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Further information on sampling design of JARPNII

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ABSTRACT

In accordance with the recommendations on the sampling design of JARPNII presented by the members of the Expert Panel Workshop for the final review of the JARPNII, further information on sampling design is presented in this paper. At the planning stage, tracklines for the offshore component were designed to cover a wide range of the survey area. However, when the actual surveys were conducted, some tracklines were cancelled or new tracklines were designed in accordance with seasonal changes of whale distribution influenced by the oceanographic structure and severe weather conditions. The samples were collected from wide longitudinal range of the research area during six (2002-2007 or 2008-2013) year's survey periods. Therefore, samples collected during JARPNII surveys would represent the distribution of each whale species in the research area in at least during the respective six years' periods.

KEYWORDS: COMMON MINKE WHALE; BRYDE'S WHALE, SEI WHALE, NORTH PACIFIC; SCIENTIFIC PERMIT

INTRODUCTION

JARPNII consists of dedicated sighting, whale sampling and co-operative whale sampling and acoustic/trawl prey surveys (Government of Japan, 2002). Dedicated sighting surveys were conducted independently from the whale sampling survey and the co-operative survey was concurrently conducted in the same limited blocks to collect data such as stomach contents of whales and biomass of their prey species in the field to estimate prey preferences of whales (Government of Japan, 2002).

During the Expert Panel Workshop for the final review of the JARPNII held in Tokyo, February 2016, an overview of research methodology was presented by the proponents for each survey component (Bando *et al*., 2016; Matsuoka *et al*., 2016; Kishiro *et al*., 2016) and some questions were presented from Panel members about the sampling design of the whale sampling surveys (IWC, 2016). The proponents provided detailed information about pre-determined track lines for whale sampling surveys, on effort track lines for whale sampling and dedicated sighting surveys, and co-operative survey of whale sampling and prey survey for each year and season and these maps were incorporated in the report of the meeting (Annex E in IWC (2016)). However, further recommendations were proposed by the Panel members as follows:

(1) A new paper that in addition to the information on sightings, it should document, for each year and season:
   (a) the predetermined tracklines for sampling and the rationale for those lines; and
   (b) the actual coverage of those tracklines and the rationale for any decisions taken to deviate from the predetermined lines including the rationale for any new lines developed.

   It should also address the issue of whether the actual sampling that occurred can be said to be representative of (a) the animals in the surveyed area and (b) those in the biological population(s) and discuss the extent to which this may affect those objectives/parameters/analyses for which this is or may be important.

(2) Papers using data from the inshore component must fully address the implications of the logistical rather than scientific sampling design.

This paper provides further information on the sampling design of JARPNII sampling surveys for offshore and coastal components.

SAMPLING DESIGN OF OFFSHORE COMPONENT

Principle of tracklines design

From the results of the dedicated sighting surveys under JARPNII, it was revealed that distribution of baleen whales in the survey area is narrower in the north and south due to the influence of the distribution of prey species which was affected by the water temperature, and also, it was difficult to predict those distributions in advance because it changes every year and season with the temporal changes in oceanographic structures (Appendix 1) (Murase *et al*., 2016a; 2016b)

At the planning stage, tracklines for the whale sampling surveys were designed to cover a wide range of the survey area. However, when the actual surveys were conducted, some tracklines were cancelled or new tracklines were designed to cover the actual distribution of the whales predicted by the oceanographic structures at that time.

Unfortunately, some parts of the survey area were often affected by the path of the typhoon and bad weather conditions. Fog was often dominant in the northern cold waters. Therefore, tracklines were sometimes changed to avoid these bad areas affected by such temporal weather conditions.

Furthermore, some ‘special monitoring surveys’ (SMS) were conducted in areas where the abundance of whales targeted were expected to be high. The track line in the SMS was designed separately from the original track line (Tamura *et al*., 2009).

Overview of each year’s tracklines design is summarised in Appendix 2.

Representativeness of the samples

The surveys were conducted to cover a wide longitudinal range of the research area during six (2002-2007 or 2008-2013) year’s survey periods (Figure 1). Therefore, the proponents consider that samples collected during the JARPNII surveys represents distribution of each whale species in the research area in at least during the respective six year’s periods.

For the representativeness of the ‘biological population’, the research area of JARPNII does not cover the whole distribution range of each whale species. For example, mature male of common minke whale is dominant in the research area because many of the adult females migrate into the Okhotsk Sea in the summer feeding season (Hatanaka and Miyashita, 1997). Therefore, correction would be needed depending on the purpose of the analysis.

Estimation of total amount of prey consumption, which is a main objective of JARPNII, was conducted in each sub-area and season (early and late). Sexual maturity composition was estimated in each sub-area and season, and total amount of prey consumption was estimated by extrapolating these data to total number of whales migrating to research area (Tamura *et al.*, 2016a). Representativeness of samples among the whales migrating to the research area would be secured by this analytical method.

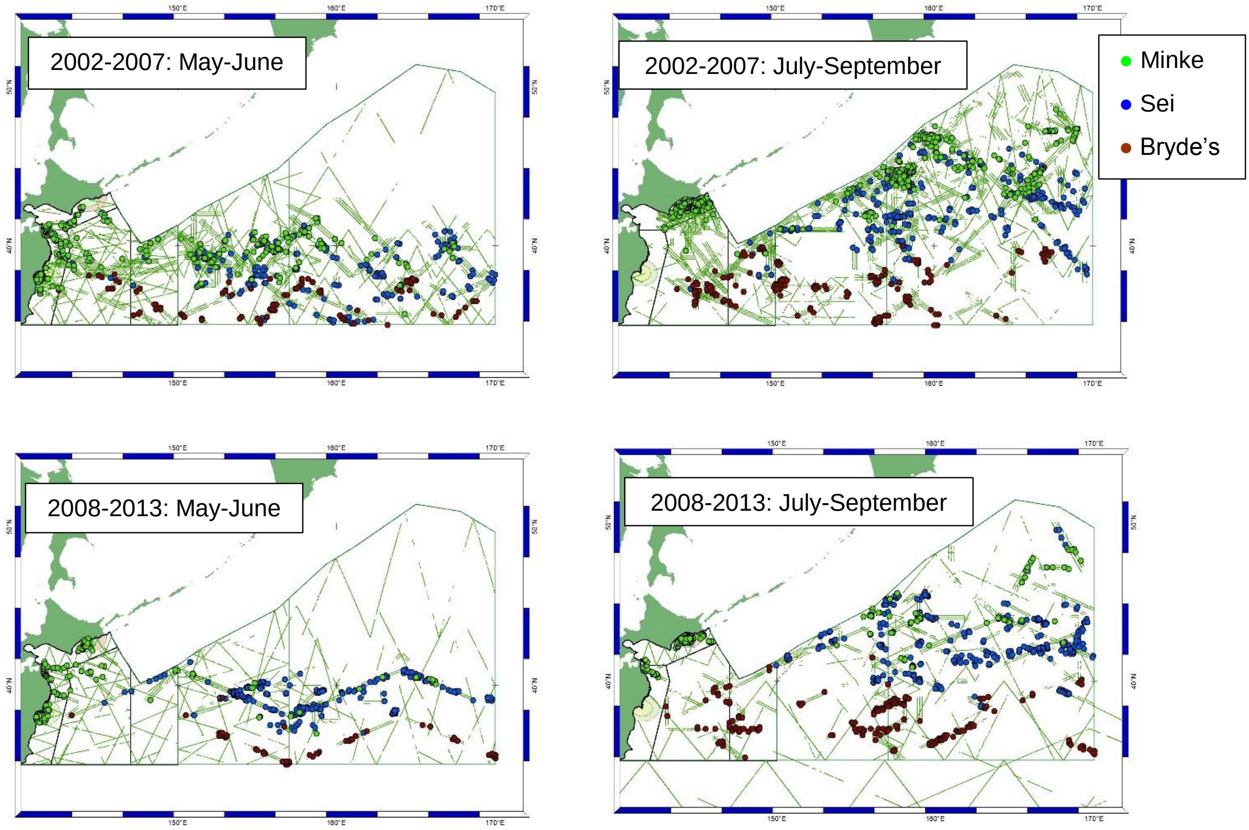

Figure 1. On effort track lines of dedicated sighting (single line) and whale sampling (parallel lines) surveys during 2002-2007 (early (upper left), late (upper right) season) and 2008-2013 (early (lower left), late (lower right) season) JARPNII surveys with sighting positions of sampled common minke, sei and Bryde's whales.

SAMPLING DESIGN OF COASTAL COMPONENT

Small-type whaling catcher boats used as sampling vessels at the coastal component are not suitable for bad weather conditions, as Kishiro *et al*. (2016) noted. They can not stay at sea for long hours, especially at night. For the logistical and safety reasons, a land-based operation system was adopted for the coastal component, where vessels departure the port every morning and return to the port every night. Their courses are set radiating out from the port with even intervals (usually at intervals of 10-15 degree each). To scan the research area as wide as possible, the courses are shifted slightly every day (usually 4 degree interval). All animals encountered were targeted for sampling, except for cow-calf pairs. From these, representativeness of animals migrating into the research area would be secured at the survey: sampling design did not significantly affect data analysis.

We also recognize that sea bottom topography is not monotonous in the research area, especially off Kushiro. There, three topography types are identified: i) continental shelf; ii) continental slope up to a depth of 1,000m; and iii) offshore area with water depth of 1,000m or more. It is reported that composition of prey species differed somewhat among the topography types (Tamura *et al*., 2016b). We will consider how to conduct more detailed analyses considering the topography features.

REFERENCES

Bando, T., Yasunaga, G., Tamura, T., Matsuoka, K., Murase H., Kishiro T. and Miyashita, T. 2016. Methodology and survey procedures under the JARPN II offshore component- during 2008 to 2014 with special emphasis on whale sampling procedures. Paper SC/F16/JR4 presented to The Expert Panel Workshop of the final review on the western North Pacific Japanese Special Permit programme (JARPN II), Tokyo, February 2016 (unpublished).14pp.

Government of Japan. 2002. Research plan for cetacean studies in the western North Pacific under special permit (JARPN II). Paper SC/54/O2 presented to the IWC Scientific Committee, May 2002 (unpublished). 115pp.

Hatanaka, H. and Miyashita, T. 1997. On the feeding migration of the Okhotsk Sea-west pacific stock of minke whales, estimated based on length composition data. Rep Int Whal Commn 47: 557-564.

International Whaling Commission. 2016. Report of the Expert Panel of the final review on the western North Pacific Japanese Special Permit programme (JARPN II) SC/66b/Rep6, 96pp.

Ishii, M., Murase, H., Fukuda, Y., Sawada, K., Sasakura, T., Tamura, T., Bando, T., Matsuoka, K., Shinohara, A., Nakatsuka, S., Katsumata, N., Miyashita, K. and Mitani, T. 2016. A short note on feeding behaviour of sei whales observed in JARPNII. Paper SC/F16/JR25 presented to The Expert Panel Workshop of the final review on the western North Pacific Japanese Special Permit programme (JARPN II), Tokyo, February 2016 (unpublished). 9pp.

Kishiro, T., Yoshida, H., Yasunaga, G., Bando, T., Mogoe, T. and Kato, H. 2016. Methodology and survey procedure under the JARPN II – coastal component of Sanriku and Kushiro- during 2008 to 2014, with special emphasis on whale sampling procedures. Paper SC/F16/JR3 presented to The Expert Panel Workshop of the final review on the western North Pacific Japanese Special Permit programme (JARPN II), Tokyo, February 2016 (unpublished). 19pp.

Matsuoka, K., Hakamada, T. and Miyashita, T. 2016. Methodology and procedure of the dedicated sighting surveys in JARPN II (2008-2013) - Offshore component. Paper SC/F16/JR2 presented to The Expert Panel Workshop of the final review on the western North Pacific Japanese Special Permit programme (JARPN II), Tokyo, February 2016 (unpublished). 12pp.

Murase, H., Hakamada, T., Sasaki, H., Matsuoka, K. and Kitakado, T. 2016a. Seasonal spatial distributions of common minke, sei and Bryde's whales in the JARPNII survey area from 2002 to 2013. Paper SC/F16/JR7 presented to The Expert Panel Workshop of the final review on the western North Pacific Japanese Special Permit programme (JARPN II), Tokyo, February 2016 (unpublished). 17pp.

Murase, H., Hakamada, T., Matsuoka, K., Nishiwaki, S., Inagake, D., Okazaki, M., Toji, N. and Kitakado, T. 2016b. Distribution of sei whales (Balaenoptera borealis) in the subarctic-sub-tropical transition area of the western North Pacific in relation to oceanic fronts. *Deep-Sea Research II* 107: 22-28, 2014. (SC/F16/JR8)

Tamura, T., Matsuoka, K. and Fujise, Y. 2009. Methodology and survey procedure under the JARPN II - offshore component- with special emphasis on whale sampling procedures. Paper SC/J09/JR4 presented to The Expert Panel Workshop of the final review on the western North Pacific Japanese Special Permit programme (JARPN II), Tokyo, January 2009 (unpublished). 16pp.

Tamura, T., Konishi, K. and Isoda, T. 2016a. Updated estimation of prey consumption by sei, Bryde's and common minke whales in the western North Pacific. Paper SC/F16/JR15 presented to The Expert Panel Workshop of the final review on the western North Pacific Japanese Special Permit programme (JARPN II), Tokyo, February 2016 (unpublished). 58pp.

Tamura, T., Kishiro, T., Yoshida, H., Konishi, K., Yasunaga, G., Bando, T., Saeki, M., Onodera, K., Mitsuhashi, M., Yamashita, Y., Funamoto, T. and Kato, H. 2016b. Updated prey consumption by common minke whales and interaction with fisheries in coastal areas. Paper SC/F16/JR17 presented to The Expert Panel Workshop of the final review on the western North Pacific Japanese Special Permit programme (JARPN II), Tokyo, February 2016 (unpublished). 47pp.

