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Status of western gray whales off northeastern Sakhalin Island, Russia in 2014

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ABSTRACT

The western gray whale population remains one of the most endangered baleen whale populations in the world. A recent abundance estimate for the population is 154 non-calf (aged 1+) individuals with the average calf survival rate of 0.70 (SE 0.07) and annual non-calf survival rate of 0.979 (SE 0.004) (Cooke *et al.* 2014). The collaborative Russia-U.S. research program on western gray whales off northeastern Sakhalin Island, Russia, has been ongoing since 1995 and has produced important data used to determine the conservation status of this critically endangered population. This paper reviews findings from 2014 research activities and combines such with data from previous years, in some cases dating back to an opportunistic survey in 1994. Photo-identification research conducted off Sakhalin Island in 2014 resulted in the identification of 79 whales, including nine calves and three previously unidentified non-calves. Two females, known from previous years, were observed for the first time with calves in 2014, which amounts to a total of 33 reproductive females observed with one or more calves during 1994-2014. Based on all years of our research, the current Russia-U.S. catalog consists of 235 photo-identified individuals. This small population of gray whales has illustrated strong site fidelity to a relatively small spatial area off Sakhalin Island, suggesting this habitat is critical to their annual survival.

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

INTRODUCTION

Gray whales (*Eschrichtius robustus*) are a highly coastal baleen whale species which only occurs in the Pacific ocean of the northern hemisphere, and are recognized as comprising two populations in the North Pacific Ocean. Significant mitochondrial and nuclear genetic differences have been found between whales in the western North Pacific (WNP) and those in the eastern North Pacific (ENP) (Lang *et al*., 2011). The ENP population is known to range from their breeding grounds off the coast and within lagoons off Baja California, Mexico to their feeding grounds in the Bering, Beaufort, and Chukchi Seas. The WNP population feeds in the Okhotsk Sea off Sakhalin Island, Russia, and in nearshore waters of the southeastern Kamchatka Peninsula (southwestern Bering Sea).

Whaling catch data suggests that gray whales seen in the Sea of Okhotsk were historically observed in much larger numbers and had a larger geographic range than has been documented today (Reeves *et al*., 2008). Whales associated with the Sakhalin feeding area can be absent for all or part of a given feeding season (Bradford *et al*., 2008), indicating they probably use other areas during the summer and fall feeding period. Some of the whales identified feeding in the coastal waters off Sakhalin, including reproductive females and calves, have also been documented off the southern and eastern coast of Kamchatka (Tyurneva *et al*., 2010). Further, whales observed off Sakhalin have been sighted off the northern Kuril Islands in the eastern Okhotsk Sea and Bering Island in the western Bering Sea (Weller *et al*., 2003).

Recent satellite tagging efforts have illustrated some individuals overlapped their range with the eastern gray whale population with one individual being observed to migrate to the breeding grounds (Mate *et al*., 2011). In addition, Lang (2010) reported two adult individuals (one male, one female) consistently observed off Sakhalin in 1998 and 2004 were genetically matched to sightings off Santa Barbara, California in March 1995. Photographic identifications efforts between the WNP and ENP photo-ID catalogs also revealed sightings of the Sakhalin gray whales off Vancouver Island and Laguna San Ignacio (Weller *et al*., 2012; Urban *et al*. 2013). Despite potential spatial overlap in occurrence, these two populations are clearly genetically separate (Lang *et al*., 2011) which suggests some unknown factor (e.g. temporal) segregates these two populations from inter-breeding.

Although it is clear that some whales feeding off Sakhalin Island during the summer/fall migrate to the west coast of North America during the winter/spring, observations of gray whales in the WNP off Japan, Korea and China during the winter/spring suggest that not all gray whales in the WNP share a common wintering ground (Weller and Brownell, 2012; Weller et al. 2013). Little is known about the current migratory routes and wintering areas in the WNP, but historical evidence indicates that the coastal waters of eastern Russia, the Korean Peninsula and Japan were part of the migratory route and that areas in the South China Sea were used as wintering grounds (Weller *et al*., 2002; Weller and Brownell, 2012; Weller et al. 2013).

