Progress report on Environmental Monitoring Task Force including 2009 Sakhalin and Vladivostock site visits

Prepared by: Glenn R. VanBlaricom and Grigory Tsidulko

WGWAP-7/9. Final version.

Trip reports, site visits to the Piltun region of Sakhalin Island, and to the A.V. Zhirmunsky Institute of Marine Biology, Far East Branch, Russian Academy of Sciences, Vladivostok, Russia, autumn 2009.

Glenn R. VanBlaricom
Grigory Tsidulko

Part 1 of 2: Report on the site visit of G. VanBlaricom, A. Galloway, and G. Tsidulko to the Piltun Region.

Sakhalin Island, Russia, 20-28 September 2009.

Personnel and affiliations: VanBlaricom and Tsidulko are members of the Environmental Monitoring Task Force (EMTF), Western Gray Whale Advisory Panel (WGWAP), International Union for the Conservation of Nature and Natural Resources (IUCN). Galloway is a doctoral student in the School of Aquatic and Fishery Sciences, University of Washington, Seattle. VanBlaricom and Tsidulko are marine ecologists with significant expertise and experience in marine benthic ecology, and in the ecology of gray whales. Galloway also has significant experience in studies of marine ecology. VanBlaricom and Galloway are experienced research scuba divers. The site visit team received significant logistical support from the Bumerang Adventure Travel Group. Bumerang Group members participating in all aspects of the site visit included Evgeniy Kostinsky, Vitaliy Vorobiov, and Kseniya Rumkina. Bumerang Group members Kostinsky, Vorobiov, and Rumkina assisted with transportation of personnel, equipment, and supplies from Nogliki to the Piltun Lighthouse Research Station, and supported assisted all aspects of field observations at the Piltun area.

Purpose of visit: The primary purpose of the site visit was to achieve improved familiarity with attributes of benthic habitats in the Piltun feeding area of the western North Pacific population of gray whales (WGWs). Habitat observations were made during scuba dives by VanBlaricom and Galloway. Information gathered during the dives will be utilized in development of an agenda for the EMTF Workshop, tentatively scheduled for April 2010 in Geneva, Switzerland, in association with the Eighth Meeting of WGWAP. VanBlaricom is Chair of EMTF and will have lead responsibility for organization and management of the subject Workshop.

Travel schedule during the visit: VanBlaricom and Galloway arrived in Yuzhno-Sakhalinsk on 20 September 2009, lodging at the Hotel Sakhalin Sapporo, with Tsidulko joining them on 21 September. VanBlaricom and Galloway met with Koen Broker during the evening of 20 September, and with Tsidulko, Doug Bell, Koen Broker, and Vladimir Efremov at the offices of Sakhalin Energy on 21 September. The team departed Yuzhno-Sakhalinsk by overnight rail on 21 September, arriving in Nogliki on 22 September and joining with the Bumerang support team. The group then travelled by truck caravan and inflatable skiff shuttle to the Piltun Lighthouse Research Station, arriving late afternoon on 22 September. Field work at Piltun was attempted from 23 to 26 September, although a strong windstorm on 26 September prevented any work. The team departed from the Piltun

Station on 27 September by truck caravan, arriving in Nogliki the afternoon of the 27th. We travelled from Nogliki to Yuzhno-Sakhalinsk by overnight rail, arriving in Yuzhno-Sakhalinsk on 28 September. VanBlaricom and Galloway departed from Yuzhno-Sakhalinsk on 28 September.

