Western Gray Whales off Sakhalin Island and Eastern Kamchatka, Russia
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INTRODUCTION

As with other species of baleen whales, gray whales annually migrate great distances from the breeding grounds in the subtropical waters to the cold and productive northern regions.. Two genetically separated populations of gray whales exist in the Eastern North Pacific region: eastern (California-Chukchi) – abundant, and healthy population (about 20,000 whales) breeding in the warm shallow lagoons in the Baja California, and coming to feed in summer time to the Chukchi and Bering sea. Another population called the western (Korean-Okhotsk) is extremely endangered: total number is about 130 whales and about 26 reproductive females producing calves once in about 3 year.

The only reason gray whales travel for thousands of miles is to feed in the abundant soft bottom benthic communities in the western part of Bering and Okhotsk Seas. This feeding period is extremely important for the this slow breeding whales, and any disturbance preventing, reducing or limiting feeding can potentially lead to stress and decrease overall health condition.

The western gray whale population is critically endangered (Weller *et al*., 2002a; Baillie *et al*., 2004) and its continued ability to survive is of concern. Hunted to such low numbers in the mid 20th century that some thought it to be extinct, the population remains highly depleted today (Weller *et al*., 2002a; Cooke *et al*., 2008). The International Whaling Commission (IWC) and the International Union for Conservation of Nature (IUCN) have each expressed serious concern about the status of this population and have called for urgent measures to be taken to help ensure its protection (see Baillie *et al*., 2004; IWC, 2004; Reeves *et al*., 2005).

This report reviews summary findings from 2010 research activities on western gray whales off Sakhalin Island and the eastern Kamchatka coast (Olga bay) in the Russian

Far East, and integrates new information with data from previous years, in some cases ranging back to 1994. Discussion of the current status of the population and a review of threats to its continued survival, including potential impacts associated with large-scale oil and gas development activities on the summer feeding ground and entrapments in trap nets off Japan during migration, are provided herein.

In 2010 we expanded our effort to Kamchatka, because gray whale numbers in eastern Kamchatka appear to be increasing in recent years (Vertyankin et al, 2004, Burdin unpublished data) and regular movements between Sakhalin and Eastern Kamchatka have been reported. Working in Piltun area in Sakhalin Island, we have yet to see any of the nine calves from 2007 back on Sakhalin. In Tyurneva et al.'s recent paper (2010), she notes that eight of the nine 2007 calves they identified were seen off Kamchatka in 2008. Three of the six Sakhalin whales that we saw in Olga bay in 2010 were 2007 calves. It turns out that 2007 came out as the worst year in the western gray whales body condition analysis, so it rises a question how a bad year affects distribution and site fidelity in the next year and beyond?

According to our data and communication with Tyurleva and Vertyankin, 2008 was also the year of the first Kamchatka MC sighting and the seemingly low number of whales off Piltun in general. When we combine data collected in 2010 (August survey and satellite tagging project), we have seen six of the seven 2009 calves this year off Sakhalin. So, there is considerable variability in the temporary emigration of young (and other) whales and an interesting piece of the puzzle to consider.

The main goals of 2010 Eastern Kamchatka gray whale survey was to make photo ID of whales feeding in this area and compare this images from the existing western gray whale catalog (from Sakhalin Island). This allows us to find out what percentage of these whales are from Sakhalin Island. The eastern Kamchatka coast is a potential area where the two distinct populations of the gray whales mix on the feeding grounds. The second very important goal of this study was to collect biopsy samples from the whales off Sakhalin (in our case, from eastern Kamchatka coast).



MATERIAL AND METHODS

The overall consistency in research design, data collection techniques and data analysis maintained in 2010 allowed inter-annual comparisons to be made. Additional information, collected during more limited surveys off Piltun in 1994 and 1995 (Brownell *et al.*, 1997; Weller *et al.*, 1999), is also presented here to better describe inter-annual trends and facilitate a long-term interpretation for some results. Data from these 1994 and 1995 studies include gray whale photographs obtained between 7-12 September 1994 during the filming of a wildlife documentary by H. Minakuchi (for description see Weller *et al.*, 1999) and from 14-20 August 1995 during a pilot study to determine the feasibility of conducting boat- and shore-based research in the study area (Brownell *et al.*, 1997).
In addition to our routine annual work in northeastern Sakhalin, including lighthouse observation (July-August, 2010) on the whales distribution in the near shore waters of Piltun lagoon, and photo ID survey conducted in August 2010, we conduct a survey along the eastern Kamchatka coast (from Petropavlovsk-Kamchatsky to Olga Bay in Kronotsky Gulf) to look for gray whales and other cetaceans in the nearshore waters off Kamchatka, conduct photo ID and collect biopsy samples.