Western gray whales travel for thousands of miles to feed on the abundant soft-bottom benthic communities in the western part of Bering and Okhotsk Seas. This feeding period is extremely important for these slow breeding whales, and any disturbance preventing, reducing or limiting feeding can potentially lead to physiological stress and compromise the health of these whales. The near-shore affinity of gray whales makes them particularly vulnerable to environmental fluctuations and anthropogenic activities. For the past decade, industrial development in the coastal waters of northeastern Sakhalin, namely oil and gas development and related exploration (including seismic surveys, offshore platform installation, pipeline construction, dredging, vessel traffic) became a cause for concern, especially since the oil and gas fields overlap with the primary feeding ground of western gray whales (Blokhin and Burdin, 2001; Gailey *et al*., 2011). Many individuals return annually to the same feeding sites off northeastern Sakhalin Island, indicating a site-specific dependence to this geographic area (Weller *et al*., 2007). This critically important habitat is especially vital for nursing females and their calves, as female energetic requirements are increased during lactation, and calves need to be ready to separate and begin to feed on their own.

The western gray whale population is critically endangered and its continued ability to survive is of concern (Weller *et al*., 2002a; Baillie *et al*., 2004). 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*., 2002; Cooke *et al*., 2014). 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 2014 research activities on WNP gray whales off Sakhalin Island in the Russian Far East and integrates new information with data from the last two decades. 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 and fisheries on the summer feeding ground, and entrapments in trap nets off Japan during migration, are provided herein.

METHODS

In order to perform inter-annual comparisons, in 2014 we maintained the overall consistency in research design, data collection techniques and data analysis. 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

The study area is located near Piltun Lagoon 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.

Photo-identification surveys

Gray whales have distinctive body markings, such as natural coloration and pigmentation patterns, as well as scars that are unique to an individual and can be used for individual recognition. Boat-based photo-identification surveys were conducted on all good weather days during the 2014 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 2013 used right-side dorsal

flank markings for identification (Brownell et al., 1997; Weller et al., 1999, 2006), and for the sake of intra- and inter-annual reliability, we continued this methodological approach. Attempts were made to photograph the right dorsal flank of each whale, followed by efforts to photograph the left dorsal flank and fluke. Photographic/video surveys involved slow travel in a 4.5 m outboard-powered inflatable boat. To photograph whales we used a Nikon D7000 digital camera with a 100-400 mm Nikon lens. Measures of environmental conditions, water depth, geographic position, and group size were recorded for each group photographed.

RESULTS

Survey effort and photo-identification

Twenty photo-identification surveys, with a total of 41.7 hrs spent in direct observation of 203 whale groups, were conducted between 4 July and 29 August in 2014 (Table 1). Eight surveys were conducted in July, and twelve in August. Between 1994 and 2014, 235 western gray whales have been identified during 431 boat-based surveys off northeastern Sakhalin Island (Table 1). One hundred nineteen of the whales in the photo-catalog were animals first identified as calves, while the remaining 116 whales were considered non-calves (i.e. adults or subadults). However, not all of these 235 individuals are thought to be alive (see Cooke et al., 2014).

Table 1. Annual survey effort, groups encountered, and whales identified in 1994-2014.

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
2010	08/09 - 08/26	4	11.5	40	42
2011	06/28 - 08/26	14	32.7	83	82
2012	06/24 - 08/30	11	48.8	78	88
2013	07/07 - 08/24	16	54.4	148	94
2014	07/08 - 08/23	20	41.7	203	79
Overall		431	925.7	3492	235 [1]

[1] The number of whales identified annually includes resightings of individuals from previous years, resulting in a total of 235 identified individuals. The number of whales identified does not correspond to the size of the population.

