

1997/1998 IWC-SOUTHERN OCEAN WHALE AND ECOSYSTEM RESEARCH (IWC-SOWER) BLUE WHALE CRUISE, CHILE

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Introduction

The 1997/1998 IWC -SOWER Blue Whale Cruise was carried out in the southeastern Pacific Ocean off the coast of Chile during December 1997 and January 1998. This was the third cruise of the IWC's programme of research on Southern Hemisphere blue whales and the second to be undertaken under the Southern Ocean Whale and Ecosystem Research (SOWER) initiative. The first was a joint IWC Japanese cruise. The main objective of this programme is to assess the status of "true" blue whales (*Balaenoptera musculus intermedia*) in the Southern Hemisphere. The initial and present objective of the programme's research is to obtain scientific information relevant to developing shipboard identification methods of distinguishing "true" blue whales and pygmy blue whales (*B. musculus brevicauda*). The initial two cruises (in Australian waters in 1995/96 and south of Madagascar in 1996/97) had centered on this aspect. This cruise arose as an opportunity for continuation of this research off the west coast of South America prior to the 1997/98 SOWER Antarctic cruise to Area II.

Approaches to be used to meet the research objective included acoustic sampling, genetic analyses of skin samples, and observations of whale behaviour and external morphology.

The IWC provided partial funding for the cruise. The research vessels *Shonan Maru* and *Shonan Maru No 2*, their crews and equipment, and two researchers were provided by the Government of Japan. The Government of Australia provided funding for one researcher, while the Government of the USA provided funding for one researcher, and sonobuoys used for acoustic research.

The research vessels were the same as those used during the previous two cruises.

Planning

Planning of the 1997/98 SOWER Blue Whale Cruise was carried out at a two-day meeting held in Tokyo on 8 and 9 August 1997 (Anon 1997a).

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Research Area

Three areas of summer (November to January) concentrations of blue whales off the west coast of South America were identified. These were:

1. Off Paita, Peru (about 5° S)
2. Off Iquique, Chile, (between 18°30' S and 22° S and east of 72° W)
3. Between Valparaiso and Talcahuano, Chile (between 31°00' S and 40°00' S and east of 75° W).

The planning meeting concluded that the areas of the two southern concentrations (hereafter referred to as the Iquique and Valparaiso/Talcahuano sectors) would be the most suitable for research. The proposed research plan was for both the vessels to depart from Iquique, for one vessel to search the Iquique sector from 18°30' S for approximately 7 days before transiting to the northern limit of the Valparaiso/Talcahuano sector (30°00' S) and begin searching southwards in this sector. At the same time the other vessel would transit directly to the southern limit of the Valparaiso/Talcahuano sector (at 38° 00' S) and begin searching northwards. A cruise track for the first 14 days of the cruise (based on historical catches of blue whales off Chile) was suggested and is shown in Figure 1. After approximately 14 days the vessels would meet at about 32° 00'S and a decision would be made as to where to concentrate research effort during the second half of the cruise.

It was stressed that the priority of the cruise was to obtain information on the differentiation of the two blue whale forms, and not to obtain an estimate of abundance of blue whales in the research area. The aim of the cruise would therefore be to maximise encounters with blue whales and not to complete full coverage of the research area. Considerable flexibility to modify the suggested cruise track was given to the senior scientists aboard each vessel.

The detailed cruise schedule is given in Anon (1997a). Permission to survey within the 200 n mile EEZ, but outside the 12 n.mile territorial limit of Chile, was applied for and received from the Chilean Government.

Research Personnel

Eight researchers were selected for the cruise at the Tokyo planning meeting. Two observers attended the cruise on behalf of the Chilean Government. Researchers were assigned to the vessels as follows:

Shonan Maru: Ken Findlay (South Africa), Paul Ensor (New Zealand), Don Ljungblad (USA), Hiroshi Iwakami (Japan), Rodrigo Hucke-Gaete (Chilean National observer).

Shonan Maru No.2: Robert Pitnlan (USA), Deborah Thiele (Australia), Koen Van Waerebeek (peru), Hiroyuki Shimada (Japan), Gian Paolo Sanino Vattier (Chilean National observer).

Research protocol

The research protocol and equipment used in this cruise are fully discussed in Anon (1997a) and Anon (1997b). For terms of reference they will be briefly summarised below.

Searching

Research was planned for 12 hours per day (06h00 - 18h00) under acceptable weather conditions as determined by the senior scientist and Captain. Acceptable weather conditions on this cruise were generally found to be at a wind speed of less than 25 knots. All searching would be carried out in passing mode with closing on blue whales (primary target species) and other large baleen whales to confirm identification. Closures on secondary target species (in order of priority -right, humpback, minke and Bryde's whales) would be carried out for biopsy and photo-identification as long as they

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did not interfere with the aim of maximising encounters with blue whales. Large groups of rare or rarely seen species could be closed with at the senior scientist's discretion. Closures on secondary and "other" species were to be limited to less than thirty minutes with a maximum of three such closures per day.

As on the 1996/1997 IWC-SOWER Blue Whale Cruise to the south of Madagascar this selective closing mode was assigned a "BB" research effort code.

Protocol for approaching whales

Blue whales

The protocol for closing on blue whales adopted on this cruise would be similar to that used on the 1996/1997 IWC SOWER Blue Whale Cruise, although no photogrammetry was carried out during this cruise. On confirming a sighting as a primary target species the vessel would approach to approximately 1 n.mile and acoustic monitoring equipment would be deployed. An initial acoustic monitoring period of over half an hour would be maintained during which time dive time experiments would be carried out. After completion of the acoustic monitoring and dive time experiments, the animal(s) would be approached for biopsy, and still and video photography. If possible biopsy sampling would be carried out from the small boat, with photography being carried out from the main vessel after the small boat had been recovered. If the approach was to be carried out from the main vessel then biopsy and photography were to be carried out simultaneously. After completion of biopsy sampling and photography, acoustic monitoring could be continued at the discretion of the acoustician in consultation with the senior scientist.

The identifications of blue whales to sub-species level on the cruise are preliminary field identifications expressing the observers opinion of the sub-species. After all sightings of blue whales, topmen were to be interviewed as to the characteristics used in making the identification.

Secondary target species

Secondary target species would be approached for biopsy (right, humpback, minke and Bryde's whales) and photo-identification studies (right and humpback whales) where such approaches did not compromise the aim of the cruise of maximising encounters with blue whales.

"Other" target species

Sightings of other species could be approached at the senior scientist's discretion. Such approaches would be limited to large groups of rare or rarely seen species.

On completion of the closure the vessels would not return to the constructed trackline, but proceed directly from the point of leaving the sighting to the next planned waypoint.

Other experiments

Oceanographic Sampling

No decision on oceanographic sampling was made at the Tokyo planning meeting as it was agreed to defer a decision until after the 49th meeting of the IWC Scientific Committee. The IWC Scientific Committee's Working Group on Environment reviewed the adequacy of the oceanographic sampling of the SOWER programme to date, and it was decided that oceanographic sampling on this cruise would be carried out on an opportunistic basis.

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The following changes to the research protocol were made at the pre-cruise meeting and during the cruise.

1. As with the 1996/1997 Blue Whale Cruise, greater flexibility was given to the senior scientist on each vessel to close with large whales for confirmation. Furthermore, smaller cetaceans close to the trackline could be closed with at the senior scientist's discretion.
2. It was decided at the pre-cruise meeting that oceanographic sampling was to be carried out at the discretion of the senior scientist on each vessel and should be limited to poor weather conditions when sighting effort was not possible, the vicinity of blue whales (possibly while other blue whale research is being carried out -in which case it would have no priority over other blue whale research) , or if the vessels are well ahead of schedule.
3. Provision of VHF headsets allowed for behavioural observations to be relayed to the acoustician. On the *Shonan Maru* the dive time observations were recorded simultaneously with acoustic recording experiments whilst on the *Shonan Maru 2* all of the topman's commentary during blue whale experiments was relayed to the acoustician.

Modifications to the Vessels and Equipment since previous SOWER cruises.

Based on recommendation from last years cruise, the following modifications had been made to the vessels:

1. A new small boat had been purchased for each vessel.
2. The gun deck had been painted with a non-slip surface and a waterproof box was provided on the gun deck for storage of research equipment during experiments..
3. Angle boards had been provided for researchers on the front bridge.

It was recommended after the 1996/97 IWC-SOWER Blue Whale Cruise that researchers be provided with reticule binoculars, but these were not available.

Narrative of the Cruise

Pre-cruise Meeting and Transit to the Research Area

The vessels arrived in Iquique on schedule on 9 December. A pre-cruise meeting was held at the Hotel Atenas between 09h00 and 16h00 on 10 December, and was attended by the captains, officers and boatswains of each vessel, the researchers and the Chilean observers.

In transit from Japan to Iquique, the *Shonan Maru* had called in at Honolulu to load research equipment required for the cruise. This equipment was unpacked and checked by researchers on 9 December, when it was found that the biopsy heads for the two crossbow systems aboard each vessel had not been received. An immediate request was made to the Southwest Fisheries Science Center, USA for heads to be sent by courier to Iquique. These heads did not arrive in Iquique by the proposed departure time at 15h00 on 12 December, although were expected later on the same day. A decision to wait in the Iquique roads for the evening of 12 December was made and the ships departed from the quay on schedule at 15h00, further delay resulted in the ships waiting overnight. The *Shonan Maru* departed from Iquique roads at 10h00 on 13 December while the *Shonan Maru No 2* waited a further hour for the biopsy heads. Both vessels carried out biopsy training exercises outside the 12 n. mile territorial waters to the west of Iquique during which time biopsy heads were transferred to the *Shonan Maru*. These training exercises were conducted from both the main vessel and the small boats.

The *Shonan Maru No 2* arrived at the northern limit of the Iquique sector at 06h00 on 14 December and began searching this sector The *Shonan Maru* steamed to the southern limit of the Valparaiso-Talcahuano sector, arriving at 38°00' S 77° 00' W by 06h00 on 18 December. A total of 42h 28m of

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searching over 474.8 n miles was carried out by both vessels in transit to the research areas. No research time was lost to poor weather during the transits to the research areas.

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Iquique sector (18° 30' S -23°00' S)

This sector was bounded by the 18° 30' S and 23° S latitudes and the boundary of the Chilean territorial waters (12 n. mile from the coast) and the 073° W longitude, and the cruise track in this sector comprised five survey transects totaling 777.5 n. miles (Figure 1). The *Shonan Maru No 2* started searching this sector at 06h00 on 14 December and completed all five survey transects by 10h12 on 21 December. A total of 62h57m of searching over 742.9 n miles was carried out by the *Shonan Maru No 2* in this Sector. Two sightings of pygmy blue whales were made in this sector.

Antofagasta - La Serena sector (23° 00' S -30° 00' S)

In transit to the southern limit of the Valparaiso - Talcahuano sector, the *Shonan Maru* made one sighting of a pygmy blue whale and one sighting of a "like" blue whale approximately 20 n. miles apart in the region of 29° S; 073° 30' W. Consequently it was decided to increase the *Shonan Maru No 2*'s survey coverage in the area between the Iquique and Valparaiso -Talcahuano sectors. An additional survey sector, the Antofagasta -La Serena sector, was established for the *Shonan Maru No 2* between 23° 00' S and 30° 00' S, rather than having the vessel transit directly to 30° 00' S. Three survey transects were planned for this sector comprising a total of 601.8 n. miles and these are shown in Figure 1. The *Shonan Maru No 2* began searching this sector on 21 December.

On 24 December the *Shonan Maru No 2* sighted three pygmy blue whales and one unidentified large baleen whale in the region of 27° S; 071° 50' W. A further three pygmy blue whales were sighted offshore of these over the next two days. These sightings and the two sightings made by the *Shonan Maru* in the region during the southward transit to the Valparaiso -Talcahuano sector, were the highest sighting rates of blue whales during the initial survey. The region between 26° 00' S and 30° 00' S and 074° W and the 12 n. mile limit was chosen for concentrated survey for the remainder of the scheduled research time. It was planned that *Shonan Maru* would search northwards between 30° 00' S and 28° 30' S, while the *Shonan Maru No 2* would search between 26° 00' S and 28° 30' S. The *Shonan Maru* reached the northern limit of the Valparaiso -Talcahuano sector (at 30° S) on 01 January and moved into the Antofagasta -La Serena sector for the final day of scheduled research (2 January).

A total of 90h 33m of searching was carried out by both vessels in this sector, during which 1039.3 n. miles were searched and 13 sightings of 20 pygmy blue whales were made.

