Review of the recent scientific data on the Okhotsk Sea white whale (*Delphinapterus leucas*) population structure and its application to management

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INTRODUCTION

In 2000, Sub-Committee on Small Cetaceans recognized 29 white whale, or beluga, stocks, out of which 3 were from the Okhotsk Sea (OS, Fig. 1.): Shelikhov, Sakhalin-Amur and Shantar stocks. One more, the 4rth, possibly extirpated Tauyskaya Bay (or Tauy Inlet) stock was also mentioned in report (IWC, 2000). No reliable abundance estimates and knowledge on geographic range, genetic and contamination-load data were available for any of the OS stocks. The entire OS abundance estimate of 18,000-20,000 (1987) accepted by the Sub-Committee was one of the numerous – often based on expert evaluations or calculations with unreasonably high coefficients – estimates that varied between 6-8,000 (Berzin and Yablokov, 1978) and 35-45,000 whales (Melnikov, 1984; Popov, 1986). Most of available in literature abundance estimates were the result of multiplying a visually observed number of whales by a 'surface beluga coefficient' (up to ×20 for feeding or quickly-moving groups, Bel'kovich, 1960). Usually in 1970-1990s, during aerial counts this coefficient was taken equal 10 or 12; sometimes it ranged from 6 to 12 depending on the beluga behavior (Nikolaev, 1974). Further, at the IWC meeting (2000) it was pointed that both Sakhalin-Amur and Shantar stocks experience few occasional takes and few live-captures per year, and that no threats are documented for either of them, although both may be subject to current or future petroleum developments. The information on the OS white whales discussed at the meeting was based on the review submitted to IWC by V. Melnikov (1999).

Here we present the review of recently published data on the OS beluga abundance, seasonal movements, and population structure obtained from the two research projects: 1) *Current*

status of the Sakhalin-Amur beluga aggregation (The Okhotsk Sea, Russia): sustainability assessment (2007-2012, by Dolphin and I, ltd) and 2) *The White Whale Program* (2009-2012, by IPEE RAS). Further, we describe historic harvest and current situation with the beluga live-captures in Sakhalin-Amur region and provide recommendations for sustainable use of the studied stocks.

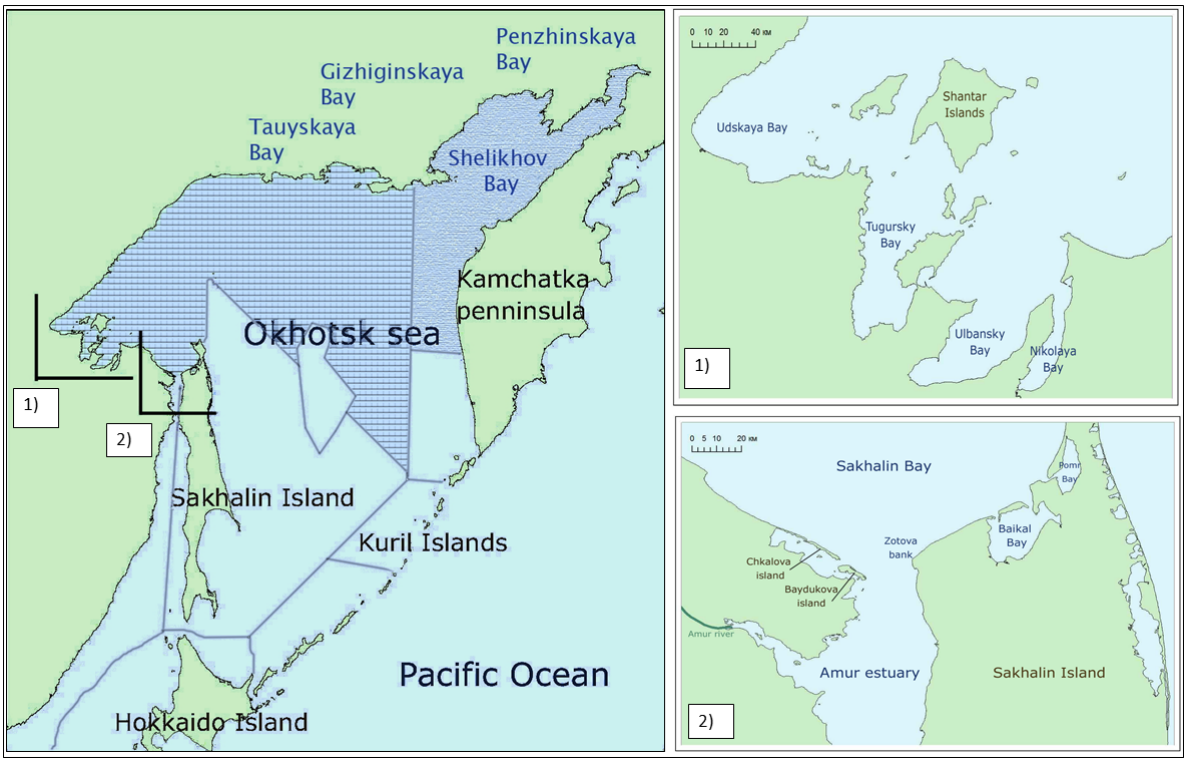

Figure 1. The Okhotsk Sea. Fishing subzone borders are marked with blue lines. Northern-okhotsk and western-kamchatka subzone areas are painted with darker textures. 1) Shantar region. 2) Sakhalin-Amur region.

