# Ministry of the Environment
# Erimo Area Kuril Harbor Seal Management Project Implementation Plan, FY 2020

March 2020

Hokkaido Regional Environment Office

## Contents

**Background**

The Ministry of the Environment establishes an “Erimo Area Kuril Harbor Seal Management Project Implementation Plan” (hereafter the “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”) (Phase II)”, which was established in March 2020.

The goal of the Management Plan is to establish procedures for population management, damage prevention and the like 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 FY 2020 Implementation Plan shall be defined as given below, taking into account the results of the projects implemented in the Phase I Management Plan period from 2016 to 2019.

**FY 2019 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 particularly severe damage 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 fishing season: 20 cm × 20 cm [made of Dyneema®], autumn fishing season: 18 cm × 18 cm [made of Dyneema®], etc.) at the tunnel entrance to the bag net in trap nets that were particularly susceptible to 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, as these are thought to more easily allow *Salmoniformes* to enter.

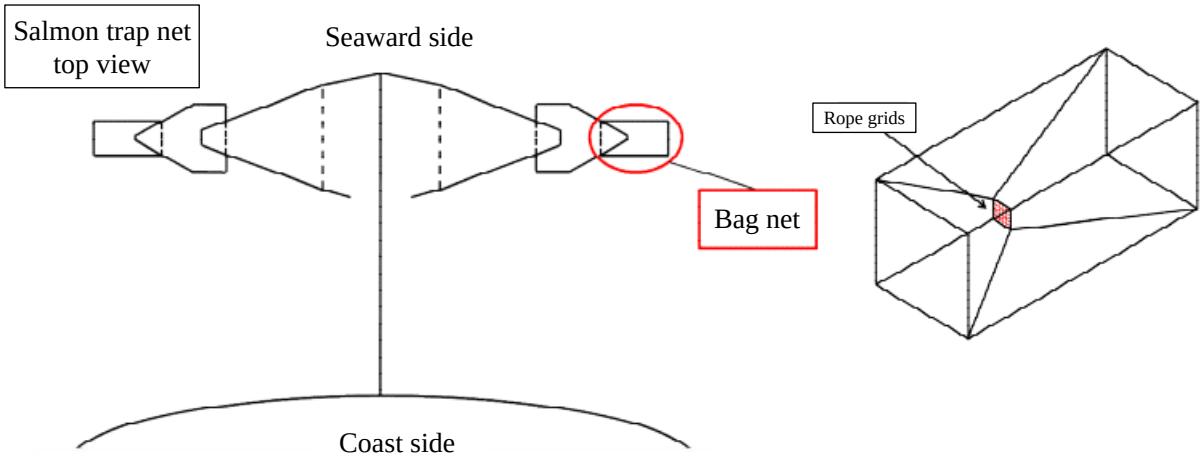
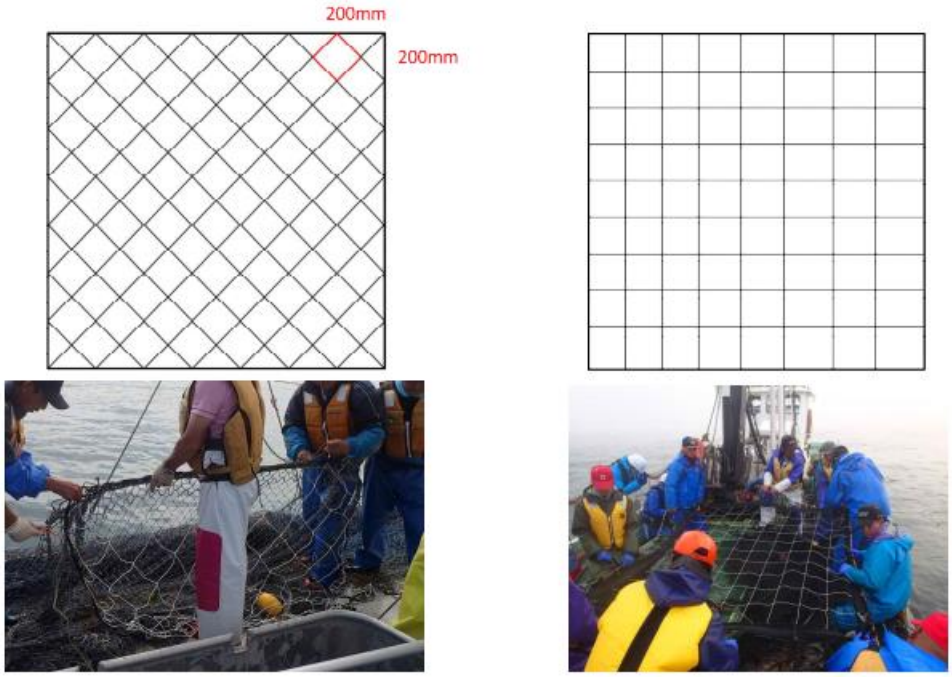



Fig. 1. Rope grid installation

(slits: when sized at 20 cm x 20 cm)




Angled rope grids
(slits: 16 – 20 cm x 16 – 20 cm)

Conventional horizontal rope grids
(slits: 16 – 20 cm x 16 – 20 cm)

