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Glazov D.M.¹, Chernook V.P., Shpak O.V.^{1,3}, Solovyev B.A.^{1,4}, Nazarenko E.A.¹, Vasilev A.N.², Chelintsev N.G.¹, Kuznetsova D.M.¹, Mukhametov L.M.^{1,3}, Rozhnov V.V.¹

The results of beluga whale (Delphinapterus leucas) aerial surveys in the Okhotsk Sea in 2009 and 2010

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Comprehensive studies on the beluga whale ab
 dance and distribution of the northern and sou
 western parts of Okhotsk Sea were conducted
 three times in 1986. (Berzin et al., 1986; 1990
 Most of published papers provide only a
 visual count estimates without any math analysis. The
 absence of standardized method makes comparisc
 the data between years difficult if not impossib
 During almost 20 years, until 2009, aerial surveys
 the Okhotsk Sea beluga whales have not been
 conducted; the abundance of whales is unknown. I
 we present a summary of the results of 2009
 2010 aerial surveys and provide the beluga wh
 abundance estimates for each of the survey reg
 of the Okhotsk Sea.
 Aerial surveys with the modern technical equipment
 (Q_jgh b dj 2008) were conducted in late su
 mer from a specially equipped airplane AB using
 the same method in 2009 and 2010. Almost all
 Okhotsk Sea coastal waters were covered (Fig. (1, 2).
 In 2009, before conducting the main abundance su
 vey, we flew a series of reconnaissance flights in
 western part of the sea (Shantar region) and cov
 the entire water area of the bays using the paral
 track-line method. We found belugas only in coas
 zones, which proved economical effectiveness of
 such method in the given region. In future, para
 or chainsaw trackline survey was conducted on
 in Sakhalinsky Bay and the Amur Estuary. In otl
 regions, the survey was conducted as a contin
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of all beluga coastal aggregations. Each year, surveyed the western part of the sea twice: in 2009 the first series of flights was conducted on August 8, and the second one on September 113 (columns 2009¹ and 2009² in Table2); in 2010 both surveys were conducted in August with a 15-day interval (August 78 and 2324; columns 2010¹ and 2010² in Table 2, respectively). The other regions were surveyed once each year. Flight altitude effort was predominantly 400 m, but could range from 300 to 700m.

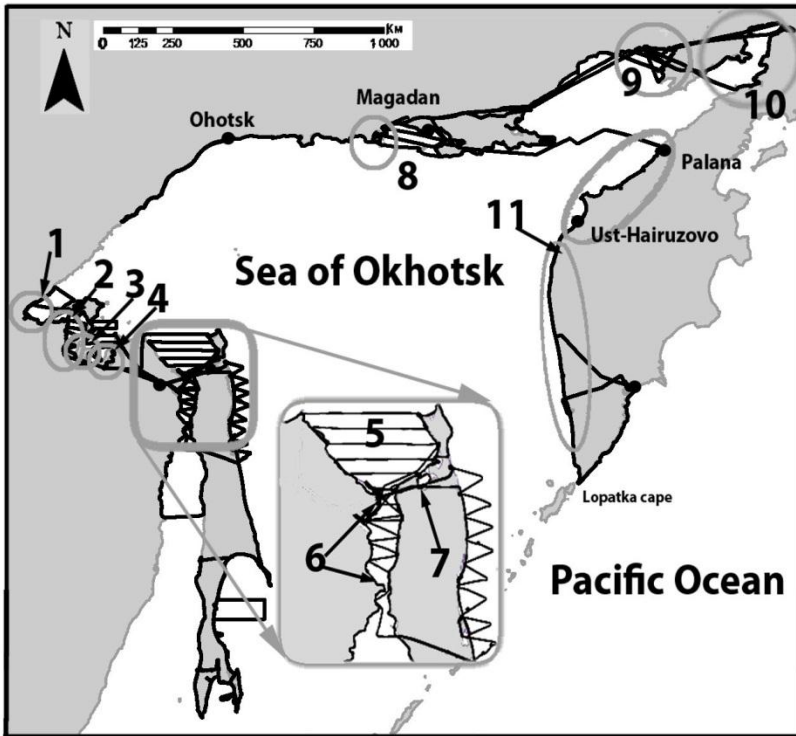
Beluga abundance estimate was calculated based on visual observations corrected and supplemented especially for dense aggregations with the photogrammetric material analysis. Due to the large size of the water area surveyed, we used the LYLGHG LW RQW JLRQV`WKDW FRUHHVSRQGH coastal water area (Fig. 1, 2). Abundance estimate was conducted separately for each survey region. For the southern part of Sakhalinsky Bay and the Amur Estuary, beluga abundance was calculated using the LQ WKH SURJUDP 3% (/8.+ \$ a` tion method (Chelintsev, 2010; 2012). For the other regions where we conducted direct count, beluga abundance was taken to be equal to the number of animals detected by the observers, and in cases of large aggregations visually observed number corrected with photographs (table 1, 2). All estimates DID NOT take into account belugas invisible to observers due to being underwater (no availability correction); thus, we consider the obtained results as 3PLQLPDO DEXQG DQFH`

As a result of our flights, we found out that in August-September belugas mainly concentrate in the mouths of big rivers. The major beluga aggregations (over 100 individuals) that we detected may be grouped according to two regions spatially set apart: the northeastern part of the Okhotsk Sea (Gizhiginskaya, Penzhinskaya gulfs and the coastal waters of western Kamchatka) and western part of the Sea (The Amur Estuary, Sakhalinsky Bay, bays: Baikal, Nikolaya, Ulbansky, Tugsky, and Udszkaya Gulf).