POPULATION STATUS RELATED DATA

White Whale abundance estimates, 2009-2010

In 2009-2010 aerial surveys of the coastal OS (except for Kuril Islands chain) were conducted in August-September (Glazov et al., 2012). Sakhalin-Amur and Shantar regions were surveyed each year twice. Beluga abundance was calculated based on visual counts and photographs. Due to the large size of the water-area surveyed, it was divided onto the *survey regions* that corresponded to geographic features of the coast line. Abundance estimate was conducted separately for each survey region (Table 1). For the southern part of Sakhalinsky Bay and the Amur Estuary, which were surveyed in parallel line-transects, beluga abundance was calculated in the program 'BELUKHA 2' with the extrapolation method (Chelintsev, 2010a; 2010b; 2012). For the other regions, where the single-line coastal survey was done,

beluga abundance was taken to be equal to the number of visually detected animals, and in cases of large aggregations – visually observed number corrected with photographs. All estimations *did not* take into account belugas invisible to observers due to being underwater (no availability correction); thus, the results presented by Glazov *et al.* (2012) reflected 'minimal abundance'. In August-September belugas mainly concentrated in the mouths of big rivers. The major beluga aggregations (over 100 individuals) detected may be grouped according to two regions spatially set apart: 1) western part of the Sea – Sakhalin-Amur area and the Shantar bays, and 2) northeastern part of the OS – Shelikhov Bay and coastal waters of western Kamchatka (Table 1).

For the reasons of poor weather conditions and incomplete area coverage, the results of some sections of the surveys in 2009 and 2010 were considered unsatisfying. For the entire OS beluga abundance estimate, the results for 2010-survey for the northeastern part (1,333 whales) and the first of the 2010 surveys in the western part (4,780 whales; note, in Glazov *et al.* (2012), the western OS abundance equals 4,783 – summation error) were taken into account. **Minimal abundance** of the beluga whale population in the OS is **6,113 (CV=6.8%)** whales.

As suggested by Shpak *et al.* (2011) and supported by IUCN expert panel review (Reeves *et al*., 2011), the estimates of 2009 and 2010 beluga surveys may be corrected for availability, taking into account that 50% of whales may had remained unseen to the observers. Such **corrected abundance** estimate for the OS beluga comes to **12,226** whales.

Table 1. Results of 2010 aerial survey used for the Okhotsk Sea beluga abundance estimate: for western part of the OS (A) and for northeastern part of the OS (B) (adapted from Glazov *et al*., 2012, Chelintsev and Shpak, 2012).

A.

Date of survey 2010a	Part of region	Method of count	Estimated beluga number (Ni)	Relative statistical error (cv)
aug 8	Amur mouth	direct	35	0.000
aug 8	Amur estuary	sample	108	0.453
aug 8	Sakhalin Bay	sample	1305	0.318
aug 8	Baikal Bay	direct	126	0.000
aug 7	Tugursky Bay	direct	753	0.000
aug 7	Nikolaya Bay	direct	54	0.000
aug 7	Ulbansky Bay	direct	1167	0.000

aug 7	Udskaya Bay	direct	1232	0.000
Western OS, total			**4780**	**0.087**

B.

Date of survey 2010	Part of region	Method of count	Estimated beluga number (Ni)	Relative statistical error (cv)
aug 10	Tauyskaya Bay	direct	0	0.000
aug 19	Gizhiginskaya Bay	direct	370	0.000
aug 18	Penzhinskaya Bay	direct	312	0.000
aug 13-14	west Kamchatka, N	direct	638	0.000
aug 14	west Kamchatka, S	direct	13	0.000
Northeastern OS, total			**1333**	**0.000**

Satellite tracking, 2007-2010

In 2007-2010, 22 beluga whales (13 females and 9 males) were tagged near Chkalova Island in Sakhalinsky Bay. All whales were subadults or adults; body lengths ranged from 353 to 505 см. Excluding one tag that failed immediately after tagging, the tags transmitted 2.5 to 9.5 months, 6 months in average. One female beluga tagged in 2008 was re-captured and re-tagged in 2010 (Shpak et al., 2011). Beluga movement pattern varied with season. In summer, belugas stayed near Chkalov and Baydukov Islands, close to the tagging site. In autumn, the whales behaved differently. In Shpak *et al*. (2010) we pointed out that in autumn all 10 tagged belugas moved to the eastern Shantar region (Nikolaya Bay, and some individuals visited Ulbansky Bay) where they spent up to 3 months. Same pattern was observed for the 2 belugas tagged in 2010 (Shpak et al., 2011). Meanwhile, more tagging conducted by IPEE RAS in 2009-2010 (Shpak et al., 2012) showed that only 2 out of 9 belugas spent some time in Nikolaya Bay, and one of these two was a re-tagged beluga. One more female came west close to the entrances of Nikolaya and Ulbansky Bays, but did not go into the bays. The whales that stayed in Sakhalinsky bay in autumn moved larger distances within the bay, as compared to summer months, travelling along its eastern part and going south toward The Amur Estuary.