Synopsis of dive effort: VanBlaricom and Galloway logged a total of 3.6 person-hours of bottom time, with six dive attempts and five successful dives. Dive effort details are reviewed in the following Table:

Dive number	Date	Depth (m)	Latitude	Longitude	Location description	Visibility underwater
1	23 Sept 2009	17.1	52°49.95'N	143°21.48'E	In feeding area, due east of Lagoon entrance channel	< 0.5 m; substantial suspended sediments in water column
2	23 Sept 2009	0	52°51.68'N	143°19.05'E	Inside Piltun Lagoon, due east of lighthouse	Dive aborted, extreme current
3	24 Sept 2009	4.3	Not recorded	Not recorded	Inside Piltun Lagoon, due east of lighthouse	~ 1 m; substantial suspended sediments in water column
4	25 Sept 2009	15.5	52°51.32'N	143°21.61'E	In feeding area, north of Lagoon entrance channel	~ 2 m
5	25 Sept 2009	10.4	52°51.06'N	143°20.75'E	In feeding area, north of Lagoon entrance channel	~ 2 m
6	25 Sept 2009	6.1	52°51.21'N	143°20.03'E	In feeding area, north of Lagoon entrance channel	< 0.5 m; substantial suspended sediments in water column

Synopsis of dive conditions: Diving conditions during the visit were physically challenging, with three attributes prevailing on all dives: Low temperatures (~6°C), poor visibility (<2 m on all dives), and strong currents on the sea bottom (sufficient to prevent headway even with a strong swimming effort). Current strength was such that we experienced dragging of the skiff anchor on all dives in the feeding area. However, this normally undesirable occurrence had the unforeseen benefit of allowing us to view a substantial bottom area without loss of contact with the surface vessel, simply by hanging on to the anchor line while on the bottom.

Summary of observations by dives:

Dive 1: Observations on the bottom were not possible because of strong currents and near-blackout visibility. However, the bottom was strikingly soft and silty, contrary to our expectation of a firm sandy substratum. Most noteworthy were the observed large quantities of suspended sediments through the entire length of the water column. The observations suggested to us that the dive site

is a depositional area for large quantities of sediment, and possibly associated organic matter, carried out of Piltun Lagoon by tidal currents and estuarine circulation.

Dive 2: This dive was aborted at the surface after it became clear that current velocity was at unsafe levels.

Dive 3: This was a shore dive within Piltun Lagoon adjacent to the Piltun Lighthouse Field Station. We travelled eastward on the bottom to a depth of 4.3 m, then reversed course and returned to the entry site. We observed the following:

- There is a zone of enhanced abundance of filter-feeding invertebrates at the depth of the sublittoral fringe. Dominant organisms were mussels and burrowing anemones. We observed no filter-feeding organisms below a depth of about 1 m.
- Below 1 m depth exposed organisms were relatively few in number. We observed scattered clusters of small infaunal tubes extending above the sediment surface, but these generally appeared unoccupied. Macroalgae were scattered and small, and seen primarily in the shoaler portion of the dive.
- The sediment appeared to a silty sand, with actively propagating ripple marks at all depths. There were substantial quantities of suspended sediment and detrital particles in the water column throughout the dive.

Dives 4 and 5: These dives were made in the feeding area, along a line extending from west to east several km north of the Lagoon entrance channel. Conditions and observations were generally similar on the two dives, except that abundance of all categories of visible organisms was greater on dive 5 (depth 10.1 m) than dive 4 (15.5 m). We observed the following:

- Presence of suspended sediments in the water column was noticeably less than on dives 1 and 3. In addition, the prevalent color in the water column was green, rather than yellow-brown as seen on dives 1 and 3. The color difference suggests lesser amounts of suspended organic detritus in the sites of dives 4 and 5 as compared to dives 1 and 3.
- Bottom sediments were relatively firm fine sands. Ripple marks were actively propagating at both sites. The presence of active ripple marks at the site of dive 4, at a depth of 15.5 m, is unusual in VanBlaricom's experience.
- Exposed organisms were again relatively few in number in sediments not exposed by the dragging anchor. The primary fixed biological structures were clusters small infaunal tubes, apparently empty of organisms, extending above the sediment surface a distance of ~ I cm. The most commonly seen epifaunal organism was the isopod Synidotea sp. in the size range of 1-2 cm. The isopods were most often associated with the noted tube clusters. They were actively moving about, and often were seen curling into a ball, in the manner of terrestrial "pill bugs", and allowing themselves to be rolled along the sediment surface by the current.
- Amphipods were not seen on the surface in sediments not disturbed by the dragging anchor, but the dragging anchor turned up many amphipods from just below the sediment surface.