APPENDIX 1

Monthly changes of the Density Index

Sei whale

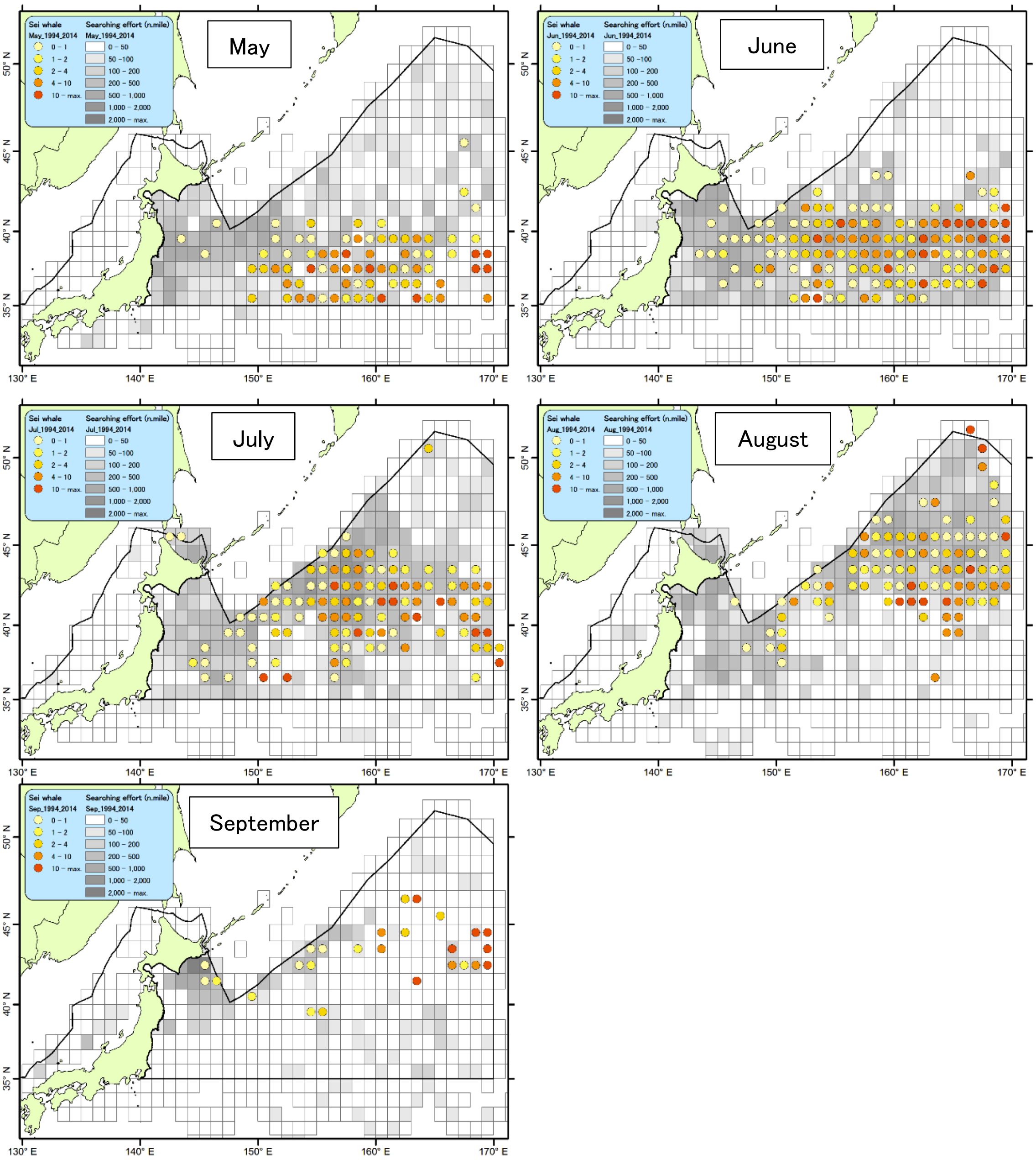

Figure. 1. Monthly change of the Density Index (number of primary sightings of whales / 100 n.mile) of sei whales during JARPN and JARPNII from 1994 to 2014 surveys by Lat.1°× Long.1°square.

APPENDIX 1

Monthly changes of the Density Index

Bryde's whale

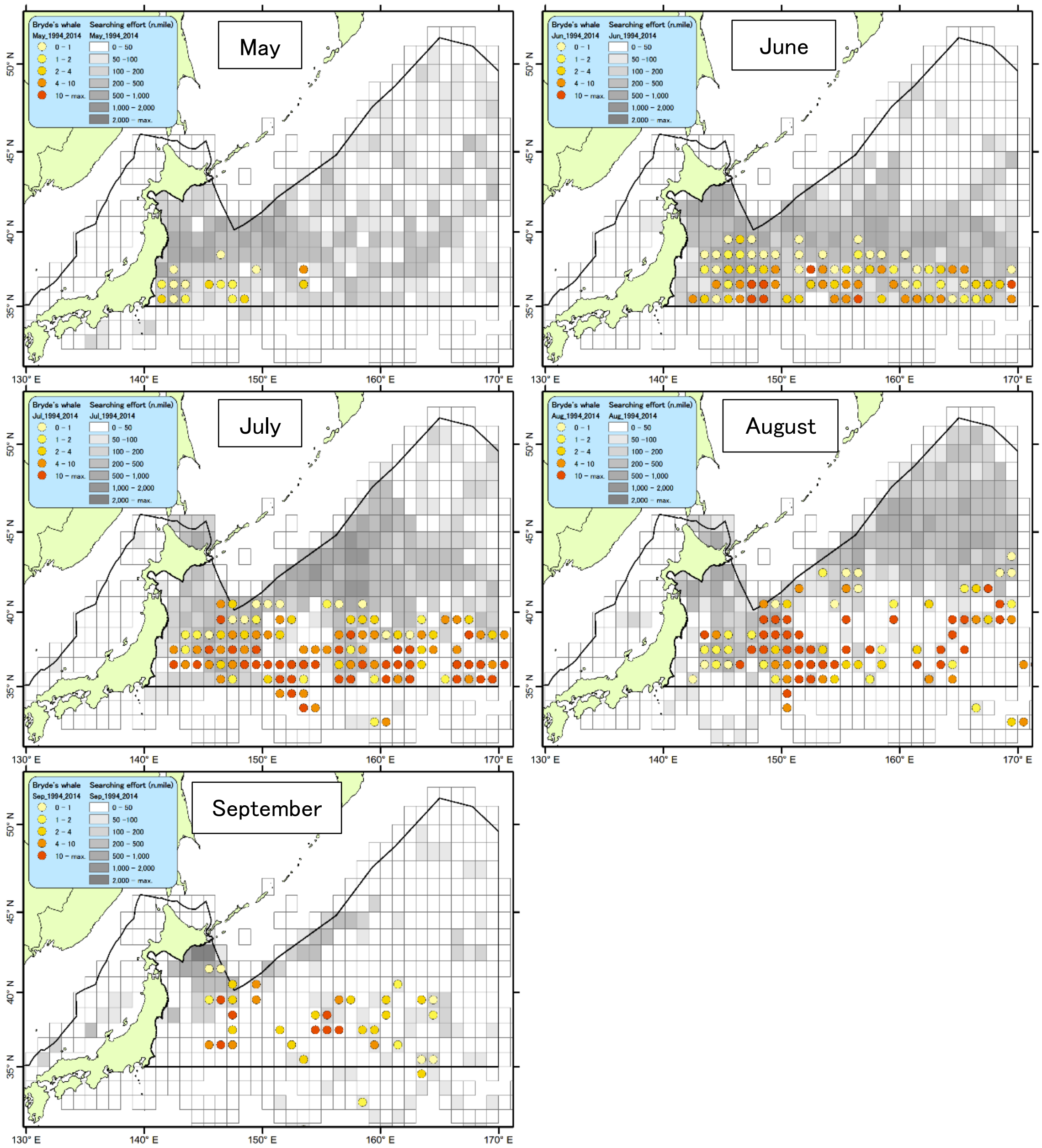

Figure. 2. Monthly change of the Density Index (number of primary sightings of whales / 100 n.mile) of Bryde's whales during JARPN and JARPNII from 1994 to 2014 surveys by Lat.1°× Long.1°square.

APPENDIX 1

Monthly changes of the Density Index

Common minke whale

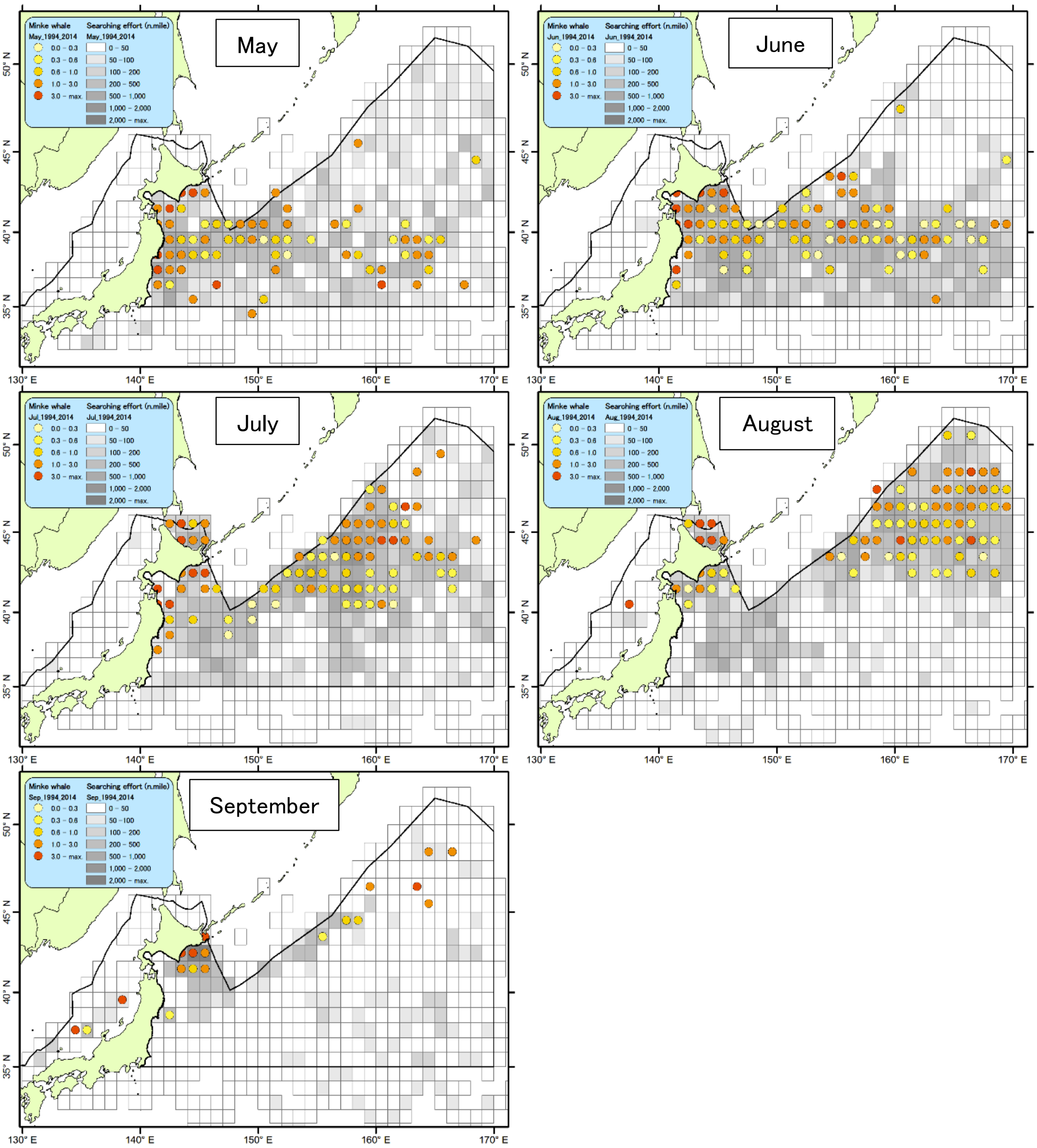

Figure 3. Monthly change of the Density Index (number of primary sightings of whales / 100 n.mile) of common minke whales during JARPN and JARPNII from 1994 to 2014 surveys by Lat.1°× Long.1°square.

Overview of the each year's survey design under the JARPNII offshore components

Year	Summary of the tracklines design
2000	Feasibility study. Co-operative survey of whale survey and prey survey was conducted in sub-area 7 and the survey focused on stock structure of common minke whales was conducted mainly in sub-area 9.
2001	Feasibility study. Co-operative survey was conducted in sub-area 7 and the survey focused on stock structure of common minke whales was conducted mainly in sub-areas 8 and 9.
2002	Focused on two co-operative surveys of whale survey and prey survey (conducted in sub-areas 8 and 9 (first survey) and 7 (second survey).
2003	Focused on two co-operative surveys (conducted in sub-areas 8 and 9 (first survey) and 7 (second survey). In addition, tracklines were designed to cover wide latitudinal range in western part of sub-area 9. Sei whale was added as target species (50 samples).
2004	Focused on eastern part of sub-area 9 where information of whale distribution and composition was not enough and tracklines were designed to cover wide latitudinal range in sub-area 9. Sample size of sei whale changed from 50 to 100. One co-operative survey was conducted (sub-area 9).
2005	Tracklines were designed to cover whole research area (sub-areas 7, 8 and 9). Two co-operative surveys were conducted in sub-area 7 (first survey) and 8 and 9 (second survey).
2006	Tracklines were designed to cover whole research area (sub-areas 7, 8 and 9). No co-operative survey was conducted in this year.
2007	Tracklines were designed to cover whole research area (sub-areas 7, 8 and 9). Three co-operative surveys were conducted in sub-areas 8 and 9 (first survey), 9 (second survey) and 7 and 8 (third survey).
2008	Tracklines were designed to cover wide latitudinal range in sub-areas 8 and 9. Two co-operative surveys (sub-areas 8 and 9 (first survey) and 7 (second survey)) were conducted. No tracklines were designed in southern part of sub-area 9 because Bryde's whales (distribute mainly in warmer temperature) were sampled during two co-operative surveys.
2009	Tracklines were designed from sub-area 7 to 9 in 38N to 41N (mainly targeting sei whales) and from sub-area 8 to 9 in 35N-38N (mainly targeting Bryde's whales). Survey in northern part of sub-area 9 could not be conducted because successive passage of low pressure and long lasted fog. Sample size of common minke whales was 43. One co-operative survey (sub-areas 8 and 9) was conducted.
2010	At the planning stage, tracklines were designed to cover wide range of research area. However, because of prevalence of rain front, long lasted for and passage of typhoon, only part of predetermined track lines were surveyed in northern part of sub-area 9 and sample size of common minke whale was only 14. Tracklines were not designed in southern part of sub-areas 7 and 8 because sampling of Bryde's whales was focused in sub-area 9. Two co-operative surveys (sub-areas 8 and 9 (first survey) 9 (second survey)) were conducted.
2011	At the planning stage, tracklines were designed to cover wide longitudinal range of research area. However, because of prevalence of rain front, long lasted for and passage of typhoon, only part of predetermined track lines were surveyed and sample size of common minke and sei whale were 49 and 95, respectively. Tracklines were not designed in southern part of sub-areas 8 and 9 because sampling of Bryde's whales was focused in sub-area 7. One co-operative survey (sub-areas 8 and 9) was conducted.
2012	At the planning stage, tracklines were designed to cover wide longitudinal range of 38N to 41N. However, because of prevalence of rain front, long lasted for and passage of typhoon, only part of predetermined track lines were surveyed and sample size of common minke and Bryde's whale were 74 and 34, respectively. One co-operative survey (sub-areas 8 and 9) was conducted. Only part of tracklines in 35N to 38N was surveyed because sampling of Bryde's survey was focused during co-operative survey.
2013	At the planning stage, tracklines were designed to cover northern part of sub-area 9 because survey period was later than previous surveys and water temperature in southern part of research area has already raised not appropriate for the distribution of sei whales. However, northern part of predetermined tracklines could not be surveyed because of bad weather conditions. Sample size of common minke and Bryde's whales were three and 28, respectively. Only Special Monitoring Surveys were conducted in southern part of research area because sampling of Bryde's whales was focused during co-operative survey (the main purpose of the co-operative survey in this year was recording of underwater behaviour of Bryde's and sei whales by using acoustic transmitters (Ishii *et al.*, 2016)).

