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Preliminary results Research Program of the Okhotsk-Korean Gray Whale (*Eschrichtius robustus*) Population Habitat Using Satellite Telemetry

JOINT REPORT

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BACKGROUND

The western population of North Pacific gray whales (*Eschrichtius robustus*) is one of the smallest whales populations in the world and listed as critically endangered (IUCN, 2008). The population is estimated to contain about 130 individuals age one or older, of which only about 25 are reproductive females, and it faces a number of anthropogenic threats throughout its range. Known threats to the population include interactions (some fatal) with coastal net fisheries along its migration route(s) and oil and gas development in and near its principal summer feeding area. It is commonly accepted, that the western population is isolated and these whales feed near the Sakhalin Island coast during ice free period and breed south from Korea and Japan in winter. However, existing data did not allow an unambiguous conclusion on whale migratory routes. Several migration scenarios could be suggested. One alternative scenario suggests that Western population is not isolated and winters off North America coast (Ilyashenko, 2009). Evidently, the issue could only be resolved by direct observations of migrations.

The IWC Scientific Committee and various panels convened under the auspices of IUCN have proposed repeatedly that satellite telemetry is an efficient way to investigate the migratory routes and wintering grounds of western gray whales. Which should begin without delay. Upon the IWC Scientific Committee guidance, B. Mate tagged 17 females of the eastern population in San Ignacio Lagoon on the west coast of Baja, Mexico in 2005 with satellite transmitters to study potential health consequences for gray whales. The tagging has not been reported to affect their health.

At the Scientific Committee of 62 Session of IWC (2010, Agadir, Morocco) the Russian Federation announced the readiness to conduct the gray whales tagging project in collaboration with foreign specialists and submitted the research program. The Program was indorsed and its implementation was recommended.

Program participants: Dr. V.V. Rozhnov, Dr. V.Yu. Ilyashenko, G.A. Tsidulko, (A.N. Severtsov Institute of Ecology and Evolution of the Russian Academy of Sciences); Dr. B. Mate, L. Irvine, C. Hayslip (Oregon State University, Marine Mammal Institute, USA); A. Bradford (Washington State University, USA); V.V. Vertyankin (Kronotsky State Biosphere Reserve); Yu.N. Poltev (Sakhalin Fisheries and Oceanography Institute); Dr. O. Tyurneva (A.V. Zhirmundsky Institute of Marine Biology Far East Branch of Russian Academy of Sciences).

Key Program objectives:

1. Deploy 12 Argos satellite radio tags on gray whales off northeast coast of Sakhalin in 2010;

2. Identify the timing and routes of spring and autumn migrations;

3. Identify the wintering grounds

In addition, biopsy sampling and photoidentification effort were not the key, yet important element of the program aiming to further study the genetic traits and sex composition of the Okhotsk-Korean population of gray whales and expand both of Russia-US and Russian Programs Western gray whales photo catalogs.

Field effort.

Pre-tagging work

In August 2011 Russia-US Program field team conducted its effort on Sakhalin. A. Bradford, who studied gray whales off Sakhalin and had experience in "real-time" identification of whales at sea, joined the team prior to tagging to participate in photo identification effort and get prepared for the identification of whales-candidates prior to tagging. G. Tsidulko also joined the team to collect biopsy samples from maximum possible number of whales to avoid spending time on this during tagging.

Tagging

The tagging effort on placement of 12 satellite radio tags on gray whales off Sakhalin Island lasted from 29 August till 7 October 2010 (including set-up meetings, vessel transit and demobilization time). For the purposes of satellite tracking of western gray whales tags were specially designed for the project by Oregon State University. The tags and tagging methodology were endorsed and recommended by IWC for this project. All parties participating in the Western Gray Whale Satellite Tagging program were committed to minimize any potential impact of this research effort on the marine environment and specifically on the western gray whale population. The Whales Safety Protocols (see Annex 1) were drafted, reviewed and endorsed by all parties involved in the Program's implementation. The purpose of this document is to outline specific protection measures related to vessel based western gray whale satellite tagging program in order to help minimize any potential disturbance to these whales. The tagging methodology developed by Oregon State University and Whales Safety Protocols were followed throughout the tagging effort.