Valparaiso -Talcahuano sector (30° 00' S -38°00' S)

This sector was bounded by the 38° S and 30° S latitudes and the 12 n. mile limit of Chilean territorial waters and the 077° W longitude. The constructed cruise track in this sector comprised five survey transects totaling 1246.9 n. miles (Figure 1). The *Shonan Maru* started searching this sector at 06h00 on 18 December. The fourth transect of this sector was truncated at its midpoint (32° 42' S; 074° 30' W) at 15h30 on 26 December, and a new transect was established between this point and 12 n. mile limit at 30° S. This modification was made so the vessel could move more quickly to the north-east of the sector where a higher sighting rate was anticipated based on sightings made by the *Shonan Maru No 2* in the Antofagasta - La Serena Sector. Sightings of 4 pygmy blue whales were made by the *Shonan Maru* in the region of 31° 00' S on the modified transect and these resulted the region of concentrated survey being extended to 31° 00' S. The *Shonan Maru* reached the northern limit of the Valparaiso - Talcahuano sector (at 30° S) on 01 January. A total of 99h 42m and 1157.9 n. miles of searching was carried out in the Valparaiso -Talcahuano sector during which time 12 sightings of 12 pygmy blue whales were made.

Transit to Punta Arenas

Both the *Shonan Maru* and the *Shonan Maru No 2* commenced the transit to Punta Arenas from near the coast in the region of 30°00' S at 18h00 on 02 January. Additional coverage of the Valparaiso - Talcahuano sector was made by both vessels during the transit. The vessels arrived at the entrance to

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the Magellan Straits on 9 January. The transit of the *Shonan Maru* followed a course approximately 20 n. miles from the coast, with the *Shonan Maru No 2* transiting between 10 and 15 n. miles to the west of *Shonan Maru* until 06 January when *Shonan Maru No 2* moved to between 5 and 8 n. miles to the west of the *Shonan Maru* trackline to search closer to the coast. A total of 94h 11m of search effort covering 1039 n. miles was carried out by both vessels during the transit to Punta Arenas. Six sightings of pygmy blue whales were made by both vessels during these transits. Totals of 16 and 26 minutes of drifting were carried out by the two vessels during a transfer of data at sea on 3 January 1998.

Mid-cruise Meeting

No mid-cruise meeting was held as no concentrations of blue whales had been identified after the initial 14 days of survey, and it was felt that effort would be maximised if the vessels continued to search in separate areas until a concentration of blue whales had been identified.

Post-cruise Meeting

A post-cruise meeting was held on the afternoon of 10 January at the Hotel Navigantes, Punta Arenas. This meeting was attended by the researchers, observers and the ships' captains.

Results

All results presented here are preliminary as the data have not been through a final validation screening.

Survey Effort

The *Shonan Maru* completed 179h 23m of search effort and 2065.4 n. miles of trackline during the cruise (Figure 1a). The *Shonan Maru No 2* covered 2388.5 n. miles of searching in 210h 35m of search effort during the cruise (Figure 1b). Tables 1a and b summarise the research effort carried out by each vessel in each of the three sectors and during transit time during the survey.

All search effort was carried out in "BB" mode (passing mode with direct closures to selected sightings at the discretion of the senior scientist).

Weather

The wind conditions experienced by each vessel in each sector are summarised in Figure 3a and b. No research time was lost to poor weather during the transits to the research areas, nor by the *Shonan Maru No 2* in the Iquique sector. Marginal weather conditions were experienced by the *Shonan Maru* in the southern region of the Valparaiso -Talcahuano sector and 10h 44m of drifting were carried out by the *Shonan Maru* in this region. The *Shonan Maru No 2* lost 34m of research time to poor weather in the Antofagasta -La Serena sector. The transit to Punta Arenas was steamed in variable weather conditions and 12h 49m and 8h 50m were lost to poor weather by the *Shonan Maru* and *Shonan Maru No 2* respectively.

Sightings

The number of groups and individuals of each species sighted by the vessels in each sector are presented in Tables 2a-b and the distribution of all sightings are shown in Figure 3a.

Blue whale sightings.

Twenty-two sightings of 22 individual blue whales were made by the *Shonan Maru*, and 17 sightings of 25 individual blue whales were made by the *Shonan Maru No 2* during the cruise. One sighting of one "like" blue whale was made by the *Shonan Maru*. Thirty seven groups (comprising 45 animals) were tentatively identified as pygmy blue whales. A further 2 groups of 2 animals were identified as undetermined blue whales. Visual recognition data were collected for all sightings of

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pygmy blue whales that were confirmed. The distribution of blue whale sightings are shown in Figure 3b.

Sperm whales were the most frequently sighted large cetacean during the cruise (Figure 3c), while Bryde's whales were the most commonly sighted baleen whale (Figure 3d). Bottlenose dolphin was the most commonly sighted small cetacean (Figure 3e).

Experiments

The time expended on experiments during closing of sightings by both the *Shonan Maru* and *Shonan Maru No 2* are summarised in Tables 3a and b respectively. Totals of 57h 32m and 51h 41m were spent on experiments during closures by the *Shonan Maru* and *Shonan Maru No 2* respectively. Of these, totals, 55h 28m and 34h 29m were spent on experiments on blue whales by the *Shonan Maru* and *Shonan Maru No 2* respectively.

Blue whales

Biopsy Sampling

Results of the biopsy sampling experiments carried out by each vessel are summarised in Tables 4a and b respectively. Seven samples were obtained from 17 blue whales approached for biopsy sampling by the *Shonan Maru*, while the *Shonan Maru No 2* obtained 12 samples from 11/12 blue whales approached for biopsy sampling. Biopsy sampling was usually carried out with other experiments such as video and still photography and the time solely on biopsy sampling by each vessel is impossible to determine.

Two samples of pygmy blue whales were lost from the *Shonan Maru* when the heads broke off the Paxarms darts on impact. As a result two darts were made up with heads epoxy glued into the dart body. These heads could not be removed for cleaning, so the entire dart tips were dipped in alcohol and flamed. After collection of a biopsy sample (number 9856007) with one of these two darts on 5 January, the head was sawed off the dart for removal of the sample and a second biopsy sample was found lodged in the cavity behind the biopsy head. It is assumed that this sample was taken from sighting number 008 or 010 on 2 January (both sightings were pygmy blue whales) when a strike without a recovered sample was recorded. (At the time of this strike the researcher (KF) was confident that a sample had been taken by the dart.) It is uncertain whether this found biopsy has any value for genetic analysis and the entire biopsy has been stored in DMSO as sample number 9856008.

Observations and photography of individual external morphology

Results of the observations and photography of individual external morphology are summarised in Table 5a and b. Totals of 376 still frames and 117.06 minutes of video of blue whales were collected from the *ShonanMaru*, while 86 still frames and 63.11 minutes of video of blue whales were collected by the *Shonan Maru No 2*.

Dive Time Studies

Results of the dive time experiments are summarised in Table 6a and b. A total of 14h 07m of dive time observations were carried out on 13 blue whales from the *Shonan Maru*. The *Shonan Maru No 2* undertook 2 h 13 m of dive time observations on 7 blue whales.

Acoustic Studies

Results of the acoustic experiments are summarised in Table 7a and b. A total of 72h 01m of acoustic monitoring was carried out from the *Shonan Maru* at 15 stations in the vicinity of blue whales during research hours (06h00 -18h00). Bio-calls were recorded at 9 of these stations, while possible bio-calls were heard at a further two stations. A further 79h 50m of acoustic monitoring were carried out from *Shonan Maru* at 14 acoustic stations held "after hours" between 18h00 and 06h00. Bio-calls were recorded at 3 "after hours" stations and possible bio-calls were heard at a further two stations. The *Shonan Maru No 2* undertook 26h 23m of acoustic monitoring at 20 stations during research hours

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and 76h 59m of acoustic monitoring at 16 stations “after hours”. No possible blue whale calls were heard by the *Shonan Maru No 2*.

Secondary target species

Biopsy Sampling

Biopsy samples from two humpback and 9 Bryde’s whales were obtained. *Photo-*

Identification Studies

Results of the photo-identification experiments are summarised in Table 8. No photo-identification experiments were carried out from the *Shonan Maru*. The *Shonan Maru No 2* undertook 16 photoidentification experiments on 5 humpback whales and 13 Bryde’s whales.

Other species

Results of the experiments carried out on other species are summarised in Table 9.

Oceanographic Studies

A total of 22 CTD and 9 XBT stations were carried out during the cruise (Table 10).

Discussion

Schedule and Survey Design of the Cruise

Considerable flexibility was incorporated into both the schedule and the survey design of the cruise, so that no attempt was made to stick to a fixed schedule other than the scheduled end of research to ensure that sufficient time was available for transit to reach Punta Arenas on 10 January 1998.

The initial delay in departure of the vessels due to the non-arrival of the crossbow biopsy heads resulted in each vessels arriving one day late at their respective starting points of research. The termination of the 4th survey transect in the Valparaiso -Talcahuano sector at its midpoint allowed *Shonan Maru* to recover some of this time and to proceed directly to the region where a higher concentration of blue whales was anticipated.

Although adding an additional two to three days to the *Shonan Maru No 2*'s schedule the survey transects planned for the *Shonan Maru No 2* in the Antofagasta -La Serena sector were an extremely fortuitous addition to the survey design as they identified the northern limit of the major concentrations of blue whales encountered during the cruise (at approximately 26° 30' S).

The fact that no areas of blue whale concentrations had been identified after the initial 14 days of survey resulted in no mid-cruise meeting being held around the 26 December.

The vessels were still relatively far north towards the end of the scheduled research time and seven rather than five days were required for the transit to Punta Arenas. This seven day transit time allowed for an average of two research hours (of closing and experiments) each day.

Distribution of blue whale...

Blue whales were distributed throughout the area surveyed and it was only after the initial 14 day survey period that a region of higher sighting rates was identified. A high sighting rate of blue whales was found immediately offshore of the 12 n.mile limit of Chile and it is possible that higher concentrations may have been found inshore of the 12 n. mile limit.

Modifications to the Vessels

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The new small boats

After the initial training exercise researchers on both vessels felt that the new small boats were underpowered and that chasing blue whales with them would be difficult. The *Shonan Maru* launched the small boat on a blue whale sighting on one occasion (on 30 December) and a biopsy sample was obtained relatively easily once the small boat was underway from the main vessel. The *Shonan Maru No 2* did not launch their small boat. Weather conditions largely precluded the use of the small boats. Researchers felt that a) during this cruise the small boats were unnecessary, b) given that the small boats can be prepared during the dive time and acoustic experiments, they may be a cost-effective means of biopsy-sampling blue whales, and c) that under good weather conditions in regions of high blue whale concentrations, the small boats could be useful as secondary biopsy platforms.

Gun deck surface

The researchers felt that the non slip surfaces on the gun decks were a major improvement over the previous surface and that as a consequence sampling in poorer weather conditions was greatly facilitated.

Angle boards

There were varying opinions on the effectiveness of the new angle boards which remained unresolved at the time of the meeting.

Experiments on Blue Whales

The protocol for approaching blue whales developed during the 1996/1997 IWC-SOWER Blue Whale Cruise worked well during this cruise. This protocol is fully described in Anon (1997b).

Acoustic experiments

The possible blue whale calls perceived by the *Shonan Maru* ranged between 9 and 44 Hz and were between 1 and 32 seconds in duration. An interesting acoustic result obtained on the *Shonan Maru* on this year's cruise was the detection of "unique" calls from blue whales during biopsy sampling attempts. These calls consisted of tonal sounds at about 11 Hz with harmonics at 24, 36 and 44 Hz and all occurred when the main vessel was approaching the whale at full speed. After the initial recording of such a call, acoustic recording was carried out whenever possible during biopsy sampling attempts.

There was a considerable difference in the number of detected blue whale calls between the two vessels. The *Shonan Maru* detected possible blue whale calls at nine stations, while no possible blue whale calls were detected by the *Shonan Maru No 2* (although they might well have been recorded). Although this difference was originally considered biological with many of the *Shonan Maru* sounds being perceived offshore in the Valparaiso -Talcahuano sector, the *Shonan Maru* did record sounds in the southern inshore region of the Antofagasta -La Serena sector.

Biopsy Experiments

Three biopsy systems were available on each vessel, including the Paxarms system, a compound crossbow system and a standard crossbow system. Researchers generally used the systems they were most familiar with.