APPENDIX 2

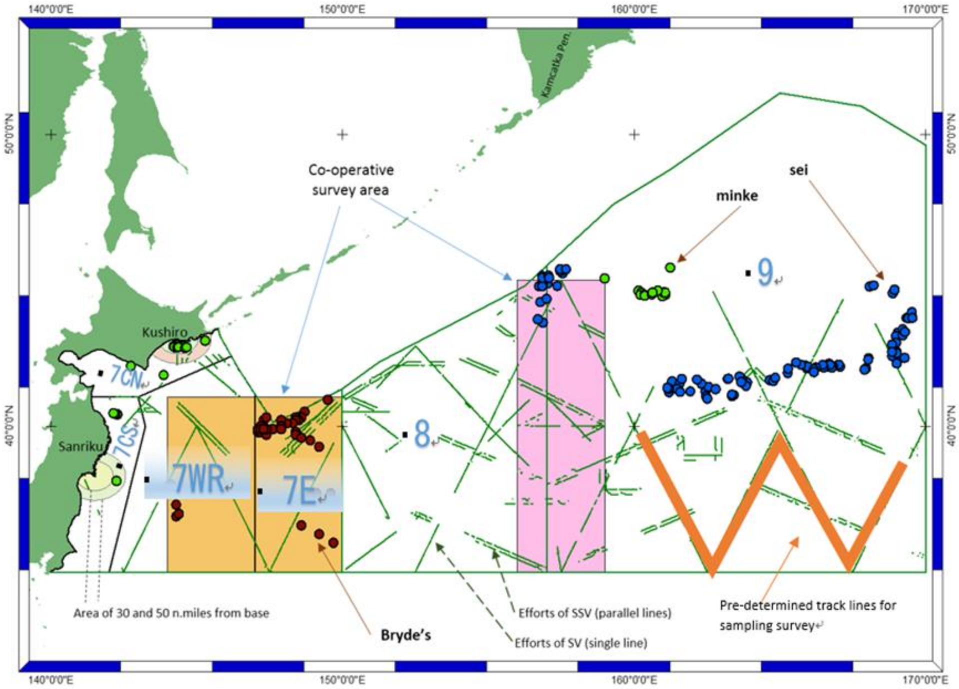

Figure 1. Overview of the survey design under the JARPNII. Pre-determined track lines for whale sampling surveys in the offshore component are shown in orange; on effort track lines of dedicated sighting (single line) and whale sampling (parallel lines) surveys in green. Concurrent whale/prey surveys are shown by color squares. Only the research areas are shown for Sanriku and Kushiro (extracted from Annex E of IWC (2016)).

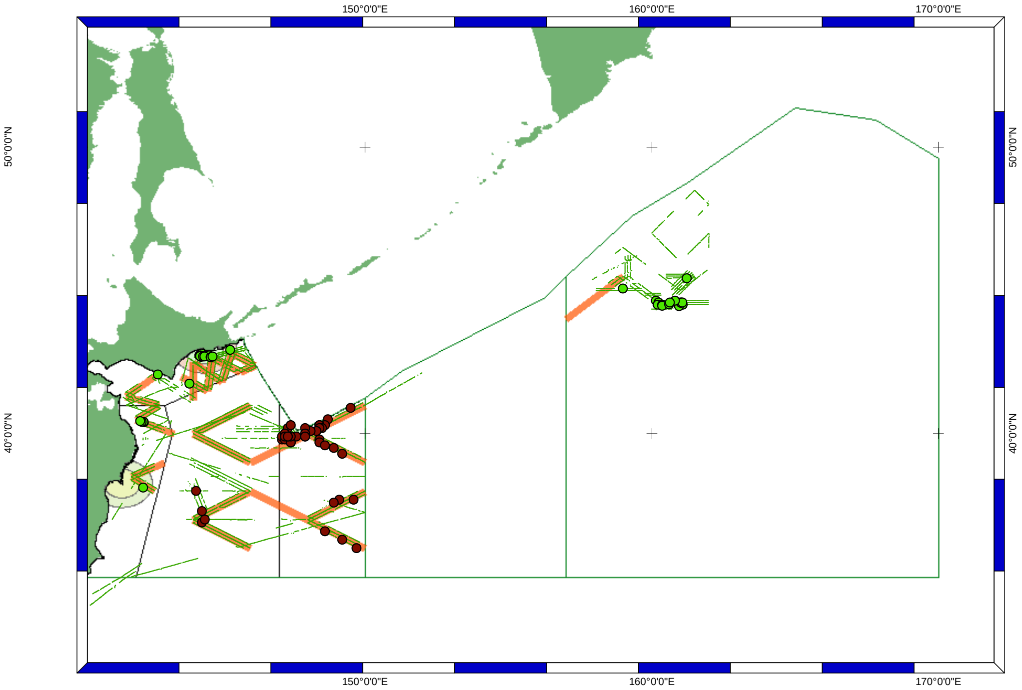

Figure 2. 2000 JARPNII in late season (July, August, September and October). The survey in 2000 was conducted only in late season.

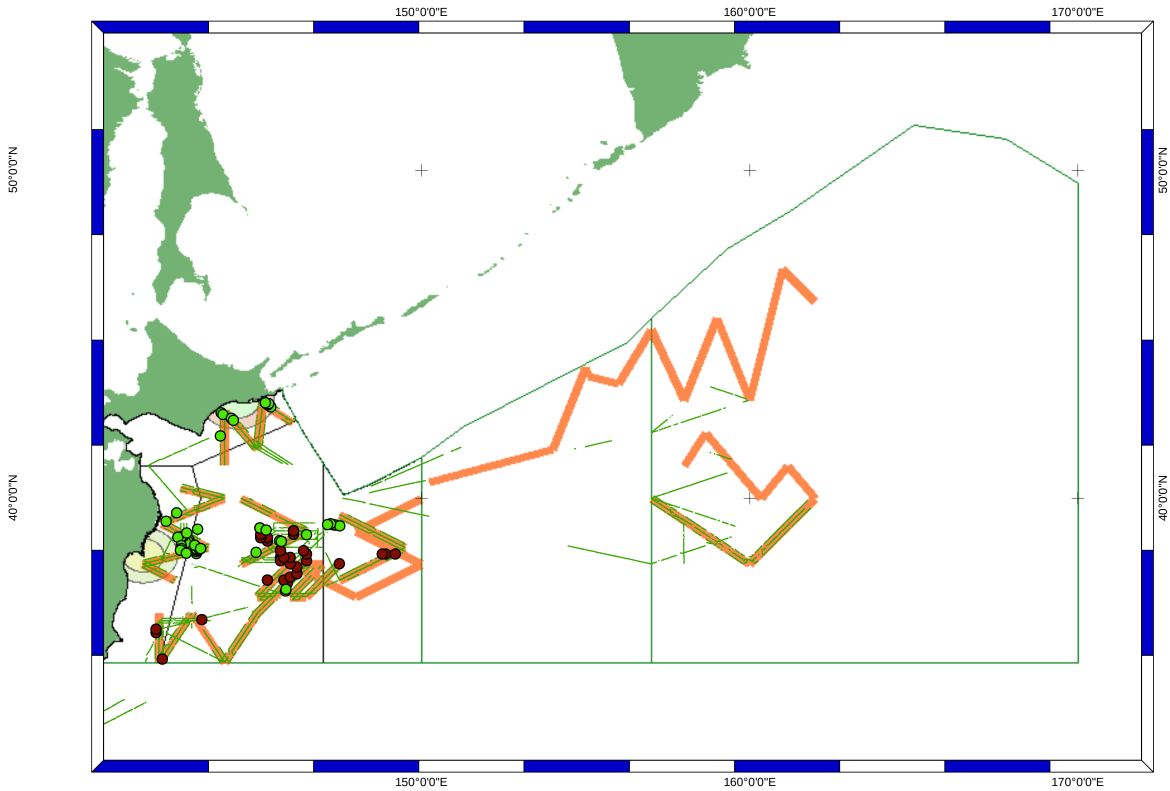

Figure 3. 2001 JARPNII in early season (April, May and June).

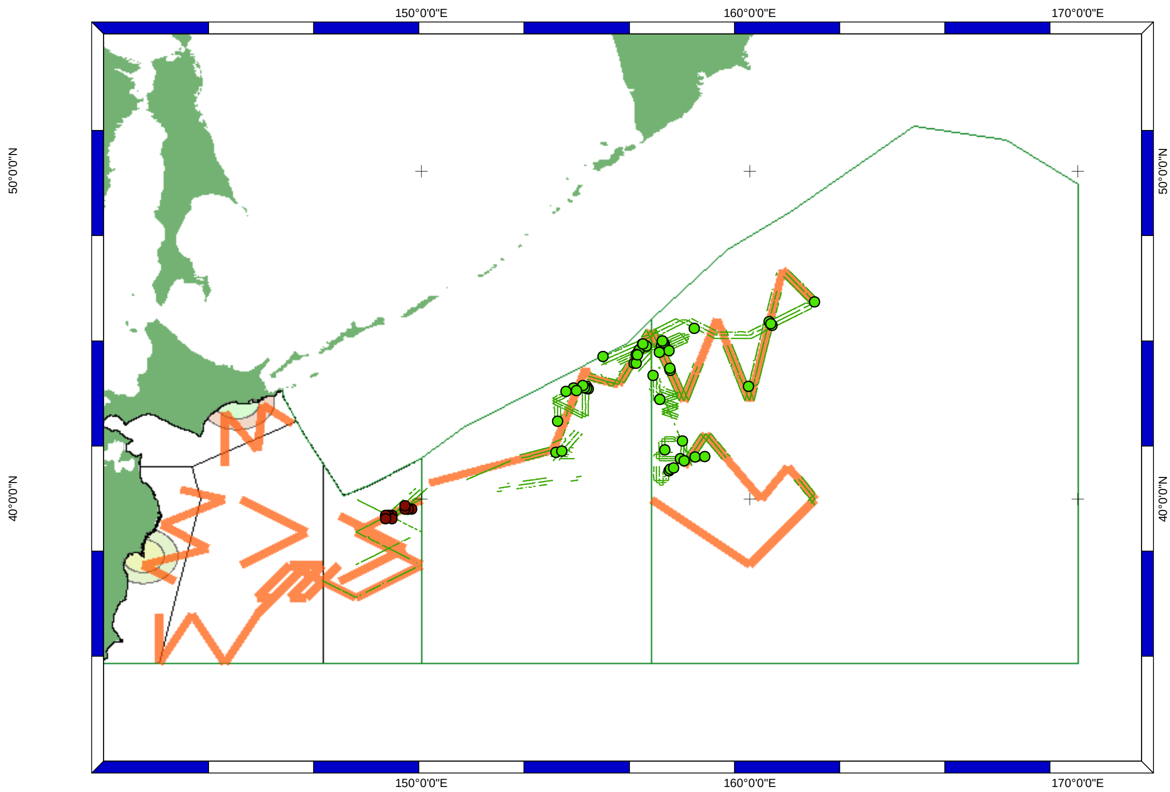

Figure 4. 2001 JARPNII in late season (July, August, September and October).