Seventy-nine naturally marked individual whales, including 9 calves, were identified during 2014 (Table 1, 2). In 2011, the highest number of calves (12) was identified off northeastern Sakhalin among all years of our research. Although, in 2014, as well as in 2013 this number was lower than in 2011, it was almost twice higher than in 2012. Of the 70 non-calves identified in 2014, 67 whales (95.7%) had previous sightings in the Piltun area during 1994-2013 photographic efforts (Table 2). The mean pod size for all groups (n=203) encountered during 2014 was 1.97 ± 1.30 ranging from 1 (95 groups, or 46 %) to 8 (1 group consisting of 4 mother-calf pairs) individuals per pod. In general, all whales were distributed in water depths ranging from 2.6 m to 17.0 m (average 9.6 ± 2.59 m).

Table 2. Annual sighting trends and resighting percentages, 1994-2014.

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	2	97.6%
2010	42	3	1	97.4%
2011	82	12	1	98.6%
2012	88	5	4	95.2%
2013	94	9	2	97.6%
2014	79	9	3[2]	95.7%

[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.
[2] One individual is new to the Russia-U.S. catalog (meaning never observed in Piltun area before), however, it had previously been sighted/photographed the off central coast of Sakhalin in 2013 (Sakhalin Environment Watch, 2013).

The number of gray whale resightings during the 2014 field season ranged from one to twelve (Fig. 1). Sixteen (20%) individuals were observed only once throughout the 2014 season, as opposed to thirty-three (35%) in 2013. One individual was seen eleven times, and one individual was seen twelve times during the 2014 season. These two individuals were a mother-calf pair; they were observed together eleven times. And on one occasion, the calf was observed alone after separating from its mother. Four individuals identified as calves in 2013 came back to Piltun feeding area in 2014, with two of them having high resighting rates of seven and eight sightings.

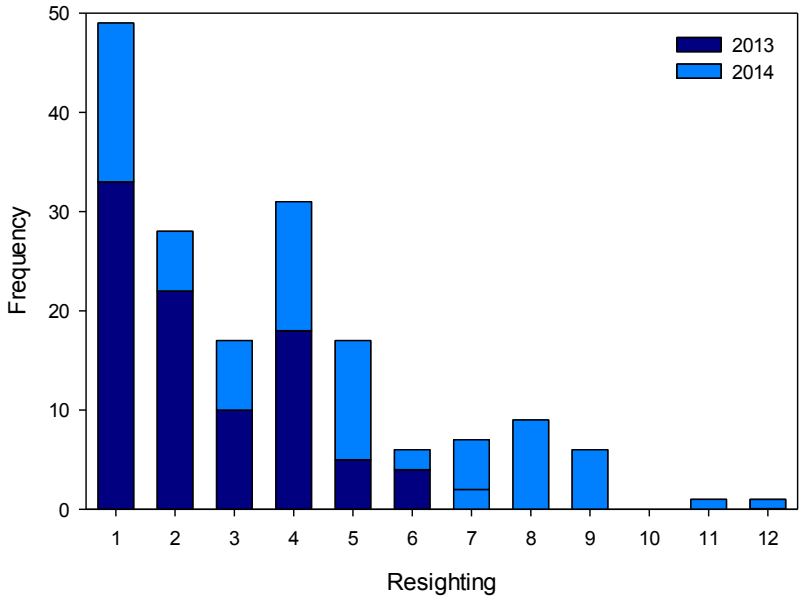

Figure 1. Resighting rates of gray whales observed in Piltun in 2013 and 2014.

Mother-calf pairs

Nine mother-calf pairs were identified in 2014. All nine mothers have been sighted in the study area prior to 2014; seven of them have had multiple calves and two of them have never been observed with calves in previous years. These new mothers contribute to the total of 33 known reproductive females that have been documented since 1995. One of these two females was first identified as a calf herself in 2004. We presume that this is her first calf. The first sighting of a mother-calf pair in 2014 occurred on 16th July. Based on our photo-ID surveys, mother-calf pairs were observed in proximity to the Piltun lagoon entrance more often than in other parts of our study area compared to other (non-mother-calf) individuals (Fig. 2). This distribution pattern has been observed in previous years as well.

