Ministry of the Environment Erimo Area Kuril Harbor Seal Management Project Implementation Plan, FY 2017

March 2017
Hokkaido Regional Environment Office

Contents

Background

The Ministry of the Environment will establish an “Erimo Area Kuril Harbor Seal Management Project Implementation Plan,” (hereafter, “Implementation Plan”) every fiscal year in order to appropriately implement the project, in accordance with the “Erimo Area Kuril Harbor Seal Specified Rare Wildlife Management Plan,” (hereafter, the “Management Plan”) which was established on 18. March 2016.

The goal of the Management Plan is to establish procedures for population management, damage prevention measures, monitoring, etc., in order to work toward present and future coexistence in the Erimo area between Kuril harbor seals and the local community, including the coastal fishing industry; the Ministry of the Environment will establish these procedures through partnership with various organizations, including the Hokkaido Government, Erimo Town, fishing industry associations, members of the fishing industry, local residents, related organizations, and universities and research institutions. Working toward the accomplishment of these goals, the 2017 Project Implementation Plan shall be defined as given below, taking into account the results of the project implemented during 2016.

FY 2016 Project Implementation Results and Assessment

1 Damage Prevention Measures

The following initiatives were implemented in order to mitigate damage to the fishing industry.

(1) Improvement of fishing nets

With the goal of establishing procedures to mitigate the particularly severe damage done to trap nets, and in order to block entrance by Kuril harbor seals into salmon trap nets, the Ministry of the Environment installed rope grids (20 cm × 20 cm, 25 cm × 25 cm, etc.) at the tunnel entrance to the bag net in trap nets with particularly severe damage in the Cape Erimo area during the trap net fishing seasons in spring and autumn, and verified their effectiveness.

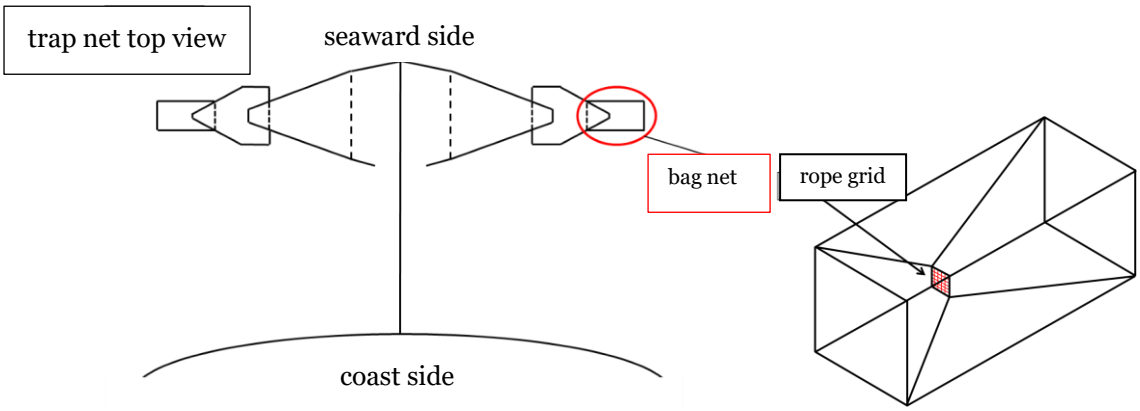


Fig. 1. Rope Grid Installation

Rope grid installation

Table 1. Rope grid types and installation periods

Trap net season	Sector Name	Number of nets with rope grids installed	Type of rope grid	Installation period
Spring	Toyo	1	20 cm × 20 cm	5/19 - 6/29
Autumn	Honcho	1	20 cm × 20 cm, and custom made grids (approx. 18 cm × 18 cm)	9/21 - 10/6
	Toyo	1	25 cm × 25 cm, 20 cm × 20 cm	10/5-
	Cape Erimo	3	25 cm × 25 cm, 20 cm × 20 cm, And custom made grids (various sizes)	2 nets：9/5 - 1 net：10/5 - removed when appropriate
	Shoya	1	20 cm × 20 cm	9/30 - 10/5

<Results of monitoring of the improvement of fishing nets>

- Upon comparison of capture nets (with installed rope grids measuring 20 cm × 40 cm or 25 cm × 25 cm through which seals can enter but not easily exit) and damage preventing nets (with installed rope grids measuring 20 cm × 20 cm through which seals cannot easily enter) in individual trap nets during the spring trap net fishing season, it was found that the number of fish caught in damage preventing nets was higher, and the damage-to-catch ratio was lower.

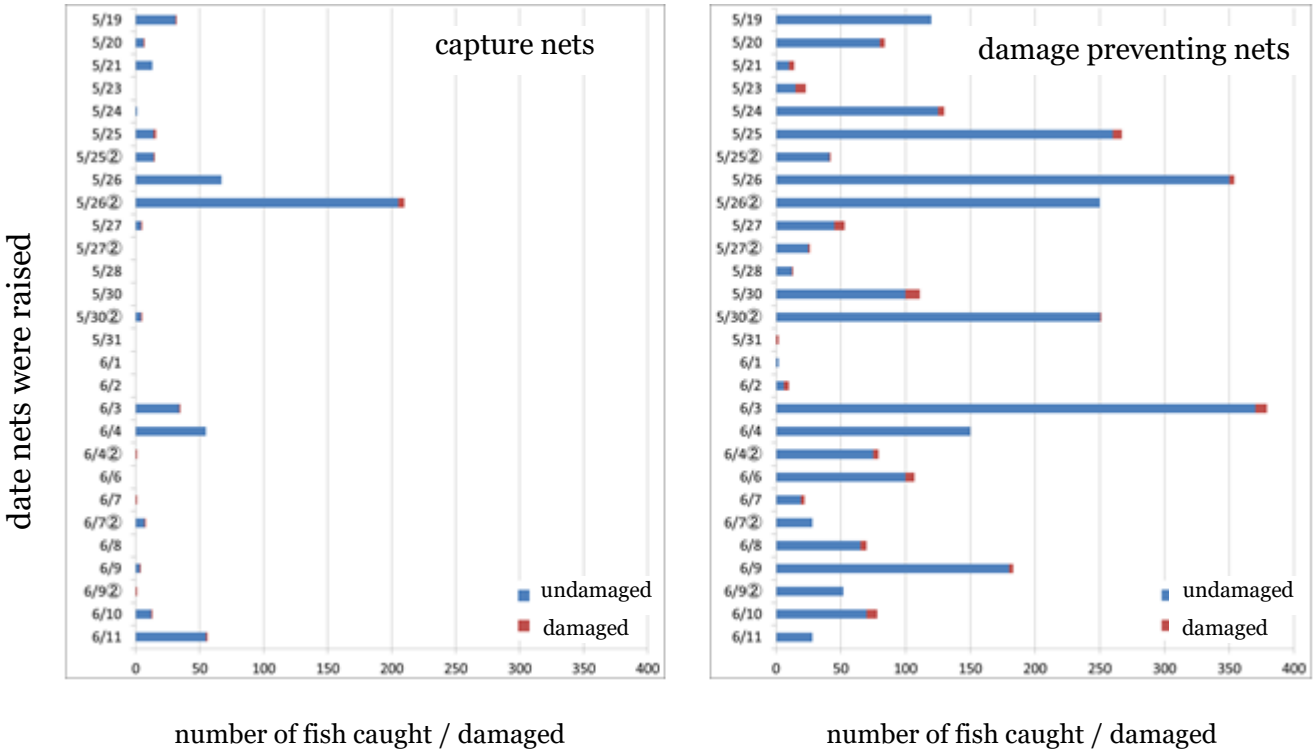


Fig. 2. Daily number of fish caught and number of fish damaged (data selected for the period up to 11. June, due to the large number of fish caught)

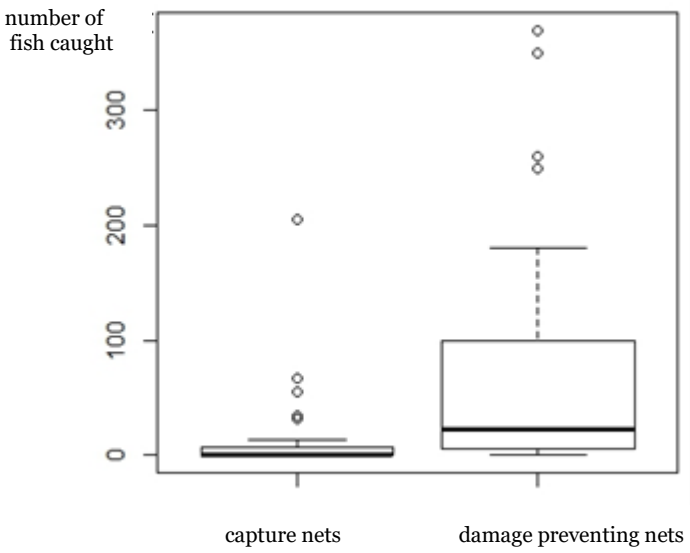


Fig. 3. Comparison of number of fish caught during monitoring period

- Monitoring of variation in number of salmon caught, number of fish damaged, and damage-to-catch ratio before and after the installation of rope grids in individual trap nets during the autumn trap net fishing season showed that after installation, the number of fish damaged was reduced and the damage-to-catch ratio was lower. Further, underwater cameras showed Kuril harbor seals carrying

salmon out of nets before the installation of rope grids, whereas after they were installed, the seals could no longer enter the nets, and the frequency of visits to the nets was confirmed to be lower.

