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Revised research plan for a dedicated cetacean sighting survey in 2019

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INTERNATIONAL WHALING COMMISSION

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ABSTRACT
This paper presents a revised sighting survey plan for western North Pacific in 2019. The original plan was presented to the IWC SC in 2018, which included sub-area 6E to be covered by *Yushin –maru No. 2* (*YS2*) and sub-areas 7WR and 7E to be covered by *Kaiyo-maru No. 7* (*KY7*) in May-June 2019. The revised plan presents two differences regarding the original one: i) sub-areas 7WR and 7E will be covered in May-June by two vessels, *Yushin-maru No. 1* (*YS1*) and *Yushin-maru No. 3* (*YS3*), instead of one; ii) an additional survey will be carried out in sub-area 7WR from August to September 2019 by one vessel (*KY7*). The main objective of the surveys is to investigate the distribution and abundance of common minke whales in those sub-areas. The sighting protocols are the same in all surveys.

KEYWORDS: COMMON MINKE WHALE, SIGHTING SURVEY, NORTH PACIFIC

INTRODUCTION

In the western North Pacific dedicated cetacean sighting surveys based on the survey procedures of the International Whaling Commission/Southern Ocean Whale and Ecosystem Research (IWC/SOWER) and more recently International Whaling Commission/Pacific Ocean Whale and Ecosystem Research (IWC/POWER), has been conducted since 1995. Based on the collected data, the distribution pattern of large whales such as blue, fin, sei, Bryde's, common minke, humpback, right and sperm whales and abundance estimate of common minke, sei and Bryde's whales was investigated and reported to the IWC SC (IWC, 2001; 2010; 2016).

The National Research Institute of Far Seas Fisheries (NRIFSF) has also conducted dedicated sighting survey for cetaceans in the North Pacific since the 1980s (Buckland *et al.,* 1992; Miyashita and Kato, 2004; 2005).

The Government of Japan started the New Scientific Whale Research Program in the western North Pacific (NEWREP-NP) (GOJ, 2017). The NEWREP-NP includes a dedicated whale sighting component aimed to produce abundance estimates of western North Pacific common minke whale and North Pacific sei whale. Abundance information will contribute to providing direct input for the statistical catch-at-age analysis (SCAA), which will be conducted in the context of future Revised Management Procedure (RMP)'s *Implementations* for those species.

There are two NEWREP-NP research objectives related to abundance estimates. One is Objective I (ii): Estimate the abundance of the J and O stocks in coastal waters of Japan and the other is Objective II (i): Abundance estimates for North Pacific sei whale taking into account of additional variance (GOJ, 2017). Abundance estimates require sighting data collected in a systematic manner under the guidelines agreed by the International Whaling Commission Scientific Committee (IWC SC) (IWC, 2012).

At the NEWREP-NP review workshop, the Panel highlighted several issues that must be considered when designing line transect surveys that are expected to provide abundance information to address multiple objectives. The Panel recommends that issues related to survey design, data collection protocols and priorities, data analyses and coordination are included in the plans to be submitted to the IWC SC for approval, before the surveys start. The main additional issues that should be covered in the proposals for surveys submitted to the IWC SC are: (a) Evaluation of past surveys' analytical difficulties, (b) Appropriate temporal stratification of the surveys, (c) Appropriate direction of travel, (d) Use of independent observer (IO) mode, (e) Use of passive independent observer mode, (f) Development of protocols/priorities for biopsy-related activities, (g) Evaluation of additional variance analysis and spatial model and (h) 'Regime shift'-related aspects (IWC, 2017).

A plan for a dedicated sighting survey in the North Pacific in 2019 under NEWREP-NP was presented to the 2018 IWC SC meeting. In that plan, the survey would be conducted in sub-area 6E using the research vessel

Yushin-maru No. 2 (*YS2*) and in sub-areas 7WR and 7E using the research vessel *Kaiyo-maru No. 7* (*KY7*) (Hakamada *et al*., 2018). Instead of *KY7*, two research vessels *Yushin-maru* (*YS1*) and *Yushin-maru No.3* (*YS3*) will be used for the sighting survey in sub-areas 7WR and 7E from May to June in 2019. In addition, a dedicated sighting survey in sub-area 7WR will be conducted from August to September using the research vessel *KY7*. The sighting survey in summer will not be conducted under NEWREP-NP however sighting protocols will be the same as those used in May-June.