One fact falls out of our suggestion on summer highly residential behavior of Sakhalin-Amur belugas: in July 2009 and 2010 we re-sighted 2 and 1 previously tagged belugas in Nikolaya Bay. The quality of photos did not let identify the individuals, and it is possible that a whale seen in 2010 was one of the 2 individuals observed in 2009 (Shpak *et al*., 2011). Either

belugas travel between the bays during summer time, or in different years chose different bays as summer grounds remains unknown.

Thus, two-thirds of the tracked belugas from Sakhalin-Amur aggregation moved to the eastern part of the Shantar region in autumn, while others did not follow this route. At least two Sakhalin-Amur belugas were observed in Nikolaya bay in summer time.

In winter, belugas travelled offshore, northward, keeping to the dense ice or the ice edge.

Analysis of IPEE RAS data (Shpak *et al*., 2012; Fig. 2) has shown that belugas tagged in one place (around Chkalova Island, Sakhalinsky Bay) did not travel together on winter migrations and used different wintering grounds of different depths: some stayed mainly within the shelf zone, while others fed in the areas of 200-500m depths. Diet preferences were suggested as one possible reason for such choice of wintering grounds.

None belugas went east beyond Tauyskaya Bay (E151°), i.e. they did not enter either Shelikhov Bay or western Kamchatka waters. We obtain limited tracking data (unpubl.) that suggest that belugas summering along western Kamchatka coast do not migrate westward enough (do not pass E155°) to mix with Sakhalin-Amur belugas.

Based on the satellite tracking data obtained by 'Current status of Sakhalin-Amur beluga aggregation...' project, we suggested that belugas from Sakhalin-Amur and eastern Shantar aggregations share common grounds in autumn and that Sakhalin-Amur belugas wintering in the northern OS may mix with belugas from Shelikhov Bay and Kamchatka aggregations (Shpak *et al*., 2010, 2011). More satellite tracking data obtained by IPEE RAS showed that Sakhalin-Amur belugas do not necessarily visit eastern Shantar bays in autumn (Shpak *et al*., 2012), and that wintering grounds of Sakhalin-Amur and western Kamchatka belugas (data based on 1 individual) do not overlap (Shpak and Glazov, unpubl.).

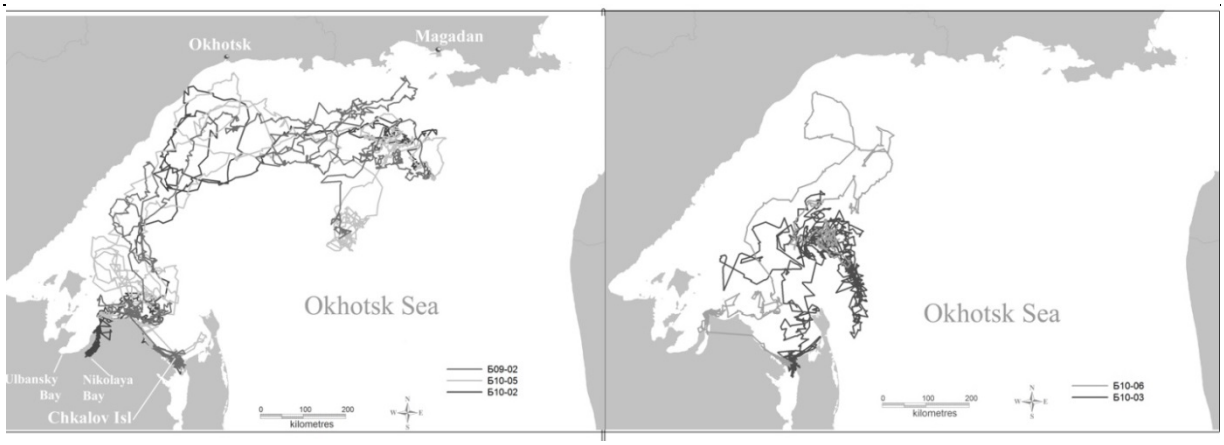

Figure 2. Sakhalin-Amur beluga seasonal movements (2009-2010). 'Eastern' winter group (left) and 'western' winter group (right) (from Shpak *et al*., 2012).

Genetic data

It has been long discussed how many beluga populations (1 to 3) occupy the OS area (Kleinenberg *et al*., 1964; Berzin *et al*., 1990; Vladimirov, 1995; Doroshenko, N. and Doroshenko, A., 1996; Melnikov, 1999). Below we present recent results based on a large pool of genetic material that has been collected since 2004. With recently analysed samples from off western Kamchatka, it became possible to review the population structure of beluga whales in the OS.

In Meschersky *et al*. (2013), a general analysis of Far Eastern beluga genetic data (collection 2004-2010) is presented, where, instead of using all available specimens, the authors chose to limit the analysis of the OS Shantar sample by selecting only the sub-sample of Udskaya Bay, the furthest from Sakhalin-Amur region. Yazykova *et al.* (2012) conducted a dedicated analysis on population structure of belugas summering in the western OS, i.e. in Sakhalin-Amur and Shantar regions (Table 2).