- We observed occasional small gastropods and bivalves, always as scattered individuals with low density.

Dive 6: Conditions on this dive were very similar to conditions found on dive 1, and observations of organisms on the bottom were again not possible because of very poor visibility. The primary observed differences in sites of dives 1 and 6 was sediment character. Bottom sediments at the site of dive 6 were relatively firm fine sands, similar to those observed at the sites of dives 4 and 5.

We collected single core samples at the sites of dives 4, 5, and 6 to allow viewing of common infauna not visible during dives. Cores were 12 cm in diameter and sampled a surface area of ~110 cm^2 to a depth of ~12 cm. Cores were brought to the surface and screened through a mesh with 1 mm square apertures. The primary infauna collected by coring were pericarid crustaceans, including amphipods in the size range of 0.2 to 1 cm (maximum body length), isopods (*Synidotea* sp.) to a length of ~1.5 cm, and cumaceans (0.5-1 cm). The cores suggested densities of several hundred to perhaps 1000 individuals per m^2 for amphipods, and substantially lesser densities for other taxa collected. However, coring effort was below the minimum necessary for meaningful generalizations about infanual density patterns.

Potential insights from the dives: Generalizations can only be offered with caution because of the relative brief time period available for diving observations, as a result of scheduling and travel constraints, and limitations imposed by weather and sea conditions. Recognizing our limitations, we nevertheless developed several strong impressions of relevance to WGW conservation and ecology:

1) Effects of effluent waters and sediments from Piltun Lagoon to portions of the feeding area proximate to the Lagoon entrance channel appear to be substantial, particularly with regard to suspended sediments, associated detritus, and possibly associated microbiota. Bottom sediments directly offshore from the Lagoon entrance channel were clearly more silty than those at any other dive site, and suggest a strongly depositional local environment.
2) As a consequence of persistently strong bottom currents, for which the Piltun feeding area is well-known, the sediment surface is unusually dynamic, with actively propagating ripple marks a consistent feature. Sedimentary habitats of this type often pose harsh physical challenges to benthic species that develop and disperse via planktonic larvae, such as many species of bivalve mollusks and polychaete worms. In contrast, species that are well-armored and brood their young internally often flourish in such habitats. The dynamic sediments and high organic inputs probably contribute to the substantial biomass densities of pericarid crustaceans, and particular gammaridean amphipods in the region.
3) The dynamic sediment surfaces and locally high levels of suspended sediments probably restrict the development of dense suspension-feeding assemblages in benthic habitats of the area. We observed suspension feeders to be uncommon within Piltun Lagoon, and rare in the feeding area. Bioturbation of the area by foraging WGWs probably contributes to the relative rarity of suspension feeders.

Part 2 of 2: Report on site visit of G. VanBlaricom and G. Tsidulko to the laboratory of Dr. Valeriy I. Fadeev, A.V. Zhirmunsky Insititue of Marine Biology, Far East Branch, Russian Academy of Sciences.

Vladivostok, Russia, 17-21 November 2009.

Personnel and affiliations: VanBlaricom, Tsidulko, and Fadeev are members of the Environmental Monitoring Task Force (EMTF), Western Gray Whale Advisory Panel (WGWAP), International Union for the Conservation of Nature (IUCN). VanBlaricom and Tsidulko are members of WGWAP. Dr. Fadeev is Chief of the Laboratory of Ecology, Shelf Communities, at the A.V. Zhirmunsky Insititue of Marine Biology (IMB), Far East Branch, Russian Academy of Sciences, and is the lead investigator for monitoring of the benthic biological environment in the Sakhalin II Project Area by the Sakhalin Energy Investment Company (Sakhalin Energy). The Sakhalin II Project Area encompasses significant portions of the primary feeding areas of the western North Pacific gray whale (*Eschrichtius robustus*) population (WGW). VanBlaricom and Tsidulko are marine ecologists with significant expertise and experience in marine benthic ecology, and in the ecology of gray whales.