The objective of this paper is to outline revised research plan for dedicated sighting surveys in 2019 in the western North Pacific.

The survey plans for 2019 considers the recommendations above as much as possible, and obviously the design and implementation will follow the 'Requirements and Guidelines for Conducting Surveys and Analyzing Data within the Revised Management Scheme (RMS)' (IWC, 2012). Details on the main additional issues and response to recommendations are summarized in Annex 1.

RESEARCH PLAN

Research vessels

The survey in 2019 will be based on the research vessels *YS1*, *YS2* and *YS3* from May to June (Figure 1) and the research vessel *KY7* from August to September (Figure 1).

Research vessels *YS1, YS2*, *YS3* and *KY7* are equipped with a top barrel platform (TOP), independent observer platform (IOP) and upper bridge. The ICR research data collecting system is set on the vessel. Specifications of the vessels are shown in Table 1.

Research schedule

In 2019, the planned number of the research days are 47 days, 30 days, 30 days and 42 days for *YS2, YS1, YS3* and *KY7*, respectively. The survey itineraries are shown for *YS2*, *YS1, YS3* and *KY7* in Tables 2A, 2B, 2C and 2D, respectively. At this stage, home port for the sighting survey from August to September is not decided yet.

Researchers on board and oversight person

Experienced researchers on line transect whale sighting surveys, biopsy and photo-id experiments will be selected. Koji Matsuoka (Institute of Cetacean Research) will be the responsible person for these surveys. He is proposed as the oversight person on behalf of the IWC SC.

Research area and track line design

The research area for the survey from May to June in 2019 will be comprised between 33ºN-45ºN and 128ºE-150ºE (a part of sub-areas 6E, 7WR and 7E for minke whale's RMP *Implementation*). Areal coverage of sub-areas 6E, 7WR and 7E are 100% (assuming the borderline between 6W and 6E to be same as the EEZ line between Japan and foreign countries), 89% and 57%, respectively. The cruise track in sub-area 6E is not changed at all whereas those in sub-areas 7WR and 7E are changed. The survey blocks and pre-determined track lines are shown in Tables 3A, 3B and 3C and Figure 2. *YS2* will start the survey at WP101 and end at WP131 in sub-area 6E. The *YS1* will start the survey at WP201 and end WP212 in sub-area 7WR and *YS3* will start at WP301 and end at WP308 in sub-area 7E. Both vessels will survey in ascending order of WP number. Planned searching distance are 2087.0 n.miles,1180.3n.miles and 874.3 n.miles in sub-areas 6E, 7WR and 7E, respectively.

The research area for the survey from August to September in 2019 will be comprised between 35ºN-43ºN and 142ºE-147ºE (a part of sub-area 7WR for minke whale's RMP *Implementation*). Areal coverage of sub-area 7WR is 89%. The survey blocks and pre-determined track lines are shown in Table 3D and Figure 3. *KY7* will start the survey at WP401 and end WP412 in sub-area 7WR. *KY7* will survey in ascending order of WP number. Planned searching distance is 1196.1 n.miles in sub-area 7WR.

The start points of the track lines in the 2019 surveys are decided at random using the Distance program ver. 7.0 (Thomas *et al.*, 2010), and the number of lines (width in the longitude) is decided by the research schedule based on the IWC survey guideline (IWC, 2012).

Survey modes
Sighting activities in the 2019 surveys will be classified into two principal types: 'On-effort' and 'Off-effort'. On-effort means sightings activities executed under weather and sea state conditions considered acceptable. Off-effort means all activities that are not On-effort. All sightings to be recorded On-effort will be classified as 'Primary sightings. All other sightings will be classified as 'Secondary sightings. Sighting effort will be conducted by the boatswain and topmen from the top barrel (there will be always two primary observers on the top barrel) and the upper bridge where the helmsman, captain or officer-onwatch, researchers, and the chief engineer (or second engineer) will be also present (always two primary observers and four secondary observers). The sighting survey will be conducted using (1) Passing with abeam closing mode (NSP) and (2) Passing with Independent Observer (IO) mode in order to estimate whale abundance considering estimated $g(0)$. Both survey modes follow the protocol endorsed for the IWC/SOWER surveys (e.g. Matsuoka *et al.*, 2003, IWC, 2008).