In the northeastern part of the Okhotsk Sea, between August 21±September 7, 2009, we detected 1027 beluga whales. In addition, a group of 10 whales was recorded for Tauyskaya Gulf. Penzhinskaya Gulf was surveyed under poor conditions (low fog), there for we suspect an underestimate for survey region in 2009. In 2010 (August-19), we found 1333 belugas in the northeastern part of the Sea; in Tauyskaya Gulf no belugas were sighted.

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The coastal waters of Penzhinskaya Gulf were surveyed under the good weather conditions, and the number of observed belugas doubled that from the previous year. We consider the results for 2010 survey are more demonstrative for this part of the Sea, and suggest that the 2010 beluga abundance estimate be used for this region (table 1).



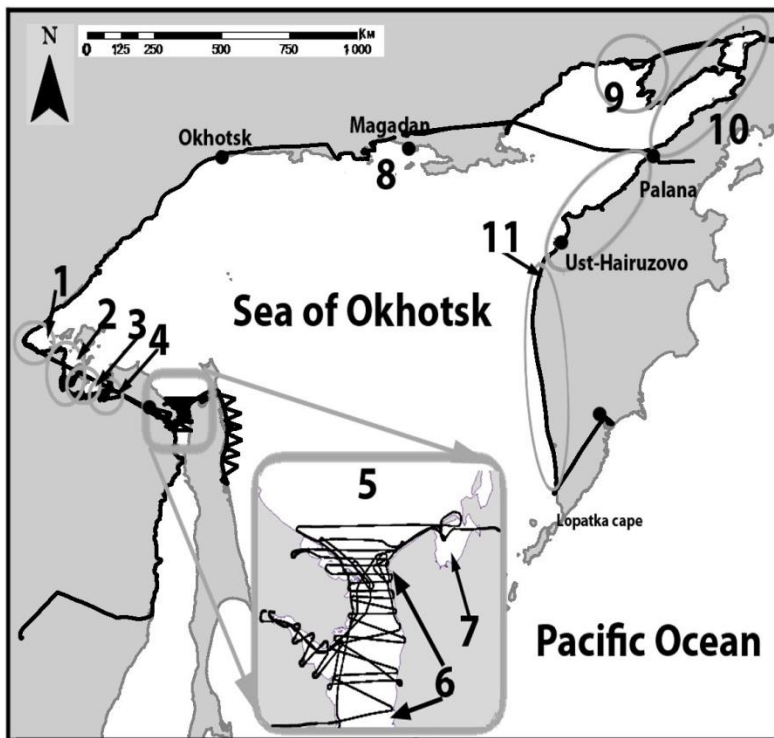
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Fig. 1. Flight routes and areas where belugas were encountered, August-September 2009. Black lines - flight routes, grey ovals - regions where belugas were sighted: 1 - Utskaya Bay; 2 - Tugursky Bay; 3 - Ulbansky Bay; 4 - Nikolaya Bay; 5 - Sakhalinskiy Bay; 6 - Amur estuary; 7 - Baikalskiy Bay; 8 - Tauiskaya Bay; 9 - Gishigai Bay; 10 - Penzhinskaya Bay; 11 - Moroshechnaya.

Table 1. Beluga number estimates based on aerial surveys in the eastern part of the Okhotsk Sea, 2009, 2010.

Survey region	2009		2010	
	Date of survey	Number estimate	Date of survey	Number estimate
Utskaya Bay	16/08	15	10/08	0
Gishigai Bay	21/08	278*	19/08	370
Penzhinskaya Bay	25-26/08	146*	18/08	312
Kamchatka from r. Moroshechnaya (included) to r. Palana	07/09	442	13-14/08	638
Kamchatka from Cape Lopatka to r. Moroshechnaya (not including)	02/09	146	14/08	13
Total		1027		1333

* - Beluga number estimates based on aerial surveys in the eastern part of the Okhotsk Sea under fog conditions (low fog)



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Fig. 2. Flight routes and areas where beluga whales were encountered during aerial surveys, August 2010. Black lines - flight routes, regions where belugas were sighted - grey ovals. 1 Udskeya Bay; 2 Tugursky Bay, 3 Ulbansky Bay; 4 - Nikolaya Bay, 5 Sakhalinskiy Bay, 6 - Amur estuary; 7 Baikal Bay; 8 - Tauskaya Bay; 9 - Gizhiga Bay; 10 - Penzhinskaya Bay; 11 - Moroshechnaya

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During the first beluga count in the western part of the Okhotsk Sea (survey 2009), 1853 belugas were observed. During the second survey, 1567 belugas were detected. As shown in our data (table 2), relatively few belugas were detected in Sakhalinskiy Bay during the 2009 survey. This fact has led to a low abundance estimate, which can be explained by ineffective (reconnaissance) route design that mainly covers the open part of the bay not typically used by belugas in summer. A significant difference (August - September flights) in numbers of whales observed in the Shantar region bays may have been caused by worse weather conditions in September or/and by the fact that the flights were conducted at different phases.

