed. A relative stability of the frequency interferential structure of the noise field within the band to 600 Hz allows to make a conclusion that their sources are stationary and the frequency shifts in the interferential maximums observed in $G(f,t)$ after 4 a.m. could be caused by the changes in the direction of the tidal flow, which resulted in a turn by 180^0 of the anchored maintenance vessels.

In September the autonomous sonar buoy was installed in the point p.6 (see Fig. 1.1). In July the main sources of the acoustic noise in that aquatorium were the maintenance vessels of the oil-extraction complex «Molikpaq», occasionally coming tankers and the mechanisms working at the «Molikpaq» and «Okha». In September an important source of the acoustic noise, close to the feeding area of gray whales was the «Sakhalinskaya burovaya» (see Fig. 1.1) and its maintenance vessels. In that period the vessels «Smit Sakhalin», «Smit Sybu», «Agat», «Neftegaz-16» were working at the studied aquatorium. According to the visual observations from the lighthouse there was a vessel constantly during the acoustic measurements in the point p.6 between the «Sakhalinskaya burovaya» and the «Molikpaq» (closer to the «Sakhalinskaya burovaya») постоянно находилось vessel.

In Fig. 4.16 and Fig. 4.17 the sonograms of the spectrum $G(f,t)$ of the acoustic background, measured in the point p.6 are given. These figures give both a qualitative and quantitative illustrations of the frequency-temporal interferential structure of the noise field in the point p.6. The color shows the level or the spectral density of the acoustic noise at that frequency

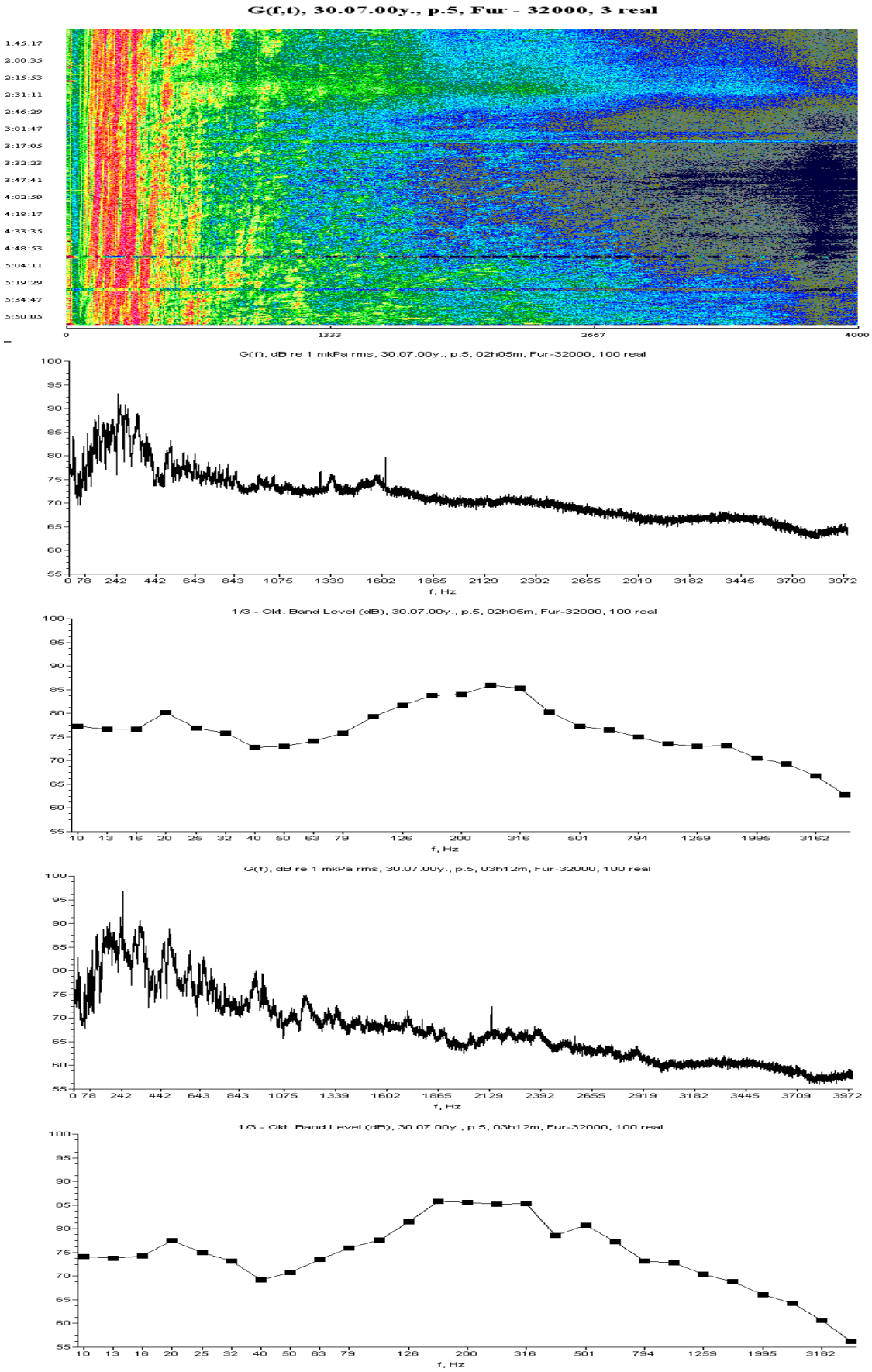


Fig. 4.15. The results of spectral analysis of the acoustic background measured in the point p.5 at night on July 30 in 2000.

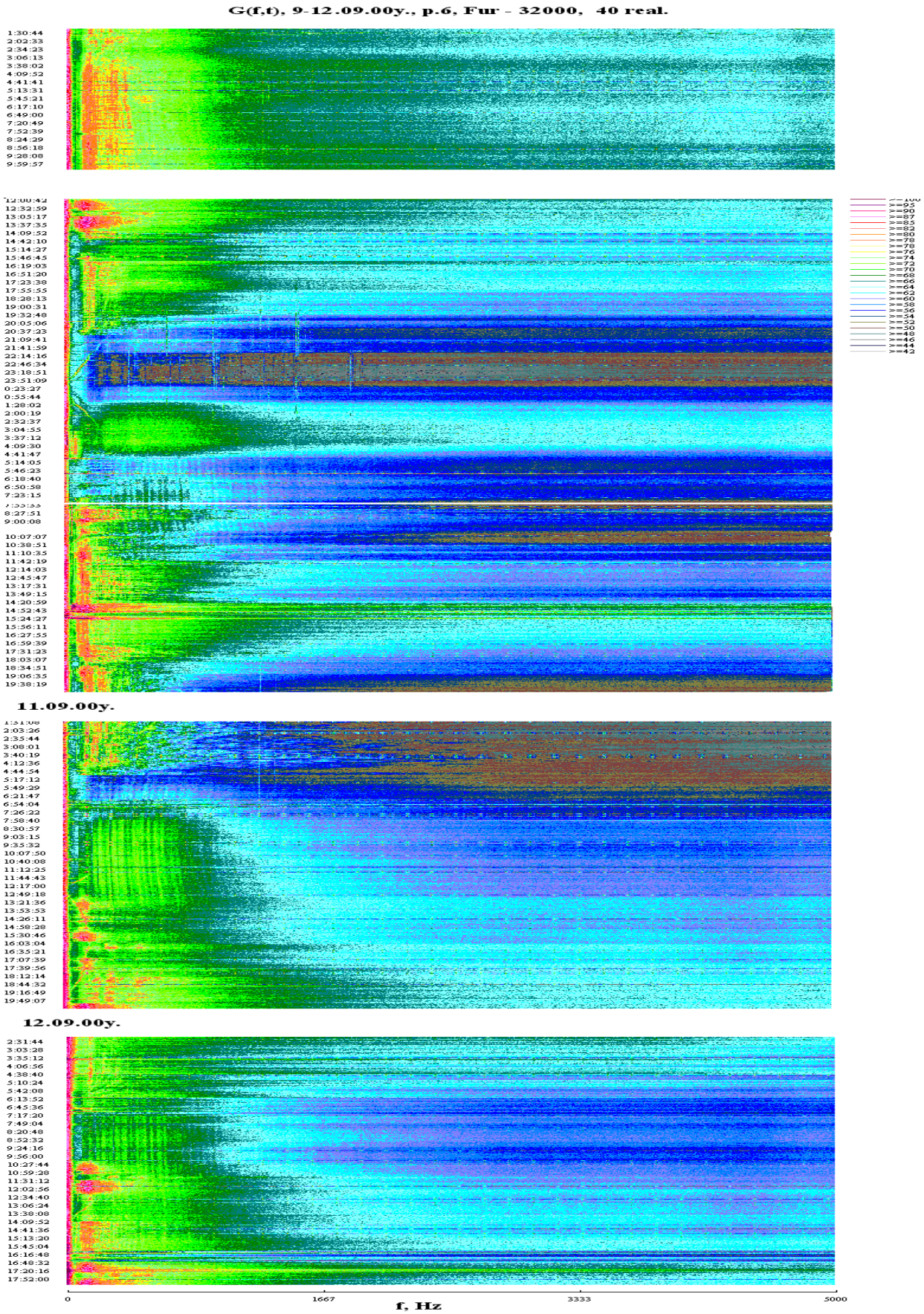


Fig. 4.16. Sonogram of the spectrum $G(f.t)$ of the acoustic background measured in the point p.6 (see Fig. 1.1) in September 2000.

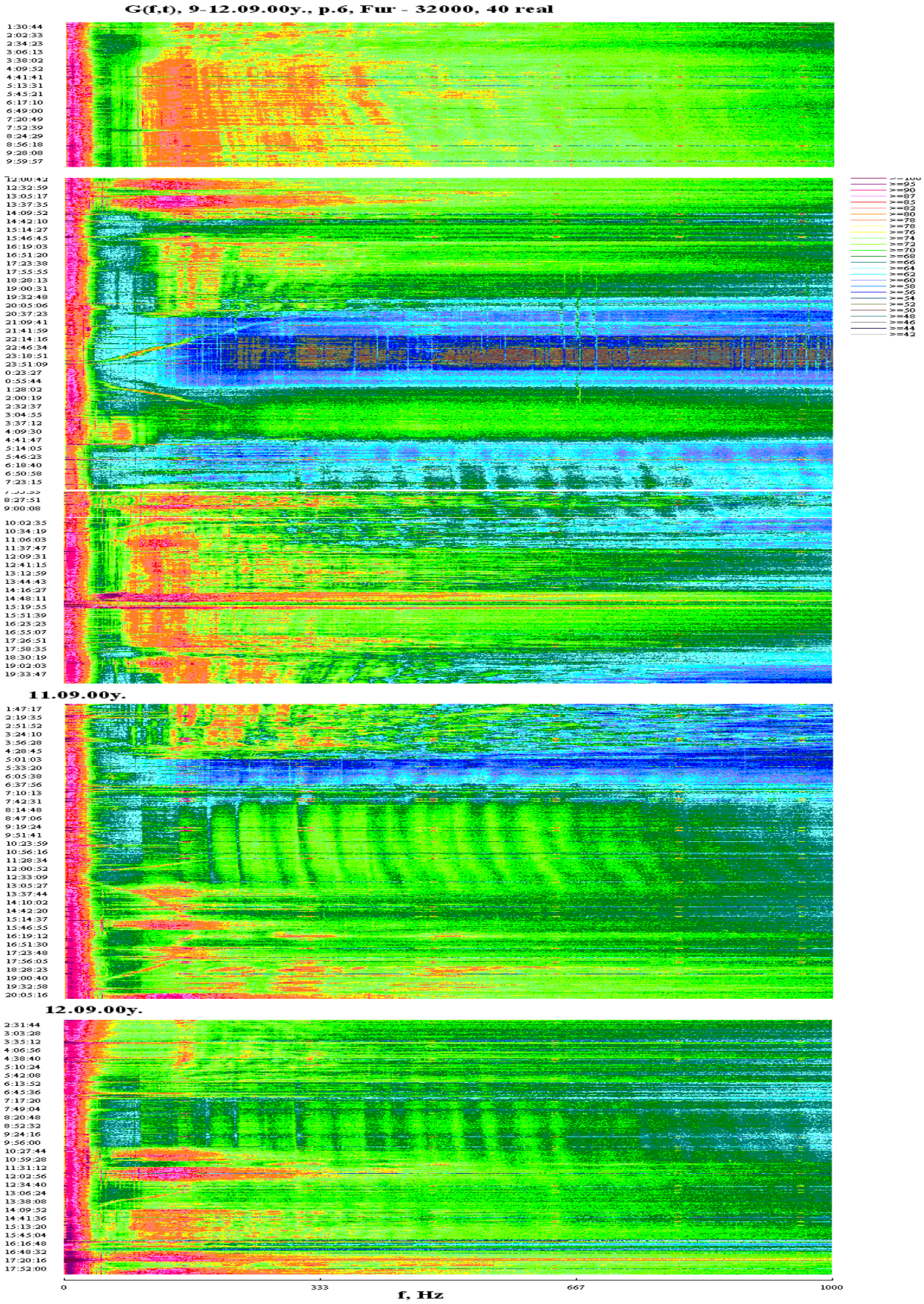


Fig. 4.17. The same as in Fig. 16, but the frequency-temporal interferential structure of the acoustic background in the low frequency band is shown in more detail.