Under NSP mode, there will be two primary observers on the TOP. These observers will search for cetaceans by using angle board and binoculars (7x), which include the distance estimate scales. Members of two observer teams on TOP will be fixed and will operate in one or two hours-shifts. There will be open communication between the upper bridge and the TOP. These observers report sighting information to researchers and other observers on the upper bridge for data recording.

Under IO mode, there will be two primary observers on the TOP and one primary observer on the IOP. These observers on TOP and IOP platforms will conduct searching for cetaceans by using angle board and binoculars (7x). Members of the two observer teams on TOP will be fixed and will operate in one or two hours-shifts. There will be no open communication between the IOP and the TOP. The observers on the upper bridge will communicate to the TOP (or IOP) independently, with the topmen required only to clarify information without distracting them from their normal search procedure. These observers report sighting-information to researchers and other observers on the upper bridge for data recording.

Experiments
Distance and angle measurement training is to be conducted at the first stage of the survey. The experiment to evaluate measurement error is to be conducted around the last stage of the survey following the protocol for the IWC/SOWER cruise (IWC, 2008).

When large cetaceans such as blue, North Pacific right and humpback whales are found, photographs are to be taken for photo-identification studies. Biopsy skin sampling of baleen whales will be collected on an opportunistic basis using Larsen system for investigating stock structure.

Protocols for photo-id and biopsy sampling are similar to those used in the IWC-POWER surveys.

Satellite tag experiment will be conducted by *YS2* and *YS3*. Target species are planned to be common minke and sei whales.

Data entry and analysis
The researcher will input data collected (weather, effort, sighting and from experiments data) to the computer on board during the survey as was done for previous IWC-SOWER cruises. These data will be stored at the ICR and submitted to the IWC secretariat based on the IWC SC Guidelines (IWC, 2012).

The report of the sighting survey in 2019 will be submitted to the 2020 IWC SC meeting. Scientists at the ICR will analyze these data using the methods developed and modified by Hakamada *et al.* (2009), Matsuoka *et al*. (2011) and by Okamura and Kitakado (2004). Collaboration work with NRIFSF will be conducted for abundance estimation of cetaceans in the surveyed area.

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Table 1. Specification of the research vessels used for the surveys.

	Yushin-Maru	*Yushin-Maru No.2*	*Yushin-Maru No.3*	*Kaiyo-Maru No.7*
Call sign	JLZS	JPPV	7JCH	JECL
Length overall [m]	69.61	69.61	69.61	60.02
Molded breadth [m]	10.4	10.8	10.8	10.6
Gross tonnage [GT]	724	747	742	649
Top barrel height [m]	19.5	19.5	19.5	17.5
IO platform height [m]	13.5	13.5	13.5	12.7
Upper bridge height [m]	11.5	11.5	11.5	9.6
Bow height [m]	6.5	6.5	6.5	4.5
Engine power [PS/kW]	5,280/3,900	5,280/3,900	5,280/3,900	2,100/1,544

Table 2A. Expected itinerary of the *YS2* survey in 2019.

Date	Event
11-May-19	Vessel (*YS2*) depart Shiogama, Japan
14-May	*YS2* arrive at the starting point in the research area (sub-area 6E)
23-Jun	*YS2* complete sub-area 6E (40 days) and move to Shiogama
26-Jun	*YS2* arrive Shiogama, Japan

Table 2B. Expected itinerary of the *YS1* survey in 2019.

Date	Event
10-May-19	*YS1* depart Shimonoseki, Japan
13-May	*YS1*arrive at the starting point in the research area (sub-area 7WR)
4-Jun	*YS1* complete sub-area 7WR (23 days) and move to Shimonoseki
8-Jun	*YS1* arrive Shimonoseki, Japan

Table 2C. Expected itinerary of the *YS3* survey in 2019.

Date	Event
10-May-19	*YS3* depart Shimonoseki, Japan
13-May	*YS3* arrive at the starting point in the research area (sub-area 7E)
3-Jun	*YS3* complete sub-area 7E (22 days) and move to Shimonoseki
8-Jun	*YS3* arrive Shimonoseki, Japan

Table 2D. Tentative itinerary of the *KY7* survey in 2019.