In 2010-1 survey we visually detected 4470 whales. During the second series of flights we did not have a chance to survey Udskeya Gulf, the place for the largest in the Shantar region aggregation of belugas. Therefore, the data from 2010 survey may not be used for the abundance estimate in the western part of the sea. In the rest of the survey regions of the part of the sea we found 2220 belugas. We consider the 2010 survey to be the most representative and comprehensive for the western Okhotsk Sea, and suggest that the data obtained during August 2010 flights are used for the total Okhotsk Sea beluga abundance estimate.

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LZbf h[jZahf gZrZ hp_gdZ fbgbfZe Thus, our estimate of minimal beluga abundance in the Okhotsk Sea, based on the data from the surveys of a satisfying quality, equals 6116K(=6.8%) of a satisfying quality, equals 6116K(=6.8%) whales.

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Table 2. Beluga number estimates based on aerial surveys in the western part of the Okhotsk Sea, 2009, 2010.

=h^mq_lZ Survey year	2009				2010			
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Lm]mjkaZeb\ Tugursky Bay	05/08	135	11/09	18	07/08	753	23/08	314
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AZeb\GbNioe laya Bay	05/08	34	11/09	6	07/08	54	23/08	104
AZeb\ ;ZcdZe Baikal Bay	07/08	33	13/09	89	08/08	126	23- 24/08	0
KZoZebgkdbc :fmjkdbc ebfZ khalinskiy Bay and Amur estuary	08/08	475* (67,3) <u>232</u>	13/09	2204* (36,9) <u>1278</u>	08/08	1448* (28,8) <u>1138</u>	23- 24/08	2064* (53,8) <u>708</u>
<k_]Total	2096(15,3)		2493(23,1)		4783 (87)		**	

* - hp_gdZ qbke_gghklb ihemq_gZ ijb wdklZiheyppb gZ iehsZ^v jZch (CV%); *күрсөм* \u^_e_gh qbkeh [_emo \bamZevgh aZnbdkbjh\Zggh_gZ[ex^ j_dlbjh\Zggh_ ih nhvBeluga number estimate was obtained by extrapolation to the area of the region; in brackets coefficient of variance (CV%); *in italics* -the number of belugas visually detected by the observers and corrected by photo.* - baaZ g_ ijh\h^b\r_]hky mq_lZ \ M^kdhc]mq_lhklhZsy h]pbg ^b eZVNo data available due to incomplete coverage of the study area (no survey in Udskeya Bay).

>ZggZ[h]Zuiehg_gjZfdZkh]jm^g bq This work has been conducted as collaboration of 3:KLWH :KUDRUJHDP´ E\ 7KH 3HUF of IPEE RAS (financial support: Russian Geograp DELOLW\ DVVHVVP HQW´ E\ 'RC support:Ocean Park Corporation, Hong Kong; Geor Aquarim Inc., Seaworld Parks & Entertainment, Mystic Aquarium and Institute for Explor ation, USA; Kamogawa Sea World, Japan.) We are grateful to all vey and analysis participants, the pilots and employ of 39RVWRN´ DLU FRPSDQ\ .KDE

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of Cetaceans in the Sea of Okhotsk in 1985. Pp. 128 in Research work on marine mammals in the
North Pacific in 1984-1985. Moscow

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[Berzin A.A., Vladimirov V.L., Doroshenko N.V. 1990 Results of airborne research on distribution and abundance of bowhead, gray and beluga whales in the Sea of Okhotsk in 1985. Proceedings of TINRO, vol. 112: 51-60]

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2010c. The method of beluga (Delphinapterus leucas) number estimation on data of aerial surveys of the Holarctic. Collection of Scientific Papers. Kaliningrad

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Melentyev V., Glazov D., 2008. Laboratory aircraft L410 application for instrumental aerial surveys of the marine mammals. (In the G L W L R Q 3 0 D W H U L D O V R I W K H , Q W H U Q D W L R Q D O & R Q I H U H
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Glazov D.M, Shpak O.V., Kuznetsova D.M., Ivanov D.I., Mukhametov L.M., Rozhnov V.V.
Preliminary results of tracking the beluga whale (Delphinapterus leucas) movements in the White Sea in 2010-2011
A.N. Severtsov Institute of Ecology and Evolution RAS, Moscow, Russia

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The beluga whale (*Delphinapterus leucas*) is the only cetacean species that permanently resides in the White Sea. Based on summer aerial surveys in 2008 and 2010, the total abundance is estimated to be 5000 to 7500 individuals without correction for belugas underwater. (e Z a h ^ j 2006, 2008, 2010; Glazov et al. 2007). In winter, a considerable part of population, at least 2000 individuals, remains in White Sea water area (e Z a h ^ j 2010). Until now it has been suggested that in winter a big