Researchers found that blue whales on this cruise were easier to approach, and less inclined to run than on the previous two cruises. It is suggested that every attempt should be made to obtain biopsy samples on the initial close approach of the blue whale, and that if possible the initial approach should be made downwind as this greatly facilitates the chance of striking the animal, particularly in high wind or sea conditions.

Both tethered and untethered Paxarms systems were supplied on this cruise. The tethered system was only attempted once in strong winds when recovery of the dart would have been difficult and the animal was missed on this attempt. The wind drag on the line appeared to affect the flight of the

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dart, although sea conditions and poor marksmanship (KF) may well have played a part in this. Other problems encountered with the Paxarms system included the loss of two Best biopsy heads on striking whales, and two samples (one from a pygmy blue whale and one from a humpback whale) were not taken on strikes by Paxarms biopsy heads. The possible loss of a further sample (number 9856008) through lodging in the rear of a modified Paxarms dart from *Shonan Maru* is unfortunate.

The Barnett RC300 compound crossbow systems were a valuable addition to the biopsy sampling equipment, greatly increasing the range over the simple crossbow. The two miss-fires with the compound crossbow system on the *Shonan Maru* possibly resulted from the bolt floatation affecting the seating of the bolt in the crossbow. Planned modifications to the compound crossbow bolts (including improvement to the knocks and floatation systems) should result in an even higher success rate with the crossbow system.

The Japanese air gun systems obtained three samples on this cruise and the option to use them in future cruises should remain at the discretion of the senior scientist on the vessel.

Photo and Video Experiments

The majority of video photography from the *Shonan Maru* was carried out from the IOP barrel or radar platforms as sea conditions often precluded the use of the camera on the gun deck. Still photography on the *Shonan Maru* was carried out from the gun deck in good weather conditions and from the IOP barrel or radar platforms in poorer weather conditions. Both the IOP and radar positions provided good platforms for video and still photography of head and blowhole shape of blue whales. It was found on the *Shonan Maru No 2* that under low contrast situations it was better to use the video in manual mode; that the 2nd radar platform provided the least obstructed view; and long life batteries as supplied on *Shonan Maru* may be useful in cold conditions. The 1.4 x teleconverters, purchased for the still camera lenses as recommended following the experience on the last cruise, were not used due to whales being easier to approach on this cruise.

Dive Time Experiments

Dive time experiments on *Shonan Maru* were generally carried out at distances of between 0.5 and 2 n. miles, although if the whale approached the vessel closer than this no attempt was made to move the vessel. If the whale surfaced at over about 1.3 n. miles then the vessel made a slow approach to a distance of about 1 n. mile. The experiments on *Shonan Maru* generally followed the protocol of one observer calling out cues to a) a data recorder who noted the time of the cue and recorded it on the data sheet, b) to a hand held tape recorder and c) to the acoustician via the headsets. All cues were detected by the observer by naked eye and Polaroid sun-glasses. All cues and their associated distances and angles were called by the topman and noted by the data recorder. No problems were associated with this protocol.

The VHF headsets for communication between the dive time observer and the acoustician proved to be a valuable addition to dive time experiments on *Shonan Maru*, both in terms of collection of dive time data on the acoustic tape and for providing the acoustician with information on the whale's behaviour. On the *Shonan Maru No 2* the relaying of information from the topman to the acoustician was found to be valuable.

1997/1998 IWC-SOWER Blue Whale Cruise

Recommendations

1. Based on the experience of this cruise the necessity of the small boats is questioned. The researchers recommend that these boats remain available for use in certain conditions (good weather and large whale groups). However the possibility of increasing the power needs to be investigated (for instance, removal of propeller guards or long shafts).
2. It is recommended that the necessity for further dive time experiments be investigated at the Planning Meeting. The researchers feel that a) there is considerable variation in individual behaviour within trials, and b) that the techniques used to collect these data are not consistent or representative.
3. The headsets used for communications between the front bridge and acoustician during experiments on *Shonan Maru* proved to be very useful for the acoustician. It is recommended that these systems be used in experiments (including biopsy approaches) on future cruises.
4. While it is realised that the 1997 Annual Meeting of the IWC was held after the Tokyo planning meeting, it is recommended that in future years all relevant documents (including data usage notes) from the Tokyo planning meeting to researchers be sent immediately after the meeting or at least within a month thereafter.
5. It is recommended that all equipment needed for the cruise be requested four months prior to the commencement date for the cruise. Equipment checklists for biopsy and acoustic systems will be developed by researchers at this meeting, to be provided to the cruise leader for the next cruise prior to the next Planning Meeting.
6. Ljungblad provided a GPS system for use in his cabin during acoustic experiments on this cruise. The system allowed for the interpretation of where the sonobuoy and vessel were positioned at any time. It is recommended the IWC's GPS system be provided for future cruises. It should be noted that such a GPS system would require an external antenna. Furthermore considerable interest in directional hydrophones was shown by the IWC Scientific Committee two years ago. For the past two years the sonobuoys have had directional capabilities which could not be utilised with the present receivers. It is recommended that the IWC investigate the possibility of procuring directional receivers.
7. The Sonobuoy receivers require a VHF antenna on board the ships. In the past these have been provided by Ljungblad. During this cruise the *Shonan Maru* radio officer kindly provided the VHF antenna from the marine -band radio. The researchers recommend that if the vessels are to be modified then an active VHF antenna be supplied for acoustic experiments.
8. Four biopsy systems were available on each vessel, including the Paxarms system, a compound crossbow system, a standard crossbow system and the Japanese air gun system. Researchers on this cruise recommend (a that personnel use the systems that they are the most familiar with and (b that a biopsy training exercise be continued to be carried out at the first available opportunity on subsequent cruises.
9. It is recommended that the IWC purchase five compound (RC300) crossbow systems and two standard crossbow systems for use on these cruises. The standard crossbow should be used for small cetaceans only. The decision of where the equipment will be stored and maintained between cruises needs to be made by the planning meeting.
10. The 120 -minute DAT tapes have been found to jam in the recorders in the past. It is recommended that in future only 90 -minute DAT tapes are used on SOWER cruises.
11. The 6 metre bamboo poles used for dart recovery on this cruise, saved considerable time and should be available on future cruises.

1997/1998 IWC-SOWER Blue Whale Cruise

12. Computer data entry was not a requirement of this cruise. However, Paolo Sanino spent considerable time and effort developing interactive software for data entry. This software was extremely valuable for both data entry and compilation of this report. It is recommended that the IWC investigate the use of this software on future SOWER cruises.
13. The computer entry on *Shonan Maru No 2* was done on researchers personal computers. It is strongly recommended that another Pentium computer be purchased, so that both vessels have one.

References

- Anon., 1997a. Report of the Planning Meeting for the 1997/98 IWC/SOWER Blue Whale Cruise, Tokyo, 8-9/8/97. Available from the IWC Secretariat, Cambridge, United Kingdom.
- Anon., 1997b. IWC SOWER -Blue Whale Cruise off Chile 1997/98 -Information for researchers. Available from the IWC Secretariat, Cambridge, United Kingdom.

Acknowledgments

The researchers thank the crews of both research vessels, the *Shonan Maru* and *Shonan Maru No 2*, for their hard work and dedication and hospitality during this survey. We wish to acknowledge the staff of The Institute of Cetacean Research (Tokyo), The National Research Institute of Far Seas Fisheries (Shimizu), the Southwest Fisheries Science Center (La Jolla) and the Secretariat of the IWC for their assistance in pre-cruise arrangements. Computers, software and tape recorders for acoustic recording, CTD sampling equipment and XBT monitoring equipment were provided by The National Research Institute of Far Seas Fisheries. Thanks are due to Southwest Fisheries Center, USA for the loan of 3 Barnett crossbow biopsy systems. Dr. Walter Seilfeld and Dr. Luis Pastene are gratefully acknowledged for assistance with pre- and post-cruise arrangements in Iquique and Punta Arenas.

1997/1998 IWC-SOWER Blue Whale Cruise Table Ia.

Summary of search effort undertaken by the *Shonan Maru* during the 1997/1998 Blue Whale Cruise.

Area	Start Date - time	End Date - time	BB Time (h:m)	BB Dist. (h:m)	CO Time (h:m)	DR Time (h:m)	TD Time (h:m)	Blue whale Exp. Time (h:m)	Other whale Exp. Time (h:m)	Oceanographic Exp. Time (h:m)
Transit to Research Area	13/12/97 : 10h00	18/12/98 : 06h00	39:57	445.7	3:34	2:43	1:43	6:22	1:58	
Valparaiso-Talcahuano sector	18/12/97 : 06h00	02/01/98 : 06h00	99:49	1157.9	20:45	10:44	0:39	35:59	0:06	5:40
Antofagasta - La Serena sector	02/01/98 : 06h00	02/01/98 : 18h00	1:03	14.5	1:40	0:0	0:0	9:18	0:0	0:0
Transit from Research Area	02/01/98 : 18h00	8/01/98 - 18h00	38:34	447.3	6:42	0:26	12:49	3:49	0:0	0:0

1997/1998 IWC-SOWER Blue Whale Cruise Table

lb. Summary of search effort undertaken by the *Shonan Maru No 2* during the 1997/1998 Blue Whale Cruise

Area	Start Date - time	End Date - time	BB Time (h:m)	BB Dist. (n. miles)	CO Time (h:m)	DR Time (h:m)	TD Time (h:m)	Blue whale Exp. Time (h:m)	Other whale Exp. Time (h:m)	Oceanographic Exp. Time (h:m)
Transit to Research Area	13/12/97 : 14h14	13/12/97 : 18h00	2:31	29.1	0:10	0	0	0	0:58	0
Iquique Sector	14/12/97 : 06h00	21/12/97 : 10h12	62:57	742.9	10:39	0	0	3:16	6:12	4:28
Angofagusta - La Serena Sector	21/12/97 : 10h54	2/1/98 : 18h00	89:30	1024.8	13:46	0:26	0:36	30:11	9:32	1:45
Transit from Research Area	02/1/98 : 18h00	8/1/98 : 18h00	55:37	591.7	1:30	0:16	8:50	1:02	0:30	0

1997/1998 IWC-SOWER Blue Whale Cruise

Table 2a Summary of sightings made by the *Shonan Maru* during the 1997/1998 Blue Whale Cruise.

Species	Transit from Iquique to Valparaiso - Talcahuano sector		Valparaiso - Talcahuano sector		Antofagasta - La Serena sector		Transit to Punta Arenas	
	Groups	Indiv.	Groups	Indiv.	Groups	Indiv.	Groups	Indiv.
Pygmy blue whale	1	1	12	12	3	3	5	5
Undeterm. Blue whale			1	1				
Like blue whale	1	1						
Fin whale	1	1	3	4			3	11
Sei whale	3	4	9	11			1	1
Bryde's whale	4	7	13	17	5	5	1	2
Humpback whale	1	1					1 ¹	2
Like Fin whale			1	1				
Like Sei whale			1	1				
Like minke whale	1	1						
Like Bryde's whale	1	1						
Sperm whale	7	21	26	61			9	10
Like sperm whale			1	2				
Cuvier's beaked whale			1	1				
Undeterm.. Ziphiid	2	9	1	1	1	1		
Undeterm. Mesoplodon								
Killer whale								
Pilot whale	5	44	4	70				
Risso's dolphin							1	7
Southern right whale dolphin							9	324
Bottlenose dolphin	11	305	2	2012			1	22
Undeterm. Bottlenose dolphin ²	3	511						
Common dolphin			5	192				
Dusky dolphin	2	75	1	4			2	6
Unidentified large whale			1	1			2	2
Unidentified large baleen whale	1	1	6	6	1	1	4	5
Unidentified small whale	5	13						
Unidentified dolphin	13	132	17	1116			8	547
Unidentified small cetacean	1	50						

1. Seen in the Magellan Straits.

2. New code 88 : Undetermined bottlenose dolphin.

1991/1998 IWC-SOWER Blue Whale Cruise

Table 2b Summary of sightings made by the *Shonan Maru No 2* during the 1997/1998 Blue Whale Cruise.