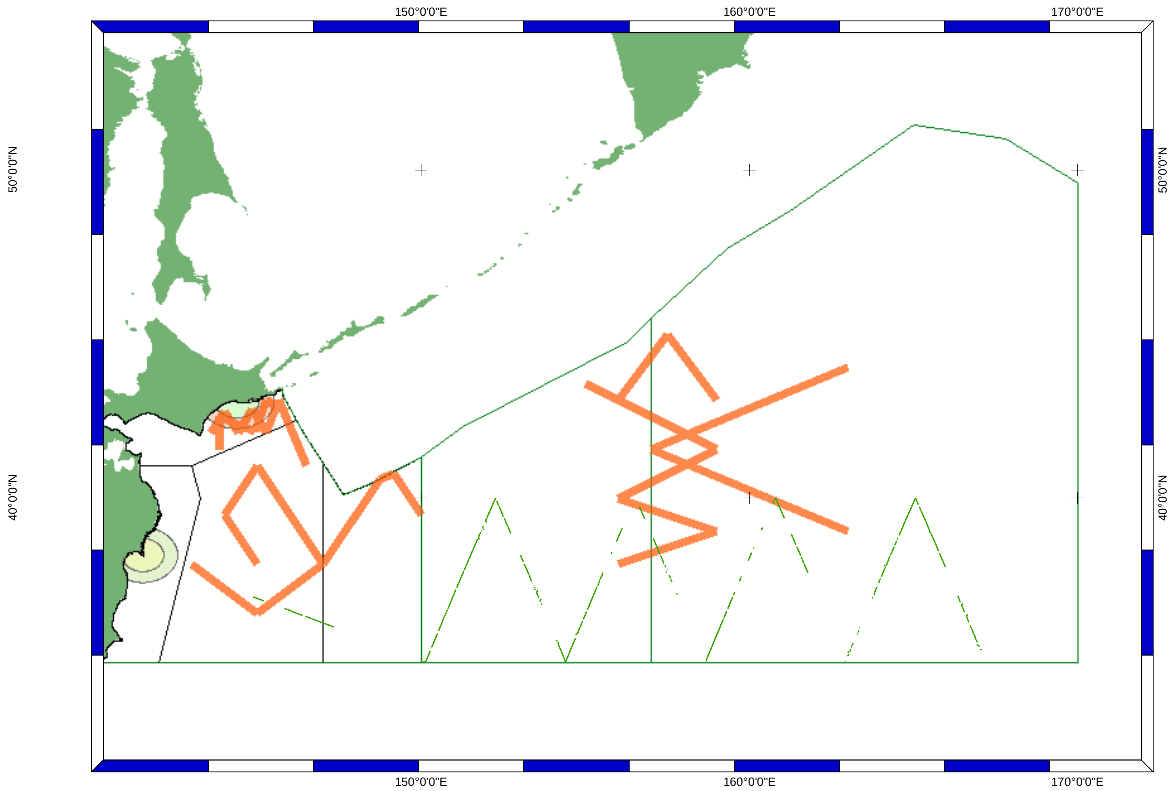

Figure 5. 2002 JARPNII in early season (April, May and June).

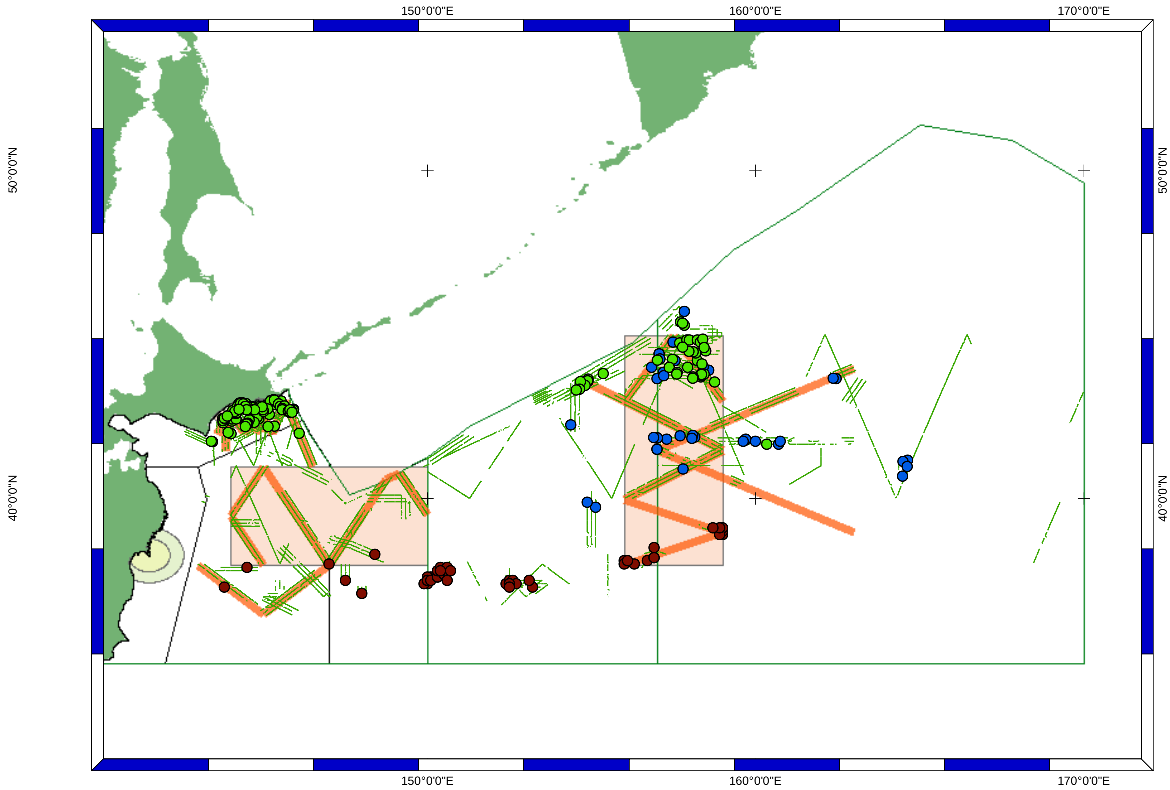

Figure 6. 2002 JARPNII in late season (July, August, September and October).

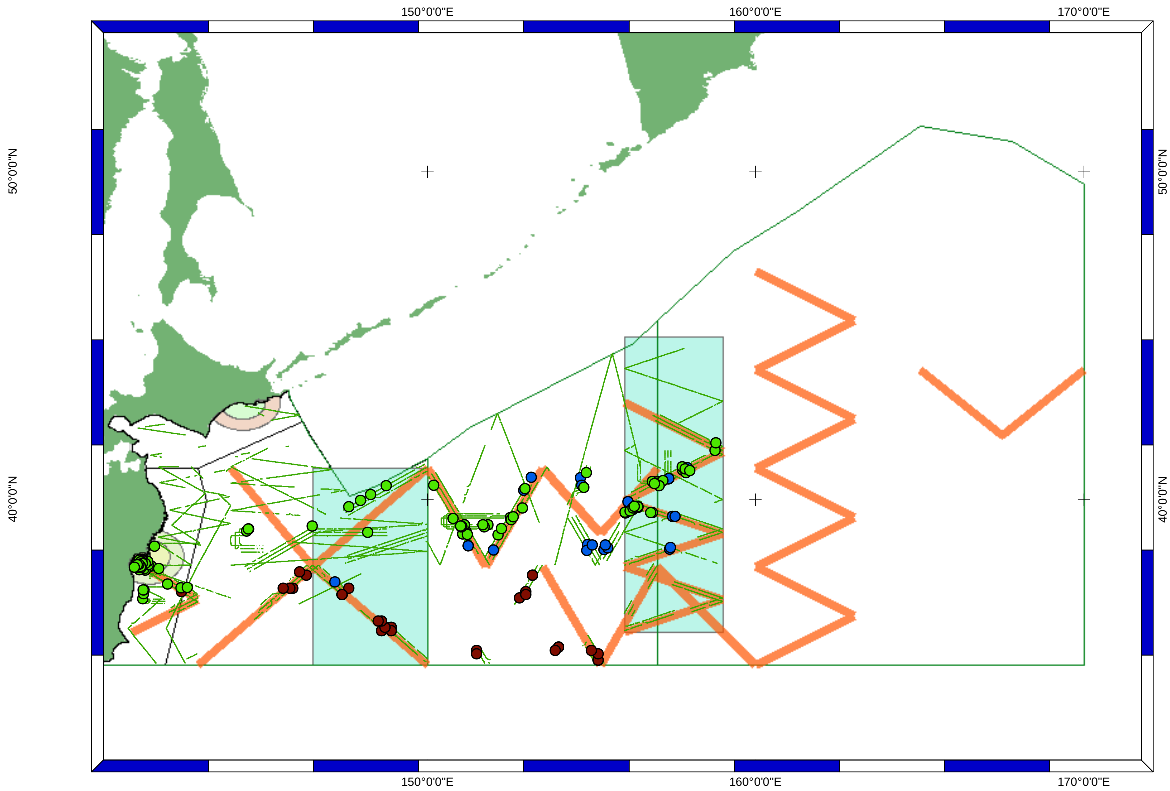

Figure 7. 2003 JARPNII in early season (April, May and June).

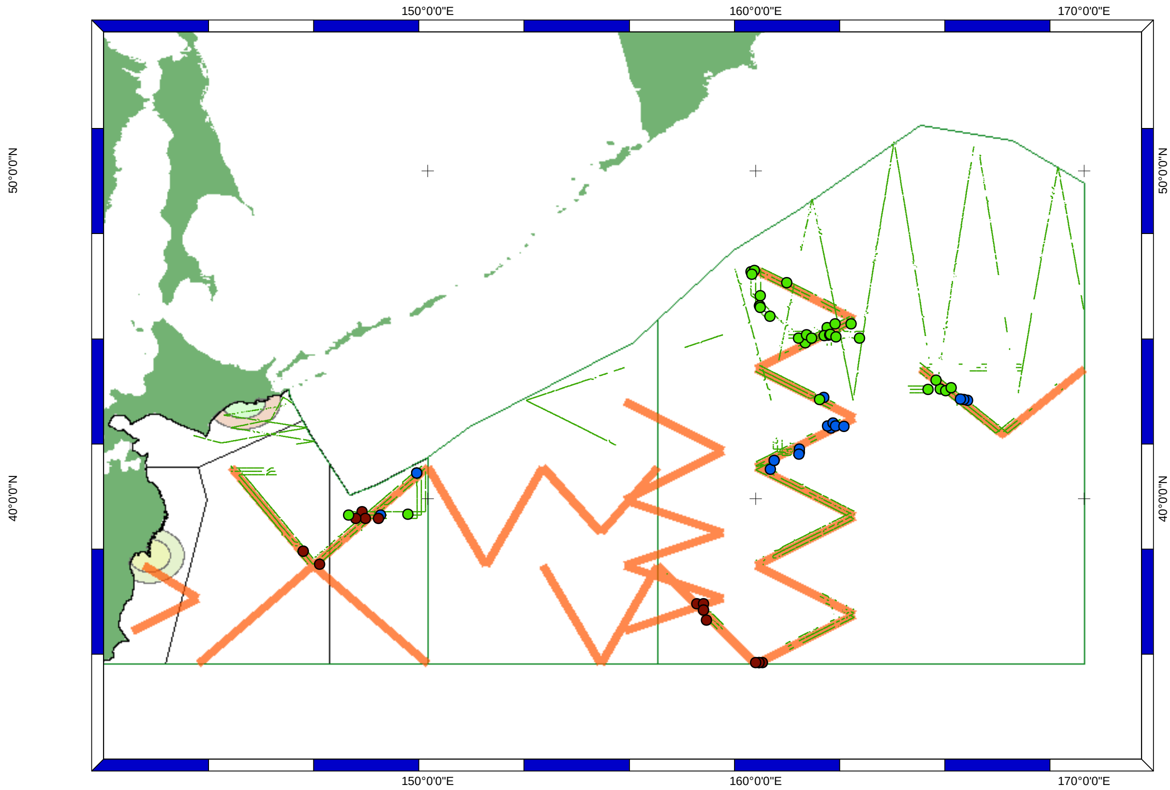

Figure 8. 2003 JARPNII in late season (July, August, September and October).

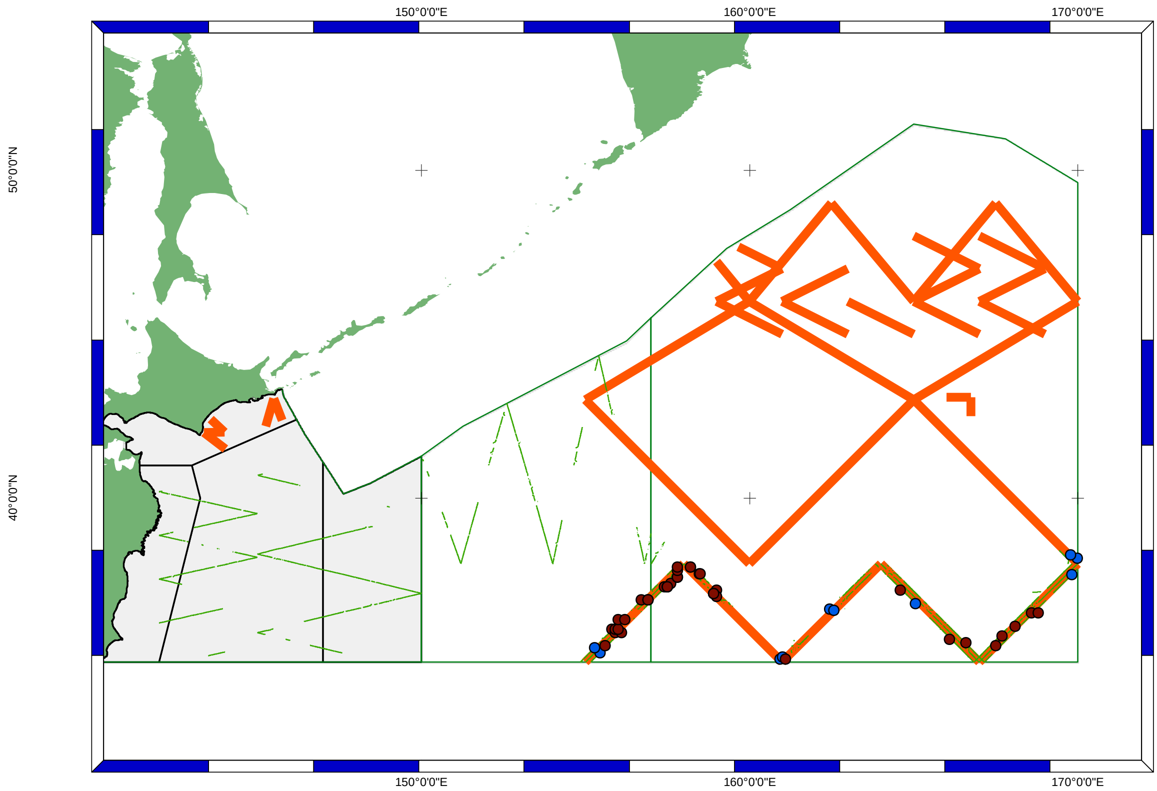

Figure 9. 2004 JARPNII in early season (April, May and June).

