

# PROPOSAL FOR THE 2014 IWC-PACIFIC OCEAN WHALE AND ECOSYSTEM RESEARCH (POWER)

Kato, H.<sup>1)</sup>, Matsuoka, K.<sup>2)</sup>, Miyashita, T.<sup>3)</sup>, Murase, H.<sup>3)</sup> and Pastene, L.<sup>2)</sup>

- 1) *Tokyo University of Marine Science and Technology (TUMSAT), 4-5-7 Konan, Minato-ku, Tokyo 108-8477, Japan; e-mail contact, [katohide@kaiyodai.ac.jp](mailto:katohide@kaiyodai.ac.jp)*  
 2) *The Institute of Cetacean Research, 4-5, Toyomi-cho, Chuo-Ku, Tokyo, 104-0055, Japan.*  
 3) *National Research Institute of Far Seas Fisheries (Yokohama), 2-12-4, Fukuura, Kanagawa, Yokohama, 236-8648, Japan.*

## ABSTRACT

This document outlines the line transect sighting survey cruise plan for the 2014 IWC Pacific Ocean Whale and Ecosystem Research (POWER). The research vessel, *Yushin-Maru No.3* (YS3) would be engaged for this cruise. The research area for 2014 survey was proposed in the eastern north Pacific between 170°E and 160°W, from 30°N to 40°N that has not been surveyed previously. Photo-id and biopsy experiments also will be planned. The cruise will take place in July and August and will involve about 15 day-transit to and from the research area and thus some 45 days of research. Information collected from this survey will provide essential information for the intersessional workshop to plan for a medium-long term international programme in the North Pacific. The data and report of this survey will be submitted to the IWC SC meeting.

## BACKGROUND

During the 61<sup>st</sup> annual meeting of the Scientific Committee of the International Whaling Commission (IWC/SC) in 2009, Japan presented a proposal and preliminary plan for a mid- to long-term research programme involving sighting surveys to provide information for cetacean stock management in the North Pacific. The cruise was organized as a joint project between the IWC and Japan. The IWC SC welcomed the initiative and agreed the value of a large-scale, middle-long term integrated research programme in the North Pacific and strongly encouraged this in the context of international collaboration under IWC auspices. The IWC/SC recommended that the planning process should start with a review of the current discussions on North Pacific issues within the Committee and a careful examination of available information and identification of gaps in knowledge (IWC, 2010).

The IWC/SC has been conducting the international whale sighting survey program in the Southern Hemispheres every year since 1978/79 Antarctic season as the International Decade of Cetacean Research Program (IWC/IDCR: 1978/79-1995/96 seasons), and as the Southern Ocean Whale and Ecosystem Research (IWC/SOWER: 1996/97-2009/10 seasons) (IWC, 2010).

To start the organization of this research programme the IWC SC established an intersessional group with the following terms of references (TORs) (IWC, 2010):

- (1) Review the Committee's issues in the North Pacific and circulate a paper before the next Annual Meeting.
- (2) Review the past and ongoing survey activities and available data in range states from completed pro forma.
- (3) Consider possible line transect survey plan and additional data collection (e.g. photo ID and biopsy) for 2010 season.
- (4) Prepare proposal for intersessional workshop (between SC62 and SC63) on future surveys beyond 2011.

To initiate and review progress of the work related to those TORs, an intersessional meeting (IM) was held in Tokyo on 27 September, 2009. The IM reviewed progress for each of the TORs listed above. In particular, the IM initiated discussions about medium-long-term objectives of the research programme. Specific group was identified to complete the works related to TORs (1) and (2) above. Another group was identified to make a proposal for an intersessional workshop to plan for a mid-to long-term programme within the North Pacific (TOR (4) above). The report of the IM was presented at the 62<sup>nd</sup> annual meeting of IWC SC (IWC, 2011).

Regarding TOR (3) above the IM discussed and agreed on a survey cruise plan for 2010. The 2010 research plan (Kato *et al.*, 2010) was presented to the 62<sup>nd</sup> annual meeting of IWC SC. After the meeting, the research cruise of the IWC/Japan Joint Cetacean Sighting Survey in the North Pacific was conducted successfully in 2010 summer (Matsuoka *et al.*, 2010).