Below we give a description of the hydrometeorological conditions and the water surface situation (in the light time of day) during those measurements:

- 8 p.m. – August 8: eastern ripples in the sea with waves to 1.5 m high, the tide and the tidal flow rate are close to maximal (to 3.5 m/sec) because it is almost full noon, there is an anchored vessel south of the «Sakhalinskaya burovaya», the torch at the «Molikpaq» is burning, there is a tanker north-east of the «Molikpaq»;
- from 11 p.m. on September 8 to 2 a.m. on September 9 the noise signals of the marine animals are heard, the sky is clear;
- 8 a.m. – September 9: the sky is clear, sun, north-west wind, low tide, flow noise are almost not heard, at 8.40 a.m. a group of 3 whales is feeding between the shore and the buoy;
- 9.13 a.m. – September 9: the «Sakhalinskaya burovaya» discharges water, west wind becomes stronger, eastern ripples stopped;
- 10.21 a.m. - September 9: west wind 12-15 m/sec, surface waves with “white caps”, no ripples;
- 0.31 p.m - September 9: the second vessel moves to the «Sakhalinskaya burovaya» from the «Molikpaq», at 0.39 p.m. it was sterned under the crane of the «Sakhalinskaya burovaya», at 0.43 p.m. the vessel moved from the «Sakhalinskaya burovaya» to the «Molikpaq», at 1.11p.m. (**по углу**) the vessel passed half of the way;
- 1.45 p.m. - September 9: another vessel is moving to the «Sakhalinskaya burovaya», at 2 p.m it is anchored;
- 5 p.m. - September 9: clear sky, west wind 8-10 m/sec, only wind surface waves in the sea, a vessel is maneuvering near the «Sakhalinskaya burovaya», like in the morning between the point p.6 and the shore a whale is feeding;
- 7.20 p.m. - September 9: west wind, its rate less 6 m/sec, no ripples, no surf, waves without «white caps», approximately 1 point, high tide, near

«Sakhalinskaya burovaya» there is an anchored vessel, the torch is burning at the «Molikpaq», east of the «Molikpaq» a tanker is anchored;

- 11.50 p.m. - September 9: still sea, remote signals of the marine animals can be heard;
- 6 a.m.- September 10: weak wind, still sea, the vessels at the studied aquatorium did not change their positions;
- 8.15 a.m. - September 10: a motor boat with the whale observers passed along the shore, the tanker moved to «Okha», sun, clear sky, no ripples;
- 8.52 a.m. - September 10: the tanker between «Molikpaq» and «Okha»;
- 10.12 a.m. - September 10: the tanker is moored to «Okha» and the whole «chain» is supported by a tugboat;
- 1.58 p.m. - September 10: our motor boat left the **borov** and is moving to the buoy (point p.6) for electric power supply, the wind activity in the sea is up to 3 points, at 2.33 p.m. the buoy is found;
- 3.08 p.m. - September 10: the works with the buoy are finished, flow rate in the point p.6 is 3.2 m/sec, the engines are switched on, moving in the direction of the mouth of Piltun Bay;
- 7.38 p.m. - September 10: north wind ceased, the surface waves without «white caps», clear sky, no vessels near the «Sakhalinskaya burovaya», all the vessels and the tanker are near «Okha», oil transfer is conducted;
- 1.15 a.m. - September 11: a vessel near the «Sakhalinskaya burovaya», oil transfer continues, the tugboat is working;
- 5 a.m. - September 11: still sea, fog, the torch at the «Molikpaq» is burning;
- 9ч.08мин. - September 11: no ripples, waves without «white caps», sun, heap clouds, a vessel near the «Sakhalinskaya burovaya», the tanker has, a vessel between the «Sakhalinskaya burovaya» and the «Molikpaq»;
- 3.24 p.m. - September 11: south wind, waves with rare «white caps», a vessel near the «Sakhalinskaya burovaya», a vessel is moving from the «Molikpaq» to the «Sakhalinskaya burovaya», at 3.36 p.m. it passed the traverse of an

anchored vessel, at 3.39 p.m. that vessel was sterned under the crane of the «Sakhalinskaya burovaya», at 4 p.m. it moved in the direction of the «Molikpaq» and at 4.30 p.m. it was anchored;

- 6.30 p.m. - September 11: two vessels near the «Sakhalinskaya burovaya», south wind, clouded sky;
- 7.50 a.m. - September 12: still sea, heavy fog;
- 1.05 p.m. - September 12: the «Sakhalinskaya burovaya» in fog, surface waves with «white caps», south wind, approximately 8 m/sec.

Let us consider in more detail the peculiarities of the acoustic noise, measured in the point p.6 on September 9 to 12, 2000. In Fig. 4.18 the sonograms $G(f,t)$ and the plots of the power density spectral values $G(f)$ of the acoustic background, measured at night on September 9 at 2 a.m. and at 3.15a.m. are given. The plots $G(f)$ give quantitative characteristics in the differences in the acoustic background, which are well expressed in the sonogram as well $G(f,t)$. After 3 a.m. in the low-frequency part of the noise spectrum $G(f)$ the tonal components, exceeding the noise level by 6-12 dB are well expressed. Fig. 4.19 allows to study the quantitative peculiarities of the acoustic background considering the hydrometeorological conditions and the visual observations of the movement of the vessels at the surveyed aquatorium. For example, the plots $G(f)$ - 1.10 p.m. correspond to the time of the measurements, when near the «Sakhalinskaya burovaya» one vessel was anchored, and another vessel was moving in the direction of the «Molikpaq» and had passed half of the way by that time already. The plots $G(f)$ - 11.17 p.m. characterize the spectrum of the industrial noise, generated by the stationary sources, including the anchored maintenance vessels and the anchored tanker (it was on roadstead east of the «Molikpaq»), because the flow rate was minimal at that time and the weather was almost still. In Fig. 4.19 it is seen, that the sonar buoy that we used allows to take reliable measurements of the levels of the acoustic signals exceeding 50 dB in a given frequency band,

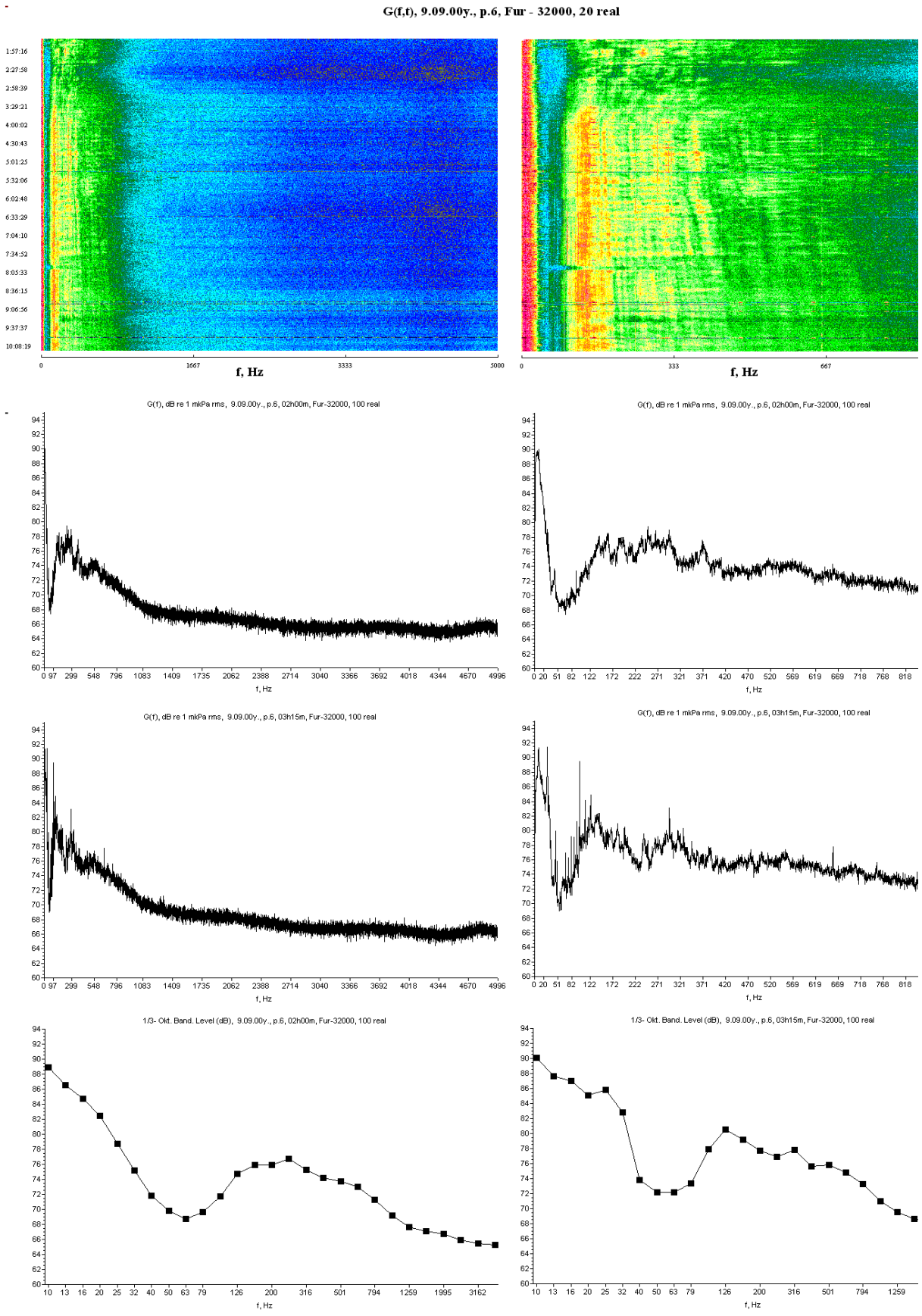


Fig. 4.18. Sonogram $G(f,t)$ and spectra $G(f)$ of the acoustic background, measured on September 9 in 2000. in the point p.6.