Date	Event
16-Aug-19	*KY7* depart a home port
20-Aug	*KY7* arrive at the starting point in the research area (sub-area 7WR)
23-Sep	*KY7* complete sub-area 7WR (35 days) and move to the home port
26-Sep	*KY7* arrive the home port

Table 3A. Waypoint (WP) in sub-area 6E during the sighting survey in 2019 using *YS2*. Asterisks (*) indicate that sighting survey will not be conducted between the WP and next WP.

6E	WP	Lat.				Lon.				
	101	40	-	3.13	N	139	-	55.9	E	
	102	41	-	0.00	N	137	-	29.2	E	
	103	38	-	29.3	N	139	-	30.7	E	*
	104	38	-	22.6	N	139	-	27.5	E	
	105	40	-	26.9	N	135	-	32.2	E	*
	106	40	-	26.4	N	135	-	31.0	E	
	107	37	-	14.4	N	138	-	20.2	E	*
	108	37	-	11.7	N	138	-	16.3	E	
	109	39	-	19.2	N	134	-	19.0	E	*
	110	39	-	17.9	N	134	-	17.7	E	
	111	36	-	35.1	N	136	-	34.5	E	*
	112	36	-	25.8	N	136	-	25.5	E	
	113	37	-	53.5	N	133	-	38.6	E	*
	114	37	-	40.8	N	133	-	26.1	E	
	115	35	-	41.4	N	134	-	59.4	E	*
	116	35	-	39.5	N	134	-	35.0	E	

6E	WP	Lat.				Lon.				
	117	36	-	43.0	N	132	-	28.3	E	*
	118	36	-	30.6	N	132	-	9.45	E	
	119	35	-	30.5	N	132	-	51.2	E	*
	120	35	-	5.27	N	132	-	19.4	E	
	121	35	-	46.5	N	130	-	47.7	E	*
	122	35	-	39.4	N	130	-	39.8	E	
	123	34	-	25.3	N	131	-	22.6	E	*
	124	34	-	6.87	N	130	-	51.9	E	
	125	34	-	37.9	N	129	-	29.1	E	*
	126	34	-	27.4	N	129	-	23.1	E	
	127	33	-	27.5	N	129	-	47.4	E	*
	128	33	-	5.09	N	129	-	40.5	E	
	129	33	-	28.6	N	128	-	4.90	E	*
	130	33	-	27.7	N	128	-	4.05	E	
	131	33	-	0.00	N	128	-	1.34	E	*

Table 3B. Waypoint (WP) in sub-area 7WR during the sighting survey in 2019 using *YS1*. Asterisks (*) indicate that sighting survey will not be conducted between the WP and next WP.

7WR	WP	Lat.				Lon.				
	201	42	-	15.4	N	145	-	51.6	E	
	202	41	-	48.5	N	146	-	32.2	E	*
	203	41	-	46.6	N	146	-	33.5	E	
	204	40	-	37.9	N	143	-	5.5	E	*
	205	40	-	31.1	N	143	-	7.3	E	
	206	39	-	20.9	N	147	-	0.0	E	
	207	38	-	10.5	N	142	-	47.0	E	*
	208	38	-	1.8	N	142	-	44.8	E	
	209	36	-	49.5	N	147	-	0.0	E	
	210	35	-	32.6	N	142	-	7.9	E	*
	211	35	-	31.2	N	142	-	7.6	E	
	212	35	-	0.0	N	144	-	4.8	E	

Table 3C. Waypoint (WP) in sub-area 7E during the sighting survey in 2019 using *YS3*. Asterisks (*) indicate that sighting survey will not be conducted between the WP and next WP.

7E	WP	Lat.				Lon.			
	301	40	-	49.9	N	149	-	8.5	E
	302	40	-	32.8	N	149	-	60.0	E
	303	39	-	32.4	N	147	-	0.0	E
	304	38	-	31.1	N	149	-	60.0	E
	305	37	-	28.9	N	147	-	0.0	E
	306	36	-	25.8	N	149	-	60.0	E
	307	35	-	21.8	N	147	-	0.0	E
	308	35	-	0.0	N	148	-	0.9	E

Table 3D. Waypoint (WP) in sub-area 7WR during the sighting survey in 2019 using *KY7*. Asterisks (*) indicate that sighting survey will not be conducted between the WP and next WP.