Study area
Zaliv Pil'tun (referred to as Piltun Lagoon) is on the northeastern shore of Sakhalin Island, Russia. The lagoon is approximately 80-90 km long and 15 km across at its widest point. A single channel connecting the inner lagoon with the Okhotsk Sea occurs at 52° 50′ N and 143° 20′ E, and has considerable biological influence on the surrounding marine environment. A lighthouse, near the lagoon channel, served as the base from which studies reported here were conducted. The nearshore marine environment of the study site is mostly sand substrate, characterized by a gradually sloping and broad continental shelf. Water depths within 5 km of shore are mostly less than 25 m deep. Despite the similarity of Piltun Lagoon to the coastal lagoons used during the winter by eastern gray whales off Baja California, Mexico, whales do not enter this lagoon.

The Olga bay located at 54° 32′ N and 161° 02′ E in the northward part of Kronotsky Gulf, East Kamchatka cost, on the territory of Kronotsky State Biosphere Preserve. The coast morphology is very similar to Piltun area, and presented mostly by long sandy

beaches. The dominant benthic communities in the northern part of Kronotsky Gulf, presented by the sea urchin (*Echinarachnius parma* - Common Sand Dollar), amphipods, and infauna – typical sand bottom benthic communities in the western Bering and Okhotsk Seas. The first information about gray whales from this area became available from the 1995 (Vertyankin et al, 2004), but we observed two gray whales in August 1994 in the central part of Kronotsky Gulf (Burdin, unpublished data). We expected that gray whales regularly visited Kronotsky Gulf earlier, but the whale number was low, and no sightings were recorded. Compared with northeastern Sakhalin, gray whale feeding area in Kronotsky Gulf is very limited, extending only for 20 km southward from Olga cape. Up to 70 gray whales were observed here and all of them were concentrated only on this 20 km area and close inshore (few meters – 1 km) in the shallow waters.

Photo-identification surveys

Boat-based photo-identification surveys were conducted on all good weather days during the 2010 study period. Identical methodology was employed during each survey, with the primary objective of encountering and photographically identifying as many whales as possible. Previous photo-identification data gathered in the Piltun area between 1995 and 2009 used right-side dorsal flank markings for identification (Brownell *et al.*, 1997; Weller *et al.*, 1999, 2006a), and for the sake of intra- and inter-annual reliability, we continued this methodological approach. Attempts were made to simultaneously photograph and videotape the right dorsal flank of each whale, followed by efforts to photograph the left dorsal flank and flukes. The majority of whales identified to date now have images of right and left flanks as well as ventral surface of flukes in the photo-identification catalog allowing for useful identification images to be collected from nearly any body region. Since May 2006, the western gray whale photo-identification catalog complied by our Russia-U.S. research program is available on request to all interested parties (Weller *et al.*, 2006a).



RESULTS

Survey effort and photo-identification

In July 9-15 2010 a team of researchers sponsored by IFAW, conducted a gray whale survey along the eastern Kamchatka coast from Petropavlovsk-Kamchatsky to Kronotsky Peninsula. The survey was conducted in the area where gray whales are known since 1990, but the number of whales observed in Olga bay was routinely low (4-6) until 2004-2005. In total, from the period from 9 July to 15 July we documented 23 gray whales, all in Olga Bay, but photograph only 19 of them. Six (31.6 %) of these whales are known as "Sakhalin whales" (Table 1), while 13 (68.4%) have never been observed off northeast Sakhalin.

Table 1. Gray whales identified and biopsy taken in Olga Bay, Kronotsky Gulf, Eastern Kamchatka in July 2010.