Species	Transit from Iquique to Iquique Sector		Iquique Sector		Antofagasta - La Serena Sector		Transit to Punta Arenas	
	Groups	Indiv.	Groups	Indiv.	Groups	Indiv.	Groups	Indiv.
Fin whale					1	1		
Sei whale					1	1		
Sperm whale			36	150	11	88	12	23
Bryde's whale			23	27	20	24	1	1
Humpback whale	1	1	1	1	2	3		
Unidentified whale			5	8	4	4	1	1
Killer whale			2	6	2	4		
Ziphiidae			5	9	9	15		
Pilot whale			3	48	2	30		
Southern right whale dolphin							9	820
Unidentified dolphin			7	49	16	278	1	15
Unidentified whale/dolphin					2	2		
Risso's dolphin			15	238	8	114		
Striped dolphin			1	60				
Common dolphin sp.			2	100				
Long-beaked common			1	300				
Dusky dolphin					3	450	1	30
Bottlenosed dolphin	2	200	8	218	20	2281	2	85
Short-beaked common dolphin					2	550		
False killer whale			1	100				
Cuvier's beaked whale					2	4		
Mesoplodont			12	32	4	9		
Like Bryde's whale			4	5	2	2		
Pygmy sperm whale			1	1				
Pygmy blue whale			2	2	13	21	1	1
Like Sei whale					1	1		
Like sperm whale							1	1
Unidentified small whale			3	3	1	1		
Unidentified large baleen whale					2	2		
Like humpback whale			1	1				
Unidentified small cetacean	2	40	2	6				
Like pilot whale			1	20				
Undetermined blue whale					1	1		

1997/1998 IWC-SOWER Blue Whale Cruise

Table 3a. Summary of experimental effort carried out from cetacean sightings on the *Shonan Maru* during the 1997/1998 IWC-SOWER Blue Whale Cruise.

Date	Sighting Number	Species	Group size	Experiment	Total time (h:m)
Transit (Iquique to Valparaiso - Talcahuano sector)					
15/12/97	003	Pygmy blue whale	1	A;D;V;P;T	6:22
17/12/97	007	Humpback whale	1	T	1:34
17/12/97		Sei whale	1	T	0:12
19/12/97		Fin whale	1	T	0:12
Valparaiso - Talcahuano sector					
21/12/97	006	Pygmy blue whale	1	A;D;V;T	4:14
22/12/97	004	Pygmy blue whale	1	A;V;P;T	1:55
23/12/97	001	Pygmy blue whale	1	A;D;V;T	3:17
24/12/97	003	Pygmy blue whale	1	A;D;V;P;T	2:02
27/12/97	001	Pygmy blue whale	1	A;D;V;P;T	5:08
28/12/97	004	Pygmy blue whale	1	A;D;T	3:25
29/12/97	001	Pygmy blue whale	1	A;D;V;P;T	8:44
29/12/97	002	Pygmy blue whale	1	A	
29/12/97	003	Pygmy blue whale	1	A;D;V;P;T	
30/12/97	010	Pygmy blue whale	1	A;D;V;P;T	4:12
31/12/97	002	Pygmy blue whale	1	A;D;V;P;T	2:33
01/01/98		Pygmy blue whale	1	A;V	0:29
26/12/97		Bryde's whale	1	T	0:06
Antofagasta - La Serena sector					
02/01/98	007	Pygmy blue whale	1	A;D;V;P	3:47
02/01/98	008	Pygmy blue whale	1	A;D;V;P;T	5:31
02/01/98	010	Pygmy blue whale	1		
Transit to Punta Arenas					
03/01/98	004	Pygmy blue whale	1	D;V;P;T	1:58
03/01/98	005	Pygmy blue whale	1	V;T	0:13
03/01/98	006	Pygmy blue whale	1	V;T	
05/01/98	012	Pygmy blue whale	1	A; V; P; T	0:38
05/01/98	014	Pygmy blue whale	1	A;V;P;T	1:00

A = Acoustic; D = Dive time; V = Video; T = Biopsy; P = Photo-identification.

1997/1998 IWC-SOWER Blue Whale Cruise

Table 3b Summary of experimental effort carried out on cetacean sightings from *Shonan Maru* No 2 during the 1997/1998 IWC-SOWER Blue Whale Cruise.

Date	Sighting Number	Species	Group size	Experiment	Total time (h:m)
97/12/17	25	Pygmy blue whale	1	A,V,D,B	2:11
97/12/19	17	Pygmy blue whale	1	A,P,V,B	1:05
97/12/24	2, 3	Pygmy blue whale	2	A,P,V,B	6:39
97/12/24	8	Pygmy blue whale	1	A,P,V,B	1:11
97/12/25	4	Pygmy blue whale	2	A,P,V,B	2:37
97/12/26	9	Pygmy blue whale	1	A,P,V,D,B	0:54
97/12/28	4	Pygmy blue whale	1	A,P,V,D,B	3:35
97/12/29	8	Pygmy blue whale	1	A,P,V,D,B	2:20
97/12/30	11	Pygmy blue whale	1	A,V,D,B	2:58
98/01/01	1	Pygmy blue whale	5	A,P,V,B	3:11
98/01/01	2	Pygmy blue whale	3	A,V,B	2:12
98/01/02	2	Pygmy blue whale	1	A,P,V,B	1:47
98/01/02	4	Pygmy blue whale	2	A,V,B	2:08
98/01/03	4	Pygmy blue whale	1	A,V,B	1:02
97/12/31	10, 11	Undeterm. Blue whale	2	A, V,B	0:39
97/12/13	2	Humpback whale	1	V,P,B	0:58
97/12/16	8	Humpback whale	1	V,P,B	0:29
97/12/22	6	Humpback whale	2	V,P,B	0:59
97/12/23	12	Humpback whale	1	V,P,B	0:51
97/12/14	6	Bryde's whale	1	V,B	0:11
97/12/15	5	Bryde's whale	1	B	0:22
97/12/15	9	Bryde's whale	1	V,P,B	1:10
97/12/16	5	Bryde's whale	1		0:00
97/12/17	23	Bryde's whale	1	V,P,B	0:37
97/12/17	33	Bryde's whale	1	V,P,B	0:41
97/12/17	36	Bryde's whale	1	V,P,B	0:43
97/12/19	5	Bryde's whale	1	V,P,B	0:09
97/12/20	23	Bryde's whale	2	-	0:35
97/12/20	24	Bryde's whale	1	V,B	0:15
97/12/21	1, 2	Bryde's whale	2	V,B	1:00
97/12/21	13	Bryde's whale	2	V,B	0:33
97/12/21	15	Bryde's whale	1	V,B	0:12
97/12/21	17	Bryde's whale	1	V,B	0:37
97/12/24	6	Bryde's whale	1	V,P,B	0:06
97/12/24	7	Bryde's whale	1	V,P,B	0:11
97/12/26	6	Bryde's whale	1	V,P,B	0:25
97/12/26	20, 21	Bryde's whale	2	V,B	0:30
97/12/27	2, 3	Bryde's whale	2	V,P,B	1:01
97/12/27	14	Bryde's whale	1	B	0:41
97/12/29	1	Bryde's whale	1	B	0:28
97/12/29	3	Bryde's whale	2	V,B	0:36
97/12/29	11	Bryde's whale	2	V,P,B	0:40
97/12/30	8	Bryde's whale	1	V,B	0:35
97/12/30	10	Bryde's whale	1	V,P,B	0:35
97/12/31	6	Bryde's whale	1	B	0:22
98/01/03	7	Bryde's whale	1	V,B	0:17
97/12/23	2	Fin whale	1	V,P,B	0:49
97/12/16	13	Sperm whale	(dead)	V,P,B	0:12

1997/1998 IWC-SOWER Blue Whale Cruise

Table 3b continued.

97/12/18	11	Sperm whale	(dead)	V,B	0:22
97/12/20	8	Pygmy sperm whale	(dead)	V,P,B	0:18
97/12/18	12	Bottlenose dolphin	100	P,B	0:06
97/12/18	10	Striped dolphin	60	V,B	0:04
97/12/17	16	Common dolphin	30	V,P,B	0:04

A = Acoustic; D = Dive time; V = Video; T = Biopsy; P = Photo-identification.

1997/1998 IWC-SOWER Blue Whale Cruise

Table 4a. Results of the Biopsy Sampling from the *Shonan Maru* during the 1997/1998 IWC-SOWER Blue Whale Cruise.

Date	Sight No.	School Size	Whale No.	System ¹	Verdict	Sample No.	Comments
Pygmy blue whale							
15/12/97	003	1	1	C	No shot fired		
		1	1	P	No shot fired		
		1	1	S	No shot fired		
21/12/97	006	1	1	C	Hit - no sample		
		1	1	P	Miss		
22/12/97	004	1	1	P	Miss-fire		
		1	1	P	Miss-fire		
		1	1	C	Miss-fire		
23/12/97	001	1	1	P	Miss		
		1	1	C	Miss		
24/12/97	003	1	1	P	No shot fired		
		1	1	C	No shot fired		
27/12/97	001	1	1	P	Hit	9856002	
		1	1	C	Hit	9856002	
		1	1	P	Hit	9856002	
28/12/97	004	1	1	C	Miss		
		1	1	S	Miss		
		1	1	P	Hit - no sample		Dart tip broken
29/12/97	001	1	1	C	Hit	9856004	
		1	1	J	Hit - no sample		
		1	1	P	Miss		
		1	1	S	Miss		
29/12/97	003	1	1	P	Hit - no sample		Dart tip broken
		1	1	C	Miss		
		1	1	S	Miss		
		1	1	J	Hit	9856003	Large sample
30/12/97	010	1	1	P	Hit	9856005	From small boat
31/12/97	002	1	1	P	Miss		
		1	1	C	Miss		
		1	1	J	Miss		
01/01/98		1	1				
02/01/98	008	1	1	J	Hit - no sample		
		1	1	P	Miss		
02/01/98	010	1	1	J	Hit	9856006	Large sample
		1	1	P	Hit and lost		
		1	1	S	Hit - no sample		
02/01/98	008/010	2	?	J	Hit - no sample		
		2	?	P	Hit - sample detected later ²	9856008	Sample found lodged in rear of dart on 5/01/98
		2	?	S	Miss		
		2	?	J	Miss		
03/01/98	004	1	1	P	No shot fired		
	006	1	1	P	No shot fired		
05/01/98	012	1	1	P	Hit	9856007	
		1	1	J	Hit No sample		
05/01/98				P	No shot fired		
				S	No shot fired		
				J	No shot fired		
Humpback whale							
17/12/97	007	1	1	P	Hit - no sample		
		1	1	C	Miss		
		1	1	C	Miss		
		1	1	S	Miss		
Bryde's whale							
26/12/97		1	1	P	Hit	9806001	
				C	Stuck		Dart stuck in animal

1. P = Paxarms; J = Japanese air gun; C = Compound crossbow and S = Simple crossbow.
2. Sample found concealed inside dart on 5/01/98 (see text on biopsy sampling results) and stored in DMSO only.

1997/1998 IWC-SOWER Blue Whale Cruise

Table 4b. Results of the Biopsy Sampling from the *Shonan MaruNo 2* during the 1997/1998 IWC SOWER Blue Whale Cruise.

Date	Sight No.	School Size	Whale No.	System	Verdict	Sample No.	Comments
Pygmy blue whale							
97/12/17	25	1		C	Hit	9856107	video
				S	Hit no sample		
97/12/19	17	1		C	Hit	9856113	video, photos
97/12/19	17	1		S	Hit	9856113	video, photos
97/12/24	2	1		C	Miss		video, photos
				C	Miss		
				S	Miss		
				S	Miss		
97/12/24	3	1		C	Hit	9856119	video, photos
				S	Miss		
				S	Miss		
97/12/24	8	1		C	Not shot		video, photos
97/12/25	4	2	1	C	Hit	9856122	video, photos
				C	Miss		
97/12/25	4	2	1?	C	Hit	9856123	video, same animal as last?
				C	Hit		
97/12/26	9	1		C	Hit	9856124	video, photos
				C	Hit		
				S	Miss		
97/12/28	4	1		S	Miss	9856128	video, photos
				C	Hit		
				C	Hit		
				C	Miss		
				C	Miss		
				C	Miss		
				C	Miss		
				C	Miss		
97/12/29	8	1		C	Hit	9856129	video, photos
				S	Miss		
97/12/30	11	1		2C, 1S	No shots		video
98/01/01	1	5	1	C	Hit	9856132	photos/video of this group
				C	Miss		
98/01/01	1	5	2	C	Hit	9856133	from same group as above
				C	Hit		
98/01/01	1	5	3	C	Hit	9856134	from same group as above
				C	Hit		
				S	Miss		
98/01/01	2	3		S	Miss		video
98/01/02	2	1		C	Miss		video, photos
98/01/02	4	2		2C, 1S	No shots		
98/01/03	4	1		C	Miss	9856135	video
				C	Misfire		
				J	Hit		

1997/1998 IWC-SOWER Blue Whale Cruise

Table 4b. continued.