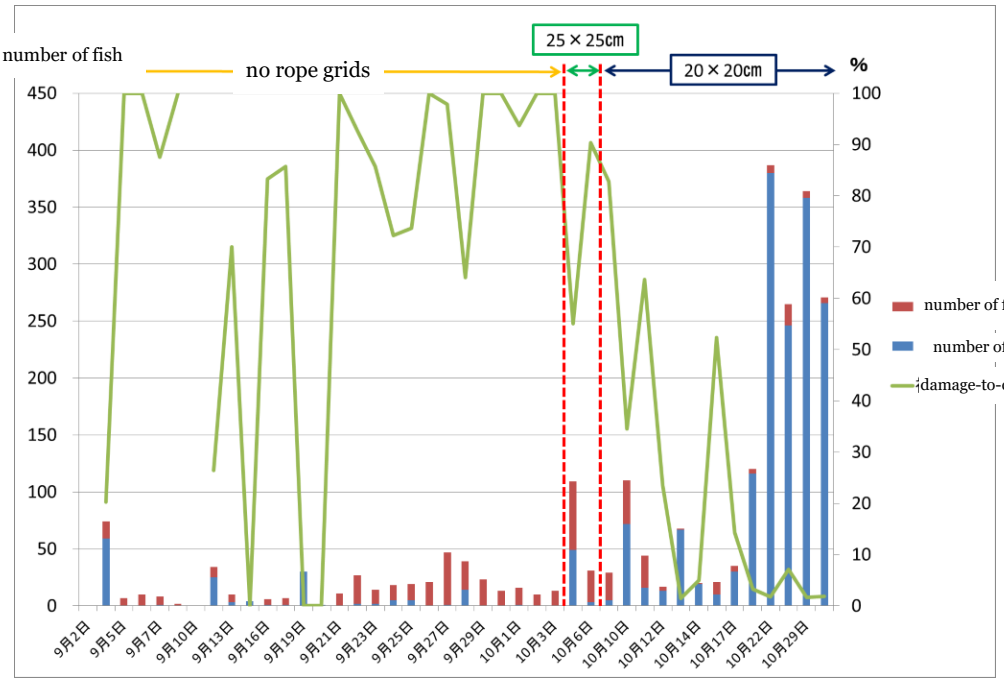


Fig. 4. Catch and damage conditions before and after rope grid installation

<Assessment of the improvement of fishing nets>

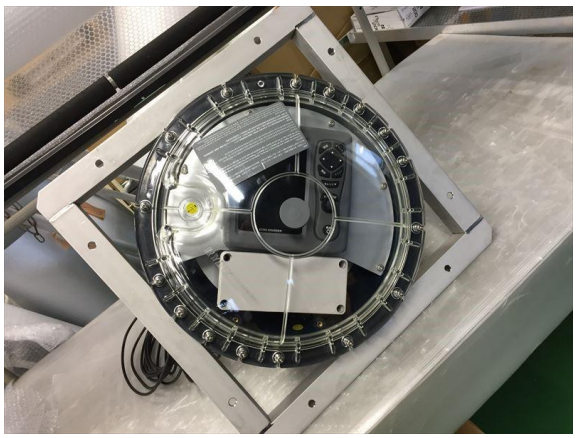
○ In a manner consistent with previous results, the damage mitigation effects of installing rope grids in individual trap nets were confirmed, and their effectiveness as a prevention method in trap nets with particularly severe damage was shown. Further, it has been confirmed that the frequency of Kuril harbor seal visits to the areas around nets is decreased, and it is reasonable to expect mitigation effects for undetected damage, such as salmon being carried out of nets.

○In 2016, rope grids were installed in one trap net in one sector during the spring season, and in six trap nets in four sectors during the autumn season, an increase from 2015, in which rope grids were installed in one trap net in one sector and two trap nets in one sector during the spring and autumn seasons, respectively. This is the result of wider adoption of rope grids and increasing awareness of their damage mitigation effects, but it also suggests that the scope of the damage is broadening. Because there are members of the fishing industry who are concerned about the effects on salmon, it is essential to plan further improvements aimed at creating damage preventing nets that are highly effective at preventing Kuril harbor seals from entering, while also having minimal effects on salmon, in order to further the adoption of damage prevention measures through improvements made to fishing nets in the future.

(2) Improvement of acoustic repellent equipment

For the development of equipment (hereafter, “repellent equipment”) which effectively emits ultrasonic waves that have been shown to be effective in repelling Kuril harbor seals in previous experiments (Tamura et al. 2016), examinations of Kuril harbor seal behavior were conducted using floating cages. Further, improvements were made regarding how often sound waves are emitted, as well as the configuration of the equipment, etc. in anticipation of the equipment being installed on or near trap nets. Improvements to repellent equipment included adjustments to the configuration of the equipment aimed at making it more suitable for practical use, made in light of opinions gathered from members of the fishing industry.

Repellent equipment installed in a floating cage (before improvement)

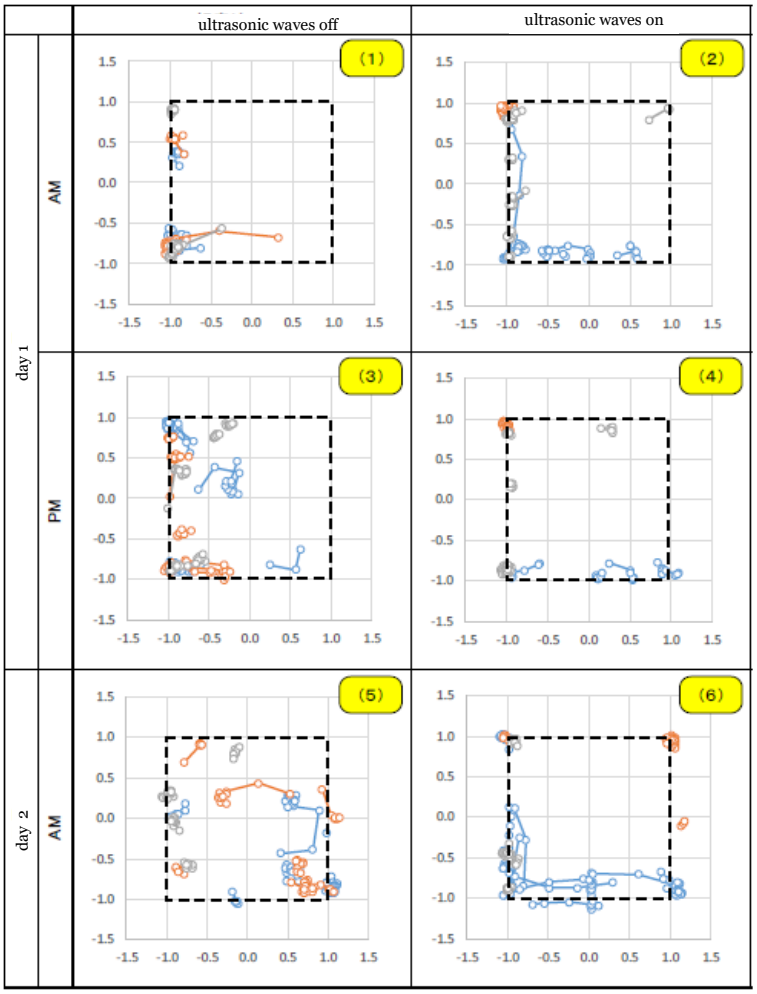


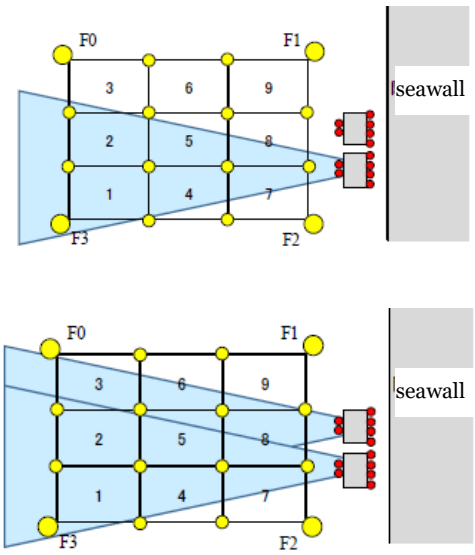
Improved repellent equipment

<Results of monitoring (testing) of improvement of acoustic repellent equipment>

○In examinations of Kuril harbor seal behavior conducted using floating cages, sufficient repellent effects were found, including three juvenile Kuril harbor seals which displayed flight behavior such as swimming to the corners of the cage or

escaping from the cage when ultrasonic waves were emitted from an experimental model.





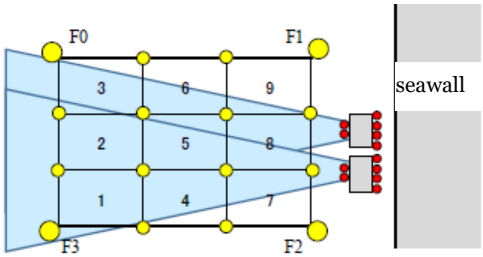


Fig. 5. Results of examinations of acoustic repellent equipment conducted in floating cages

<Assessment of improvement of acoustic repellent equipment>

○In addition to creating equipment with repellent effects, improvements are also being made to the configuration, etc. of the equipment in anticipation of installing it on or near trap nets, and the work toward the development of effective equipment is proceeding. There is a need for investigations into effective procedures etc. for installing the equipment near trap nets, in order to mitigate the damage done to the fishing industry in the future.

2 Population management

The Ministry of the Environment attempted to capture seals using trap nets, gillnets, and seal capture traps, in order to perform population management aimed at both mitigating the damage done to the fishing industry and maintaining a sustainable Kuril harbor seal population level. Attempts were made to capture seals alive to the greatest extent possible, and research data necessary for developing future measures was gathered, after which captured individuals were transferred to aquariums, etc, fitted with EM transmitter tags and released, or euthanized by a veterinarian.