The research team - V.V. Vertyankin (Kronotsky State Biosphere Reserve) – expedition lead, G.A. Tsidulko (IPEE RAS), Yu.N. Poltev (Sakhalin Fisheries and Oceanography Institute), Dr. B. Mate, L. Irvine, C. Hayslip (OSU), A. Bradford (WSU), based at the vessel «Igor Maksimov». The tagging was conducted from a 5 and 7 m motorboat(s) launched from the mothership: (***a***) 7 m rigid haul rescue boat powered by stationary 170 W diesel jet (further «plastic boat»; initially provided by the sponsoring companies as a tagging platform; (***b***) 5 m inflatable Zodiac powered by 40 hp 4-stroke outboard (further «inflatable») [also see *associated experiments and observations*]. It has turned out that the plastic boat could not serve as a proper platform for the close approaches to whales, needed for the tag placement, due it's noise and limited steering capabilities. This forced the team to seek for an alternative boat which ended up being a 5,3 m inflatable Zodiac with the 40 hp, 4-stroke outboard.

The tagging team consisted of: tagger, «decider»-ID specialist, 1-2 photographers, video operator, and boat driver. As the effort transferred from plastic boat to inflatable the boat team was reduced to tagger, «decider», photographer, boat driver. At least a single observer served as a support team aboard «Igor Maksimov» and informed the boat team about the whales within the sight range.

The tagging effort was conducted between September 3 and October 7, 2010. Total time spent on site (including bad weather days and departures to seek the shelter from storm) was 28 days. Due poor weather conditions a small vessel launch and tagging operations were initiated on only 12 days with the tagging survey duration ranging from 1,5 to 10 hours. Only 2 surveys lasted about 10 hours while average survey time was 4,9 hours (Table 1).

As recommended by IWC, the tagging approaches were undertaken only to identified whales, known as males («candidate») from previous genetic studies. Total 71 «candidates» were sighted (including re-sightings) over the course of 12 surveys; these sightings amounted to 25 individual candidates. The behavior of whales in 2010 differed from previous years with boat avoidance being exhibited at much garter distances and in more instances than usually. In 2010 whales reacted to the approaching boat at 150-200 m distance which resulted decrease of the surface time and increase of the dive time and/or avoiding the boat directionally at good speed.

Table 1: Summary of tagging effort during 2010 western gray whale tagging project

Date Boat*	Start Location	End Location	Dist Traveled (km)	Time on water (hrs)	# Whales Observed	# Whales ID'd	# Candidates	# Photos
9/6/2010	53 14.30	53 10.6	42.5	5.75	12	12	8	220
R	143 17.52	143 17.75						
9/12/2010	52 52.31	52 49.149	47.6	5.17	1	1	0	16
R	143 23.43	143 23.191						
9/13/2010	53 08 23.1	53 01.4	38	4	9	9	3	241
R	143 28 21.3	143 21.75						
9/14/2010	53 15.73	53 03.335	39.2	4.33	20	17	6	279
R	143 16.32	143 20.400						
9/15/2010	53 18.32	53 03.882	50.3	5.5	20	20	5	458
R	143 15.88	143 21.055						
9/17/2010	52 56.096	52 53.989	10.8	1.33	3	3	2	87
R	143 21.987	143 22.823						
9/18/2010	53 07.11	53 00.13	31.1	4	19	18	13	451
R	143 17.96	143 20.315						
9/20/2010	53 07.236	53 09.967	10.1	1.5	4	4	2	49
Z	143 19.396	143 19.121						
9/25/2010	53 22.05	53 12.866	32.1	4.33	24	24	8	218
Z	143 13.54	143 16.498						
9/27/2010	53 19.633	53 54.390	69.6	9.75	24	24	12	551
Z	143 14.634	143 17.93						
10/3/2010	53 13.526	53 04.785	18	3	6	5	3	41
Z	143 20.275	143 20.161						
10/4/2010	52 53.148	53 15.690	83	9.75	24	23	9	382
Z	143 22.690	143 17.747						
Total			472.3	58.41				2,992
average			39.4	4.9	13.8	13.3	5.9	~50/hr

* Boat-types are rigid-hull jet-drive (R) and Zodiac (Z).