Table 2. Total sample sizes for nucleotide sequencing of the mtDNA control region (497 bp) and detecting of alleles of the nDNA microsatellite loci from different OS summer aggregations (multiple years). Note the difference in number of loci in Meschersky *et al*. (2013) and Yazykova *et al*. (2012).

Area and place of sampling	Number of specimens			
	in Meschersky *et al.*, 2013		in Yazykova *et al*., 2012	
	mtDNA	9 nDNA microsat loci	mtDNA	19 nDNA microsat loci
Western OS 1: Sakhalin-Amur				
Sakhalinsky Bay	106	71	72	37
Western OS 2: Shantar				
Nikolaya Bay	-	-	8	8
Ulbansky Bay	-	-	61	61
Tugursky Bay	-	-	31	26
Udskaya Bay	46	45	84	77
Northeastern OS:				
western Kamchatka	14	14	-	-

Meschersky *et al.* (2013) has found statistically significant differences in allele frequencies between the samples of beluga whales from the western and northeastern OS, but not between two regions within the western part of the sea (Sakhalinsky and Udskaya Bays). The differences between western Kamchatka whales and those from Udskaya Bay were smaller than between Kamchatka and Sakhalinsky Bay belugas. A clustering method (Structure

v.2.3.3 software, Pritchard *et al.* (2000)) was used to assess the probability of individuals to belong to various populations (genetic groups), and the use of 'Admixture-LOCPRIOR' model (but NOT 'Admixture' model) confirmed isolation of western Kamchatka belugas from Sakhalin-Amur and Shantar whales (Fig. 3, note that a sample from the Bering Sea (4) is included).

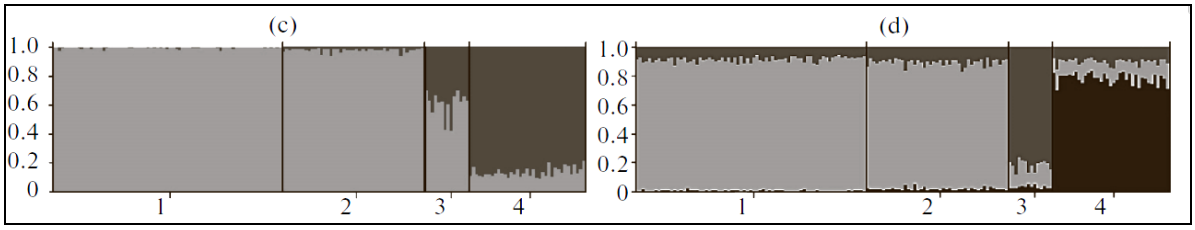

Figure 3. Probability of individuals (n = 167) summering in Sakhalinsky Bay (*1*), Udskaya Bay (*2*), waters off the western Kamchatka coast (*3*), and the Anadyr Estuary, Bering Sea (*4*) to belong to one of the two (K = 2, c) or three (K = 3, d) genetic groups (presented as various tints of gray). Admixture–LOCPRIOR model, 500 000 repl., 9 microsatellite loci (fragment of Fig. 2 in Meschersky *et al*. (2013)).

The distribution of mtDNA haplotypes in Meschersky *et al*. (2013) revealed a high level disjunction of sets of maternal lines among all studied samples, including Sakhalinsky Bay and Udskaya Bay (*Fst* = 0.21583–0.54484; all $P < 0.00001$). The characteristics of the set of mtDNA lines – the high level of haplotypic and nucleotide diversity – in Sakhalinsky beluga whales are typical for a large population that has existed over a long period of time.

The authors conclude that belugas summering in the western part of the sea, in Sakhalin-Amur and Shantar regions, represent a single heterogeneous population, while belugas sampled off western Kamchatka belong to a different population with a high degree of probability.

Meschersky *et al.* (2012) have also described the pattern of distribution of mitochondrial lines for western OS, northeastern OS and the Bering Sea belugas, but in this paper much larger sample sizes, comparing to Meschersky *et al.* (2013), were analysed; and all Shantar samples – from Nikolaya, Ulbansky, Tugursky and Udskaya bays – were used in analysis. For all samples, statistically significant differences were found ($p<0.000001$) not only for the frequency of occurrence of particular haplotypes (according to Fst), but also for the mean genetic distances (according to Φst) between the haplotypes present in each study region. At the same time, Yazykova *et al*. (2012), having analysed genetic structure of the beluga

population in the western OS (all 4 Shantar bays and Sakhalin-Amur area, Table 2) using nuclear DNA alleles distribution, have demonstrated that a high heterogeneity of the total sample did not correlate with beluga spatial distribution (Fig. 4).