(1) Capture using trap nets

With the cooperation of trap net fishermen in the Cape Erimo area, nets from which Kuril harbor seals cannot easily escape were deployed for a total of 41 days in the spring season (between 19. May and 28. June) and a total of 50 days in the autumn season (between 3. September and 22. October). Rope grids measuring either 20 cm × 40 cm or 25 cm × 25 cm and timer-operated shutter devices (Fig. 6) were installed at the entrances of these nets in order to capture seals. During the deployment periods, nets were raised 44 times and 34 times, respectively.

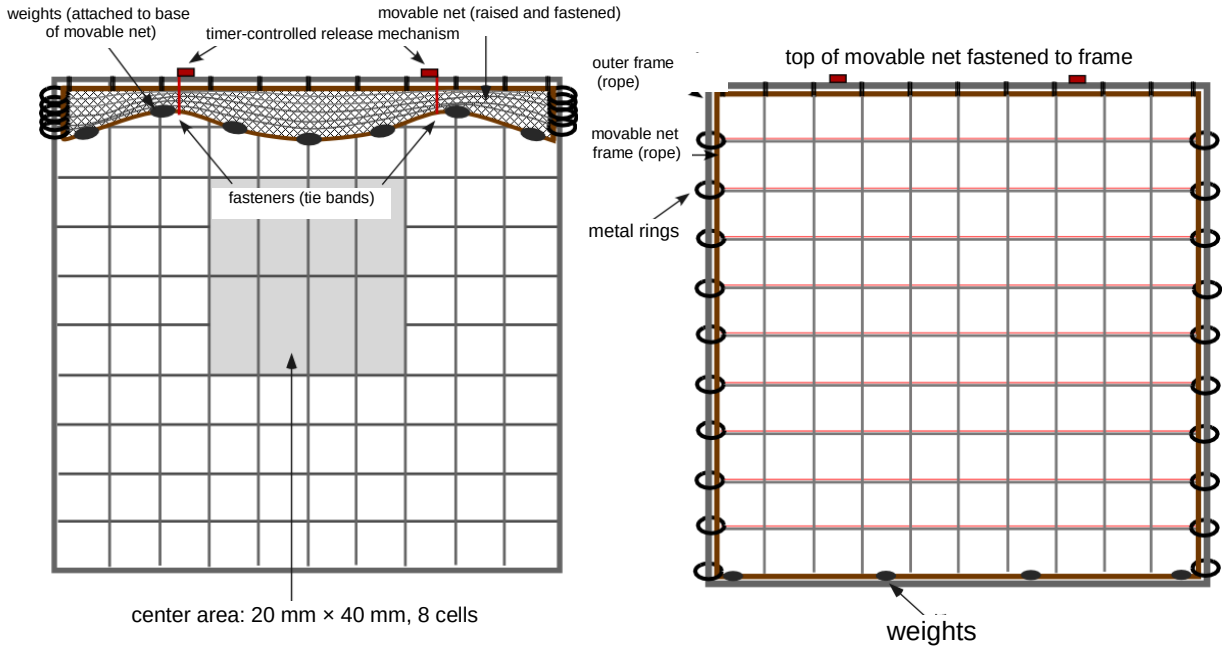


Fig. 6. Timer-operated shutter devices (above: shutter open, below: shutter closed)

(2) Capture using gillnets

Capture of seals using gillnets was performed with the cooperation of fishermen near the rocky shore reefs of Cape Erimo for 8 days between September and November. (Approximately 3 hours were spent working at sea on each day of seal capture. Nets were set and hauled in multiple times per day.)

(3) Capture using seal capture traps

Capture was attempted using either 1 seal capture trap or 6 seal capture traps (Fig. 7), which were set in the vicinity of trap nets for a total of 31 days between 30. May and 28. June.

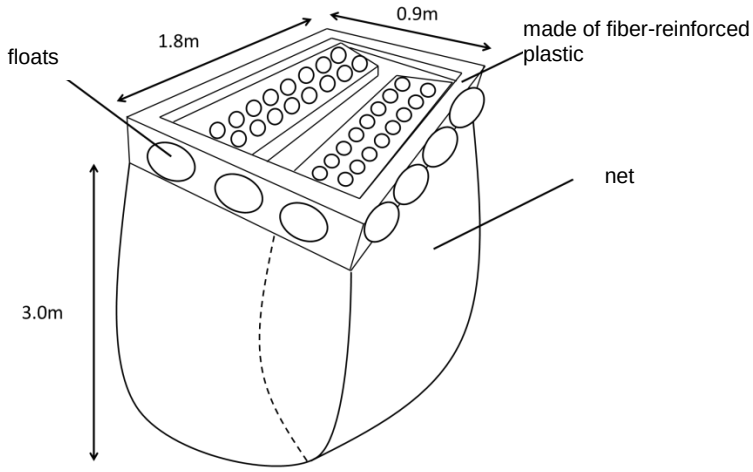


Fig. 7. Structure of a seal capture trap

(4) Capture results

Between May and November 2016, a total of 48 seals were captured using trap nets, gillnets, and seal capture traps. (Among these, 2 juveniles were fitted with EM transmitter tags and released, and 1 individual of unknown age escaped.) Further, seals were categorized using age estimates made based on growth curves, with individuals aged 5 years and older designated as adults (sexually mature individuals), and immature individuals aged 4 years and younger designated as juveniles at age 1 and younger, and designated as subadults at age 2 to 4 years.

Table 2. Kuril harbor seal capture results by capture method

Capture method	juveniles (1 year and younger)		subadults (2 to 4 years)		adults (5 years and older)		age unknown	total
	male	female	male	female	male	female	sex unknown	
Spring trap nets (44 times)	2(1)	8(3)	0	0	0	1(1)	0	11(5)
Autumn trap nets (34 times)	2(0)	2(0)	1(0)	0	0	0	0	5(0)
subtotal	14(4)		1(0)		1(1)		0(0)	16(5)
Gillnets (8 days)	11(2)	13(3)	3(2)	2(1)	1(0)	1(0)	1(0)	32(8)
subtotal	24(5)		5(3)		2(0)		1(0)	32(8)
Seal capture traps (26 days)	0		0		0		0	0
total	38(9)		6(3)		3(1)		1(0)	48(13)

*Numbers given in parentheses represent the number of captured individuals that died.
*This total includes 2 juveniles that were fitted with EM transmitter tags and released, and 1 individual of unknown age that escaped.

<Results of monitoring of population management>

① Population size and structure

○The largest number of individuals hauling out found in a long-term land based census (performed by Tokyo University of Agriculture) was 368 individuals on 20. September. Further, in aerial surveys performed by unmanned aerial vehicle (UAV) the largest number of individuals hauling out found was 413 individuals on 24. August.

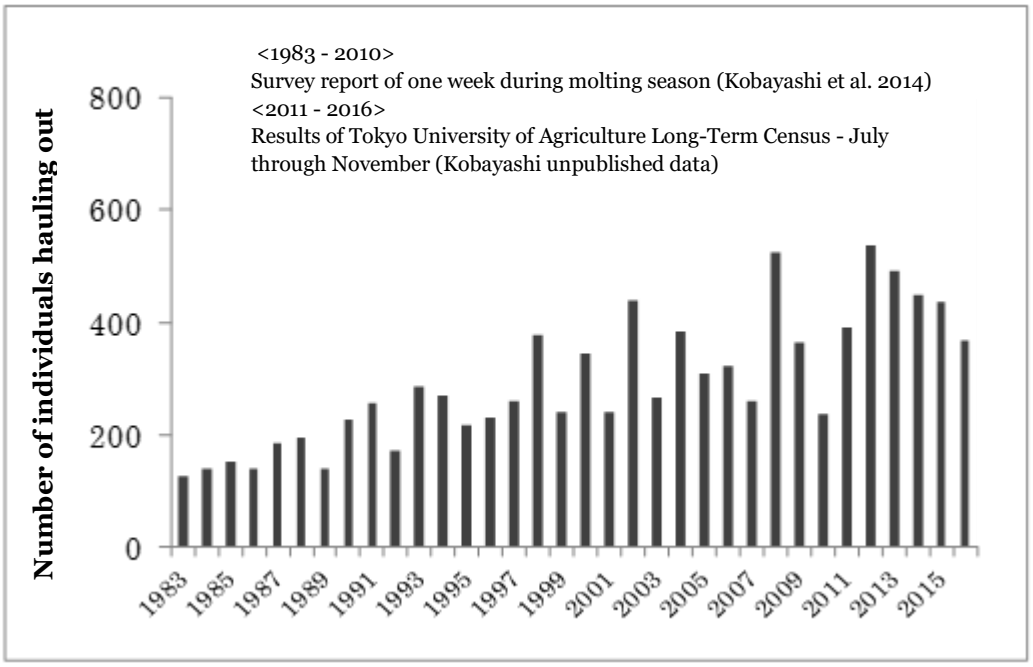


Fig. 8. Largest number of Kuril harbor seals hauling out at Cape Erimo

○Analysis of images captured by UAV (measurements of body length, girth, etc.) was used to ascertain the structure of the population; it was found that there is variation in composition of hauled out individuals from one rocky shore reef to another.