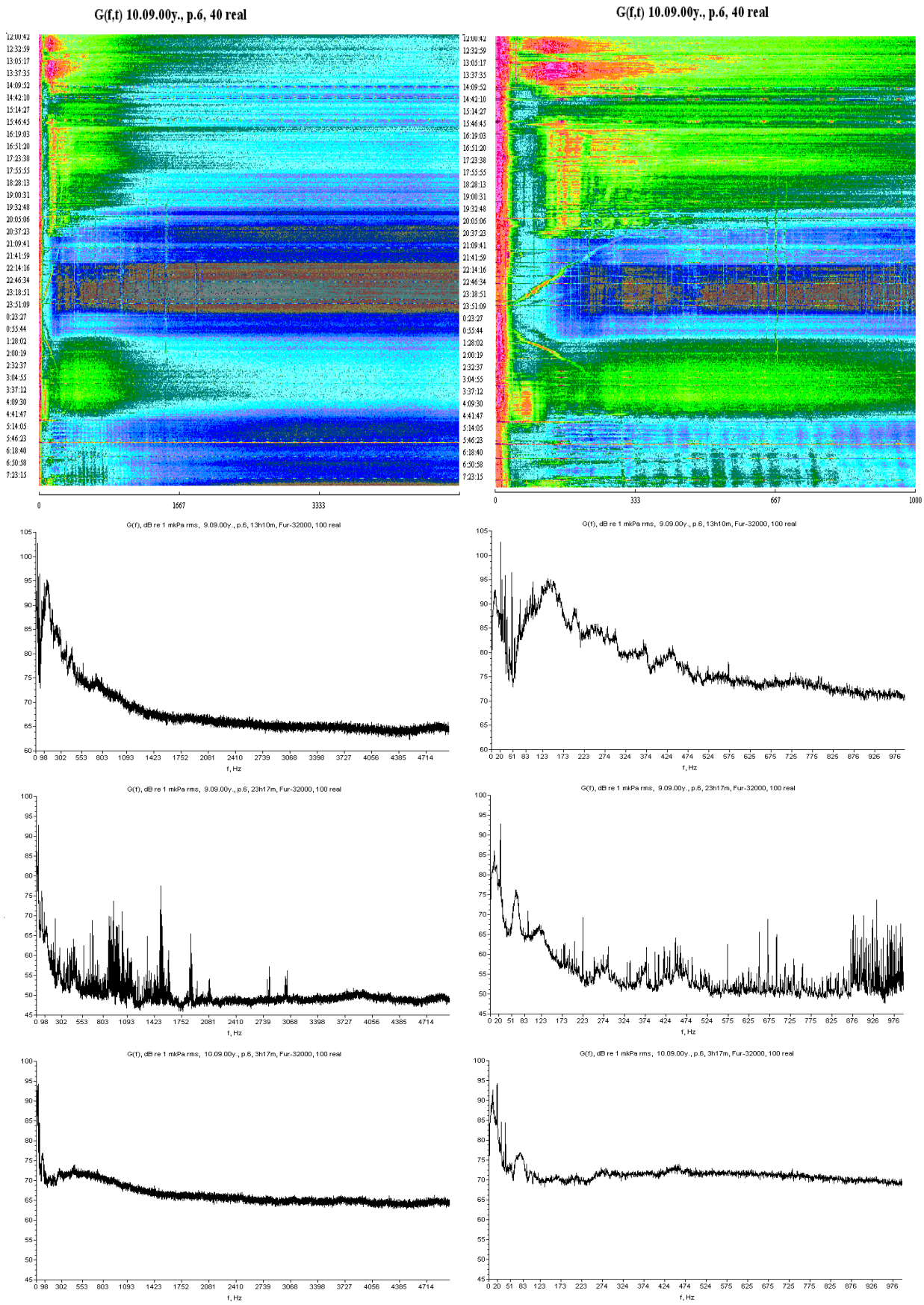


Fig. 4.19. Sonogram $G(f,t)$ and spectra $G(f)$ of the acoustic background, measured on September 9-10 in 2000 in the point p.6.

In the spectrum $G(f)$ of the industrial noise registered in the point p.6, the main tonal and narrow-band noise signals are present, which were observed near the «Molikpaq». For example, the level of the noise tonal component with the frequency of $\approx$1.6 kHz in September in the point p.6 was 78 dB; in July in the point p.5 it was 75-78 dB (see Fig. 4.12), and in the points p.3 and p.4 (see Fig. 4.5) 76 and 90 dB, correspondingly, and it was 83dB in the point p.2 in June (see Fig. 4.1).

The plots $G(f)$ - 3.17 a.m. in Fig. 4.19 correspond to the time of maximal flow rate of tidal current ($\approx$3.5 m/sec, full noon). Turbulent noise and flow noise raised the permission threshold of the acoustic signals in the studied frequency band by 10-20 dB, approximately to 70 dB.

Fig. 4.20 illustrates the frequency-temporal changeability of the acoustic background in the point p.6, corresponding to the end of the oil transfer and the departure of the tanker (presumably at в 3 a.m.). At night sea was still and it was foggy. At day time the waves with rare «white caps». The plots $G(f)$ - 3.31 p.m. in Fig. 4.20 correspond to the background measured during the movement of the vessel from the «Molikpaq» to the «Sakhalinskaya burovaya», and the plots $G(f)$ - 2.48 a.m., presumably correspond to the acoustic noise generated by the vessels near «Okha» at the end of the transfer works and the departure of the tanker. It is difficult to understand the nature of the wide-band noise the frequency-temporal interferential structure of which has well-expressed bands corresponding to the lesser or bigger intensity of the sound; the figure corresponds to the slow change of the distance between the source of the sound and its receiver (see $G(f,t)$ at the time interval from 7.30 a.m. до 1 p.m.).

For a comparison, in Fig. 4.21 the spectra of the acoustic background in the band 1 Hz – the plot $G(f)$ and 1/3 – okt. band, corresponding to the minimal noise level in the point p.6 (11.17 p.m.) and during the movement of the maintenance vessels at the aquatorium are presented. Согласно Fig. 4.21 (the plot 1.10 a.m.),

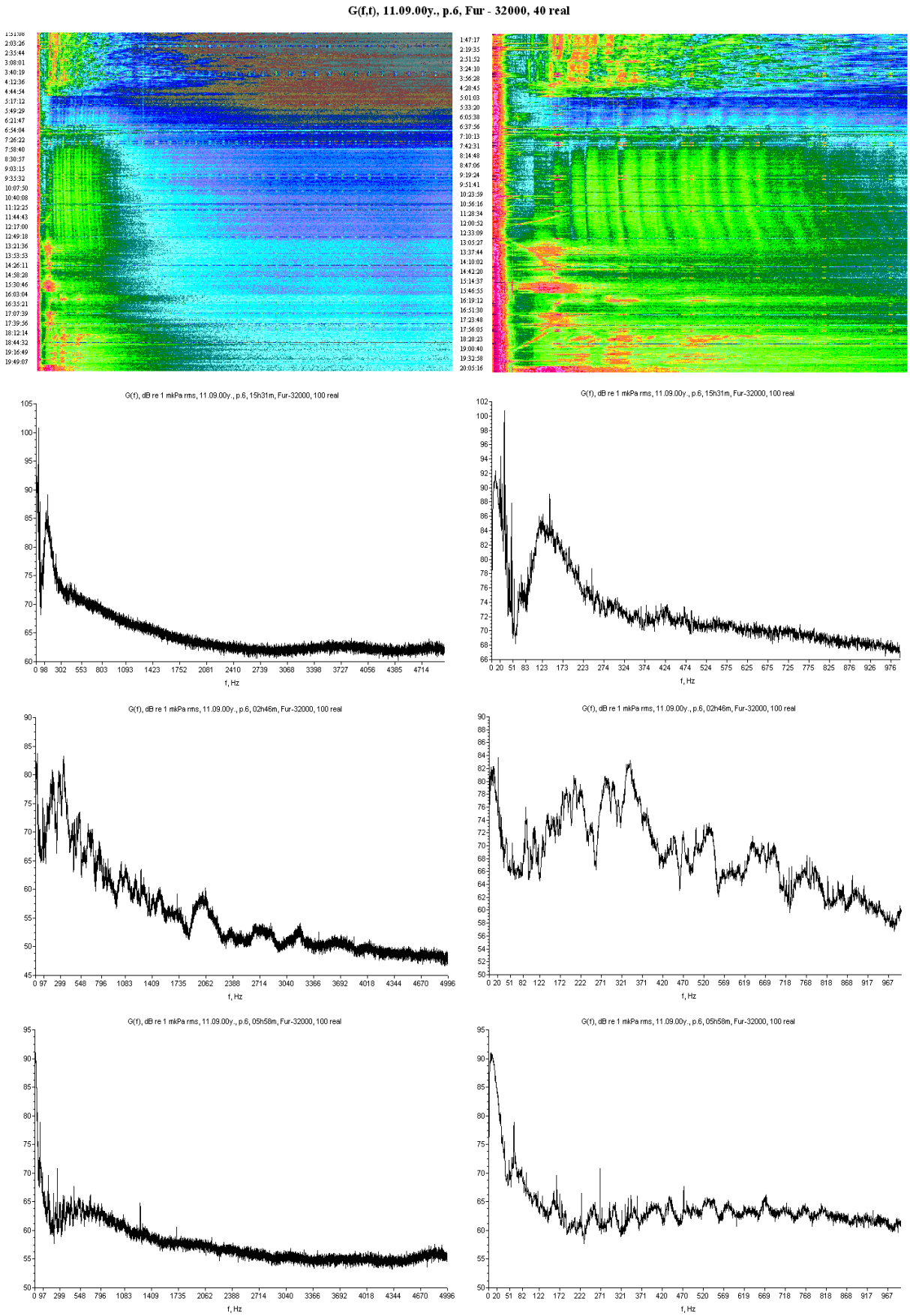


Fig. 4.20. Sonogram $G(f,t)$ and spectra $G(f)$ of the acoustic background, measured on September 10-11 in 2000 in the point p.6.

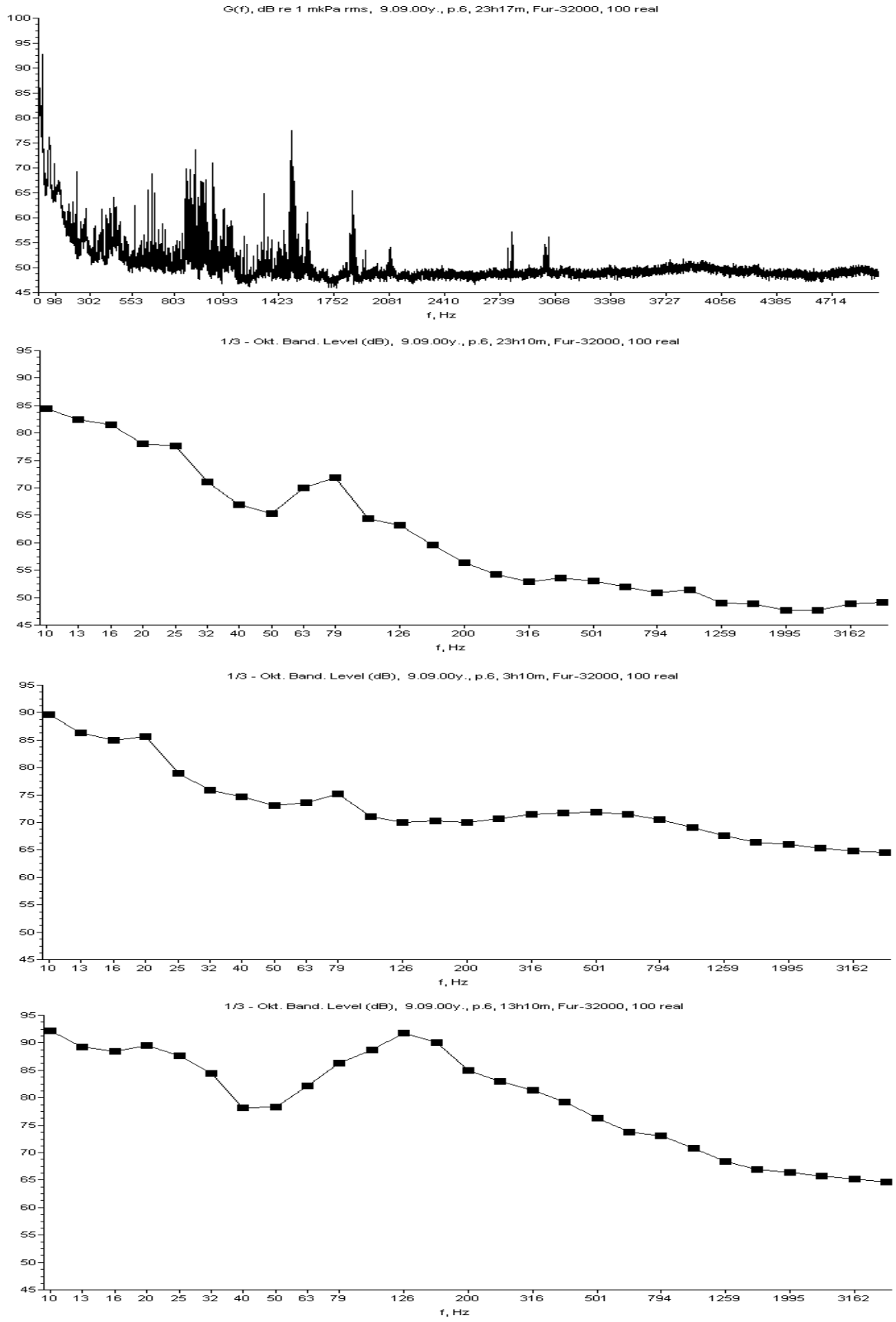


Fig. 4.21. Spectral values $G(f)$ of the acoustic background, measured on September 9 in 2000 in the point p.6.

A vessel moving from the «Sakhalinskaya burovaya» to the «Molikpaq» raises the level of the acoustic background in the point p.6: in the band to 40 Hz by10 dB, at 126 Hz - by 30 dB, and at the frequencies above 1 kHz the comparison becomes difficult due to flow noise.

