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Gray Whales off Sakhalin Island, Russia: June – September 2001
A Joint U.S. – Russia Scientific Investigation

By

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TABLE OF CONTENTS

INTRODUCTION

Numerous species of marine mammals inhabit the Sea of Okhotsk. Two of the most endangered populations of large whales in the world; the Okhotsk Sea bowhead whale (*Balaena mysticetus*) and the western North Pacific (Okhotsk-Korean) gray whale are known to occur in this sea (Brownell *et al.*, 1997; Clapham *et al.*, 1999). Concerns regarding the status of these whale populations have been intensified by the onset of offshore oil and gas development programs in Okhotsk waters. Anthropogenic activities related to oil and gas exploration off the northeastern Sakhalin Island shelf include geophysical seismic surveying, drilling and production operations, waterborne discharges of a variety of materials, seafloor dredging, and vessel/aircraft traffic. These activities pose potential threats to the northeastern Sakhalin marine ecosystem and may impact the critically endangered western gray whale population that annually feeds there (Brownell and Yablokov, 2001; Weller *et al*., 2002a, 2002c). However, properly conducted biological monitoring can provide the requisite information needed to help prevent significant anthropogenic impacts, and in some cases, such as development of Habitat Conservation Plans (U.S. Fish and Wildlife Service, 1998), assist with mitigating unavoidable ecosystem impacts to acceptable levels. Studies in the U.S. and Canadian arctic or near-arctic, on bowhead whales, white whales (*Delphinapterus leucas*), and gray whales have demonstrated that knowledge of habitat use and behavioral reactions can help to plan industrial activities in a fashion that allows animals and human development to coexist (summaries in Würsig, 1990; Richardson and Würsig, 1995, 1997). Therefore, it has been recommended by the Russian and U.S. governments that biological investigations of potential industry-related ecosystem impacts off the coast of Sakhalin Island and elsewhere in Russia be conducted concurrent to oil and gas development projects (Anonymous, 1997).

Detailed information on responses of marine mammals to industrial activities and noise can help gauge potential ecosystem effects (Richardson *et al.*, 1995; Richardson and Würsig, 1997; Moore and Clarke 2002). Results from studies on the reactions of cetaceans to underwater noise and other human-related activities are highly variable, ranging from no apparent response to active avoidance (for review see Richardson *et al.*, 1995). While some studies have documented no or only subtle short-term changes in behavior, it is important to recognize that tolerance of noise does not necessarily indicate that it has no deleterious effects (Richardson and Würsig, 1997). Long-term effects of noise and disturbance at the individual and population level are

presently little understood. Gray whales provide the best example of behavioral changes as a result of industrial activities. Several studies on eastern gray whales have documented behavioral changes (Jones *et al*., 1986; Dahlheim, 1987; Malme *et al.*, 1988; Moore and Clarke, 2002) and distribution shifts or complete abandonment of known wintering areas (Bryant *et al.,* 1984) in relation to increased anthropogenic activity (for review see Richardson *et al.*, 1995).

RATIONALE

Sakhalin Island, Russia (Fig. 1) is a region with abundant offshore oil and gas deposits that, until recently, have been relatively unexploited. To date, there are at least nine offshore oil and gas areas in various stages of development off the shores of Sakhalin (Fig. 2). Investment in these projects over the next 40 years is expected to exceed 100 billion dollars, and oil production levels could reach 30 million metric tonnes per year. Development activities are currently underway in Sakhalin I and II (Fig. 2), including production of 80,000 barrels of oil per day from the "Piltun-Astokhskoye" (PA) feature of Sakhalin II (Fig. 3). Portions of the Sakhalin I and II projects overlap with the region recognized as the primary feeding ground of critically endangered western gray whales.

Oil development involves industrial activities that pose potential threats to gray whales (see reviews by Richardson *et al*., 1995; Moore and Clarke, 2002). Potential problems include those associated with disturbance from underwater noise, oil and chemical spills, ship strikes, entanglements in cables or lines, pollution from drilling muds or similar materials, and physical habitat changes such as those caused by dredging or sand pumping (reviews by Jones *et al*., 1986; Dahlheim, 1987; Richardson *et al.*, 1989; Moore and Clarke, 2002). For example, on 27 September 1999 an oil spill (2.0158 bbls) occurred at the offshore platform *Molikpaq*, and other spills of 0.1675 and 0.00022 bbls were recorded in 2000 and 2001, respectively. While the influence of these relatively small oil spills are thought to be negligible (SEIC, 2001), the impact of a larger spill on the surrounding marine flora and fauna is poorly understood and of great concern with regard to gray whales and their benthic prey.

In addition, displacement of whales from critical feeding and migratory habitat is possible due to disturbance from seismic surveys or other industrial noise and activity (Weller *et al*., 2002c). Strong acoustic sources, such as the open-water seismic exploration, have been reported in some environments as being audible to gray whales at distances exceeding 100 km (Richardson *et al.*,

1995). Acoustic monitoring during 1997 in the PA field revealed near shore received sound levels from seismic pulses of approximately 153 dB re 1 µPa, zero-to-peak; 159 dB re 1 µPa, peak-to-peak; and 139 dB re 1 µPa, averaged over one second, while 3-D seismic surveying was conducted 30-35 km from shore (Würsig *et al.*, 1999). These findings indicated that even at relatively large distances, seismic noise was detectable in the near-shore area where gray whales were typically located.

A notable shift in whale distribution during 1997 indicated that animals moved into deeper water as the summer season progressed. This distribution change suggested that groups may have remained closer to shore during seismic periods (July to mid-August) and shifted to more offshore waters (late-August to early-September) once seismic surveying was terminated (Würsig *et al.*, 1999). The 1997 data, however, represented relatively small sample sizes collected during a short period within one season. Therefore, other potential natural causes of the observed distribution shift, such as prey availability, distribution and abundance, cannot be ruled out.

A similar change in group distribution, showing that whales moved into deeper water as the summer season progressed was observed in 1998 when no seismic surveys were conducted (Würsig *et al*., 2000). However, in 1998 the temporary drilling rig *Sakhalinskaya* and permanent drilling and production platform *Molikpaq* were installed near the feeding ground, and extensive sand pumping operations associated with pad preparation for the Molikpaq were conducted. These activities, alone and in combination, represented novel acoustic stimuli in the environment. Therefore, it is possible that noise and other potential sources of disturbance occurring offshore in 1998 initially kept whales closer to shore but that habituation to such eventually occurred and resulted in whales moving further from shore. However, as mentioned above, other natural factors including prey dynamics may have also contributed to the observed change in whale distribution.

Although whales were present in the study area throughout the 1998 research period, they were especially low in numbers between 31 August and 5 September (Würsig *et al*., 2000). This period of particularly low abundance corresponded to a more northern distribution of whales and overlapped precisely with the arrival of the Molikpaq and 10-15 associated support vessels. While speculative, the noticeable but temporary decline in the number of whales in the study area at that time may have represented a short-term shift in distribution, resulting from unusually

high industrial activity. In 1999 and 2000, whale distribution was seemingly characterized by a more northern distribution of groups than had been detected during previous shore-based studies between 1997-1998 (Blokhin *et al*., 2001). Blokhin hypothesized that this change in distribution represented a shift away from sources of disturbance related to oil and gas activities to the southeast of the entrance of Piltun Lagoon, or possibly in response to a change in prey density (Blokhin *et al*., 2001). While industry-related impacts cannot be ruled out as contributing to the aforementioned shifts in distribution, other naturally occurring phenomena may also have explanatory power.

Out of concern about the small size of the western population, its future survival, and the potential for increased industry-related disturbance on their feeding grounds, a joint U.S.-Russia research program on gray whales was initiated in 1995 as part of the Marine Mammal Project under Area V: Protection of Nature and the Organization of Reserves within the U.S.-Russia Agreement on Cooperation in the Field of Environmental Protection (Brownell *et al*., 1997; Weller *et al*., 2002a). Since its initiation, this research program on western gray whales (and other marine mammals) off the northeastern Sakhalin coast has been ongoing (1995, 1997-2001). This research has been jointly conducted by KIENM and TAMU and has included participation of Russian scientists and students from the Pacific Institute of Fisheries and Oceanography (TINRO - Vladivostok), All-Russian Research Institute of Fisheries and Oceanography (VNIRO - Moscow), Pacific Oceanological Institute (Vladivostok), Moscow State University, Yaroslaval State University, and Vladivostok State University.

BACKGROUND

The western Pacific (Okhotsk-Korean) gray whale population is one of the most endangered in the world (Clapham *et al*., 1999; Hilton-Taylor, 2000; Weller *et al*., 2002a). Western gray whales were thought to be extinct as recently as 1972 (Bowen, 1974), but are known to survive today as a small remnant population (Berzin, 1974; Brownell and Chun, 1977; Würsig *et al*., 1999, 2000; Weller *et al*., 1999, 2000, 2001, 2002a). In contrast to the recovery from low numbers of the eastern gray whale, the western population remains severely depleted (Weller *et al.*, 2002a). The initial decline of the western population can be attributed largely to modern commercial whaling off Korea and Japan between the 1890s and 1960s.

Recent findings show that eastern and western gray whales can be genetically differentiated at the population level, and should be recognized as geographically and genetically isolated population units (LeDuc *et al*., 2002). Two population estimates of 100 and 250 have been reported in the Russian literature (Vladimirov, 1994; Blokhin, 1996), but the quantitative basis for these assessments were not provided. Therefore, these estimates cannot be considered reliable or used as the foundation for understanding the current population status of western gray whales. Despite the fact that 106 whales had been identified off northeastern Sakhalin Island between 1994 and 2001 (Weller *et al*., 2002a; this report), not all of these individuals can be assumed to have survived (Bradford *et al*., 2002). Therefore, the actual population size of western gray whales, based on contemporary photo-identification data, is estimated to be less than 100 (Weller *et al.*, 2002a).

Based largely on research conducted by the KIENM-TAMU collaborative study on western gray whales between 1995 and 2000, the World Conservation Union (IUCN) and the International Whaling Commission (IWC) have taken measures to help ensure additional protection of this population. The small number of whales remaining in the population, in combination with the possibility that fewer than 50 reproductive individuals exist, lead the IUCN to list the western gray whale as Critically Endangered in 2000 (Hilton-Taylor, 2000; Weller *et al*., 2002a). Although the number of mature whales estimated was < 50, the number of known reproductive females in the population is 14 (this report) and likely to be < 20 (LeDuc *et al*., 2002). Serious concern about the status of this population has also been expressed by the Scientific Committee of the IWC (IWC, 2002a). As a result of this, a *Resolution* calling for concerted action by range states and others to pursue actions to eliminate anthropogenic mortality and disturbance of this population was passed in 2001 (IWC, 2002b).

Although the historic distribution of western gray whales is thought to have extended from the northern reaches of the Okhotsk Sea to southern China, the present day range appears to be considerably more restricted (Weller *et al*., 2002a, 2002b, 2002d). Despite relatively extensive aerial and ship-based marine mammal surveys in the Okhotsk Sea between the 1960s and 2001, sightings of western gray whales are uncommon outside of the feeding ground off northeastern Sakhalin Island, Russia (e.g. Berzin *et al.,* 1988, 1990, 1991; Weller *et al.*, 2002a, 2002d).

Sighting records from past Russian aerial and vessel surveys in the Okhotsk Sea during the 1960s, 1970s, and 1980s (e.g. Berzin, 1974; Berzin *et al.,* 1988, 1990, 1991), and results from

recent surveys between 1998 and 2000 (Sobolevsky, 2000, 2001; Weller *et al.*, 2002b) indicate that gray whales aggregate predominantly along the shallow-water shelf off northeastern Sakhalin Island during summer-autumn. Particularly high numbers of whales were observed offshore of the southern portion of Piltun Lagoon (see also Blokhin *et al*., 1985; Blokhin, 1996). This region of the Okhotsk Sea is characterized by high benthic biomass densities of 1,000,000 kg/km^2 (Koblikov, 1986), and is the only currently known feeding ground for western gray whales (e.g. Blokhin *et al.,* 1985; Weller *et al*., 2002a, 2002d).

The wintering ground(s) of the western gray whale population remain unknown. Sightings of this species in other parts of its distribution, including waters off Japan, North and South Korea, and China are rare (see reviews by Zhu, 1998; Kato and Tokuhiro, 1997; Kato and Kasuya, 2002; Weller *et al*., 2002a, 2002d). However, some reliable records from the South China Sea suggest that the wintering grounds are located off southern China (Henderson, 1972, 1984, 1990; Wang, 1978, 1984; Zhu, 1998).

Recent photo-identification research (1994-2001), shore-based studies (1997-2001), and aerial surveys (1998-2000) have corroborated the earlier Russian survey data by documenting the annual occurrence of gray whales off Piltun Lagoon (e.g. Brownell *et al*., 1997; Würsig *et al*., 1999, 2000; Weller *et al.*, 1999, 2000, 2001, 2002a, 2002b; Sobolevsky, 2000, 2001). Photo-recognition research identified 94 individuals between 1994-2000, and documented high levels of annual return and seasonal site fidelity for a majority of all known whales (e.g. Weller *et al*., 2001). Shore-based counts and theodolite determined sighting data indicated that 95% of all observed gray whale groups were located within 5 km of shore (Tsidulko, 1998; Ivashchenko, 1999; Würsig *et al*., 1999, 2000). Feeding gray whales have been observed > 30 km from shore and in some cases considerable distance to the south of the Piltun Lagoon area (Sobolevsky 2000, 2001; Miyashita *et al*., 2001; Weller *et al*., 2002d). These sightings are thought to represent localized movements between areas related to foraging.

Three whales photographed > 30 km from shore and approximately 60-65 km southeast of the Piltun area during August 2000 by a Japanese research vessel surveying the Okhotsk Sea (see Miyashita *et al*., 2001) all had previous sightings in near shore waters near Piltun Lagoon (Weller *et al*., 2002d). The area that these whales were sighted and photographed in 2000 is consistent with reports of similar sightings in that area during 2001 (S. Blokhin, personal communication, TINRO).

Although whales show significant intra- and inter-annual site fidelity to the coastal waters offshore of Piltun Lagoon, individuals are not always present (Würsig *et al*., 1999, 2000; Weller *et al*., 1999, 2000, 2001, 2002a, 2002d). This pattern suggests that whales travel while on the feeding ground. The continental shelf off northeastern Sakhalin Island consists of at least two benthic communities, one inshore and one offshore (Würsig *et al*., 2000; P. Slattery, personal communication, Moss Landing Marine Laboratory). Both communities contain known prey of gray whales (see Nerini, 1984 for review of eastern gray whale prey), but based on analysis of western gray whale scat, their preferred prey while feeding close to shore appears to consist of brackish-water amphipods (*Pontoporeia* spp.) that occur almost exclusively near shore (Würsig *et al*., 2000; P. Slattery, personal communication, Moss Landing Marine Laboratory 1999; Weller *et al*., in prep). Although the primary feeding habitat for western gray whales is in relatively near shore waters, a secondary prey base may also be available further offshore.

Activities related to offshore oil and gas exploration and production, including increased vessel and aircraft traffic, geophysical seismic surveys, well-drilling, and production operations have recently been initiated in near proximity to the Piltun feeding ground. While short-term behavioral responses to such activities have been noted (Würsig *et al*., 1999, 2000; Weller *et al*., 2002c), the long-term cumulative effects of such industrial disturbance are poorly understood (for reviews see Richardson *et al*., 1995; Richardson and Würsig, 1997; Moore and Clarke, 2002; Weller *et al*., 2002c). Studies on eastern gray whales have documented behavioral changes, distribution shifts, and temporary abandonment of known wintering areas in relation to increased anthropogenic activity (Bryant *et al*., 1984; Jones *et al*., 1986; Malme *et al*.**,** 1988; Moore and Clarke, 2002).

Between 1997 and 2001, western gray whale studies conducted by KIENM-TAMU off northeastern Sakhalin were sponsored by a variety of agencies (Table 1). In addition to the 2001 photo-identification program presented here, other secondary research activities including biopsy sampling and shore-based observations were conducted. Presentation of results from these secondary research components is, however, beyond the scope of the present report.

METHODS

Photo-identification research methodologies employed during the 2001 field study were identical to those employed during earlier studies by our team between 1997 and 2000. The

overall consistency in research design, data collection techniques and data analysis maintained in 2001 allowed some inter-annual comparisons to be made. Additional information collected during surveys off Piltun in 1994 and 1995 (Brownell *et al.*, 1997; Weller *et al.*, 1999) are also presented here to better describe inter-annual trends and facilitate a long-term interpretation for some results. Data from these 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 Piltun area (Brownell *et al.,* 1997).

Study Area

Zaliv Pil'tun (referred to as Piltun Lagoon) is on the northeastern shore of Sakhalin Island, Russia (Fig. 4). The lagoon is approximately 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 143°20' E, and has considerable biological influence on the surrounding coastal waters. A lighthouse, near the lagoon channel, served as the base from which studies reported here were conducted. The near-shore 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 similarly of Piltun Lagoon to the coastal lagoons used by eastern gray whales off Baja (see Jones, 1990), whales do not enter this lagoon.