WGW Catalog ##	Sex	First met in Sakhalin	First met in Kamchatka	Side photographed	biopsy
Kam1	Unknown	no	11 July 2010	R&L	
Kam2	Unknown	no	11 July 2010	R&L	
Kam3	Unknown	no	11, 12 July	R&L	
Kam4	Unknown	no	11 July 2010	R&L	Yes
Kam5	Unknown	no	12 July 2010	R&L	Yes
Kam6	Unknown	no	12 July 2010	R&L	Yes
Kam7	Unknown	no	12 July 2010	R&L	Yes
Kam8	Unknown	no	12 July 2010	R&L	
Kam9	Unknown	no	12 July 2010	R&L	Yes
Kam10	Unknown	no	12 July 2010	R&L	
Kam11	Unknown	no	12 July 2010	R&L	Yes
Kam12	Unknown	no	12 July 2010	R&L	
Kam13	Unknown	no	12 July 2010	R&L	
Sa98	male	calf in 2001	12 July 2010	R&L	Yes
Sa135	female	calf in 2004	12 July 2010	R&L	
Sa159	female	calf in 2007	12 July 2010	R&L	
Sa162	female	calf in 2007	12 July 2010	R&L	
Sa165	male	calf in 2007	12 July 2010	R&L	Yes
Sa172	unknown	calf in 2008	12 July 2010	R&L	

Most of the whales that we know so far from Kamchatka are young whales from Sakhalin. They seem to eventually make their way back to Sakhalin. We always knew that temporary emigration rates of younger animals was high, now we have a better explanation for this finding.

This year we saw two whales off Sakhalin that had not been seen there since they were calves in 2003. The important thing to note is that reproductive females continue to demonstrate strong fidelity to the Sakhalin feeding area. Nine of the 43 whales identified during in 2010 were reproductive females. One of them is a mother (Lena) that had also been observed with a calf off Kamchatka.

Between 1994 and 2010, 185 western gray whales have been identified during *370* boat-based surveys off northeastern Sakhalin Island (Table 2). Eighty-four of the whales in the photo-catalog were animals first identified as calves, while the remaining 101 whales were considered non-calves (i.e. adults or subadults). However, not all of these 185 individuals are alive (see Cooke *et al*., 2008).

Table 2. Annual survey effort, groups encountered and whales identified 1994 to 2010.

Year	Sampling Period	Number of Surveys	Observation Hours	Groups Encountered	Whales Identified
1994	09/07 - 09/12	1			9
1995	08/15 - 08/19	5	10.1	23	28
1997	07/09 - 09/08	22	33.4	114	47
1998	07/06 - 09/29	35	50.5	125	54
1999	06/29 - 10/13	56	122	434	69
2000	06/25 - 09/16	40	56.5	365	58
2001	06/25 - 09/25	49	101.8	448	72
2002	07/01 - 09/25	36	75.6	411	76
2003	07/15 - 09/13	22	41.7	219	75
2004	07/29 - 09/12	21	33.8	194	94
2005	07/04 - 09/09	20	40.9	160	93
2006	07/23 - 08/25	10	24.1	96	79
2007	07/26 - 09/09	20	32.2	187	83
2008	07/08 - 08/21	12	47.0	38	45
2009	06/24 – 08/26	17	67.0	126	84
2010	08/09-08/26	4	11.5	40	42
Overall		370	748.1	2980	185 [1]

[1] The number of whales identified annually includes resightings of individuals from previous years, resulting in a total of 185 identified individuals. The number of whales identified does not correspond to the size of the population.

Four photo-identification surveys, with 11.5 hrs spent in direct observation of 40 whale groups, were conducted between 9-27 August in 2010 (Table 1). Forty-two naturally marked individual whales, including three calves, were identified during 2010 (Table 2). Of the 39 non-calves identified in 2010, 38 whales (97.4%) had previous sightings in the Piltun area during 1994-2009 photographic efforts (Table 3).

