Ministry of the Environment Erimo Area Kuril Harbor Seal Management Project Implementation Plan, FY 2019

August 2019
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 in 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 2019 Project Implementation Plan shall be defined as given below, taking into account the results of the projects implemented from 2016 to 2018.

FY 2018 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 salmon trap nets, and in order to block entrance by Kuril harbor seals into salmon trap nets, the Ministry of the Environment installed rope grids (spring season: 20 cm × 20 cm (made of Dyneema®), autumn season: 18 cm × 18 cm (made of Dyneema®), 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. In addition to the conventionally used horizontal rope grids, rope grids angled at 45 degrees from the horizontal were also used, which are thought to more easily allow Salmoniformes to enter.

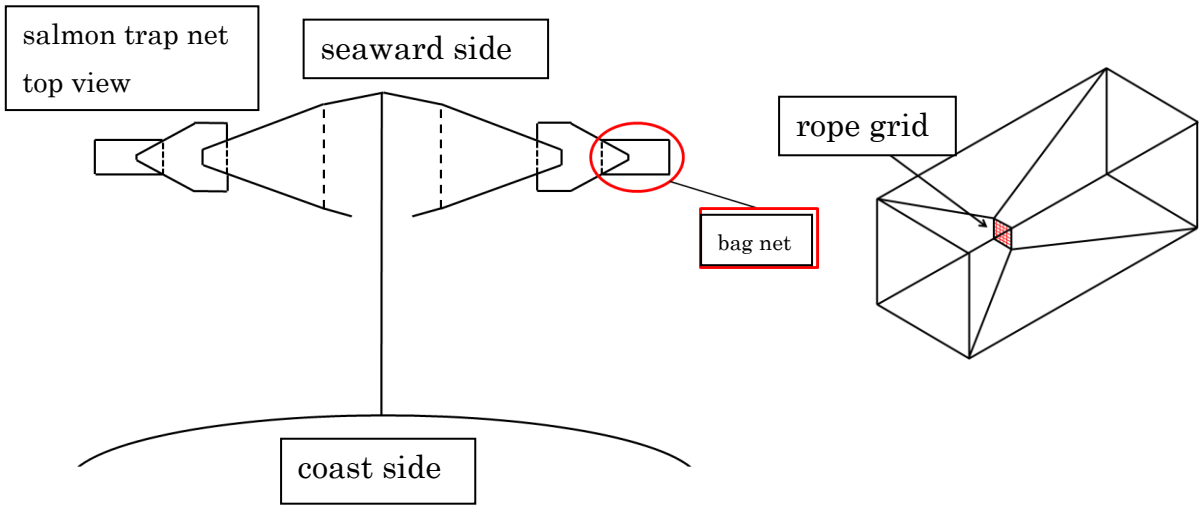
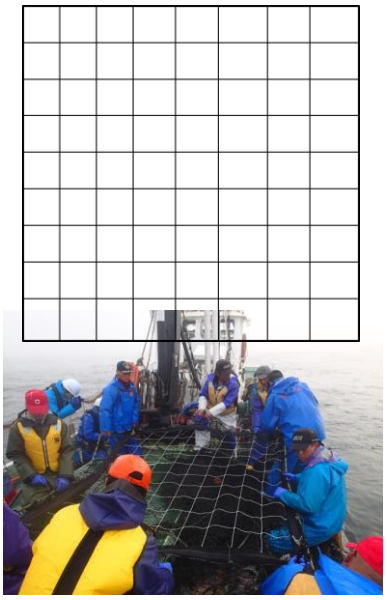


Figure 1. Rope Grid Installation

(slits: when sized at 20 cm × 20 cm)



Angled (slits: 16 – 20 cm × 16 – 20 cm)　　Horizontal (slits: 16 – 20 cm × 16 – 20 cm)

Figure 2. Angled Rope Grids (left) and Conventional Horizontal Rope Grids (right)

Table 1. Rope Grid Types and Installation Periods

Salmon 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 (angled)	5/9 - 6/27
Autumn	Toyo	1	20 cm × 20 cm (angled)	9/1 – 11/20
	Cape Erimo	3	20 cm × 20 cm, 18 cm × 18 cm, 16 cm × 16 cm (mainly angled, with some horizontal grids used)	2 nets: 9/1 – 11/20 1 net: 9/7 – 11/17
	Shoya	2	18 cm × 18 cm (angled)	1 net: 9/14 – 9/29, 10/22 – 11/20 1 net: 9/7 – 11/20

<Results of monitoring of the improvement of fishing nets>

① Spring Season (Testing Conducted in Toyo Sector)

Damage prevention through the installation of damage preventing nets in the spring 2018 season was carried out in Toyo sector (Cape Erimo west side), which was the same sector as in the spring 2016 and spring 2017 seasons, in one salmon trap net (seaward side). The configuration of the damage preventing nets was 20 cm × 20 cm, as had previously been confirmed to reduce damage, however, in addition to the conventionally used horizontal rope grids, rope grids angled at 45 degrees from the horizontal were also used, which are thought to more easily allow Salmoniformes to enter.
Further, regarding the material used, Vectran™ (golden brown) was used in 2017 in order to reduce the effect of salmon avoidance behavior caused by color. However, the fishermen were unable to notice any difference, and so the stronger Dyneema® (white) material was used in 2018 as it had been previously.

Throughout the whole period, the damage-to-catch ratio was kept low. (Fig. 3)

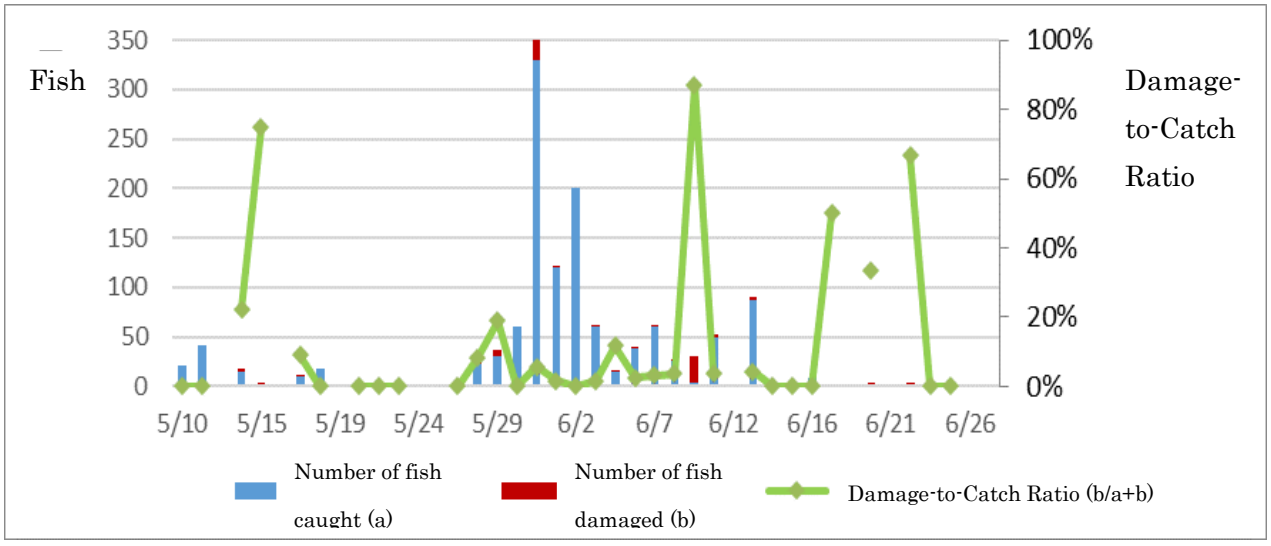


Figure 3. Damage Preventing Net Installation and Damage Conditions by Day
(Toyo Sector Seaward Side)
(Throughout the whole period: 20 cm × 20 cm, angled)

② Autumn Season (Cape Erimo Sector)

Damage prevention through the installation of damage preventing nets in the autumn season was carried out in Cape Erimo sector, which was the same sector as in the 2016 and 2017 autumn seasons, in one salmon trap net. Regarding the sizes of the slits (rope grids) at bag net entrances, horizontal slits sized 20 cm × 20 cm, 18 cm × 18 cm, and 16 cm × 16 cm (Dyneema®), which showed a certain degree of damage prevention effects last year, were used in some areas, the angled slits which were found to be effective in the spring season of this year were primarily used. The total catch size and damage-to-catch ratio were investigated with each type of slit installed.

The results of this investigation showed damage concentrated in the nets on the southern seaward side, with damage kept low in the other nets (Figures 4 – 6). Moreover, in the nets on the southern seaward side in which the damage was large, residual parts of damaged salmon were found on the tops of the bag nets with slits installed, making it conceivable that salmon are at times attacked by seals in the heart rather than inside the bag nets with slits installed. Based on the results of previous experiments, it is considered that while they do not completely prevent damage, 18 cm × 18 cm grids with angled slits are relatively effective at preventing damage, while still guaranteeing a favorable total salmon catch size.