Photo-Identification Surveys

Photo-identification methods have proven extremely useful for gray whale studies (Darling, 1984; Jones, 1990; Calambokidis *et al*., 1994; Weller *et al.*, 1999), as individuals are particularly well marked along their sides, backs, and flukes (Fig. 5). Boat-based photo-identification surveys were conducted on all good weather days during the 2001 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 1994-2000 used mainly right-side dorsal flank markings for identification (Brownell *et al.*, 1997; Weller *et al.*, 1999; Würsig *et al.*, 1999, 2000), and for the sake of intra- and inter-annual reliability, we continued this methodological approach.

Photographic surveys involved slow travel in a 4.5-m outboard-powered inflatable boat. The research team consisted of a boat driver, data recorder, digital video camera operator, and 35-mm camera photographer. Systematic visual search by observers on the survey vessel was maintained until a whale sighting was made. Upon initial sighting of a group, the survey vessel slowed to idle speed, and maneuvered to a vantage point approximately 50 m from the whale(s). From this position, observations on group location (as determined by Global Positioning System, or GPS), time, behavior, and number of whales were recorded.

The research vessel was then moved within 6-12 m of the whale group and individuals were photographed. During the photographic effort, a running commentary regarding the film frame and video counter number as related to particular whales was recorded onto data sheets. Measures of water depth (as determined by digital depth sounder), location (as determined by GPS), and environmental conditions were recorded every 3-5 min throughout each photographic session. In all cases, attempts were made to simultaneously photograph and videotape the right dorsal flank of each whale, followed then by photos of the left dorsal flank and flukes. Photographs were taken with a Nikon F5 35-mm camera equipped with a 100-300 mm zoom telephoto lens, high-speed motordrive, and databack. Video footage was recorded on a Sony DCR-VX1000 digital video camera. Two 35-mm film types were used: Kodachrome 200 ISO color slide film, and Fujichrome 400 ISO color slide film.

Contact with whale groups was maintained until all individuals encountered had been photographed. The boat was then motored away from the group, where initial estimates of group size and composition were revised if necessary, and all film and written records reviewed for completeness. These procedures were repeated as the research vessel resumed travel and additional whale groups were encountered.

A group was defined as either a solitary individual, or two or more whales observed in close spatial proximity (within several body lengths of each other), and swimming in close association and generally coordinating their diving or direction of movement (see Clapham, 1993). Group size estimates were based on field observations, and represented the product of a consensus among observers on the survey vessel. The term “calf” is used here to refer to young of the year. In all cases, calves were initially identified by their small body size (about one-third to one-half that of a mature adult), and constant association with a particular adult whale.

Photo and Video Analysis

A total of 75 rolls of film were taken during the 2001 field season. Images of individual gray whales consisted of various aspects of the body, including head, back, dorsal flanks, and flukes. Based on the photographic methodology employed during 1995-2000 field efforts in the Piltun area (Brownell *et al.*, 1997; Weller *et al.*, 1999, 2000, 2001; Würsig *et al.*, 1999, 2000), the 2001 research team also targeted the right dorsal flank of each whale as the primary body aspect for identification purposes. Attempts were made in all cases to follow this standard approach; however, it was not always possible. Therefore, to maximize the collection of data, whales were photographed sequentially from head to fluke on either the left or right side, and the top and bottom of their flukes. Written observations and video footage collected at the time of each photographic session were used to link inter-individual aspects whenever possible.

Individual identification images were first examined on a light table using an 8x loupe. A whale was not given a permanent subject identification number unless its right dorsal flank was photographed at some point during the field season. Additional aspects of the body were used as identification tools only if they were first matched with their respective right flank. In an effort to identify as many whales as possible, all images of acceptable quality (even if unmatched) were archived for subsequent identification purposes.

Photographic matching was done by comparing a "new" individual to all images of already-cataloged whales. If a prospective match was determined, the current image was repeatedly compared to previous images, and was required to match before being confirmed as a re-identification of a known individual. If a photograph could not be matched, then photographs of remaining individuals were inspected. Although labor intensive, this systematic search process increased the probability that most, if not all, previously-sighted whales would be resighted. If a match was not found after this comprehensive inspection, the individual was considered a new sighting.

Digital video footage was collected simultaneously to still photography during photo-identification surveys. The use of digital video in tandem with 35-mm photography proved valuable in individual identification and served as a visual record of whale behavior during group encounters. In addition, video footage was reviewed in the field; thereby allowing initial cataloging of identified individuals during the field season. A total of 4.0 hrs of digital video footage, acquired at 30 frames per second, was obtained during the 2001 research effort. Each

video session was subsequently reviewed frame by frame to enhance and refine the 35-mm photographic record. Upon completion of the 2001 photo-identification catalog, comparisons were made with whales identified in the Piltun study area between 1994 and 2000, and a comprehensive database containing sighting histories for each whale was established.

RESULTS

Survey Effort

Forty-eight photo-identification surveys were conducted between 25 June and 25 September 2001. The later portion of June and most of July were characterized by heavy sea fog. This weather pattern limited photographic work from our small research vessel. Although only 17 days of photo-identification research were completed between 25 June and 31 July, improving weather allowed 31 surveys to be completed between 1 August and 25 September. Despite the generally poor weather experienced during June and July, August and September were characterized by mostly good working conditions. Sea surface temperature and salinity in 2001, as measured from our research vessel during Beaufort sea state conditions ≤ 3 (winds ≤ 7-10 kts), ranged from 3.0-11.0 °C and 27-36 ppt, respectively (Table 2).

Approximately 288.1 hrs of survey effort was conducted and 100.8 hrs were spent in direct observation of 448 whale groups. On average, 13.2 mins (± s.d. 0.23) were spent with each group. Seventy-five rolls of film (~2700 frames) and 4 hrs of digital video were used for individual identification (Table 3).

Group Size and Distribution Patterns

Mean group size for 447 groups encountered during 2001 was 1.8 (± s.d. 1.08) with a range of 1-9 whales per group (Table 4). A majority (79.6%) of all groups observed (n = 447) were composed of two whales or less (Fig. 6). The mean group size for calf-groups (groups containing one or more calves) and non-calf groups (groups containing no calves) were 2.7 (± s.d. 1.45, n = 71) and 1.7 (± s.d. 0.92, n = 376), respectively (Fig. 7).

The mean water depth in which groups were encountered was 11.1 m (± s.d. 3.58, n = 446, range = 3.3 – 24.0 m) and 96.4% (n = 430) were distributed in waters < 18 m deep (Fig. 8). The mean water depth for calf- and non-calf group locations was 6.9 (± s.d. 1.9, n = 70) and 11.9 (± s.d. 3.25, n = 376), respectively (Fig. 9). GPS determined group locations were generally within 5 km of shore (Fig. 10), a pattern similar to that observed since 1995 (see Appendix 1). On

several occasions, exceptional sea conditions allowed us to expand our more typical survey coverage to include areas ~60 km north and up to 25 km south of the entrance to Piltun Lagoon. In all cases, whales photographed to the north and south were individuals known to also occur off the lagoon channel mouth. Many surveys documented individual whales moving distances of 50 km or more in less than 24 hours, while other whales demonstrated strong site fidelity (sometimes over days) to relatively small regions. In general, during 2001 the distribution of whales as determined by shore-based observations was similar to that observed in 1999 and 2000 (see Blokhin *et al*., 2001 for description of a more northern distribution during 1999 to 2000; Weller *et al*., 2002c). This said, a more southern distribution of whales, with particularly high numbers aggregated near the entrance to Piltun Lagoon and to the south of it between 1 August and 9 September 2001 (Weller *et al*., 2002c). The timing of this change in distribution overlapped with the period that seismic surveying was conducted to the north in the "Odoptu Block" of Sakhalin I (for information on timing and schedule of seismic activity see Johnson, 2002). Once seismic surveys had ceased on 9 September, whales started to return to their pre-seismic distribution to the north (Weller *et al*., 2002c).

Individual Recognition and Sighting Patterns

Seventy-two naturally marked individual whales, including six calves, were identified between 25 June and 25 September 2001. The rate at which individual whales were first identified during each field season between 1994 and 2001 is presented in Figure 11. Table 5 provides information on annual survey effort and numbers of whales identified. The rapid increase in the slope of the rate of discovery curve during 1994-1997 represents the initial identification of unrecognized whales. Sightings of new animals, however, leveled early in 1998. The rate of increase in this function was quite limited in 2001, with only six additional non-calves identified. The leveling in the slope of the discovery curve at the end of each field period between 1997-2001 suggests that most whales in the search area during each respective year had been identified.

Occurrence Patterns

The monthly presence or absence of identified whales during 2001, and for the previous 1994-2000 photographic efforts, is presented in Figure 12. The mean number of months in which whales were identified during 2001 was 2.5 ($\pm$ s.d. 1.01) with a range of 1-4 months (Fig. 13). It

is important to note, however, that only three surveys were completed in June, thereby greatly diminishing the opportunity for whales to be sighted in the 4-month category. Fifty-eight whales (80.5%) were sighted in two or more months while 19.5% (n =14) were sighted in only a single month. Of the 14 whales sighted in only one month, 14.3% (n = 2) were identified in June, 57.1% (n = 8) sighted in July and 28.6% (n = 4) in August.

Resighting and Site Fidelity Patterns

The 72 whales identified during the 2001 field season consisted of 66 non-calves (i.e. adults or subadults) and six young of the year calves. Of the 66 non-calves identified during 2001, 91.0% (n = 60) had previous sightings in the Piltun area during 1994-2000 photographic efforts (Table 6). Sighting frequencies for photo-identified individuals, based on a one-sighting-per-day criterion, ranged between 1-28 with an overall mean of 9.5 ($\pm$ s.d. 6.57) sightings per whale (Fig. 14).

Mother-Calf Pairs

Fourteen mothers and 22 calves have been identified between 1997 and 2001 (Table 7). Three calves were disaffiliated (i.e. weaned) from their respective mothers prior to their first sighting in the study area, suggesting that up to 17 mothers may potentially exist. However, it is also possible that these three calves belonged to one of the 14 already known mothers. Six mother-calf pairs were identified during 2001 (Table 6) and ranked among some of the most frequently sighted whales. The observed crude birth rate for 2001, as calculated by dividing the number of calves observed by the total number of all whales identified, including calves, in a given year (see Clapham and Mayo 1990), was 8.3% (Table 6). This crude birth rate is the second highest recorded during the study. All six of the mother-calf pairs identified in 2001 were closely affiliated upon arrival to the study area, and all but one pair had disaffiliated by the final boat survey on 25 September. This extended affiliation between whales 092 and 099 represents the longest observed mother -calf affiliation recorded to date.

All six of the mothers identified in 2001 had previous sightings in the study area prior to 2001 (see Fig. 12) and each was sighted in 2000 while pregnant (Table 8). In addition, four (009, 018, 036, 055) of these six females (66.7%) were recorded as mothers in previous years (Tables 6 and 7). Although the sample size is relatively small, the inter-birth interval for a majority of the known reproductive females appears to follow a three year cycle. For example, whale 018 was

observed in the study area during 1997 while pregnant, returned in 1998 with a calf that was likely to have been born in January of that year (see Rice and Wolman, 1972 for estimates of gray whale birthing dates), was sighted in 1999 while "resting" between pregnancies, observed again in 2000 while pregnant and most recently sighted in 2001 with a calf that was likely to have been born in January of that year. Thus, the period between 018s two calves (January 1998 to January 2001) agrees with a three-year calving interval.

Of the 16 calves identified between 1997 and 2000, only six (37.5%) have been sighted in at least one year subsequent to their birth year (Table 9) and four (66.7%) of these six calves were born and first sighted in 1998. If calf return rates correspond with calf survivorship, these findings suggest that overall calf mortality within the first year of life may be as high as 62.5% (see Bradford *et al*., 2002).

Physical Condition and Health Status

During the 2001 field season, as was also true in 1999 and 2000, our team regularly observed and documented whales that were unusually thin (also referred to as skinny). In 2001, 19 whales were recorded as thin, including all of the six identified mothers with calves. The evident thinness of these animals could be noticed, in most cases, within several minutes of approaching individuals by small boat for photo-identification purposes. Initial laboratory analysis of 1999-2001 photographs and video revealed several morphological attributes correlated with a particular individual being described as unusually thin. Diagnostic features varied between individuals, but consisted of at least one of the following: (1) an obvious subdermal protrusion of the scapulas from the body with associated thoracic depressions at the posterior and anterior insertion points of the flipper; (2) the presence of noticeable depressions or concavities around the blowholes and head; and (3) a pronounced ridge along the neural/dorsal spine of the lumbar and caudal vertebrae resulting in the appearance of a bell-shaped body and a “bulge” along the lateral flank (see Brownell and Weller, 2001; Weller *et al*., 2001, 2002a).

Based on visual observation of whales between 1999 and 2001, a total of 48 individuals were observed to be skinny (Table 10). Thirty-four whales (70.8%) were reported skinny in only one year between 1999 and 2001, while nine whales (18.8%) were observed to be skinny in two years and five (10.4%) in all three years. Nine known reproductive females were reported as skinny in the year they were accompanying calves. In these cases, the high energetic investment

in their calves may be at least partially responsible for their observed condition. However, two females were recorded as skinny the year they were pregnant and the following year when they accompanied a calf. Further, two known reproductive females were skinny in three consecutive years. It is important to emphasisze that findings presented here are based on visual observations from our research boat and should be viewed as preliminary and subject to change until a detailed analysis of all photographic materials is completed.

DISCUSSION

Photo-identification studies on the primary feeding grounds off northeastern Sakhalin Island have identified a total of 106 individual whales. These photo-identification data indicate high levels of annual return and pronounced seasonal site fidelity for a majority of all whales. While new individuals continue to be identified annually, the rate at which this occurs is low (Weller *et al*., 2000, 2001). However, not all whales are sighted in all years. This pattern suggests that, on at least some occasions, individual whales are present but not photographed while on the feeding ground, may move into and out of the area intra-seasonally, or may remain outside of the study area during the summer (Weller *et al*., 2002d).

Industrial activities on the continental shelf off eastern Sakhalin Island have steadily increased in the past five years and are scheduled to continue and expand. The nearly constant drilling and production activities during ice-free periods, in addition to the associated increase in aircraft and shipping traffic now occurring off Piltun, have all introduced new sources of potential disturbance to western gray whales on their feeding grounds. Planned industrial development in other regions around Sakhalin Island (see Fig. 2) will also introduce probable sources of disturbance to gray whales as they migrate to and from their southern wintering grounds.

Although data collected in 1997 and 1998 revealed subtle behavior shifts possibly related to industrial activity (Würsig *et al*., 1999, 2000), the high level of annual return and seasonal site fidelity to the Piltun region suggest that whales have not abandoned their summer feeding grounds in response to an increased anthropogenic presence. This said, cumulative effects are as of yet undetermined and only long-term monitoring of known individuals will allow this trend to be evaluated in future years. The possibility of a more northern distribution of whale groups during 1999 and 2000 (Blokhin *et al*., 2001; Weller *et al*., 2001) as compared to 1997 and 1998, in combination with a similar pattern observed during June, July, and the later part of September

2001 are of concern (Weller *et al*., 2002c). Although this change may be related to prey dynamics or other natural factors, the influence of noise or other anthropogenic activities that are at present predominately south of the entrance to Piltun Lagoon cannot be ruled out as a possible explanation for the observed shift in whale distribution. Similarly, the shift to a more southern distribution, mostly near the entrance to Piltun Lagoon and to its south, in August and early September 2001 coincided with the period that seismic surveying was being conducted in the Odoptu Field and may indicate a general movement away from the seismic-related noise and ship traffic (Weller *et al*., 2002c).

The occurrence of unusually skinny whales between 1999 and 2001 remains unexplained (see Brownell and Weller, 2001). After reviewing photographs of unusually thin whales taken in 1999, a group of ten experts on large whales (not affiliated with our project), including biologists, toxicologists, physiologists, and veterinarians, concluded that the whales were abnormally thin, had significantly diminished overall muscle mass, and appeared to be in generally "poor" physical condition. The continuation in the number of whales reported to be thin during 2001 is certainly of major concern. Although the causal mechanism(s) for the observed deterioration in physical condition of these skinny whales first observed off Piltun between 1999 and continuing in 2001 is unknown, any of the following factors may be contributing alone or in combination: 1) disease; 2) stress induced metabolic shifts; 3) natural or human produced changes in prey availability; 4) habitat perturbation by anthropogenic activities. The most likely cause of this condition is nutritional stress but the underlying reason for the condition remains unknown.

Interestingly, during 1999 the eastern gray whale population experienced unusually high mortality of immature/adult whales, and low calf production (LeBoeuf *et al*., 2000). Although the causal mechanism(s) responsible for this event are currently unknown, LeBoeuf *et al*. (2000) hypothesize that gray whale benthic prey biomass has been depleted due to the combined influence of increased annual water temperatures in the Bering Sea and over grazing of the feeding grounds by a population that may now exceed pre-exploitation levels. Some unusually thin stranded whales were reported during 1999 and several more in 2000 (Moore *et al*., 2001). In addition, shore-based observations of apparently thin whales migrating north were also observed off California (W. Perryman, personal communication, National Marine Fisheries Service).