Bryde's whale							
97/12/14	6	1		C	Hit	9806104	video
97/12/15	5	1		C	Miss		
				C	Miss		
				C	Miss		
97/12/15	9	1		2C, 1S	No shots		video, photos
97/12/17	23	1		2C, 1S	No shots		video, photos
97/12/17	33	1		2C, 1S	No shots		video, photos
97/12/17	36	1		C	Miss		video, photos
				S	Miss		
97/12/19	5	1		C	Hit	9806111	video, photos
97/12/20	23	2		2C, 1S	No shots		
97/12/20	24	1		2C, 1S	No shots		video
97/12/21	1, 2	2	1?	C	Hit	9806115	video
				S	Hit		
				S	Miss		
97/12/21	13	2	?	C	Hit	9806116	video
				C	Miss		
				S	Hit, no sample		
				S	Hit, no sample		
97/12/21	15	1		2C, 1S	No shots		video
97/12/21	17	1		2C, 1S	No shots		video
97/12/24	6	1		C	Hit	9806120	video, photos
				C	Hit		
97/12/24	7	1		C	Hit	9806121	video, photos
				C	Miss		
97/12/26	6	1		2C, 1S	No shots		video, photos
97/12/26	20, 21	2		2C, 1S	No shots		video
97/12/27	2, 3	2		S	Miss		video, photos
				C	Miss		
				C	Miss		
97/12/27	14	1		2C, 1S	No shots		
97/12/29	1	1		S	Miss		
				C	Miss		
				C	Miss		
				C	Miss		
				C	Miss		
97/12/29	3	2		2C, 1S	No shots		video
97/12/29	11	2		2C, 1S	No shots		video, photos
97/12/30	8	1		C	Hit	9806130	video
				C	Hit		
97/12/30	10	1		C	Hit	9806131	video, photos
				C	Miss		
97/12/31	6	1					
98/01/03	7	1					video
Humpback							
97/12/13	2	1		C	Miss		video, photos
97/12/16	8	1		C	Hit	9807105	video, photos
				S	Miss		
97/12/22	6	2	1	C	Hit	9807117	video, photos; sampled largest animal
				S	Miss		
97/12/23	12	1					video, photos
Fin whale							
97/12/23	2	1		C	Miss		video, photos
Sperm whale							
				C	Hit	9805138	adult male

P = Paxarms; J = Japanese air gun; C = Compound crossbow and S = Simple crossbow.

1997/1998 IWC-SOWER Blue Whale Cruise

Table 5a. Summary of still and video photography of blue whale external morphology and behaviour undertaken from the *Shonan Maru* during the 1997/1998 IWC-SOWER Blue Whale Cruise.

Date	Sight No.	School Size	Number of Still Frames Exposed	Body Surface Photographed	Opportunity for Still Photography	Video total time (minutes)	Opportunity for Video Photography
15/12/97	003	1	30	HD;LL;OT	P	4.40	P
21/12/97	006	1				17.50	E
22/12/97	004	1	34	LL	P	1.96	P
23/12/97	001	1				2.03	P
24/12/97	003	1	36	HD;LD;LL;BH	G	16.35	E
27/12/97	001	1	29	LL;RL;HD;RD; LD	P	4.07	P
28/12/97	004	1				2.10	E
29/12/97	001	1	5	HD	E	16.26	E
29/12/97	002	1					
29/12/97	003	1	13	RL	E	1.51	E
30/12/97	010	1	17	LL;LD	E	3.90	G
31/12/97	002	1	27	HD	G	11.86	G
01/01/98	004	1				2.21	P
02/01/98	007	1	7	HD	E	7.36	P
02/01/98	008&010	1+1	85	HD	E	2.22 + 1.45(010) ¹	E
03/01/98	004	1	26	HD	P	11.32	E
	005	1				1.63	P
	006	1				1.41	P
05/01/98	012	1	9	HD	E	3.15	E
	014	1	58	RD	G	4.37	E

1. 2.22 Minutes of sighting number 008 or 010 and 1.45 minutes of sighting number 010

HD = head; LL = left lateral; RL = right lateral; LD = left dorsal; RD = right dorsal; BH = blowhole.

E = excellent; G = good; P = poor.

1997/1998 IWC-SOWER Blue Whale Cruise

Table 5b. Summary of still and video photography of blue whale external morphology and behaviour undertaken from the *Shonan Maru No 2* during the 1997/1998 IWC-SOWER Blue Whale Cruise

Date	Sighting #	School Size	Number of Still Frames	Photo contents	Opportunity for still Photography	Video Total Time	Video contents
17/12/97	25	1				0:02:06	FSS,AS,LL,FSS
19/12/97	17	1	10	By T; Surfacing sequence.	E	0:01:32	BL,H
24/12/97	2	1	10	By T; left lateral surfacing sequence.	E	0:02:28	PSS,DF,RL,FSS
24/12/97	3	1	11	#25 by S, rest by T;surfacing sequence.	E	0:10:04	PSS,RL,FSS
24/12/97	8	1	3	By T; head, dorsal, R lateral.	P	0:04:07	FSS,BL,H
25/12/97	4	2	14	By T; 14-20 first attempt, blank 21, 22-29 2nd time.	E	0:02:09	H,FSS,BL
26/12/97	9	1	14	By T; Head, surfacing sequence, fluke up dive.	E	0:02:09	FSS,TFU
28/12/97	4	1				0:08:24	BLOW,FSS,BL
29/12/97	8	1	8	By T; Dorsal and R lateral surfacing shots.	G	0:02:47	FSS
30/12/97	11	1	4	By T; head & body surfacing sequence.	G	0:04:35	RL,FSS
1/01/98	1	5	3	Taken by T (Surfacings)	P	0:04:55	FSS,RL
1/01/98	2	3				0:04:55	PSS,LL,RL,DF
2/01/98	2	1	9	Taken By T ; Full surfacing, blow, biopsy	P	0:04:28	PSS
2/01/98	4	2				0:05:58	PSS
3/01/98	4	1				0:02:30	FSS

1. FSS = Full Surfacing Sequence; AS = Approaching Ship; LL = Left Lateral; BL = Blowhole; H = Head; PSS = Partial Surfacing Sequence; TFU = Tail Fluke Up; DF = Dorsal Fin; Blow = Blow Sequence.

E = excellent; G = good; P = poor; T = Thiele; S = Shimada.

1997/1998 IWC-SOWER Blue Whale Cruise

Table 6a. Summary of the Dive Time experiments carried out on blue whales from the *Shonan Maru* during the 1997/1998 IWC-SOWER Blue Whale Cruise

Date	Sight No.	School Size	Total Dive time (h:m)	Comments
15/12/97	003	1	1:28	
21/12/97	006	1	0:58	
22/12/97	004	1		No Dive time experiment carried out as animal was close to vessel at confirmation
23/12/97	001	1	1:12	
24/12/97	003	1	1:40	
27/12/97	001	1	1:05	
28/12/97	004	1	1:01	
29/12/97	001	1	1:06	
29/12/97	002	1		Animal not relocated after experiment with sighting number 001
29/12/97	003	1	1:00	
30/12/97	010	1	1:14	
31/12/97	002	1	1:12	
01/01/98	004	1		No dive time experiment carried out due to time constraints
02/01/98	007	1	1:01	
02/01/98	008	1	0:27	
02/01/98	010	1		
03/01/98	004	1	0:43	
03/01/98	005	1		No dive time experiment carried out due to time constraints
03/01/98	006	1		No dive time experiment carried out due to time constraints
05/01/98	012	1		No dive time experiment carried out due to time constraints
05/01/98	014			No dive time experiment carried out due to time constraints

1997/1998 IWC-SOWER Blue Whale Cruise

Table 6b. Summary of the Dive Time experiments carried out on blue whales from the *Shonan Maru* No 2 during the 1997/1998 IWC-SOWER Blue Whale Cruise

Date	Sight No.	School Size	Total time (h:m)	Comments)
97/12/17	25	1	0:03	
97/12/19	17	1	0	
97/12/24	3	1	0	
97/12/24	8	1	0	
97/12/25	4	2	0:03	
97/12/26	9	1	0:28	
97/12/28	4	1	0:12	
97/12/29	8	1	0:36	
97/12/30	11	1	0:51	
98/01/01	1	5	0	
98/01/01	2	3	0	
98/01/02	2	1	0	
98/01/02	4	2	0	
98/01/03	4	1	0	

1997/1998 IWC-SOWER Blue Whale Cruise

Table 7a. Summary of Acoustic Monitoring carried out from the *Shonan Maru* during research periods (06h00 -18h00) and after research hours (18h00-16h00) during the 1997/1998 IWC-SOWER Blue Whale Cruise.

Date	Station	System ¹	Position		Time monitored (h:m)	Calls heard (Y/N)	Comments
06h00-18h00							
15/12/97	1	SB	28° 58.5' S	73° 29.08' W	1:04	N	
19/12/97	6	TF	36° 08.90' S	73° 49.70' W	1:00	N	
21/12/97	7	SB	35° 31.3' S	75° 18.25' W	13:40	P	
22/12/97	8	SB	34° 51.12' S	76° 52.57' W	8:45	Y	
23/12/97	9	SB	34° 49.6' S	76° 28.4' W	4:00	Y	
24/12/97	11	SB	34° 16.77' S	74° 35.74' W	0:30	N	
24/12/97	14	TF	32° 42.08' S	74° 30.29' W	0:25	Y	
27/12/97	16	SB	32° 23.76' S	74° 07.28' W	3:52	P	
28/12/97	18	SB	30° 48.45' S	72° 31.03' W	3:25	Y	
29/12/97	20	SB	30° 36.87' S	72° 16.87' W	9:00	Y	
30/12/97	22	SB	30° 46.28' S	72° 46.97' W	2:35	Y	
31/12/97	24	SB	30° 41.78' S	73° 06.51' W	5:55	Y	
01/01/98	26	SB	30° 03.08' S	72° 24.92' W	10:00	P	
02/01/98	28	SB	29° 47.90' S	71° 52.16' W	5:35	Y	
05/01/98	29	SB	39° 59.63' S	74° 07.59' W	2:15	Y	
18h00-06h00							
15/12/97	2	TF	29° 25.93' S	73° 39.83' W	1:30	N	
17/12/97	3	TF	37° 29.70' S	76° 51.06' W	4:52	N	
18/12/97	4	TF	37° 00.23' S	74° 32.48' W	9:33	N	
19/12/97	5	TF	36° 12.07' S	73° 35.20' W	4:30	N	
23/12/97	10	TF	34° 23.30' S	75° 04.70' W	3:58	N	
24/12/97	12	TF	34° 00.87' S	73° 26.52' W	5:00	N	
25/12/97	13	SB	33° 13.85' S	72° 37.52' W	8:05	P	
26/12/97	15	SB	32° 25.99' S	74° 16.98' W	8:00	Y	
27/12/97	17	SB	31° 49.71' S	73° 27.41' W	7:55	N	
28/12/97	19	TF	30° 38.53' S	72° 21.26' W	4:00	N	
29/12/97	21	SB	30° 52.49' S	72° 03.83' W	3:07	N	
30/12/97	23	SB	30° 51.86' S	72° 28.46' W	7:50	Y	
31/12/97	25	SB	30° 24.81' S	72° 28.14' W	2:55	Y	
02/01/98	27	SB	29° 51.81' S	72° 02.64' W	8:35	P	

1. SB = Sonobouy; TF = Towfish Hydrophone

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1997/1998 IWC-SOWER Blue Whale Cruise

Table Th. Summary of Acoustic Monitoring carried out from the *Shonan Maru No 2* during research periods (06h00 -18h00) during the 1997/1998 IWC-SOWER Blue Whale Cruise.