At the 62<sup>nd</sup> annual meeting of IWC SC, it was also agreed that a planning meeting for the 2011 research cruise and mid- to long- term objectives for the programme would be held in Tokyo from late September to early October 2010 (IWC, 2011a). The planning meeting was held from 28 September to 1 October 2010, and general discussion on the 2011 cruise plan was made there. At the meeting, a small discussion group was formed to develop a detailed plan for the 2011 research cruise by the end of November 2010, and also formed to develop a detailed plan for the 2012-2015 short term research cruises by the SC63.

At the 63<sup>rd</sup> annual meeting of IWC SC, it was also agreed that a planning meeting for the 2012 research cruise and mid- to long- term objectives for the programme would be held in Tokyo from late September to early October 2011 (IWC, 2012a). At the meeting, a Technical Advisory Group (TAG) on POWER was formed to develop a detailed plan for the 2012 research cruise and also formed to develop a detailed plan for the 2013-2015 short term research cruises by the SC64. The TAG and planning meetings were held from 26-30 September 2011, and general discussion on the 2012 cruise plan was made there (IWC, 2012b and 2012c).

At the 64<sup>th</sup> annual meeting of IWC SC, it was also agreed that a planning meeting for the 2013 research cruise and after the 64<sup>th</sup> annual meeting of IWC SC, the research cruise of the IWC-Pacific Ocean Whale and Ecosystem Research (IWC-POWER) was conducted successfully in 2012 summer (Matsuoka *et al.*, 2013).

This document outlines the research cruise plan for the 2014 IWC Pacific Ocean Whale and Ecosystem Research (POWER) following the general guidelines agreed at the planning meeting (IWC, 2012c).

## **CRUISE PLAN FOR 2014**

### **Research area and rationale**

The cruise will be conducted in summer 2014 in the area shown in Figure 1 for the following reason:

This area has been poorly covered by previous surveys and not at all in recent decades thus representing an important information gap for several large whale species.

The cruise will be focused on the collection of line transect data to estimate abundance and biopsy/photo-identification data, would make a valuable contribution to the work of the Scientific Committee on the management and conservation of populations of large whales in the North Pacific in a number of ways, including:

- (a) providing information for the proposed future in-depth assessment of sei whales in terms of both abundance and stock structure;
- (b) providing information relevant to *Implementation Reviews* of whales (e.g. common minke whales) in terms of both abundance and stock structure;
- (c) providing baseline information on distribution and abundance for a poorly known area for several large whale species/populations, including those that were known to have been depleted in the past but whose status is unclear;
- (d) providing biopsy samples and photo-identification photos to contribute to discussions of stock structure for several large whale species/populations, including those that were known to have been depleted in the past but whose status is unclear;
- (e) providing essential information for a medium-long term international programme in the North Pacific.

### **Recent surveys in the Western North Pacific**

Figure 1 shows the areas in the North Pacific, which have been covered by cetacean scientific surveys in recent years. The proposed research area from 2014 survey onward has not been surveyed previously.

### **Distribution of previous catches of large whales in the proposed research area**

To examine the possibility of encounter with large whale species in the proposed survey area the distribution of previous catches in that North Pacific was plotted (Appendix 1). This was done for blue, fin, sei, Bryde's, humpback, North Pacific right and sperm whales using the catch data recorded in the IWC database (ver. 4.0). There are no minke and right whale catch records in the database for the proposed survey area. From the plotting it can be noted that the research area match the catch distribution for the other species examined.

Information collected from this single survey will provide essential information for the intersessional workshop to plan for a medium-long term international programme in the North Pacific.