Fig. 2. Angled rope grids (left) and conventional horizontal rope grids (right)

Table 1. Rope grid types and installation periods

| Salmon trap net fishing season | Sector name | Number of nets with rope grids installed | Type of rope grids | Installation period |
|---|---|---|---|---|
| Spring | Toyo | 1 | 20 cm x 20 cm (angled) | 5/28 – 7/1 |
| Autumn | Toyo | 1 | 20 cm x 20 cm (angled) | 9/24 – 11/13 |
| | Cape Erimo | 3 | 18 cm x 18 cm, 16 cm x 16 cm (mainly angled 18-cm grids, with some horizontal grids used) | 8/31 – 11/20<br>9/3 – 11/20<br>9/5 – 11/20 |
| | Shoya | 2 | 18 cm x 18 cm (angled) | 9/13 – 11/20<br>9/10 – 10/7 |

*Trap net fishing is not practiced in the waters east of Cape Erimo during the spring fishing season.

<Results of the monitoring of the improvement of fishing nets>

① Spring fishing season (Toyo sector)

Damage prevention through the installation of damage preventing nets in the spring of 2019 was carried out in one salmon trap net (seaward side) in the Toyo sector (Cape Erimo west side*), which was the same sector as in the spring fishing seasons from 2016 to 2018. The configuration of the damage preventing nets was 20 cm x 20 cm, which 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, as these are thought to more easily allow *Salmoniformes* to enter. Regarding the material used, Dyneema® (white) was selected as in 2018.

*Trap net fishing is not practiced in the waters east of Cape Erimo during the spring fishing season.

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

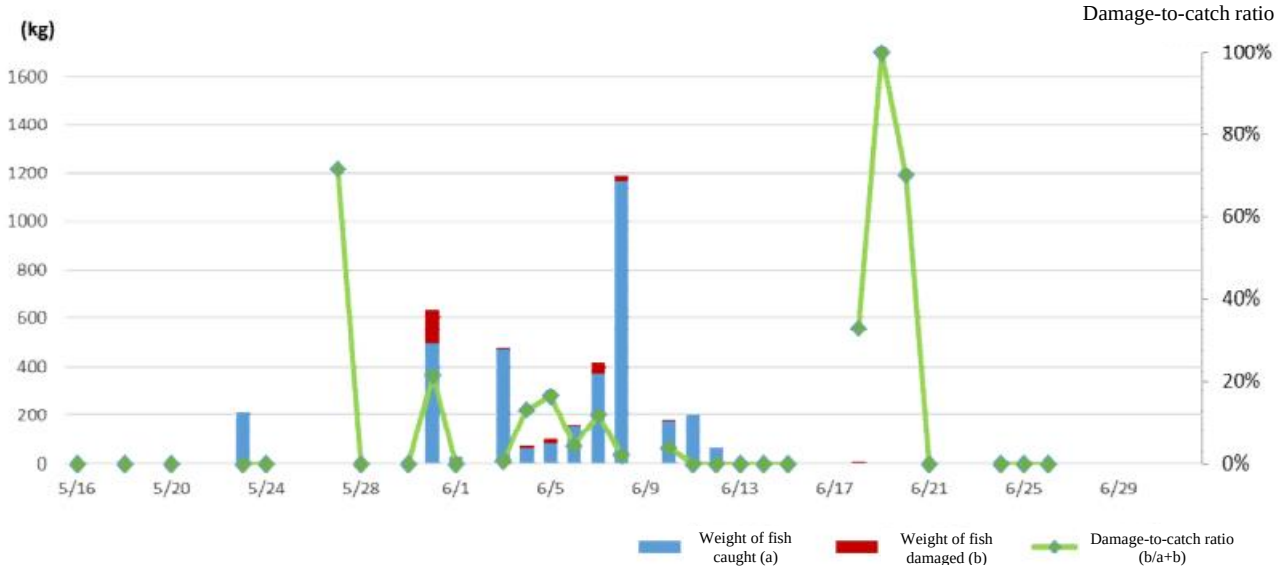



Fig. 3. Damage preventing net installation and damage conditions by day (Toyo sector seaward side)
(Throughout the whole period: 20 cm x 20 cm, angled)

② Autumn fishing season (Cape Erimo sector)

Damage prevention through the installation of damage preventing nets in the autumn fishing season was carried out using one salmon trap net in the Cape Erimo sector, which was the same sector as in the 2016 and 2017 autumn fishing seasons. Regarding the sizes of the slits (rope grids) at bag net entrances, horizontal slits sized 20 cm x 20 cm, 18 cm x 18 cm, and 16 cm x 16 cm (Dyneema®), which showed a certain degree of damage prevention effects last year, were used in some areas, but the angled slits which were found to be effective in the spring fishing 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 that damage was concentrated in the nets on the southern seaward side and kept low in the other nets (Figs. 4 – 7). 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 chamber nets, not just in the bag nets with slits installed. Based on the results of previous experiments, it is considered that 18 cm x 18 cm grids with angled slits are relatively effective at preventing some but not all damage, while still guaranteeing a favorable total salmon catch size.