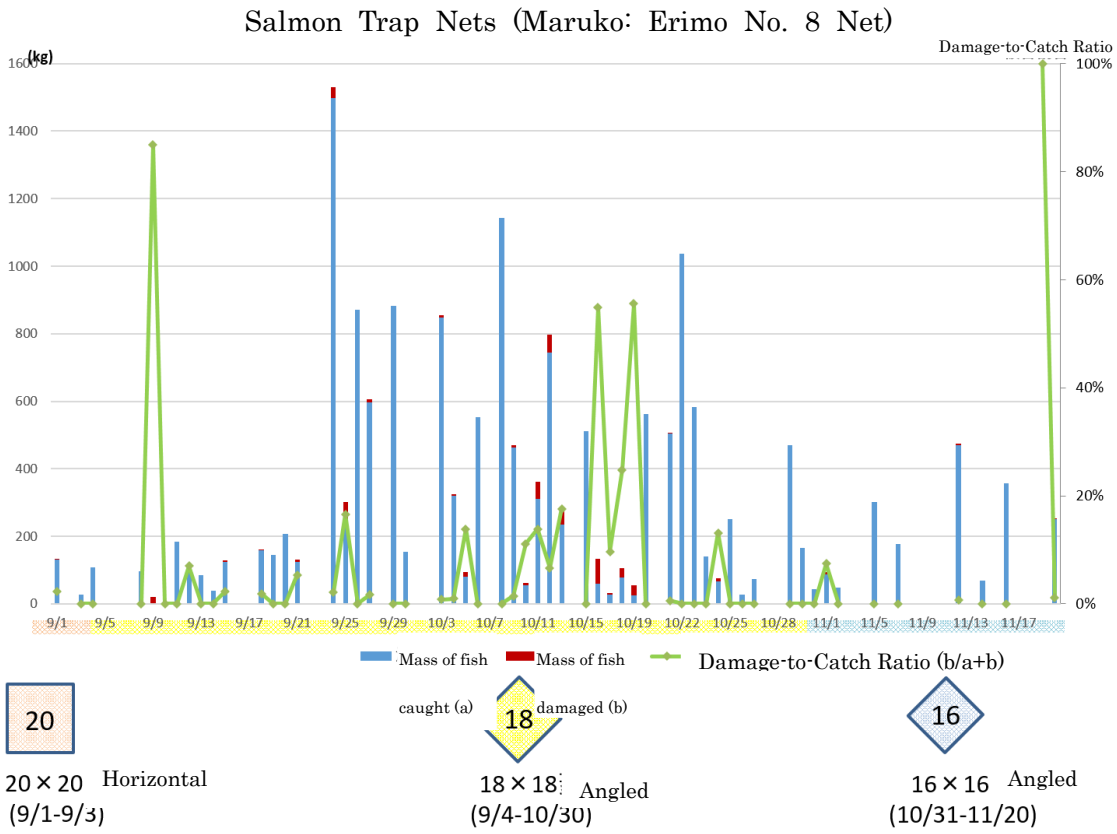


Figure 4. Damage Preventing Net Installation and Total Catch Size, Damage-to-Catch Ratio (Cape Erimo Sector, Net: Southern Land Side)

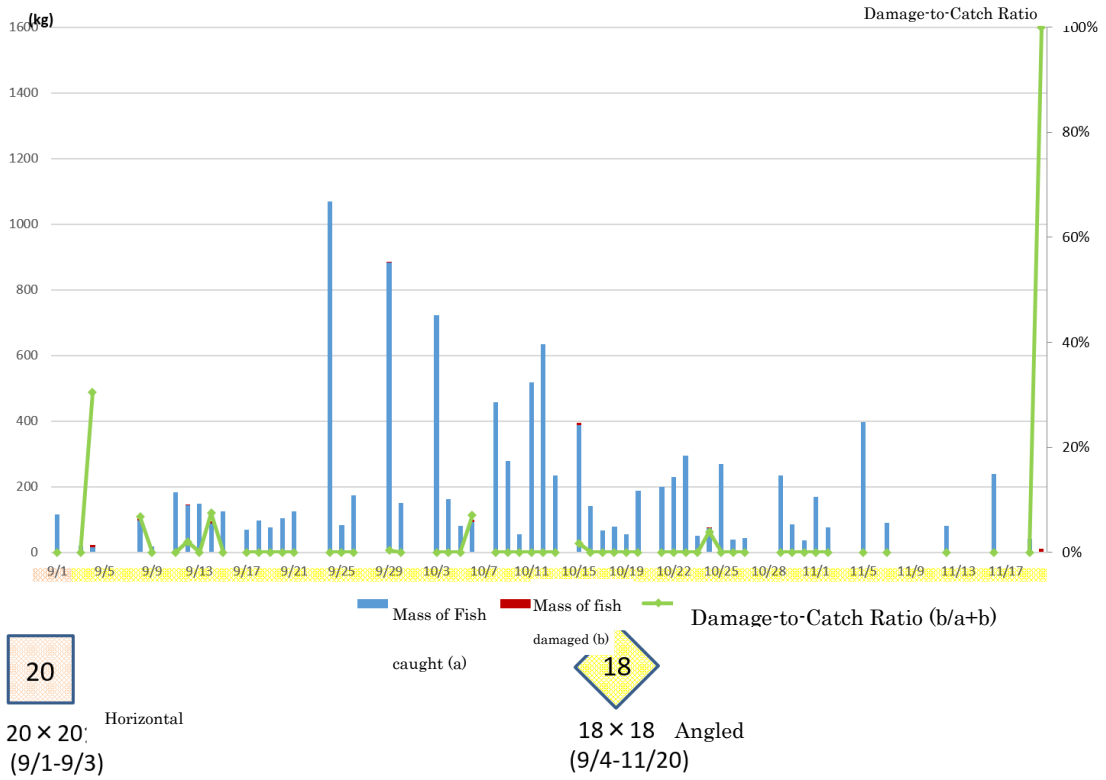


Figure 5. Damage Preventing Net Installation and Total Catch Size, Damage-to-Catch Ratio (Cape Erimo Sector, Net: Northern Land Side)

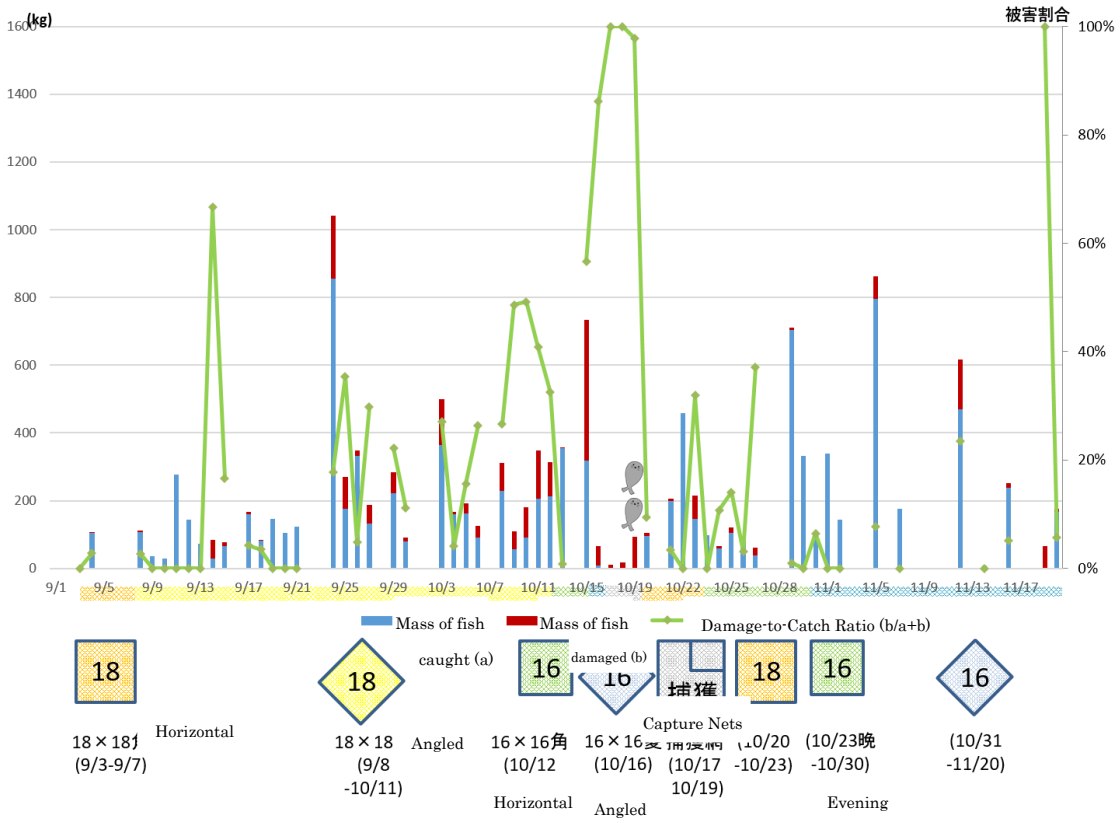


Figure 6. Damage Preventing Net Installation and Total Catch Size, Damage-to-Catch Ratio (Cape Erimo Sector, Net: Southern Seaward Side)

<Assessment of the improvement of fishing nets>

○In a manner consistent with previous results, the damage mitigation effects of installing rope grids in individual salmon 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 net areas is decreased, and it is reasonable to expect mitigation effects for undetected damage, such as salmon being carried out of nets.