### **Stratification of the research area and trackline in the research area**

Figure 2 shows the planned trackline for the 2014 survey. Every location within the study area has an equal probability of being sampled which is calculated by the software "DISTANCE". For this aim the starting points of transect lines within the study area were randomized following IWC SC guidelines (IWC, 2005). Outer limit of foreign EEZs is provided by NOAA Office of Coast Survey and the data are available from [http://www.nauticalcharts.noaa.gov/csdl/docs/GIS\\_EEZ\\_Alaska.zip](http://www.nauticalcharts.noaa.gov/csdl/docs/GIS_EEZ_Alaska.zip).

### **Cruise track and itinerary**

Following is a tentative cruise plan because budget from Government of Japan is a provisional at this moment. A total cruise of about 60 days (i.e. including transit time) represents the maximum operation period of the vessel without refuelling/resupplying. Based on past JSV data and catch data, it could be considered that a southern boundary at 30°N and a northern boundary at 40°N would incorporate the expected latitudinal range of sei and Bryde's whales at that time of the year and allow sufficient coverage.

The cruise will take place in July and August and will involve about 15 day-transit to and from the research area and thus some 45 days of research. Based on experience elsewhere in the North Pacific, allowing for poor conditions and time for photo-identification and biopsy sampling work should enable for an average of about 90 n.miles per day to be covered in primary searching effort (70 n.miles for the 2012 cruise). It is supposed that the 2014 research area (between 30°N-40°N) is more good sea conditions rather than 2010 -2012 research areas (north of 40°N). Table 1 shows a tentative itinerary for the 2014 cruise.

Table 1. Tentative itinerary for the 2014 cruise (60days).

<b>Date</b>	<b>Event</b>
2 July 2014	Vessel departs Shiogama, northern Japan
16 July 2014	Vessel arrives in the research area to the starting point at 170°00'E
24 August 2014	Vessel completes the research at 160°00'W
30 August 2014	Vessel arrives Shiogama, northern Japan

### **Research vessel**

The research vessel, *Yushin-Maru No.3* (YS3) would be engaged for this cruise. The YS3 is equipped with a top barrel platform (TOP) and upper bridge. The ICR research data collecting system (Japanese survey version) is set onboard the vessel. Searching will occur at the most comfortable cruising speed normally 11.5 knots. It will have space for three or four researchers. Specification of the YS3 is shown in Table 2.

Table 2. Specification of the YS3.

<i>Yushin-Maru No.3</i>	
Call sign	7JCH
Length overall [m]	69.61
Molded breadth [m]	10.80
Gross tonnage (GT)	742
Barrel height [m]	19.5
Upper bridge height [m]	11.5
Bow height [m]	6.5
Engine power [PS / kW]	5280 / 3900

### International researchers

The *Yushin-Maru No.3* can accommodate maximum four researchers. An appropriate researcher from each of the US, Republic of Korea, Japan and another country would participate in the 2014 survey cruise. The steering group of this cruise which established in the IWC SC will nominate these researchers.

All researchers must submit their personal details, including Last Name, First Name, Sex (M/F), Nationality, Date of Birth (Y/M/D), Institute, Address, TEL, FAX, E-mail, Passport No., Language, Survey experience (Y/N); Line Transect: (Y/N), Biopsy: (Y/N), Photo-ID: (Y/N), Acoustics: (Y/N).

Researchers will need to bring their own protective clothing, computers, office supply as in previous years. The daily subsistence charge aboard the vessel will be ¥2,500 per day for each researcher.

### Details of the cruise

#### *Survey modes and length of research days*

Activities onboard the ship are classified into two principal groups: on-effort and off-effort. On-effort activities are times when full search effort is being executed and conditions (such as weather and sea conditions) are within acceptable parameters to conduct research. Off-effort activities are all activities that are not on-effort. All sightings recorded while the ship is on-effort are classified as primary sightings. All other sightings are secondary sightings.

Two survey modes, Normal Closing Mode (NSC) and Independent Observer with passing mode (IO) were used in 2010 cruise as in the case of the SOWER cruises in the Antarctic. However, the use of passing mode in the POWER would result in very high proportions of unidentified cetaceans. For example, priority species such as fin, sei and Bryde's whales are difficult to identify unambiguously unless close to the vessel. Because of the reason, the TAG recommended that Passing with abeam closing mode (NSP) is the most appropriate survey mode, both with respect to confirming species identity and school size (IWC, 2013). NSP was used in 2011 and 2012. When the sighting passed abeam of the vessel, the ship approached the sighting for confirmation of species and school size. Normally, sightings within 3 n.miles, perpendicular distance from the trackline) were approached. Sighting records were made by the international researchers and all data submitted to the IWC secretariat in each year.