Purpose of visit: The primary purpose of the site visit was to allow VanBlaricom and Tsidulko to become more familiar with procedures for sample processing, data generation, data analysis, and data management in association with benthic monitoring activities conducted by Sakhalin Energy in Sakhalin II. In addition, VanBlaricom and Tsidulko engaged in discussions with Fadeev and his colleagues regarding several issues relating to benthic biological monitoring in Sakhalin II that are of current interest to EMTF and WGWAP. Information gathered by VanBlaricom and Tsidulko will be utilized in development of an agenda for the as-yet unscheduled EMTF Workshop. VanBlaricom is Chair of EMTF and will have lead responsibility for organization and management of the subject Workshop.

Synopsis and schedule of activities during the visit: VanBlaricom and Tsidulko arrived in Vladivostok on 17 November 2009, lodging at the Hotel Gavan. Discussions with Dr. Fadeev and his staff and colleagues regarding benthic monitoring procedures, and regarding key issues of current interest to WGWAP in the context of benthic monitoring, were held at IMB on 18 and 19 November 2009. The visit to IMB also included discussions with the following scientists, all with regard to biological issues and processes in the marine waters of the Russian Far East: Ms. N.L. Demchenko (ecology and systematics of amphipod crustaceans in the benthic communities of the WGW feeding areas, Piltun region, Sakhalin Island), Dr. A. Yu. Zvyagintsev (discussions of monitoring of invasive species), Dr. Tatyana Yu. Orlova (discussions of toxic phytoplankton populations), and Drs. Sergey I. Kiyashko and Vladimir I. Kharlamenko (discussions of application of stable isotope and fatty acid analytical methods to questions about structure and process in marine food webs). VanBlaricom and Tsidulko also met briefly with several other IMB scientists, including Dr. Yu. M. Yakovlev, Dr. S.I. Maslennikov, and Dr. M.B. Ivanova.

Associated activities: VanBlaricom and Tsidulko were provided a guided tour of the museum at IMB on 18 November. VanBlaricom and Tsidulko also were invited by Professor N.P. Fadeeva to visit the Department of General Ecology at Far Eastern National University (FENU) in Vladivostok on the afternoon of 19 November. At FENU VanBlaricom and Tsidulko met briefly with Dr. N.K. Khristoforova, and VanBlaricom gave an invited seminar presentation regarding his current benthic research on ecological effects of bivalve aquaculture in Puget Sound, Washington, USA. At Professor Fadeeva's request, VanBlaricom and Tsidulko then met for informal conversation with the FENU Student English Club. The final event of the site visit was a tour of the Scientific Museum of FENU, arranged by Professor Fadeeva and guided by the Director of the Zoology Department at the Museum, Dr. Irina Volvenko, on 20 November. VanBlaricom and Tsidulko departed from Vladivostok on 21 November 2009.

Observations and findings:

1. Overview of procedures for processing of benthic biological samples from the WGW feeding areas, Piltun Region, Sakhalin Island:

