Status of western gray whales off northeastern Sakhalin Island and eastern Kamchatka, Russia in 2010

ALEXANDER M. BURDIN [1], AMANDA L. BRADFORD [2], GRIGORY A. TSIDULKO [3], MAXIM SIDORENKO [4]
Contact e-mail: fewr@mac.com

[1] Kamchatka Branch of Pacific Institute of Geography, Far East Branch - Russian Academy of Sciences, Petropavlovsk, Kamchatka, RUSSIA

[2] School of Aquatic and Fishery Sciences, University of Washington, Seattle, Washington, USA

[3] Severtsov Institute of Ecology and Evolution, Russian Academy of Sciences, Moscow, RUSSIA

[4] Pacific Oceanological Institute, Far East Branch, Russian Academy of Sciences, Vladivostok, RUSSIA

ABSTRACT

The western gray whale population is critically endangered and its continued ability to survive is of concern. The most recent population assessment, using a Bayesian individually-based stage-structured model, resulted in a median 1+ (non-calf) estimate of 130 individuals (90% Bayesian CI = 120-142). The collaborative Russia-U.S. research program on western gray whales summering off northeastern Sakhalin Island, Russia, has been ongoing since 1995 and has produced important data that has be used to determine the conservation status of this critically endangered population. This paper reviews findings from 2010 research activities and combines such with data from previous years, in some cases ranging back to an opportunistic survey in 1994. Photo-identification research conducted off Sakhalin Island in 2010 resulted in the identification of 43 whales, including four calves. One previously unidentified non-calf was observed. When combined with data from 1994-2009, a catalog of 186 photo-identified individuals has been compiled. Not all of these 186 whales can be assumed to be alive, however. No new reproductive females were recorded in 2010, resulting in a minimum of 26 reproductive females being observed since 1995. Additional effort off eastern Kamchatka identified 19 whales, including six individuals previously encountered off Sakhalin. In addition to a number of biological difficulties that western gray whales are facing, the large-scale offshore oil and gas development programs near their summer feeding ground, as well as fatal net entrapments off Japan during migration, pose significant threats to the future survival of the population.

KEYWORDS: WESTERN GRAY WHALE; RUSSIA; POPULATION BIOLOGY; BEHAVIOR; CONSERVATION

INTRODUCTION

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; Bradford *et al.*, 2008; 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 (i.e. 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.

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 Sakhalin 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 of 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 off northeastern Sakhalin Island, we also conducted a survey along the eastern Kamchatka coast (from Petropavlovsk-Kamchatsky to Olga Bay in the Kronotsky Gulf) to collect photo-identification images and biopsy samples from gray whales in the nearshore waters. We expanded our effort to this area because the number of gray whales off eastern Kamchatka appears to have increased in recent years (Vertyankin *et al.*, 2004; Burdin, Unpublished data) and regular movements between Sakhalin and eastern Kamchatka have been reported (Tyurleva *et al*., 2010). The main goal of our 2010 eastern Kamchatka gray whale survey was to compare obtained photographs and biopsy samples to existing western gray whale catalogs (photo and genetic) from Sakhalin Island.

Study areas

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.

Olga bay is located at 54° 32' N and 161° 02' E in the northern portion of Kronotsky Gulf, eastern Kamchatka, in the territory of the Kronotsky State Biosphere Preserve. The coastal topography is very similar to Piltun area, characterized mostly by long sandy beaches. The dominant benthic communities in the northern part of Kronotsky Gulf include sea urchin, amphipods, and infaunal invertebrates typical of sandy bottom benthic communities in the western Bering and Okhotsk Seas.

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. 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

From 9-15 July 2010, a survey for gray whales was conducted along the eastern Kamchatka coast from Petropavlovsk-Kamchatsky to the Kronotsky Peninsula. In total, 23 gray whales were encountered, all in Olga Bay, but photographs of only 19 individuals were obtained. Six (31.6 %) of these whales are known from our Sakhalin Island study (Table 1), while 13 (68.4%) have not been observed off northeast Sakhalin.

Four photo-identification surveys, comprising 11.5 hours spent in direct observation of 40 whale groups, were conducted off Sakhalin Island between 9-27 August 2010 (Table 2). Forty-three naturally marked individual whales, including four calves, were identified (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).