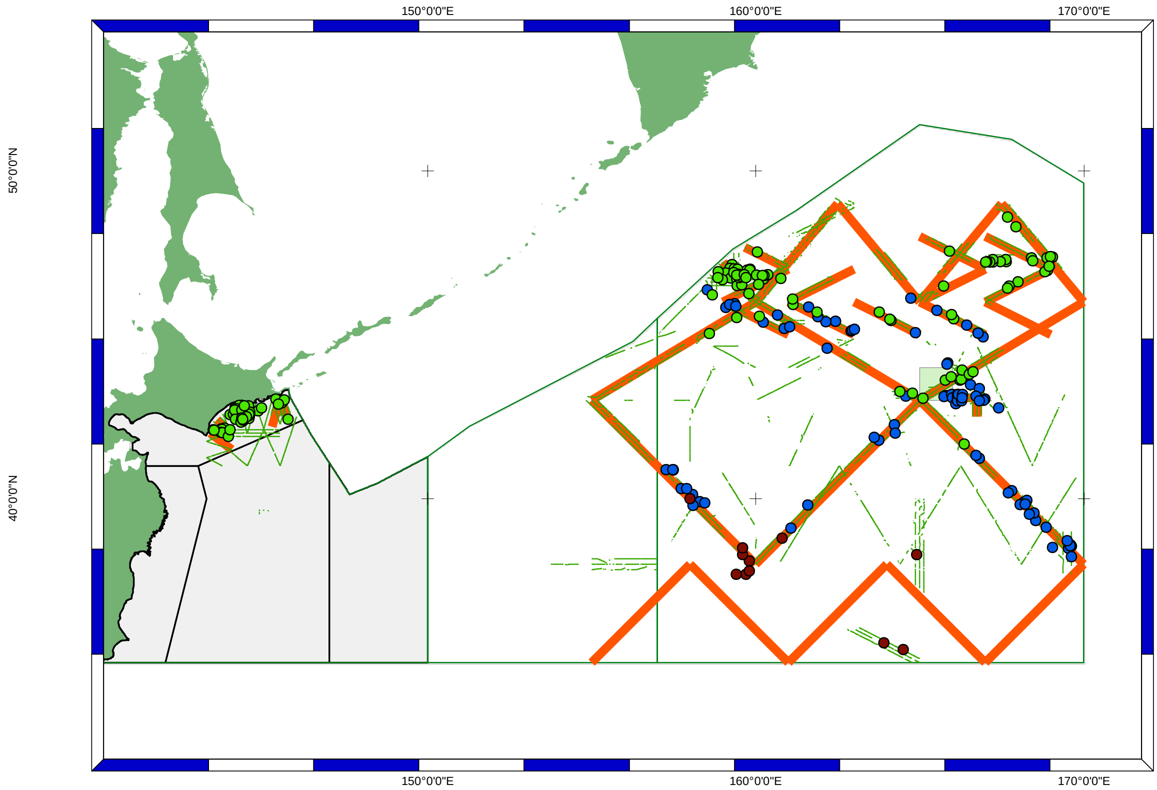

Figure 10. 2004 JARPNII in late season (July, August, September and October).

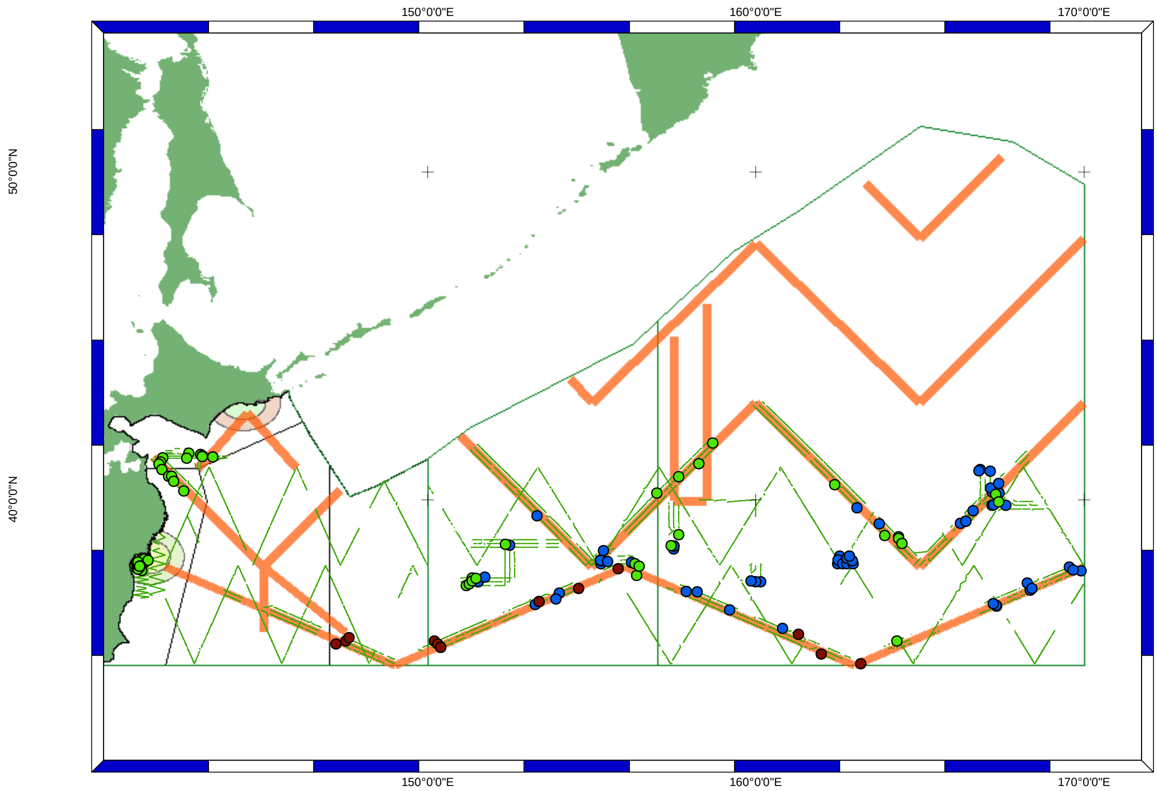

Figure 11. 2005 JARPNII in early season (April, May and June).

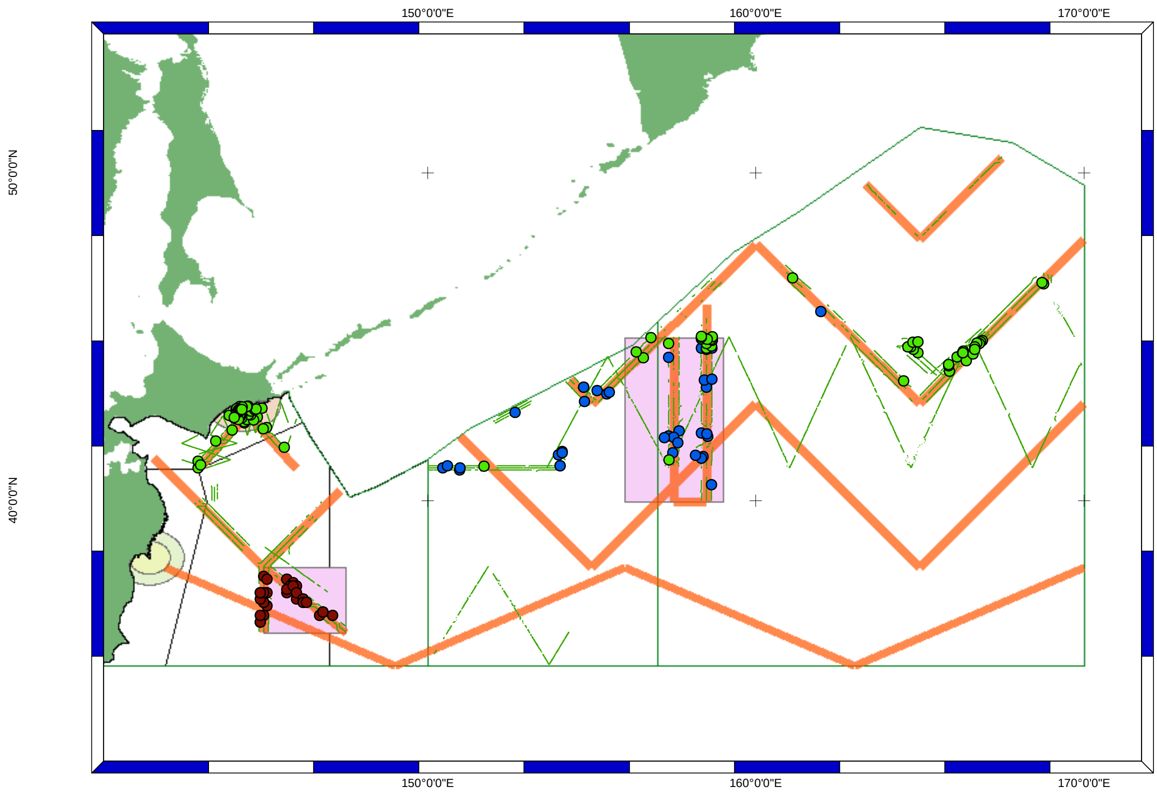

Figure 12. 2005 JARPNII in late season (July, August, September and October)

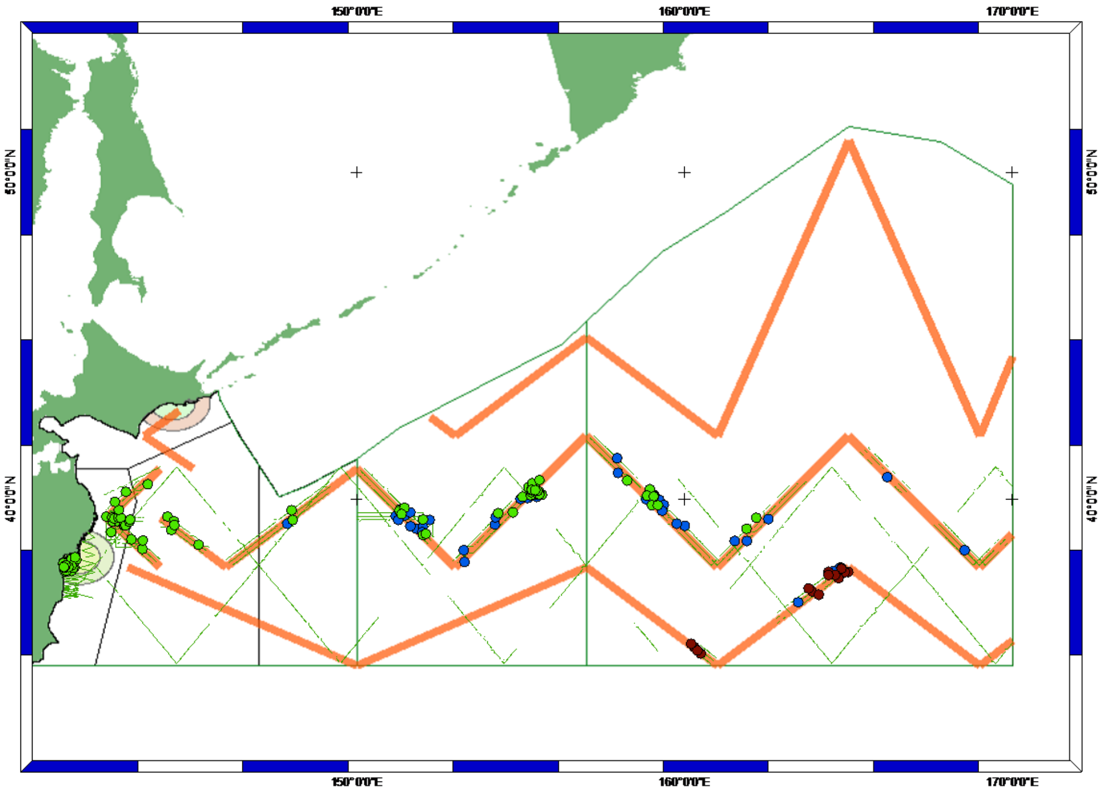

Figure 13. 2006 JARPNII in early season (April, May and June).

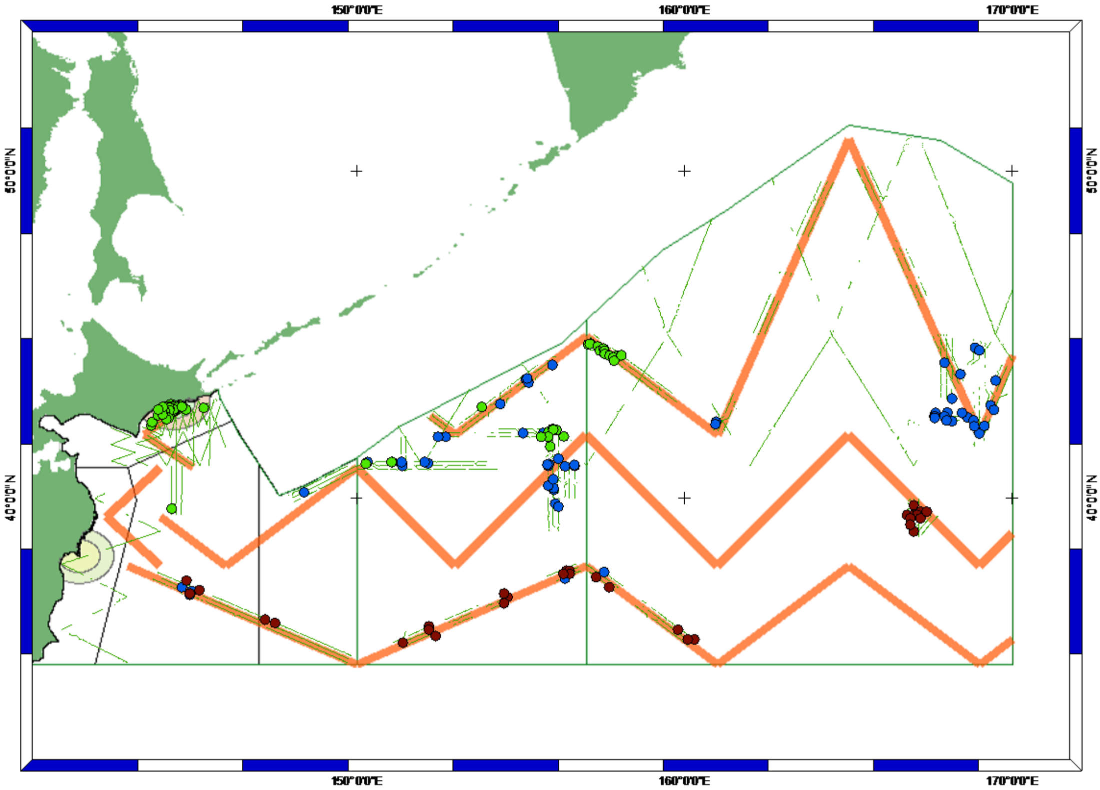

Figure 14. 2006 JARPNII in late season (July, August, September and October)