Descriptions of sampling methods, distribution of sampled sites, and numbers of samples per site are presented in reports by Fadeev and colleagues at WGWAP meetings. The subject reports are accessible through the IUCN/WGWAP web pages. Benthic samples are collected in the field (Van Veen or Ponar "grab" samplers, or diver-operated coring devices) and screened (sequential mesh sizes of 5.0, 1.0, and 0.5 mm) onboard the research vessel *Academic Oparin SV*. Screened materials from each sample are stored and preserved in separate containers, and shipped to IMB for further processing and analysis. Fadeev arranged for VanBlaricom and Tsidulko to observe the following components of sample processing activities at IMB for samples collected in the Sakhalin II Project Area in summer 2009:

a) Rough sorting of samples: IMB staff members were observed separating animals from other sampled matter such as detritus or debris, and sorting the collected animals into major taxonomic categories (amphipod crustaceans, isopod crustaceans, cumacean crustaceans, polychate worms, anemones, etc.). Work is done under dissecting microscopes by two IMB staff members.

b) Identification and enumeration of species in samples: Ms. N.L. Demchenko, a doctoral student at FENU, staff member at IMB, and expert on the taxonomy and ecology of amphipod crustaceans, demonstrated methods and data generation for amphipod crustaceans obtained from benthic samples and sorted as noted above. It is widely recognized that amphipod crustaceans are the dominant group of benthic organisms in the shallow coastal waters of northeastern Sakhalin Island (e.g., Demchenko 2007), and the primary prey of gray whales feeding in the Piltun region. Amphipods are first separated by species, using taxonomic literature and accumulated experience and expertise to make taxonomic decisions. For each species found in a sample, individuals are measured (maximum body length in mm), sexed if possible (sex is difficult to determine in juvenile

amphipods, but typically is obvious in adults of most species), and weighed (mg). Two data sets are created for each sample. The first contains data on numbers of individuals by species for each sample. The second contains data on sex, length, and weight by individual for each species in each sample. Fadeev reported that similar methods are utilized for the other taxonomic categories of animals, recognizing that each taxon may have unique characteristics that influence availability of certain kinds of data, such as sex of individuals.

c) Creation of a geospatial database: Data from the benthic samples are now being entered to a geospatial database. The essential feature of this effort is to link benthic data, including the variables described above, to specific cells in a spatial grid that encompasses surveyed areas in the WGW feeding areas of the Piltun region. Once fully developed, the geospatial database will be useful in asking questions about linkages of benthic prey population dynamics to geospatial aspects of WGW foraging behavior.

2. Issues emerging from discussions, during the site visit, that relate to concerns of WGWAP and EMTF:

a) Possible expansion of categories of contaminants to be sampled and analyzed:

Following on conversations at prior meetings of WGWAP, we discussed the possibility of increasing the scope of contaminant surveys, done in association with surveys of benthic biota, to include categories of persistent organic compounds (POCs) not previously surveyed. Previous surveys have produced data on levels of petroleum hydrocarbons, heavy metals, and some POCs, including DDTs and HCHs. VanBlaricom proposed that POC surveys be expanded to include polychlorinated biphenyls (PCBs). PCBs are known to be capable of producing compromised immune systems and disruption of reproductive hormone systems in mammals. Elevated PCB concentrations in marine sediments are known to be a frequent correlate to industrial activity on a regional scale. Given the likely sensitivity of WGW population dynamics to overall survival rates and to the number of reproductively active females, careful monitoring of PCB residues in benthic habitats used for foraging by WGWs is appropriate. Fadeev indicated that analysis of samples for PCB residues by IMB would be considered, given a formal request from WGWAP to Sakhalin Energy and pending approval by Sakhalin Energy.

b) Possibility of expanding ecological survey work in Piltun Lagoon;

From its inception, WGWAP and its various predecessor Panels has been interested in the question of ecological linkages of Piltun Lagoon with the WGW feeding area near Piltun Lagoon. The issue remains controversial and unresolved, but the Panel continues to believe that a precautionary approach must be taken to protection of the Lagoon to disturbances that may influence the nearby feeding area. During the site visit by VanBlaricom and

Tsidulko, the matter of ecological monitoring of Piltun Lagoon was discussed in regard to two specific questions:

i) In the context of monitoring related to oil spills;