○In 2018, rope grids were installed in one salmon trap net in one sector during the spring season, and in six trap nets in three sectors during the autumn season; this was an increase of one trap net compared to 2017, and there was an increase in the total number of days on which trap nets were installed. It is considered that this is the result of increasing expectations of damage reduction effects from rope grids by fishermen who are already using them. 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.

（２） Improvement of ultrasonic wave 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 (Murata et al. 2016), tests of this equipment installed on salmon trap nets, as well as examinations of Kuril harbor seal behavior were conducted using floating cages. Further, based on opinions of fishermen who used the equipment in 2017, improvements were made in the batteries and emission directions of the equipment (previous equipment: single direction → improved equipment: two directions on each side).

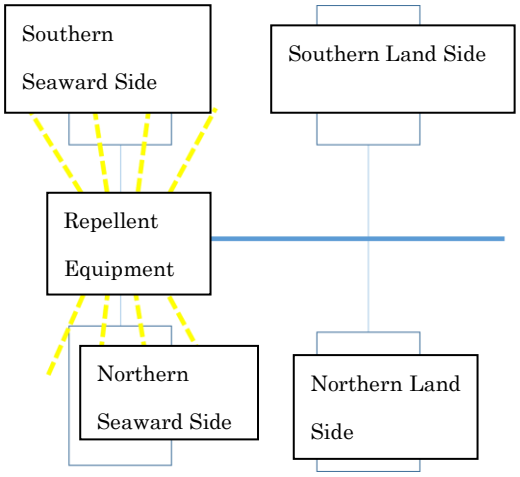
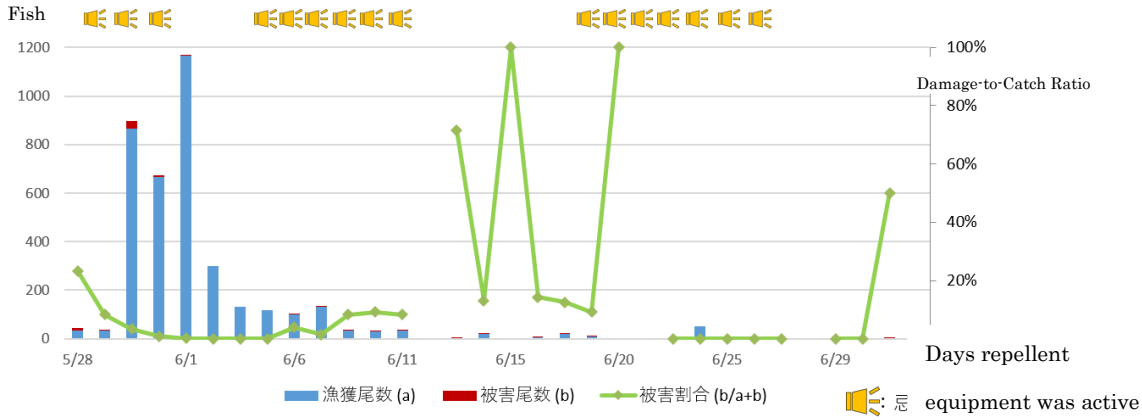


Illustration of Repellent Equipment Installation

Improved Repellent Equipment



Number of fish caught (a) Number of fish damaged (b) Damage-to-Catch ratio (b/a+b)

Figure 7. Installation of Repellent Equipment and Damage Conditions by Day (Spring Salmon Trap Nets)

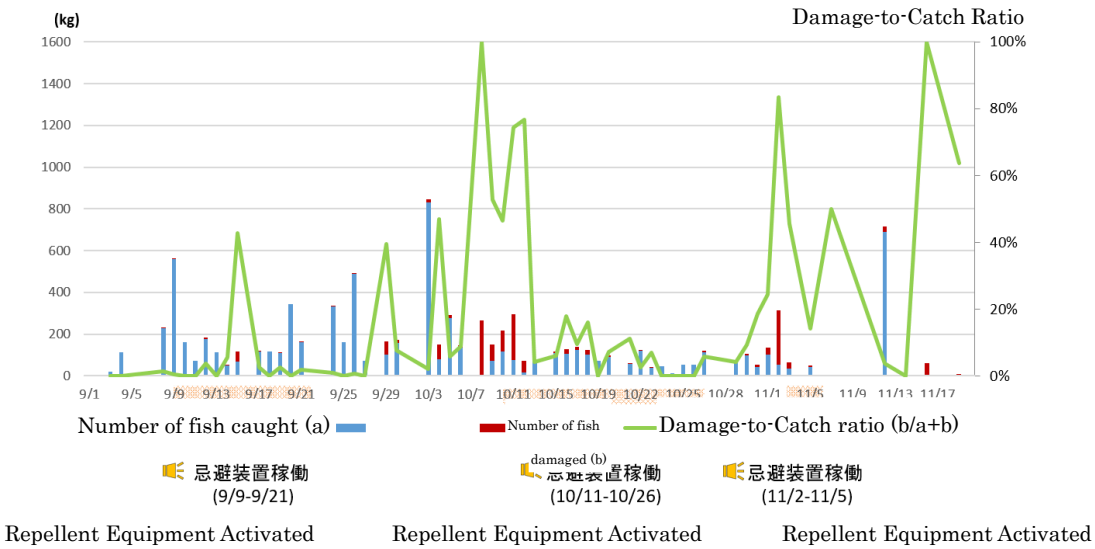


Figure 8. Installation of Repellent Equipment and Damage Conditions by Day (Autumn Salmon Trap Nets)

In the spring salmon trap nets (using repellent equipment alone) the damage-to-catch ratio was kept low (Fig. 7). In the autumn salmon trap nets (used along with damage preventing nets), during the period when repellent equipment was installed, while there was one day which showed a large damage-to-catch ratio (October 11th), the other days showed lower levels than the period when the equipment was not installed (Fig. 8).

Further, in tests conducted with floating cages, the repellent equipment was activated one hour per day for a period of twelve days, and seal behavior was recorded while the equipment was active and while it was inactive. Because no conspicuous changes in behavior were found in the results of these tests, it is considered that verification is necessary, focusing on assessment of the test results and tests with the equipment actually installed on salmon trap nets.

Table 2. Comparison between Current Specifications and Improved Basic Design Specifications

No.	Item	Prototype Specifications	Improved Basic Design Specifications
1	Structure（main unit and power supply）	separated	separated
2	Housing configuration	circular × 2 units	circular × 1 unit square × 1 unit
3	Housing rough dimensions	950 × 530 × 550 mm	1070 × 670 × 790 mm
4	Housing material	stainless steel	stainless steel
5	Weight-in-air	46.5 kg or less	71.7 kg or less（main unit）
6	Ultrasonic wave oscillator	600 W × 1	600 W × 2
7	Frequency of emission of ultrasonic waves	selectable (default: continuous)	selectable (default: continuous)
8	Ultrasonic wave intensity	adjustable (9 levels)	adjustable (9 levels)
9	Ultrasonic wave emission angle	linear 0 – 90° (from vertical to horizontal)	linear 0 – 90° (from vertical to horizontal))
10	Ultrasonic wave emission output switching	impossible	possible
11	Battery capacity*	3 days (default settings)	4 days (default settings)

*Battery capacity adjusted separately on the battery unit.

<Assessment of improvement of ultrasonic wave repellent equipment>

○Reductions in damage were found in tests of installation on salmon trap nets. Moving forward, in addition to making further improvements based on the opinions of fishermen, it is necessary to continue to verify

the effectiveness of the equipment through methods including tests of long-term installation with trap nets, which could not be conducted in this year due to unfavorable circumstances.

2 Population management

The Ministry of the Environment attempted to capture seals using salmon trap nets, gillnets, etc. 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. Further, 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 salmon trap nets

With the cooperation of salmon trap net fishermen in the Cape Erimo area, tunnel capture nets from which Kuril harbor seals cannot easily escape (Fig. 9) were deployed in the spring season for a total of 50 days between 9. May and 27. June, and a total of 17 days in the autumn season, between 3. September and 19. September. During the deployment periods, nets were raised 39 times and 11 times, respectively.