Five mother-calf pairs were identified in July, and four pairs were initially observed in August. Our sighting data showed that out of nine mother-calf pairs, four separated sometime in August. For the other five pairs, calves remained with their mothers at our last sighting, and therefore, no information on weaning time for them was documented (Table 3).

Table 3. Mother -calf pair IDs, dates of first sightings and separation dates

Mother	Calf Field ID #	First Time Observed	Last Time Observed Together	First Time Observed Separated
A	01	16 July 2014	22 August 14	NA
B	02	27 July 2014	18 August 14	23 August 14
C	03	27 July 2014	22 August 14	NA
D	04	27 July 2014	22 August 14	NA
E	05	27 July 2014	22 August 14	NA
F	06	01 August 14	01 August 14	10 August 14
G	07	01 August 14	01 August 14	18 August 14
H	08	06 August 14	06 August 14	09 August 14
I	09	18 August 14	18 August 14	NA

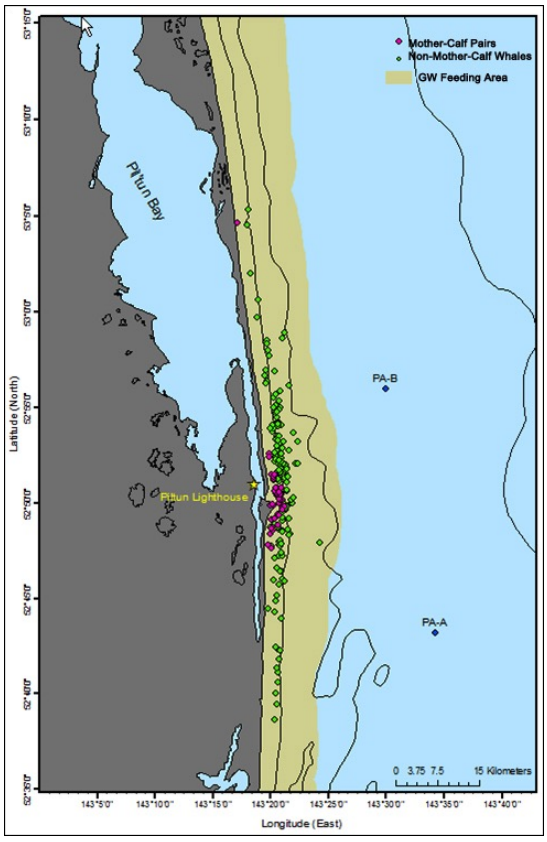

Figure 2. Distribution of mother-calf pairs and non-mother-calf individuals in the study area in 2014.

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 research and monitoring program.

Population size

Despite the apparent spatial overlap between WNP and ENP populations and the potential inter-mixing among individuals, both mitochondrial and nuclear DNA genetic analyses illustrate genetic differences between these two populations suggesting some unknown life history parameter minimizes inter-breeding among these gray whales. Given to the new information on movements of some western gray whales from Sakhalin feeding grounds to Mexican wintering grounds, a reevaluation of the WNP population estimate is necessary. However, data we collected for almost 20 years of research supports the idea that the size of the western gray whale population is extremely small compared to other baleen whale populations. Photo-identification studies off northeastern Sakhalin Island have identified a total of 235 individual whales during 431 surveys conducted between 1994 and 2014. Although our photo-catalog now contains 235 whales, not all of these individuals are assumed to be alive. The most resent western gray whale population abundance estimate is 154 whales for the age 1-plus (non-calf) in 2013 (Cooke et al. 2014).

Reproduction and survival

In 2014, two new (i.e. never been sighted with the calf before) reproductive females were observed in the Piltun area, making the total number of known reproductive females 33. But compared to other species and populations of large cetacean, the number of breeding females in the WNP population is still very low, and the Piltun area still remains the main feeding area for females and calves. The small population size of western gray whales coupled with the low number of reproductive females makes this population highly susceptible to potential extinction. The population growth rate for western gray whales is at approximately 3% per year, which increases the concern for this endangered population (Bradford *et al.* 2008). Calf production also has an unexplained male bias (2:1) sex ratio of

calves with a 22% (14-31%) annual mortality of calves which maybe a limiting factor for population growth (Cooke *et al.,* 2008).