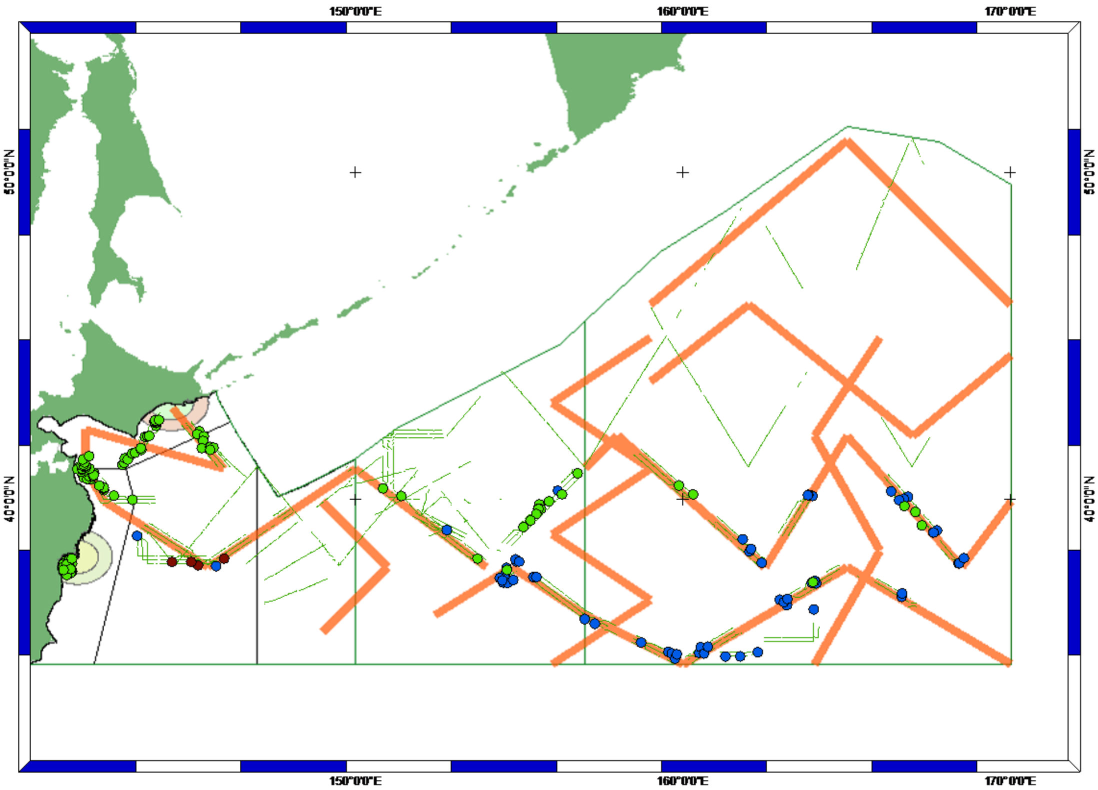

Figure 15. 2007 JARPNII in early season (April, May and June)

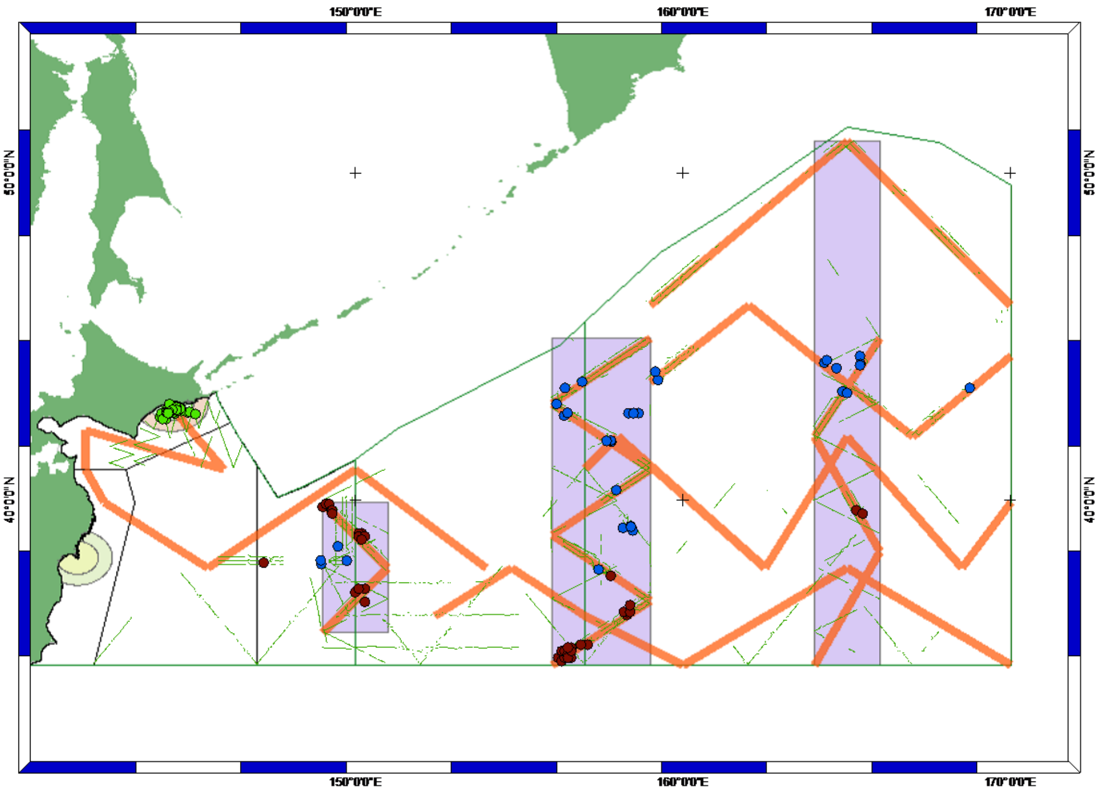

Figure 16. 2007 JARPNII in late season (July, August, September and October)

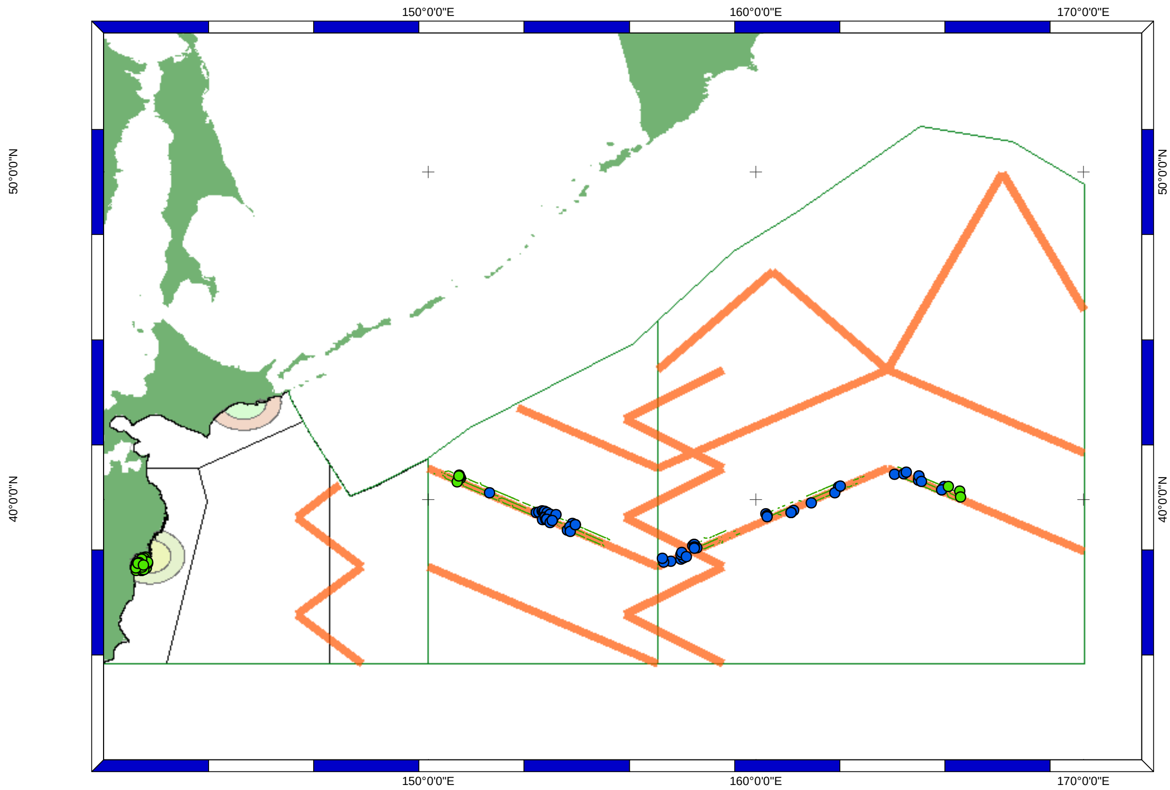

Figure 17. 2008 JARPNII in early season (April, May and June)

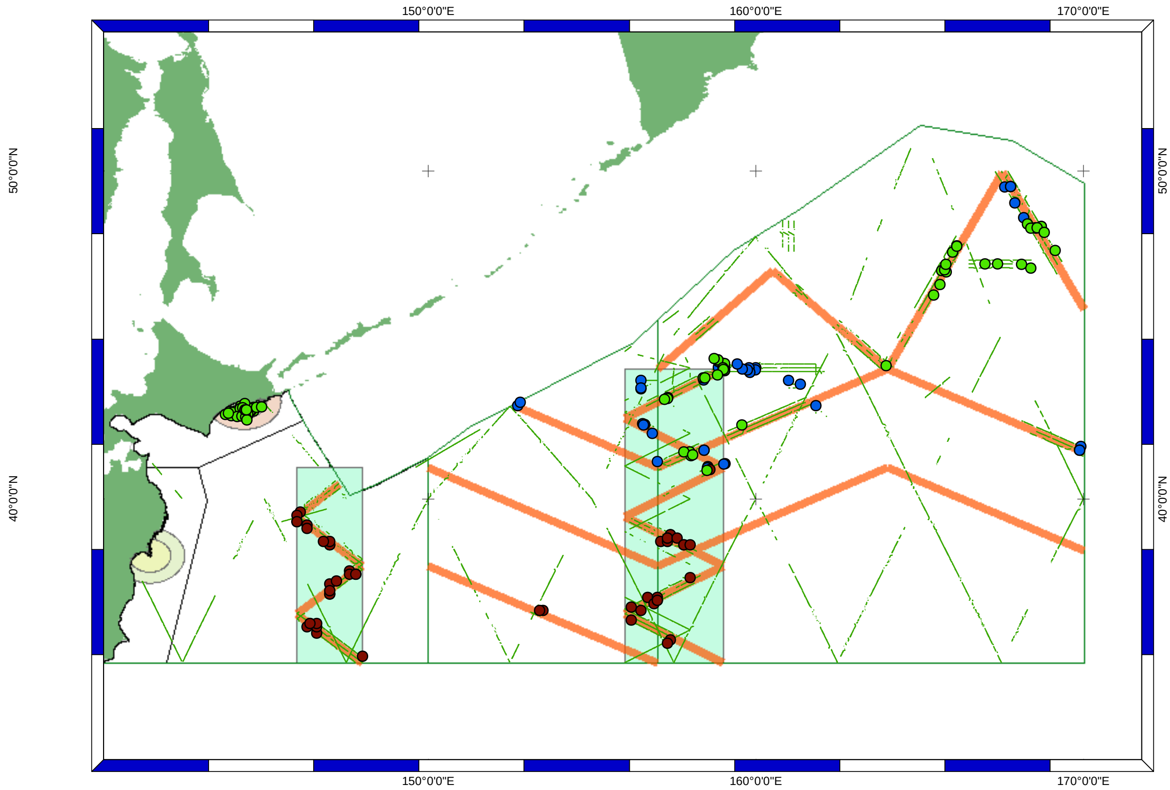

Figure 18. 2008 JARPNII in late season (July, August, September and October)

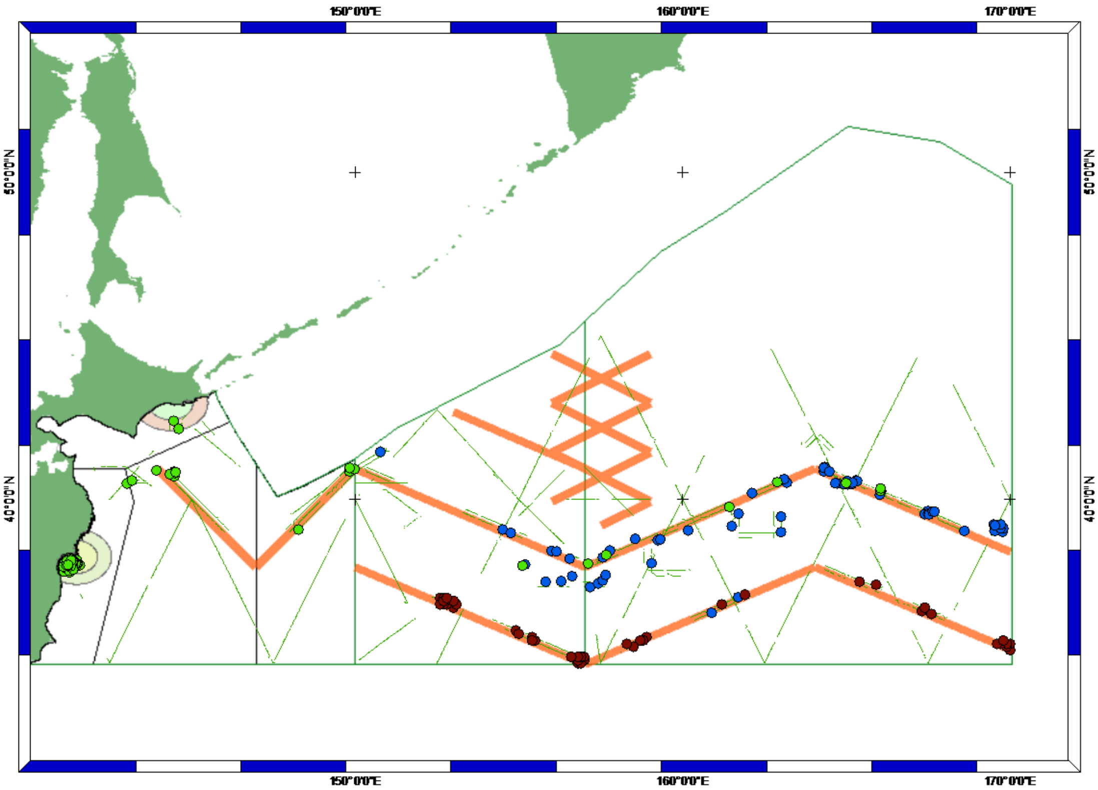

Figure 19. 2009 JARPNII in early season (April, May and June)