While the above explanations for the reported trends in the eastern population appear plausible, observations of "skinny" western population gray whales between 1999 and 2001 on the Okhotsk Sea feeding ground prove puzzling. The western population, at fewer than 100 individuals, cannot be over grazing their benthic food base or exceeding the carrying capacity of the Okhotsk Sea feeding ground (Brownell and Weller, 2001). Nevertheless, as is true for the eastern population, the western population has also experienced at least some level of apparent malnourishment. Therefore, the simultaneously occurring "skinny" whale phenomenon in both the eastern and western populations suggest that the causes underlying the "skinny" whale phenomenon may be global or ocean basin wide in nature, rather than regional (Brownell and Weller, 2001).

However, it is also possible that influences from industrial activities near the feeding ground and other potential factors in the southern range of the western population are contributing to the skinny whale phenomenon, and any connection to similar events in the eastern population are purely coincidence. For example, the poor physical condition noted for some whales between 1999 and 2001 may be compounded by cumulative physiological stress correlated with long-term exposure to anthropogenic variables such as underwater noise (Richardson *et al*., 1995; Brownell and Yablokov, 2001). Regardless of the causes for this change in physical condition, any disruption of normal feeding behaviors, total cumulative time spent feeding, or feeding locations off northeastern Sakhalin is of concern for all whales, especially those observed to be skinny and/or mother-calf pairs (see Weller *et al*., 2002c).

CONCLUSIONS AND RESEARCH RECOMMENDATIONS

Given the critically endangered status of the western gray whale population and the continuing presence of unusually thin individuals on the feeding ground, we strongly recommend that the current research effort be continued to further monitor the health status, annual return, calf and adult survivorship and crude birth rates. At the same time, additional studies should be done to examine: behavioral reactions of whales to industrial noise including aircraft and vessel traffic; near shore benthic habitat and prey communities; and distribution and occurrence patterns of whales at broader spatial scales along the eastern Sakhalin Island coast.

Our research recommendations include the following:

1. To further monitor the survivorship, annual return, and health-related status of individually identified whales (especially those deemed to be in poor physical condition during 1999 and 2001), we strongly recommend that photo-recognition research be continued in 2002 and beyond.

2. The health status of unusually thin whales off Piltun needs further follow-up evaluation using a suite of techniques including benthic assessments of prey density and physiological and toxicological evaluations of blubber, skin, and fecal samples to assess the potential contribution of disease, stress, and diet. In addition, comparative studies between western and eastern gray whales, to better understand the skinny whale phenomenon that has affected both populations, are needed. This research would provide insight into the factors causing this condition in both populations.

3. Conduct benthic sampling of invertebrate communities inside as well as immediately outside areas where observations indicate that gray whales are feeding. Benthic sampling should lead to descriptions of prey types and estimates of prey density in these areas, within and between open-water seasons. Qualitative assessments should be made of feeding pits or other bottom features made by gray whales. Prey can be characterized by transect sampling by divers, video cameras, qualitative bottom grabs, and/or side-scan sonar. Measurements of organic carbon levels in the habitat are needed to establish a baseline to detect changes in organic substances that could be attributed to possible contamination resulting from oil and gas development and production. Similar baseline information is needed to detect and assess physical changes in the habitat resulting from oil and gas development activities.

4. Conduct a detailed program to record underwater sounds believed to be within the hearing range of gray whales. This involves measurements of sound attenuation at various distances from industrial activity, and in various depths and habitats of gray whales. Long-term recordings, including those made during periods of darkness and inclement weather, can be achieved with hydrophone systems that are bottom mounted. Finally, efforts should be made to characterize ambient noise levels in this area.

5. Shore-based behavioral studies incorporating theodolite and focal animal observation techniques following those developed by KIENM-TAMU (Würsig *et al*., 1999, 2000) should be conducted concurrent to continuous acoustic monitoring to evaluate the relationship between noise and whale behavior.

6. Although telemetry studies (radio and satellite) may provide insight regarding intra- and inter annual movement patterns and migration corridors, no such tagging should commence until first tested on eastern gray whales to ensure safety and effectiveness (as *recommended* by the IWC in 2001 and 2002). Because the western gray whale population is so small, injury or in the worse case death of even a single whale due to tag related complications may have significant impact on this population's ability to recover.

7. A workshop/meeting, including oil company representatives and gray whale scientists, should be convened annually to discuss past results and generate future research plans for western gray whales off northeastern Sakhalin Island and elsewhere.

8. A review/analysis/synthesis of all photo-identification data collected between 1997 and 2001 (or beyond) should be completed. This project would also include a detailed analysis of skinny whales and long-term estimates of survival, abundance and overall population trends.

The types of studies described above, in combination, have proven highly valuable in evaluating the influence of oil and gas development on bowhead whales feeding in the Arctic Ocean (see Richardson *et al*., 1989; National Marine Mammal Laboratory 2000). With regard to mitigation strategies, some industry operations such as seismic surveying, blasting, and dredging of the sea floor should be timed so as not to overlap with periods of high whale abundance (June-October) on the feeding ground. Efforts to minimize underwater noise and regulate ship and air traffic to maintain appropriate distance and altitude to prevent disturbance of whales should also be implemented.

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LIST OF TABLES

Table 1. Funding agencies, listed alphabetically by year, for gray whale studies between 1997 and 2001.

Year	Funding Agency
1997	Exxon Neftegas Ltd., Sakhalin Energy Investment Company
1998	Exxon Neftegas Ltd., Sakhalin Energy Investment Company
1999	Sakhalin Energy Investment Company
2000	International Fund for Animal Welfare, Sakhalin Energy Investment Company, U.S. National Fish and Wildlife Foundation
2001	International Fund for Animal Welfare, Sakhalin Energy Investment Company, U.S. Environmental Protection Agency, U.S. Marine Mammal Commission, U.S. National Marine Fisheries Service

Table 2. Sea surface temperature and salinity statistics associated with group sighting locations in 2001.

Variable	Sample Size	Mean	SD	Median	Mode	Range
Temperature (°C)	26	8.3	2.07	9	7	3-11
Salinity (ppt)	35	31.0	2.11	30	30	27-36

Table 3. Annual survey effort, groups encountered and whales identified between 1994 and 2001.

Year	Sampling period (mo, d)	Number of surveys	Hours of observation	Rolls of film used	Groups encountered	Whales identified
1994	09/07 - 09/12	-	-	-	-	10
1995	08/15 - 08/19	5	10.1	15	23	27
1997	07/09 - 09/08	22	33.4	72	114	47
1998	07/06 - 09/29	35	50.5	91	125	54
1999	06/29 – 10/13	56	122.0	160	434	70
2000	06/25 – 09/16	40	56.5	76	365	58
2001	06/25 - 09/25	48	101.8	75	448	72
Overall		206	374.3	489	1509	106*

* The number of whales identified annually includes resightings of individuals from previous years, resulting in a total of 106 known individuals.

Table 4. Group size summary statistics for the period between 1995-2001.

Year	Number of Groups	Mean Group Size	Median Group Size	Mode Group Size	± S.D. Group Size	Range in Group Size
1995	23	2.3	2	2	± 1.18	1-6
1997	114	1.8	1	1	± 1.33	1-9
1998	125	2.0	2	2	± 1.02	1-6
1999	434	1.8	1	1	± 1.03	1-7
2000	365	1.6	1	1	± 0.84	1-5
2001	447	1.8	2	1	± 1.08	1-9
Overall	1509	1.9	1.5	1.3	± 1.08	1-9

Table 5. Survey years, sequential survey numbers and cumulative number of whales identified.

Year	Survey Numbers	Cumulative Number of Whales Identified by Final Survey
1994	1	10
1995	2-6	39
1997	7-28	59
1998	29-63	72
1999	64-118	88
2000	119-158	94
2001	159-206	106

Table 6. Annual sighting trends and resighting percentages of whales photo-identified.

Year	Whales Identified	Calves/Non-Calves Identified (Crude Birth Rate)	New Non-Calves Identified	Percentage of Non-Calves Identified from Previous Years
1994	10	-	10	N/A
1995	27	2/25	20	20.0% (n = 5)
1997	47	2/45 (4.3%)	25	44.4% (n = 20)
1998	54	8/46 (14.8%)	5	89.1% (n = 41)
1999	70	3/67 (4.3%)	13	80.6% (n = 54)
2000	58	3/55 (5.2%)	3	94.5% (n = 52)
2001	72	6/66 (8.3%)	6	91.0% (n = 60)

Table 7. Mother-calf pairs identified between 1997 and 2001.

Mother ID	Calf ID	Year	Mother ID	Calf ID	Year
019	020	1997	040	077	1999
031	032	1997	NA	086	1999
005	060	1998	019	089	2000
009	058	1998	087	090	2000
015	057	1998	NA	091	2000
018	061	1998	007	100	2001
036	062	1998	009	097	2001
055	056	1998	018	096	2001
063	064	1998	036	095	2001
NA	066	1998	055	098	2001
038	071	1999	092	099	2001

Table 8. Calving intervals for mothers identified between 1997 and 2001. X = sighted that year, XX = sighted that year with a calf, 0 = not sighted that year.

Mother ID	1997	1998	1999	2000	2001
005	X	XX	X	X	X
007	X	X	X	X	XX
009	X	XX	X	X	XX
015	X	XX	X	X	X
018	X	XX	X	X	XX
019	XX	X	X	XX	X
031	XX	0	0	0	0
036	X	XX	X	X	XX
038	X	X	XX	0	X
040	X	X	XX	0	0
055	0	XX	X	X	XX
063	X	XX	0	X	X
087	0	0	X	XX	X
092	0	0	0	X	XX

Table 9. Post birth-year calf sighting patterns.

Year	Calves	Number of Years Sighted Post Birth Year				
		0 Yrs	1 Yrs	2 Yrs	3 Yrs	4 Yrs
1997	2	1	0	1	0	0
1998	8	4	0	2	2	NA
1999	3	3	0	0	NA	NA
2000	3	2	1	NA	NA	NA

Table 10. Summary of skinny whales, based on field observations, between 1999 and 2002. X = Observed as Skinny; Y = Observed not Skinny; N = Not Observed; NA = Not Applicable; X MOM = Skinny Mom; X CALF = Skinny Calf.

Whale ID	1999	2000	2001	No. Years Skinny
002	Y	X	N	1
004	Y	X	X	2
006	X	Y	Y	1
007	Y	Y	X MOM	1
008	N	X	Y	1
009	X	X	X MOM	3
011	Y	X	Y	1
014	Y	X	Y	1
015	X	X	X	3
018	Y	Y	X MOM	1
019	Y	X MOM	Y	1
023	Y	X	Y	1
027	Y	Y	X	1
028	X	X	X	3
029	N	X	X	2
030	X	N	Y	1
035	Y	X	X	2
036	Y	X	X MOM	2
038	X MOM	N	Y	1
039	X	N	N	1
041	X	X	Y	2
043	Y	X	Y	1
044	X	X	X	3
047	Y	X	Y	1
049	Y	X	X	2
051	Y	X	X	2
052	X	X	X	3
054	Y	X	Y	1
055	X	Y	X MOM	2
056	Y	X	Y	1
062	Y	X	N	1
063	N	X	Y	1
069	N	X	Y	1
070	X	Y	Y	1
071	X CALF	N	N	1
072	X	N	N	1
074	X	X	N	2
075	X	N	Y	1
081	Y	X	Y	1
084	Y	X	Y	1
087	Y	X MOM	Y	1

Table 10. Continued.

Whale ID	1999	2000	2001	No. Years Skinny

088	X	N	N	1
092	N	Y	X MOM	1
093	N	X	Y	1
094	N	X	N	1
100	NA	NA	X CALF	1
103	N	N	X	1
105	N	N	X	1

LIST OF FIGURES

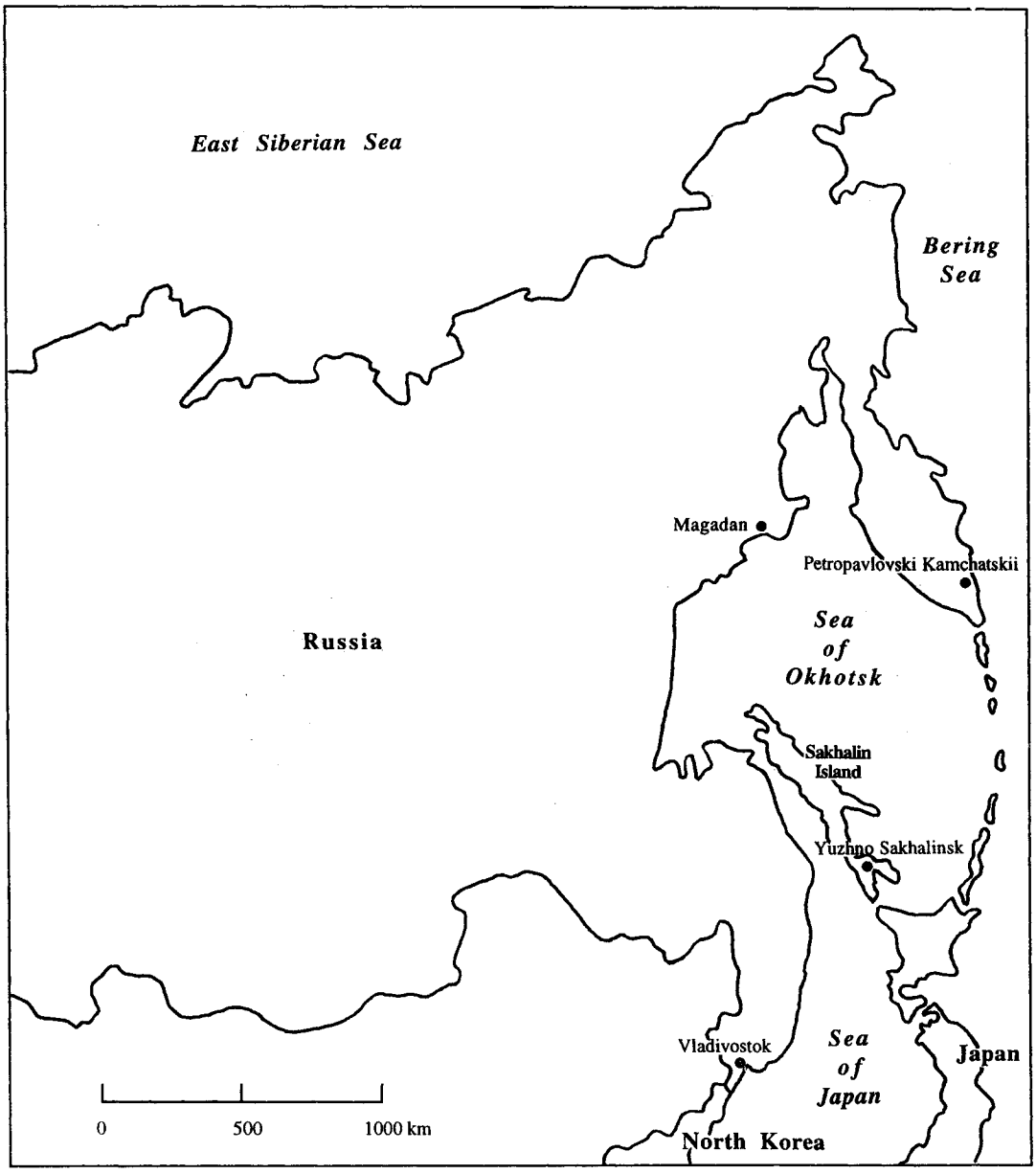

Figure 1. Far East Russia, showing the location of Sakhalin Island.

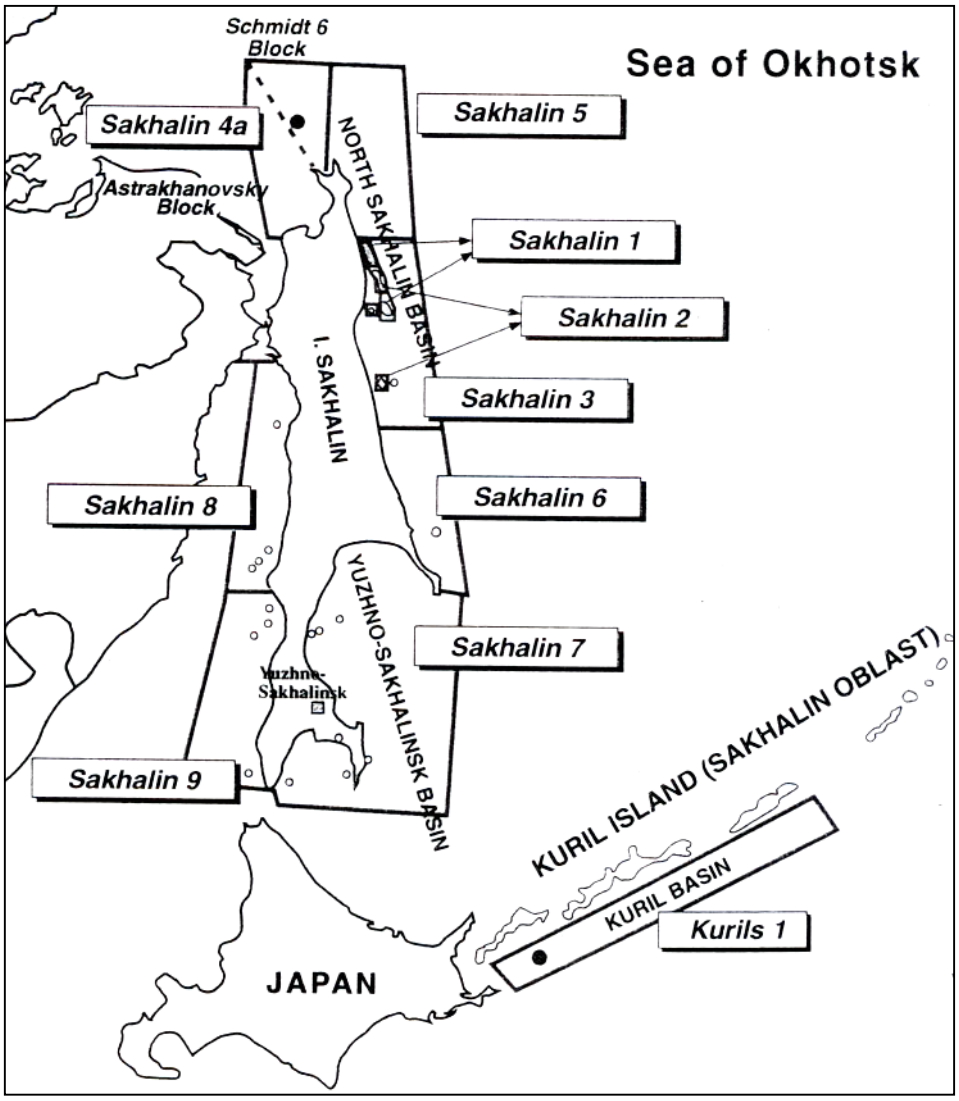

Figure 2. Locations of major offshore oil and gas fields off Sakhalin Island.