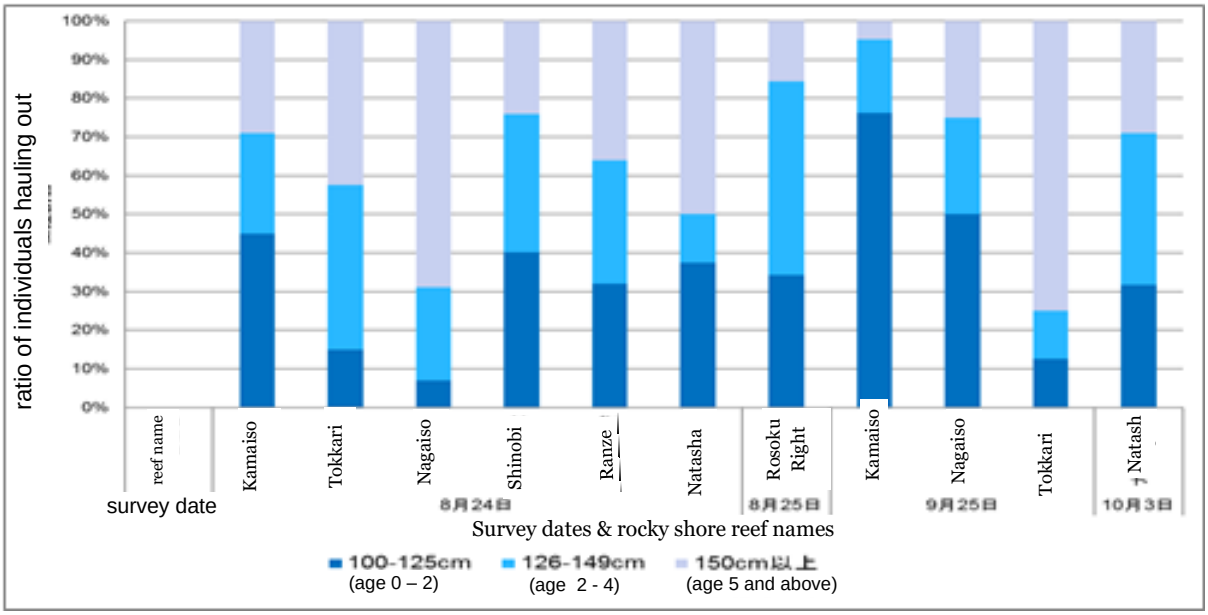
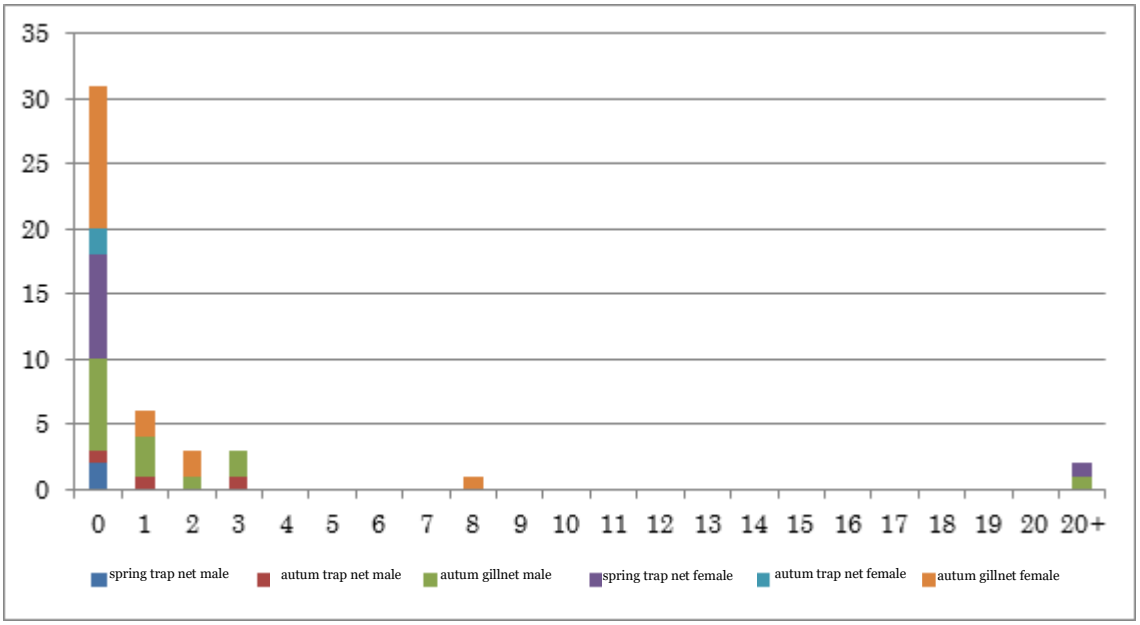


Fig. 9. Composition of hauled out individuals by rocky shore reef

② Population trends

○Ecological data necessary to ascertain population trends (body length, body weight, age, sex, blubber thickness, breeding conditions, etc.) was obtained from captured and bycaught individuals. Age estimation using body length data and growth curves showed a disproportionate number of juveniles among both captured and bycaught individuals. Further, there was a higher number of females in both groups.



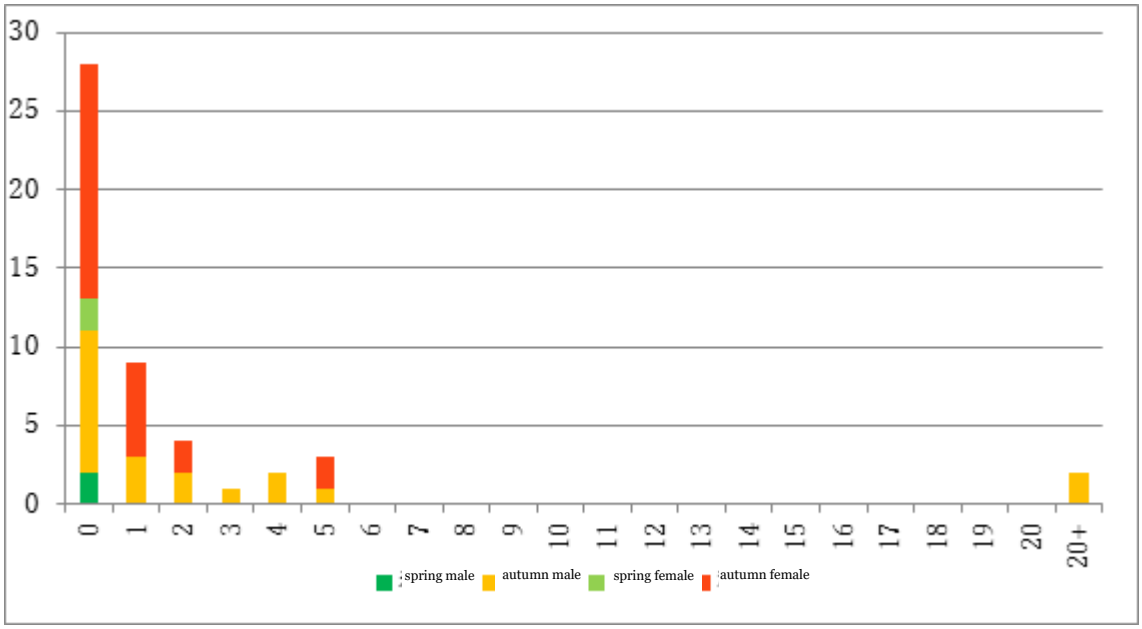
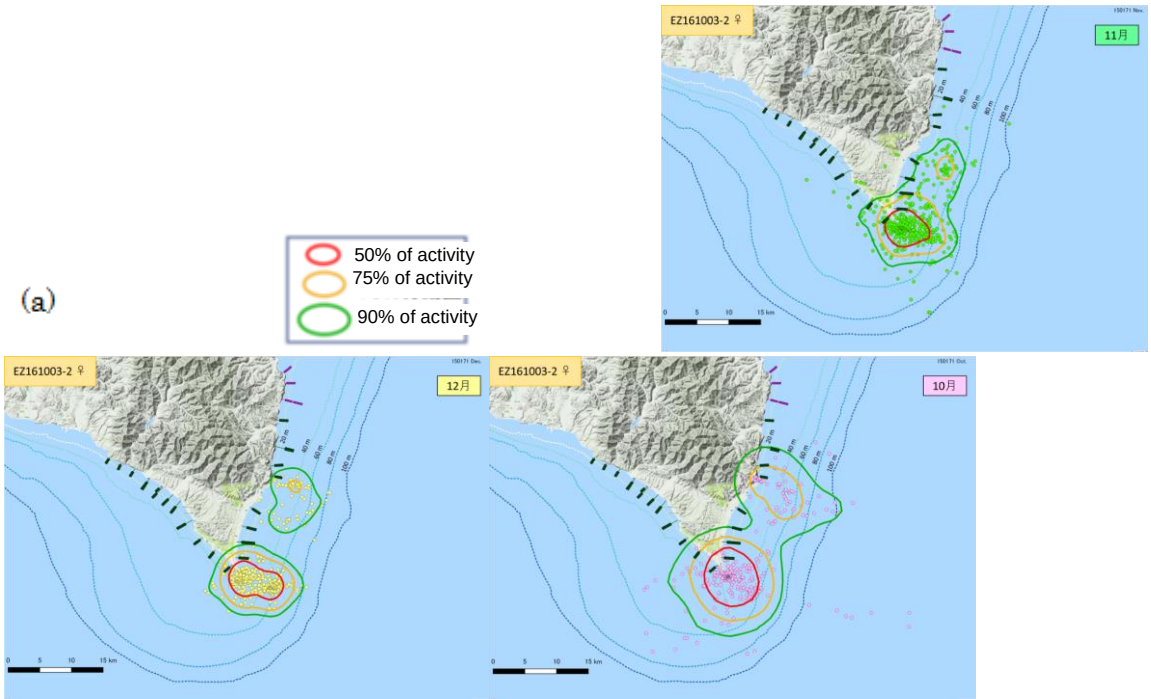


Fig. 10. Sex and age of captured individuals (above) and bycaught individuals (below)

○The results of a survey of range of activity, etc. using EM transmitter tags fitted to two juveniles confirmed that the animals concentrate their activity in the shallow waters of the Cape Erimo and Shoya sectors, which was consistent with the results of previous surveys.