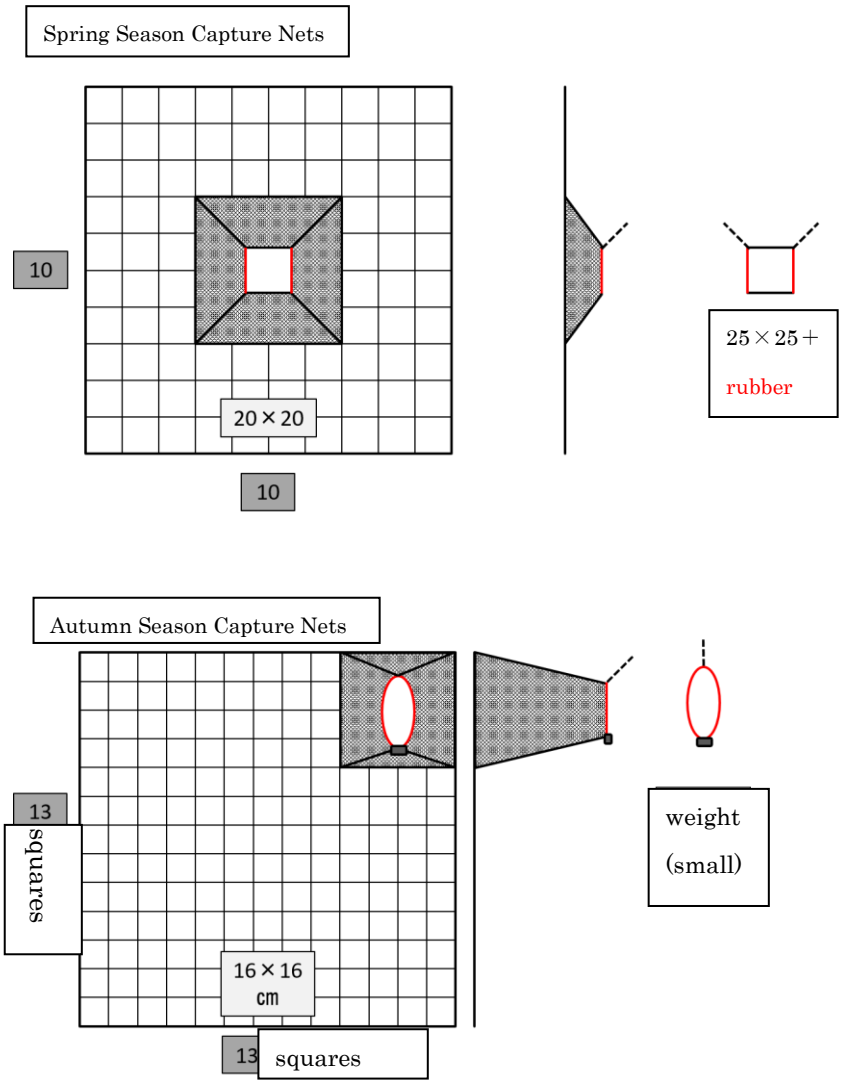


Figure 9. Structure of Tunnel Capture Nets Installed on Salmon Trap Nets (above: spring; below: autumn)

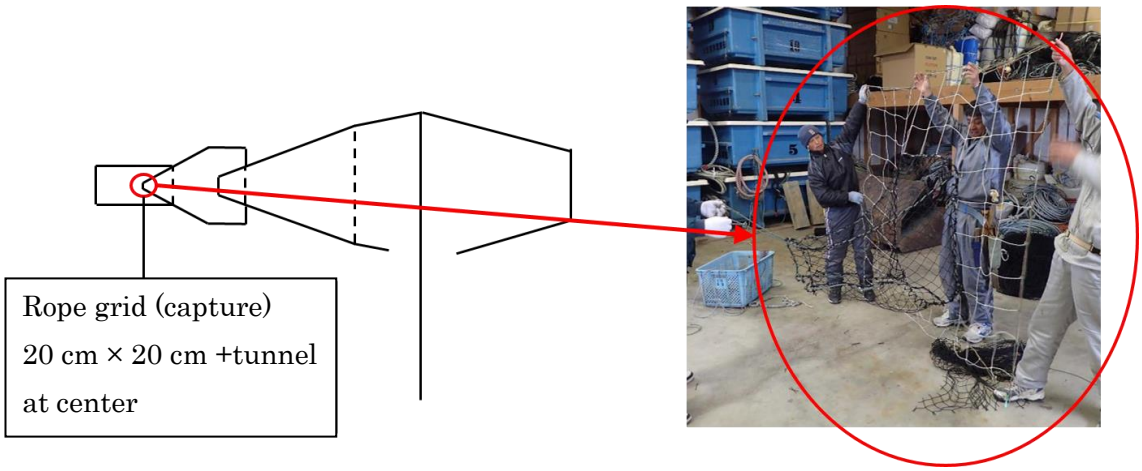


Figure 10. Structure of Tunnel Capture Nets Installed on Salmon Trap Nets

（２） Capture using gillnets

Capture of seals using gillnets was performed with the cooperation of members of the fishing industry near the rocky shore reefs of Cape Erimo on 5 days between 23. May and 26. June, 2018. (Approximately 3 hours were spent working at sea on each day of seal capture.)

（３） Capture as part of an academic investigation (test firing of firearms)

In order to investigate the possibility of using firearms for capture, as well as the effects on the Kuril harbor seals, etc., test firing by two marksmen using air guns was carried out in the presence of a veterinarian, near the rocky shore reefs of Cape Erimo on 22. February 2018. [Contents of FY 2017 implementation.]

（４） Capture results

Between May and November 2018, a total of 143 seals (not including 5 individuals which were fitted with EM transmitter tags/patches and released) were captured using salmon trap nets, gillnets, etc.

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), with immature individuals aged 2 to 4 years designated as subadults. Additionally, while individuals aged 1 year old or in their first year of life were designated as juveniles, this data was tabulated separately.

Table 3. Kuril Harbor Seal Capture Results by Capture Method

Capture method	Juveniles (<1 year)		Juveniles (1 year)		Subadults (2 to 4 years)		Adults (5+ years)		Total
	Male	Female	Male	Female	Male	Female	Male	Female	
Spring salmon trap nets (33 times)	0	0	0	0	0	0	0	3	3
Autumn salmon trap nets (24 times)	0	1	0	1	0	2	5	2	11
Subtotal	1		1		2		10		14
Gillnets (5 times)	63	59	0	4	0	0	0	3	129
Total	123		5		2		13		143

*Does not include 5 individuals which were fitted with EM transmitter tags/patches and released.

<Results of monitoring of population management>

①Population 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 295 individuals on 11. October.

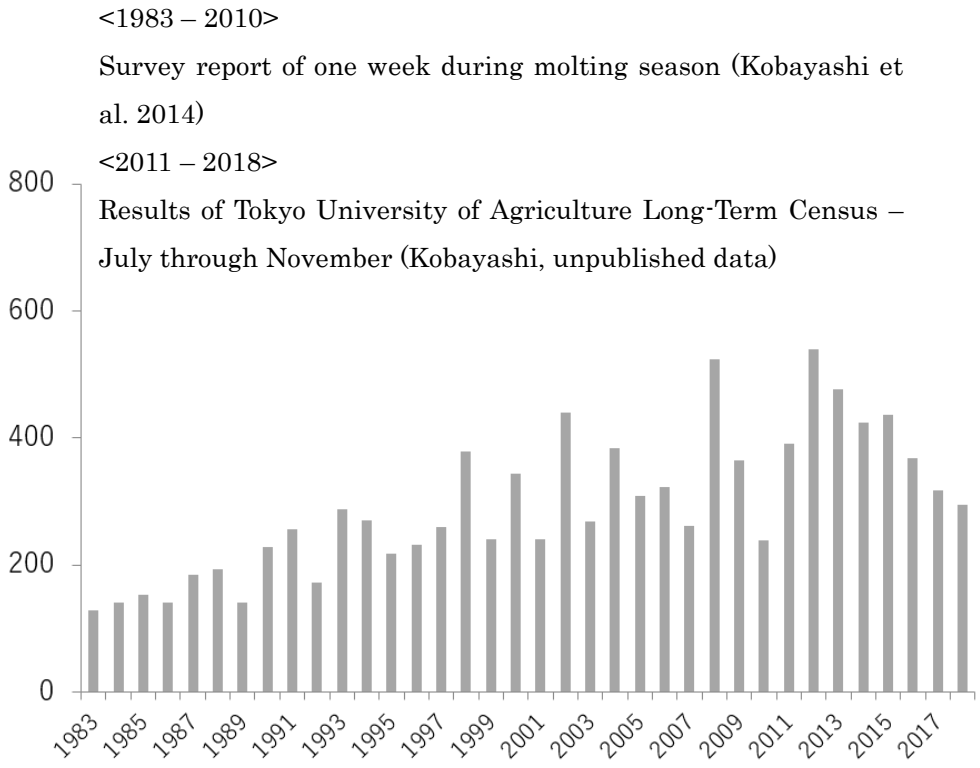


Figure 11. Largest Number of Kuril Harbor Seals Hauling out at Cape Erimo

○Images captured by UAV were used to generate orthographic images and ascertain differences in size of individuals at each rocky shore reef haul out site.