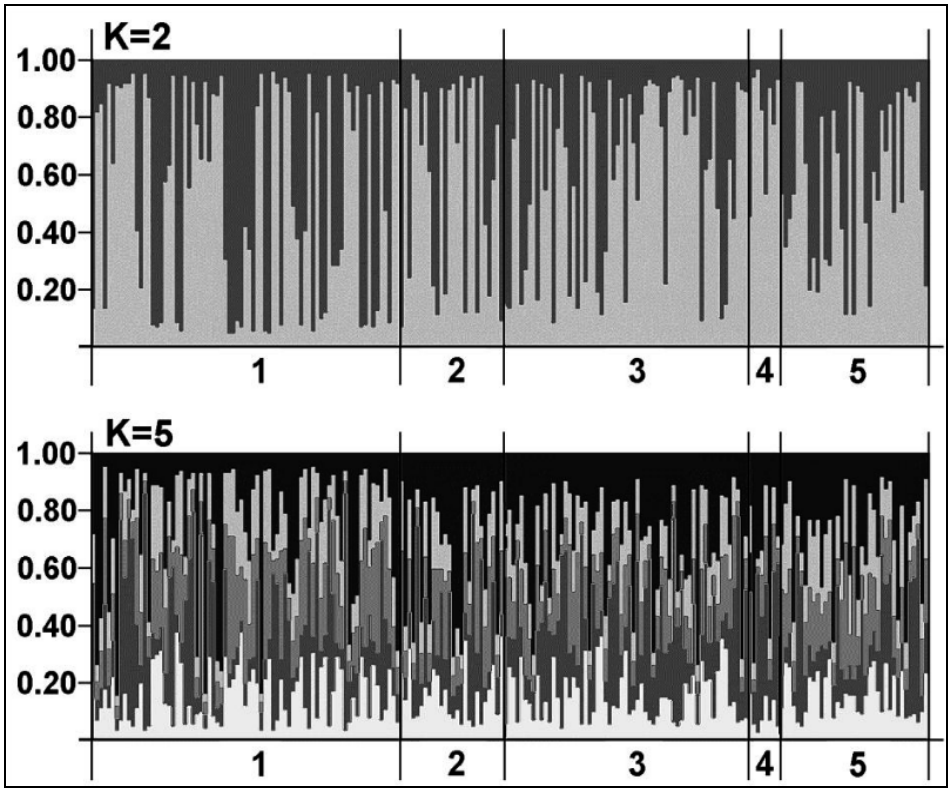

Figure 4. Probability of individuals of the total sample (n=209) to belong to one of two (K=2) or five (K=5) genetic groups (presented as various tints of gray). Admixture-LOCPRIOR model, 300 000 repl. 1 – Udskaya Bay, 2 – Tugursky Bay, 3 – Ulbansky Bay, 4 – Nikolaya Bay, 5 – Sakhalinsky Bay (from Yazykova *et al*. (2012)).

The data on the beluga stock structure *within* Sakhalinsky Bay have not been published, but the limited data available were presented in an unpublished report (Meschersky and Yazykova, 2011). Mitochondrial DNA were successfully sequenced for 9 of 10 specimens collected in 2011 near Zotova bank, southeastern part of Sakhalinsky Bay. No new haplotypes among the 5 defined were found. The ratio of main haplotype occurrence was similar for Zotova Bank sample and the sample of 121 belugas biopsied near Chkalova Island in 2004-2011. For the two samples (121 'chkalova' and 9 'zotova' belugas), population pairwise Φ_{ST} value was -0.00660 and Φ_{ST} P = 0.42808; population pairwise F_{ST} value was -0.01307, F_{ST} P = 0.53430, i.e. no significant difference was found.

Alleles of 17 loci microsatellite loci were successfully determined for 5 out of 10 Zotova specimens. Population pairwise F_{ST} based on number of different alleles for 5 Zotova specimens and 37 other belugas from Sakhalinsky Bay (36 from Chkalova Island region and 1 from the western coast of Sakhalin Island) was estimated as 0.00919 (F_{ST} P = 0.24235), i.e. no significant difference was found. Clustering analysis also did not assign Zotova specimens to a separate group (Fig. 5, unpubl., courtesy of I. Meschersky). Although the sample-size for southeastern Sakhalinsky Bay is insufficient, there are no grounds, based on available data, to expect a subdivision within Sakhalin-Amur aggregation.