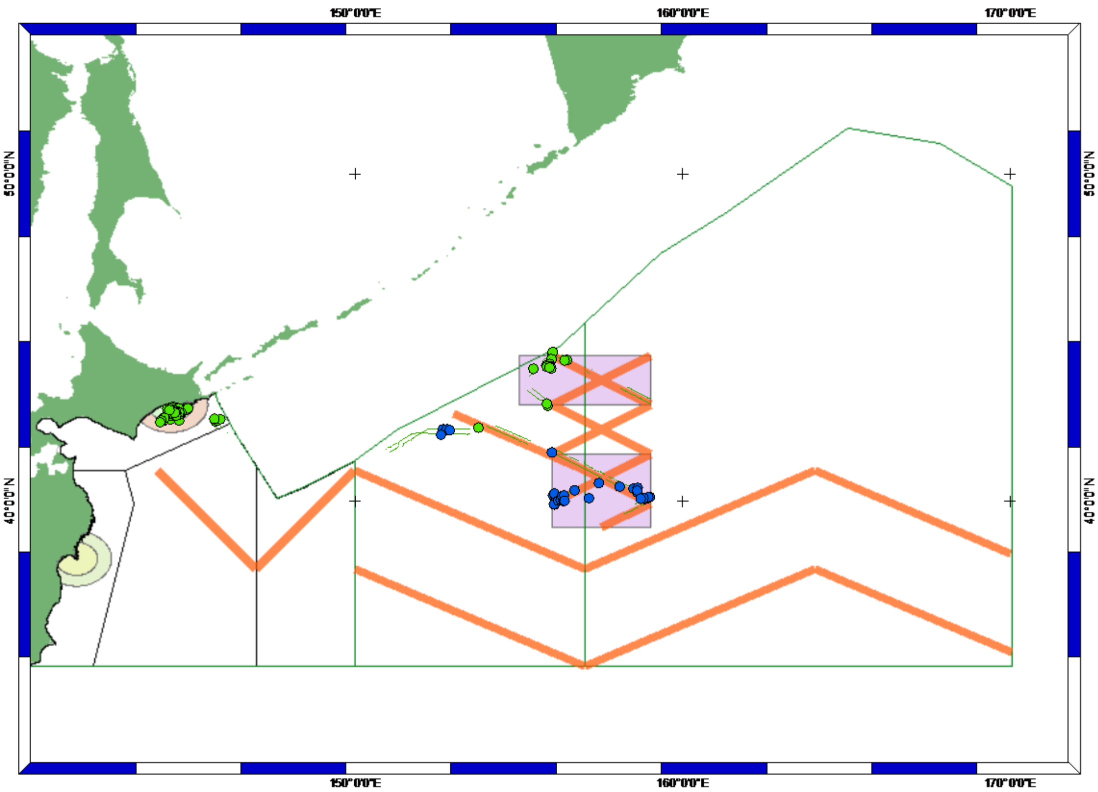

Figure 20. 2009 JARPNII in late season (July, August, September and October)

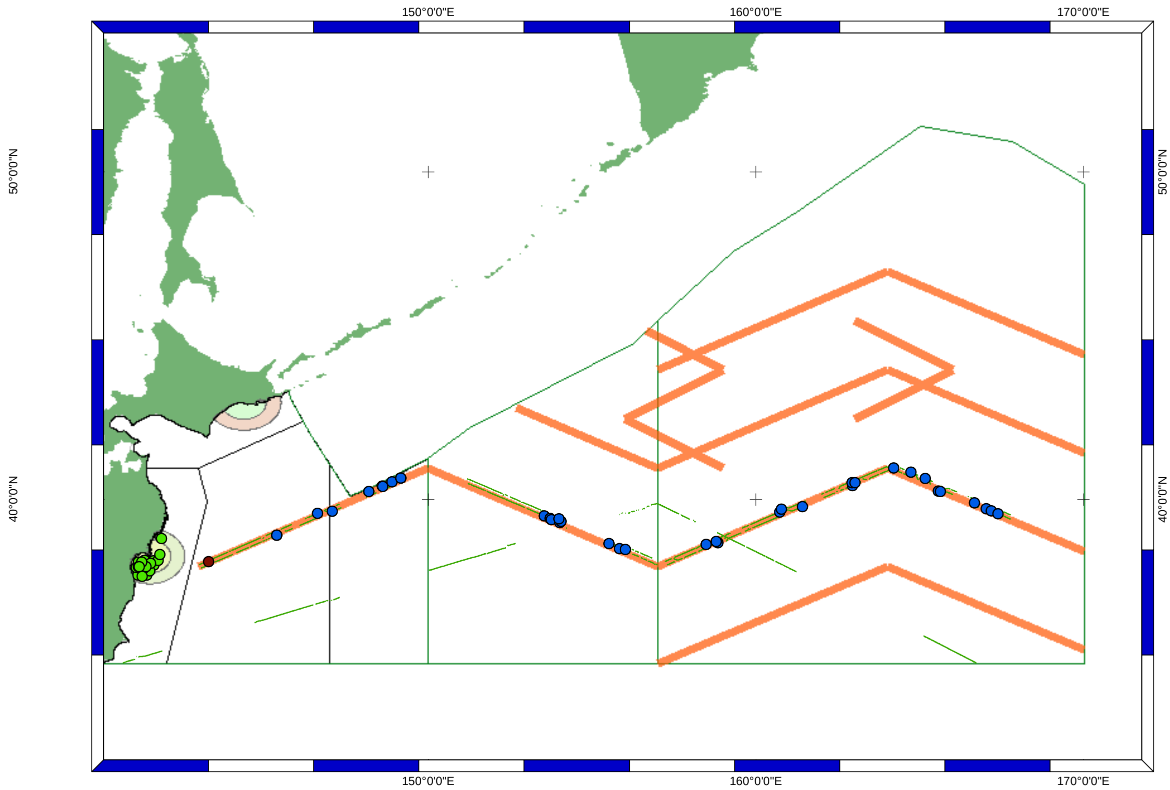

Figure 21. 2010 JARPNII in early season (April, May and June)

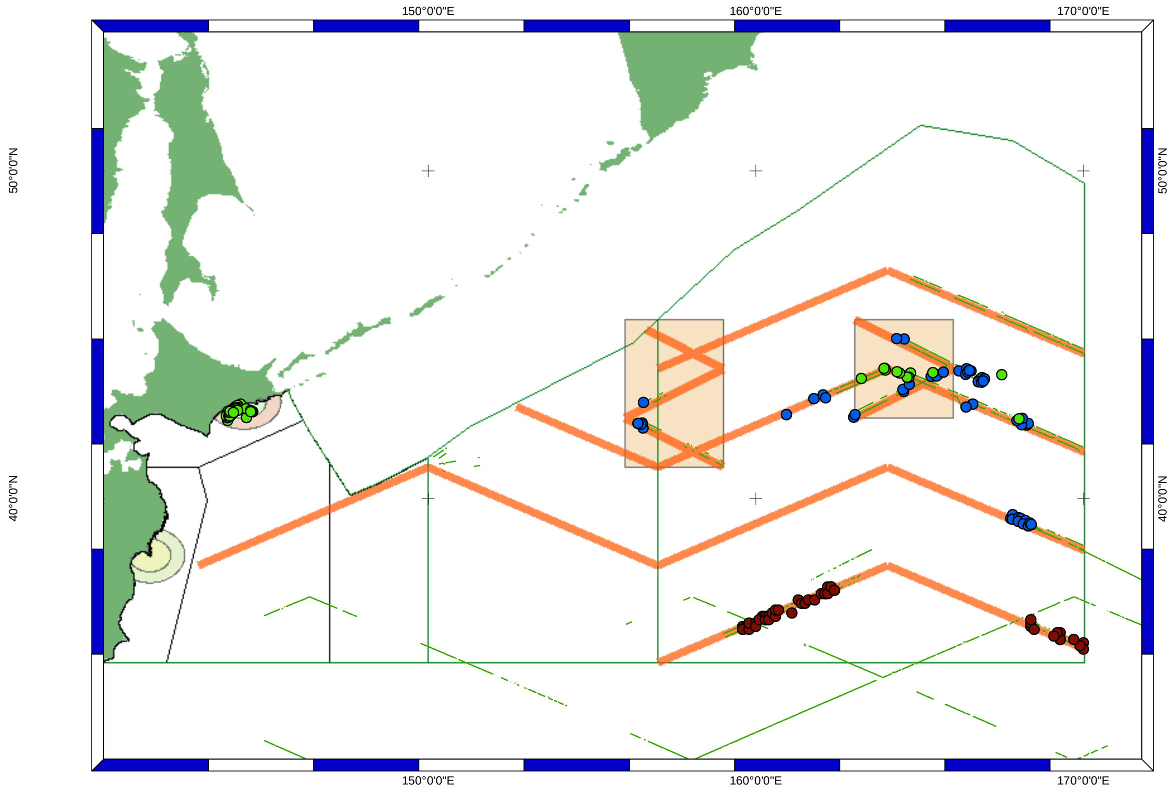

Figure 22. 2010 JARPNII in late season (July, August, September and October)

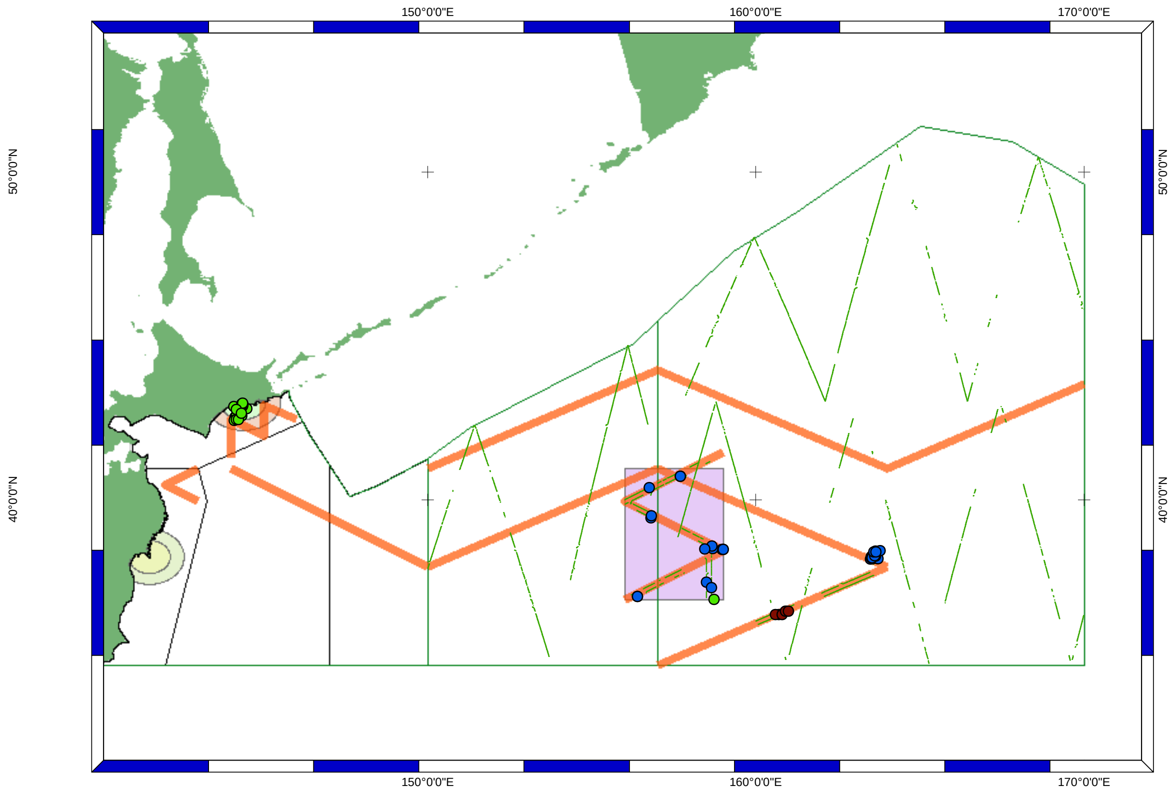

Figure 23. 2011 JARPNII in early season (April, May and June)