Between 1994 and 2010, 186 western gray whales have been identified during 370 boat-based surveys off northeastern Sakhalin Island (Table 2). Eighty-six of the whales in the photo-catalog were animals first identified as calves, while the remaining 100 whales were considered non-calves (i.e. adults or subadults). However, not all of these 186 individuals are presently alive (see Cooke *et al*., 2008).

Biopsy sampling

One of our main research objectives during the 2010 Kamchatka survey was biopsy sampling of gray whales observed in the area. In total, we encountered 23 gray whales in Olga Bay and obtained 8 biopsy samples of these individuals. Two of these samples were from whales known from Sakhalin Island (calves in 2001 and 2004), which had been previously biopsied. However, six biopsy samples were taken from previously unidentified and unbiopsied whales (Table 1).

Mother-calf pairs (Sakhalin)

Only one mother-calf pair was identified during 2010 due the late start of survey effort. The other three calves were first identified post-weaning. The identified mother has been previously been sighted and observed with a calf in the study area over multiple years. Therefore, the number of known reproductive females recorded between 1995 and 2010 remains at 26.

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.

Gray whale occurrence in eastern Kamchatka coastal waters has apparently increased (Vertyankin *et al.*, 2004) and sightings there offer interesting insights into western gray whale life history. All six whales we identified off Kamchatka in 2010 that were previously identified from Sakhalin are young individuals first sighted off Sakhalin as calves. Five (83.3%) of these individuals have not been observed off Sakhalin since being sighted as a calf. These Kamchatka sightings support previous observations and high estimated temporary emigration rates of young Sakhalin whales (Bradford *et al*., 2007). In that regard, one whale we observed off Sakhalin in 2010 had not been seen there since it was a calf in 2003. It is important to emphasize, however, that reproductive females continue to demonstrate strong fidelity to the Sakhalin feeding area. Nine of the 43 whales identified during 2010 are reproductive females.

Interestingly, of the nine calves identified off Sakhalin in 2007, none have been resighted there in subsequent years. Tyurneva *et al*. (2010) note that eight of nine 2007 Sakhalin calves observed by an industry-sponsored research group were observed off Kamchatka in 2008. Three of the six Sakhalin whales that we sighted in Olga bay in 2010 were 2007 calves. According to a recent assessment, the body condition of western gray whales off Sakhalin was poorest in 2007 (Bradford *et al*., In press). This finding raises the question of how a bad feeding season affects the distribution and site fidelity of individuals in the next year and beyond.

According to our data and personal communications with O. Tyurneva and V. Vertyankin, 2008 was also the year of the first mother-calf sighting off Kamchatka and a seemingly low number of whales off Piltun in general. When we combine data collected during our 2010 survey effort and that of the 2010 western gray whale tagging study, six of the seven 2009 calves were sighted off Sakhalin in 2010 (Bradford, 2010). Thus, there is substantial variability in the temporary emigration of young (and other) whales.

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 Sakhalin feeding ground in 2008 was very low in comparison to 2009 and previous years with a similar amount of spatial and temporal survey effort (see Table 2). Given the short duration and small number of surveys in 2010, 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 (Weller *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).

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 results of benthic studies off eastern Kamchatka conducted in 1985 (Sidorov and Burdin, 1986), we conclude that observed concentrations of up to 70 whales (V. Vertyankin, Pers. comm.) in the relatively small feeding area in Olga bay, Kronotsky Gulf, will likely not be sustained 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 population 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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Table 1. Gray whales photo-identified and biopsy sampled in Olga Bay, Kronotsky Gulf, eastern Kamchatka in July 2010.

Identification Number	Sex	First Identified off Sakhalin	First Identified off Kamchatka	Side Photographed	Biopsy Obtained?
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	
Sak1	Male	calf in 2001	12 July 2010	R&L	Yes
Sak2	Female	calf in 2004	12 July 2010	R&L	
Sak3	Female	calf in 2007	12 July 2010	R&L	
Sak4	Female	calf in 2007	12 July 2010	R&L	
Sak5	Male	calf in 2007	12 July 2010	R&L	Yes
Sak6	Unknown	calf in 2008	12 July 2010	R&L	

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	08/18 - 08/24	4	11.5	40	43
Overall		370	748.1	2980	186 [1]

[1] The number of whales identified annually includes resightings of individuals from previous years, resulting in a total of 186 identified individuals. The number of whales identified does not correspond to the size of the population.

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	9	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	43	4	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.