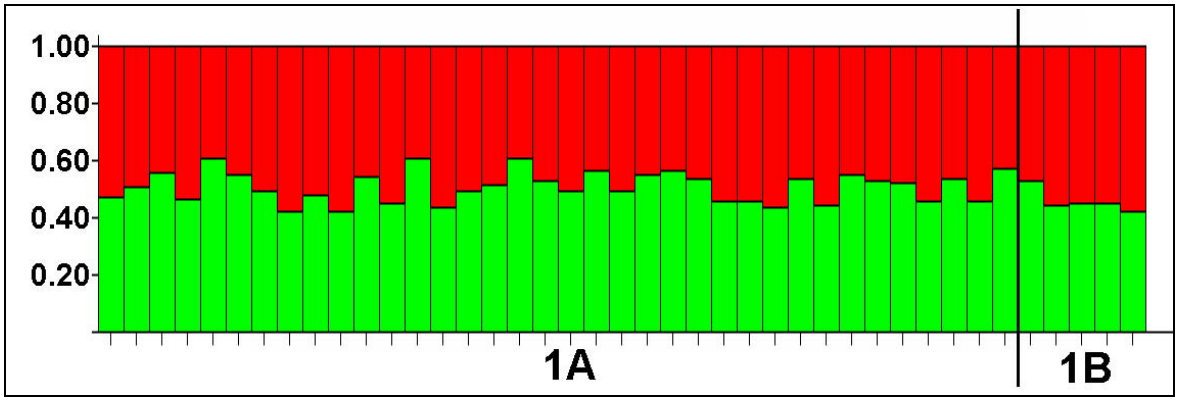

Figure 5. Probability of individuals from southwestern part of Sakhalinsky Bay (1A, n=36) and individuals from southeastern part of Sakhalinsky Bay (1B, n=5) to belong to 2 (K=2) genetic groups. Admixture-LOCPRIOR model, 17 microsatellite loci.

Thus, genetic data available to-date suggest that at least 2 beluga populations inhabit the OS. Belugas summering in Sakhalin-Amur and Shantar regions belong to a single highly heterogeneous 'western-okhotsk' population. This heterogeneity (division into subpopulations or dems) revealed by clustering method is not related to geographic distribution of whales. Unique sets of maternal lines provide evidence for a strong philopatry; a common gene pool of the population is likely maintained due to the mixture of different demographic units during the mating season in late winter-early spring.

MANAGEMENT RELATED DATA

Brief review of historic harvest

Historically, belugas were not an important harvest species for local people in Priamurye, the area from the Amur to the Uda river (Kreynovich, 1934, 1935 – cited from: Bogoslovskaya and Krupnik, 2000).

Large scale beluga whaling started in Sakhalinsky Bay in 1915 and lasted at least to 1937. The average annual take was approximately 1000 belugas ranging from 607 (in 1917) to 2817 (in 1933) whales (Shpak *et al.*, 2011, Appendix 4). Some harvest still existed during the II World War (numbers taken unknown), and by 1957 it ceased completely. Later, the economic benefits of the white whale harvest were several times discussed, and the take numbers comparable to those of 1930s were recommended. For example, Melnikov (1984) in recommendations on whaling and processing of the beluga wrote: *'At present, in Sakhalin-Shantar region, the beluga abundance is estimated to be 20,000-25,000, which allows recommendation of a take of approximately 1,000 individuals'.* Nonetheless, commercial interest was low, and the harvest in Sakhalinsky Bay has not revived. In 1999, a quota for harvest of over a hundred (exact number not available) belugas was issued; and by the time the permit was called away, 31 beluga whales had been killed in Sakhalinsky Bay to be sold as meat to Japan (Mukhametov, pers.comm.).

In the Shantar area, the harvest did not exceed 80 whales before the II World War, but reached its peak when in mid1950s the operations moved from Sakhalinsky to Udskaya and Tugursky bays where 800-1000 belugas were killed annually (Kleinenberg *et al*., 1964, Melnikov, 1984).

On western Kamchatka coast, the beluga harvest existed as early as in 1880 in the Tigil river mouth, but the numbers are not available. Arsenyev (1925) presented very low numbers for beluga takes for Tauyskaya, Gizhiginskaya, Penzhinskaya bays and the Tigil mouth (6-8, 2-3, 5-6, 1-2 accordingly). In 1929 and 1930 in Tauyskaya Bay, 388 and 148 whales were harvested (Dorofeev and Arsenyev, 1936). In 1936, same authors mentioned Tauyskaya Bay as a place for one of the main beluga aggregations in the sea. Belugas were still present there in 1960s (Kleinenberg *et al*., 1964). We do not have information on when beluga harvest ceased in Tauyskaya Bay, but in 1985 Vladimirov (1985) noted the shift in the beluga distribution and pointed out that no beluga aggregations were seen in Magadan area (Tauyskaya Bay).

In the OS, beluga harvest operations were shut down in early 1960s being substituted by the Soviet whaling industry specialised on large whales.

Bogoslovskaya and Krupnik (2000) suggest that along Kamchatka approximately 10 belugas and in Priamurye (Sakhalinsky to Udskaya bay) around 20-30 whales can be taken annually by locals. To our knowledge, at present local people of the Shantar region may kill 1-3 belugas per village, primarily, to feed the dogs during the winter. It is noteworthy that the seals, abundant in the area, are their preferable object for harvest. The culture of using the

beluga for different human needs is disappearing: for example, the melons traditionally used for medical purposes had not been removed from the several corpses that we found. The blubber and meat, though, are still being used for food in the villages with limited supplies.
More detailed information on historic harvest of the OS belugas was presented in our unpublished report to IUCN review panel (Shpak *et al*., 2011, Appendix 4).