An index of relative importance was calculated from the ranking of the number of individuals using each haul out site and the number of days of use in all seasons, and by season, shown in graph form in Figure 12. In spring, Nishi, Natasha, Rosoku Right, and Kamaiso were commonly used; during molting season, Rosoku Left, Kamaiso, Poroiso, and Nagaiso were commonly used; in autumn, Rosoku Right, Nagaiso, and Natasha were commonly used. The haul out sites used in autumn were similar to those used during molting season, but those used in spring were quite different. Moreover, the haul out sites which were highly important throughout the whole period were Kamaiso, Natasha, and Rosoku Right.

Further, the differences in usage organized by season and rocky shore reef for each growth stage are shown in Figure 13. Adults in spring mainly used Shinobi; during molting season and autumn, many individuals hauling out were spotted at Tokkari and Kanbaraiso in addition to Shinobi. Investigation into whether there were differences in the individuals using each rocky shore reef in all seasons, or whether there were differences in the individuals using each rocky shore reef in each individual season, showed that there are differences in all seasons. That is, different tendencies were shown in the individuals using each rocky shore reef.

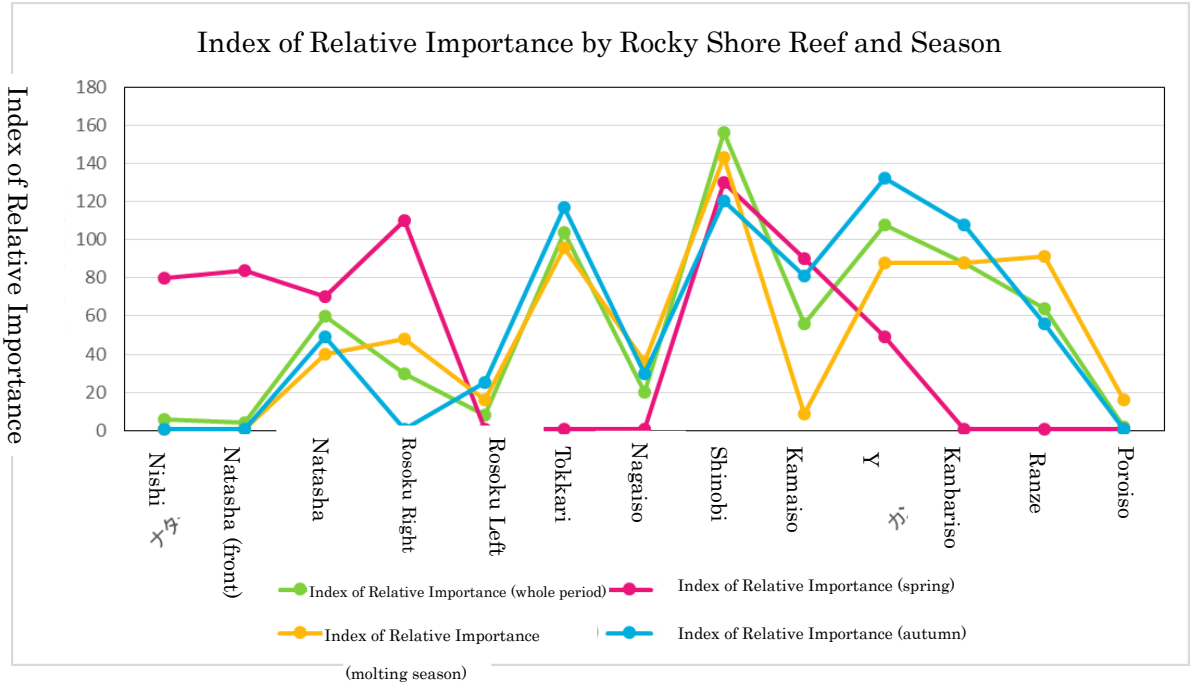


Figure 12. Index of Relative Importance by Rocky Shore Reef and Season

*Smaller values indicate greater importance.

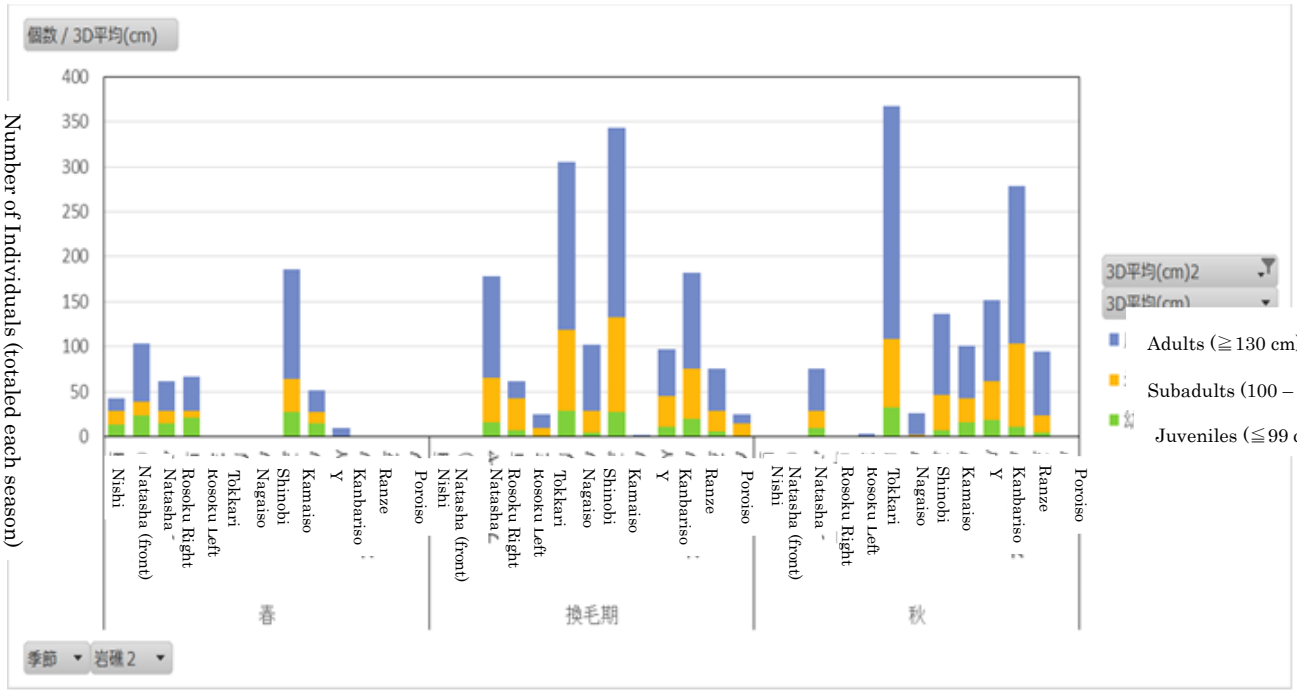


Figure 13. Differences in Use for Each Growth Stage by Rocky Shore Reef Haul Out Site in Each Season

②Population 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 larger number of juveniles (<1 year old) among both captured and bycaught individuals. Further, there was a higher number of females among those individuals not <1 year old. (Fig. 14).

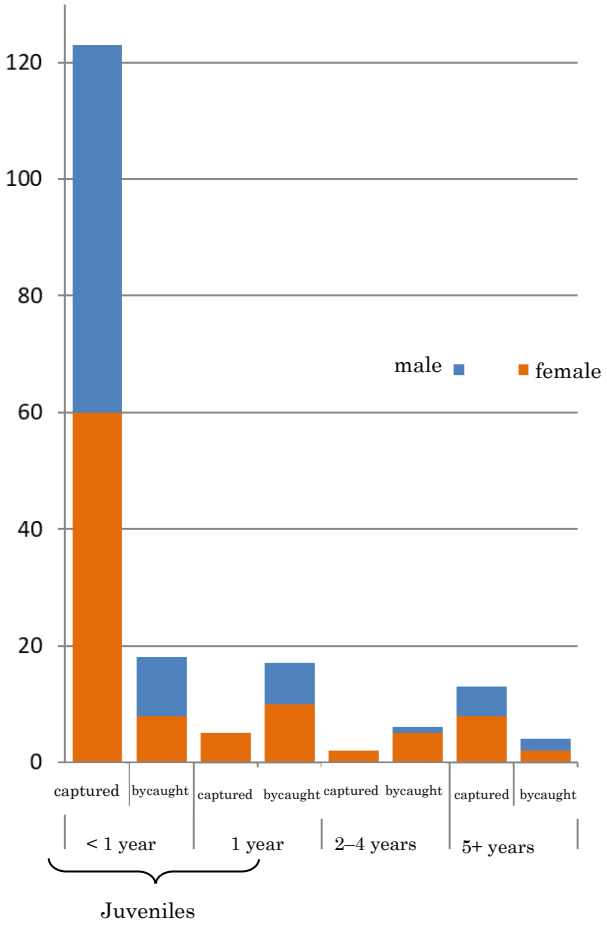


Figure 14. Estimated Age and Sex of Captured and Bycaught Individuals in 2018.