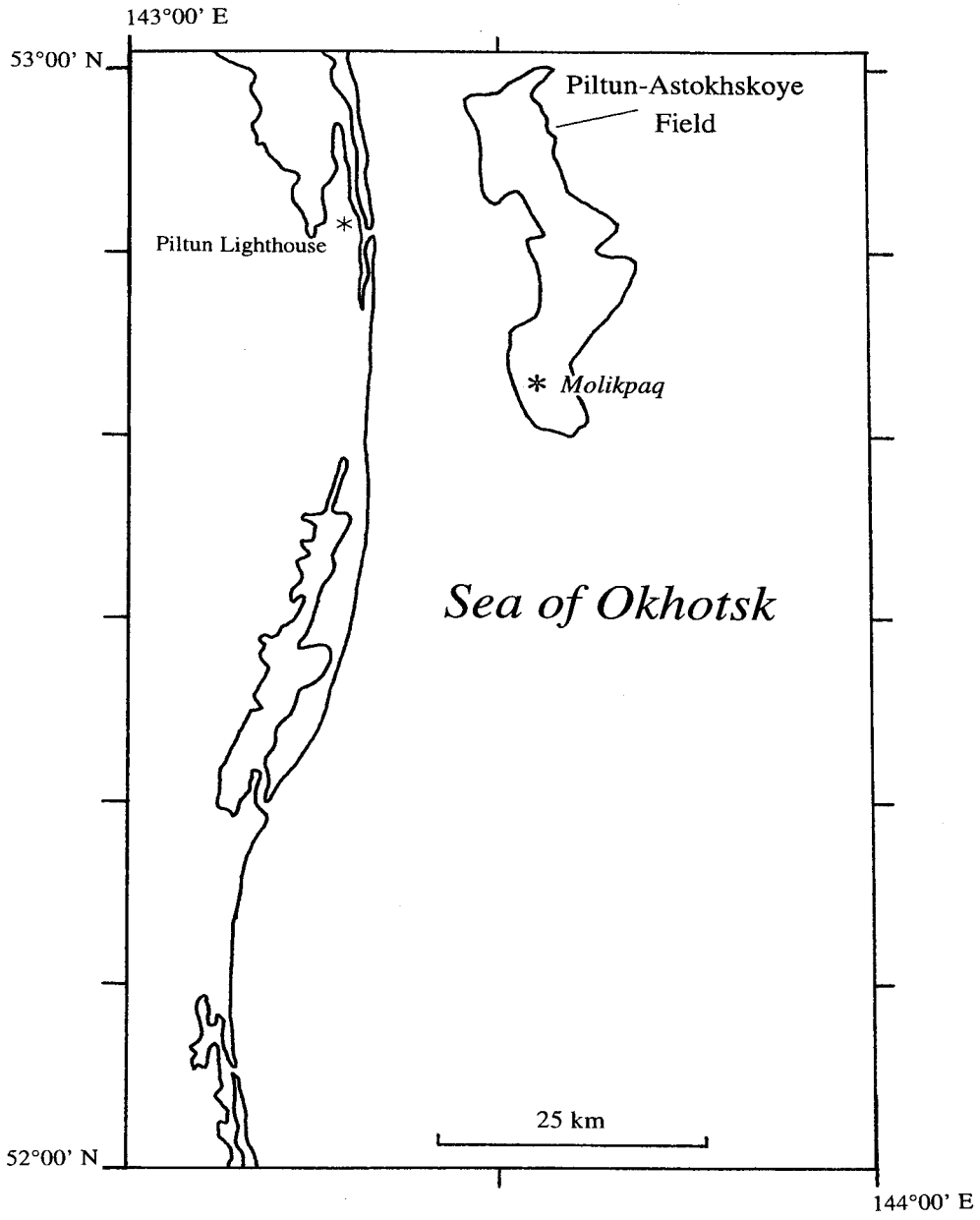

Figure 3. Location of the Piltun-Astokhskoye oil field in relation to the Piltun Lighthouse and channel opening of Piltun Lagoon.

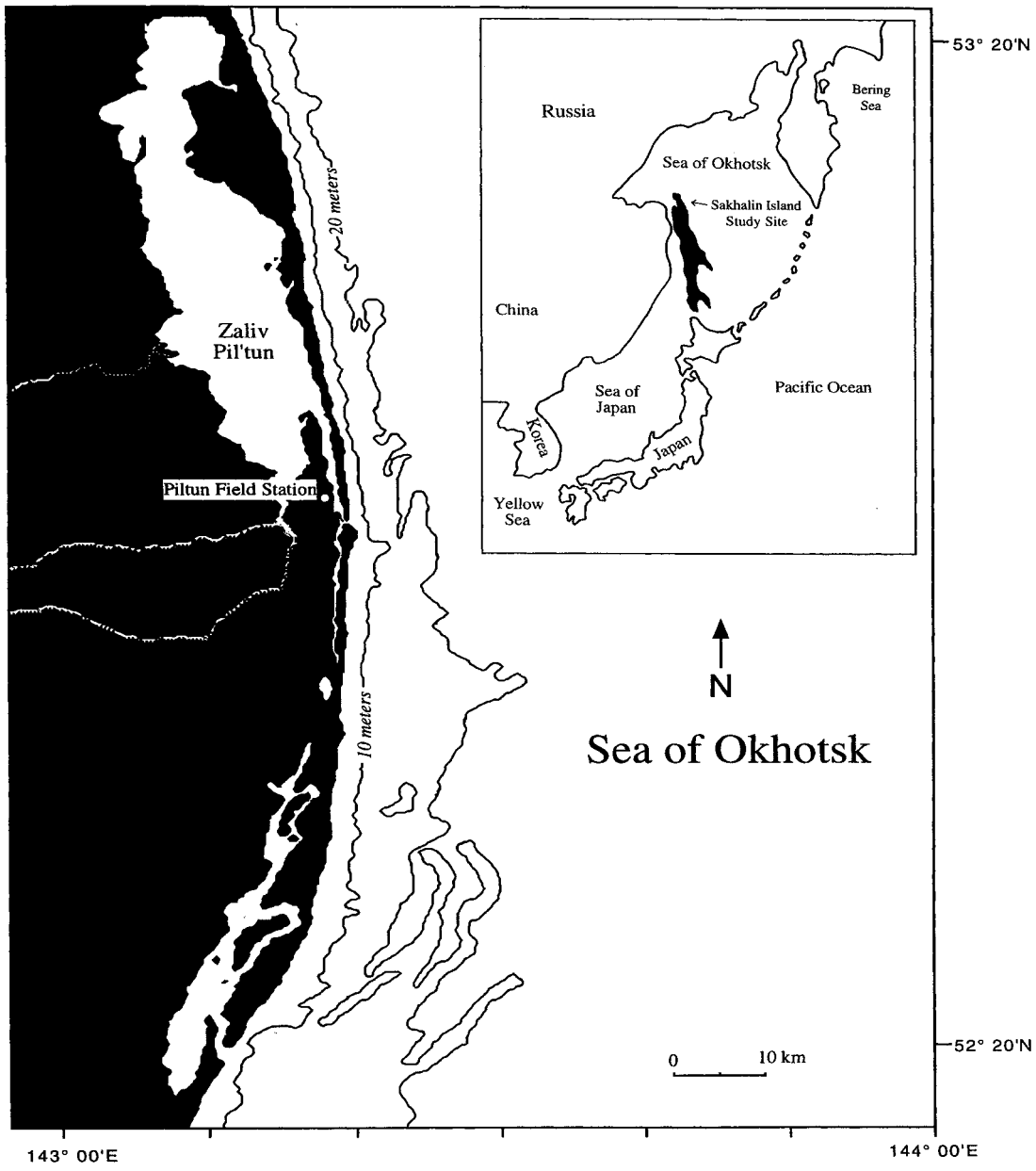

Figure 4. Map of the Piltun study area. Inset shows relative location of Sakhalin Island in the Sea of Okhotsk.

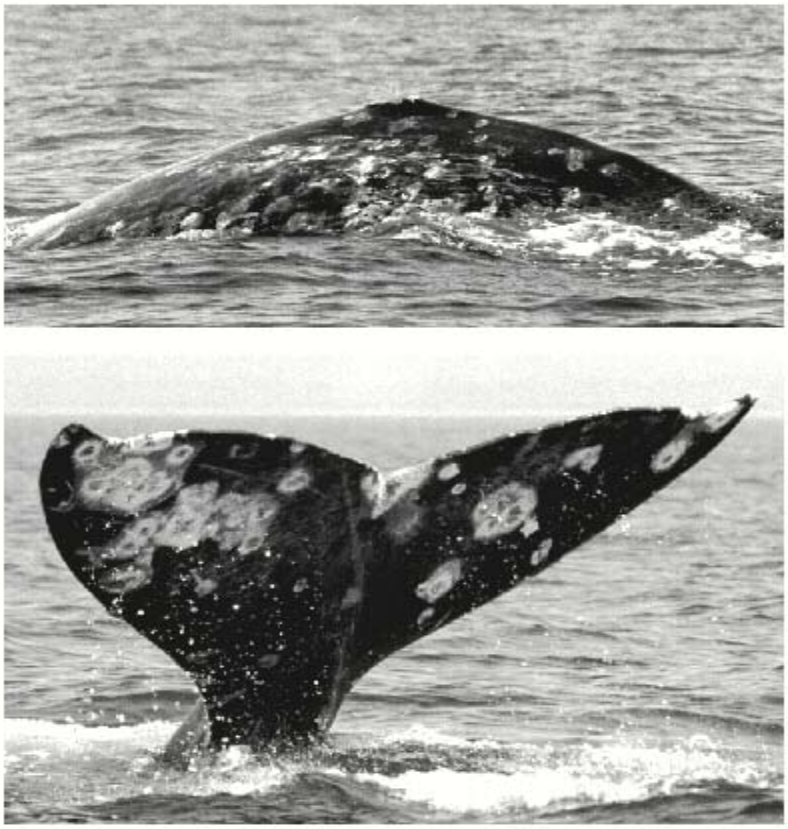

Figure 5. Pigmentation and other patterns used to photographically identify individual whales.

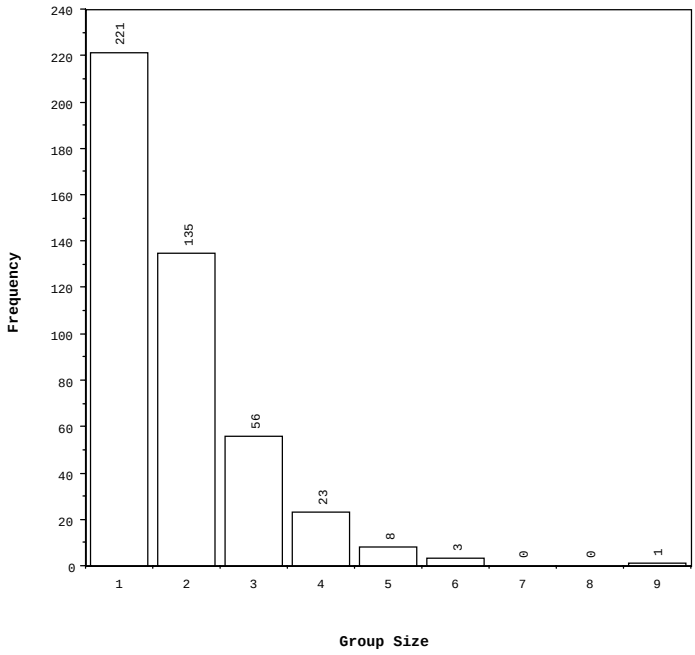

Figure 6. Distribution of group sizes for all groups encountered.

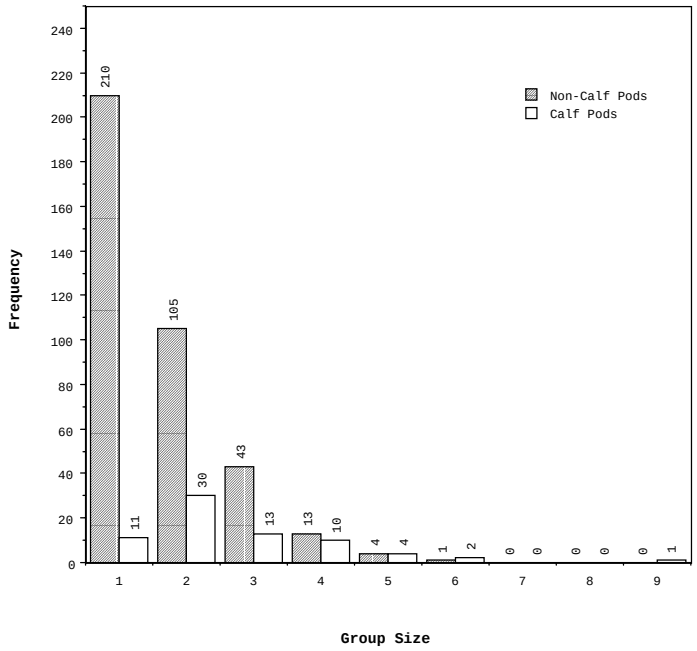

Figure 7. Distribution of calf- and non-calf groups encountered.

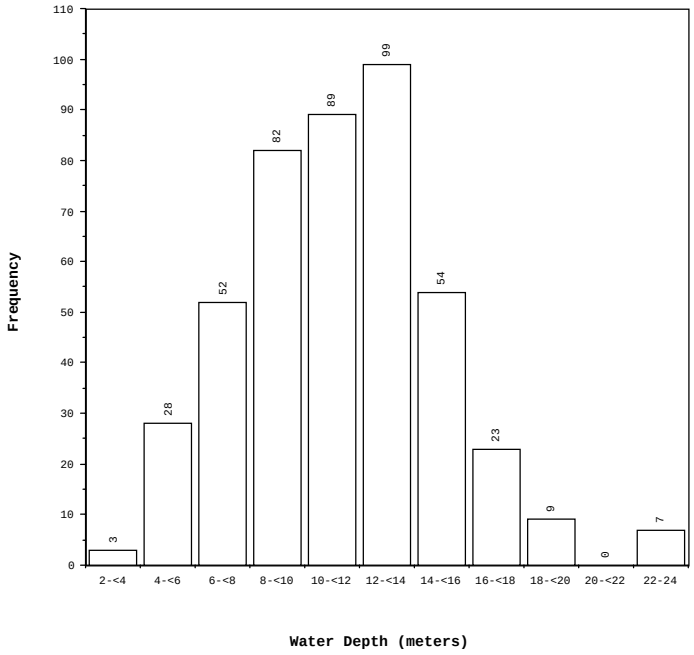

Figure 8. Distribution of water depths for all groups encountered.

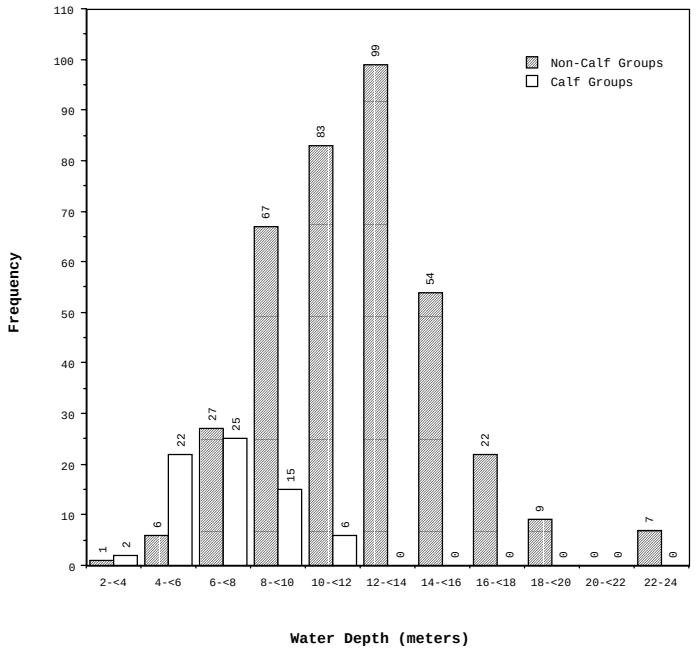

Figure 9. Distribution of water depths for calf- and non-calf groups encountered.