Live-captures

Total Allowed Takes (TAT) of water biological resources are scientifically-based volumes of annual takes of a certain species and are defined and regulated under RF Government Decree #531 from 25.06.2009 (Postanovlenie Pravitelstva RF №531 ot 25 iyunya 2009 g. 'Ob opredelenii i utverzhdenii obschego dpoustimogo ulova vodnyh biologicheskih resursov i ego izmenenii'). TATs are calculated for different 'subzones', internationally recognised fishing areas. Within the TATs for marine mammal species, quotas for harvest and live-captures per each designated sub-zone are set by Federal Fisheries Agency. The quotas for live-captures are subdivided according to the purposes of capture: 1) scientific-research and control, and 2) educational and cultural-display. Quotas for beluga harvest are seldom requested. To our knowledge, a quota for traditional harvest in north-okhotsk subzone (Fig.1) for 90 beluga whales was issued in 2012, but no whales have been harvested under this permit. Possibly, traditional harvest quotas are being requested by local communities for 'political' reasons.
Live-captures in Sakhalinsky Bay have been conducted since 1986 by the team of Nikolaevsk-na-Amure residents headed by N. Marchenko, first for TINRO-Tsentr (Pacific Scientific-Research Fisheries Centre, Vladivostok), and later – for different dolphinaria as well. All capture operations were (and still are) conducted along Baydukova and Chkalova Isl. chain in the southwestern part of Sakhalinsky Bay (Fig.1). The numbers of live-captured permanently removed belugas and corresponding TATs are available for certain years (Table 3). It is noteworthy that belugas captured for permanent removal are usually sub-adult whales of 2-4 years old, which are easier to transport and to adapt in a new environment.
The beluga Total Allowed Takes (TAT) for west-kamchatka subzone are also calculated, and quotas are being issued regularly, but neither harvest, no live-captures have been conducted there so far, except for temporary removals (for scientific-research and control purpose) with subsequent release (satellite tagging by IPEE RAS in 2010, 2011).

Table 3. The annual beluga Total Allowed Takes (TAT, where available) for north-okhotsk/west-kamchatka subzones, and *actual* permanent removals* (# of whales) by live-

capture (LC) from Sakhalinsky Bay, north-okhotsk subzone (from Shpak *et al*. (2011), amended).

year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
TAT	n/a	n/a	n/a	n/a	n/a	n/a	1000 /0	400/ 400	100/ 100	300/ 300	300/ 300	150/ 150	360/ 50	360/ 50
LC	10	22	10	26	25	31	20	0	25	24	30	33	44	

*belugas temporary removed and released back to the wild (IPEE RAS, 2007-2010) are not included.

In last years, the voices of Scientific-Research Fisheries Institute specialists (VNIRO and TINRO) on resuming beluga and other marine mammal species harvest have raised. Their major reasoning is growing population of marine mammals. For example, Myasnikov (2011) believes that in 1970s the world beluga population was 40-45,000, and in 30 years it grew over 3 times – to 150,000, or even 200,000 excluding Russian waters, the last number is cited by author from Wikipedia. In the absence of demand for traditional harvest, Myasnikov finds a solution in increasing a pool of live-captured belugas in the dolphinaria and provides multiple arguments for justification and necessity of the growth of captive beluga numbers. Boltnev with co-authors (2011) provide a more developed reasoning for resuming the marine mammal harvest by citing the data on marine mammal consuming volumes, discussing misbalance in marine ecosystems caused by marine mammal predation. While competition between marine mammals and fisheries is well understood, the logic of the scientists, who explain the necessity of marine mammal harvest by comparing marine mammal consume volumes (often unknown) to fish TATs, appears weak. At the same time, we are not aware of any carrying capacity research for any marine mammal species in Russian waters.

Nonetheless, dogmatized by Fisheries specialists marine mammal over-exploitation of fish resources has resulted in increase of quotas issued for the beluga live-captures in north-okhotsk subzone. In summer 2012, TAT for north-okhotsk subzone was re-assessed and increased from 150 (initially assigned for 2012) to 360, and the number of issued live-capture quotas increased 5 times, up to 212 whales. The actual number of captured belugas appeared to be relatively low (44) due to delays with permitting paperwork. For 2013, the same TAT numbers were established, and the following live-capture quotas for north-okhotsk subzone have already been issued: scientific-research and control – 18, educational and cultural-display – 245, in total – 263 beluga whales. For west-kamchatka subzone, in total, quotas for 45 belugas have been issued for 2013.

The increase in number of quotas and number of applying organizations (14 vs. 3-5 in previous years) has led to increase in number of capture operations. To our knowledge, along

the Chkalova and Baydukova Islands, there will be at least 3 separate capture teams operating simultaneously.

Not only the expected number and a narrow age-class of captured whales, but the probable high level of disturbance to the entire aggregation causes concern. Based on our observations and multiple recaptures of well-recognised belugas (carrying the satellite transmitters or the scars from the tag deployment), we may conclude that the beluga groups in Sakhalinsky bay may have fixed feeding 'slots' along the coast and demonstrate a 'fine-scale' site-fidelity. Several catching teams working simultaneously during a prolonged period of time in the southwestern part of Sakhalinsky bay, with high probability, will cause a chronic stress in resident groups. Marchenko's capture team consists of 2 long wooden boats – 'baydas' and 3-4 motorboats for chasing belugas into the net. The net is made of two pieces, total length of 1.6km. We assume, taking in account successful experience of the first team, that two new capture operations will be organized in a similar way. This will lead to approximately 6 large boats, 9-12 motorboats operating and 4-5 linear km of net being deployed simultaneously in the southwestern part of Sakhalinsky Bay.