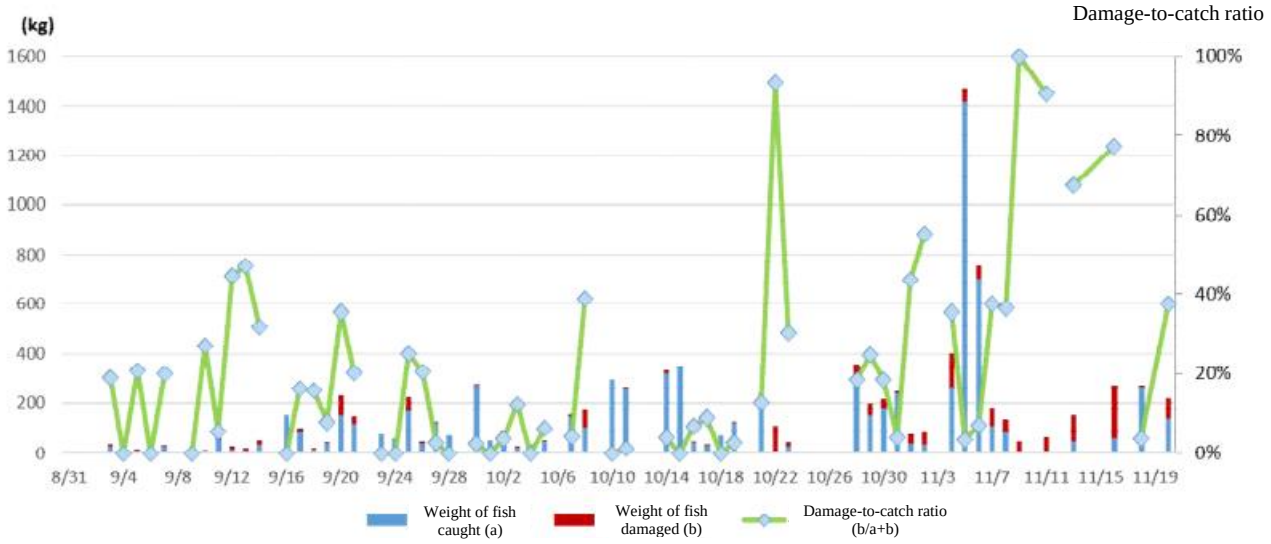



Fig. 4. Damage preventing net installation, total catch size and damage-to-catch ratio
(Cape Erimo sector, net: southern seaward side)

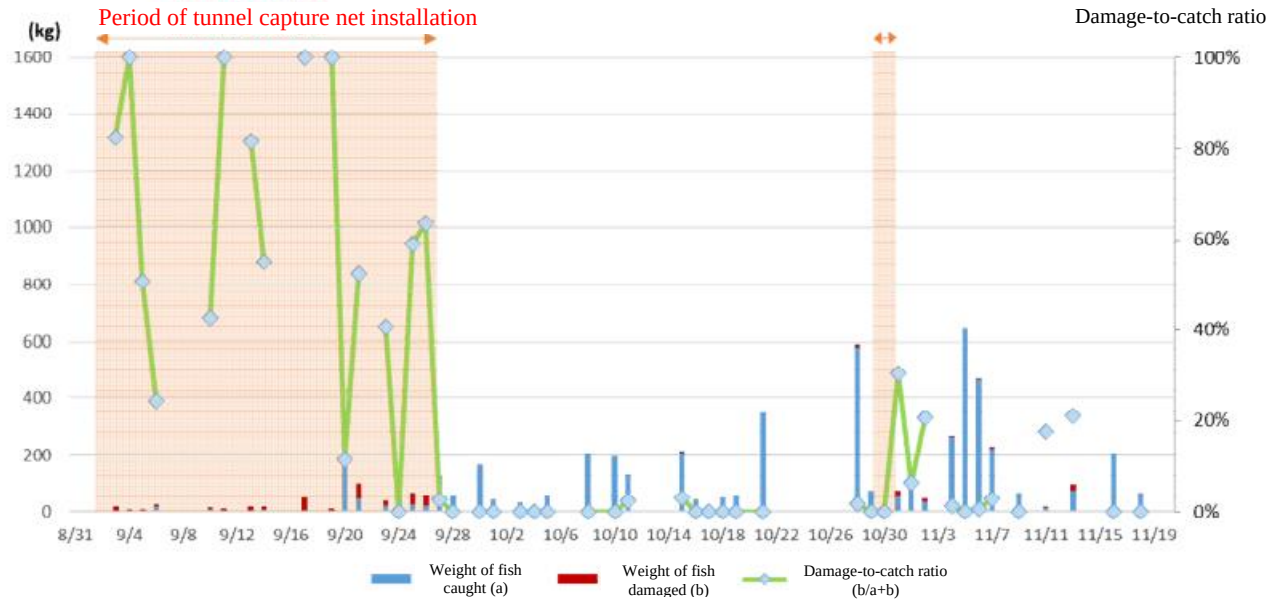



Fig. 5. Damage preventing net and tunnel capture net installation, total catch size and damage-to-catch ratio
(Cape Erimo sector, net: northern seaward side)