Risks of oil spills in Piltun Lagoon have increased substantially as a consequence of pipeline installation across Piltun Lagoon in association with the Sakhalin I project. Recent information about problems and failures of the subject pipeline lead to increasing concern about associated spill risks. Spilled oil, transported by winds or currents from the Lagoon to the adjacent feeding area, could cause direct contamination of any WGWs in the area, and could contaminate benthic prey populations. Monitoring of Lagoon biota and habitats over time may produce helpful information on spilled oil, particularly in cases of low-level seepage from the Sakhalin I pipeline that could cause chronic ecological damage without direct, visually obvious detection of spillage.

ii) In the context of ecological functioning of lagoon effluent for the WGW feeding area:

Oil spilled in Piltun Lagoon could contaminate resident biota in the Lagoon, with the potential to interfere with Lagoon-based processes that may provide trophic subsidies to the nearby WGW feeding area. A comprehensive program of monitoring of Lagoon biota over time would be a necessary component in identifying and understanding effects of oil spills in the context of the possible trophic link between the Lagoon and the nearby feeding area.

Fadeev informed VanBlaricom and Tsidulko that a plan for long-term monitoring of relevant biota in Piltun Lagoon would be considered in response to a formal request from WGWAP to Sakhalin Energy, pending Sakhalin Energy approval.

c) Problem of prohibition of sampling by divers, with resulting introduction of biases in benthic sampling (Van Veen grab, Ponar grab, diver-operated corer); related question of separate presentation of data from diver-collected vs. grab-collected samples.

Sampling of benthic populations utilized as prey by gray whales has involved two methods depending on water depth. In the Piltun feeding area, whales have been observed feeding in depths ranging from a few (<5) meters to ~20 meters. It follows that sampling of benthic prey populations must encompass the stated depth range of foraging. Fadeev's team has traditionally used a Van Veen grab sampler, requiring a large surface vessel for deployment, to sample benthos in waters > 10 m. Sampling in shoaler depths has been done by scuba divers, operating a manually deployed device to sample benthic organisms. Recently, scuba

diving has been prohibited in projects funded by Sakhalin Energy as a result of Company safety policies. As a consequence, benthic sampling in waters < 10 m depth is now done with a Ponar grab sampler deployed from a small skiff. Fadeev reports that the Ponar grab is a relatively inefficient sampler due to small size, light weight, and reduced penetration depth as compared to either the Van Veen grab sampler or the diver-operated sampler previously used. Fadeev expressed concern that sampling of a given benthic assemblage with the Ponar grab sampler will produce different data from samples taken in the same assemblage by the diver-operated sampler. As a result, temporal consistency of data from shallow water sites is lost with the change from diver-operated to Ponar samplers. The only solution to the problem is a calibration study can be to determination the relationship of benthic abundance estimates based on samples by the Ponar and diver-operated samplers.

As a consequence of the discussion, it is apparent that two actions should be taken. First, the noted calibration study should be done. Should results indicate that consistent calibration between methods is statistically defendable, it may be possible to reconnect data collected by the two different methods and restore a consistent time series of benthic data. Fadeev indicated that a calibration study would be considered, given a formal request from WGWAP to Sakhalin Energy and pending approval by Sakhalin Energy. Second, all present agreed that in all future communications of survey results from shallow water, data collected with diver-operated samplers should be clearly distinguished from data collected with Ponar samplers, at least until an accepted calibration method can be applied to the data.

d) Question about the ecological significance of sediment-associated bacteria and microflora in the effluent from Piltun Lagoon.

During deliberations of WGWAP and predecessor Panels, there have been frequent discussions of the possible mechanisms by which Piltun Lagoon may be providing trophic subsidies to the benthic communities of the Piltun WGW feeding area. Speculation has focused on the likely role of detrital particulate material, transported by physical processes from the Lagoon to the feeding area, as the primary vehicle of the subsidy. Piltun Lagoon supports large fields of the eelgrass Zostera marina, which generate large quantities of detritus that are eventually transported out of the Lagoon. However, recent stable isotope studies have cast doubt on the significance of detrital matter as the mechanism of the subsidy.