Regretfully due unexpected technical difficulties and whale's behavior only one whale was tagged on October 4, 2010. The tag was placed on a 13-year old whale (this whale is known as Flex in the Russia-US Program phot catalog) is known since 1997 when first sighted as a calf near shore Piltun Lagoon, Sakhalin Island. For the IBM RAS photo catalog this whale is known as Belokhvost (#KOGW068) since 2003.

The tag placement process took 42 minutes. The whale surfaced 41 sec after tagging and continued its movement in the same direction. Throughout the day Flex was sighted 3 times feeding in association with other whales.

Post field data collection, management and analysis.

In this track analysis of the tagged whale messages of all location classes were used. It is planned to further analyze the data using different Argos system filters and messages ranked by location class, but is worth noting that after whale's departure from Sakhalin shelf, relatively limited number of high class location messages were received. Analysis of whale's movements based only on high class locations may result loosing some fine scale movement data.

Satellite data from the tag deployed on the 13-year old male (named – Flex) started to come to the IPEE RAS dedicated computer on the October 4, 2010 – immediately after the tag placement.

October 4 – December 11, 2010. Flex remained near shore Sakhalin Island and moved along approximately 35 km of the shoreline within 5 km offshore (Fig.1).

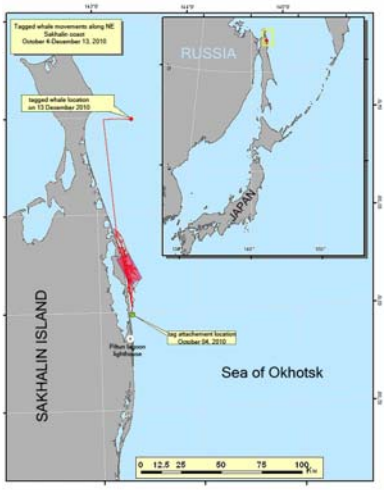

Figure 1. *Schematic map of Flexes movements near shore Sakahlin Island in October-December 2010. Pink rectangle indicates the area of Lebedinskoye seismic survey area.*

December 12. Flex has left the Sakhalin self zone and by December 16 reached west coast of Kamchatka peninsula.

16 December 20103- 3 January 2011. The whale mooved around Kamchatka and left the shelf zone off Kamchatka bay (abeam Chazhma river).

January 3-9, 2011 Flex has crossed the Bering Sea and by January 12 reached Pribiloff Islands area.

January 12-18, 2011 Flex passed the Aleutian chain and moved from Pribiloff Islands to Shumagin Islands.

18 January-2 February, 2011 the whale crossed the Gulf of Alaska and reached North America mainland abeam Quillaute River (Washington State, USA).

The last message was received on February 5, 2011 when whale was abeam Otis city (Oregon, USA).

The resulting track of the whale lasted for 124 days including 55 days, 7546 km migration from Sakhalin Island (Russia) to Oregon (USA) (Fig.2). Average whale speed during the migration was 5,7 km/h.

Figure 2. *Flee's track schematic map.*

It will be useful to further examine the period October 4-December 11,2010, while Flex remained in the general vicinity to the area being used for active seismic exploration by the Rosneft at Lebedinskoye field (Fig.1). The survey reportedly went from August 20 until 20 November, 2010 and used reduced power air guns (relative to ones used by Sakhalin Energy and ENL in 1997/2010 and 2001 respectively). Detailed analysis will have to combine the location quality of whale

locations, their frequency to interpret movements, Rosneft operational logs and ideally local calibrated acoustic data if it is available.

Information on Flexes route was presented and regularly updated at IPEE RAS (http://www.sevin.ru/menues1/index_rus.html) and OSU (http://mmi.oregonstate.edu/Sakhalin2010) websites.