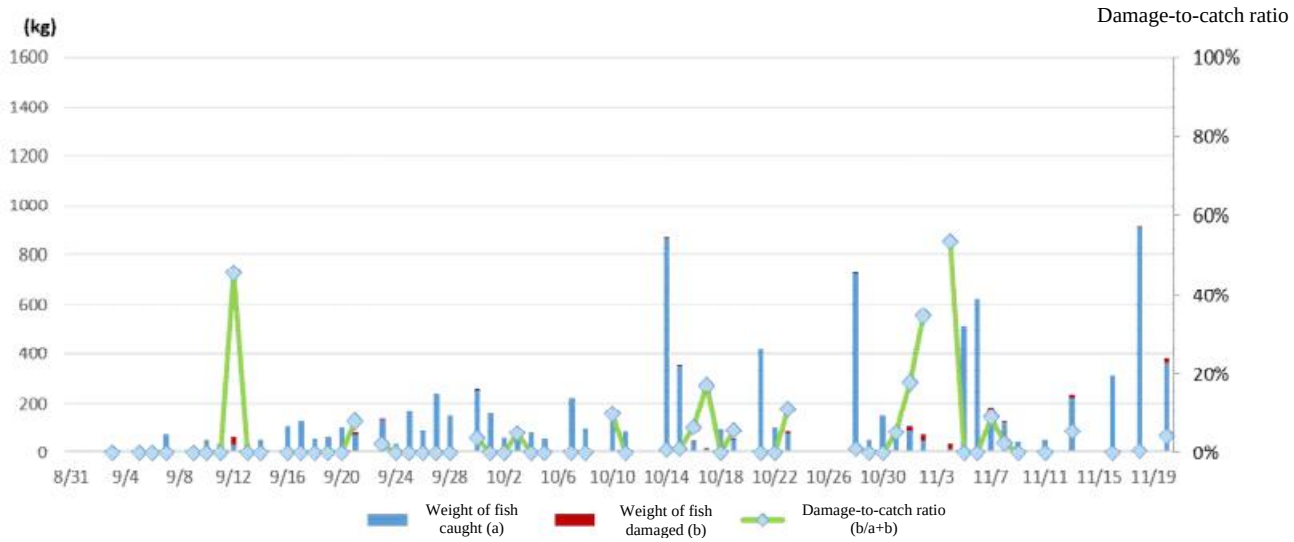



Fig. 6. Damage preventing net installation, total catch size and damage-to-catch ratio

(Cape Erimo sector, net: southern land side)

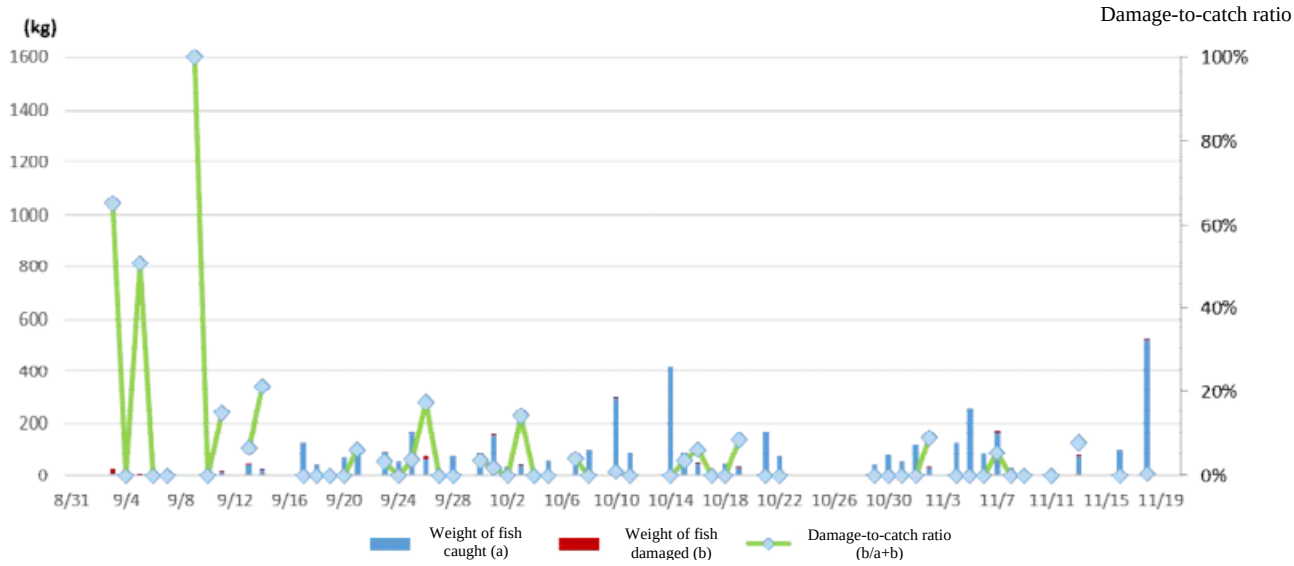



Fig. 7. Damage preventing net installation, total catch size and damage-to-catch ratio

(Cape Erimo sector, net: northern land side)

<Assessment of the improvement of fishing nets>

- ○ As in previous results, the damage mitigation effects of installing rope grids in individual salmon trap nets were confirmed, and their effectiveness as a means of damage prevention for trap nets that were susceptible to severe damage was shown. Further, since it has been confirmed that the frequency of Kuril harbor seal visits to the net areas is decreased, it is reasonable to expect mitigation effects for undetected damage, such as salmon being taken from nets.
- ○ In 2019, the total number of days on which salmon trap nets with rope grids were installed increased: with one net installed in one sector during the spring fishing season and six nets in three sectors during the autumn fishing season. This is considered to reflect growing expectations for the damage reduction effects of rope grids by fishermen who are already using them. It is essential to further improve damage preventing nets to make them highly effective at preventing Kuril harbor seals from entering the nets while also having minimal effects on salmon. The use of such nets according to the amounts of fish caught and damaged should also be examined.