Incidental mortality

Human-caused beluga incidental mortality – bycatch in salmon traps or gillnets and poachers' sturgeon nets as well as ship-strikes – is nearly impossible to be estimated in the study regions due to rejection to report by the persons implicated in such cases, the vast scarcely populated area and impossibility to arrange regular coastal patrols (Shpak et al., 2011). We are aware of few cases of bycatch in nets, and 3 times in 2007-2012 we or our colleagues have witnessed beluga bycatch in a salmon net (1- in Nikolaya bay, 2 – in Ulbansky bay). The first animal was successfully released without any trauma, another was found dead, and the last one could have been released with a minor wound on the tail, but was killed instead. The analysis of photomaterial collected in Sakhalin-Amur, Shantar and western Kamchatka regions revealed very few whales with scars/injuries that may be potentially caused by boat engines (Shpak et al., 2011, Russkova et al., 2012; Tarasyan et al., 2012, 2013). At present, beluga-ship/motorboat collisions are unlikely to be an issue of concern in the study areas. Thus, although we do not have enough information to assess incidental human-caused mortality, we suppose, its influence on beluga population in the OS is negligible.

Recommendations on TAT-calculations and live-capture process organisation

Based on the analysis of nuclear DNA and winter beluga movements, minimum 2 different management units corresponding to northern-okhotsk population and western-okhotsk population must be considered while issuing Total Allowed Takes (TAT). Although Sakhalin-Amur and Shantar belugas share the same nuclear gene pool, there is a clear evidence of a strong philopatry among discrete summer aggregations. For management purposes, the independent demographic units (Sakhalin-Amur, Ulbansky, Tugursky and Udskaya Bay summer aggregations) should be considered as **separate units**, i.e. TAT should be calculated for each aggregation separately. Nikolaya Bay is seasonally inhabited (or visited) by a small stock or, possibly, several family groups from Sakhalin-Amur and should not be considered as a place for captures at all.

In Shpak *et al*.(2011) and Reeves *et al.* (2011), PBR-method was recommended to estimate a sustainable quota for beluga live-captures in the OS (in absence of traditional harvest). Following recommendations of the IUCN review panel, we re-calculated the *PBR* presented in Shpak *et al.* (2011) as $PBR_{mean}=f(N_{mean}, cv(N_{mean}))$, *where* N_{mean} is arithmetic mean of abundance estimates of all aerial surveys used for calculation.

Here we present the results of PBR-calculation for Sakhalin-Amur beluga aggregation (unpubl. rep., Chelintsev and Shpak, 2012).

Arithmetic mean of three successful abundance estimates of Sakhalin-Amur area was obtained and further corrected for availability (correction = 0.5) to obtain corrected abundance estimate: $N_{cor} = N_{mean}/0.5$.

For *PBR* calculation (for all PBR component definitions see Wade and Angliss, 1997), we used N_{cor} to calculate minimum population estimate N_{min} , one-half the maximum theoretical net productivity rate of the stock ($1/2R_{max}$=0.02) and a recovery factor F_r values of 0.5 and 0.65. Recovery factor F_r = 0.5 was suggested by IUCN panel (Reeves *et al*., 2011) as a precautionary approach, assuming that due to historic over-exploitation and uncertain level of recovery the current population status 'should be considered at best as 'unknown'. We considered the data we had collected on Sakhalin-Amur aggregation sufficient to call the stock 'stable' and raised the recovery factor to 0.65 (Table 4).

In view of apparently excessive unjustified 2013-quotas issued for north-okhotsk subzone, we would strongly recommend to re-approach discussion of the recovery factor F_r value used for PBR estimation based on the scientific report on consequences of the summer-2013 capture operations (if available).

Table 4. Sakhalin-Amur 2009-2010 aerial survey results and calculation of PBR.

Year of survey	Region	Estimation of beluga number, N	Relative statistical error, cv
2009	Sakhalin-Amur	2293	0.355
2010a	Sakhalin-Amur	1574	0.266
2010b	Sakhalin-Amur	2064	0.538
N_{mean}		**1977**	**0.242**
N_{cor}		**3954**	
N_{min}		**3233**	
$PBR_{mean\ (0.5)}$		**32**	
$PBR_{mean(0.65)}$		**42**	

In conclusion, the beluga capture operations and transportation must be regulated according to the Russian Governmental decree #171 from 21 March 2000 (Postanovlenie Pravitelstva Rossiyskoy Federatsii ot 21.03.2000 № 171 'O pravilah otlova i transportirovki kitoobraznyh dlia nauchno-issledovatelskih, kulturno-prosvetitelskih i inyh nepromyslovyh tseley'). Execution of the decree must be supervised by qualified inspectors. All whales accidentally killed during the captures must be considered as removed, i.e. included in the quota of the corresponding organization. Also, in order to minimise the risks of animal mortality and stress, it is highly recommended to implement licensing for organisations conducting marine mammal live-captures.

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