Associated experiments and observations

Photo identification

Over the course of 12 surveys 2992 photos of whales were shut during 168 whale encounters (*including repeats*). Some results of the photo identification (including for *pre-tagging* work) can be found in the report submitted by A. Bradford to the 9-th Western Gray WhaleAdvisory Panel meeting (http://cmsdata.iucn.org/downloads/wgwap_9_doc_12_bradfordwgwtaggingstudiesreportiucn_final.pdf).

Besides, all collected whales photographs were matched (O. Tyurneva) to IBM catalog and resulted 56 matches. Of these 56 whales 25 were sighted off Kamchatka in previous years (2002-2010). 22 whales of 25 sighted off Kamchatka, were recorded visiting both Kamchatka and Sakhalin in the same year, including 13 sighted off Kamchatka and Sakhalin in 2010.

Biopsy sampling

Collection of biopsy samples provided an opportunity to initiate biopsy samples collection prior to the main tagging stage which allowed genetic samples be collected and reduce time the research vessel spent around whales during tagging effort.

Total 9 biopsy samples were collected. Each sample was divided on halves with one be stored at IPEE RAS and second, as recommended by IWC, to be sent for storage to Southwest Fisheries Science Centre, La Jolla, USA. Photo-identification data showed that these samples were collected from 8 animals.

To date IPEE RAS gray whale tissue samples collection gathers over 80 samples from Chukotka (collected by D. Litovka), Koryakia (collected by V. Burkanov), Kamchatka (provided by V. Burkanov, A. Burdin) and Sakhalin (collected by G. Tsidulko). The result of genetic analysis

undertaken by IPEE RAS will be presented as a separate report to 63-d IWC Scientific Committee meeting.

Acoustic comparison of tagging platforms

The unexpectedly strong boat avoidance exhibited by most whales on approach of the plastic boat led the research team to conduct the measurements of the plastic boat acoustic features. For the comparison a 5,3 m inflatable Zodiac a powered by 40 hp 4-stroke outboard was used (photoidentification platform for the Zhirmundsky Institute of Marine Biology team). The measurements and further comparison were made possible as there was a Pacific Oceanography Institute team of acousticians operating in the area and their recording acoustic buoys were already in the water.

The acoustic comparison a two boats were conducted using same movement parameters: trajectories and 6 speed regimes. The measurements were also conducted for both boats moving on a straight line and turning.

The preliminary results of comparison showed that the plastic boat at all modes and trajectories was 2-4 times louder than the Zodiac at frequencies <1 KHz and 8-10 times louder at frequencies >1 KHz.

This information, combined with a number of days where the whales appeared to start avoiding the boat even during the candidate identification process led us to believe that the plastic boat (originally provided by sponsoring companies as the main tagging platform) was loud enough that it was reducing likelihood of successful tagging. Additionally, the jet pump steerage did not respond quickly at slow speeds, which is necessary to make the final close approach during tagging. These considerations led the expedition leader – V. V. Vertyankin, (after consultations with the team members) to change tagging vessels to Zodiac with its much quieter and more maneuverable 40 hp 4-stroke outboard engine.

Whales safety protocols for tagging operations

Set-up meetings were organized by the sponsoring companies (Exxon Neftegaz Ltd and Sakhalin Energy) to review, discuss and finalize the safety protocols for the offshore operations and specifically for tagging effort.

«Whales safety» protocols for tagging operations also were reviewed in detail and finalized [Annex 1]. The protocols were agreed by assigned employees of ENL, Sakhalin Energy and by attending marine mammal specialists from Russia and USA.

Key results, *preliminary findings and conclusions*

1. One satellite Argos system radio beacon (tag) was placed on the gray whale off northeast Sakhalin.

2. The tag transmitted for 124 days, which allowed tracking the whale's migration from Sakhalin Island across the Sea of Okhotsk, around Kamchatka peninsula, across the Bering Sea, Aleutian chain, Gulf of Alaska to the coast of Oregon, USA.