Date	Station	System	Position		Time monitored	Calls heard
			°S	°W		
06h00-18h00						
17-Dec-97	11:31	HJ	20 39.3	71 25.6	0:31	No
17-Dec-97	12:13	SB	20 39.3	71 25.4	2:08	No
19-Dec-97	16:55	SB	21 56.2	70 31.5	1:05	No
20-Dec-97	12:54	HJ	22 34.1	71 42.1	0:20	No
21-Dec-97	10:20	HJ	23 00.0	73 00.0	0:20	No
24-Dec-97	7:33	SB	26 41.9	71 58.1	0:32	No
24-Dec-97	12:10	HJ	26 50.4	71 34.7	0:30	No
25-Dec-97	14:20	HJ	27 33.4	73 29.1	0:32	No
25-Dec-97	17:30	HJ	27 32.8	73 36.1	0:30	No
26-Dec-97	9:50	HJ	27 44.1	72 31.8	0:30	No
28-Dec-97	12:56	SB	27 56.5	72 55.4	1:58	No
29-Dec-97	12:14	SB	27 38.4	73 59.7	1:48	?
29-Dec-97	14:03	SB	27 35.2	73 59.7	0:55	No
30-Dec-97	15:30	SB	28 06.1	71 48.6	0:30	No
1-Jan-98	6:47	SB	28 40.1	71 46.5	4:05	No
1-Jan-98	11:02	SB	28 43.7	71 40.3	4:04	No
1-Jan-98	16:53	SB	28 44.8	71 44.0	1:07	No
2-Jan-98	12:24	SB	29 25.8	71 52.3	1:37	No
2-Jan-98	16:10	SB	29 47.4	71 51.6	1:49	No
3-Jan-98	8:33	SB	32 10.3	72 19.6	1:32	Sperm whale
18h00-06h00						
15-Dec-97	3:20	HJ	18 44.0	72 19.1	0:30	No
15-Dec-97	20:01	SB	19 40.5	72 09.7	3:00	No
17-Dec-97	19:19	SB	20 38.5	71 25.7	6:31	No

1997/1998 IWC-SOWER Blue Whale Cruise

Table 7b. continued.

19-Dec-97	18:00	SB	21 56.2	70 31.5	1:25	No
19-Dec-97	21:49	SB	22 06.1	70 37.7	6:23	Humpback whale
20-Dec-97	18:30	HJ	22 49.0	72 25.6	1:24	No
21-Dec-97	18:14	HJ	23 43.2	72 17.0	2:06	No
22-Dec-97	19:12	SB	25 17.7	70 44.6	8:06	No blue whale
23-Dec-97	18:25	HJ	26 36.1	71 50.5	2:15	No
24-Dec-97	18:05	SB	27 08.4	71 45.4	8:10	No
25-Dec-97	17:30	HJ	27 32.8	73 36.1	1:20	No
28-Dec-97	19:10	SB	27 56.0	73 05.1	6:51	No
29-Dec-97	21:07	SB	27 14.9	73 28.7	7:43	Clicks
30-Dec-97	18:10	SB	28 16.7	71 48.8	8:11	L.pilot & ?
31-Dec-97	18:07	SB	28 38.7	71 45.8	6:01	No
1-Jan-98	18:00	SB	28 44.8	71 44.0	7:03	No

1. SB = Sonobouy, HJ = Japanese Hydrophone

RD

1997/1998 IWC-SOWER Blue Whale Cruise

Table 8 Results of photo-identification experiments carried out on secondary target species from the *Shonan Maru* and *Shonan Maru No 2* during the 1997/1998 IWC-SOWER Blue Whale Cruise

Date	Sighting number	Group size	Number photographed	Opportunity	Body surface photographed
Shonan Maru					
No photo-identification experiments undertaken					
Shonan Maru No 2					
Bryde's Whales					
15/12/97	9	1	1	P	Taken by K; head, dorsal fin.
16/12/97	5	1	1	P	Taken by T; Distant shot of lateral view.
17/12/97	23	1	1	E	By T; head, dorsal fin, left lateral.
17/12/97	33	1	1	E	By T; head, R & L lateral, dorsal fin, surfacing.
17/12/97	36	1	1	P	By T; dorsal, body, head.
19/12/97	5	1	1	E	By T; Surfacing, head and body.
24/12/97	6	1	1	G	Looked like a minke, surfacing & R lateral.
24/12/97	7	1	1	G	By T; head, dorsal surface, L lateral.
26/12/97	6	1	1	P	By T; R dorsal side of surfacing animal.
27/12/97	2	1	1	G	By T; R dorsal & lateral view.
29/12/97	11	2	2	P	By T; female and calf surfacing, light bad.
30/12/97	10	1	1	E	By T; surfacing sequence from 1st radar platform.
Humpback whale					
13/12/97	2	1	1	P	Taken by K; No flukes
16/12/97	8	1	1	G	Taken by T; dorsal fin left side, head, body, tail
22/12/97	6	2	2	E	Both tail flukes, dorsal surface
23/12/97	12	1	1	G	By T, shot 12 by S; surfacing shots.

1997/1998 IWC-SOWER Blue Whale Cruise

Table 9. Summary of experiments carried out on "other" species by the *Shonan Maru* and the *Shonan Maru No 2* during the 1997/1998 IWC-SOWER Blue Whale Cruise.

Date	Sighting number	Species Code	School size	Biopsy	Photo	Video
<i>Shonan Maru</i>						
19/12/97	004	2	1	0	No	No
17/12/97	016	3	1	0	No	No
<i>Shonan Maru No 2</i>						
13/12/97	3	76	20	1	No	No
13/12/97	4	23	100	0	No	No
13/12/97	5	23	100	3	No	Yes
14/12/97	1	21	300		No	Yes
15/12/97	1	10	3		Yes	Yes
16/12/97	13	5	1	1	Yes	Yes
17/12/97	16	19	30		Yes	Yes
17/12/97	17	63	1		No	No
17/12/97	18	5	2		No	No
17/12/97	19	17	10		No	No
17/12/97	20	11	2		No	No
17/12/97	21	11	1		No	No
17/12/97	22	17	3		No	No
17/12/97	24	15	1		No	No
17/12/97	26	9	1		No	No
17/12/97	27	32	100		Yes	No
17/12/97	28	5	20		Yes	Yes
18/12/97	10	18	60		No	Yes
18/12/97	11	5	1	1	No	Yes
18/12/97	12	23	100	2	Yes	No
19/12/97	14	17	22		No	No
19/12/97	15	15	4		No	No
19/12/97	16	23	5	1	No	Yes
20/12/97	8	45	1	1	Yes	Yes
21/12/97	7	23	10		No	Yes
23/12/97	2	2	1		Yes	Yes
23/12/97	5	23	150	1	No	No
23/12/97	6	15	30		No	Yes
26/12/97	11	23	30	1	Yes	No
26/12/97	12	38	2		Yes	No
26/12/97	15	23	150	2	No	No
27/12/97	4	15	30		Yes	No
27/12/97	17	5	30		No	Yes
29/12/97	4	31	50		Yes	Yes
29/12/97	10	31	500		No	Yes
30/12/97	7	23	200		No	Yes
30/12/97	12	22	200		Yes	No
30/12/97	13	12	10		No	Yes
5/01/98	2	14	350		No	Yes
5/01/98	4	23	70		No	Yes
6/01/98	6	14	30		Yes	No
7/01/98	5	14	150	2	No	No
7/01/98	6	5	1	1	No	No

1997/1998 IWC-SOWER Blue Whale Cruise

Table 10. Results of the Oceanographic Studies from the *Shonan Maru* and the *Shonan Maru No 2* during the 1997/1998 IWC-SOWER Blue Whale Cruise. X -Measurement using XBT; C -Measurement using CTD

Station	Date	Position	Sampling method
<i>Shonan Maru</i>			
1	18/12/97	37°59.7' S 077°77.4' W	C
2	22/12/97	35°26.9' S 075°31.5' W	C
3	22/12/97	35°00.0' S 077°00.2' W	C
4	24/12/97	34°22.4' S 074°30.0' W	C
5	25/12/97	33°30.0' S 071°55.7' W	C
6	26/12/97	33°42.1' S 074°30.2' W	C
7	28/12/97	31°22.0' S 073°0503' W	C
8	30/12/97	30°59.7' S 071°5504' W	C
9	31/12/97	30°30.1' S 074°00.2' W	C
<i>Shonan Maru No 2</i>			
1	97/12/14	18° 34' S 070° 43' W	C
2	97/12/15	18° 51' S 073° 00' W	C
3	97/12/15	19° 24' S 073° 00' W	C
4	97/12/16	20° 20' S 070° 31' W	C
5	97/12/17	20° 32' S 071° 02' W	X
6	97/12/17	20° 40' S 071° 25' W	C
7	97/12/18	21° 02' S 072° 27' W	X
8	97/12/18	21° 08' S 072° 49' W	C
9	97/12/19	21° 57' S 070° 31' W	C
10	97/12/20	22° 23' S 071° 12' W	X
11	97/12/20	22° 34' S 071° 42' W	C
12	97/12/20	22° 48' S 072° 22' W	X
13	97/12/21	23° 00' S 073° 00' W	C
14	97/12/22	25° 19' S 070° 45' W	C
15	97/12/23	25° 44' S 071° 19' W	X
16	97/12/24	26° 36' S 071° 51' W	C
17	97/12/25	27° 27' S 073° 06' W	X
18	97/12/25	27° 33' S 073° 36' W	C
19	97/12/31	28° 15' S 071° 47' W	C
20	98/01/03	33° 13' S 072° 40' W	X
21	98/01/03	33° 50' S 072° 57' W	X
22	98/01/04	35° 00' S 073° 26' W	X

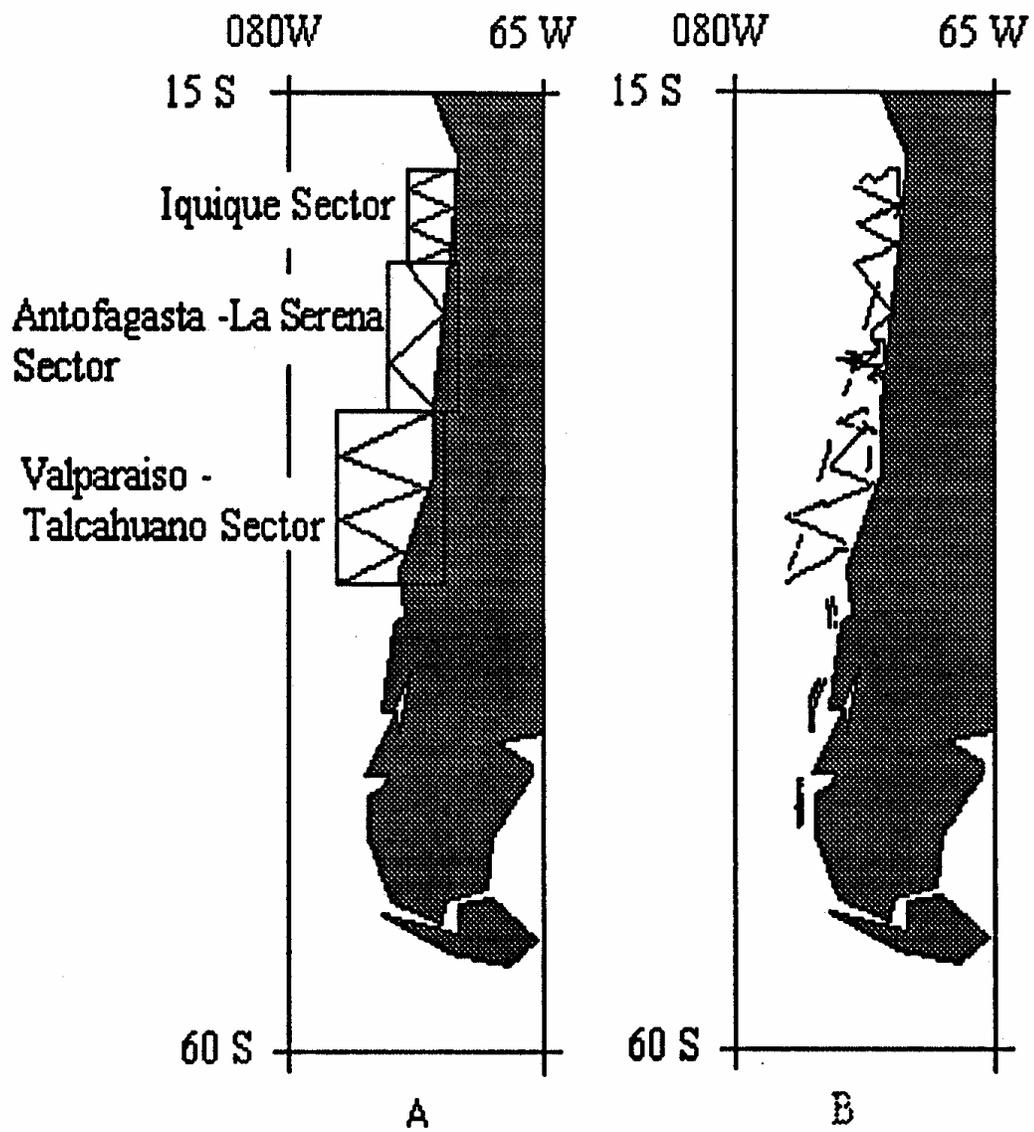


Figure 1. The proposed cruise track of the 1997/1998 IWC-SOWER Blue Whale Cruise showing the three sectors (A) and the search effort carried out in during the cruise (B).