Biopsy sampling

One of our most important research objectives during the 2010 Kamchatka survey was biopsy sampling of gray whales observed in the area. In total, in Olga Bay we encountered 23 gray whales and obtained 8 biopsy samples. Two of these samples were from whales known from Sakhalin Island (calves in 2001 and 2004) and may possibly have been biopsied before. However, 6 biopsy samples ware taken from unknown whales (Table 1).

Mother-calf pairs (Sakhalin)

Only one mother-calf pair was identified during 2010 (due the late start of the photo identification efforts in 2010 moms for two other whales identified as calves of the year were not observed). This mom has been sighted in the study area prior to 2010, and was observed in previous years with a calf. Therefore, the number of known reproductive females recorded between 1995 and 2010 remains 26.

Table 3. Annual sighting trends and resighting percentages 1994 to 2010.

Year	Whales Identified	Number of Calves	New Non-Calves	% Non-Calves Previously Identified
1994[1]	9			
1995[1]	28	2	20	23.1%
1997	47	2	25	44.4%
1998	54	8	5	89.1%
1999	69	3	12	81.8%

2000	58	3	3	94.5%
2001	72	6	6	90.9%
2002	76	9	3	95.5%
2003	75	11	2	96.9%
2004	94	8	3	96.5%
2005	93	6	4	95.4%
2006	79	4	3	96.0%
2007	83	9	2	97.3%
2008	45	3	0	100.0%
2009	84	7	2	97.4%
2010	42	3	1	97.4%

[1] Data from 1994 and 1995 were opportunistic and pilot in nature (respectively) and are thereby viewed as incomplete for some of the reported values.

DISCUSSION

A number of biological parameters in concert with a variety of human-related threats, as identified during the current long-term study and discussed below, raise concern about the ability of the western gray whale population to rebound from its highly depleted state and highlight the importance of continuing the long-term Russia-U.S. collaborative research and monitoring program.

The importance of gray whale research in Kamchatka waters is supported by the following information. Working only in the Piltun area off Sakhalin Island, we have yet to see any of the nine calves from 2007 back on Sakhalin. In Tyurneva et al.'s recent paper (2010), she notes that eight of the 2007 calves they identified were seen off Kamchatka in 2008. Three of the six Sakhalin whales that we saw in Olga bay in 2010 were 2007 calves. It turns out that 2007 was the worst year in the western gray whale body condition analysis, so it raises a question of how a bad year affects distribution and site fidelity in the next year and beyond?

According to our data and communication with Tyurleva and Vertyankin, 2008 was also the year of the first Kamchatka MC sighting and the seemingly low number of whales off Piltun in general. When we combine data collected during the 2010 survey effort six of the seven 2009 calves were sighted this year off Sakhalin (Bradford, pers. comm.). Thus, there is substantal variability in the temporary emigration of young (and other) whales.

Population size

The size of the western gray whale population is extremely small compared to most other baleen whale populations. Photo-identification studies off northeastern Sakhalin Island have identified only 185 individual whales during 370 surveys conducted between 1994 and 2010. Although the photo-catalog now contains 185 whales, not all of these individuals are assumed to be alive. The most current mark-recapture analysis conducted estimated the abundance for the population to be 99 (95% CI = 90-109) in 2003 (Bradford *et al*., 2008). A population assessment by Cooke *et al*. using a Bayesian individually-based stage-structured model fitted to the same photo-identification data as used in the mark-recapture studies, but also including data from 2004 through 2007 has recently been completed. Should current population and demographic trends continue, this assessment projected a median 1+ (non-calf) estimate of 130 (90% Bayesian CI = 120-142) in 2008 (Cooke *et al*., 2008).

Reproduction and survival

Although calves are being born annually, the limited number of known reproductive females (n = 26) in combination with relatively low calf survival (Bradford *et al*., 2006; IISG, 2006; Cooke *et al*., 2008) is likely to be limiting potential population growth. In recent years, the interval between calves in the western population appears to be shifting from a three-year interval to a two-year interval (Weller *et al*., 2009). If this change persists, the general increase in calf production will continue and, in turn, contribute to an increase (albeit slow) in the growth rate of the population.