3. A single tagged whale migration does not allow drawing the conclusions on the origin, identifying **all** migration routes and winter/breeding areas of whales summering off Sakhalin Island. However it obviously showed that at least one whale from Sakhalin migrated to the west coast of North America (as far as Oregon, USA) as earlier supposed by V. Ilyashenko (2009).

4. For 68 days the tagged whale remained within a relatively small area in the general vicinity of seismic survey work, which will be examined in further detail , when other data regarding this survey are available.

5. Weather conditions, storms specifically, may affect the transmission efficiency which causes gaps in the data flow.

6. Tagging photo-identification data were matched to both Russia-US and IBM teams catalogs. Of whales identified, 25 were sighted off Eastern Kamchatka in previous years, including 13 whales sighted off both Kamchatka and Sakhalin in 2010.

7. Samples from 8 whales were collected offshore Sakhalin in 2010. Currently IPEE RAS obtained over 80 samples of gray whale tissue from Chukotka, Koryakia, Kamchatka and Sakhalin. Findings of undertaken analysis will be reported at 63-d IWC Scientific Committee meeting.

8. For the future tagging effort it should be taken in account that stationary diesel powered and/or jet boats proved being ineffective platform for research requiring close approaches to whales (photo identification, tagging, biopsy sampling).

AKNOWLEDGEMENTS

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ANNEX 1

Satellite Tagging Whale Safety Protocols

All parties participating in the Western Gray Whale Satellite Tagging program are committed to minimize any potential impact of this research effort on the marine environment and specifically on the western gray whale population. The purpose of this document is to outline specific protection measures related to vessel based western gray whale satellite tagging program in order to help minimize any potential disturbance to these whales.

This document describes general protection measures to be applied to all activities conducted from the *Igor Maximov* and small boats. These guidelines are based on compliance with Russian law, the ENL and Sakhalin Energy Marine Mammal Protection Plans (MMPP) and the incorporation of good international practice in the field of marine mammal protection, such as the current restrictions for whale-watching vessels outlined by the scientific committee of the International Whaling Commission (IWC) with regard to the approaching distance for vessels including boats with the whales.

General Protection Measures

a) Priorities: Crew safety first, whale safety second, data LAST

b) Vessels, engines and other equipment should be maintained and operated during vessel activities to minimize any additional sounds, and as such to reduce, as far as practicable, adverse impacts on gray whales

c) A marine mammal observer (MMO) should be present on the vessel to maintain a continuous watch during daylight hours in order to keep track of all western gray whales or other marine mammals that occur in the proximity of the vessel.

d) MMO recording whale sightings during any vessel movements has the ability to communicate immediately with the vessel captain and/or navigation officer and has the authority to advise the captain and/or navigation officer to slow speeds, change course to deflect from a whale(s), or stop the vessel.

e) The *Igor Maximov* is required to keep within navigational corridors and comply with associated speed limits when on transit to the research area, unless essential for safety.

f) The *Igor Maximov* will remain at or offshore of the 20m depth line while in the Piltun feeding area, unless specifically required to perform a certain activity (see specific protection measures).

g) When traveling between areas, the *Igor Maximov* should transit outside of known feeding areas. Where feasible, the *Igor Maximov* should remain outside the boundaries of known feeding areas during periods of reduced visibility (<1 km) and during the night. If traveling through the feeding areas in reduced visibility (<1 km), the speed limit should be up to a maximum of 5kts.

h) Avoid unnecessary sudden changes in speed and course

i) Do not pursue, head off, encircle whales, or cause groups of whales to separate

j) *Igor Maximov* will neither cross the course of moving whales, nor maneuver in the immediate vicinity of stationary and moving whales. When moving parallel to whales, *Igor Maximov* will maintain a constant speed and course.

k) The *Igor Maximov* should maintain a 1000m separation from gray whales or other large whales when they are in transit.

l) Due to the nature of the satellite tagging, the *Igor Maximov* may need to be in closer proximity to whales in feeding areas than 1000m. If any whale is observed heading for the vessel, the captain and/or navigation officer should take all necessary action to avoid a collision or close-quarter situation with the whale and attempt to maintain at least a 500m minimum distance between the *Igor Maximov* and the whale.