On-effort sightings survey research is conducted by the Passing Mode - are scheduled for specific legs during the survey of the research area. Sighting effort is conducted by the two primary observers, researchers and the chief engineer or deputies are also present. Primary search effort is only conducted in acceptable weather conditions. These conditions are used as guidelines; in some circumstances, less severe conditions may still be inappropriate for search effort (see below).

The following sections describe each of the survey modes. Research hours during the cruise will be the same as on recent SOWER cruises (from 6:00-18:00; begin 60 minutes after sunrise and end 60 minutes before sunset, with a maximum 12 hours per day). As in the SOWER programme, for biopsy sampling/photo-identification work on priority species (sei, common minke, North Pacific right, blue, humpback, fin, with higher priority to the former two species in this cruise –see items (a) and (b) in page 2-) there may be occasions when it is beneficial to extend research outside the normal research hours. The basis for such special extension of research hours will involve mutual agreement between the captain and

cruise leader and an allocation of equivalent time-off the following morning or evening. Details of photo-identification and biopsy works are shown below.

The research day in transits will begin 30 minutes after sunrise and end 30 minutes before sunset, with a maximum of a 12-hour research day. Time-zone changes will be in 30-minute intervals, coming into effect at midnight.

#### *Number of crew on effort*

Two topmen observe from the barrel at all times in passing mode. Two primary observers will be in the barrel whenever full searching effort by reticles binoculars with the angle board is conducted. Two primary observers (captain and helmsman) will be at the upper bridge by binoculars with reticles, regardless of the research mode. Also present on the upper bridge, whenever the sighting survey is conducted, will normally be the chief engineer (or an alternate). There will be four researchers on the vessel. During survey, the number of researchers searching from the Upper Bridge should be standardised.

#### *Acceptable conditions*

The usual guidelines for acceptable conditions will apply, i.e. visibility (to see a minke whale) is greater than 2.0 n.miles and wind speed is <21 knots; the sea state should be <Beaufort 6.

#### *Estimated angle and distance training and experiment*

The experiment is designed to calibrate and identify any biases in individual observers' estimation of angle and distance. The experiment should be conducted during weather and sea conditions representative of the conditions encountered during the survey. The detailed protocol can be found in the Guide for Researchers.

#### *Data format*

The survey will be conducted using the same data forms as on the SOWER cruise (see the Guide for Researchers) and the 2011 cruise data forms (Anon, 2010).

#### *Biopsy sampling*

As appropriate and decided by the Cruise Leader, research time will be given for biopsy sampling of sei, common minke, blue, humpback, grey, fin and Bryde's whales (bowhead and North Pacific right whales are unlikely to be seen south of 40°N), with higher priority given to the former two species in this cruise (see items (1) and (2) in page 2). Biopsy of killer and sperm whales will be attempted on an opportunistic basis.

Biological sample collection will occur from large vessel surveys using biopsy sampling (skin/blubber collected by projectile dart). Projectile biopsies will be collected using either a compound crossbow or the Larsen gun system. During any single encounter, no more than five biopsy sampling attempts per individual will be made. It is rare that an animal would be targeted for biopsy more than twice during one encounter, but we conservatively request five sample attempts to allow for occasional low success rates. If signs of harassment such as rapid changes in direction, prolonged diving and other behaviours are observed from an individual or a group, the biopsy activities will be discontinued on that individual or group. The animals to be sampled will either approach the vessel on their own or be approached by the main research vessel during normal survey operations. The projectile biopsy sample will be collected from animals within approximately 5 to 30 m of the bow of the vessel.