(b)

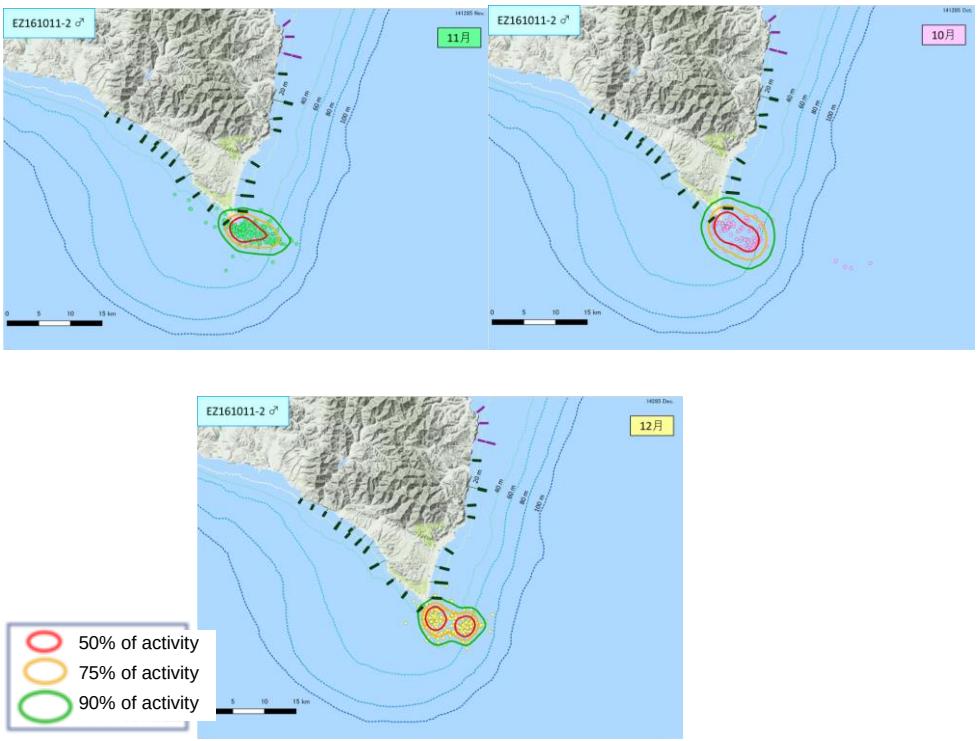
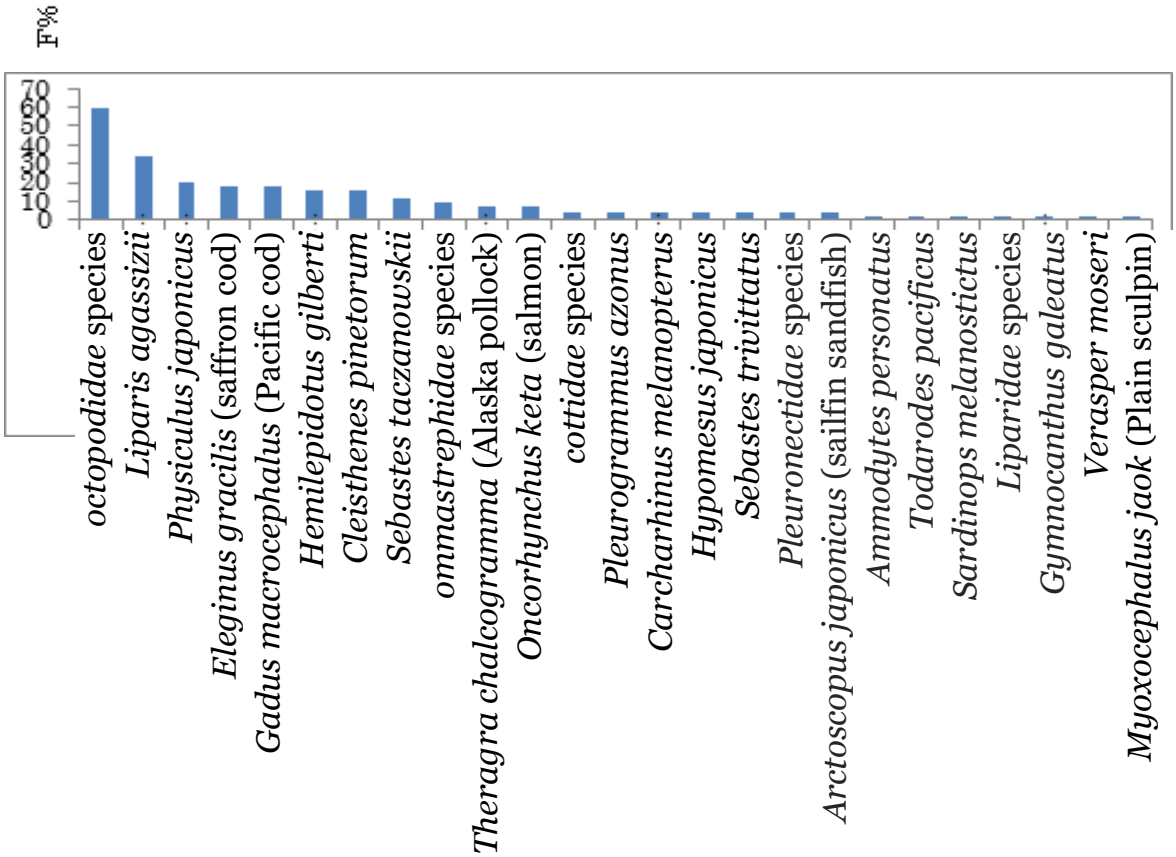


Fig. 11. Home ranges of individuals fitted with EM transmitter tags from October to December. (a: juvenile female, b: juvenile male)

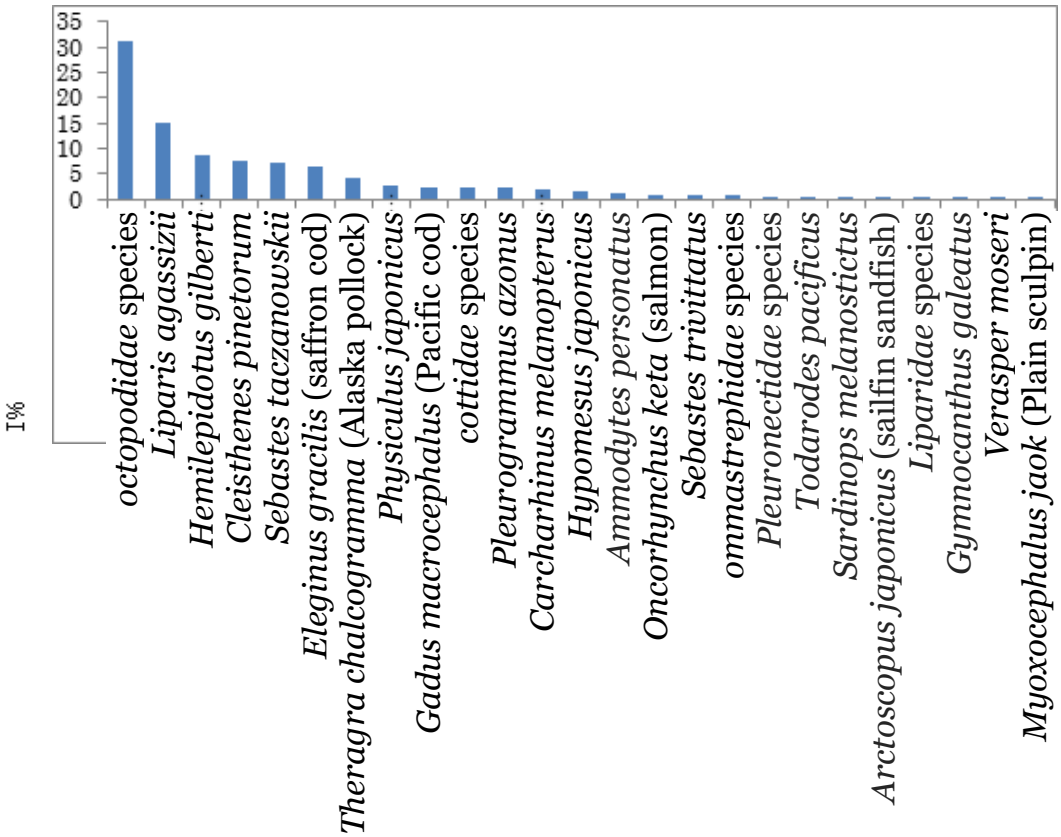
③Survey of stomach contents of captured and bycaught individuals

○In a survey of the stomach contents of 86 captured and bycaught individuals, stomach contents were found in 42 individuals. Salmon was found infrequently, with cephalopods, gadidae, etc. taking up the majority, which was consistent with the results of previous surveys.