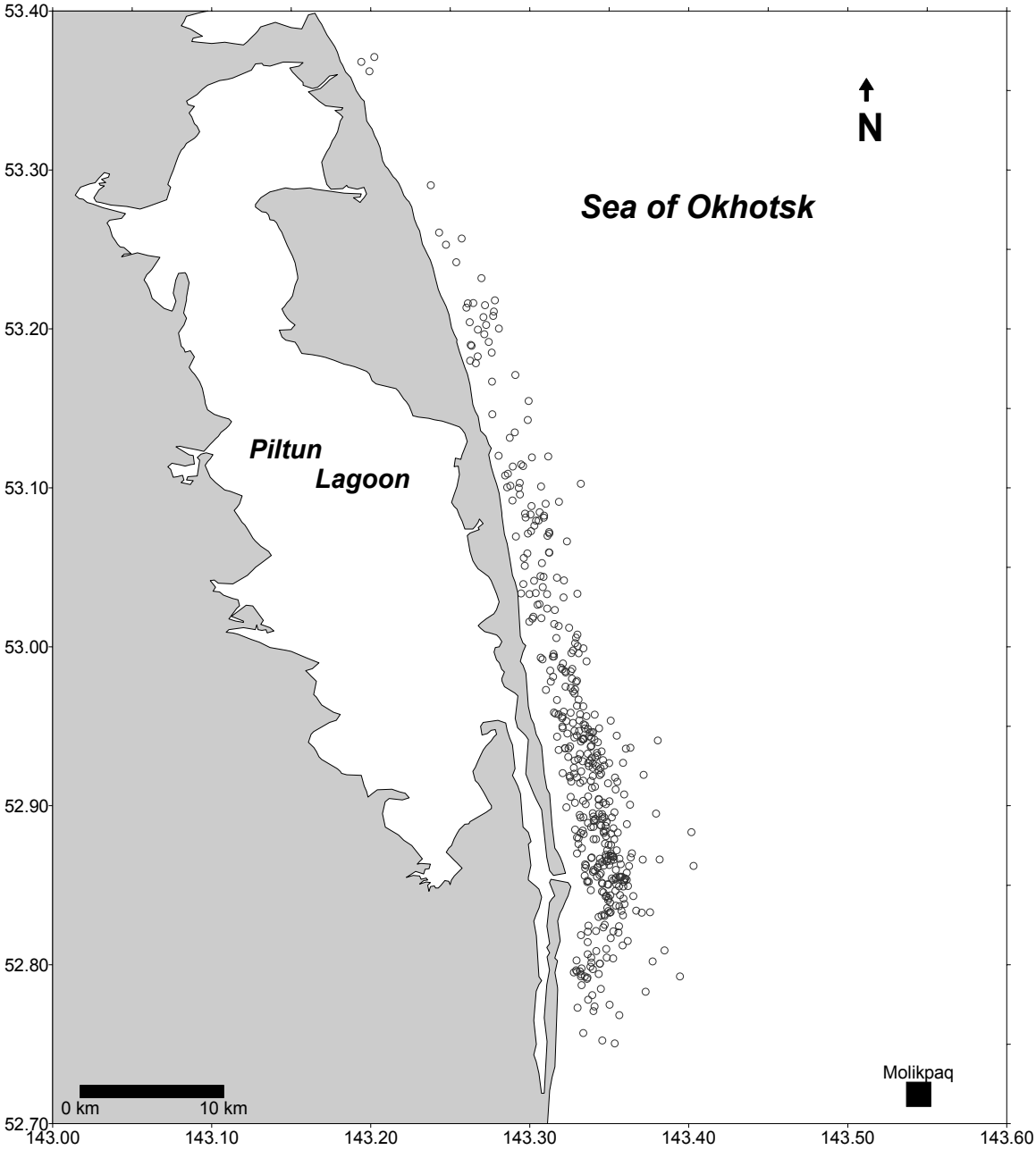

Figure 10. Spatial distribution of whale groups encountered during 2001. The Molikpaq location is denoted by a black square at the lower right of the figure. Latitude and longitude are displayed in decimal degrees.

Whale ID	1994	Aug. 95	Jul. 97	Aug. 97	Sep. 97	Jul. 98	Aug. 98	Sep. 98	Jun. 99	Jul. 99	Aug. 99	Sep. 99	Oct. 99	Jun. 00	Jul. 00	Aug. 00	Sep. 00	Jun. 01	Jul. 01	Aug. 01	Sep. 01
001																					
002																					
003																					
004																					
005						M	M														
006																					
007																			M	M	M
008																					
009						M	M												M	M	M
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011																					
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013																					
014																					
015						M	M	M													
016																					
017																					
018		M				M	M	M											M	M	
019		M	M	M											M	M	M				
020			C	C	C																
021																					
022																					
023																					
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025																					
026																					
027																					
028																					
029																					
030																					
031			M	M	M																
032			C	C	C																
033																					
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035																					
036						M	M	M											M	M	M
037																					
038									M	M	M										
039																					
040										M	M	M									
041																					
042																					
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044																					
045		C																			
046		C																			
047																					
048																					
049																					
050																					
051																					
052																					
053																					
054																					
055						M	M	M											M	M	M
056						C	C														

Figure 12. Occurrence patterns for whales identified 1994-2001. Shaded areas indicate presence of specific individuals in the study area. **M** = Mother and **C** = Calf.

Whale ID	1994	Aug. 95	Jul. 97	Aug. 97	Sep. 97	Jul. 98	Aug. 98	Sep. 98	Jun. 99	Jul. 99	Aug. 99	Sep. 99	Oct. 99	Jun. 00	Jul. 00	Aug. 00	Sep. 00	Jun. 01	Jul. 01	Aug. 01	Sep. 01
057						C	C	C													
058						C	C														
059																					
060						C	C														
061						C	C														
062						C	C	C													
063							M														
064							C														
065																					
066							C	C													
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089															C	C	C				
090																C	C				
091																	C				
092																				M	M
093																					
094																					
095																			C	C	C
096																			C	C	C
097																			C	C	C
098																			C	C	C
099																				C	C
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Figure 12. Continued.

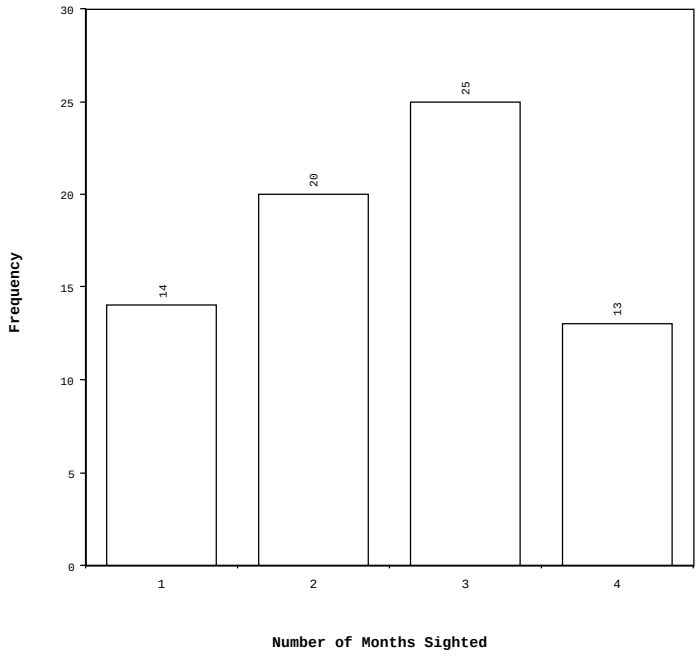

Figure 13. Monthly sighting frequencies for whales identified.

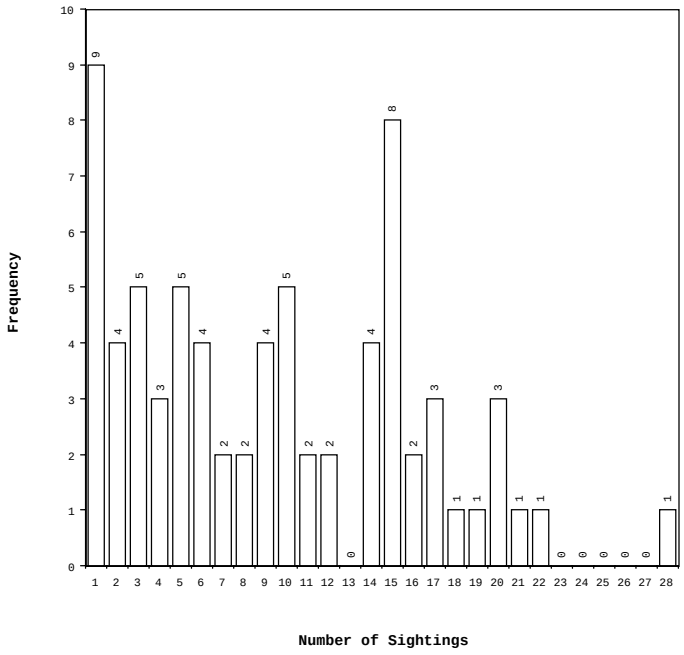

Figure 14. Sighting frequencies for whales identified.

APPENDIX I

Sighting records for whales photographically identified in 2001.

Whale ID number	Aspect	Date	Group number	Initial sighting location (degrees north)	Initial sighting location (minutes north)	Initial sighting location (degrees east)	Initial sighting location (minutes east)	Initial Depth (m)	Sea surface temperature
002	R,L	01/07/04	9	53	4.327	143	18.735	14.0	
002	R,L	01/07/17	1	52	51.999	143	20.648		
002	L	01/07/28	12	53	6.051	143	18.432	13.5	
002	R,L	01/07/30	5	53	3.551	143	18.747	12.5	
002	L	01/08/18	13	53	2.608	143	19.030	12.5	
004	R,L	01/06/25	1	52	51.722	143	21.751		
004	L	01/06/25	2	52	51.972	143	22.907	16.5	
004	R,L	01/07/03	6						
004	R,L	01/07/10	3	52	58.669	143	19.752	14.0	
004	R,F	01/07/12	1	52	52.118	143	20.986		
004	L,F	01/07/14	4	52	55.619	143	21.528	22.0	
004	R	01/07/28	2	52	50.437	143	20.964	6.3	
004	L	01/07/29	6	52	47.646	143	20.609	8.3	7.0
004	R,L	01/07/30	10	53	6.074	143	17.273	7.8	
004	R,L	01/08/04	2	52	48.509	143	20.515	10.5	
004	L	01/08/12	2	52	47.631	143	19.948	8.3	
004	R	01/08/18	9	52	53.251	143	20.702	11.5	
004	L	01/08/19	1	52	51.201	143	21.667	15.5	
004	R,L	01/08/19	3	52	51.035	143	21.272	11.5	
004	L	01/08/20	5	52	48.262	143	20.323	10.5	
004	R,L	01/08/21	12	52	48.044	143	20.652	7.5	
004	L	01/08/26	10	52	55.896	143	20.551	14.0	
004	R	01/09/03	9	52	51.883	143	20.741	10.5	11.0
004	L	01/09/08	3	52	51.579	143	21.257	13.0	
004	R,L	01/09/09	3	52	53.272	143	20.662	11.5	
004	R,L	01/09/13	4	52	59.633	143	18.923	9.5	
004	R,L	01/09/20	9	53	8.093	143	17.440	11.0	
005	R,F	01/06/25	1	52	51.722	143	21.751		
005	R,L	01/06/25	2	52	51.972	143	22.907	16.5	
005	R,F	01/07/10	1	52	52.149	143	20.877		
005	R,L,F	01/07/17	3						
006	R	01/07/03	7	53	12.974	143	15.875		
006	R,L	01/07/14	7	52	55.718	143	20.768		
006	R	01/07/28	15	53	12.895	143	16.320	11.5	
007	R,L	01/07/04	3	52	55.126	143	19.516	5.7	
007	R,L	01/07/09	1	52	50.809	143	20.311	4.8	
007	L	01/07/17	3						
007	R,L	01/07/30	7	53	4.158	143	17.483	6.2	
007	R,F	01/08/03	10	53	12.802	143	15.618	7.8	
007	R,L	01/08/04	2	52	48.509	143	20.515	10.5	
007	R	01/08/04	3	52	47.747	143	19.898	6.2	
007	L	01/08/10	6	52	49.980	143	21.059	7.3	
007	L	01/08/10	8	52	50.337	143	21.036	7.5	
007	R,L	01/08/11	6	52	51.747	143	20.803	11.5	
007	L	01/08/18	1	52	48.850	143	20.192	7.3	
007	R	01/08/19	3	52	51.035	143	21.272	11.5	
007	R,L	01/08/19	8	52	47.089	143	20.693	8.5	
007	R,L	01/08/20	6	52	48.267	143	20.909	7.3	

Whale ID number	Aspect	Date	Group number	Initial sighting location (degrees north)	Initial sighting location (minutes north)	Initial sighting location (degrees east)	Initial sighting location (minutes east)	Initial Depth (m)	Sea surface temperature
007	R,L	01/08/21	17	52	46.424	143	20.454	8.7	
007	R	01/08/29	11	52	59.750	143	19.852	14.5	
007	R,L	01/09/03	4	52	48.727	143	21.509	8.7	
007	L	01/09/05	1	52	49.474	143	20.221	4.8	
007	R,L	01/09/13	14	53	21.726	143	11.957	9.5	
007	L	01/09/17	4	52	59.760	143	19.575	14.0	
007	R,F	01/09/18	6	52	58.450	143	19.549	12.5	9.5
007	L	01/09/20	2	52	55.064	143	19.792	9.5	
008	R,L	01/06/30	2	52	51.283	143	21.269	7.5	
008	L	01/06/30	7					13.5	
009	R,L	01/07/29	8	52	49.896	143	20.818	4.2	
009	R,L	01/07/29	10	52	49.116	143	19.942	5.0	
009	R	01/08/04	5	52	50.569	143	20.864	4.8	
009	R	01/08/11	2	52	49.246	143	20.196	5.8	
009	R	01/08/12	1	52	48.162	143	19.771	4.0	
009	R,L	01/08/13	1	52	47.707	143	19.668	3.5	
009	R,L	01/08/14	3	52	55.231	143	19.245	5.5	9.0
009	L	01/08/18	4	52	47.223	143	19.960	8.5	
009	L	01/08/20	10	52	45.420	143	20.029	7.6	8.0
009	R,L	01/08/21	13	52	47.832	143	20.385	9.0	10.0
009	L	01/09/02	8	53	1.441	143	18.665	10.5	
009	L	01/09/03	8	52	51.907	143	20.935	11.0	
009	R,L	01/09/07	1	52	51.303	143	21.391	13.5	
009	R	01/09/07	8	52	51.253	143	21.096	11.5	
009	R,L	01/09/08	19	52	49.499	143	20.834	8.7	
009	L	01/09/09	5	52	49.403	143	20.783	8.5	
009	L,F	01/09/10	1	52	50.031	143	21.466	17.0	
009	R	01/09/18	6	52	58.450	143	19.549	12.5	9.5
009	R	01/09/19	5	52	59.165	143	19.613	12.5	
009	L	01/09/20	4	52	57.476	143	18.976	6.7	9.0
009	R,L	01/09/23	5	53	6.467	143	17.077	6.2	7.0
009	R	01/09/24	4	52	51.647	143	20.097	6.5	
010	R,L	01/07/04	1					13.0	
010	R,L	01/07/10	1	52	52.149	143	20.877		
010	L	01/07/28	1	52	49.839	143	20.830	4.8	10.0
010	L	01/07/29	1	52	51.792	143	21.439	13.5	
010	R	01/07/30	5	53	3.551	143	18.747	12.5	
010	L	01/08/04	10	52	51.228	143	21.239	12.0	
010	L	01/08/18	3	52	47.514	143	20.183	8.6	
010	L	01/08/18	5	52	46.248	143	20.405	9.6	
010	R,L	01/08/19	6	52	47.554	143	23.671	19.5	
010	R	01/08/21	16	52	46.488	143	21.019	10.0	
011	R	01/06/29	3	52	57.034	143	20.095	13.5	
011	R	01/06/29	4	53	0.137	143	19.718		
011	R	01/06/30	1	52	52.518	143	20.977	13.5	
011	R,L	01/06/30	2	52	51.283	143	21.269	7.5	
011	R	01/06/30	3	52	51.321	143	21.410	13.0	
011	R,L	01/07/03	3						
011	R,L	01/07/04	3	52	55.126	143	19.516	5.7	