Let us consider in more detail the peculiarities of the noise spectra (Fig. 4.22, Fig. 4.23), calculated on the basis of the measurements, carried out on September 10 in the point p.6 during the oil transfer from «Okha» to the tanker. The plots $G(f)$ - 10.10 a.m. correspond to the north direction of the «chain»: «tank», «Okha», the tanker, a working tugboat. At daytime north wind was blowing and there were surface waves with «white caps» in the sea, by the evening the wind ceased, but there were ripples in the sea. At 7.35 p.m. all the maintenance vessels and the tanker gathered near «Okha». The «chain» turned southward, which corresponds to the possible maximal distance of the tanker and the working tugboat from the point p.6.

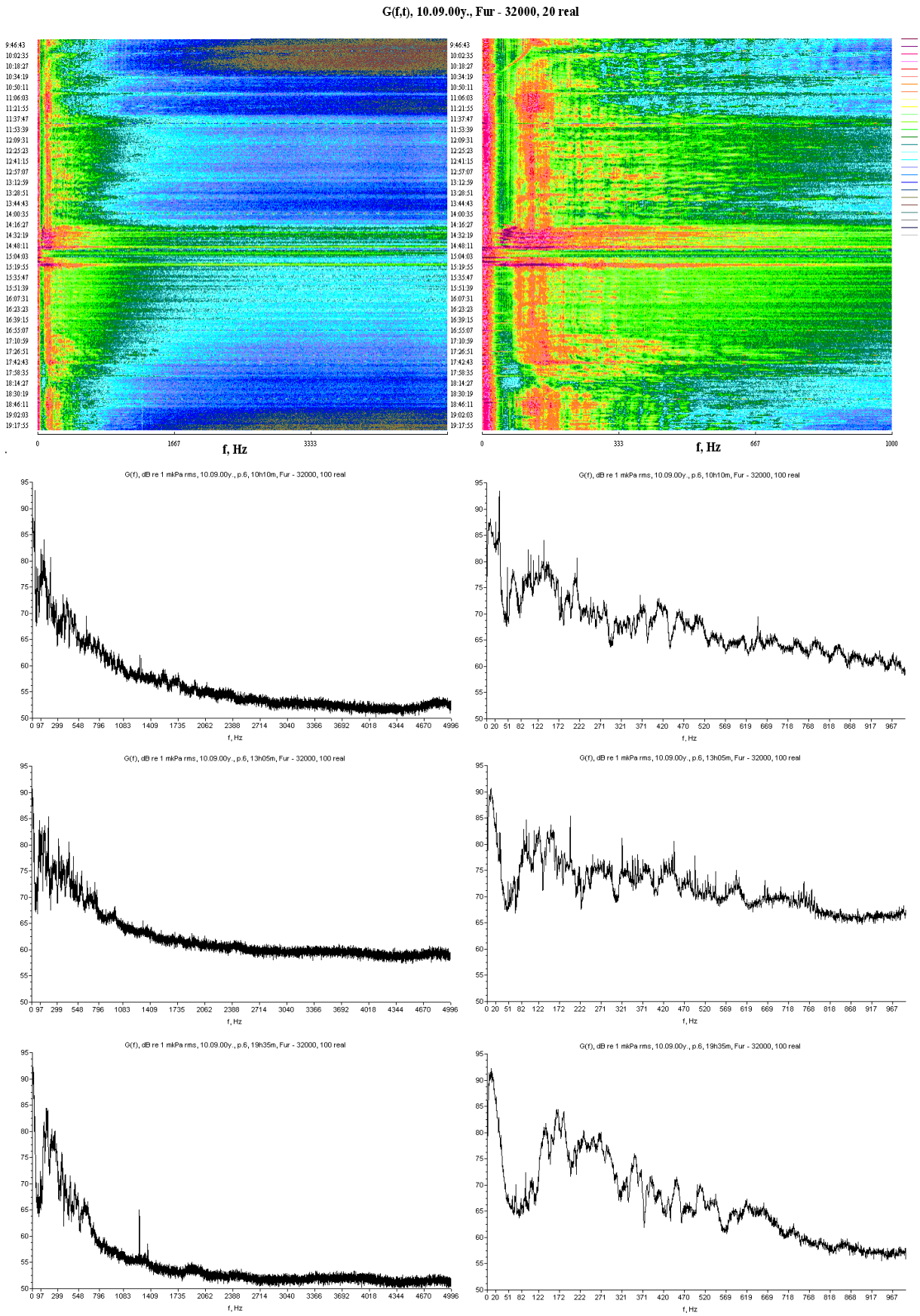


Fig. 4.22. Spectral values $G(f)$ of the acoustic background, measured on September 10 in 2000 in the point p.6.

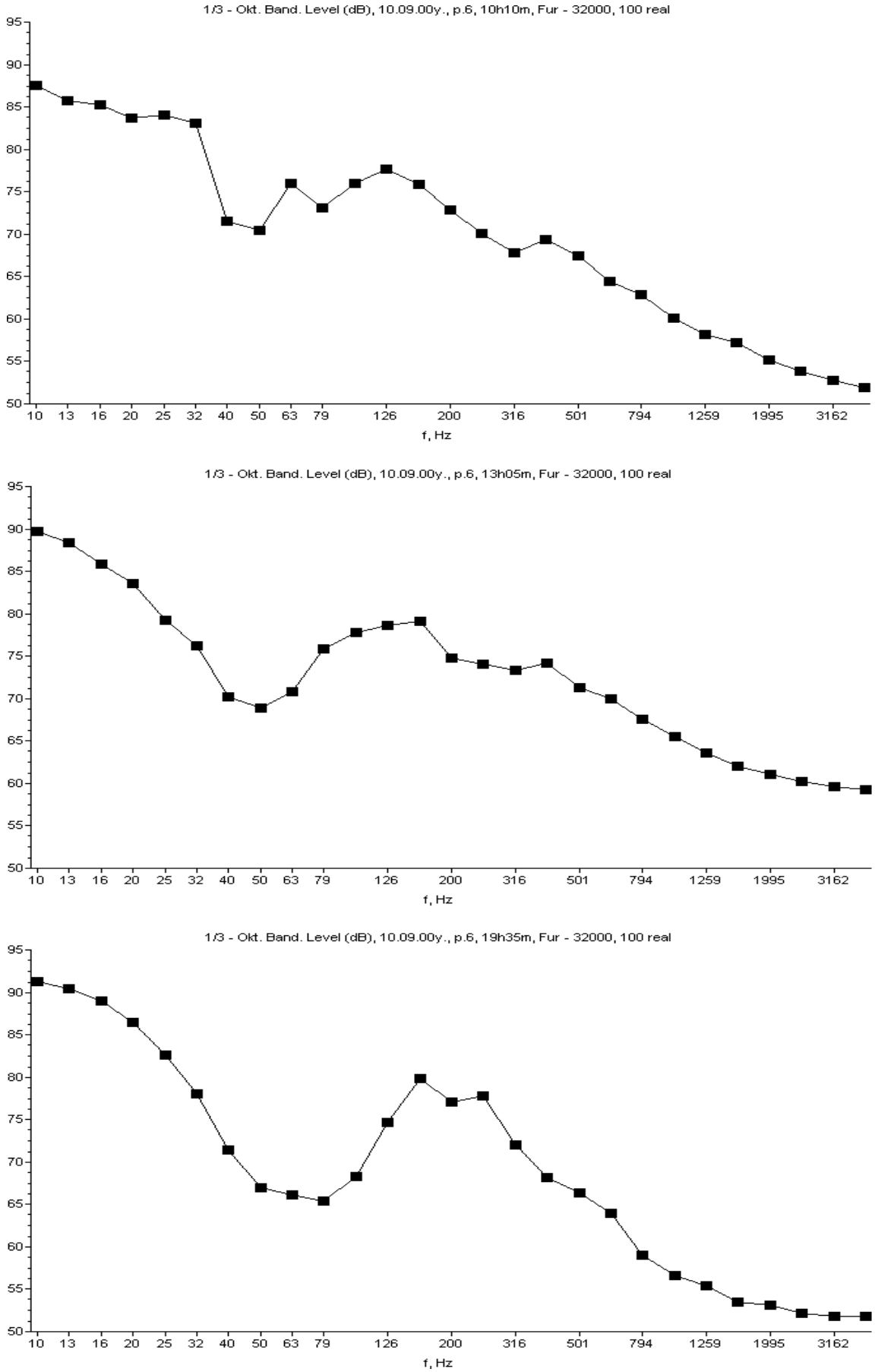


Fig. 4.23. Spectral values $G(f)$ of the acoustic background, measured on September 9 in 2000 in the point p.6.

4.3. Results of Experimental Studies of Sound Propagation along the Molikpaq –Piltun Route

The studies of the peculiarities of the propagation of the sound generated in the «Molikpaq» area to the offshore zone (see in Fig. 1.1 the «Molikpaq - Piltun» route) – the traditional feeding area gray whales, were conducted for the fist time experimentally and theoretically (for the model with «liquid» bottom) in 1999. The results of those studies were presented in the Report for 1999. In section 4.1 the results of the analysis of the measurements of the noise and tonal acoustic signals in situ, carried out synchronously in two points of the route p.4 and p.3 were presented. In section 4.2 it was shown that in the area of whales aggregations (see point p.5 and p.6 in Fig. 1.1) the industrial noise with line and continuous spectra are registered almost all the time, which are generated by the stationary and moving sources, which levels in the frequency band to 1.5 kHz vary from 60 to 90 dB in the band 1/3 – okt. band, and the level of the tonal components at the frequencies less 50 Hz can exceed 100 dB. It was interesting to make a numerical modeling of the propagation of the sound with different frequency along a route with the same parameters as the «Molikpaq – Piltun» route taking into consideration the real - «resilient» qualities of the bottom-forming rocks. Below the results of such study are presented.

The propagation of the acoustic waves was modeled by normal waves in adiabatic approximation by means of the program MOATL (Miller, Wolf, 1980) for «resilient» and «liquid» bottom. This program allows making calculations of the losses during the propagation of the sound in the waveguide taking into account the changing hydrological conditions along the route and the real geometry of the bottom. For each measurement of hydrology and geometry of the bottom given in the table the parameters of normal waves are calculated; the coefficient of attenuation of each mode is integrated in accordance with the distance.

The results of the calculations of losses during the propagation of the sound with the frequencies of 50 and 1600 Hz in a channel with liquid bottom are shown in Fig. 4.24. The calculations were made for the sound source situated at a depth of 6 м and the receiver moving from the source to shallow water part of the channel at a depth of 15 м. Sound rate (C) in «liquid» semispace – bottom was 1700 m/sec. In the upper layer the C value showed linear changes with the depth and was 1494 m/sec at the sea surface, 1470 m/sec at the horizon of 6 m, 1460 m/sec at a depth of 10 м, and further to the bottom its values were constant. In Fig. 4.24 it is seen that in the model with the «liquid» bottom the intensity of the sound with the frequency of 50 Hz due to the propagation in that cline decreased by over 50 dB, and the sound with the frequency of 1.6 kHz, by over 60 dB. According to Fig. 4.21 (see the plot $G(f)$ - September 9, 2000, p.6, 11.17 p.m.) the level of the tonal acoustic signal with the frequency of ≈ 1.6 kHz measured at point p.6 in favorable hydrometeorological conditions of September was 78 dB. In July (see Fig. 4.4) the levels of the noise signals synchronously measured at that frequency in the points p.4 и p.3 (see map in Fig. 1.1) were 92 and 76 dB. The distance between those points was approximately 5 km. Therefore, the real losses during the propagation of the sound with such frequency to the shallow-water part of the shelf are ≈ 3 dB/km which agrees with the results of the numerical modeling. Therefore, the level of the acoustic noise with the frequency of 1.6 kHz, generated near the «Molikpaq» was ≈ 128 dB in September.