○Individuals were fitted with EM transmitters, and a survey of area of activity, etc. was conducted.

Two individuals were fitted with EM transmitters, and a survey of area of activity was conducted. The first individual was EZ180917-3, a male, with an estimated weight of 45 kg, determined to be a juvenile, fitted with Spot6, and released on 18. September, 2018. The second individual was EZ180917-1, a male, with an estimated weight of 80 kg, determined to be an adult, fitted with MK-10, and released on 18. September, 2018. Signals from the first individual were only received a few times, but the second individual was tracked for 95 days. The activity of the second individual is shown in Figure 15.

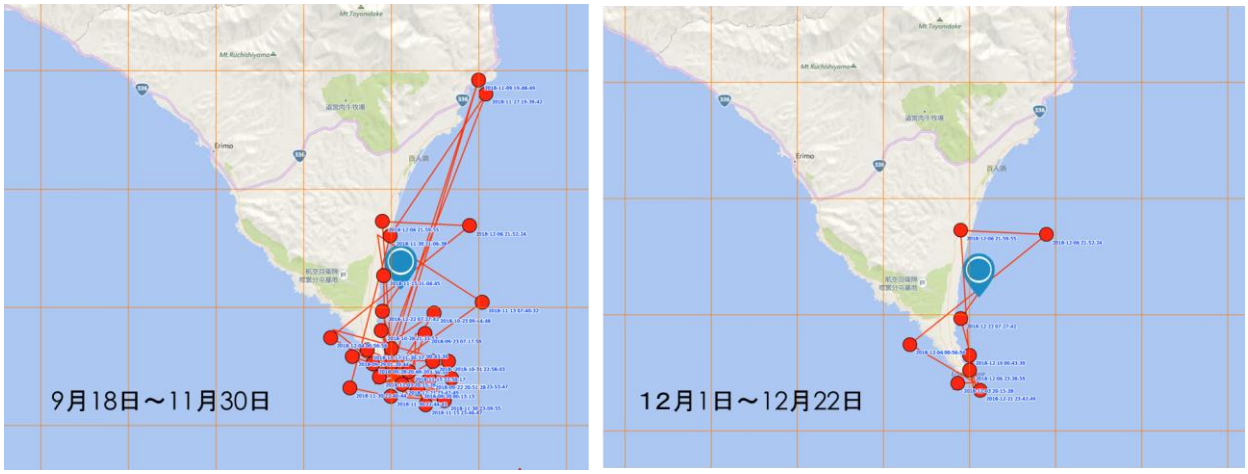


Figure 15. Analysis of the Activity of a Male Adult

③ Survey of stomach contents of captured and bycaught individuals

A combined rank index (CRI) was developed on analysis of stomach contents, shown separately for captured individuals and bycaught individuals (Fig. 16, Fig. 17).

The results show that the bycaught individuals depend on a wider variety of prey organisms; among captured individuals, the most important prey were *Eleginus gracilis*, *octopodidae*, salmon, etc. while among bycaught individuals, the most important prey were *Eleginus gracilis*, *Hypomesus japonicus*, *octopodidae*, etc. with salmon as the ninth highest in importance. Analyzing only the individuals which had eaten salmon, all individuals were in salmon trap nets, and all were 50 kg or over (Table 4).

Combined Rank Index among Captured Individuals at Erimo, 2018.

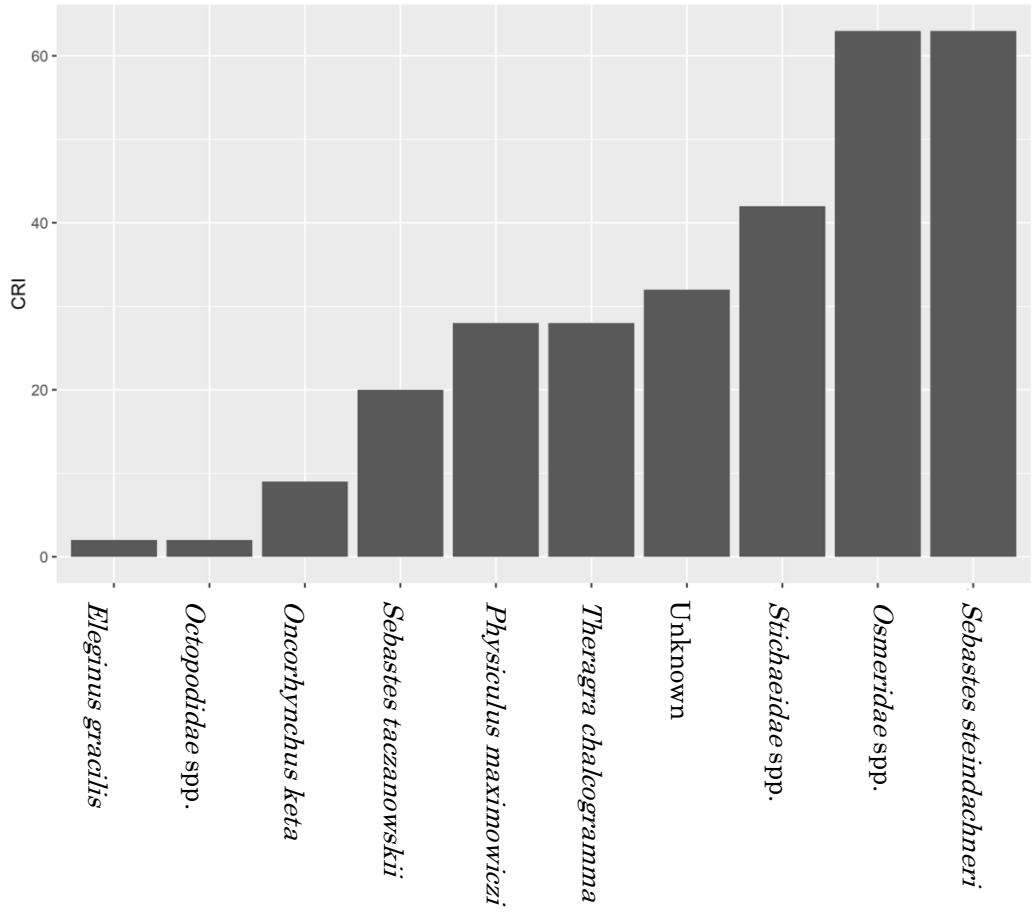


Figure 16. Combined Rank Index among Captured Individuals at Erimo, 2018.