Mother-calf pairs

Only one mother-calf pair was identified during 2010 (due the late start of the photo identification efforts in 2010 moms for two other whales identified as calves of the year were not observed). This mom has been sighted in the study area prior to 2010, and was observed in previous years with a calf. The annual return of reproductive females while pregnant, resting and lactating indicates that the nearshore Sakhalin Island feeding area is of significant importance to the continued survival of this population. The behavior of these females indicates that this feeding ground is vital to population survival and growth.

Threats to the population

In addition to the biological difficulties (e.g., small population size, low number of reproductive females) that western gray whales face, the onset of large-scale oil and gas development programs off Sakhalin Island in the mid-1990s introduced new threats to the future survival of the population (Weller *et al*., 2002a; Reeves *et al*., 2005; IISG, 2006). Sakhalin Island is a region rich with large reserves of offshore oil and gas that, until recently, have been unexploited. Industrial activities on the continental shelf of this region have steadily increased in the past ten years and are scheduled to expand at a rapid pace into the future. Oil and gas development activities that may negatively impact western gray whales include: (1) disturbance from underwater noise associated with seismic surveying (Weller *et al*., 2002b; 2006b, 2006c), pipeline dredging, ship and helicopter traffic and platform operations; (2) direct interactions between whales and an oil spill or other waterborne chemicals, ships, and possible entanglements in cables or lines; and (3) habitat changes related to seafloor modifications associated with dredging and sand pumping activities that may adversely impact gray whale prey (for reviews see Reeves *et al*., 2005; IISG, 2006).

The number of individual whales photo-identified on the nearshore feeding ground in 2008 was very low in comparison to 2009 and in previous years with a similar amount of spatial and temporal survey effort (see Table 1). Given the short nature and small number of surveys in 2010 the direct comparison with 2009 data is inappropriate, nonetheless 42 whales identified during four surveys suggest 2010 is similar to previous years except 2008. While the low numbers observed in 2008 continues to be of concern, it is clear that results from 2009 and 2010 are more typical. It is possible that the observed pattern in 2008 was anomalous and was simply attributable to natural variation in behavior. It is also plausible, however, that the change reflected whales being displaced from the feeding area or, worse, indicates partial abandonment of what has traditionally been a critical feeding habitat (especially for mother-calf pairs) for the population. While natural variation in food resources and other biological factors are being investigated by industry-sponsored research groups, additional investigations need to be undertaken to examine the possible contributions of pile driving activities and a seismic survey that both occurred in close proximity to the nearshore feeding ground in summer 2008. Until more conclusive explanations can be drawn with regard to the low number of whales observed in 2008, the influence of industrial activities cannot be ruled out as contributing factors.

Another significant threat to the western gray whale population involves incidental catches in coastal net fisheries, particularly off Japan, within their migratory route (Wel-

ler *et al*., 2002a; Kato *et al*., 2005, 2006, 2007; Brownell *et al*., 2007; Weller *et al*., 2008). In 2005, three female western gray whales (one mother-calf pair and one yearling) died in fishing nets on the Pacific coast of Japan during their northward migration. Unfortunately, in 2007 another young female western gray whale died after being entrapped in a trap net also on the Pacific coast of Japan (Anonymous, 2007a,b,c; Brownell *et al*., 2007; Kato *et al*., 2007; Weller *et al*., 2008). Projections from recent population assessments suggest that if this level of net-related mortality continues, there is a high probability the population will decline to extinction (Cooke *et al*., 2008). In addition, an analysis of anthropogenic scarring of western gray whales found that 18.7% (n = 28) of 150 individuals identified between 1994 and 2005 were determined to have been previously entangled in fishing gear (Bradford *et al*., 2009), further highlighting the overall risks coastal fisheries pose to western gray whales. Finally, while nothing is known about net entrapments or entanglements in other regions (e.g., Korea and China) within the range of the population, it is likely that coastal net fisheries outside of Japan also contribute to some level of mortality.

Other threats to the western gray whale population include continued mortality from an undetermined level of suspected poaching in the central portion of the range (Brownell and Kasuya, 1999; Baker *et al*., 2002), as well as a potential increase in the likelihood of disturbance, exposure to pollution, and probability of ship strikes due to substantial nearshore industrialization and shipping congestion throughout the migratory corridor(s).