(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 were conducted. The repellent equipment used was the same as that used in 2018, which was based on improvements (i.e., emission in two directions on each side and more powerful batteries).

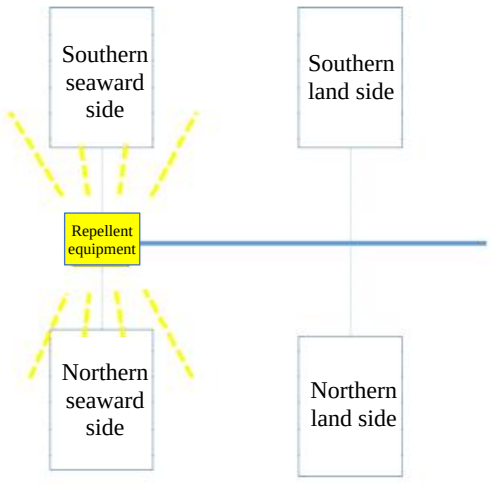



Illustration of repellent equipment installation

Improved repellent equipment

○ **Spring fishing season (Toyo sector, using repellent equipment alone)**

In the spring fishing season, ultrasonic wave repellent equipment alone was installed and activated from May 30 to June 14 in one salmon trap net on the seaward side in the Toyo sector.

No clear difference was shown by the presence or absence of the repellent equipment. A certain amount of damage was found while the repellent equipment was installed, and a seal was sighted near the net fitted with the equipment on the day after its installation (Figs. 8 and 9).

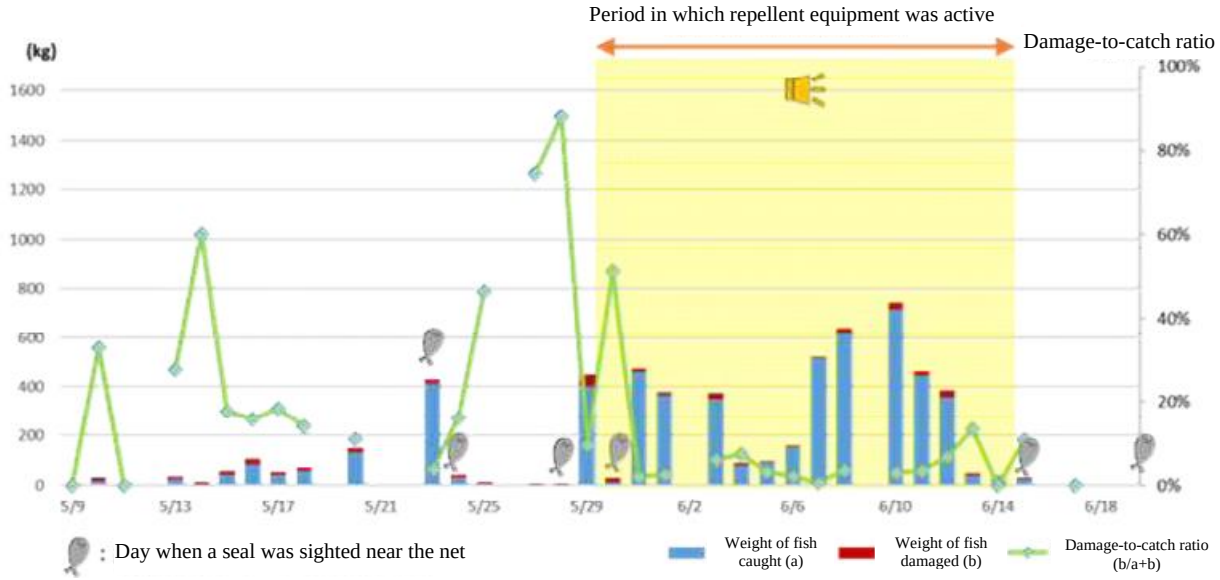



Fig. 8. Repellent equipment installation and damage conditions by day (with repellent equipment, on the seaward side)