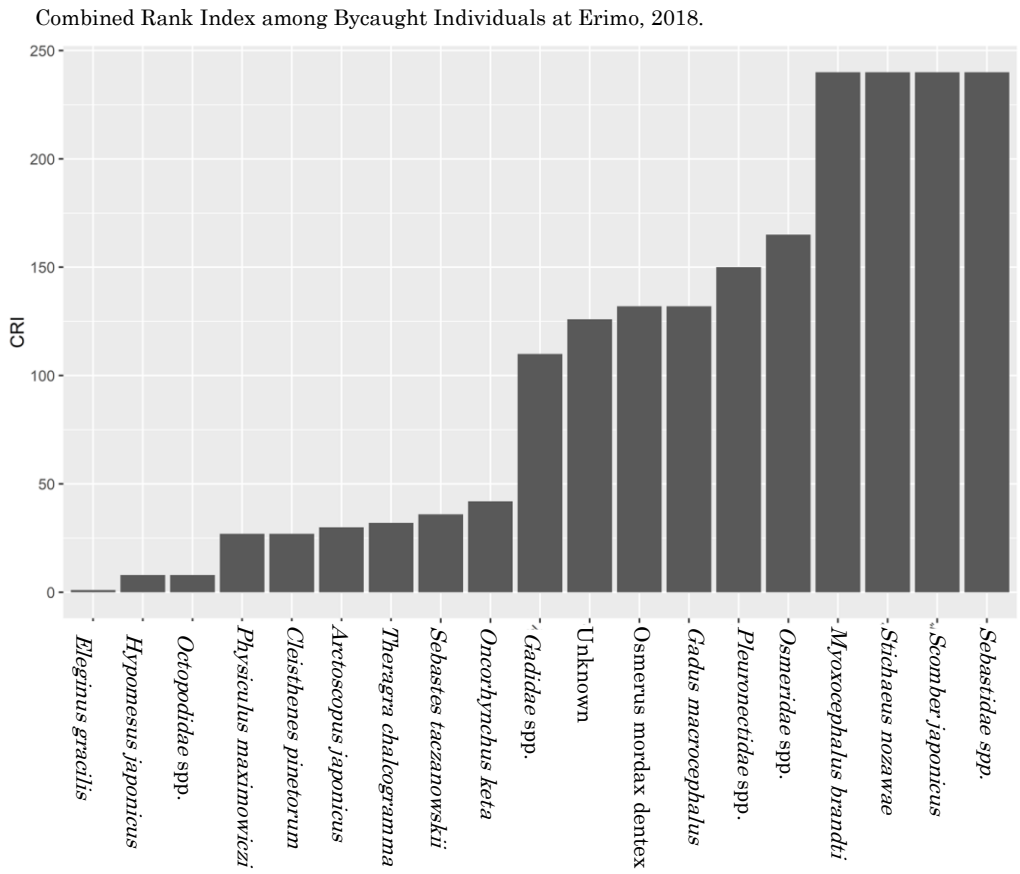


Figure 17. Combined Rank Index among Bycaught Individuals at Erimo, 2018.

Table 4. Summary of Individuals with Salmon Found in Stomach

Individual Number	Date of Death	Sex	Weight	Growth Stage	Manner of Death	
EZ1897	6/14	F	107	Adult	Capture	Salmon Capture Net
EZ18144	9/3	F	72	Adult	Bycatch	Salmon Capture Net
EZ18149	9/4	F	53	Subadult	Bycatch	Salmon Capture Net
EZ18157	9/8	F	51	Subadult	Capture	Salmon

						Capture Net
EZ18163	9/9	M	138	Adult	Capture	Salmon Capture Net
EZ18183	9/29	F	51	Subadult	Bycatch	Salmon Capture Net
EZ18186	11/1	M	168	Adult	Bycatch	Salmon Capture Net

<Assessment of population management>

①Capture results

○ The number of individuals captured was 143, which was close to the predetermined goal of 140 for 2018. Similar to 2017, the number of individuals captured in salmon trap nets was relatively low, but many larger individuals were captured, conversely, while the number of individuals captured in gillnets was high, many smaller individuals were captured. In the future, it will be necessary to make improvements in capture methods using trap nets, as well as to capture seals without an imbalance in growth stage, taking advantage of both trap nets and gillnets. Further, caution is needed in order to avoid reductions in capture efficiency due to seal learning.

②Population size, trends, etc.

○Since 2012, a declining trend has been seen in the number of individuals hauling out. However, because the results of population surveys of wild animals vary greatly from year to year, it is difficult to assess increases or decreases in population from the results of surveys conducted in only a few years. Further, the frequency of the surveys, 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.

○It is necessary to accumulate continuous data about population structure, genetic diversity, infectious disease, etc. Further, regarding home ranges, in addition to working toward the accumulation of information from long-term continuous surveys and information about subadult and adult individuals, which are currently insufficient, it is necessary to conduct monitoring and fully understand any variation in seal activity accompanying population management.

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. Compared to 2017, which had a record poor catch, and 2016, the total catch size recovered in 2018. However, compared to that in and before 2015, the damage-to-catch ratio was near to the same standard (Fig. 18).

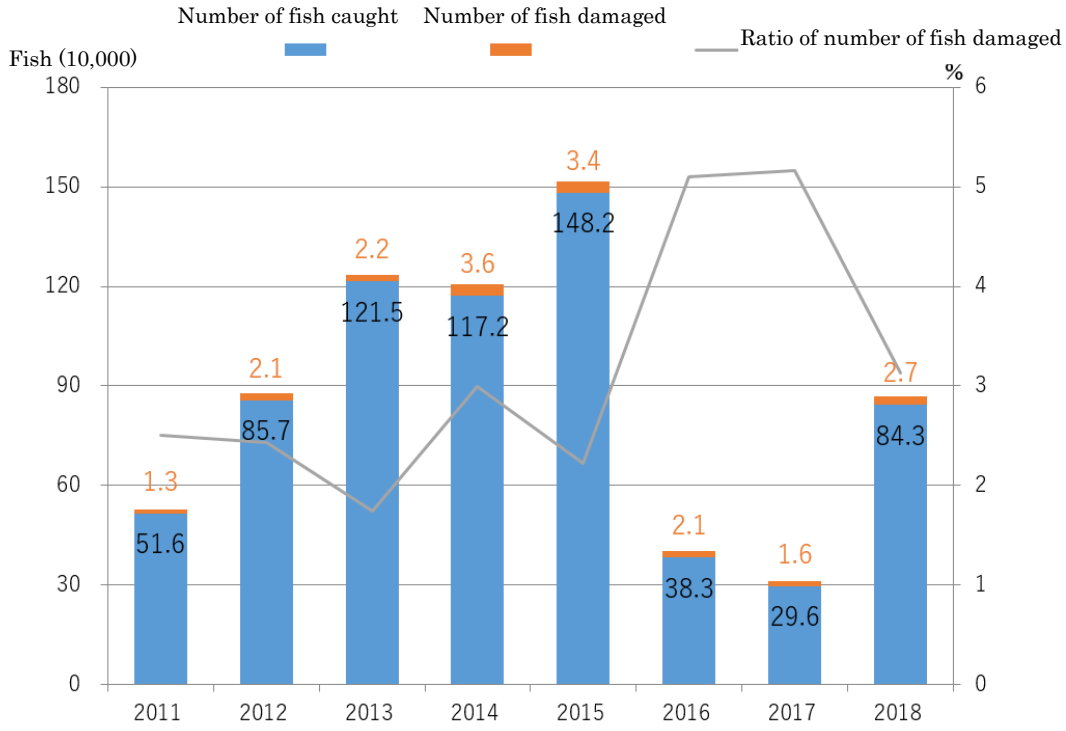


Figure 18. Changes in Damage-to-Catch Ratio in All Areas of Erimo

○Comparison of the damage situation in each sector showed that the Toyo, Cape Erimo, and Shoya areas, which have had high damage-to-catch ratios until now, continue to tend to have high damage-to-catch ratios, while the amount of damage was lower than in 2015 and earlier in the Toyo and Erimo areas, in which damage preventing nets have been installed long-term in salmon trap nets. (Page 20, Fig. 19).

○The Ministry of the Environment conducted field studies of the damage

done to the longline octopus fishing industry using boats.

<Assessment of the damage done to the fishing industry>

○Compared to 2017 and 2016, during which the overall catch was extremely poor, the catch improved, reaching approximately the same level as 2012. However, the damage-to-catch ratio was approximately the same level as in and before 2015, and the current situation does not merit an assertion that the damage done to the fishing industry is on a declining trend. For this reason, it is necessary to continue to perform monitoring while adopting damage prevention measures in the future.