For large cetaceans, small samples (<1 gram) will be obtained from free-ranging individuals using a biopsy dart with a stainless steel tip measuring approximately 4 cm in length with an external diameter of 9 mm and is fitted with a 2.5 cm stop to ensure recoil and prevent deeper penetration (so that only 1.5 cm of the tip is available to penetrate the animal). Between sample periods, the biopsy tips are thoroughly cleaned and sterilized with bleach. Biological samples may be collected from adults, juveniles, females with calves and calves. The same size biopsy dart would be used for calves as for adults. No biological samples will be taken from newborn calves. The age of a calf would be determined by the subjective

judgment of our field biologists who have up to 20+ years experience in the field. They would, and would be instructed to, be on the side of caution and not biopsy an animal that appeared too young.

#### *Photo-id*

As appropriate and decided by the Cruise Leader, research time will be given for photo-identification and /or video taping of right, blue, humpback whales in this cruise. Killer whale is "non-target" cetacean which lower priority on the opportunistic basis. As noted above, the estimated daily number of miles to be steamed in searching mode has a built in allowance for such work. Photographs will be available under the standard IWC Guidelines. Generally, large whales will be approached within approximately 15-20 meters. Photo-identification of adult and juvenile males and females will occur. If the opportunity arises, females accompanied by calves may be approached for photo-identification, but efforts will cease immediately if there is any evidence that the activity may be interfering with pair bonding, nursing, reproduction, feeding or other vital functions.

#### *Acoustic studies*

This will depend on whether it is practical to use a towed array for sperm whales and whether it is possible to obtain suitable sonobuoys for blue whales.

#### *Oceanographic studies*

No specific oceanographic studies are planned for 2014.

#### *Identification of home port organiser*

It will be the responsibility of the Japanese scientists to organise matters in the home port Shioyama.

#### *Necessary permits*

The US EEZ of Hawaiian Islands occurs in the planned research area. It should be noted that at least three different kinds of permit or permission would be needed to work in US waters. Research permits (a US MMPA and ESA) are needed for any surveys for cetaceans. Such permits are granted by the US National Marine Fisheries Service.

A second kind of permission needed would be from the US government (State Department) for entry of a foreign vessel into US waters to carry out research.

CITES permits will also be required to ship the IWC half of the biopsy samples to the SWFSC in La Jolla, as is the case for the SOWER samples.

#### *Data holders and transportation of equipment*

The rules for data availability, shipping and storage will be as for the previous IWC/SOWER cruises and the 2011 survey cruise in the North Pacific. It also noted that existing IWC equipment used in the 2013 cruise could be used on the 2014 cruise if required. All records will be discharged in Shioyama and will be sent to the IWC Secretariat under the responsibility of the cruise leader.

All photo-ID digital photographs of this cruise are to be sent to IWC and copied to Japan as same as previous IWC/SOWER and the 2011 North Pacific survey cruises. Photographs are available under standard IWC guidelines. Copied data will be stored at the Institute of Cetacean Research (ICR).

Samples for molecular genetic analyses are to be divided in half, with one half of the sample for IWC (to be sent to the NOAA/NMFS Southwest Fisheries Science Center (SWFSC)) and the other half for Japan. All samples will be frozen. In addition, when biopsy samples have a significant amount of blubber attached, the blubber is to be separated from the skin, wrapped in aluminium foil, and frozen. Details can be found in the "Information for researchers" (Anon., 2011).

### *Meetings*

Arrangements for the holding of pre- and post cruise meetings with crew and researchers will be the responsibility of the cruise leader and Japanese scientists.

### *Reports*

The cruise will follow the requirements for reports and documentation developed for cruises that could provide data for use under the RMP. This will be the responsibility of the cruise leader.

A draft of the cruise report will be prepared, in accordance with the guidelines documented in IWC (1994), prior to arrival in the home port and, as necessary, the draft will be reviewed during the post-cruise meeting. The Cruise Leader will email the final report to the IWC Secretariat as soon as possible. It will also be made available on the IWC website.

Copies of the final report will be forwarded by the IWC Secretariat to all Steering Group members, all researchers, the captain, the US Government (through Brownell), Korean Government (through An) and the Fisheries Agency of Japan (through cruise leader).