7WR	WP	Lat.				Lon.				
	401	42	-	6.1	N	145	-	51.6	E	
	402	41	-	11.6	N	146	-	32.2	E	*
	403	41	-	11.3	N	146	-	33.5	E	
	404	40	-	32.0	N	143	-	5.5	E	*
	405	40	-	23.6	N	143	-	7.3	E	
	406	38	-	41.2	N	147	-	0.0	E	
	407	38	-	4.4	N	142	-	47.0	E	*
	408	37	-	56.3	N	142	-	44.8	E	
	409	36	-	6.0	N	147	-	0.0	E	
	410	35	-	29.5	N	142	-	7.9	E	*
	411	35	-	28.0	N	142	-	7.6	E	
	412	35	-	0.0	N	144	-	4.8	E	

Figure 1. Research vessels to be used in the dedicated sighting surveys in 2019: *Yushin Maru No. 1* (Upper left) *Yushin Maru No. 2* (Upper right), *Yushin Maru No. 3* (Lower left) and *Kaiyo Maru No. 7* (Lower right).

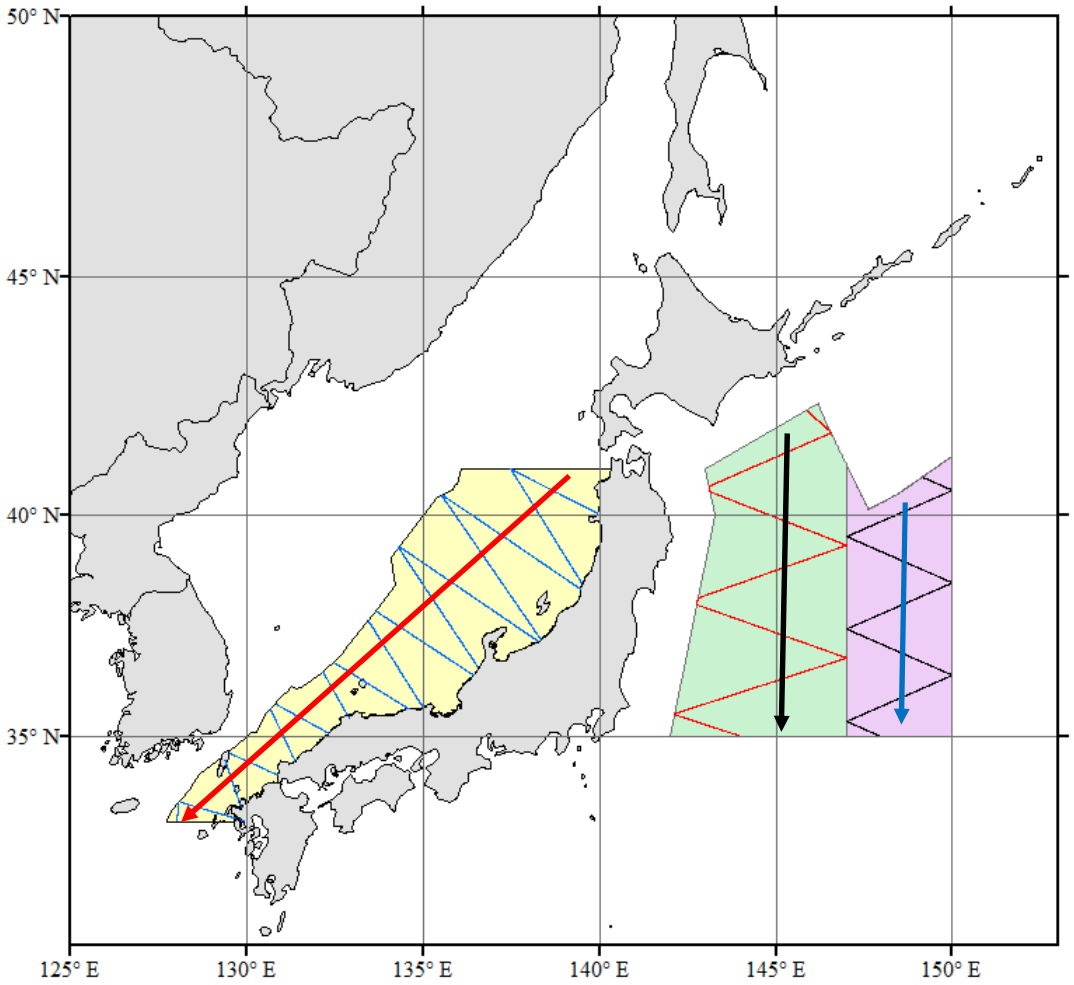

Figure 2. Research area and pre-determined track line of the 2019 survey from May to June. Blue lines indicate track lines in sub-area 6E covered by *YS2*. Red lines indicate track lines in sub-area 7WR covered by *YS1*. Black lines indicate track lines in sub-area 7E covered by *YS3*. Red, Black and Blue arrows show survey order of the planned cruise tracks for *YS2, YS1* and *YS3*, respectively.