It is known that a significant part of the energy of the low-frequency acoustic field can be transferred to the offshore zone by the surface seismic waves, propagating on the border between any two media, if in at least one of them **shear** waves can propagate. In a theoretical work by Bespalov et al. (1998) it was shown that for the sound generated in the water layer, with the frequency of 1 Hz and above, the use of the layer sand and the border sand- limestone instead of the sand semispace produces a sharp increase in the field amplitudes of the off-bottom

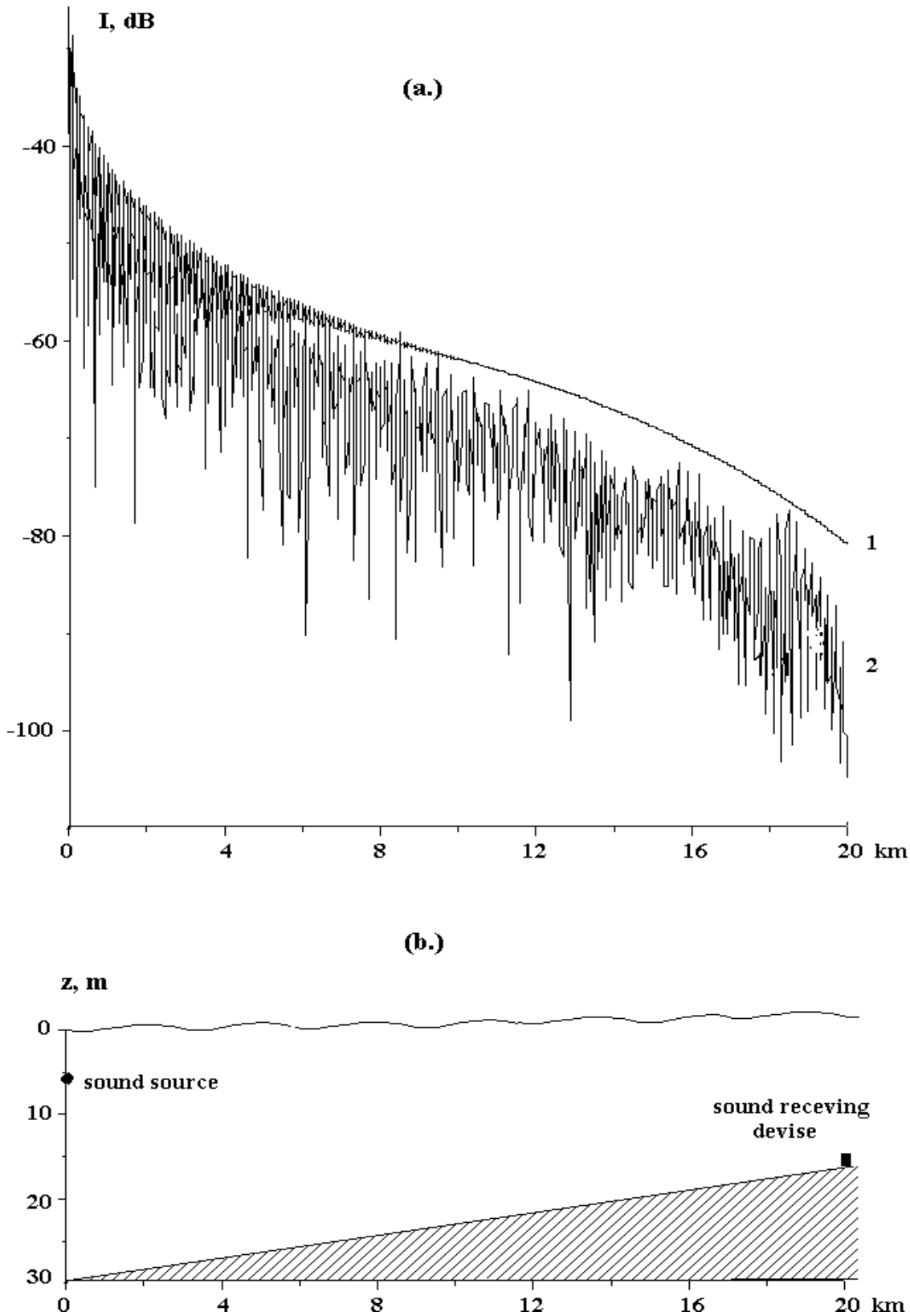


Fig. 4.24. Geometry of a 20-km site of the modeled acoustic route «liquid» bottom (b.) and the results of calculations of (a.) the losses during sound propagation with the frequency of 50 Hz – curve 1 and 1600 Hz – curve 2, generated at a depth of 6 м. Bottom – «liqid» semispace with the parameters: $C = 1.7$ km/s, $\rho = 1.2$ g/sm^3.

area. This addition comprises at a distance of 20 km to 50 dB at the frequency of 1 Hz and to 60 dB at the frequency of 10 Hz.

In Fig. 4.25 the results of our numerical experiment carried out for the waveguide with «resilient» bottom (semispace) under a sand layer 1 m thick. The distribution of the field the sound velocity in the water layer was the same as in the model with the «liquid» bottom. The acoustic characteristics of the bottom are shown in figure legend. The losses calculations during the propagation of the acoustic signals with the frequencies of 26 and 50 Hz were made for the sound source situated at a depth of 6 m (Fig. 4.25a) and in the bottom on the border between sand and a «resilient» bottom (Fig. 4.24b). In Fig. 4.25a, for comparison, the plot (curve 3.2) of the losses during the propagation of the sound with the frequency of 26 Hz, calculated for the model with «liquid» bottom (see Fig. 4.24b.), is given. From the comparison of the curves 3.2 and 1.2 in Fig. 4.25a it is seen that in the model with resilient bottom the losses during the sound propagation to the shallow-water part of the route was significantly smaller than in the model with «liquid» bottom due to the decrease in the losses as a result of the reflection of the propagating sound from the «resilient» bottom and the concentration of its energy in the water layer.

A distinctive characteristic of the the plots $G(f)$ of acoustic noise, measured in the shallow-water part of the shelf in the points p.5 and p.6 is the presence of minimum in their spectral density at the frequencies from 30 to 90 Hz. It is known that the shallow-water cline is an effective filter of the acoustic waves with low frequencies. This is connected with their absorption and great losses during the propagation in the bottom. The high levels (over 90 dB) of tonal acoustic signal with the frequency of $\approx$26 Hz (see, for example, Fig. 4.19) can be explained by minor losses during the propagation of the seismic waves with such frequencies (Bespalov et al., 1998). In this case, a seismic wave generated at the «Molikpaq», can propagate as a plane wave on the border between sand and petrified sediments,

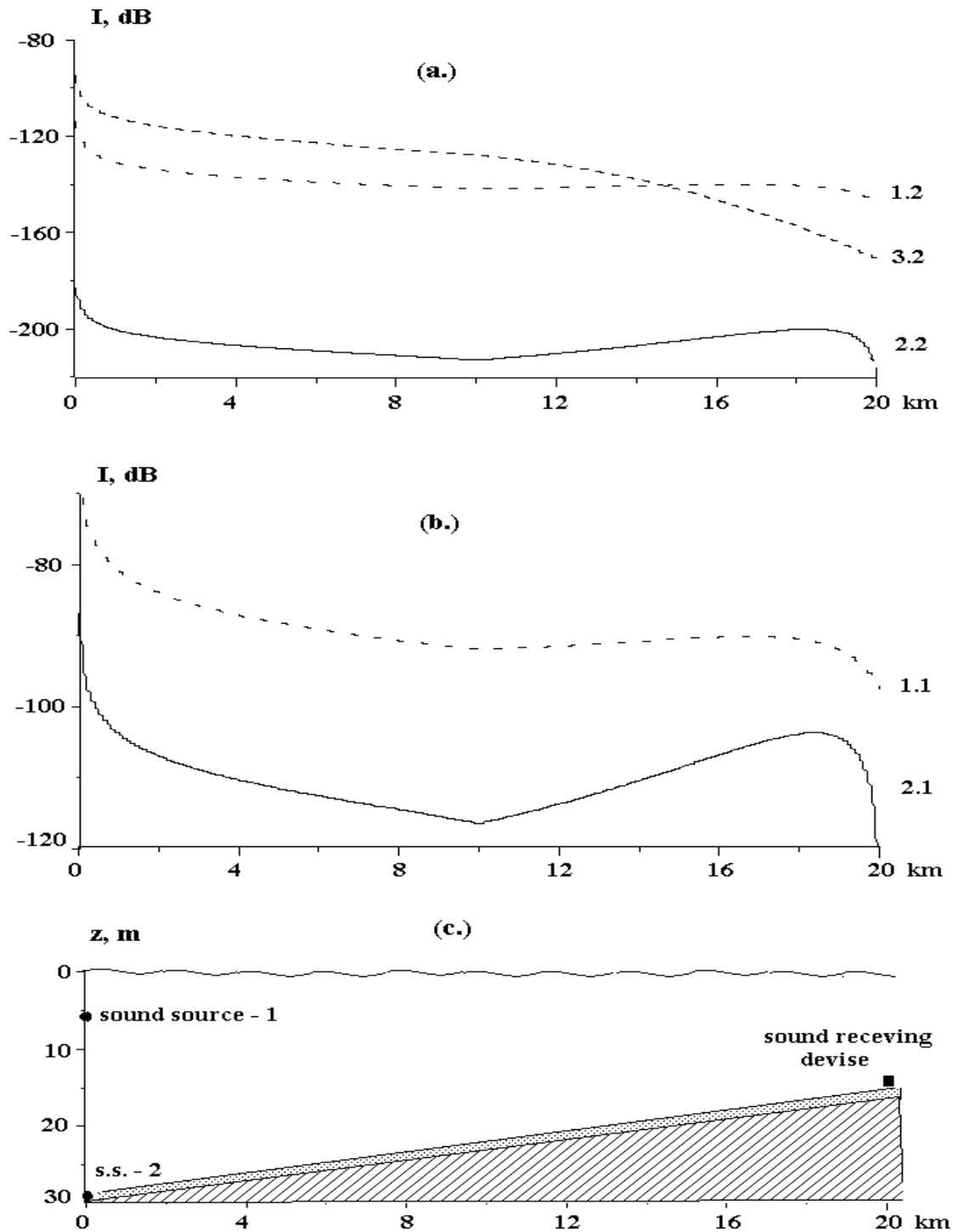


Fig. 4.25. Geometry of a 20-km site of the modeled acoustic route «liquid» bottom (c.) and the results of calculations of (a.) the losses during sound propagation with the frequency of 26 Hz – (curves 1.1, 1.2, 3.2) and 50 Hz (curves 2.1, 2.2), generated at a depth of 6 м (a.) and in the bottom (b.) at the border between the sand layer (C = 1.7 km/s, ρ = 1.2 g/sm^3) 1 m thick (see Fig. 4.25a) and «resilient» semispace with the following parameters: C_l = 5.5 km/s, C_t = 600 m/s. ρ = 5.5 g/sm^3. The plot 3.2 in Fig. 4.25a corresponds to the losses during sound propagation with the frequency of 26 Hz in the model with «liquid» bottom, shown in Fig. 4.24.

inducing the acoustic field at the bottom. At higher frequencies this mechanism is not effective. Let us go back to Fig. 4.25. The modeling of the sound propagation in the channel with two-layered and «resilient» bottom confirms our conclusions. The level of the acoustic field, generated by the source situated on the border of the «resilient» bottom (Fig. 4.25b) is by 40 dB higher than that of the source situated at a depth of 6 m (Fig. 4.25a). The level of the acoustic signal with the frequency of 26 Hz is significantly higher than that of the signal with the frequency of 50 Hz. Therefore, a significantly low level of industrial noise within the frequency band of 30 to 100 Hz, which are observed in the shallow-water part of the shelf can be explained by the high losses during the propagation of both acoustic waves, the length of which is bigger than the depth of the water layer, and seismic waves in the cline.

Discussion

The measurements of the acoustic background carried out in 2000 at the aquatorium of the oil-extraction complex «Molikpaq» and the offshore zone in the traditional feeding area of gray whales showed that, similar to 1999, the moving maintenance vessels were the main sources of the most intensive acoustic noise within the band of 50 to 1000 Hz. A test drilling conducted in September («Sakhalinskaya burovaya») close to the whales' aggregation did not change significantly, as compared with July, the acoustic background in the offshore zone. However, a short-term increase of its level within the band to 600 Hz, which is caused by the maintenance vessels occasionally coming to the «Sakhalinskaya burovaya» platform, should be noted. In spite of the significant attenuation (to 60 dB) during sound propagation along the «Molikpaq –Piltun» route in the feeding area of whales, the noise signals are easily registered, which are generated by the stationary mechanisms and the vessels working in the deep-water part of the route. In their spectra the tonal components are well expressed, including those at infralow frequencies. Their level can reach 100 dB re 1 mkPa rms. One of those components with the frequency of $\approx$26 Hz seems to be generated by the L. P. Compressor, the rotation rate of which depends on its working regime and can very within the range of 25 – 60 Hz. We registered an acoustic signal with such frequency in 1999 near the «Molikpaq» and close to the shore. The numerical modeling taking into account the «resilient» properties of the bottom showed that the sound with such frequency can propagate to the shallow-water part of the shelf with the losses less 30 dB. In a work by Richardson [1986] it was shown that bowhead whales use infra-low frequencies in their biosonar. The studies of the acoustic signals, generated by gray whales, the results of which are presented in a paper by Cummings et al. [1968], testify that gray whales also use the acoustic signals, which spectrum starts at 15 Hz. The level of the industrial tonal and narrow-band noise in the feeding area of gray whales even at the frequency of

1600 Hz may exceed the level 76 dB re 1 mkPa rms (see the plot $G(f)$ - 11.17 p.m. in Fig. 20). In accordance with the results of the in situ studies of the acoustic signals generated by whales in Laguna San Ignacio presented in a paper by Dahlheim at al. (1984), gray whales generate the acoustic signals of approximately six types, but they are mainly the series of impulses with the concentration of acoustic energy within the range of 300 to 800 Hz. The authors of that paper noted that depending on the level of industrial noise in the low-frequency band or the noise of biological origin in the high-frequency band (above 2 kHz) whales shift the power density spectral peak in the signals generated by them. Therefore, a conclusion can be made that gray whales can hear well the acoustic signals generated as a result of anthropogenic activities in the oil extraction field, but they seem to adapt to that acoustic background and its frightening variations and it does not disturb their hydrolocation. The same can be applied to killer whales. We registered the group acoustic signals generated by them at night on September 1999 near the «Molikpaq» (see Fig. 4.10), and in July and September 2000 in the feeding area of whales (see Fig. 4.14). These large marine animals have a biosonar that enables them both to solve the hydrolocation tasks and the communication problems of the herd.