(a) Frequency of occurrence (F%) of prey organisms



(b) Proportion of all prey represented by a particular species of prey organism (I%)



(c) Combined Rank Index of prey organisms (CRI = F% rank × I% rank)

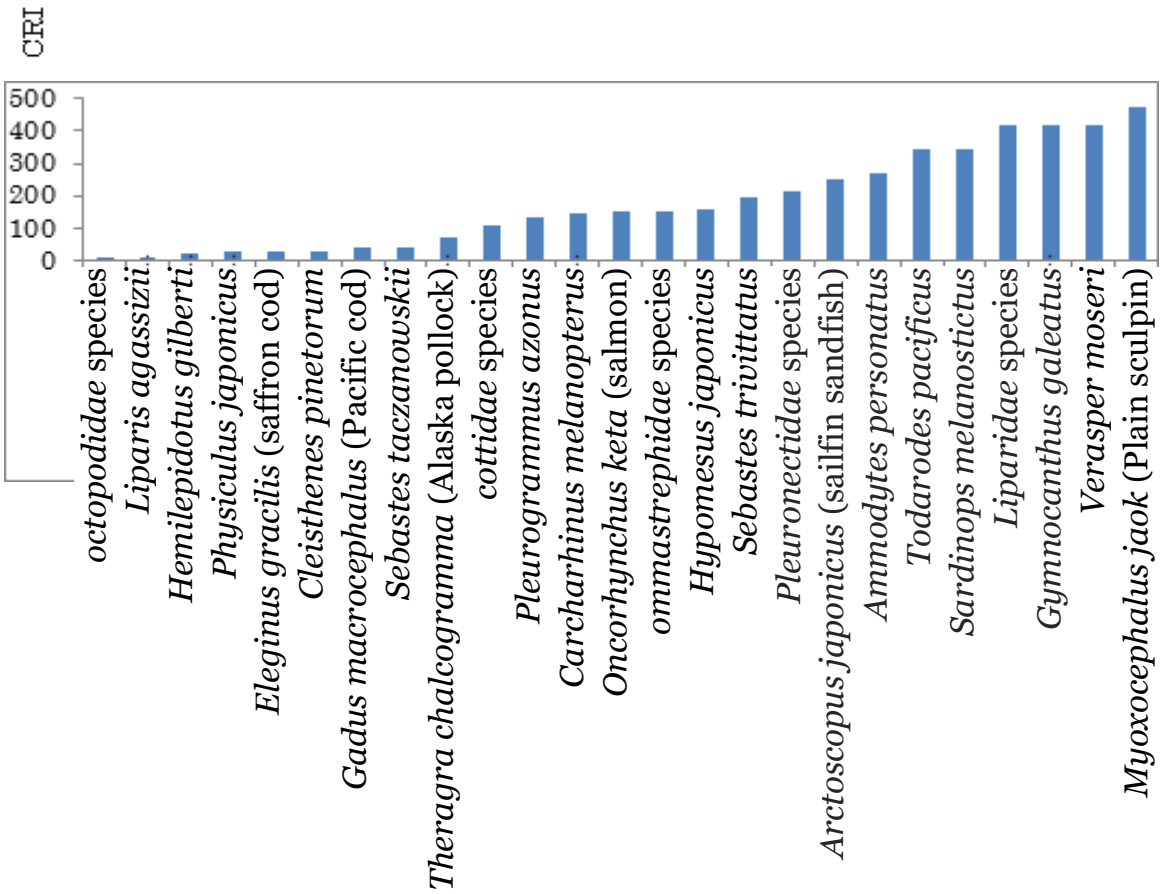


Fig. 12. Results of analysis of stomach contents of captured and bycaught individuals (a) - (c)

④Assessment of sustainability

○Upon assessment of population conditions based on quantitative analysis reflecting the latest survey data (the largest number of Kuril harbor seals hauling out in 2014 and 2015, and the capture and bycatch results from May to December of 2016 (including sex and age composition)), it was confirmed that the probability of extinction within the next 100 years is nearly 0% if the population in 2018 is managed at a level that is 80% of the population at the time the Management Plan was established (March 2016), and if this level is maintained from 2019 onward, which was consistent with the results of previous assessments.

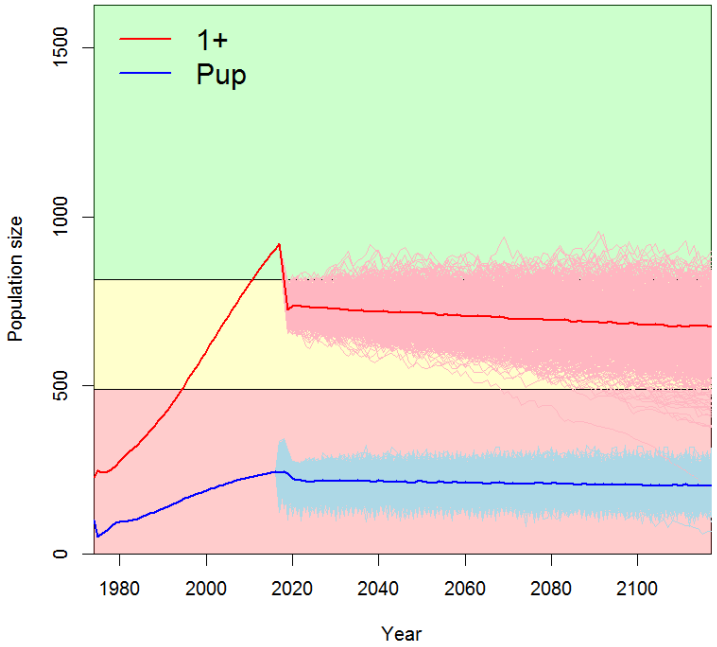


Fig. 13. Assessment of population conditions based on quantitative analysis

<Assessment of population management>

①Capture results

○The number of individuals captured was 48, which was less than half of the predetermined goal of approximately 100 individuals. In particular, the number of individuals captured using trap nets was only 16. However, it is possible that this was influenced by the fact that the number of fish caught in the autumn 2016 salmon fishing season in the Erimo area was extremely low (38.4% of the average over the past 5 years, according to the Hokkaido Government Hidaka Subprefectural Bureau), which resulted in fewer autumn salmon inside the bag nets to attract the Kuril harbor seals, as well as the fact that nets were raised relatively infrequently, among other possible influences. In the future, it will be necessary to respond in a variety of ways, including lengthening the period for capture using gillnets, which was more effective, as well as improvements in capture methods using trap nets. Further, caution is needed in order to avoid reductions in capture efficiency due to seal learning.

②Population size, trends, etc.

○The confirmed number of individuals hauling out in 2016 was comparatively lower than in recent years, however, it is possible that this was influenced by weather conditions (approaching typhoons, etc.) when census data was being

gathered. Because the results of population surveys of wild animals vary greatly from year to year, it is not possible to assess increases or decreases in population from the results of surveys conducted in only a few years. Further, variation in haul-out frequency due to capture, etc. must be taken into consideration. In addition to future long-term population monitoring, the frequency and accuracy of surveys need to be improved.

○Because it is difficult to assess population structure, genetic diversity, infectious disease, etc. in single years, continuous data collection is necessary. Further, even in home ranges in which variation has not yet been found, it is necessary to continue to conduct monitoring and fully understand any variation in activity accompanying population management.

○Surveys of stomach contents confirmed the same feeding habits as had been previously found. It is necessary to collect data throughout the year by capturing individuals in winter and performing analysis of stomach contents, etc., as well as to monitor year-to-year variations.

③ Sustainability assessment

○Although the current results are not significantly different from the results of previous sustainability assessments, it is necessary to continue to perform such analyses annually. Further, it is necessary to reflect the latest data in each analysis.

3 Survey of damage done to the fishing industry

<Results of monitoring of damage done to the fishing industry>

○An understanding of the damage done to the fishing industry was gained through analysis of questionnaires completed by autumn salmon trap net fishermen in the Erimo area (representing a total of 21 nets) which recorded the number of fish damaged on each fishing day; it was found that while the number of fish damaged was comparatively lower than in a typical year, because the total number of fish caught was vastly lower than average, the damage-to-catch ratio was higher.

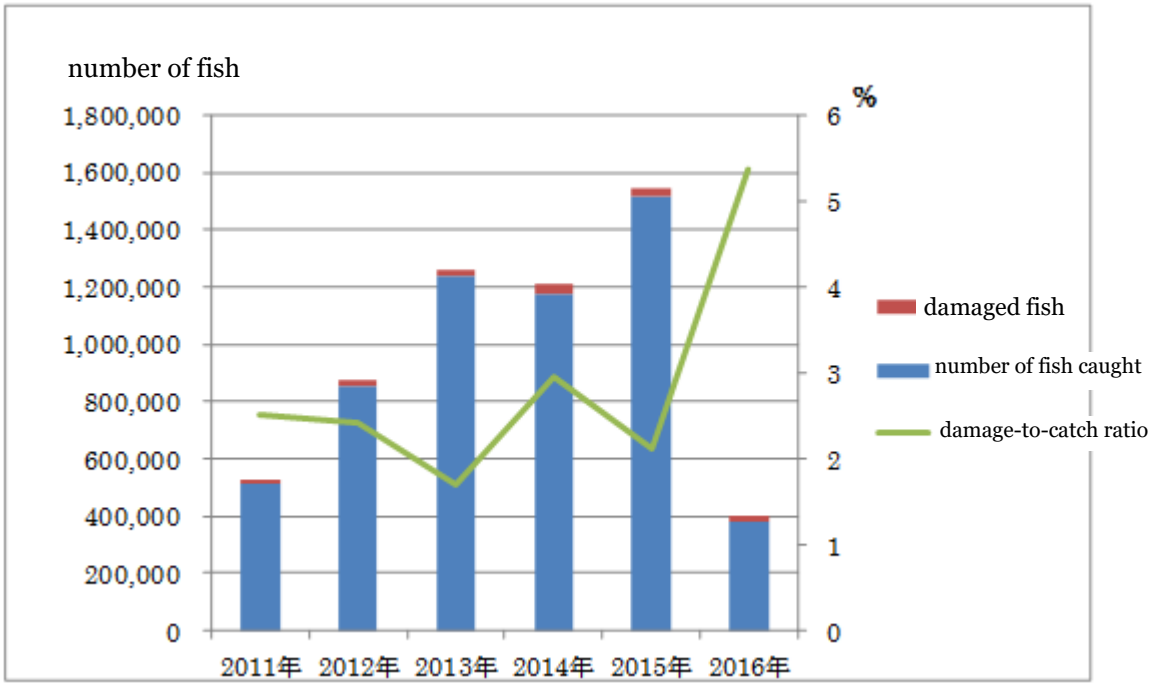


Fig. 14. Autumn salmon trap net damage situation in the Erimo area

○Comparison of the damage situation in each sector showed that the damage-to-catch ratio was higher in every sector; however, it was found that the number of fish damaged was vastly lower than the previous year in the Toyo and Cape Erimo sectors, in which damage preventing nets have been installed long-term in trap nets. Further, comparison with 2011 (in which the whole region saw the lowest total number of fish caught in the past 5 years) showed that the number of fish damaged was greatly reduced in only the Cape Erimo sector. (See Fig. 15 below.)