Genetics

Given the small size of the western population and its isolation from the eastern population, the potential for continued loss of genetic diversity due to genetic drift or removal of individuals with rare alleles is of concern (Lang *et al*., 2004; 2005). The limited number of females in the population may hinder reproductive output and in turn slow population recovery. The male bias observed for calves indicates lower recruitment of females into the adult population. This pattern further perpetuates the problem of a limited number of females being available to reproduce.

Previous genetic research on the western gray whale population has documented clear genetic differentiation from the eastern population on the basis of mitochondrial DNA haplotype frequencies (LeDuc *et al*., 2002). More recently, a study by Lang *et al*. (2004) used bi-parentally inherited nuclear DNA markers to measure the differentiation and relative levels of genetic diversity in the nuclear genome between the western and eastern populations. For these purposes, 93 western gray whales and 126 eastern gray whales were genotyped at six polymorphic microsatellite loci. All six microsatellite loci

showed higher levels of genetic diversity in the eastern population (mean H_e = 0.759) when compared with the western population (mean H_e =0.724), mirroring results found using mtDNA haplotypes. A comparison of allele frequencies between the western and eastern populations confirmed them to be genetically distinct ($p<0.001$) and indicated negligible gene flow between populations.

Future directions of our genetic research on western gray whales (see Lang *et al*., 2004) will provide significant new information regarding the population and include the following: (1) combine nuclear genetic data from microsatellite analysis with mitochondrial data to determine if sex-specific patterns of gene flow exist; (2) examine relatedness of individuals; (3) determine potential paternity of animals first identified as calves, allowing differential male reproductive success to be explored; (4) estimate the effective population size (number of breeding adults); (5) determine the level of genetic diversity present within the population and thereby evaluate loss of genetic diversity through inbreeding; and (6) catalog DNA "fingerprints" of all individuals sampled to facilitate matching to stranded animals and whales caught directly or taken incidentally in fishing gear.

CONCLUSIONS

Based on the results reported here, it is clear that the western gray whale population is precariously balanced between survival and extinction. In addition to the variety of biological factors that may be limiting population growth, large-scale oil and gas development programs that may alter the prey base or introduce disturbance to feeding whales, as well as entrapment and entanglement in fishing gear, especially in trap nets off Japan during northbound and southbound migrations, are of serious concern with regard to the future survival of the population.

Based on the result of the eastern Kamchatka benthic comminutes study conducted in the 1985, we can conclude, that concentrations of up to 70 whales as reported by Vertyankin (pers. Comm.) in the relatively small feeding area in Olga bay (Kronotsky Gulf, Kamchatka) cannot be sustained for over the long-term, because food recourses in this area are too limited.

Given the continued uncertainty regarding the ability of the western gray whale population to increase from its depleted state, impacts from oil and gas development activities off the northeastern Sakhalin Island coast need to be closely monitored and stringently mitigated to reduce disturbance to the lowest possible level. In addition, net entrapments of western gray whales off Japan and possibly elsewhere can lead the popu-

lation to extinction (IISG, 2006; Cooke *et al*., 2008; Brownell *et al*., 2007; Weller *et al*., 2008). Thus, human related mortality during migration and in the (yet to be determined) wintering area(s) must be addressed and mitigated to the lowest possible level. Where scientific knowledge is lacking, the precautionary principle should be applied as the best measure of protection. With this in mind, the photo-identification and genetic biopsy research conducted since 1995, and reviewed here, must be continued to further monitor survival of individuals, describe the overall population trend and to recommend further conservation and protection measures.

In conclusion, protection of the Sakhalin Island feeding habitat, including the coastal lagoon systems that appear integrally related to the high benthic biomass used by the whales in the nearshore area, is clearly paramount to successful conservation of the western gray whale population. The unique method of benthic feeding by these whales makes them an "umbrella" species (Hooker and Gerber, 2004), whereby protection of their habitat provides protection for the biological diversity of the entire northeastern Sakhalin Island shelf. Thus, the feeding habitat of the western gray whale needs to be considered a "hot spot" for conservation planning now and in the future and every effort should be taken to protect its biological integrity. In continuation of this research and looking for the development of western gray whale conservation measures, the next step should be intensifying research of gray whales around both Kamchatka coasts: eastern and western.