Whale ID number	Aspect	Date	Group number	Initial sighting location (degrees north)	Initial sighting location (minutes north)	Initial sighting location (degrees east)	Initial sighting location (minutes east)	Initial Depth (m)	Sea surface temperature
012	R,F	01/06/25	2	52	51.972	143	22.907	16.5	
013	R	01/06/25	4	52	57.748	143	20.025	13.5	
013	R,L	01/07/14	8	52	57.381	143	20.149	13.0	
013	R,L	01/07/17	3						
013	R	01/07/28	15	53	12.895	143	16.320	11.5	
013	R	01/07/30	4	53	3.157	143	18.464	11.0	
013	R,L	01/08/12	16	53	2.639	143	18.524	11.0	
013	L	01/09/02	3	52	54.061	143	20.878	13.0	
013	R,L	01/09/13	2	52	56.769	143	20.271	13.0	
014	R,L,F	01/08/21	6	52	55.342	143	20.604	13.5	
014	R,L	01/08/21	7	52	55.418	143	20.678	13.5	
014	L	01/08/21	8	52	55.961	143	20.194	12.0	
014	L	01/08/26	4	52	56.155	143	21.634	22.0	
015	R,L	01/07/03	2						
015	R,L	01/07/03	3						
016	L	01/07/29	1	52	51.792	143	21.439	13.5	
018	R,L	01/07/29	3	52	52.770	143	19.845	7.1	
018	L	01/07/29	9	52	52.197	143	19.785	5.5	
018	R,L	01/07/31	1	52	50.764	143	20.731	6.1	
018	R,L	01/08/02	2	52	51.788	143	20.097	7.2	
019	R	01/07/03	5	52	56.771	143	20.348	14.0	
019	R	01/07/04	5	52	54.901	143	21.306	17.5	
019	R	01/07/13	3	52	54.847	143	20.960	16.5	
019	R,L	01/07/28	16	53	12.649	143	16.652	12.5	
019	R,L	01/08/11	14	53	2.014	143	17.678	3.3	
019	R,L	01/08/12	8	52	57.985	143	19.029	9.0	
019	L	01/08/18	14	53	4.275	143	17.939	9.0	
019	R,L	01/08/21	6	52	55.342	143	20.604	13.5	
019	R	01/08/21	8	52	55.961	143	20.194	12.0	
019	R,L	01/08/26	15	52	59.627	143	18.877	10.0	
019	L	01/08/29	12	53	0.342	143	19.747	15.0	
019	L	01/09/07	6	52	58.388	143	19.715	13.0	
021	R,L	01/06/25	4	52	57.748	143	20.025	13.5	
021	R,L,F	01/06/30	4	52	51.899	143	20.915		
021	R,L,F	01/07/03	1	52	53.302	143	21.669	19.0	
021	R,L	01/07/03	5	52	56.771	143	20.348	14.0	
023	R,L,F	01/06/25	4	52	57.748	143	20.025	13.5	
023	R,L	01/07/13	7	52	56.825	143	19.695	11.0	
023	L	01/07/17	6	52	57.067	143	20.037	9.5	
023	L,F	01/07/28	8	52	59.450	143	20.151	15.0	
023	R,L	01/08/03	11	53	12.966	143	15.673	8.7	
023	L	01/08/12	17	53	2.665	143	18.414	10.5	
023	R	01/08/21	9	52	56.819	143	19.868	12.0	
023	R	01/08/26	1	52	53.026	143	20.791	11.5	
023	R,L	01/08/26	2	52	54.423	143	21.568	16.5	
023	R	01/08/29	8	52	56.651	143	19.782	10.5	
023	L,F	01/09/02	3	52	54.061	143	20.878	13.0	
023	R	01/09/02	5	52	56.264	143	20.325	13.0	
024	R,L	01/07/28	11	53	4.990	143	18.035	11.0	

Whale ID number	Aspect	Date	Group number	Initial sighting location (degrees north)	Initial sighting location (minutes north)	Initial sighting location (degrees east)	Initial sighting location (minutes east)	Initial Depth (m)	Sea surface temperature
024	R,L,F	01/07/30	6	53	4.879	143	17.854	9.5	
024	L	01/08/03	9	53	11.507	143	16.456	9.5	
024	R,F	01/08/26	5	52	55.611	143	21.001	15.5	
024	R	01/08/29	13	53	0.783	143	19.099	11.5	
024	R	01/09/02	12	53	7.887	143	17.250	9.0	
024	R,F	01/09/10	3	52	51.575	143	20.407	13.5	
024	R,L	01/09/13	8	53	4.767	143	18.340	11.5	
024	R	01/09/13	10	53	5.744	143	17.637	8.7	
024	L	01/09/17	8	53	11.972	143	16.048	8.6	9.5
024	L	01/09/20	7	53	6.532	143	17.186	8.0	
025	R,L	01/07/03	7	53	12.974	143	15.875		
025	R	01/07/04	11						
027	R,L	01/07/31	5	52	53.681	143	20.736	13.0	
028	R,L,F	01/06/30	4	52	51.899	143	20.915		
028	R,L	01/07/03	5	52	56.771	143	20.348	14.0	
028	R,L	01/07/13	2	52	51.999	143	21.391		
028	R,L	01/07/30	2	52	53.444	143	20.438	10.5	
028	L	01/07/31	4	52	53.202	143	20.408	10.5	
028	R	01/07/31	6	52	53.191	143	20.314	10.5	
028	R	01/08/03	5	53	1.077	143	18.446	9.5	
028	R,L	01/08/11	15	53	4.361	143	18.055	10.5	
028	R,L	01/08/18	11	52	55.602	143	20.394	12.0	
028	L	01/08/26	7	52	55.816	143	20.473	13.5	
028	L	01/08/27	6	52	54.674	143	20.356	11.0	
028	R	01/08/29	9	52	57.451	143	19.907	12.0	
028	R	01/09/07	3	52	53.587	143	20.408	11.0	7.0
028	R	01/09/08	6	52	53.002	143	24.107	23.0	
028	L	01/09/09	2	52	52.067	143	21.157	13.0	
028	R,L	01/09/10	8	52	55.154	143	20.644	13.5	11.0
028	L	01/09/11	2	52	55.430	143	20.379	12.0	
028	R,L	01/09/13	9	53	5.021	143	17.828	9.2	
029	R,L	01/08/26	15	52	59.627	143	18.877	10.0	
029	R	01/08/29	8	52	56.651	143	19.782	10.5	
029	R	01/09/02	7	52	58.495	143	19.357	12.0	10.5
029	L	01/09/07	4	52	54.184	143	20.021	9.5	
029	R,L,F	01/09/08	14	52	55.707	143	19.705	9.5	
029	R,L	01/09/13	8	53	4.767	143	18.340	11.5	
029	L	01/09/17	7	53	9.276	143	17.964	13.5	
030	R,L,F	01/07/03	7	53	12.974	143	15.875		
032	R,L,F	01/06/29	2	52	55.954	143	19.901	10.5	
032	R	01/06/29	3	52	57.034	143	20.095	13.5	
032	R,F	01/06/29	4	53	0.137	143	19.718		
032	R,L	01/07/03	4	52	55.676	143	20.005	11.5	
032	R,L	01/07/04	2						
032	R,L	01/07/13	1	52	51.449	143	20.689		
032	R,L	01/07/13	2	52	51.999	143	21.391		
032	R,L	01/07/27	2	52	51.535	143	20.466	9.5	
032	R,F	01/07/30	8	53	5.520	143	17.354	8.0	
032	L,F	01/08/04	1	52	49.003	143	21.062	12.5	

Whale ID number	Aspect	Date	Group number	Initial sighting location (degrees north)	Initial sighting location (minutes north)	Initial sighting location (degrees east)	Initial sighting location (minutes east)	Initial Depth (m)	Sea surface temperature
032	R,L	01/08/11	12	52	56.989	143	19.236	8.7	
032	R,F	01/09/03	6	52	50.287	143	21.577	16.5	
032	R,L	01/09/07	4	52	54.184	143	20.021	9.5	
032	R,L	01/09/08	6	52	53.002	143	24.107	23.0	
032	R,F	01/09/08	18	52	50.625	143	21.413	14.0	
032	L,F	01/09/09	2	52	52.067	143	21.157	13.0	
032	R	01/09/11	7	52	59.366	143	19.258	11.0	
032	L	01/09/20	8	53	6.802	143	17.360	9.7	
033	R	01/06/25	1	52	51.722	143	21.751		
033	R,L	01/06/29	3	52	57.034	143	20.095	13.5	
033	R,L	01/07/03	6						
033	L	01/07/04	12	53	4.950	143	18.549	15.5	
033	L	01/07/13	5	52	56.490	143	20.449	14.0	
033	L	01/07/14	5						
033	R	01/07/14	6	52	54.233	143	20.614	13.0	
033	R	01/07/28	5	52	56.572	143	19.689	10.0	
033	R	01/08/10	4	52	52.567	143	20.848	12.0	
033	R,L	01/08/11	9	52	54.061	143	20.121	10.5	
033	L	01/08/12	17	53	2.665	143	18.414	10.5	
033	L	01/08/29	5	52	55.611	143	20.209	11.0	
033	L	01/09/02	11	53	6.882	143	17.676	10.5	
033	L	01/09/13	16	53	22.265	143	12.142		
033	R	01/09/20	16	53	13.915	143	16.182	14.5	
033	R,L	01/09/23	9	53	11.799	143	16.294	10.5	
034	L	01/07/13	6	52	56.912	143	20.087		
034	R	01/08/11	3	52	46.095	143	21.387	12.0	
034	R,L	01/08/11	6	52	51.747	143	20.803	11.5	
034	R	01/08/12	13	53	1.985	143	18.663	11.5	
034	R	01/08/12	15	53	2.000	143	19.805	18.5	
034	R	01/08/21	7	52	55.418	143	20.678	13.5	
034	R,L	01/09/03	5	52	45.023	143	21.210	11.5	
034	R	01/09/10	3	52	51.575	143	20.407	13.5	
035	R	01/07/03	7	53	12.974	143	15.875		
035	R,L	01/07/04	3	52	55.126	143	19.516	5.7	
035	R,L	01/07/10	1	52	52.149	143	20.877		
035	R,L	01/07/10	2	52	56.567	143	20.332		
035	R,L	01/07/13	7	52	56.825	143	19.695	11.0	
035	R,L	01/07/14	3	52	53.555	143	21.100	14.0	
035	R,L	01/07/14	6	52	54.233	143	20.614	13.0	
035	R,L	01/07/15	2	52	53.384	143	20.904	13.5	
035	L	01/07/28	14	53	12.008	143	16.839	12.5	
035	R	01/08/03	4	52	54.942	143	20.025	10.0	
035	R	01/08/11	4	52	50.787	143	21.238	12.0	
035	L	01/08/12	6	52	53.589	143	20.747	12.5	
035	L	01/08/12	7	52	53.552	143	19.916	8.5	
035	R	01/08/13	2	52	52.117	143	21.061	12.5	
035	R,L	01/08/14	1	52	54.253	143	20.609	13.0	
035	R	01/08/18	9	52	53.251	143	20.702	11.5	
035	R	01/08/19	9	52	47.559	143	20.081	9.7	9.5

Whale ID number	Aspect	Date	Group number	Initial sighting location (degrees north)	Initial sighting location (minutes north)	Initial sighting location (degrees east)	Initial sighting location (minutes east)	Initial Depth (m)	Sea surface temperature
035	R,L	01/08/20	1	52	51.093	143	20.731	9.5	
035	R	01/08/26	12	52	56.240	143	19.530	9.5	
035	R	01/08/27	2	52	50.950	143	21.537	14.0	
035	L	01/08/27	3	52	51.246	143	21.615	14.5	
035	R	01/08/29	2	52	54.036	143	21.790	19.0	
035	L	01/08/31	1	52	52.052	143	20.871	11.0	
035	R,L	01/09/02	14	53	17.421	143	14.272	10.0	
035	R	01/09/07	3	52	53.587	143	20.408	11.0	7.0
035	L	01/09/08	7	52	51.728	143	24.188	19.0	
035	L,F	01/09/10	7	52	55.059	143	21.221	19.0	
035	R	01/09/13	14	53	21.726	143	11.957	9.5	
035	R,L	01/09/18	2	52	55.494	143	20.523	14.0	
035	L	01/09/18	11	52	59.077	143	19.553	12.5	
035	R,L,F	01/09/20	16	53	13.915	143	16.182	14.5	
035	R,F	01/09/24	5	52	53.144	143	21.160	15.0	
036	R,L	01/07/29	4	52	52.393	143	19.971	7.3	
036	R	01/07/30	7	53	4.158	143	17.483	6.2	
036	L	01/08/03	3	52	51.745	143	20.130	7.3	3.0
036	L	01/08/04	3	52	47.747	143	19.898	6.2	
036	L	01/08/10	7	52	49.797	143	20.604	4.2	
036	L	01/08/11	2	52	49.246	143	20.196	5.8	
036	L	01/08/18	12	53	1.063	143	18.109	6.3	
036	R,L	01/08/19	2	52	50.729	143	20.785	7.2	
036	R	01/08/19	8	52	47.089	143	20.693	8.5	
036	L	01/08/21	15	52	46.677	143	20.210	8.0	
036	L	01/08/29	4	52	54.719	143	20.466	11.5	
036	R,L	01/09/05	3	52	48.038	143	20.652	7.5	
036	L	01/09/11	3	52	59.209	143	19.180	10.0	
036	R,L	01/09/17	7	53	9.276	143	17.964	13.5	
036	R,L	01/09/20	4	52	57.476	143	18.976	6.7	9.0
036	L	01/09/25	1	52	52.202	143	21.067	12.5	
037	R	01/07/28	10	53	1.863	143	19.280	14.5	
037	R	01/08/02	5	52	57.310	143	19.228	9.2	
037	L	01/08/11	13	52	57.447	143	19.100	8.3	
037	L	01/08/26	4	52	56.155	143	21.634	22.0	
037	L	01/08/27	5	52	52.049	143	20.345	9.0	
037	R	01/08/29	3	52	54.606	143	21.242	15.0	
037	R	01/09/11	9	53	0.461	143	19.803	16.5	
037	R,L	01/09/23	5	53	6.467	143	17.077	6.2	7.0
037	R,L	01/09/25	5	53	2.491	143	18.165	8.6	8.0
038	R	01/07/30	9	53	6.182	143	17.628	10.0	
041	R,L	01/06/30	5	52	52.314	143	21.290	13.5	
041	R,L	01/07/04	8	53	4.871	143	18.539		
041	L	01/07/13	4	52	55.995	143	20.536		
041	R,L	01/07/14	1	52	51.967	143	22.275	16.5	
041	L	01/07/28	3	52	53.350	143	20.203	9.7	
041	R	01/08/04	8	52	49.976	143	22.546	16.0	
041	L	01/08/12	5	52	52.098	143	21.104	12.5	
041	L	01/08/13	3	52	52.316	143	20.931	12.0	

Whale ID number	Aspect	Date	Group number	Initial sighting location (degrees north)	Initial sighting location (minutes north)	Initial sighting location (degrees east)	Initial sighting location (minutes east)	Initial Depth (m)	Sea surface temperature
041	L	01/08/18	7	52	51.256	143	21.602	14.5	
041	L	01/08/21	16	52	46.488	143	21.019	10.0	
041	L	01/08/27	4	52	51.199	143	21.554	14.0	
041	R,L	01/08/29	1	52	50.967	143	21.713	16.0	10.0
041	R	01/09/02	1	52	51.125	143	21.558	14.5	
041	R,L	01/09/08	10	53	2.504	143	19.297	16.0	
041	R	01/09/11	3	52	59.209	143	19.180	10.0	
041	R	01/09/11	10	53	0.718	143	19.494	14.0	
043	R	01/08/11	10	52	54.866	143	19.905	9.5	
043	R,F	01/08/21	2	52	52.846	143	20.882	13.5	
043	R,L,F	01/08/29	6	52	55.815	143	20.359	11.5	
043	R,L	01/09/13	15	53	22.082	143	11.653	11.0	
043	R,L,F	01/09/20	5	53	1.386	143	18.950	13.0	
043	R,L,F	01/09/25	1	52	52.202	143	21.067	12.5	
044	R,L	01/07/17	2	52	53.239	143	20.865		
044	R	01/07/27	2	52	51.535	143	20.466	9.5	
044	L	01/07/28	1	52	49.839	143	20.830	4.8	10.0
044	L,F	01/07/29	6	52	47.646	143	20.609	8.3	7.0
044	R,L	01/08/02	4	52	56.172	143	19.337	8.0	
044	L	01/08/03	2	52	51.654	143	20.565	10.0	
044	R,L	01/08/04	2	52	48.509	143	20.515	10.5	
044	R	01/08/20	1	52	51.093	143	20.731	9.5	
044	R	01/08/21	18	52	45.140	143	20.739	9.7	
044	R	01/09/02	1	52	51.125	143	21.558	14.5	
044	L	01/09/08	13	53	5.999	143	17.591	10.0	
044	L	01/09/18	7	52	51.315	143	20.535	8.7	
044	L	01/09/19	2	52	56.158	143	19.472	9.5	
044	L	01/09/20	3	52	56.726	143	19.430	9.7	
044	L	01/09/23	1	52	51.060	143	20.750	9.0	
044	R,L	01/09/24	2	52	52.968	143	19.931	7.5	8.0
047	R,L,F	01/06/30	2	52	51.283	143	21.269	7.5	
047	R,L	01/06/30	4	52	51.899	143	20.915		
047	L	01/06/30	6					10.5	
047	R	01/07/04	7	52	59.863	143	19.644	15.0	
047	R,L	01/07/17	3						
047	R,L	01/08/12	9	52	58.369	143	18.615	5.5	
047	L	01/08/14	2	52	54.163	143	21.015	14.5	
047	R,L	01/08/18	14	53	4.275	143	17.939	9.0	
047	R	01/08/19	6	52	47.554	143	23.671	19.5	
047	R	01/08/20	3	52	53.511	143	20.753	13.5	
047	R	01/08/29	15	52	48.592	143	20.895	9.0	
047	L	01/09/03	4	52	48.727	143	21.509	8.7	
048	R	01/06/25	1	52	51.722	143	21.751		
048	R	01/07/10	1	52	52.149	143	20.877		
048	R,L	01/07/17	4	52	56.225	143	20.308		
048	L	01/07/17	6	52	57.067	143	20.037	9.5	
048	L	01/08/04	9	52	50.591	143	21.918	17.0	
048	R,L	01/08/12	3	52	47.740	143	19.785	4.3	
048	L	01/08/26	9	52	56.395	143	20.577	14.5	