Conclusions

1. Aerial observations from the helicopter showed that most of the gray whales stayed beyond the border of the Sakhalin shelf in late June. In the traditional summer feeding areas (sites), 16 gray whales on the extensive grid and 8 whales on the intensive grid were observed. The observation of the gray whale opposite to Nyisky Bay can indirectly testify that the spring migration route of the whales goes along Sakhalin from south to north but this assumption needs additional research.
2. In July most of gray whales finished migration and were present in their summer feeding area offshore North East Sakhalin. The gray whales were scattered along the coastline at the sites about 70 km long from 53°19′north to 52°40′north. 36 gray whales were present there (extensive grid survey), which allows to assume that the «Molikpaq» platform situated south-east of the lighthouse, possibly, does not cause any negative effect on the distribution pattern of the gray whales.
3. In July-August we observed the active feeding of the gray whales and their continuous movement along the shallow-water shelf. With the approach of the salmons (pink salmon, Calico salmon, coho salmon) to the Sakhalin shores, it became common to encounter killer whales Orcinus orca and seals – Larga seal, ringed seal, bearded seal and ribbon seal at the shelf. The aggregations of seals were observed on the coastal rookeries in Chaivo, Piltun, Nyisky and Lunsky Bays. The maximal abundance of the seals on the coastal rookeries was registered on August 26 in the mouth of Chaivo Bay (4000-5000) and at the mouth of Piltun Bay (over 500).
4. In September-October most of the observed gray whales were feeding in the shallow-water shelf opposite to Piltun Bay. The whales continued to feed actively opposite to the Piltun lighthouse and north of 53°05′north. The behavior of the animals remained calm. There was no active migration to the wintering areas in that period.

5. In November most of the gray whales left their summer feeding area. In late November an active process of ice formation was observed near Piltun. The carry-overs of the ice fields at some sites of the offshore zone of North East Sakhalin comprised 5-10 km and more. The gray whales stayed separately in the young ice and ice sludge. At that period most of the seals left the bays and were swimming on staying on ice floes.
6. The studies showed that the feeding of the gray whales offshore North East Sakhalin in summer-autumnal period occurred at a very limited aquatorium (70-120 km of the coastline). The whales were mainly staying at the shallow-water sites of the shelf with a depth to 20 m and were almost not observed beyond the 50-100 m isobaths. Therefore, in the summer-autumnal period (July-October) a very small aquatorium of the shallow-water shelf remained the main feeding area of the gray whales opposite to Piltun Bay.
7. The spectrum of the acoustic noise generated by the oil extraction complex «Molikpaq» and its maintenance vessels has well-expressed tonal and narrow-band components, which level by 10-15 dB exceeds the level of the wide-band noise, the intensity of which increases sharply by 15-20 dB during the movement of any of the maintenance vessels.
8. In the traditional feeding area of gray whales the noise acoustic signals generated by the stationary and moving sources are continuously registered. The tonal and narrow-band noise signals in the points p.5 and p.6 (see Fig. 1.1) show the following levels: 80 - 100 dB re 1 mkPa rms at the frequencies less 90 Hz, within the band of 100 to 500 Hz – 70-96 dB, within the band of 600 –1000 Hz – to 76 dB. The power peaks are observed almost continuously at the frequencies of approximately 1.6, 2, 2.8 and 3 kHz, the levels of which are 78, 65, 56 and 55 dB re 1 mkPa rms , correspondingly (see Fig. 4.19 the plot $G(f)$ - 11.17 p.m.). During the movement of a vessel the level of the wide-band noise sharply increases by 10-20 dB.

9. In spite of the high anthropogenic activity accompanied by the generation of the intensive acoustic noise, the acoustic signals generated by marine animals are continuously registered in that area. The measurements taken in the shallow-water part of the shelf in the point p.5 (see map in Fig. 1.1) showed that the levels of the acoustic signals, supposedly, generated by killer whales, by 10-15 dB (see Fig. 4.14 and Fig. 4.13 values of $G(f)$ at the frequency of 2.5 kHz) exceed the level of the acoustic background of the moving vessels.

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Appendix 1
Summary table of survey results of marine mammals on shelf of North-Eastern Sakhalin in June-November 2000

Date	Time	Lat_DEC	Long_DEC	Species	Number	Note
23.6.00	16:04	52.00167	143.5211	Gray whale	1	Moving to North
23.6.00	17:37	52.32389	143.1811	Seal	300-400	Lay on sandy spit
23.6.00	17:38	52.32167	143.1833	Seal	200-250	On sandy spit
24.6.00	13:04	52.92667	143.3458	Gray whale	3	Whales stand aside each other
24.6.00	13:05	52.91833	143.3333	Gray whale	5	Circling, feeding
24.6.00	15:51	53.22833	143.2556	Gray whale	5	Behavior is calm, circling, diving,
						feeding. Two whales keep
						together (female + calf)
						active feeding, muddy spots
24.6.00	15:56	53.21111	143.2719	Gray whale	2	Active feeding, muddy spots
24.6.00	16:21	53.04361	143.297	Gray whale	1	Diving
24.6.00	17:09	52.94167	143.3333	Gray whale	1	Diving, careful behavior, the whale
						moving off shore
24.6.00	17:31	52.88334	143.3367	Gray whale	6	Group of 5 whales, 1 whale keeps
						apart
19.7.00	13:42	54.002	142.951	Seal	4	Swimming, diving
19.7.00	13:43	53.983	142.936	Seal	6	Swimming
19.7.00	14:05	53.874	142.9	Seal	2	
19.7.00	14:19	53.748	143.209	Killer whale	1	
19.7.00	14:46	53.56667	143.051	Larga seal	1	Opposite mouth of Urkt Bay
19.7.00	15:05	53.498	143.428	Killer whale	6	Group of killer whales are
						swimming together
19.7.00	15:07	53.505	143.44	Killer whale	5	Killer whales are moving
						to first group
19.7.00	15:21	53.401	143.167	Killer whale	1	Moving to south-eastern
19.7.00	15:37	53.329	143.408	Seal	1	Swimming
19.7.00	15:38	53.322	143.217	Gray whale	2	Active feeding, muddy spots
19.7.00	15:40	53.251	143.246	Gray whale	2	Feeding
19.7.00	4:30	53.241	143.236	Seal	6	Swimming near the shore
19.7.00	16:44	53.203	143.257	Gray whale	1	Swimming, diving
19.7.00	16:45	53.187	143.268	Gray whale	1	Feeding, diving
19.7.00	16:48	53.166	143.266	Gray whale	2	Sticking together
19.7.00	16:49	53.177	143.269	Gray whale	4	Active feeding, synchronous
						swimming of two
						whales, muddy spots
19.7.00	17:24	53.043	143.296	Gray whale	3	Feeding, diving
19.7.00	17:38	52.961	143.311	Gray whale	1	Diving
19.7.00	17:39	52.953	143.312	Seal	6	Swimming, diving
19.7.00	17:40	52.948	143.317	Gray whale	1	Diving, moving to North
						along the shore
19.7.00	17:41	52.916	143.349	Gray whale	2	Feeding, muddy spots
19.7.00	17:42	52.85056	143.3456	Gray whale	4	Swimming, circling
19.7.00	20:28	52.84583	8:07	Gray whale	4	Diving near the shore, circling
19.7.00	20:43	52.75	143.3517	Gray whale	4	Swimming to south of Piltun
						Bay mouth
19.7.00	20:45	52.75	143.3381	Gray whale	3	Diving, active feeding, muddy spots

19.7.00	20:53	52.74306	143.3464	Gray whale	1	Moving to North along the shore
19.7.00	20:57	52.66889	143.3389	Gray whale	1	
20.7.00	15:34	52.50278	143.1875	Seal	6	Swimming
20.7.00	15:37	52.47445	143.2944	Seal	3	Swimming
20.7.00	15:40	52.44833	143.2872	Seal	1	
20.7.00	15:45	52.41667	143.4403	Seal	1	Swimming
20.7.00	15:55	52.33167	143.1656	Seal	600-800	3 large rookeries of seals at mouth
						of Chaivo Bay on sandy spit
20.7.00	16:26	52.13361	143.1472	Seal	1	Swimming
20.7.00	16:35	52.09278	143.1528	Seal	6	Swimming
20.7.00	16:37	52.09583	143.1511	Seal	1	
20.7.00	16:56	51.98361	143.1833	Seal	6	Swimming
20.7.00	16:59	51.99445	143.1833	Seal	2	Swimming
20.7.00	17:02	51.97445	143.1667	Seal	5	The seals lay on shore
20.7.00	17:06	51.94028	143.2075	Seal	3	Swimming
20.7.00	17:08	51.91639	143.2925	Seal	1	
20.7.00	17:25	51.80695	143.2811	Seal	2	Swimming
20.7.00	17:26	51.79722	143.2875	Seal	1	
20.7.00	17:27	51.78111	143.2964	Seal	1	
20.7.00	17:29	51.73806	143.3153	Seal	> 50	Swimming at mouth of Nabil Bay
20.7.00	17:53	51.60083	143.3939	Seal	3	Swimming
20.7.00	17:59	51.58361	143.5606	Seal	1	Swimming
20.7.00	18:15	51.46556	143.4494	Seal	4	Swimming
20.7.00	18:16	51.42139	143.4625	Seal	4	Diving
20.7.00	18:28	51.33778	143.8147	Killer whale	1	Near the group of seals
20.7.00	18:28	51.33722	143.8144	Seal	3	Swimming
20.7.00	18:45	51.31611	143.4814	Seal	38	Swimming at mouth of Lunsky Bay
20.7.00	18:47	51.28556	143.5025	Seal	3	
24.7.00	11:20	53.10806	143.295	Gray whale	4	Active feeding, many muddy
						spots, circling
24.7.00	11:22	53.105	143.2847	Gray whale	2	Sticking together, female and calf :
						Active feeding, circling
24.7.00	11:53	53.0175	143.3094	Gray whale	3	Behavior is calm, feeding, muddy spots
24.7.00	12:12	53.015	143.445	Seal	2	Swimming
24.7.00	12:26	53.00056	143.6	Gray whale	2	
24.7.00	12:27	52.99805	143.3	Gray whale	2	The whales are swimming together
						near the shore
24.7.00	12:42	52.98444	143.3439	Seal	3	
24.7.00	13:00	52.95195	143.3311	Gray whale	2	Feeding, muddy trace
24.7.00	13:08	52.94889	143.4547	Seal	3	
24.7.00	13:15	52.93361	143.3194	Gray whale	2	Feeding, circling
24.7.00	13:16	52.94667	143.3225	Gray whale	3	Group of large whales, active feeding
24.7.00	14:33	52.91472	1430.475	Seal	1	Swimming
24.7.00	14:37	52.90222	1430.602	Gray whale	1	The whale is resting under water
24.7.00	14:45	53.0075	1430.321	Larga seal	1	
24.7.00	15:00	52.8625	1430.331	Seal	2	Swimming
24.7.00	15:10	52.83306	1430.518	Seal	2	Swimming
24.7.00	15:14	52.83916	1430.345	Seal	12	Piltun Bay
24.7.00	15:55	52.73167	1430.329	Seal	2	
24.7.00	15:57	52.71778	1430.38	Seal	1	Swimming
24.7.00	15:58	52.70028	1430.361	Seal	4	Swimming
24.7.00	16:01	52.69278	1430.331	Seal	3	Swimming
24.7.00	16:03	52.66694	1430.39	Seal	2	