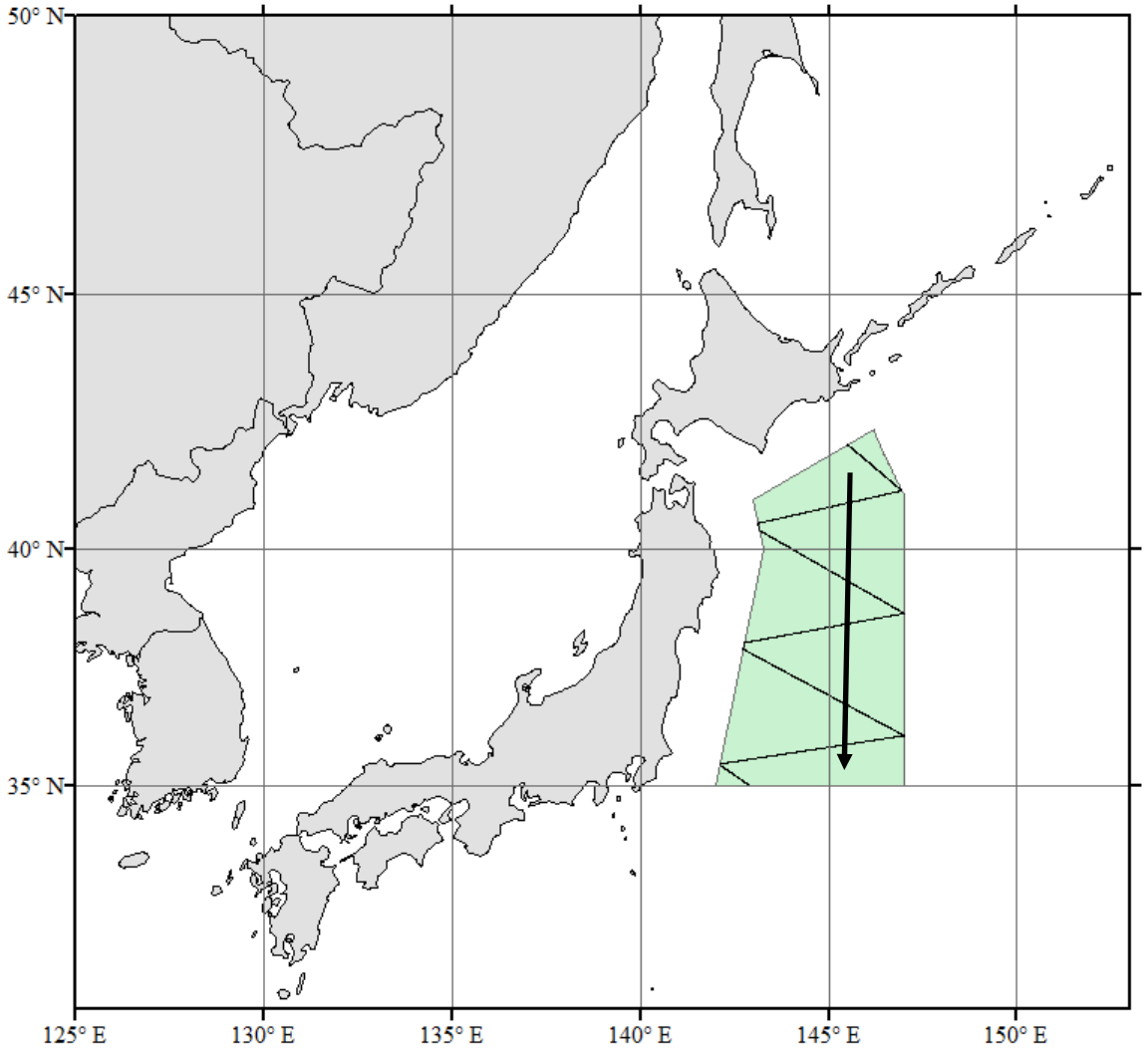

Figure 3. Research area and pre-determined track line of the 2019 survey from August to September. Black lines indicate track lines in sub-area 7WR covered by *KY7*. Black arrow shows survey order of the planned cruise tracks for *KY7*.

Appendix 1

Additional issues on sighting survey plan

The NEWREP-NP review workshop (IWC, 2017) highlighted several issues that must be considered when designing line transect surveys that are expected to provide abundance information to address multiple objectives. The workshop recommended that issues related to survey design, data collection protocols and priorities, data analyses and coordination are included in the plans to be submitted to the Scientific Committee for approval, before the surveys start. These main additional issues and the responses are as following:

(a) Evaluation of past surveys' analytical difficulties.
The JARPNII review workshop in 2009 recommended increased effort to obtain better abundance estimates, and that this should be a high priority (IWC, 2010). Under the NEWREP-NP dedicated sighting surveys will be conducted in sub-areas 6E, 10E, 11, 7CS, 7CN, 7WR, 7E, 8 and 9. Particular sub-areas, rather than several sub-areas, will be surveyed in a year. In this way larger effort will be allocated to particular sub-areas, and consequently more precise estimates of abundance will be obtained.

For inter-year comparability of abundance in a survey area, definition of survey strata in that survey area will not be changed among the years.

Data collection scheme could be modified to facilitate spatial modelling analyses, following guidelines agreed by the Scientific Committee for this kind of analyses.

(b) Appropriate temporal stratification
Previous analyses on density index (whales sighted per 100n. miles) (Hakamada *et al*., 2009), suggested that the latitudinal distribution patterns of the minke and sei whales in the period May-June were different from those in the period July-August. Given this antecedent, the survey period will be set within one of the above mentioned periods: early (April-June) or late (July-September).

(c) Appropriate direction of travel