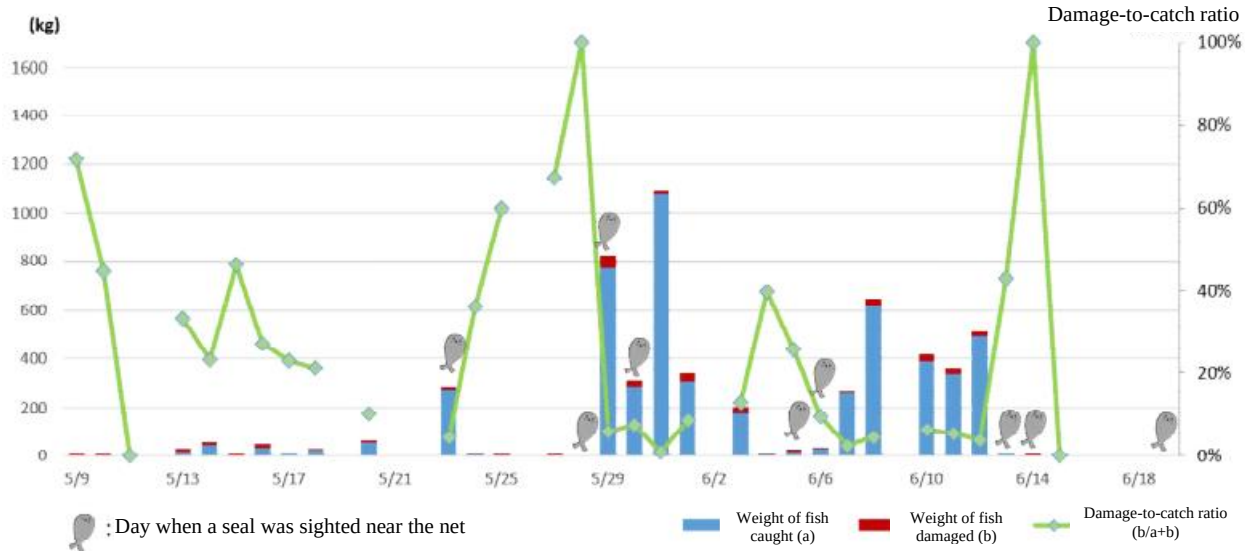



Fig. 9. Repellent equipment installation and damage conditions by day (without repellent equipment, on the land side)

○ **Autumn fishing season (Cape Erimo sector, using repellent equipment in conjunction with rope grids)**

In the autumn fishing season, ultrasonic wave repellent equipment along with rope grids was installed and activated from November 1 to 9 in one salmon trap net on the seaward side (two nets) in the Cape Erimo sector to verify its effectiveness.

The damage-to-catch ratio remained low regardless of the presence or absence of the equipment, and no clear difference was shown by the presence or absence of repellent equipment (Figs. 10 – 13).

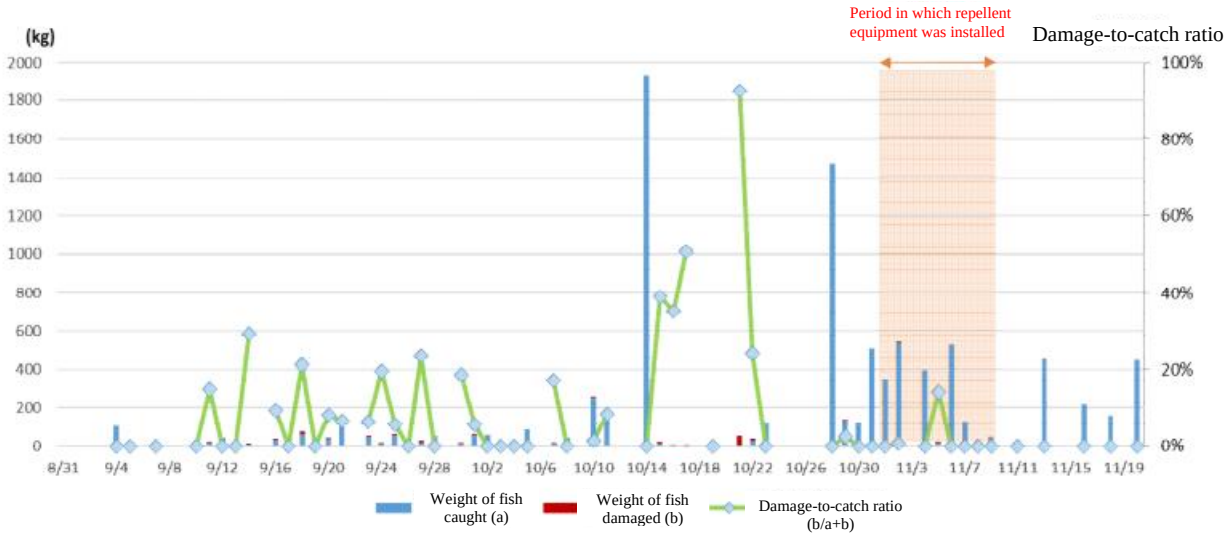



Fig. 10. Repellent equipment installation and damage conditions by day (with repellent equipment, on the southern seaward side)