24.7.00	16:06	52.66278	1430.322	Seal	2	
24.7.00	16:08	52.63445	1430.38	Seal	5	Swimming
25.8.00	14:46	52.59195	143.3228	Larga seal	1	Swimming close to the shore
25.8.00	15:36	52.71722	143.3447	Gray whale	1	Swimming to north
25.8.00	16:21	52.82222	143.3461	Gray whale	2	Diving
25.8.00	16:37	52.86361	143.3531	Gray whale	3	Swimming, diving
25.8.00	16:39	52.87	143.3492	Gray whale	2	Swimming to the shore
25.8.00	17:17	52.94972	143.3206	Gray whale	1	Feeding, mud spots
25.8.00	17:17	52.94944	143.328	Gray whale	1	Active feeding, mud spots
25.8.00	17:19	52.955	143.3219	Gray whale	2	Swimming from the shore
25.8.00	17:31	52.98361	143.3192	Gray whale	1	Diving, hidden behavior
25.8.00	17:32	52.99417	143.3272	Gray whale	1	Diving
25.8.00	17:49	53.01694	143.3036	Gray whale	1	
25.8.00	17:51	53.03695	143.3153	Gray whale	1	Feeding, mud track
25.8.00	17:53	53.03917	143.2914	Gray whale	2	A female with calf, diving
25.8.00	18:12	53.03972	143.3	Gray whale	3	Large whales, feeding, mud spots
25.8.00	18:13	53.045	143.3061	Gray whale	3	Swimming to north along the shore
26.8.00	12:35	53.87972	143.2167	Gray whale	1	Swimming to south
26.8.00	12:45	53.82472	142.9117	Seal	2	Swimming
26.8.00	12:47	53.76111	142.9472	Larga seal	1	
26.8.00	13:05	53.62056	143.0381	Gray whale	1	Diving, hidden behavior
26.8.00	13:41	53.29361	143.2369	Gray whale	1	Diving
26.8.00	13:43	53.23722	143.2622	Gray whale	2	
26.8.00	13:45	53.22194	143.2608	Gray whale	2	Feeding, mud spots
26.8.00	13:58	53.15944	143.2808	Gray whale	2	Feeding
26.8.00	13:59	53.14028	143.2808	Gray whale	3	
26.8.00	14:01	53.12444	143.2872	Gray whale	2	Female with calf
26.8.00	14:02	53.11111	143.3008	Gray whale	1	
26.8.00	14:05	53.06445	143.3017	Gray whale	3	Active feeding, mud spots
26.8.00	14:05	53.05583	143.3092	Gray whale	1	Diving
26.8.00	14:23	53.02917	143.3156	Gray whale	1	Feeding, mud spots
26.8.00	14:24	53.00611	143.3086	Gray whale	2	
26.8.00	14:24	52.99194	143.3225	Gray whale	1	
26.8.00	14:25	52.975	143.3158	Gray whale	2	Feeding, mud spots
26.8.00	14:29	52.955	143.3219	Gray whale	2	Swimming from the shore
26.8.00	14:29	52.94556	143.3297	Gray whale	2	Feeding, mud spots
26.8.00	14:30	52.93945	143.3289	Gray whale	3	Swimming from the shore to east
26.8.00	14:30	52.93139	143.3336	Gray whale	1	Note
26.8.00	14:31	52.90972	143.3347	Gray whale	1	
26.8.00	14:57	52.85167	143.3581	Gray whale	3	Feeding
26.8.00	14:59	52.83805	143.3186	Seal	> 500	Feeding, mud spots
26.8.00	17:00	52.31722	143.1861	Seal	4000-5000	Rookery at the mouth of Piltun Bay
26.8.00		52.32944	143.173	Seal		4 seals rookeries at sand spits at the
						mouth of Chaivo Bay
26.8.00	17:16	52.15917	143.1511	Seal	1	Swimming
26.8.00	17:20	52.08139	143.1531	Seal	> 400	Seals are staying on sand island at
						the mouth of Nyisky Bay
26.8.00	18:57	51.30056	143.4853	Seal	> 100	Swimming at the mouth of Lunsky Bay
30.8.00	9:29	52.13306	143.1581	Larga seal	1	Swimming
30.8.00	9:34	52.32056	143.1733	Seal	>500	Chaivo Bay, the survey conducted at
						full high tide, when most
						of the seals came to water
30.8.00	9:54	52.85278	143.3297	Gray whale	1	

30.8.00	9:55	52.86806	143.5164	Gray whale	1	
30.8.00	9:57	52.91	143.3275	Gray whale	2	Circling
30.8.00	9:59	52.95444	143.3375	Gray whale	2	Swimming to north
30.8.00	9:59	52.97361	143.3261	Gray whale	1	Swimming to north
30.8.00	10:00	52.97083	143.3467	Gray whale	3	Whales are swimming
30.8.00	10:01	52.98528	143.3464	Gray whale	1	Feeding
30.8.00	10:02	52.995	143.3211	Gray whale	3	Swimming to south along the coastline
30.8.00	10:02	53.00583	143.3222	Gray whale	1	
30.8.00	10:03	53.02361	143.3153	Gray whale	2	Whales are swimming to north
30.8.00	10:14	53.02028	143.3128	Gray whale	1	Feeding, mud spots
30.8.00	10:16	53.03861	143.3417	Gray whale	1	Feeding
30.8.00	10:20	53.05222	143.2997	Gray whale	1	
30.8.00	10:21	53.06805	143.2939	Gray whale	1	Feeding, mud spots
30.8.00	10:27	53.18111	143.2669	Gray whale	4	3 whales swimming together
30.8.00	10:30	53.20694	143.2714	Gray whale	2	Feeding, mud spots
30.8.00	10:31	53.22222	143.2495	Gray whale	3	Whales swimming together,
						synchronous diving
30.8.00	10:32	53.2325	143.2586	Gray whale	1	
30.8.00	10:33	53.23695	143.2672	Gray whale	1	Resting at one spot
30.8.00	10:34	53.23695	143.2489	Gray whale	2	Female with calf
30.8.00	10:49	53.28722	143.2319	Gray whale	1	Swimming to south along the coastline
30.8.00	10:53	53.2925	143.3128	Gray whale	3	Female with calf are swimming
						together, swimming to south along the
						coastline
30.8.00	11:08	53.31055	143.2283	Gray whale	1	Active feeding, mud spots
6.9.00	14:12	53.33194	143.3783	Seal	1	
6.9.00	14:20	53.25528	143.2433	Gray whale	3	Feeding, mud spots
6.9.00	14:22	53.24333	143.2553	Gray whale	2	Female with calf, active feeding
6.9.00	14:23	53.24694	143.2561	Gray whale	5	Feeding
6.9.00	14:33	53.16694	143.4722	Seal	1	
6.9.00	14:37	53.18111	143.2678	Gray whale	3	Mud track, active feeding
6.9.00	14:46	53.17139	143.2772	Gray whale	3	Active feeding, mud spots
6.9.00	14:54	53.08722	143.3014	Gray whale	1	Swimming from the shore
6.9.00	14:56	53.05056	143.31	Gray whale	2	Feeding, mud spots
6.9.00	14:58	53.04945	143.2944	Gray whale	2	Feeding, mud spots
6.9.00	15:08	53.01028	143.5817	Seal	2	
6.9.00	15:14	53	143.313	Gray whale	3	Whales swimming from the shore
6.9.00	15:18	52.98361	143.3156	Gray whale	1	Feeding, mud spots
6.9.00	15:20	52.97055	143.3147	Gray whale	1	Feeding
6.9.00	15:21	52.97667	143.3278	Gray whale	1	Swimming to north
6.9.00	15:24	52.92778	143.3306	Gray whale	2	Feeding, mud track
6.9.00	15:26	52.92083	143.3303	Gray whale	4	Active feeding, mud spots
6.9.00	15:44	52.90667	143.3217	Seal	1	
6.9.00	15:57	52.83445	143.3653	Gray whale	2	Feeding, mud spots
6.9.00	15:57	52.85611	143.3497	Gray whale	2	Feeding
6.9.00	16:01	52.86528	143.3478	Gray whale	1	Swimming to north
6.9.00	16:05	52.83611	143.355	Gray whale	2	
6.9.00	16:30	52.33167	143.1656	Seal	> 2000	Two large rookeries of seals at the
		52.325	143.1919			mouth of Chaivo Bay
6.9.00	19:18	52.17139	143.4092	Dolphin	2	
7.9.00	10:59	52.61666	143.6139	Dolphin	1	Resting, staying on the same place
7.9.00	12:22	52.81833	143.3661	Gray whale	1	Swimming to north

7.9.00	12:26	52.83417	143.3597	Gray whale	1	Circling
7.9.00	12:28	52.84139	143.3206	Seal	>500	A rookery at the mouth of Piltun Bay
7.9.00	12:39	52.85111	143.35	Gray whale	1	Feeding, mud spots
7.9.00	12:40	52.86306	143.3503	Gray whale	2	Feeding, mud track
7.9.00	12:42	52.86444	143.3605	Gray whale	1	Swimming from the shore
7.9.00	12:54	52.89944	143.3439	Gray whale	2	Feeding
7.9.00	13:05	52.93056	143.3378	Gray whale	1	
7.9.00	13:05	52.93056	143.3344	Gray whale	2	Feeding, mud spots
7.9.00	13:12	52.93083	143.3272	Gray whale	1	
7.9.00	13:14	52.94056	143.3178	Gray whale	1	Active feeding offshore
7.9.00	13:24	52.98195	143.3328	Killer whale	1	
7.9.00	13:26	52.98389	143.3136	Gray whale	1	
7.9.00	13:46	52.98306	143.3161	Gray whale	1	Feeding, mud spots
7.9.00	14:03	53.075	143.2953	Gray whale	5	Active feeding, mud tracks
11.10.00	11:44	53.0625	143.2953	Gray whale	2	Feeding in the offshore zone
11.10.00	14:45	52.85333	143.3214	Seal	1	Swimming
11.10.00	14:47	52.83333	143.3536	Seal	4	Swimming
11.10.00	15:07	52.79611	143.5461	Gray whale	1	Swimming to north
13.10.00	9:34	51.30083	143.485	Seal	2	
13.10.00	9:36	51.34917	143.5	Seal	2	Swimming
13.10.00	10:42	51.925	143.2322	Killer whale	5	A bloody track stretches behind the
						killer whales with a length of 50 m,
						and the width of over 10 m
13.10.00	11:30	52.31833	143.1811	Seal	800-1000	A large rookery of seals on a sand bar
						at the mouth of Chaivo Bay
13.10.00	12:28	52.8475	143.3497	Gray whale	2	
13.10.00	12:30	52.88083	143.325	Gray whale	3	Feeding, mud spots
13.10.00	12:42	52.92805	143.3322	Gray whale	1	
13.10.00	13:05	53.14111	143.2872	Gray whale	3	Swimming to the shore
13.10.00	13:08	53.14139	143.2953	Gray whale	1	
13.10.00	13:13	53.16667	143.2783	Gray whale	2	Feeding, swimming to north
13.10.00	13:22	53.17028	143.3106	Gray whale	4	Feeding, mud spots
13.10.00	13:24	53.23722	143.2606	Gray whale	1	Swimming to south
13.10.00	13:31	53.26305	143.2408	Gray whale	3	Feeding
13.10.00	13:33	53.26445	143.2825	Gray whale	2	Swimming to south along the coastline
13.10.00	13:34	53.27917	143.2661	Gray whale	1	
13.10.00	13:36	53.28667	143.2564	Gray whale	2	Feeding
14.10.00	9:45	51.92583	143.2217	Killer whale	2	Swimming to south
14.10.00	10:00	52.32028	143.1817	Seal	200-250	The survey was conducted during
						high tide
14.10.00	10:36	52.8675	143.3319	Gray whale	2	Swimming to north
14.10.00	10:37	52.88667	143.3253	Gray whale	1	Diving
14.10.00	10:56	52.96278	143.3189	Gray whale	4	Active feeding
14.10.00	11:02	52.96944	143.3278	Gray whale	2	Swimming to north
14.10.00	11:04	52.98	143.31	Gray whale	1	Diving, swimming to north
14.10.00	11:07	53.01139	143.3353	Gray whale	3	Circling
14.10.00	11:08	53.02583	143.3344	Gray whale	2	Diving
14.10.00	11:12	53.04722	143.3408	Gray whale	2	Whales resting under water, periodically
						appearing on the surface at the
						same place
14.10.00	11:22	53.095	143.2831	Gray whale	1	The whale is actively feeding offshore;
						many mud spots around the whale
14.10.00	11:25	53.10972	143.2947	Gray whale	2	Feeding