Mother-calf pairs

Nine mother-calf pairs were identified during the 2014 season. All nine mothers have been sighted in the study area prior to 2014, however, two of them have never been observed in previous years with calves. 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. Any disturbance preventing, reducing or limiting feeding could lead to stress and/or compromise the health of these whales that could affect vital life history parameters, such as survival or reproductive success.

Threats to the population

Recent satellite/photo-ID data illustrate that at least some individuals observed off Sakhalin, may have similar migration/breeding habitats to that of the eastern gray whale population. Currently, a reevaluation of the western gray whale population is being considered with a number of plausible hypotheses about population structure. However, an increasing amount of data would be needed to support these hypotheses. One potential hypothesis is that the 'true' western gray whale population is smaller than previously thought which would only heighten the conservation concern. (Weller and Brownell, 2012). Further, the migration distance from the WNP to the ENP has increased by almost 3000-4000 km. These changes create new risks for calves traveling with mothers to feeding grounds in the WNP. 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., 2002; Reeves et al., 2005; IISG, 2006). Industrial activities on the continental shelf of Sakhalin Island 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., 2002; 2006), 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).

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 surveys that both occurred in close proximity to the nearshore feeding ground in summer 2008-2010, and 2012. 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., 2002; 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, 2007; Brownell et al., 2007; Kato et al., 2007; Weller et al., 2008). Projections from 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. In fact, the first entanglement of a western gray whale was documented off northeastern Sakhalin in 2013.

In addition to oil and gas activities and nearshore fishery interactions, tourist activity was observed in 2014 in Piltun feeding area. A large (91 m) vessel, anchored within 1 km from shore near the Piltun lagoon entrance, launched eight small boats with tourists. These boats were observed to approach groups of whales, including mother/calf pairs. All boats were localized within a small distance between each other, consequently observing the same group of whales simultaneously. Western gray whales have been shown to be highly sensitive to nearby vessel activity (Gailey et al. 2010, 2014). Such intensive approach of several boats to a whale or group of whales at the same time may

increase the disturbance, especially to mother/calf pairs. Based on these observations, there is a necessity of monitoring and managing tourist activities in the area, with the possibility of reducing potential impacts to the lowest level within Piltun feeding area and developing standard protocols of approaching whales.

Although there are historical data on gray whales sightings in waters off Japan, South Korea and China, and also documented net entrapments near Japan, the wintering grounds for western population remain unclear (Weller et al. 2008; Weller and Brownell 2012; Weller et al. 2013). Some western gray whales are seen near Kamchatka, and both intra-annual and intra-seasonal exchange of individuals between feeding grounds off Sakhalin and Kamchatka are documented (Tyurneva et al. 2010, our data). In 2010 a satellite-tagging project was initiated off northeastern Sakhalin and continued in 2011. A male gray whale, which was observed as a calf in 1997 and sighted in most years of study in the Piltun area, was tagged and tracked during October 2010–February 2011. Five more whales were tagged in 2011, but only two of them transmitted for long enough to reveal anything about migration. Both whales moved at the same time to the east of the Okhotsk and Bering Sea towards North America. One of the tags stopped transmitting in the Gulf of Alaska, while another transmitted all way to Mexico lagoons and back to Sakhalin Island (Piltun area). This female traveled over 22,000 km from Sakhalin feeding grounds to the Mexico and back in 5 months (Mate *et al*., 2015). In total, nearly 30 whales observed on the feeding grounds off Sakhalin in different years were photographically matched to portions of the eastern North Pacific (Weller et al. 2012, Urban et al., 2013). This highlights that the range and potential threats this population may face may be on a larger scale than previously anticipated.