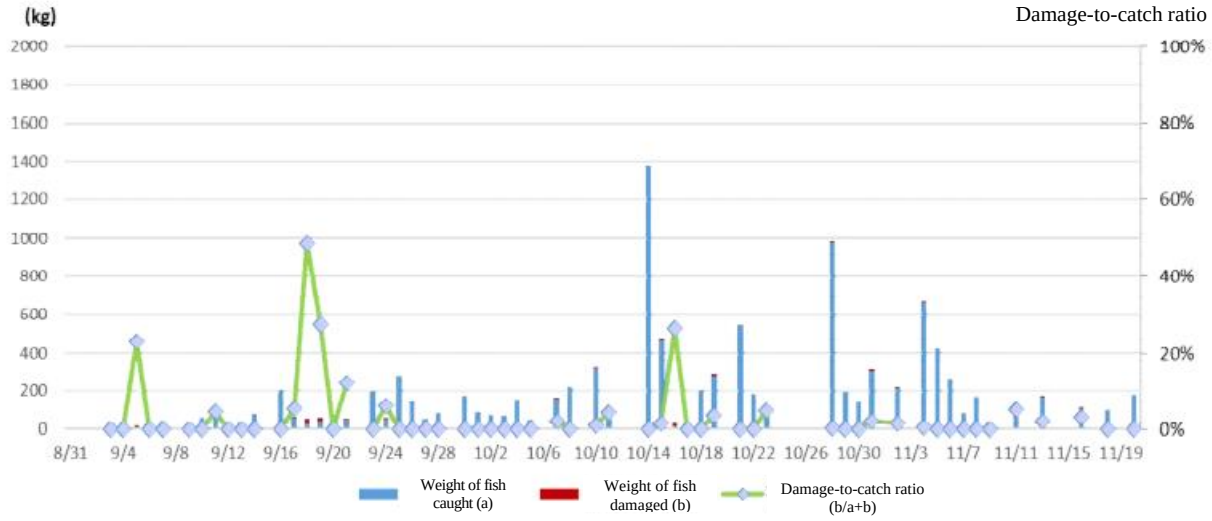



Fig. 11. Repellent equipment installation and damage conditions by day (without repellent equipment, on the southern land side)

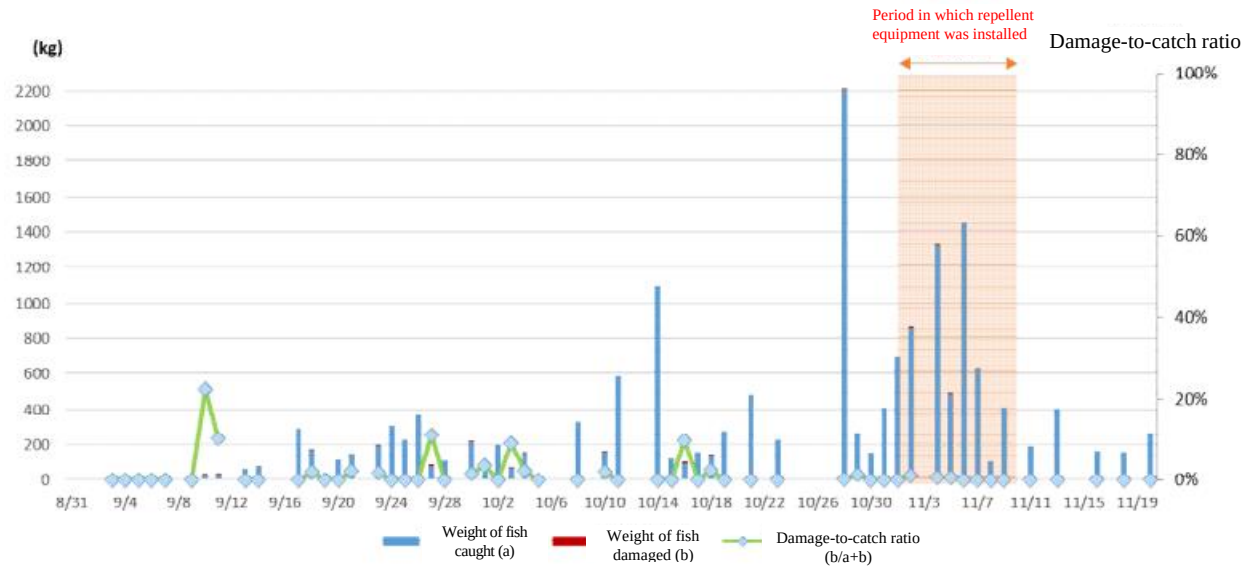



Fig. 12. Repellent equipment installation and damage conditions by day (with repellent equipment, on the northern seaward side)