○The Ministry of the Environment began surveys of the damage done to the longline octopus fishing industry using questionnaires.

<Assessment of the damage done to the fishing industry>

Because the overall catch was extremely poor in 2016, conditions did not allow sufficient assessment of the effects of damage prevention measures and population management from the perspective of the damage done to the fishing industry. For this reason, it is necessary to continue to perform monitoring in the future.

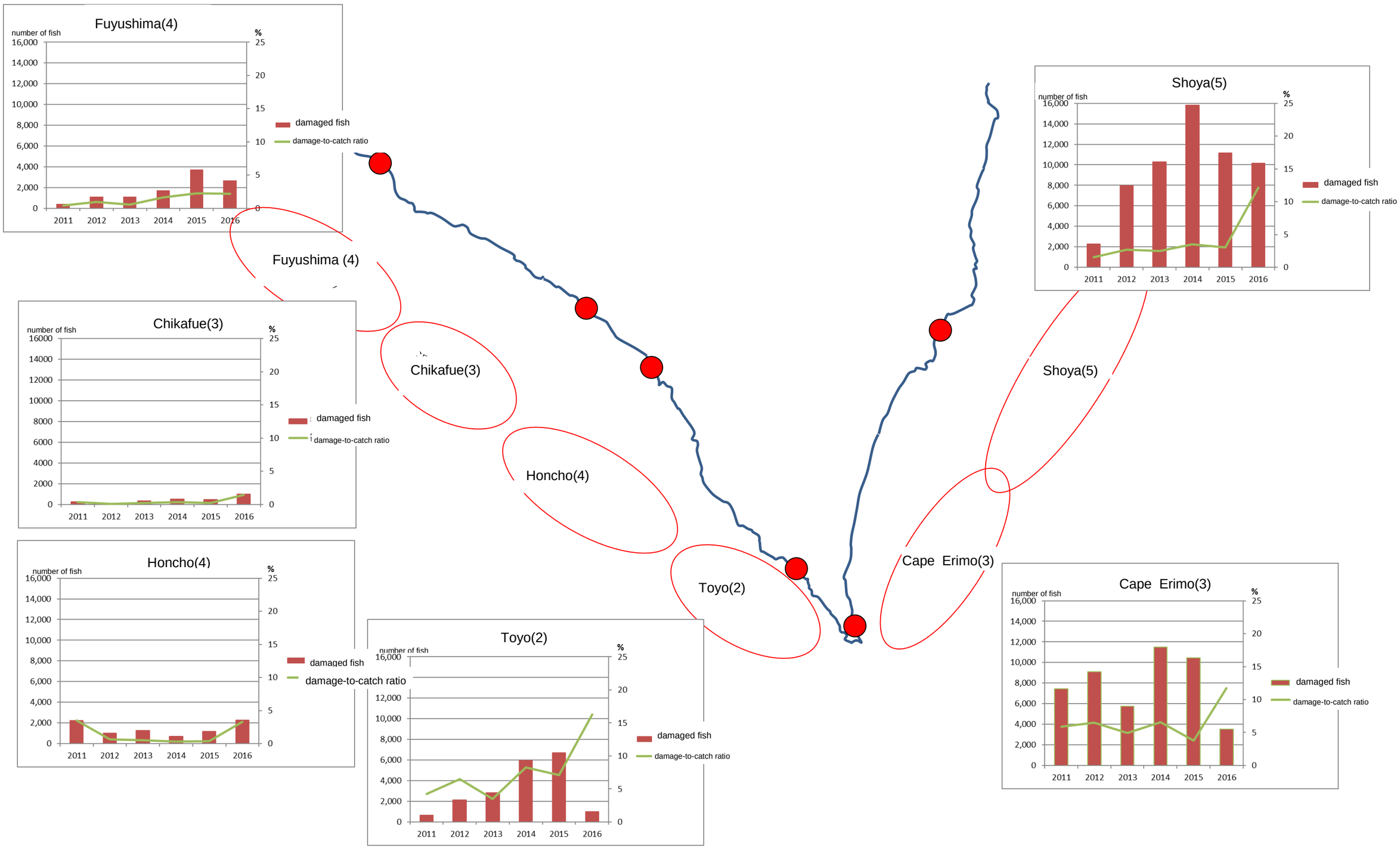


Fig. 15. Damage done to autumn salmon trap net fishing by sector

*Numbers given in parentheses next to sector names represent numbers of trap nets.

4 Public awareness

(1) Transferring animals to aquariums and zoos

○From among the individuals that were either captured or bycaught, 10 juveniles were transferred to aquariums, etc. across the country, with the assistance of the Japanese Association of Zoos and Aquariums.

Table 3. Institutions to which captured or bycaught Kuril harbor seals were transferred

Institution name	Number of individuals transferred
Noboribetsu Marine Park Nixe (Hokkaido, Noboribetsu City)	1 (1 female juvenile)
New Yashima Aquarium (Kagawa, Takamatsu City)	4 (3 female juveniles and 1 male juvenile)
Ueno Zoological Gardens (Tokyo, Taito City)	1 (1 female juvenile)
Kamogawa Seaworld (Chiba, Kamogawa City)	1 (1 male juvenile)
Yokohama Hakkeijima Seaparadise (Kanagawa, Yokohama City)	3 (3 female juveniles)
Total	10 (8 female and 2 male juveniles)

(2) Communicating information both inside and outside of the Erimo area

○In a town meeting called “An evening for discussion of the future of the fishing industry and tourism” held in Erimo town in June of 2016, initiatives working to foster coexistence between the local communities and the Kuril harbor seals were explained to attendees, and there was time for discussion and exchanging of opinions.

○ Presentations were made regarding initiatives working to foster coexistence between the local communities and the Kuril harbor seals at events including an academic conference titled “Wildlife and Society,” (held in November of 2016), a meeting for the sharing of information and opinions regarding wildlife and the fishing industry (held in December 2016), and a public symposium titled “A discussion of the problems related

to the damage done to the fishing industry by Kuril harbor seals in the Erimo area," (held in February of 2017).

○ In order to disseminate accurate information abroad, the Management Plan and the FY 2016 Implementation Plan were translated into English and used on our homepage, etc.
http://hokkaido.env.go.jp/post_34.html

<Assessment of public awareness>

○ The transfer of seals to aquariums and zoos was reported in various outlets, which furthered public awareness outside of the Erimo area. In the future, it will be necessary to foster public awareness in collaboration with related organizations, including presentations held at facilities where seals are kept.

○The effort to gain the understanding of local residents was furthered through communicating information within the Erimo area. Further, communicating information outside of the area, including overseas, created opportunities information exchange with experts, and others. It is necessary to continue to find good opportunities for communicating information in the future.

FY 2017 Project Implementation Plan

1 Damage prevention measures

The following initiatives, based on results from various inspections and prevention measures which have been implemented in the past, will be implemented to establish new and improved methods for mitigating damage to the fishing industry. Furthermore, these methods will be implemented in collaboration with researchers and other related parties, and with adequate consideration of opinions from local fishermen; in addition to presenting the results of experimentation to the community at reporting and conference meetings, etc., advice and suggestions will be gathered for more effective damage prevention efforts, etc., and these will be reflected in the Implementation Plan for the following fiscal year.

(1) Improvement of fishing nets

Methods proven in previous tests to mitigate damage by blocking entrance into trap nets (such as the installation of rope grids) will be used to further improve nets that prevent damage. Regarding improvements to nets, the following experiments will be conducted with their goal being the establishment of procedures to mitigate the particularly severe damage done to trap nets.

○During the trap net fishing seasons in spring and autumn, experiments will be conducted on damage preventing trap nets through the installation of rope grids in trap nets, where damage is particularly severe in the Cape Erimo area.

○In light of previous studies conducted abroad which have suggested that only rope grids with opening widths of less than 18 cm are able to prevent entrance into nets by young individuals, as well as that color may have an effect on fishing efficiency (Suuronen et al. 2006), tests will be performed on rope grids with opening widths of less than 20 cm, as well as rope grids with openings colored golden-brown, etc. in order to reduce salmon avoidance behavior, with the goal of improving their damage prevention effects.

(2) Verification the effects of acoustic repellent equipment

Improved repellent equipment designed in 2016 will be installed in the vicinity of trap nets, and its repellent effects on Kuril harbor seals will be verified. Further, in addition to verifying the effects of the equipment, various improvements will be considered, such as determining how often sound waves should be emitted in order to prevent a loss of effectiveness due to Kuril harbor

seal learning, as well as equipment configurations that allow easier installation and management, etc.

2 Population management

The following initiatives will be implemented in order to perform population management aimed at both mitigating the damage done to the fishing industry and maintaining a sustainable Kuril harbor seal population level.

(1) Because damage prevention alone is not enough to avoid increases in the scope of the damage, capture of Kuril harbor seals will be carried out in cooperation with members of the fishing industry, with the aim of mitigating the damage done to the fishing industry (preventing increases in the scope of the damage, reducing the severe damage done to trap nets, etc.), while also preserving the sustainability of the seal population. Furthermore, because it has been made clear in the research performed to date that it is not only the easily bycaught juvenile seals, but particular subadults and adults that cause damage in salmon trap nets, the following methods will be employed, aimed at establishing techniques to selectively capture subadult and adult individuals that persistently attack trap nets, and to avoid juvenile bycatch.