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048	R,L	01/09/02	10	53	5.399	143	18.605	14.0	
049	R,L	01/08/21	8	52	55.961	143	20.194	12.0	
049	R	01/08/29	8	52	56.651	143	19.782	10.5	
049	R,L	01/09/02	4	52	55.122	143	20.391	12.0	
049	R	01/09/03	5	52	45.023	143	21.210	11.5	
049	R	01/09/05	2	52	48.234	143	21.153	9.0	
049	R	01/09/11	8	52	59.076	143	19.350	11.5	
049	R,L	01/09/13	13	53	14.515	143	15.230	9.7	
049	R,L	01/09/24	2	52	52.968	143	19.931	7.5	8.0
049	R	01/09/25	2	52	56.422	143	19.941	11.0	
051	R	01/08/18	10	52	55.215	143	20.700	13.0	
051	L	01/08/21	10	52	56.895	143	20.202	13.5	
051	R,L	01/08/26	2	52	54.423	143	21.568	16.5	
051	R	01/09/02	13	53	8.558	143	17.929	12.5	
051	R,L	01/09/07	6	52	58.388	143	19.715	13.0	
051	L	01/09/09	2	52	52.067	143	21.157	13.0	
051	R,L	01/09/17	3	53	0.023	143	19.815	17.0	
051	R,L	01/09/18	4	52	57.208	143	21.063	19.0	
051	L	01/09/18	10	52	58.797	143	19.599	13.0	
051	R	01/09/19	3	52	56.503	143	20.023	12.5	
051	L	01/09/23	3	52	56.915	143	20.620	16.0	
052	L	01/08/03	7						
052	R,L	01/08/10	6	52	49.980	143	21.059	7.3	
052	L	01/08/10	8	52	50.337	143	21.036	7.5	
052	R	01/08/11	1	52	49.964	143	21.019	7.5	7.0
052	L	01/08/11	5	52	51.015	143	20.963	10.5	
052	L	01/08/18	6	52	50.034	143	22.022	13.5	
052	R	01/08/19	4	52	48.536	143	23.093	17.0	
052	R	01/08/19	5	52	48.121	143	22.644	15.5	
052	R,L	01/08/19	8	52	47.089	143	20.693	8.5	
052	R,L	01/08/20	6	52	48.267	143	20.909	7.3	
052	R,L	01/08/26	8	52	56.528	143	20.007	12.0	
052	R	01/08/26	11	52	56.511	143	19.998	12.0	
052	L	01/08/29	10	52	57.438	143	20.458	14.5	
052	L	01/09/02	6	52	58.236	143	19.695	12.5	
052	L	01/09/07	7	52	59.027	143	19.360	12.0	
052	L	01/09/08	12	53	4.569	143	18.180	11.5	
052	R	01/09/10	2	52	51.316	143	21.483	14.0	
052	R	01/09/13	4	52	59.633	143	18.923	9.5	
052	R,L	01/09/25	2	52	56.422	143	19.941	11.0	
053	R,L,F	01/06/30	1	52	52.518	143	20.977	13.5	
053	R,L,F	01/07/15	1	52	51.929	143	21.075		
053	L	01/07/17	2	52	53.239	143	20.865		
053	R,F	01/07/28	4	52	54.938	143	20.310	11.5	
053	L,F	01/07/29	1	52	51.792	143	21.439	13.5	
053	L,F	01/07/30	5	53	3.551	143	18.747	12.5	
053	R,L,F	01/08/03	11	53	12.966	143	15.673	8.7	
053	L	01/08/12	17	53	2.665	143	18.414	10.5	
053	R,F	01/09/20	11	53	11.104	143	16.569	10.5	

Whale ID number	Aspect	Date	Group number	Initial sighting location (degrees north)	Initial sighting location (minutes north)	Initial sighting location (degrees east)	Initial sighting location (minutes east)	Initial Depth (m)	Sea surface temperature
054	R,L	01/07/28	6	52	56.932	143	19.250	8.1	
054	R,L	01/07/29	7	52	50.227	143	21.257	13.5	
054	R,L	01/07/31	4	52	53.202	143	20.408	10.5	
054	L	01/07/31	5	52	53.681	143	20.736	13.0	
054	R,L	01/08/04	6	52	49.856	143	21.524	16.0	
054	R,L	01/08/11	8	52	52.727	143	21.196	14.5	8.5
054	R	01/08/12	3	52	47.740	143	19.785	4.3	
054	L	01/08/29	6	52	55.815	143	20.359	11.5	
054	R	01/09/02	1	52	51.125	143	21.558	14.5	
054	R,L	01/09/07	9	52	48.892	143	21.706	9.5	
054	R,L	01/09/08	3	52	51.579	143	21.257	13.0	
054	R,L	01/09/13	14	53	21.726	143	11.957	9.5	
054	L	01/09/13	15	53	22.082	143	11.653	11.0	
054	R,F	01/09/17	2	52	56.184	143	21.804	22.0	
055	R,L	01/07/31	3	52	52.802	143	19.785	6.8	
055	R,L	01/07/31	7	52	53.098	143	19.716	6.8	
055	R	01/08/02	1	52	51.130	143	20.231	5.5	
055	R	01/08/04	4	52	50.020	143	20.967	5.8	
055	R	01/08/11	1	52	49.964	143	21.019	7.5	7.0
055	R	01/08/19	4	52	48.536	143	23.093	17.0	
055	L	01/08/19	7	52	46.978	143	22.376	17.0	
055	L	01/08/20	3	52	53.511	143	20.753	13.5	
055	L	01/08/21	8	52	55.961	143	20.194	12.0	
055	L	01/08/26	1	52	53.026	143	20.791	11.5	
055	R	01/08/27	1	52	50.598	143	20.908	6.8	
055	L	01/08/29	4	52	54.719	143	20.466	11.5	
055	R,L	01/09/03	4	52	48.727	143	21.509	8.7	
055	L	01/09/11	3	52	59.209	143	19.180	10.0	
055	L	01/09/13	1	52	56.532	143	20.059	11.5	
055	L	01/09/20	11	53	11.104	143	16.569	10.5	
055	R,L	01/09/23	2	52	57.217	143	19.882	12.5	
055	L	01/09/24	1	52	52.521	143	21.071	12.5	
055	R	01/09/24	3	52	51.978	143	20.964	13.0	
055	L	01/09/25	1	52	52.202	143	21.067	12.5	
056	R,L	01/07/04	2						
056	R,L	01/07/28	13	53	6.821	143	17.757	11.0	
056	R,L	01/08/03	12	53	12.491	143	16.626	11.0	
056	L	01/08/12	17	53	2.665	143	18.414	10.5	
056	R	01/08/14	3	52	55.231	143	19.245	5.5	9.0
056	L	01/08/21	5	52	54.910	143	19.569	4.1	
056	R	01/08/29	1	52	50.967	143	21.713	16.0	10.0
056	L	01/09/02	11	53	6.882	143	17.676	10.5	
056	R,L	01/09/11	6	52	59.723	143	18.901	9.5	
056	L	01/09/20	18	53	15.636	143	14.587	8.7	
056	L	01/09/23	9	53	11.799	143	16.294	10.5	
057	R,L	01/07/04	4	52	55.515	143	20.819	14.0	
057	R,L	01/07/28	13	53	6.821	143	17.757	11.0	
057	R	01/08/18	15	53	5.311	143	18.072	10.5	
057	L	01/08/26	16	53	0.327	143	19.009	12.0	

Whale ID number	Aspect	Date	Group number	Initial sighting location (degrees north)	Initial sighting location (minutes north)	Initial sighting location (degrees east)	Initial sighting location (minutes east)	Initial Depth (m)	Sea surface temperature
057	R	01/08/29	13	53	0.783	143	19.099	11.5	
057	R,L	01/09/02	9	53	5.079	143	18.381	11.5	
057	L	01/09/02	11	53	6.882	143	17.676	10.5	
057	R	01/09/13	12	53	12.152	143	16.360	10.0	
057	R,L	01/09/20	15	53	13.073	143	16.691	13.5	
057	R,L	01/09/23	9	53	11.799	143	16.294	10.5	
057	R,L	01/09/25	5	53	2.491	143	18.165	8.6	8.0
063	R,L,F	01/07/31	2	52	51.506	143	20.395	7.6	
063	R,L	01/08/11	7	52	52.965	143	20.805	12.5	
063	R,L	01/09/18	1	52	53.711	143	20.378	11.5	
063	R	01/09/19	4	52	59.097	143	18.779	9.0	
063	L	01/09/20	5	53	1.386	143	18.950	13.0	
067	R	01/08/20	8	52	46.849	143	20.366	8.7	
068	L	01/08/02	5	52	57.310	143	19.228	9.2	
068	R,L	01/08/12	9	52	58.369	143	18.615	5.5	
069	R,L	01/06/25	1	52	51.722	143	21.751		
069	R,L,F	01/07/04	8	53	4.871	143	18.539		
069	R	01/08/04	7	52	49.965	143	22.231	13.5	
069	R,L	01/08/12	15	53	2.000	143	19.805	18.5	
069	L	01/08/18	17	53	7.186	143	18.702	15.5	
070	L	01/08/12	11	52	59.944	143	20.034	15.0	
070	L	01/09/02	14	53	17.421	143	14.272	10.0	
070	R	01/09/17	1	52	51.963	143	21.186	13.5	
070	R	01/09/18	6	52	58.450	143	19.549	12.5	9.5
070	F	01/09/24	3	52	51.978	143	20.964	13.0	
075	R,L,F	01/07/03	1	52	53.302	143	21.669	19.0	
075	R,L,F	01/07/04	13	53	15.404	143	15.436		
076	R	01/08/03	11	53	12.966	143	15.673	8.7	
079	R	01/07/28	4	52	54.938	143	20.310	11.5	
079	F	01/08/10	4	52	52.567	143	20.848	12.0	
079	L,F	01/08/11	12	52	56.989	143	19.236	8.7	
079	L	01/08/12	19	53	5.471	143	19.108	17.0	9.0
081	R,L	01/07/04	1					13.0	
081	R,L	01/07/10	4	52	58.682	143	18.802	7.7	
081	L	01/07/13	6	52	56.912	143	20.087		
081	R,L	01/07/27	2	52	51.535	143	20.466	9.5	
081	R,L	01/07/31	5	52	53.681	143	20.736	13.0	
081	R,F	01/08/03	1	52	50.492	143	21.542	16.0	
081	R,L	01/08/03	4	52	54.942	143	20.025	10.0	
081	R,L	01/08/12	14	53	2.254	143	18.495	10.5	
081	R	01/08/18	14	53	4.275	143	17.939	9.0	
081	R,L	01/08/26	1	52	53.026	143	20.791	11.5	
081	R,L	01/08/27	6	52	54.674	143	20.356	11.0	
081	L	01/08/29	6	52	55.815	143	20.359	11.5	
081	R,L	01/08/29	7	52	55.707	143	20.282	11.5	
081	R	01/09/02	1	52	51.125	143	21.558	14.5	
081	L	01/09/07	4	52	54.184	143	20.021	9.5	
081	L	01/09/09	5	52	49.403	143	20.783	8.5	
081	R,L	01/09/10	1	52	50.031	143	21.466	17.0	

Whale ID number	Aspect	Date	Group number	Initial sighting location (degrees north)	Initial sighting location (minutes north)	Initial sighting location (degrees east)	Initial sighting location (minutes east)	Initial Depth (m)	Sea surface temperature
081	L	01/09/13	1	52	56.532	143	20.059	11.5	
081	R	01/09/20	14	53	12.438	143	16.257	10.5	
083	L	01/07/29	7	52	50.227	143	21.257	13.5	
083	R	01/08/18	16	53	7.143	143	18.087	12.5	
083	R	01/08/29	2	52	54.036	143	21.790	19.0	
083	R,L	01/09/07	3	52	53.587	143	20.408	11.0	7.0
083	R,L	01/09/08	19	52	49.499	143	20.834	8.7	
083	L	01/09/10	7	52	55.059	143	21.221	19.0	
084	R,L	01/06/30	1	52	52.518	143	20.977	13.5	
084	R,L	01/07/03	7	53	12.974	143	15.875		
084	R,L	01/07/04	10	53	4.758	143	18.246	11.5	
084	L	01/07/17	5	52	57.121	143	19.637		
084	R	01/07/28	7	52	57.507	143	19.547	7.5	9.0
084	L	01/07/28	9	52	58.718	143	19.787	11.0	
084	R,L	01/07/30	1	52	50.956	143	21.372	13.0	7.0
084	R,L	01/07/31	4	52	53.202	143	20.408	10.5	
084	L	01/08/10	3	52	55.495	143	20.231	11.5	4.0
084	R	01/08/12	12	53	0.859	143	18.931	12.0	
084	L	01/08/18	17	53	7.186	143	18.702	15.5	
084	R	01/08/29	8	52	56.651	143	19.782	10.5	
084	R	01/09/02	7	52	58.495	143	19.357	12.0	10.5
084	R	01/09/07	2	52	53.747	143	21.203	15.0	
084	R,L	01/09/08	6	52	53.002	143	24.107	23.0	
084	L	01/09/09	2	52	52.067	143	21.157	13.0	
084	R	01/09/10	8	52	55.154	143	20.644	13.5	11.0
084	R	01/09/11	3	52	59.209	143	19.180	10.0	
084	L	01/09/11	7	52	59.366	143	19.258	11.0	
084	R	01/09/13	1	52	56.532	143	20.059	11.5	
085	R,L	01/08/03	8	53	10.259	143	17.464	11.0	
085	L	01/08/21	11	52	58.004	143	19.846	13.5	
085	R,F	01/08/26	6	52	56.049	143	20.713	14.5	
085	R	01/09/02	5	52	56.264	143	20.325	13.0	
085	R,F	01/09/03	7	52	51.468	143	21.663	15.0	
085	L	01/09/08	5	52	52.950	143	21.069	14.0	
087	R,L	01/06/29	1	52	53.687	143	20.619		
087	R,L	01/06/29	2	52	55.954	143	19.901	10.5	
087	R	01/06/29	3	52	57.034	143	20.095	13.5	
087	R	01/06/29	4	53	0.137	143	19.718		
087	R,L	01/07/03	6						
087	R,L	01/07/13	6	52	56.912	143	20.087		
090	L	01/07/04	2						
090	L	01/07/04	3	52	55.126	143	19.516	5.7	
090	R,L	01/07/27	1	52	50.617	143	21.045		
090	R,L	01/07/29	2	52	52.929	143	20.041	8.5	
090	L	01/07/31	7	52	53.098	143	19.716	6.8	
090	R,L	01/08/03	6	53	1.133	143	18.143	7.6	
090	R,L	01/08/04	4	52	50.020	143	20.967	5.8	
090	R	01/08/10	2	52	54.105	143	19.710	6.2	
090	L	01/08/11	11	52	56.163	143	19.344	8.2	