14.10.00	11:26	53.12	143.2856	Gray whale	2	Feeding, mud spots
14.10.00	11:28	53.16555	143.2733	Gray whale	1	
14.10.00	11:29	53.18667	143.285	Gray whale	1	Swimming to north
14.10.00	11:31	53.20028	143.2711	Gray whale	3	Swimming to north along the coatline
14.10.00	11:34	53.21778	143.2756	Gray whale	3	Swimming to north
14.10.00	11:35	53.21944	143.2789	Gray whale	2	Resting
14.10.00	11:37	53.28305	143.2281	Gray whale	2	Feeding
14.10.00	11:38	53.29361	143.2472	Gray whale	2	Diving
14.10.00	11:41	53.32333	143.2178	Gray whale	1	
14.10.00	11:45	53.33055	143.2036	Gray whale	1	Feeding, mud track
14.10.00	12:26	53.75028	142.9489	Seal	3	Swimming offshore
14.10.00	15:58	52.84083	143.3231	Seal	800-900	A large rookery at the mouth of
						Piltun Bay
14.10.00	16:15	52.65333	143.3322	Killer whale	5	Three killer whales stay in a dense
						group (large male, female and
						a young specimen)
14.10.00	16:45	52.33917	143.173	Seal	80-100	A rookery at the left shore of Chaivo Bay
14.10.00	16:45	52.32195	143.175	Seal	1000-1200	2 large rookeries at the mouth of
						Chaivo Bay (the survey was carried out
						at full low tide)
18.11.00	11:28	53.17889	143.275	Gray whale	1	Diving in pancake ice
18.11.00	11:41	53.15083	143.2839	Gray whale	1	Diving in pancake ice
18.11.00	11:47	53.06667	143.3336	Gray whale	1	Diving in pancake ice
18.11.00	12:03	53.05083	143.2944	Gray whale	1	Diving in thinly broken ice
18.11.00	12:27	52.98444	143.3339	Gray whale	1	
18.11.00	13:05	52.91667	143.3253	Gray whale	1	Diving in thinly broken ice
18.11.00	14:04	52.9	143.4181	Seal	1	
18.11.00	14:14	52.88167	143.3258	Seal	3	Swimming
18.11.00	14:29	52.83916	143.3422	Seal	6	Swimming at the mouth of Piltun Bay
18.11.00	14:37	52.80083	143.3392	Seal	2	Swimming
18.11.00	14:48	52.7875	143.3256	Seal	5	Swimming
18.11.00	15:09	52.75611	143.3745	Seal	1	Staying on ice
18.11.00	15:55	52.61666	143.3258	Bearded seal	1	Staying on ice
18.11.00	15:56	52.61722	143.3581	Seal	1	Staying on ice
18.11.00	16:06	52.6	143.3697	Seal	2	Staying on ice
18.11.00	16:10	52.60056	143.325	Seal	4	Swimming in the midst
						of pancake ice
18.11.00	16:22	52.58333	143.3333	Seal	5	On ice
19.11.00	10:46	53.83611	142.9197	Seal	1	Swimming
19.11.00	11:04	53.78361	142.935	Seal	2	Swimming
19.11.00	11:06	53.76028	142.9661	Seal	2	Offshore in the tidal area
19.11.00	11:22	53.6225	143.0364	Seal	1	Swimming
19.11.00	11:37	53.46972	143.1255	Seal	2	Swimming in the midst of pancake ice
19.11.00	11:50	53.33389	143.1839	Seal	3	Swimming in lolly ice
19.11.00	11:51	53.34555	143.2017	Seal	2	Swimming in pancake ice
19.11.00	11:52	53.29611	143.2392	Gray whale	1	Diving in pancake ice and lolly ice
19.11.00	11:56	53.26944	143.245	Seal	2	Swimming among pancake ice
19.11.00	12:05	53.24472	143.2783	Gray whale	2	Swimming in pancake ice
19.11.00	12:15	53.17139	143.2708	Seal	4	Swimming in lolly ice
19.11.00	12:20	53.11444	143.2889	Seal	2	Swimming in lolly ice
19.11.00	12:40	53.00195	143.3289	Seal	6	Swimming in lolly ice
19.11.00	12:43	52.99361	143.3111	Seal	1	Swimming in lolly ice
19.11.00	12:47	52.97194	143.3172	Seal	6	Swimming in lolly ice

19.11.00	12:49	52.96389	143.3286	Seal	3	Swimming in lolly ice
19.11.00	14:00	52.84306	143.3194	Seal	40-50	Seals staying on ice near ice holes at the mouth of Piltun Bay
19.11.00	14:03	52.84167	143.3578	Seal	9	Swimming in pancake ice
19.11.00	14:07	52.82528	143.3367	Seal	7	Swimming in young pancake ice
19.11.00	14:09	52.8025	143.3481	Seal	3	Swimming in lolly ice
19.11.00	14:12	52.78722	143.3667	Seal	1	Staying on ice
19.11.00	14:32	52.6725	143.4008	Seal	13	Swimming in pancake ice
19.11.00	14:35	52.67722	143.3556	Seal	9	Swimming in pancake ice
19.11.00	14:40	52.66222	143.3661	Seal	14	Staying on ice floes
19.11.00	14:43	52.63083	143.3733	Bearded seal	9	Staying on small ice floes
19.11.00	14:44	52.60472	143.37	Bearded seal	19	Staying on ice floes
19.11.00	14:45	52.58583	143.3639	Bearded seal	13	Staying on ice floes
19.11.00	14:46	52.57972	143.3689	Seal	9	Swimming in free spaces between pancake ice
19.11.00	14:59	52.51305	143.4161	Seal	26	Staying on ice floes in the fields of
19.11.00	15:02	52.50306	143.327	Seal	2	Staying on ice floes
19.11.00	15:22	52.32611	143.1767	Seal	3	Staying on ice floes in Chaivo Bay
19.11.00	15:23	52.315	143.1867	Seal	2	Swimming in lolly ice
19.11.00	15:26	52.25333	143.2094	Seal	12	Staying on ice floes
19.11.00	15:47	52.11722	143.157	Seal	2	Staying on ice floes in Nyisky Bay
19.11.00	16:13	51.99639	143.1767	Seal	9	Swimming
20.11.00	9:20	51.92222	143.2881	Seal	2	Swimming
20.11.00	9:41	51.78194	143.3081	Seal	4	Swimming
20.11.00	9:43	51.76611	143.3161	Seal	1	Swimming
20.11.00	9:47	51.74306	143.32	Seal	6	In the mouth of Nabil Bay
20.11.00	9:48	51.74222	143.3653	Seal	9	Swimming in lolly ice
20.11.00	10:05	51.69444	143.3667	Seal	1	Swimming in pancake ice
20.11.00	10:06	51.67333	143.3717	Seal	13	Swimming
20.11.00	10:15	51.66833	143.3703	Seal	2	Swimming
20.11.00	10:20	51.59278	143.4047	Seal	2	Staying on ice floe
20.11.00	10:36	51.5825	143.4339	Seal	3	Staying on ice floes
20.11.00	10:38	51.58333	143.4361	Seal	2	Staying on ice floe
20.11.00	11:00	51.49528	143.5303	Seal	4	Swimming
20.11.00	11:02	51.50778	143.4428	Seal	1	Swimming in lolly ice
20.11.00	11:07	51.42944	143.4819	Seal	1	Swimming in pancake ice
20.11.00	11:22	51.3425	143.4956	Seal	2	Swimming
20.11.00	11:22	51.33778	143.4989	Seal	2	Staying on ice floes
20.11.00	11:29	51.25861	143.5294	Seal	2	Staying on ice floes in the fields of pancake ice
20.11.00	11:31	51.24333	143.5408	Seal	3	Swimming in the open water space between icefloes
20.11.00	11:53	51.17389	143.5444	Seal	5	Staying on ice floes
20.11.00	11:53	51.17278	143.563	Seal	3	Staying on ice floes
20.11.00	11:54	51.16222	143.5853	Seal	3	Swimming in pancake ice
20.11.00	11:55	51.15917	143.5775	Seal	1	Swimming in pancake ice
20.11.00	11:59	51.09195	143.6003	Seal	1	Swimming

Appendix 2

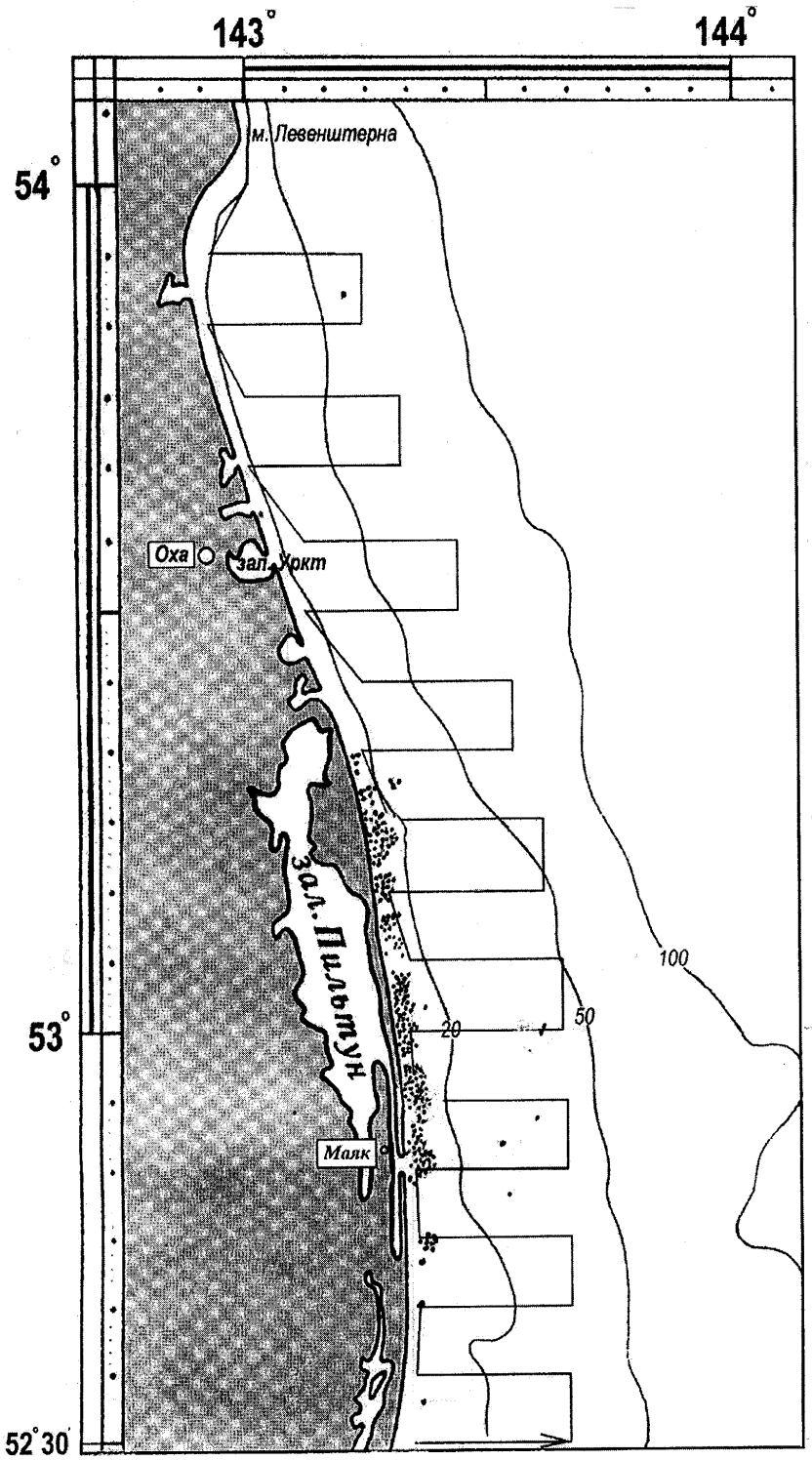

Fig. 6.4. Occurence of gray whales offshore North-Earsten Sakhalin in June-November 2000 (intensive and extensive aerial survey)