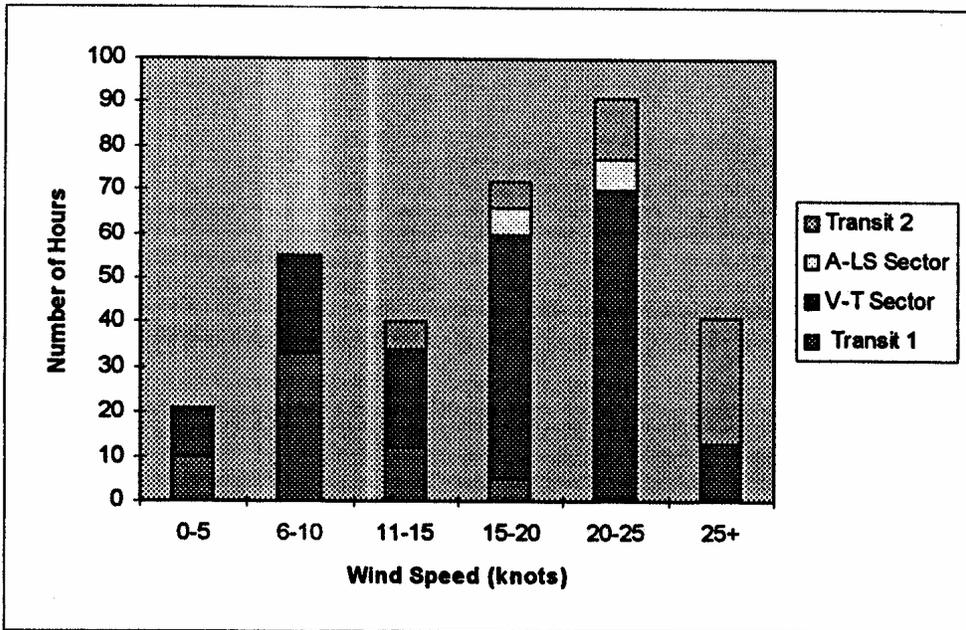


Figure 2a. Wind speed recorded on each hour between 06h00 and 18h00 (inclusive) that research was undertaken by the *Shonan Maru*. The data are stratified by sector and transit legs (A-LS sector : Antofagasta - La Serena sector; Valparaiso - Talcahuano sector : Valparaiso - Talcahuano sector; Transit 1: Transit from Iquique and Transit 2 : Transit to Punta Arenas).

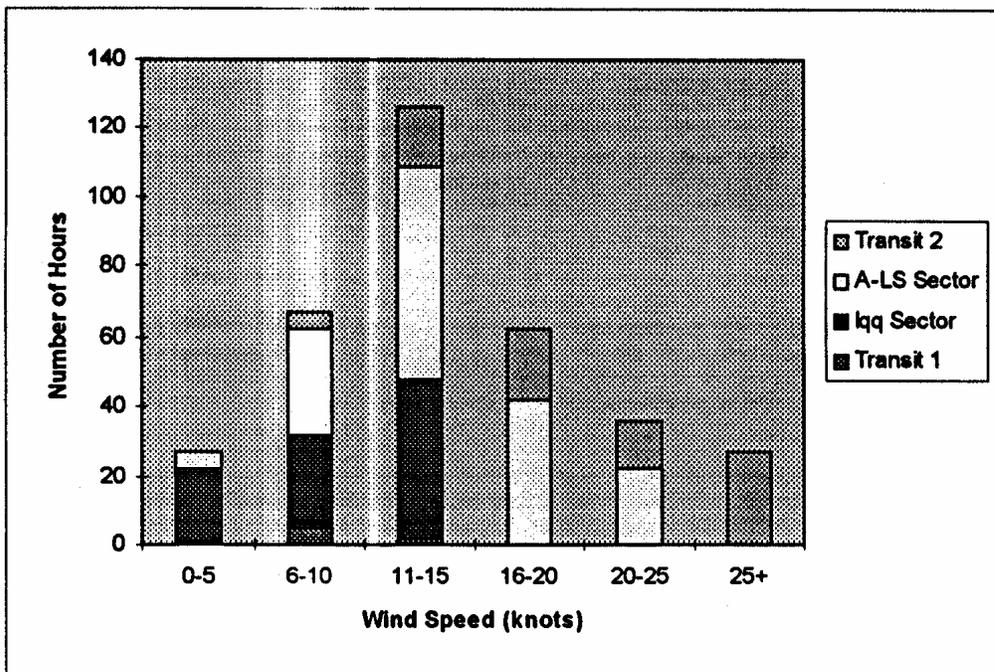


Figure 2b. Wind speed recorded on each hour between 06h00 and 18h00 (inclusive) that research was undertaken by the *Shonan Maru No 2*. The data are stratified by sector and transit legs (A-LS sector: Antofagasta -La Serena sector; Valparaiso -Talcahuano sector: Valparaiso -Talcahuano sector; Transit I: Transit from Iquique and Transit 2: Transit to Punta Arenas).

Tracklines and Sightings SOWER97/98

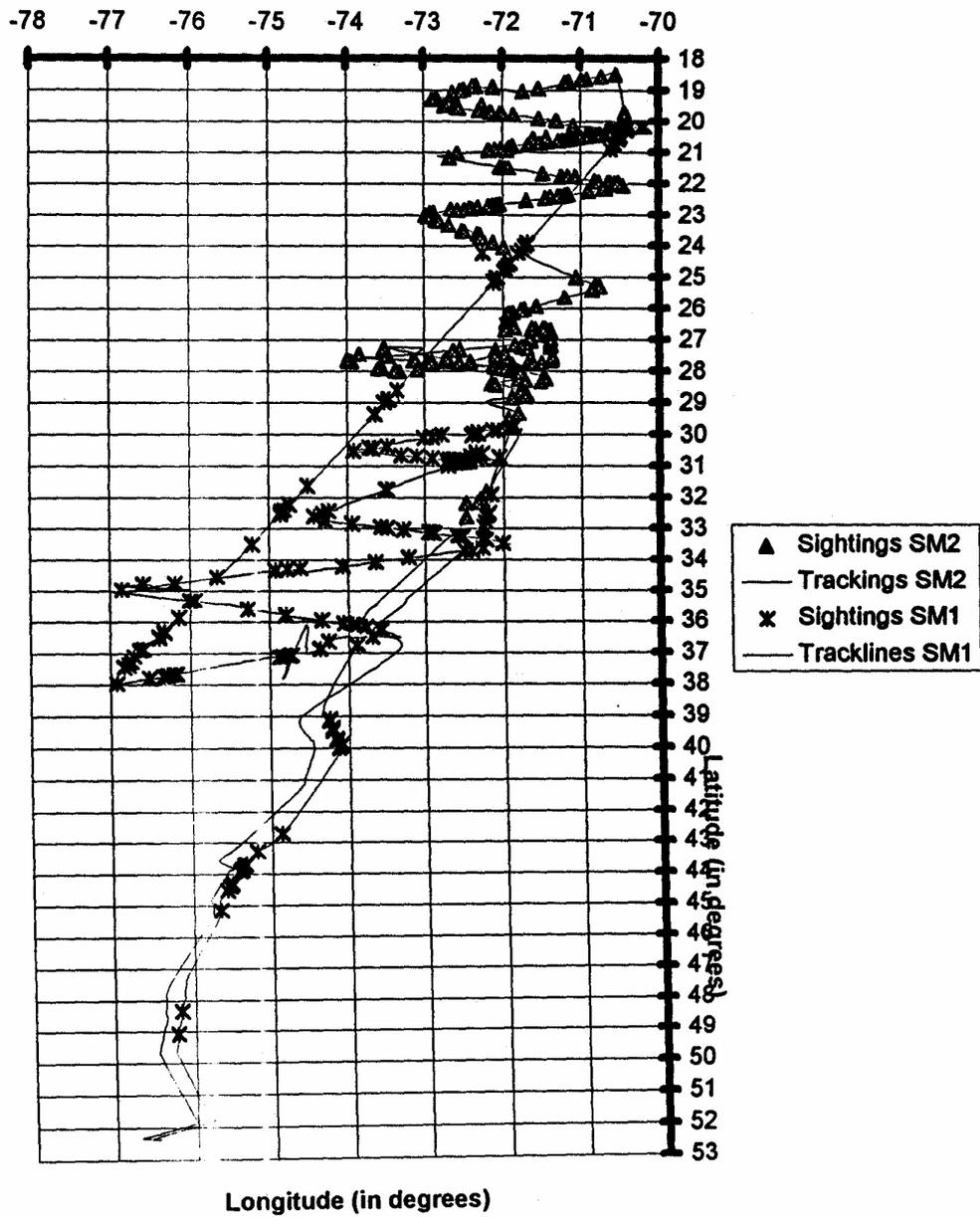


Figure 3a. The distribution of all sightings of cetaceans made by the *Shonan Maru* and *Shonan Maru No 2* during the 1997/1998 IWC-SOWER Blue Whale Cruise.

Tracklines and Sightings SOWER97/98

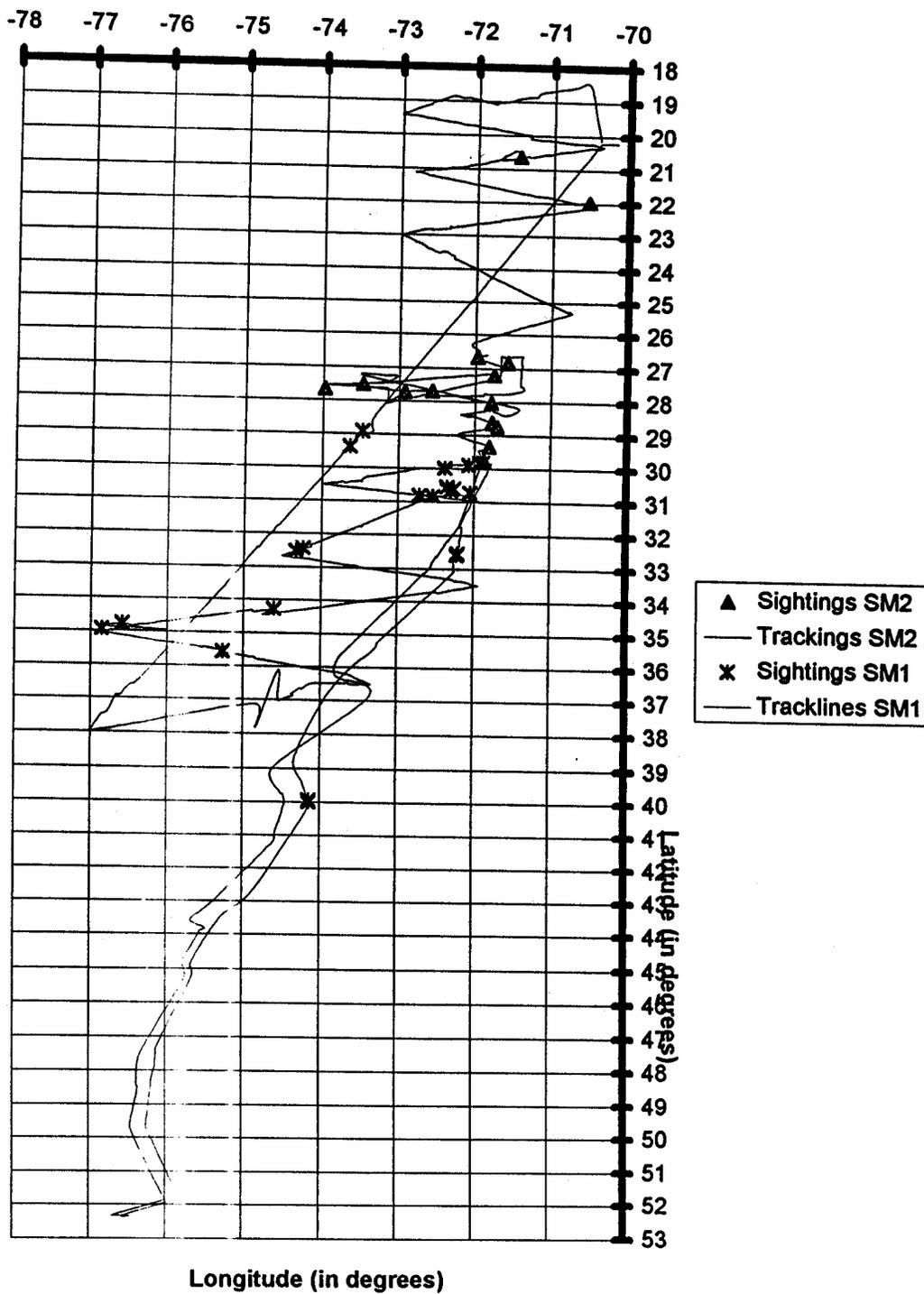


Figure 3b. The distribution of sightings of pygmy blue whales, undetermined blue whales and "like" blue whales made by the *Shonan Maru* and *Shonan Maru No 2* during the 1997/1998 IWC-SOWER Blue Whale Cruise.