Whale ID number	Aspect	Date	Group number	Initial sighting location (degrees north)	Initial sighting location (minutes north)	Initial sighting location (degrees east)	Initial sighting location (minutes east)	Initial Depth (m)	Sea surface temperature
090	R,L	01/08/14	3	52	55.231	143	19.245	5.5	9.0
090	L	01/08/20	4	52	48.393	143	20.192	8.5	
090	R,L	01/08/20	7	52	47.786	143	19.759	4.2	
090	L	01/08/20	9	52	46.374	143	19.808	5.1	
090	L	01/08/26	13	52	57.553	143	19.288	9.5	
090	L	01/09/03	2	52	49.255	143	21.155	14.0	
090	L	01/09/05	4	52	48.080	143	20.334	11.0	
090	R	01/09/08	1	52	51.197	143	21.578	15.0	
090	L	01/09/08	4	52	51.814	143	20.634	10.5	
090	L	01/09/08	14	52	55.707	143	19.705	9.5	
090	L	01/09/09	1	52	51.758	143	21.004	11.0	
090	R	01/09/13	3	52	57.515	143	18.920	5.8	
090	R	01/09/17	6	53	8.775	143	16.593	7.0	
090	R	01/09/18	9	52	56.607	143	19.036	6.0	
090	R	01/09/20	10	53	10.005	143	16.578	9.2	
090	L	01/09/23	4	53	6.150	143	19.934	4.3	
090	L	01/09/25	5	53	2.491	143	18.165	8.6	8.0
092	R,L	01/08/04	3	52	47.747	143	19.898	6.2	
092	L	01/08/10	1	52	51.120	143	20.178	4.6	
092	L	01/08/10	7	52	49.797	143	20.604	4.2	
092	R,L	01/08/12	3	52	47.740	143	19.785	4.3	
092	L	01/08/18	2	52	47.853	143	19.961	7.6	
092	L	01/08/18	4	52	47.223	143	19.960	8.5	
092	R,L	01/08/21	1	52	51.355	143	20.079	5.5	
092	L	01/08/21	4	52	53.942	143	19.388	6.7	
092	L	01/09/05	1	52	49.474	143	20.221	4.8	
092	L	01/09/07	10	52	47.463	143	20.167	8.1	
092	L	01/09/08	15	52	52.025	143	20.323	9.2	
092	L	01/09/09	6	52	49.274	143	20.503	7.1	
092	R	01/09/11	4	52	59.521	143	18.488	6.3	
092	L	01/09/11	5	52	59.584	143	18.417	5.7	
092	R	01/09/13	11	53	10.703	143	15.971	6.5	
092	L	01/09/17	6	53	8.775	143	16.593	7.0	
092	L	01/09/20	6	53	6.020	143	17.156	7.2	
092	R,L	01/09/23	6	53	10.797	143	15.759	6.2	
092	R,L	01/09/25	4	53	1.986	143	17.996	7.5	
093	R,L	01/08/11	9	52	54.061	143	20.121	10.5	
093	R,L	01/09/07	4	52	54.184	143	20.021	9.5	
093	L	01/09/10	3	52	51.575	143	20.407	13.5	
093	R,L	01/09/11	3	52	59.209	143	19.180	10.0	
095	R,L	01/07/29	4	52	52.393	143	19.971	7.3	
095	R,L	01/07/30	7	53	4.158	143	17.483	6.2	
095	L	01/08/03	3	52	51.745	143	20.130	7.3	3.0
095	L	01/08/04	3	52	47.747	143	19.898	6.2	
095	R,L	01/08/10	7	52	49.797	143	20.604	4.2	
095	R	01/08/11	2	52	49.246	143	20.196	5.8	
095	R	01/08/18	12	53	1.063	143	18.109	6.3	
095	L	01/08/19	2	52	50.729	143	20.785	7.2	
095	R	01/08/19	8	52	47.089	143	20.693	8.5	

Whale ID number	Aspect	Date	Group number	Initial sighting location (degrees north)	Initial sighting location (minutes north)	Initial sighting location (degrees east)	Initial sighting location (minutes east)	Initial Depth (m)	Sea surface temperature
095	R,L	01/08/21	15	52	46.677	143	20.210	8.0	
095	R,L	01/09/08	15	52	52.025	143	20.323	9.2	
095	L	01/09/11	5	52	59.584	143	18.417	5.7	
095	R,L	01/09/13	6	53	0.945	143	17.994	3.7	10.5
095	L	01/09/13	17	52	56.101	143	19.100	4.5	
095	L	01/09/17	6	53	8.775	143	16.593	7.0	
095	R,L	01/09/23	6	53	10.797	143	15.759	6.2	
095	L	01/09/25	5	53	2.491	143	18.165	8.6	8.0
096	R,L	01/07/29	3	52	52.770	143	19.845	7.1	
096	R,L	01/07/29	5	52	51.166	143	20.183	5.3	
096	L	01/07/29	9	52	52.197	143	19.785	5.5	
096	R,L	01/07/31	1	52	50.764	143	20.731	6.1	
096	R,L	01/08/02	2	52	51.788	143	20.097	7.2	
096	L	01/08/11	13	52	57.447	143	19.100	8.3	
096	L	01/08/12	3	52	47.740	143	19.785	4.3	
096	L	01/08/18	4	52	47.223	143	19.960	8.5	
096	R,L	01/08/21	15	52	46.677	143	20.210	8.0	
096	L	01/08/21	17	52	46.424	143	20.454	8.7	
096	L	01/09/08	8	52	51.693	143	20.565	10.5	
096	L	01/09/09	1	52	51.758	143	21.004	11.0	
096	L	01/09/10	5	52	53.559	143	20.033	9.5	
096	L	01/09/13	17	52	56.101	143	19.100	4.5	
096	R	01/09/17	5	53	2.022	143	18.230	9.0	
096	R	01/09/18	9	52	56.607	143	19.036	6.0	
096	L	01/09/19	6	53	3.522	143	17.914	9.0	
096	L	01/09/25	5	53	2.491	143	18.165	8.6	8.0
097	R	01/07/29	8	52	49.896	143	20.818	4.2	
097	R,L	01/07/29	10	52	49.116	143	19.942	5.0	
097	R	01/08/04	5	52	50.569	143	20.864	4.8	
097	R	01/08/11	2	52	49.246	143	20.196	5.8	
097	R	01/08/12	1	52	48.162	143	19.771	4.0	
097	R,L	01/08/12	4	52	50.143	143	20.932	5.2	
097	R,L	01/08/13	1	52	47.707	143	19.668	3.5	
097	R,L	01/08/14	3	52	55.231	143	19.245	5.5	9.0
097	L	01/08/18	4	52	47.223	143	19.960	8.5	
097	L	01/08/20	10	52	45.420	143	20.029	7.6	8.0
097	L	01/09/08	2	52	51.037	143	20.941		
097	R	01/09/08	4	52	51.814	143	20.634	10.5	
097	R	01/09/08	9	52	53.649	143	19.893		4.7
097	L	01/09/08	15	52	52.025	143	20.323	9.2	
097	R,L	01/09/13	6	53	0.945	143	17.994	3.7	10.5
097	R,L	01/09/17	6	53	8.775	143	16.593	7.0	
097	R	01/09/18	9	52	56.607	143	19.036	6.0	
097	L	01/09/19	6	53	3.522	143	17.914	9.0	
097	L	01/09/25	5	53	2.491	143	18.165	8.6	8.0
098	L	01/07/31	3	52	52.802	143	19.785	6.8	
098	R,L	01/07/31	7	52	53.098	143	19.716	6.8	
098	R,L	01/08/02	1	52	51.130	143	20.231	5.5	
098	R,L	01/08/04	4	52	50.020	143	20.967	5.8	

Whale ID number	Aspect	Date	Group number	Initial sighting location (degrees north)	Initial sighting location (minutes north)	Initial sighting location (degrees east)	Initial sighting location (minutes east)	Initial Depth (m)	Sea surface temperature
098	R,L	01/08/10	5	52	50.511	143	20.980	7.3	
098	L	01/08/18	4	52	47.223	143	19.960	8.5	
098	R	01/08/19	8	52	47.089	143	20.693	8.5	
098	L	01/08/20	7	52	47.786	143	19.759	4.2	
098	R,L	01/08/20	9	52	46.374	143	19.808	5.1	
098	L	01/09/05	1	52	49.474	143	20.221	4.8	
098	R	01/09/07	5	52	54.333	143	19.554	4.3	
098	R,L	01/09/08	19	52	49.499	143	20.834	8.7	
098	L	01/09/10	4	52	53.060	143	20.005	9.2	
098	L	01/09/13	17	52	56.101	143	19.100	4.5	
098	R,L	01/09/18	12	53	2.369	143	17.766	6.0	
098	R	01/09/20	13	53	12.252	143	15.739	10.5	
098	R	01/09/23	6	53	10.797	143	15.759	6.2	
098	R,L	01/09/25	5	53	2.491	143	18.165	8.6	8.0
099	R,L	01/08/04	3	52	47.747	143	19.898	6.2	
099	L	01/08/10	1	52	51.120	143	20.178	4.6	
099	R,L	01/08/10	7	52	49.797	143	20.604	4.2	
099	R	01/08/12	3	52	47.740	143	19.785	4.3	
099	L	01/08/18	2	52	47.853	143	19.961	7.6	
099	L	01/08/18	4	52	47.223	143	19.960	8.5	
099	R,L	01/08/21	1	52	51.355	143	20.079	5.5	
099	L	01/08/21	4	52	53.942	143	19.388	6.7	
099	L	01/09/05	1	52	49.474	143	20.221	4.8	
099	L	01/09/07	10	52	47.463	143	20.167	8.1	
099	R,L	01/09/08	15	52	52.025	143	20.323	9.2	
099	R,L	01/09/09	6	52	49.274	143	20.503	7.1	
099	R,L	01/09/11	4	52	59.521	143	18.488	6.3	
099	L	01/09/11	5	52	59.584	143	18.417	5.7	
099	R	01/09/13	11	53	10.703	143	15.971	6.5	
099	L	01/09/17	6	53	8.775	143	16.593	7.0	
099	L	01/09/20	6	53	6.020	143	17.156	7.2	
099	R,L	01/09/23	6	53	10.797	143	15.759	6.2	
099	R,L	01/09/25	4	53	1.986	143	17.996	7.5	
100	R,L	01/07/04	3	52	55.126	143	19.516	5.7	
100	R,L	01/07/09	1	52	50.809	143	20.311	4.8	
100	R	01/07/29	5	52	51.166	143	20.183	5.3	
100	R	01/07/29	8	52	49.896	143	20.818	4.2	
100	R,L	01/07/31	7	52	53.098	143	19.716	6.8	
100	R,L	01/08/03	3	52	51.745	143	20.130	7.3	3.0
100	R,L	01/08/13	1	52	47.707	143	19.668	3.5	
100	R,L	01/08/18	4	52	47.223	143	19.960	8.5	
100	L	01/08/20	10	52	45.420	143	20.029	7.6	8.0
100	R,L	01/08/21	14	52	47.922	143	20.298	10.0	
100	R	01/09/13	18	52	55.431	143	19.672	9.0	
100	L	01/09/17	6	53	8.775	143	16.593	7.0	
100	R	01/09/18	9	52	56.607	143	19.036	6.0	
100	R,L	01/09/20	12	53	11.394	143	15.777	6.2	
100	R,L	01/09/23	6	53	10.797	143	15.759	6.2	
100	R,L	01/09/25	5	53	2.491	143	18.165	8.6	8.0

Whale ID number	Aspect	Date	Group number	Initial sighting location (degrees north)	Initial sighting location (minutes north)	Initial sighting location (degrees east)	Initial sighting location (minutes east)	Initial Depth (m)	Sea surface temperature
101	R,L	01/06/29	1	52	53.687	143	20.619		
101	R,L	01/06/29	3	52	57.034	143	20.095	13.5	
101	R,L	01/07/04	4	52	55.515	143	20.819	14.0	
101	R,L	01/07/10	1	52	52.149	143	20.877		
101	R,L	01/07/10	2	52	56.567	143	20.332		
101	R,L	01/07/13	4	52	55.995	143	20.536		
101	R,L	01/07/14	2	52	52.738	143	20.508	11.0	
101	R	01/07/27	2	52	51.535	143	20.466	9.5	
101	R,L,F	01/08/03	1	52	50.492	143	21.542	16.0	
101	L,F	01/08/04	1	52	49.003	143	21.062	12.5	
101	L	01/08/04	10	52	51.228	143	21.239	12.0	
101	L	01/08/10	3	52	55.495	143	20.231	11.5	4.0
101	R	01/08/11	10	52	54.866	143	19.905	9.5	
101	R	01/08/12	10	52	59.146	143	19.238	11.0	
101	L	01/08/14	1	52	54.253	143	20.609	13.0	
101	L	01/08/18	17	53	7.186	143	18.702	15.5	
101	R,L	01/08/21	3	52	52.738	143	20.417	10.5	
101	L	01/08/29	5	52	55.611	143	20.209	11.0	
101	R,L	01/09/02	1	52	51.125	143	21.558	14.5	
101	L	01/09/11	3	52	59.209	143	19.180	10.0	
101	L	01/09/11	7	52	59.366	143	19.258	11.0	
101	L	01/09/18	3	52	56.626	143	20.255	14.0	
101	R,L	01/09/20	4	52	57.476	143	18.976	6.7	9.0
101	R,F	01/09/23	2	52	57.217	143	19.882	12.5	
101	R,L	01/09/24	6	52	53.502	143	20.475	12.0	
101	R,L	01/09/25	3	52	58.310	143	19.643	12.5	
102	R,L	01/06/30	8	52	55.759	143	19.833	10.0	
102	R,L,F	01/07/04	10	53	4.758	143	18.246	11.5	
102	R,L,F	01/07/10	5	53	1.610	143	18.372		
102	L	01/07/15	1	52	51.929	143	21.075		
102	R,F	01/08/02	6	52	57.363	143	19.242	9.0	
102	R	01/08/12	17	53	2.665	143	18.414	10.5	
102	R	01/08/26	3	52	56.642	143	21.290	19.0	
102	R,L,F	01/09/02	9	53	5.079	143	18.381	11.5	
102	R	01/09/03	4	52	48.727	143	21.509	8.7	
102	R,F	01/09/03	10	52	53.558	143	20.819	12.5	
102	R,L,F	01/09/13	8	53	4.767	143	18.340	11.5	
102	R,L	01/09/20	17	53	15.177	143	14.842	9.5	
102	R,L,F	01/09/23	7	53	10.964	143	16.040	8.0	
103	R	01/07/28	16	53	12.649	143	16.652	12.5	
103	R,L	01/07/31	4	52	53.202	143	20.408	10.5	
103	R	01/08/02	3	52	55.207	143	19.679	8.2	
103	L	01/08/02	4	52	56.172	143	19.337	8.0	
103	R,L	01/08/02	6	52	57.363	143	19.242	9.0	
103	R	01/08/12	12	53	0.859	143	18.931	12.0	
103	L	01/08/18	8	52	53.044	143	20.863	12.5	
103	R,L	01/08/19	1	52	51.201	143	21.667	15.5	
103	R,L	01/08/21	3	52	52.738	143	20.417	10.5	
103	R	01/08/26	3	52	56.642	143	21.290	19.0	

Whale ID number	Aspect	Date	Group number	Initial sighting location (degrees north)	Initial sighting location (minutes north)	Initial sighting location (degrees east)	Initial sighting location (minutes east)	Initial Depth (m)	Sea surface temperature
103	L	01/08/26	4	52	56.155	143	21.634	22.0	
103	L	01/08/27	3	52	51.246	143	21.615	14.5	
103	R,L	01/08/29	1	52	50.967	143	21.713	16.0	10.0
103	R	01/09/02	2	52	54.017	143	20.614	12.5	
103	R,L	01/09/03	4	52	48.727	143	21.509	8.7	
103	L	01/09/08	17	52	51.312	143	21.436	15.0	
103	R,L	01/09/10	1	52	50.031	143	21.466	17.0	
103	L	01/09/13	1	52	56.532	143	20.059	11.5	
103	L	01/09/18	7	52	51.315	143	20.535	8.7	
103	L	01/09/18	8	52	52.555	143	19.839	6.5	
103	R,L	01/09/19	1	52	51.381	143	20.640	10.5	
103	L	01/09/20	3	52	56.726	143	19.430	9.7	
103	R	01/09/23	2	52	57.217	143	19.882	12.5	
103	R,L	01/09/25	5	53	2.491	143	18.165	8.6	8.0
104	R,L,F	01/07/15	3	52	53.421	143	20.423		
104	R,F	01/07/30	3	52	57.194	143	19.390	9.2	
104	L,F	01/08/02	5	52	57.310	143	19.228	9.2	
104	L,F	01/08/03	2	52	51.654	143	20.565	10.0	
104	R,F	01/08/26	3	52	56.642	143	21.290	19.0	
105	R,L	01/07/31	5	52	53.681	143	20.736	13.0	
105	R,L,F	01/08/04	2	52	48.509	143	20.515	10.5	
105	R,L,F	01/08/12	7	52	53.552	143	19.916	8.5	
105	R,L,F	01/08/18	8	52	53.044	143	20.863	12.5	
105	L	01/08/19	1	52	51.201	143	21.667	15.5	
105	R,L	01/08/19	8	52	47.089	143	20.693	8.5	
105	R,L	01/08/29	14	52	51.198	143	21.165	11.5	
105	R,L	01/09/03	5	52	45.023	143	21.210	11.5	
105	R,L	01/09/08	11	53	3.051	143	17.819	8.1	
105	L,F	01/09/10	6	52	54.350	143	20.212	11.0	
105	F	01/09/10	7	52	55.059	143	21.221	19.0	
105	R,L	01/09/11	9	53	0.461	143	19.803	16.5	
105	R,L	01/09/13	8	53	4.767	143	18.340	11.5	
105	R	01/09/17	7	53	9.276	143	17.964	13.5	
105	L	01/09/23	1	52	51.060	143	20.750	9.0	
105	R,L	01/09/25	2	52	56.422	143	19.941	11.0	
106	R,L	01/08/26	14	52	58.866	143	18.885	9.5	
106	L	01/09/03	1	52	49.452	143	21.376	14.5	
106	L	01/09/03	3	52	49.215	143	21.353	12.0	
106	R	01/09/07	9	52	48.892	143	21.706	9.5	
106	L	01/09/08	4	52	51.814	143	20.634	10.5	
106	L	01/09/10	5	52	53.559	143	20.033	9.5	
106	R,L	01/09/11	6	52	59.723	143	18.901	9.5	
106	L	01/09/13	5	53	1.580	143	18.298	8.5	
106	R,L	01/09/13	7	53	3.352	143	17.781	7.0	
106	L	01/09/23	8	53	11.358	143	15.812	6.5	