m) If (a) whale(s) surface(s) in the vicinity of the *Igor Maximov,* all necessary measures need to be taken to avoid collisions. This may include stopping, slowing down, and/or steering away from the whale.

n) Speed limits should apply during satellite tagging. The *Igor Maximov* should travel no faster than 10kts (~18.5 km/hr) during satellite tagging. Speed should be reduced to 4-5kts (~9 km/hr) when groups of gray whales are expected to enter the 1 km safety zone. This speed (4-5 kts) is consistent with the measures recommended in the ENL Marine Mammal Protection Plan.

o) The *Igor Maximov* movements inside the feeding areas shall be reduced as much as possible. When the small boat is in the Piltun feeding area, the *Igor Maximov* should remain ***parallel and offshore*** of the small boat activities at a distance that allows constant visual contact with the small boat, i.e., away from aggregations of feeding gray whales. In the Offshore area, the *Igor Maximov* should maintain a position parallel to small boat activities and remain ~1 km from aggregations of whales. **Under no circumstances** should the *Igor Maximov* follow *behind* the small boat through a group of feeding whales. The *Igor Maximov* should not approach whales, feeding or otherwise, within 1 km.

p) Small boat should be in regular contact with the *Igor Maximov* to relay information on all whales visible in the area

q) Always drive the small boat in such a manner to maintain crew and whale safety. Keep photographic gear protected from water exposure at all times.

r) Avoid dangerous changes in small boat speed, direction (except in an emergency where there is risk to crew) that might be risk to whales or crew.

s) Do not separate a mother-calf pair.

t) Do not reverse outboard motor near whales (except in emergency or risk to crew)

u) Avoid excess motor use, gear changes, maneuvering or backing up near whales

v) Control length of exposure (i.e. during small boat sessions), especially in the presence of mother/calf pairs, juveniles, and whales with visible health indicators, such as skin

sloughing and poor body condition, to a maximum 30 minutes to photograph / identify 1st side, and an additional 15-20 minutes for the second side and flukes, and/or 60 minutes for satellite tagging. Allow at least 30 minutes before repeat exposure.

w) Approach whales from an oblique angle, i.e., parallel to and slightly from the rear and do not approach whales from directly behind (except briefly during a photo-identification fluke shot) and never drive towards a whale from the front. Travel parallel to whales matching its speed and do not approach the animal closer than 15m for a photo-identification shot.

x) Alternately, position the small boat in neutral ahead and to the side of the whale and let it approach you

y) If a calf approaches the small boat, keep the motor in neutral until the whale is a safe distance from the boat (~50m)

z) When first approaching a group of whales, slow at a distance of 200m and assess group size, and activity patterns before attempting photo-id

aa) When the small boat is stationary, the motor should be put in neutral

bb) Do not turn motor off – stay in neutral/idle – the noise lets the whale know where the vessel is located.

cc) Ensure that the small boat does not drift too close to the whale(s)

dd) If extreme disturbance of a whale(s) is observed, withdraw immediately at slow "no wake" speed (max. 4-5 kts)

ee) When leaving a whale or group of whales, move at slow "no wake" speed (max. 4-5 kts) to the outer limit of the caution zone (100 m) before *gradually* increasing speed

ff) Only engage outboards with extreme caution and awareness of the location of the whales

gg) If a whale approaches the small boat, place engines in neutral and let whale come to you; or slow down and continue on course avoiding potential collisions.

NOTE: This Western Gray Whale Satellite Tagging Whale Safety Protocol was agreed upon on 31 August 2010 by representatives of IPEE RAS (V. Ilyashenko, G. Tsidulko), Oregon State University (B. Mate, C. Hayslip, L. Irvine), University of Washington (A. Bradford), Sakhalin State University (N. Romanov), Kronotskiy State Biosphere Reserve (V. Vertyankin), Sakh-NIRO (Y. Poltev), and Exxon Neftgas Limited (M. Swindoll).