## **REVIEW OF THE BUDGET**

The plans given above assume the same level of Japanese funding being available as for the 2013 North Pacific sighting survey cruise. Direct funds would be requested for 2014 to the IWC budget (IWC, 2012b).

## **ACKNOWLEDGEMENTS**

We acknowledge the Governments of the US, Canada, Republic of Korea and Japan for their assistance in the research permit and funding for recent cruises. We acknowledge Greg Donovan of the Secretariat of the IWC, the steering group of this cruise (Hidehiro Kato (Convener), Robert Brownell, Phillip Clapham, Paul Ensor, Tomio Miyashita, Hiroto Murase, Luis Pastene and Lars Walloe), the Technical advisory group of for the cruises (Toshihide Kitakado, Sharon Hedley, Mark Bravington, and Nataly Kelly) for their assistance in arrangements and support for the recent cruises.

## **REFERENCES**

- Anon. 2010. 2010 IWC/Japan Joint Cetacean Sighting Survey Cruise in the North Pacific, Information for Researchers. 54pp.
- Barlow, J. and Forney, K.A. 2007. Abundance and population density of cetaceans in the California Current ecosystem. *Fish. Bull.* 105: 509-526.
- International Whaling Commission. 1994. Report of the Scientific Committee, Annex J. Rep. Int. Whal. Commn. 44: 168-173.
- International Whaling Commission. 2005. Report of the Scientific Committee. Annex D. Report of the sub-committee on the Revised Management Procedure. Appendix 3. Requirements and Guidelines for Conducting Surveys and Analysing Data within the Revised Management Scheme. *J. Cetacean Res. Manage.* (Suppl.) 7:92-101.
- International Whaling Commission. 2010. Report of the Scientific Committee. Annex G. Report of the Sub-Committee on In-Depth Assessments. *J. Cetacean Res. manage.* (suppl. 2) 12: 180-197.
- International Whaling Commission. 2011a. Report of the Intersessional Meeting on the North Pacific Survey Programme. Tokyo 27-28 September 2009. *J. Cetacean Res. Manage.* (Suppl.) 12:415-420.
- International Whaling Commission. 2011b. Report of the Workshop on planning for an IWC co-ordinated North Pacific research cruise Programme. Tokyo 28 September-1 October 2010. SC/63/Rep5. 33pp.
- International Whaling Commission. 2012a. Report of the Scientific Committee. Annex G, Tromso SC63, *J. Cetacean Res. manage.* (Suppl.) 13:xxx-xxx.