○In trap nets where damage is particularly severe, seals will be captured over a period of approximately one month during both the spring and autumn fishing seasons, using trap nets which may be capable of selectively capturing individuals that come into or near to the trap nets (trap nets with 25 cm × 25 cm rope grids, timer-operated shutter devices, etc. installed at the entrance to the bag net)

○Individuals hauling out on rocky shore reefs in the Cape Erimo area will be captured using gillnets (nets will be raised immediately after any Kuril harbor seal is caught) primarily during trap net fishing seasons.

○In the event that an extreme imbalance appears in the sex, age, etc. of captured individuals, or in the event that it becomes clear that the below-mentioned maximum number of individuals to be captured will not be reached, other capture methods (including the use of firearms) will be considered as necessity dictates in light of the seal capture situation.

○In order to be able to selectively capture individuals that are causing damage, methods for distinguishing individuals that persistently attack trap nets (such as checking iron rust buildup) will be considered.

○More effective yet still feasible capture methods will be considered through exchanging ideas with members of the fishing industry, other experts, and so on.

(2) Regarding capture, the maximum number of individuals to be captured will be determined based on the following considerations.

<Current habitat situation>

In recent years, the largest number of individual Kuril harbor seals hauling out in the Erimo area has been on a growing trend, rising from 400 individuals to around 600 individuals. The estimated population size, taken from the largest number of individuals hauling out corrected using the haul-out frequency and discovery rate, is approximately 1000 individuals. Further, the average population growth rate over the past 30 years has been 5% (Matsuda et al. 2015).

<Considerations essential for determining the maximum number of individuals to be captured>

○Examinations will be conducted over the course of three years from 2016 to 2018, and the maximum number of individuals to be captured will be determined.

○The following will be considered when determining the maximum number of individuals to be captured: mitigating damage to the fishing industry, while also guaranteeing population sustainability such that the Kuril harbor seal does not once again become threatened, and keeping the probability of extinction within the next 100 years to under 10%, all with continuing management beyond 2019 as a necessary condition.

○In light of the reality that the Kuril harbor seal was only recently reassessed from the status of Threatened to Near Threatened, that the Erimo population is highly occlusive, and that there are a number of uncertain elements in the estimates of population size, population structure, and ecology, it is necessary to sufficiently account for the safe sustainability of the population.

○The maximum number of individuals to be captured must be adjusted freely to fit the number of bycaught individuals and imbalances in sex and age among captured individuals (for example, in cases when a high number

of adult females, who strongly influence population trends, have been captured, or in cases when the number of juvenile bycatch deaths has decreased).

<Determining the maximum number of individuals to be captured>

○In the current resource management simulation, which takes the number of bycaught individuals, outbreaks of infectious disease, etc., into account, the probability of extinction within the next 100 years is nearly 0% if the population in 2018 is managed at a level that is 80% of the population at the time the Management Plan was established (March 2016), and if this level is maintained from 2019 onward (Kitakado 2006).

○Therefore, the Ministry of the Environment will determine the maximum number of individuals to be caught such that the population in 2018 will come down to about 80% of the population at the time the Management Plan was established; through estimation of population dynamics taking into account the number of individuals captured and bycaught in 2016, as well as the population growth rate, etc., it has been determined that approximately 140 seals (excluding the number of bycaught individuals) are to be captured in 2017.

○Because there have been few successful captures made to date, and there is very little data showing the effectiveness of damage reduction through seal capture, The Ministry of the Environment aims to use this as an opportunity to work toward establishing seal capture techniques, as well as to gather the information necessary to establish monitoring procedures in order to gain a grasp of the effects of capture on the Kuril harbor seal population and of the effectiveness of damage reduction through seal capture.

Table 4. Results of reassessment of numbers of individuals captured

Captured in 2016	Captured in 2017-2018	Captured in 2019 and beyond	P2019/2016	Min(P/K)
45	100	25	0.871(0.822)	0.408(0.355)
45	120	25	0.826(0.786)	0.401(0.334)

45	130	25	0.817(0.766)	0.396(0.325)
45	140	25	0.801(0.749)	0.392(0.323)
45	150	25	0.782(0.728)	0.385(0.304)

・Numbers in parentheses are values for the lowest 5%

・Individuals to be culled will be selected in accordance with the population age ratio, including individuals in their first year of life.

・Individuals in their first year of life make up approximately ⅔, and individuals aged 1 & 2 make up approximately ⅓ of bycaught individuals.

<Adjustments and changes to the maximum number of individuals to be captured, etc., and procedures for determining the number in future years>

○The number of individuals to be captured in 2018 will be determined flexibly in a manner that takes into account the actual capture results and monitoring results from 2017.

○The maximum number of individuals to be captured each year will be reexamined after hearing the opinion of the Science Committee.

○In the event that the number of individuals captured in a single year is too low or too high, adjustments will be made in the number of individuals to be captured in the following year.

○From the point of view of adaptive management, the information necessary for reexamining the plan will be gathered, a sustainability assessment performed, and each year from next year onward, a new Implementation Plan will be established and the maximum number of individuals to be captured will be determined.

○During the three-year Management Plan period, a formula for doing management that fits the population's situation will be developed, including a system for incorporating feedback from new data.

(3) The following other considerations will be made regarding population management.

○In the event that sudden changes in population conditions due to an unforeseen circumstance, such as an epidemic outbreak, are discovered in the population, the maximum number of individuals to be captured may be freely reassessed even during a year in which capture is being conducted.

○To the fullest extent possible, the Ministry of the Environment will effectively put captured individuals to practical use, including use for research in order to gather data which will facilitate appropriate population management, and strategically raising individuals and transferring them to zoos and aquariums for educational and other purposes. Moreover, in cases when captured individuals are to be euthanized, a method will be employed which limits their suffering to the greatest extent possible.

3 Monitoring

Surveys covering the following items will be conducted in order to appropriately manage the Kuril harbor seals, verify project implementation effectiveness, and provide feedback about the population's situation to the Management Plan. Moreover, as a part of adaptive management, survey items may be added as necessity dictates.

(1) Population size and structure

○Accurate haul-out numbers will be surveyed by performing counts of the number of individuals hauling out using visual observation from on land and images captured by unmanned aerial vehicle (UAV). The omission rate will be calculated from the counts obtained by UAV and visual observation, and attempts will be made to improve the accuracy of these measurements.

○Images captured by UAV will be analyzed (measurements of body length, girth, etc.) and all efforts will be made to ascertain the structure of the population.

(2) Survey of damage done to the fishing industry and of the effectiveness of damage prevention measures

○In addition to requesting members of the fishing industry to record the damage situation (number of fish damaged, number of individuals bycaught) on each fishing day, information from shipboard surveys, etc. will be gathered, and the degree and extent of the damage will be

ascertained. Multiple indices will be used in the assessment of the damage situation, including the damage-to-catch ratio, total catch size, total catch value, and others.

○Surveys will be conducted on the stomach contents of bycaught and captured individuals, and of the general situation of salmon predation by seals.

○The effectiveness of damage preventing nets will be verified through surveys of seal behavior and the situation of salmon entering the nets, using underwater cameras installed at trap nets, and through gathering information about the installation times and duration of installation of rope grids in trap nets.

○Surveys will be conducted on the damage situation in the local fishing industry other than damage done to salmon trap nets, using means such as interviews.

(3) Population trends

○Ecological data which is necessary in order to ascertain population trends (body length, body weight, age, sex, blubber thickness, breeding conditions, etc.) will be obtained from bycaught and captured individuals.

○Surveys will be performed on Kuril harbor seal range, etc., using EM transmitter tags.

○The Ministry of the Environment will continue to collect specimens necessary for analysis of items such as infectious disease and the population's genetic diversity.

(4) Habitat

The Ministry of the Environment will gain the cooperation of members of the fishing industry, and consider how to build a system for collecting and analyzing information, which is necessary in order to gain a complete understanding of the coastal ecosystem.

(5) Assessment of sustainability

Population conditions will be assessed based on quantitative analysis of the results of monitoring.

Literature Cited

- Kitakado, T. 2016. FY 2015 Research Commissioned by the Ministry of the Environment "Estimation of Population Dynamics of the Erimo Kuril Harbor Seal Population" Report 20-26. (in Japanese)

- Kobayashi, Y., T. Kariya, J. Chishima, K. Fujii, K. Wada, S. Baba, T. Itoo, T. Nakaoka, M. Kawashima, S. Saito, N. Aoki, S. Hayama, Y. Osa, H. Osada, A. Niizuma, M. Suzuki, Y. Uekane, K. Hayashi, M. Kobayashi, N. Ohtaishi. and Y. Sakurai. 2014. Population trends of the Kuril harbour seal *Phoca vitulina stejnegeri* from 1974 to 2010 in southeastern Hokkaido, Japan. Endangered Species Research 24(1): 61-72.

- Matsuda, H., O. Yamamura, T. Kitakado, Y. Kobayashi, M. Kobayashi, K. Hattori, and H. Kato. 2015. Beyond dichotomy in the protection and management of marine mammals in Japan. THERYA 6(2):283-296.

- Murata, M., K. Kashiwaya, M. Kobayashi, T. Sakoi, Y. Taya, S. Takahashi, Y. Hagihara, T. Nakamura, H. Takai, Y. Kuramoto. 2016. Experimental study on technologies of evasion of marine animals. Report of the Hokkaido Industrial Technology Center 14: 25-30 (in Japanese)

- Suuronen, P., A. Siira, T. Kauppinen, R. Riikonen, E. Lehtonen, H. Harjunpää. 2006. Reduction of seal-induced catch and gear damage by modification of trap-net design: Design principles for a seal-safe trap-net. Fisheries Research 79(1–2): 129-138.