In principle, surveys will be conducted from north to south (in the reverse order of the migration path of whales) to avoid double counting.

(d) Use of independent observer (IO) mode
Sighting surveys in IO mode are planned for some of the sub-areas (e.g. 10E and 11). The proponents will consider whether sighting surveys in IO mode are feasible in offshore waters where the weather and sea state conditions are poorer. In 2019 IO mode survey will be conducted alternately with passing mode with abeam closing (NSP).

(e) Use of passive independent observer mode
Combination of a passive acoustic and sighting surveys (Rankin *et al*., 2007) is one of the possibilities for the passive independent observer mode suggested. Given the importance of g(0) estimation, the proponents will examine whether this approach is feasible noting that little is known about the population's acoustic behavior of minke whales (Martin *et al*., 2013). Abeam closing will be conducted during the IO mode to obtain more precise estimation of school size.

(f) Development of protocols/priorities for biopsy-related activities
Protocols for biopsy sampling are the same as those used in the IWC POWER surveys. Priority target species and effort allocated to this research activity are determined in each sighting survey plan.

(g) Evaluation of additional variance analysis and spatial model methods
The same survey strata will be defined in the survey area so that abundance estimate can be compared among the years. This will make easier the estimation of additional variance. Potential environmental data to be used as covariates in spatial modelling will be collected such as sea surface temperature, air temperature, salinity, etc. Both approaches will be investigated under the NEWREP-NP.

(h) 'Regime shift'-related aspects

Investigation of the influence of environmental changes on whale stock is one of the ancillary objectives in the revised research proposal (Government of Japan, 2017). The information on abundance and occurrence of prey species in the Sanriku region will be obtained by collaborative research organizations, and oceanographic data will be obtained using ocean circulation models such as FRA-ROMS as mentioned in Annex 17 of the NEWREP-NP research proposal.

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