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LITERATURE CITED

Anonymous. 2007a. Japanese nets threaten grey whale's survival. [News in Brief] Nature 445:577.

Anonymous. 2007b. Not saving the whale [Editorial]. Nature 446:2.

Anonymous. 2007c. Iwate Nippo (newspaper from Iwate, Japan) [In Japanese].

Baillie, J.E.M., Hilton-Taylor, C. and Stuart, S.N. (Editors) 2004. 2004 IUCN Red List of Threatened Species. A Global Species Assessment. IUCN, Gland, Switzerland and Cambridge, UK. xxiv + 191 pp.

Baker, C.S., Dalebout, M.L. and Lento, G.M. 2002. Gray whale products sold in commercial markets along the Pacific coast of Japan. *Mar. Mamm. Sci*. 18:295-300.

Bradford, A.L., Wade, P.R., Weller, D.W., Burdin, A.M., Ivashchenko, Y.V., Tsidulko, G.A,, VanBlaricom, G.R. and Brownell, R.L., Jr. 2006. Survival estimates of western gray whales (*Eschrichtius robustus*) incorporating individual heterogeneity and temporary emigration. *Mar. Eco. Prog. Series*. 315:293-207

Bradford, A.L., Weller, D.W., Wade, P.R., Burdin, A.M., Brownell, R.L., Jr. 2008. Population abundance and growth rate of western gray whales *Eschrichtius robustus*. *Endangered Spe. Res*. 6(1):1-14

Bradford, A.L., Weller, D.W., Ivashchenko, Y.V., Burdin, A.M. and Brownell, R.L., Jr. 2009. Anthropogenic scarring of western gray whales (*Eschrictius robustus*). *Mar. Mamm. Sci*. 25(1):161-175

Brownell, R.L., Jr., Blokhin, S.A., Burdin, A.M., Berzin, A.A., LeDuc, R.G., Pitman, R.L. and Minakuchi, H. 1997. Observations on Okhotsk-Korean gray whales on their feeding grounds off Sakhalin Island. *Rep. Int. Whal. Commn*. 47:161-162.

Brownell, R.L., Jr. and Kasuya T. 1999. Western gray whale captured off western Hokkaido, Japan. Paper SC/51/AS25 presented to the IWC Scientific Committee. 7 pp.

Brownell, R.L., Jr., Kasuya, T. and Weller, D.W. 2007. Entrapment of western gray whales in Japanese fishing gear: Population threats. Paper SC/59/BRG38 presented to the IWC Scientific Committee. 9pp.

Cooke, J., Weller, D.W., Bradford, A.L., Burdin, A.M. and Brownell, R.L, Jr. 2008. Population assessment of western gray whales in 2008. Paper SC/60/BRG11 presented to the IWC Scientific Committee. 10pp.

Hooker, S. K. and Gerber, L. R. 2004. Marine reserves as a tool for ecosystem-based management: the potential importance of megafauna. *BioScience* 54:27-39.

Interim Independent Scientists Group (IISG) 2006. Report of the Interim Independent Scientists Group (IISG) on mitigation measures to protect western gray whales during Sakhalin II construction operations in 2006, Vancouver, British Columbia, 3-5 April 2006. International Union for Conservation of Nature (IUCN), Business and Biodiversity Program, [Available from http://www.iucn.org].

International Whaling Commission. 2004. Resolution on western north Pacific gray whale. *Ann. Rep. Int. Whaling Comm*. 2004.

Kato, H., Ishikawa, H., Mogoe, T. and Bando, T. 2005. Occurrence of a gray whale, *Eschrichtius robustus*, in Tokyo Bay, April-May 2005, with its biological information. Paper SC/57/BRG18 presented to the IWC Scientific Committee.

Kato, H., Ishikawa, H., Bando, T., Mogoe, T. and Moronuki, H. 2006. Status of conservation and researches on the western gray whale in Japan, June 2005-April 2006. Paper SC/58/O14 presented to the IWC Scientific Committee.

