Status of western gray whales off northeastern Sakhalin Island, Russia in 2009

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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 (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 2009 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 2009 resulted in the identification of 82 whales, including seven calves. One previously unidentified non-calf was observed. When combined with data from 1994-2008, a catalog of 180 photo-identified individuals has been compiled. Not all of these 180 whales can be assumed to be alive, however. One new reproductive female was recorded in 2009, resulting in a minimum of 26 reproductive females being observed since 1995. 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; 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 paper reviews summary findings from 2009 research activities of our Russia-U.S. research program on western gray whales off Sakhalin Island, Russia, 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

Photo-identification research methodologies employed during the 2009 field study were identical to those used during earlier studies by our team between 1997 and 2008. The overall consistency in research design, data collection techniques and data analysis maintained in 2009 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).

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 20 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.

Photo-identification surveys
Boat-based photo-identification surveys were conducted on all good weather days during the 2009 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 2008 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
Between 1994 and 2009, 180 western gray whales have been identified during 366 boat-based surveys off northeastern Sakhalin Island (Table 1). Eighty-one of the whales in the photo-catalog were animals first identified as calves, while the remaining 99 whales were considered non-calves (i.e. adults or subadults). However, not all of these 180 individuals are assumed to be alive (see Cooke *et al*., 2008).

Seventeen photo-identification surveys, with 67.0 hrs spent in direct observation of 126 whale groups, were conducted between 24 June and 26 August 2009 (Table 1). Eighty-two naturally marked individual whales, including seven calves, were identified during 2009 (Table 2). Of the 75 non-calves identified in 2009, 98.7% had previous sightings in the Piltun area during 1994-2008 photographic efforts (Table 2).

Mother-calf pairs
Seven mother-calf pairs were identified during 2009. These seven mothers all had sightings in the study area prior to 2009, and all but one had been observed in previous years with a calf. Therefore, the number of known reproductive females recorded between 1995 and 2009 is now 26.

Table 1. Annual survey effort, groups encountered and whales identified 1994 to 2009.

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	82
Overall		366	736.6	2940	180[1]

[1] The number of whales identified annually includes resightings of individuals from previous years, resulting in a total of 180 identified individuals. The number of whales identified does not correspond to the size of the population.

Table 2. Annual sighting trends and resighting percentages 1994 to 2009.

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	82	7	1	98.7%

[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.

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 180 individual whales during 366 surveys conducted between 1994 and 2009. Although the photo-catalog now contains 180 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

Of the seven females identified with calves in 2009, all had previous sightings in the study area. 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). While the low numbers observed in 2008 continues to be of concern, it is clear that results from 2009 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,

similar 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.

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.

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