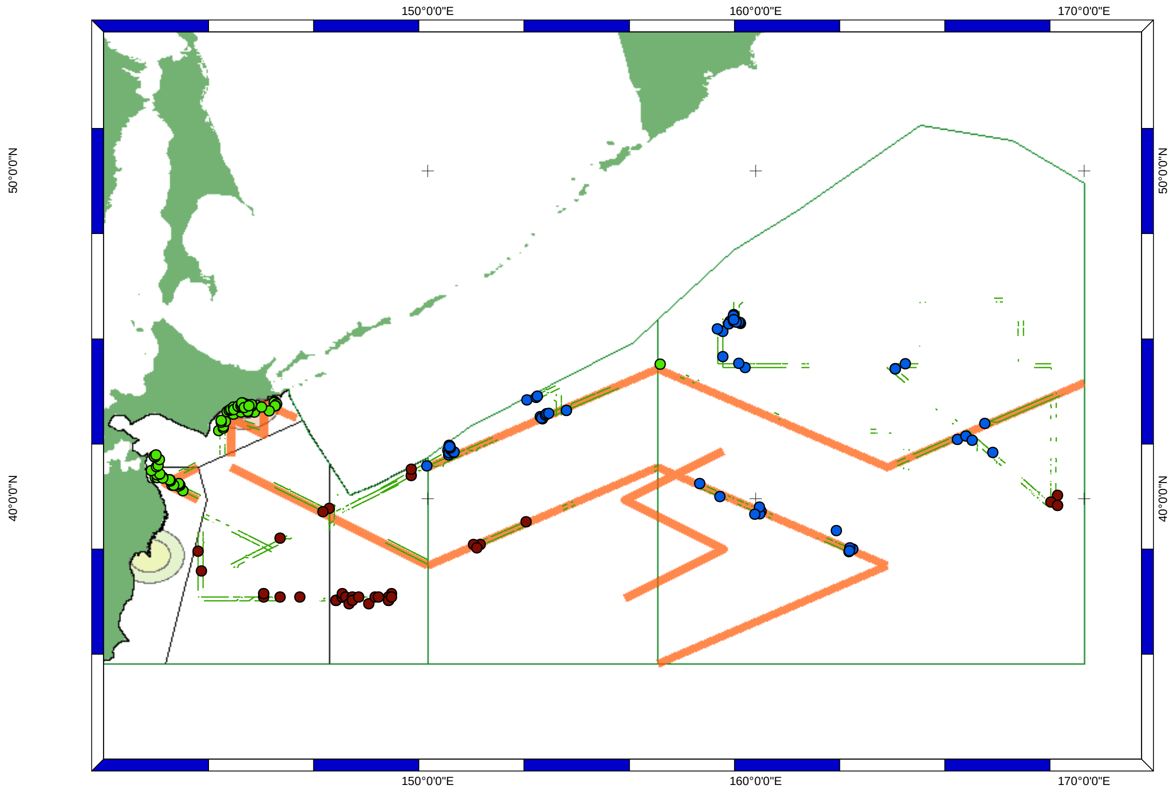

Figure 24. 2011 JARPNII in late season (July, August, September and October)

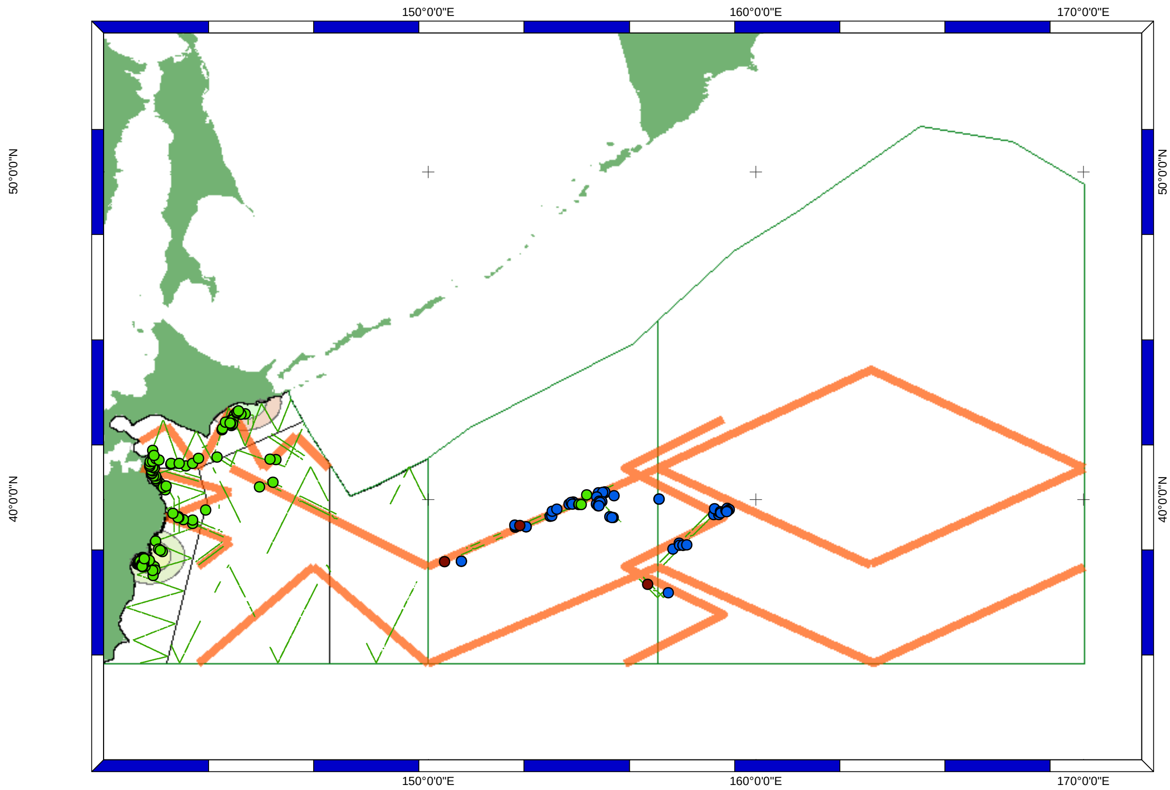

Figure 25. 2012 JARPNII in early season (April, May and June).

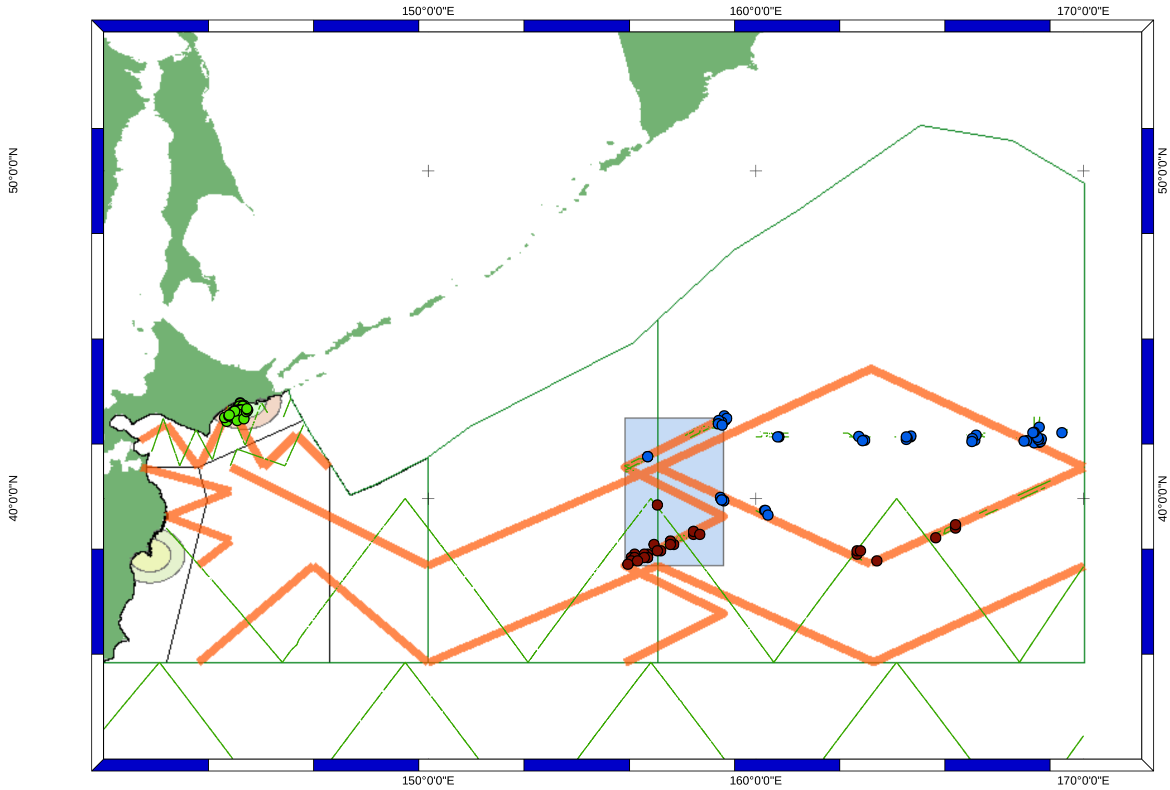

Figure 26. 2012 JARPNII in late season (July, August, September and October).

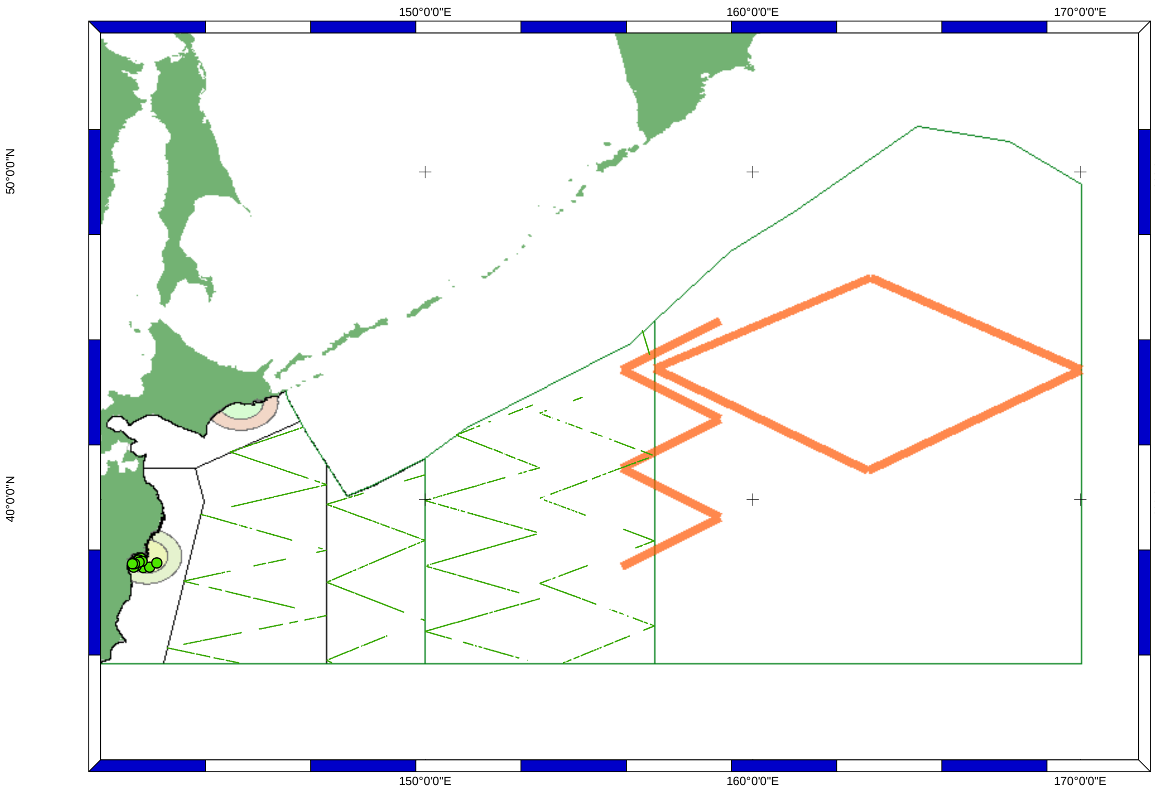

Figure 27. 2013 JARPNII in early season (April, May and June).

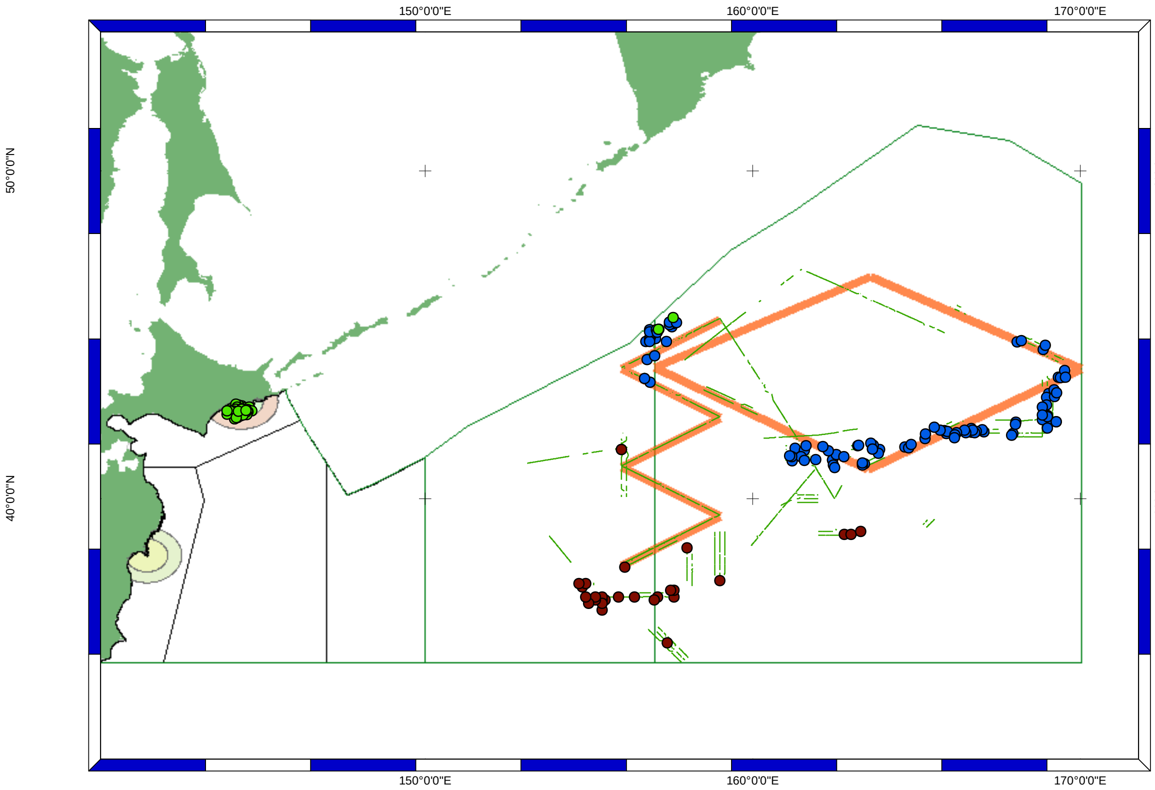

Figure 28. 2013 JARPNII in late season (July, August, September and October).