Kato, H., Ishikawa, H., Goto, M., Miyashita, T. and Moronuki, H. 2007. Status report of conservation and researches on the western gray whale in Japan, June 2006-April 2007. Paper SC/59/O18 presented to the IWC Scientific Committee.

Reeves, R.R., Brownell, R.L., Burdin, A., Cooke, J.C., Darling, J.D., Donovan, G.P., Gulland, F.M.D., Moore, S.E., Nowacek, D.P., Ragen, T.J., Steiner, R.G., VanBlaricom, G.R., Vedenev, A. and Yablokov, A.V. 2005. Report of the Independent Scientific Review Panel on the Impacts of Sakhalin II Phase 2 on Western North Pacific Gray Whales and Re-

lated Biodiversity. IUCN, Gland, Switzerland and Cambridge, UK. 123pp [Available from http://www.iucn.org]

Tyurneva O. Yu., Yakovlev Yu. M., Vertyankin V. V., Selin N. I. 2010. The peculiarities of foraging migrations of the Korean-Okhotsk gray whale (*Eschrichtius robustus*) population in russian waters of the Far Eastern seas. Rus. Jour. of Marine Biol. Vol. 36. No 2: 117-124

Vertyankin, V.V., V.C. Nikulin, A.M. Bednykh and A.P. Kononov. 2004. Sighting of gray whales (Eschrichtius robustus) near southern Kamchatka. In book: Marine Mammals in the Holarctic. Collection of scientific papers of International Conference Koktebel, Krimea, Ukraine, October 11-17, 2004. P. 126-128.

Weller, D.W., Würsig, B., Bradford, A.L., Burdin, A.M., Blokhin, S.A., Minakuchi, H. and Brownell, R.L., Jr. 1999. Gray whales (*Eschrichtius robustus*) off Sakhalin Island, Russia: seasonal and annual patterns of occurrence. *Mar. Mamm. Sci*. 15:1208-1227.

Weller, D.W., Burdin, A.M., Würsig, B., Taylor, B.L. and Brownell, R.L., Jr. 2002a. The western Pacific gray whale: a review of past exploitation, current status and potential threats. *J. Cetacean Res. Manage*. 4(1):7-12.

Weller, D.W., Ivashchenko, Y.V., Tsidulko, G.A., Burdin, A.M. and Brownell, R.L., Jr. 2002b. Influence of seismic surveys on western gray whales off Sakhalin Island, Russia in 2001. Paper SC/54/BRG14 presented to the IWC Scientific Committee. 15 pp.

Weller, D.W., Bradford, A.L., Tsidulko, G.A., Ivashchenko, Y.V., Lang, A.R., Kim, H.W., Burdin, A. M. and Brownell, R.L., Jr. 2006a. A catalog of photo-identified western gray whales from Sakhalin Island, Russia. Paper SC/58/BRG2 presented to the IWC Scientific Committee [CD available on request].

Weller, D.W., Rickards, S.H., Bradford, A.L., Burdin, A.M. and Brownell, R.L., Jr. 2006b. Influence of 1997 seismic surveys on the behavior of western gray whales off Sakhalin Island, Russia. Paper SC/58/E4 presented to the IWC Scientific Committee. 12pp.

Weller, D.W., Tsidulko, G.A., Ivashchenko, Y.V., Burdin, A.M. and Brownell, R.L., Jr. 2006c. A re-evaluation of the influence of 2001 seismic surveys on western gray whales off Sakhalin Island, Russia. Paper SC/58/E5 presented to the IWC Scientific Committee. 8pp.

Weller, D.W., Bradford, A.L., Kato, H., Bando, T., Ohtani, S., Burdin, A.M. and Brownell, R.L., Jr. 2008. Photographic match of a western gray whale between Sakhalin Island, Russia, and Honshu, Japan: First link between feeding ground and migratory corridor. *J. Cetacean Res. Manage*. 10(1):89-91.

Weller, D.W., Bradford, A.L., Lang, A.R., Burdin, A.M. and Brownell, R.L., Jr. 2009. Birth intervals and sex composition of western gray whales summering off Sakhalin Island, Russia. Paper SC/61/BRG10 presented to the IWC Scientific Committee. 7 pp.