Such a wide range in distribution makes whales vulnerable to other unknown threats to the western gray whale population including 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).

Fishing activity and entanglement incident

Increased fishing activity has been observed within the western gray whale nearshore feeding grounds in 2013, where trap-nets ~1.5 km in length were placed perpendicular to the coastline. Such nets increase the potential for gray whale interactions, especially because whales in this area are on average 1.5 km from shore (Gailey et al. 2011). In addition, mothers with calves or recently weaned calves occur significantly closer to shore, commonly within 0.8 km (Sychenko 2011). Such large-scale fishery activities in the Piltun area have heightened concerns that it can potentially have a direct impact on the animals, such as causing injuries or death to the whales.

During the 2013 field season, one of the most frequently sighted western gray whales was observed to be entangled with fishing rope wrapped around the caudal peduncle near the fluke with an associated open wound. The whale with the rope known to be a male, was first sighted in 1995 and frequently encountered in the Piltun area. He is also known to be a father of multiple calves off Sakhalin, and in 2004, he was photo-documented in the eastern North Pacific off Vancouver Island, Canada. Immediate disentanglement efforts were not realistic due to logistic difficulties, deteriorating late season weather conditions in the Sea of Okhotsk, and a low probability of finding this individual.

In 2014, the fishing activities within the Piltun feeding ground were noticeably minimized. Fishing nets, similar to nets in 2013, were observed about 25 km south of Piltun lagoon mouth, which is at the edge of southern part of gray whales Piltun feeding area. Fortunately, in 2014 the entangled individual successfully returned to the Piltun feeding area, where he was sighted seven times in July and August. No evidence of his entanglement was observed during these sightings. Despite this positive outcome, the potential for entanglement in the nearshore area represents a serious threat to the survivability of western gray whales. This case presented the first documented entanglement of a gray whale off northeastern Sakhalin, and coincided with increasing fishing activities within the western gray whale neashore Piltun feeding area.

CONCLUSIONS

Currently, a reevaluation of the WNP population is being considered with a number of plausible hypotheses about population structure. However, an increasing amount of data would be needed to support these hypotheses. One hypothesis is that WNP population could be even smaller than previously estimated and it 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 could limit feeding activity or alter the prey availiability. Although, oil

and gas operations (including seismic surveys, offshore platform installation, pipeline construction, dredging, vessel traffic) are present in the area, their impact and consequences on gray whales on both individual and population levels remain unclear. Fisheries interactions with western gray whales has already posed direct population level impact by removing reproductive females and recent calves from the population which decreases the population growth and recovery of this population. The recent entanglement observation on the feeding grounds off Sakhalin is also a serious concern to the future survival of the population. If incidents of western gray whales mortalities continue, it is likely that the population will face an extinction (IISG, 2006; Cooke et al., 2008; Brownell et al., 2007; Weller et al., 2008). Thus, human related mortality during migration and in the,currently unknown, wintering area(s) must be addressed and mitigated to the lowest possible level.

Although the number of reproductive females of western gray whales off Sakhalin shows slow growth, it still remains at low level for the population. Gray whales off Sakhalin are highly sight specific to their foraging habitat with constant annual return to a relatively small geographic area of the Piltun feeding grounds. Such site specific restrictions coupled with high resighting/residency of individuals, especially mother-calf pairs demonstrate the importance of the Piltun feeding area to the annual survival of these gray whales. With this in mind, the proposed increased oil and gas activities off northeastern Sakhalin in the future causes a serious concern to the successes of the western gray whales to survive. This includes seismic surveys in 2015 and the planned construction of temporary unloading facilities on the eastern side of the Piltun lagoon, which can lead to irreversible consequences to gray whales, as well as the whole Piltun coastal habitat and its biological diversity.

In conclusion, given the vulnerability of the WNP population to extinction, potential impacts and future oil and gas activities, fisheries, and tourist activities off the northeastern Sakhalin Island need to be closely monitored with stringently mitigation measures to reduce disturbance to the lowest possible level.

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 WNP 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. The photo-identification 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.

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