Tracklines and Sightings SOWER97/98

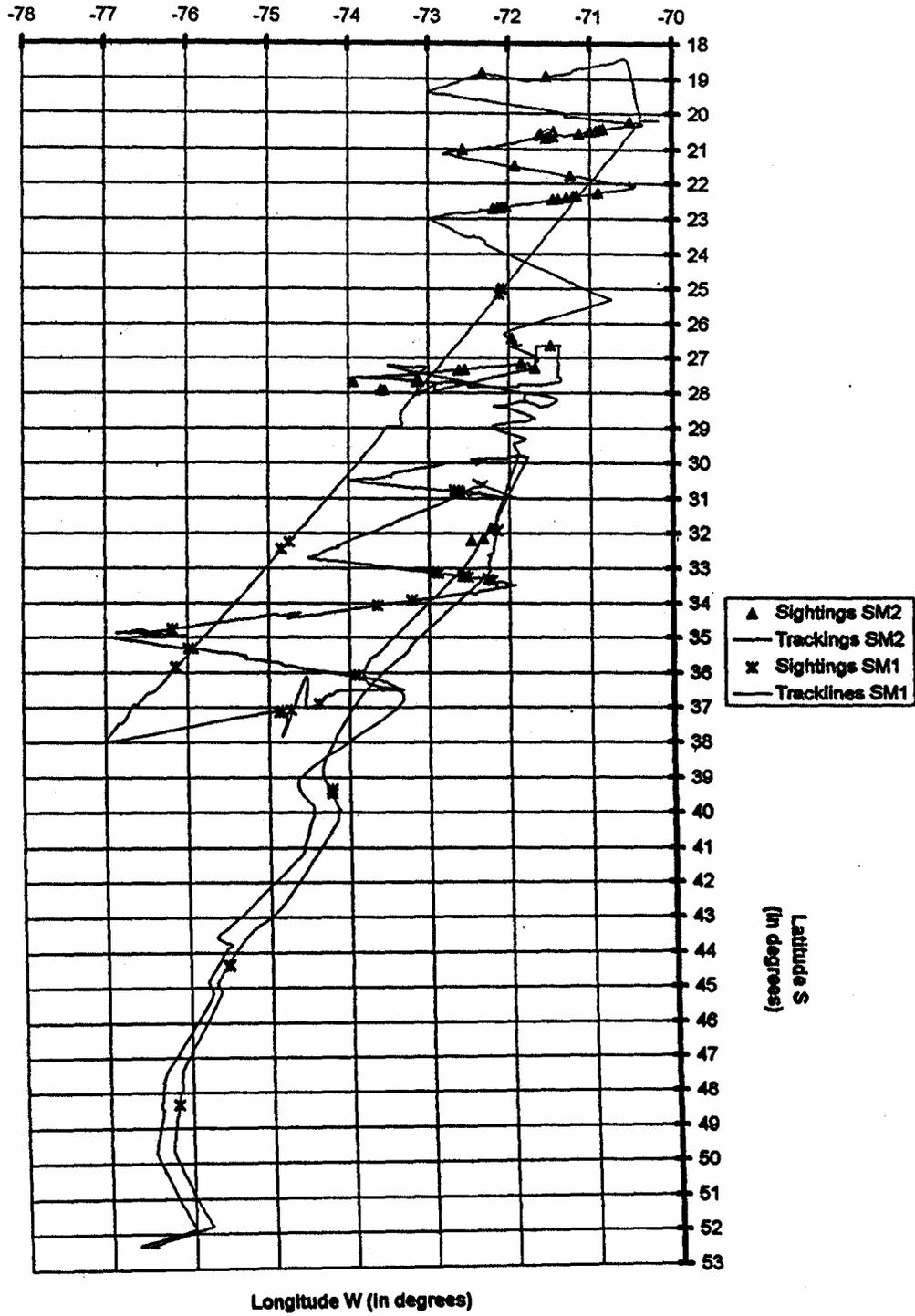


Figure 3c. The distribution of sightings of sperm whales made by the *Shonan Maru* and *Shonan Maru No 2* during the 1997/1998 IWC-SOWER Blue Whale Cruise.

Tracklines and Sightings SOWER97/98

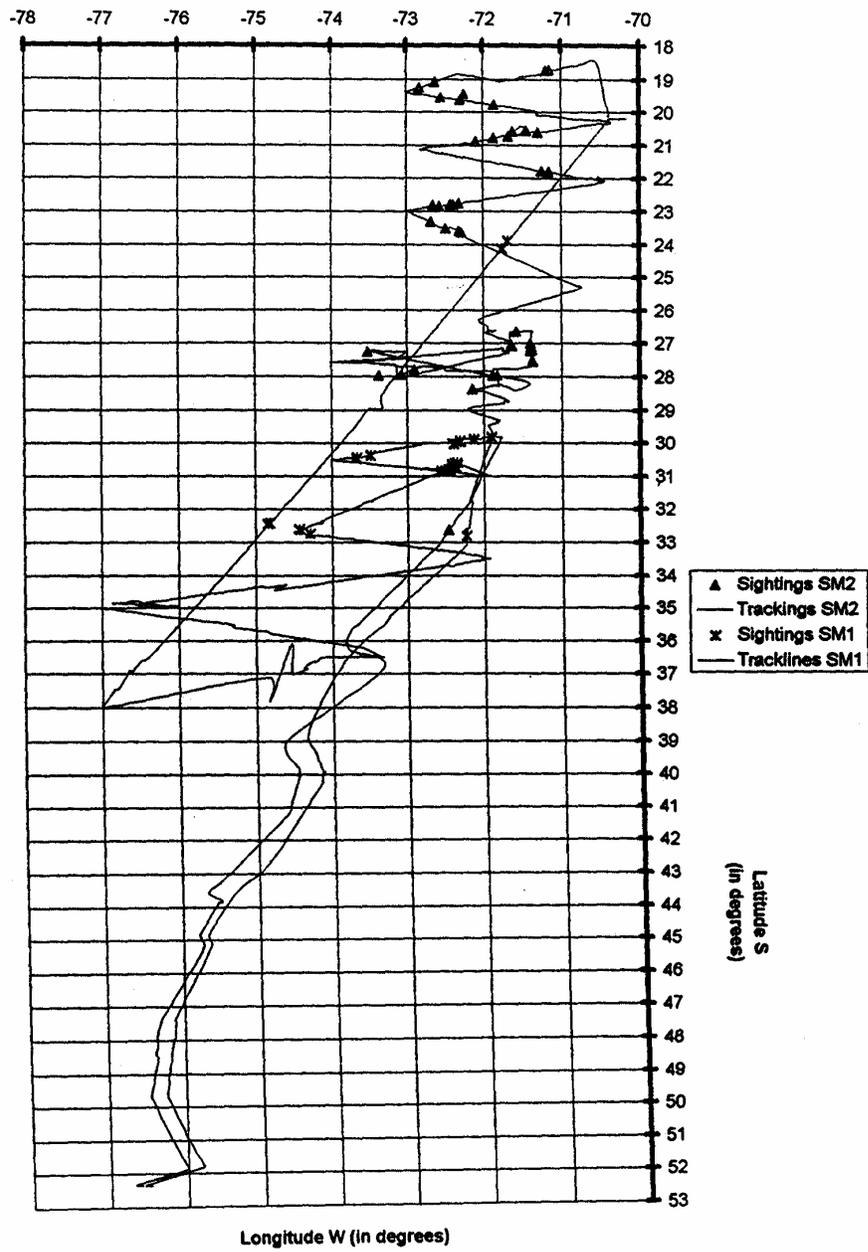


Figure 3d. Tile distribution of sightings of Bryde's whales made by the *Shonan Maru* and *Shonan Maru No 2* during the 1997/1998 IWC-SOWER Blue Whale Cruise.

Tracklines and Sightings SOWER97/98

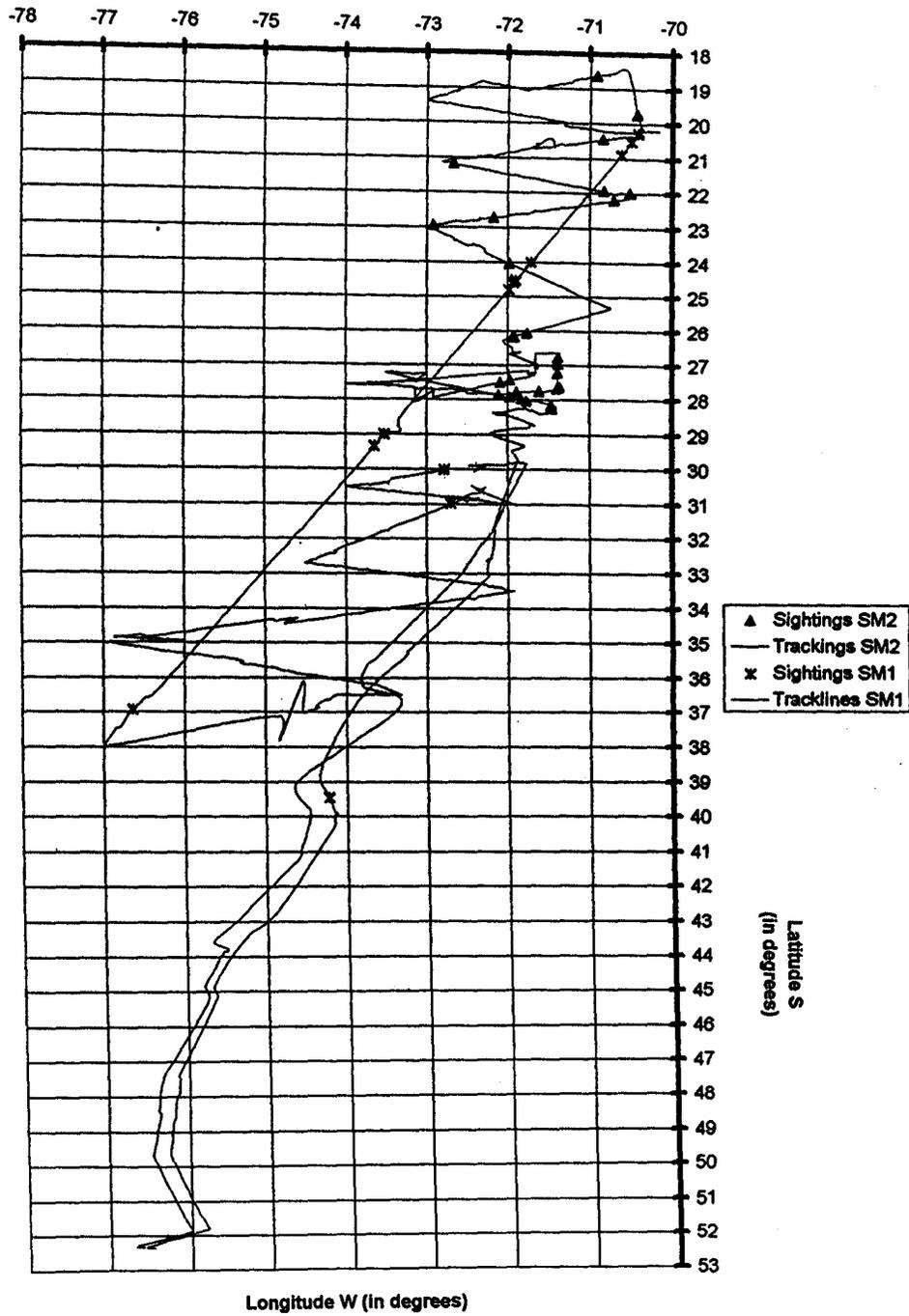


Figure 39. The distribution of sightings of bottlenose dolphins made by the *Shonan Maru* and *Shonan Maru No 2* during the I 997/1998 IWC-SOWER Blue Whale Cruise.