- International Whaling Commission. 2012b. Report of the Technical Advisory Group (TAG) meeting on the short and medium term objectives and plans for the IWC-POWER cruises. Tokyo 26-28 September 2011. SC/64/Rep1. 15pp.
- International Whaling Commission. 2012c. Report of the Planning Meeting for the 2012 IWC-POWER Cruise. Tokyo 29-30 September 2011. 15pp.
- International Whaling Commission. 2013. Report of the Technical Advisory Group (TAG) meeting on the short and medium term objectives and plans for the IWC-POWER cruises. Tokyo 26-28 September 2011. J. Cetacean Res. Manage. 14 (Suppl.) (in press)
- Kato, H., An, Y.R., Bravington, M., Brownell, B., Clapham, P., Donovan, G., Ensor, P., Matsuoka, K., Miyashita, T., Murase, H., and Walloe, L. 2010. Research Plan for the 2010 IWC/Japan Joint Cetacean Sighting Survey in the North Pacific. IWC Paper SC/62/IA10. 10pp.
- Matsuoka, K, Hakala, S., Kim, H.W., Aki, M. and Shinyasaki, Y. 2011. 2010 IWC/Japan Joint Cetacean Sighting Survey Cruise in the North Pacific. 40pp.
- Matsuoka, K, Mizroch, S. and Komoya, H. 2012. Cruise report of the 2011 IWC-Pacific Ocean Whale and Ecosystem Research (IWC-POWER). SC/64/IA5, 27pp.
- Matsuoka, K., Mizroch, S., An, Y.-R., Kumagai, S. and Hirose, K. , 2013. Cruise report of the 2012 IWC-Pacific Ocean Whale and Ecosystem Research (IWC-POWER). Paper SC/65/IAXX presented to the 65th IWC Scientific Committee, June 2013 (unpublished). 44pp.
- Miyashita, T. 2006. Cruise report of the sighting survey in the waters east of the Kuril Islands and the Kamchatka Peninsula in 2005. Paper SC/58/NPM5. 9pp.
- Moore, S.E., Waite, J.M., Friday, N.A. and Honkalehto, T. 2002. Cetacean distribution and relative abundance on the central-eastern and the southeastern Bering Sea shelf with reference to oceanographic domains. *Prog. Oceanogr.* 55: 249-261.
- Pastene, L.A., Hatanaka, H., Fujise, Y., Kanda, N., Murase, H., Tamura, T., Miyashita, T. and Kato, H. 2009. The Japanese Whale Research Program under Special Permit in the western North Pacific Phase-II (JARPN II): origin, objectives and research progress made in the period 2002-2007, including scientific considerations for the next research period. Paper SC/J09/JR1 presented to the JARPNII review meeting (unpublished). 73pp.
- Zerbini, A.N., Waite, J.M., Durban, J.W., LeDuc, R., Dahlheim, M.E. and Wade, P.R. 2007. Estimating abundance of killer whales in the nearshore waters of the Gulf of Alaska and Aleutian Islands using line-transect sampling. *Mar. Biol.* 150: 1033-1045.



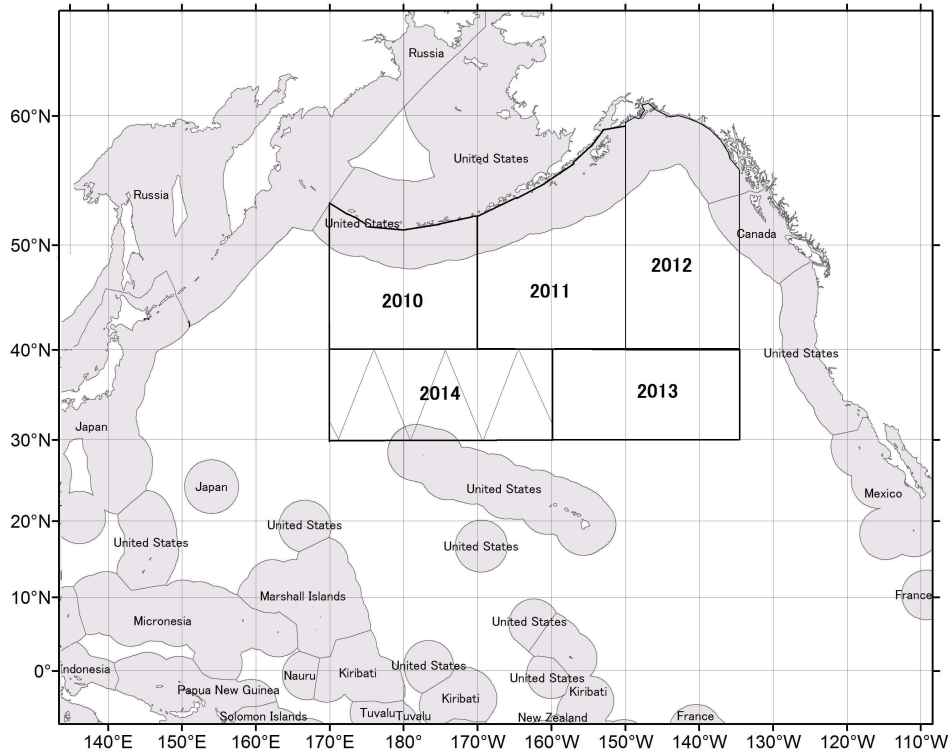


Figure 1. Proposed research area with pre-determined track line for the 2014 by the TAG. The 2010-2014 POWER research areas with foreign EEZ are shown, respectively.