On 23 September 2009, VanBlaricom and Galloway made a scuba dive to 17.1 m depth in the Piltun feeding area, directly east of the entrance channel to Piltun Lagoon, at location 52° 49.95' N, 143° 21.48' E (see Part 1 above for additional information on the site visit to the Piltun region). The divers were surprised by the dense quantities of suspended sediment in the water column, extending from the surface to the bottom, and by the highly fluid, silty nature of the bottom sediments at the site. The observed conditions contrasted

with the somewhat clearer water column and firm, well-sorted sandy bottoms observed during dives to sites with similar depth and exposure, but several km north of the entrance channel. In conjunction with observations of a dynamic suspended sediment plume offshore from the Lagoon entrance channel, apparent to surface vessel observers and clearly illustrated in satellite photographs, observations made during the dive highlighted the substantial quantities of fine sediments transported from the Lagoon to the feeding area.

The noted diver observations stimulated discussion among Fadeev, Tsidulko, VanBlaricom, Kiyashko and Kharlamenko, the latter two being specialists in application of biochemical markers (stable isotopes and fatty acid profiles) to discern marine trophic relationships, regarding other hypotheses for mechanisms of trophic subsidy from the Lagoon to the feeding area. The discussion focused on the possible significance of microbiota, including bacteria and benthic microalgae, attached to individual sediment grains. Given the obviously large volume of sediment transport out of the Lagoon to the adjacent feeding area, transport of sediment with high levels of attached microbiota has the potential to provide the subsidy in question. Transport of this type is known to occur from the terminal estuaries of large rivers into adjacent marine waters, and is viewed as ecologically significant (e.g., Columbia River; Crump and Baross 2000). It was noted that there are methodological challenges to application of biochemical methods in the case of sediment-associated bacteria. Nevertheless it was agreed that transport of sediment-associated bacteria from Piltun Lagoon to the Piltun feeding area could, in concept, be a potential mechanism for support of the trophic subsidy in question. Other mechanisms of subsidy were also discussed, including transport of planktonic diatoms and transport of dissolved inorganic nutrients, from the Lagoon to the feeding area. Fadeev and colleagues indicated a continuing interest in research directed to the resolution of the subsidy mechanism. Pursuit of such research could be considered in response to formal requests from WGWAP to Sakhalin Energy, pending approvals by Sakhalin Energy.

References:

Crump, B.C., and J.A. Baross. 2000. Characterization of the bacterially-active particle fraction in the Columbia River estuary. *Marine Ecology Progress Series* 206: 13-22.

Demchenko, N.L. 2007. Amphipods (Amphipoda: Gammaridea) from the Piltun Gray Whale Pasturing Region, Northeastern Sakhalin Island (Sea of Okhotsk). Pages 67-72 *in* Selected papers of the NAGISA World Congress 2006. Seto Marine Biological Laboratory, Field Science Research and Education Center, Kyoto University. Kyota, Japan.

Acknowledgements: We thank the IUCN Marine Programme, the U.S. Geological Survey, and the School of Aquatic and Fishery Sciences, University of Washington, for providing funding and logistical support for our site visits. We thank Sakhalin Energy, LGL Limited, the A.V. Zhirmunsky Institute of Marine Biology of the Far East Branch, Russian Academy of Sciences, and the Department of General Ecology, Far Eastern National University, for logistical support and consultations on trip planning. We are

particularly grateful to the Bumerang Adventure Travel Group for extraordinary and enthusiastic support of our field observations during the Piltun site visit, Koen Broker for his support and encouragement in planning both site visits, and Dr. Valeriy Fadeev and his colleagues for the gracious and stimulating accommodation of the visit to IMB in Vladivostok.