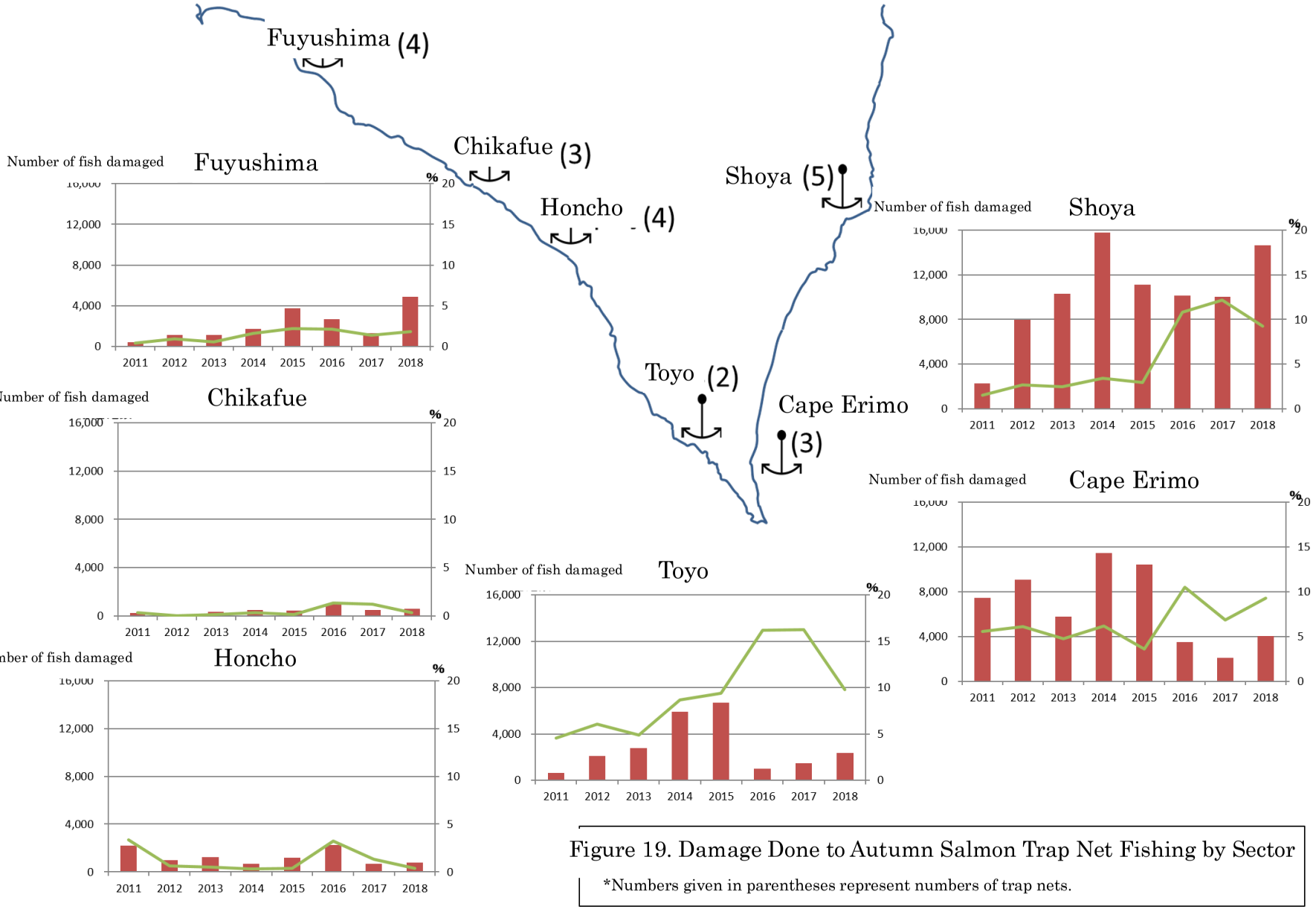


Figure 19. Damage Done to Autumn Salmon Trap Net Fishing by Sector

*Numbers given in parentheses represent numbers of trap nets.

4　Public awareness

（1）Transferring seals to aquariums and zoos

○In 2018, no seals were transferred, due to a lack of requests.

Table 5. Kuril Harbor Seals Transferred to Date

	Institution Name	Number of individuals transferred
2016	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)
2017	Yokohama Hakkeijima Seaparadise (Kanagawa, Yokohama City)	2 (1 female juvenile and 1 male juvenile)
2018	None	0
Total transferred to date		12 (9 female and 3 male juveniles)

*Additionally, a weakened individual (1 male juvenile) that washed ashore in Erimo Town in 2016 was transferred to Ouchiyama Zoo (Taiki Town, Mie Prefecture) in November 2017.

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

○At the Otaru Aquarium 60th Anniversary Special Exhibit “Animals of the Northern Seas,” the Kuril harbor seal management and damage prevention project in the Erimo area was introduced in a poster

exhibition (with collaboration on field investigations, etc. related to the exhibition).

○In partnership with the Erimo Town Board of Education, as a part of the regional curriculum, a guest lecturer visited Erimo Town Toyo Elementary School to speak about topics including measures to prevent damage to the fishing industry caused by Kuril harbor seals (December 2018).

○A lecture on coexistence between Kuril harbor seals and fishermen in the Erimo area was conducted as regional training for the Hokkai-Gakuen University Faculty of Economics (September 2018).

○ At the first Natural Environment Coexistence Technology Workshop, a report was given about the Kuril harbor seal management and damage prevention project (August 2018).

○In order to disseminate accurate information abroad, the FY 2018 Implementation Plan was translated into English and used on our homepage, etc. http://hokkaido.env.go.jp/post_34.html

<Assessment of public awareness>

○Regarding transfer to aquariums and zoos, because of systematic difficulties including the number of individuals which can be accepted, etc., by receiving institutions, as well as the conditions of transferred individuals, it is considered that transfer of a large number of individuals will not be easy; however, in the future it is necessary to spread public awareness in partnership with related organizations, including exhibitions, etc. at facilities where seals are kept, such as was held at Otaru Aquarium this year.

○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, created opportunities information exchange with experts and others. It is necessary to continue to find good opportunities for communicating information in the future.

FY 2019 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 salmon 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 salmon 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 angled at 45 degrees from the horizontal in order to reduce salmon avoidance behavior, with the goal of improving their damage prevention effects.

（2）Verification the effects of ultrasonic wave repellent equipment

Improved repellent equipment will be installed in the vicinity of salmon trap nets, and the continuance etc., of its repellent effects on Kuril harbor seals will be verified on a continuing basis.

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 salmon 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 salmon 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 (installing trap nets with tunnel shaped rope grids at some of the bag net entrances, etc.).

○According to the population management situation, 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 salmon 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 salmon trap nets 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 ratio 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 four years from 2016 to 2019, 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 2020 as a necessary condition.

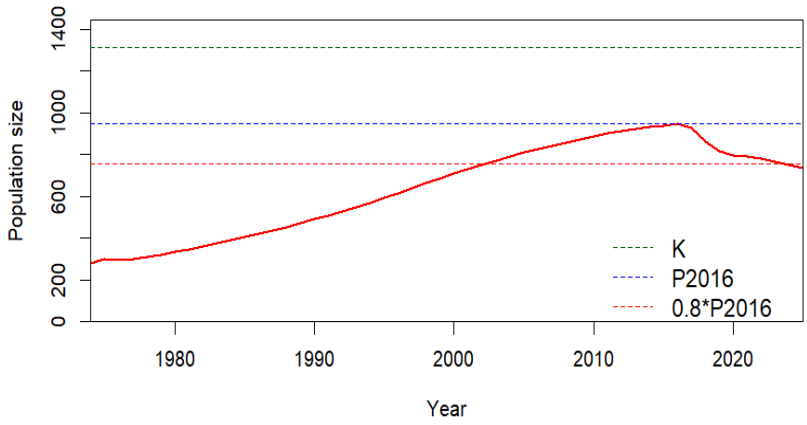
○ In light of the reality that the Kuril harbor seal was only recently reassessed from the status of Threatened to Near Threatened, that the Erimo population is highly occlusive, and that there are a number of uncertain elements in the estimates of population size, population structure, and ecology, 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 2019 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 2020 onward (Kitakado 2016).

○Therefore, the Ministry of the Environment will determine the maximum number of individuals to be caught such that the population in 2019 will come down to about 80% of the population at the time the Management Plan was established; through estimation of population dynamics (Fig. 20 Results of Reassessment of Number of Individuals Caught) taking into account the number of individuals captured and bycaught in 2016, 2017, and 2018, as well as the population growth rate, etc., it has been determined that approximately 80 seals (excluding the number of bycaught individuals) are to be captured in 2019, which is 40 higher than the 40 which had been tentatively planned.



Year	Number of seals caught	Number >1 year old	Comparison with initial 2016 number
2016	48	948	1.00
2017	137	929	0.98
2018	143	865	0.91
2019	80	816	0.86
2020	50	797	0.84
2021	50	791	0.84
2022	50	780	0.82
2023	50	766	0.81
2024		751	0.79

Figure 20. Results of Reassessment of Number of Individuals Caught

*Assuming that 50 individuals will be captured each year beginning in 2020, the dynamic population size (red solid line), will stabilize at about 80% (red dashed line) of the population size in March 2016 (blue dashed line).

*At the time the tentative version of the 2019 Implementation Plan was created, the growth stages, etc. of past captured and bycaught individuals were accounted for, the simulation was reviewed, and a reassessment was performed.

○ 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.

< 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 2020 and beyond will be adjusted based on evaluation of project implementation results to

date.

○ 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.

Further, in order to examine project assessment and future management plans, the Ministry of the Environment will examine necessary surveys and assessment methods, through a monitoring working group, etc.

（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.

○In order to improve the accuracy of population size estimates, the Ministry of the Environment will consider conducting surveys to estimate the haul-out ratio using transmitters.

（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 salmon 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.

・Kitakado, T. 2017. FY 2016 Research Commissioned by the Ministry of the Environment “Estimation of Population Dynamics of the Erimo Kuril Harbor Seal Population” Report: 6-7.

・Kitakado, T. 2018. FY 2017 Research Commissioned by the Ministry of the Environment "Estimation of Population Dynamics of the Erimo Kuril Harbor Seal Population" Report: 13-14.

・Kitakado, T. 2019. FY 2018 Research Commissioned by the Ministry of the Environment "Estimation of Population Dynamics of the Erimo Kuril Harbor Seal Population" Report: 7-13.

・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 Research24(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 Research79(1–2): 129-138.