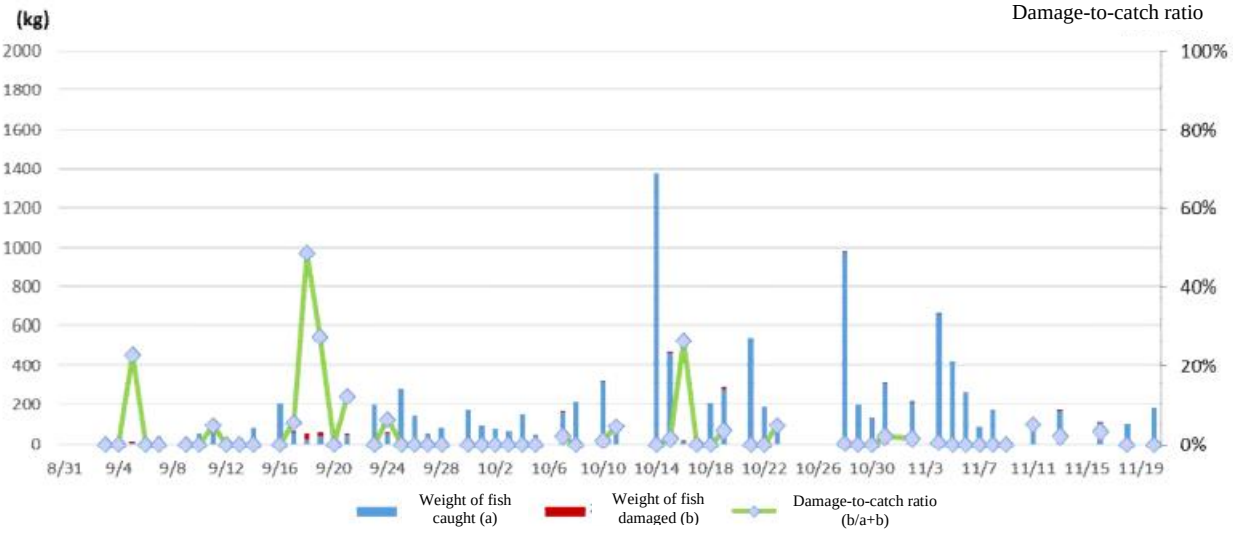



Fig. 13. Repellent equipment installation and damage conditions by day (without repellent equipment, on the northern land side)

<Assessment of ultrasonic wave repellent equipment tests >

○ In both the spring and autumn fishing seasons, the damage-to-catch ratio remained unchanged with or without repellent equipment. No evidence was found that the equipment is effective in repelling Kuril harbor seals because it was clear that seals had approached the trap nets as a certain amount of damage was found even while the equipment was activated and a seal was sighted near the equipment on the day after its installation in the spring fishing season. In fact, previous experiments that were conducted using floating cages and those using trap nets did not show any noticeable effects on repelling Kuril harbor seals. The Ministry of the Environment needs to verify the effects of the equipment on such factors as reduction in damage and the seal's risk-avoidance behavior, and to promptly decide how to use the equipment in consideration of its practicality in the fishing industry.

Table 2. Current (improved) specifications

| No. | Item | Improved basic design specifications | Prototype specifications (for reference) |
|---|---|---|---|
| 1 | Structure (main unit and power supply) | Separated | Separated |
| 2 | Housing configuration | 1 circular unit, 1 square unit | 2 circular units |
| 3 | Rough housing dimensions | 1,070 x 670 x 790 mm | 950 x 530 x 550 mm |
| 4 | Housing material | Stainless steel | Stainless steel |
| 5 | Weight-in-air | 71.7 kg or less (main unit) | 46.5 kg or less |
| 6 | Ultrasonic wave oscillator | 600 W x 2 | 600 W x 1 |
| 7 | Frequency of ultrasonic wave emission | 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 | Possible | Impossible |
| 11 | Battery capacity* | 4 days (default settings) | 3 days (default settings) |

*Battery capacity is adjusted separately on the battery unit.

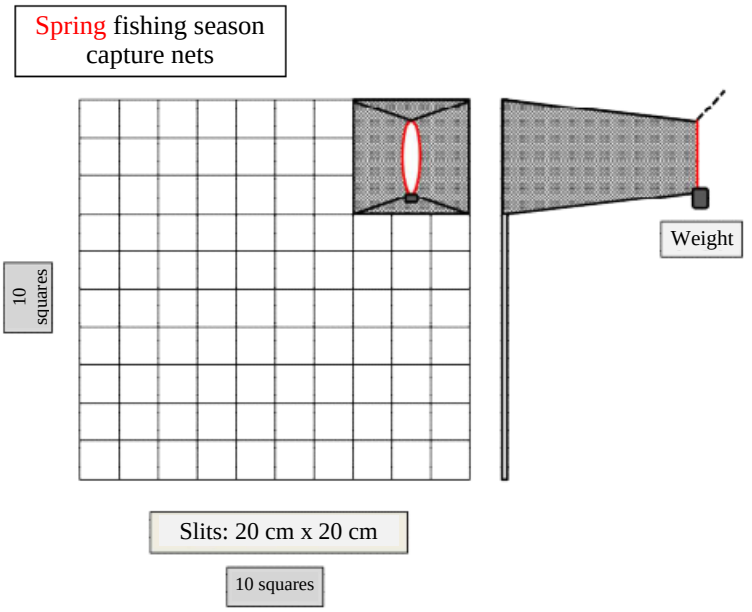
## 2. Population Management

The Ministry of the Environment captured seals using salmon trap nets, gillnets, etc. in order to perform population management aimed at both mitigating damage 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 23 of the captured individuals were fitted with EM transmitter tags and released and some others were 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 fishing season for a total of 35 days between May 28 and July 1, and a total of 26 days in the autumn fishing season between September 3 and September 26 and on October 30 and 31. During these deployment periods, nets were raised 29 times and 23 times, respectively.

Additionally, in response to the revision of the Implementation Plan in August 2019, which doubled the number of individuals to be captured from 40 to 80, additional tunnel capture nests were urgently installed on a total of three trap nets in the autumn fishing season: one trap net in the Toyo sector and two in the Cape Erimo sector. Attempts to capture seals were made as follows: for the five days between September 16 and 20 on the Toyo trap net (which was raised five times), for the 23 days between September 8 and 30 on the Cape Erimo trap net 1 (raised 19 times), and for the nine days between September 11 and 19 on the Cape Erimo trap net 2 (raised eight times).



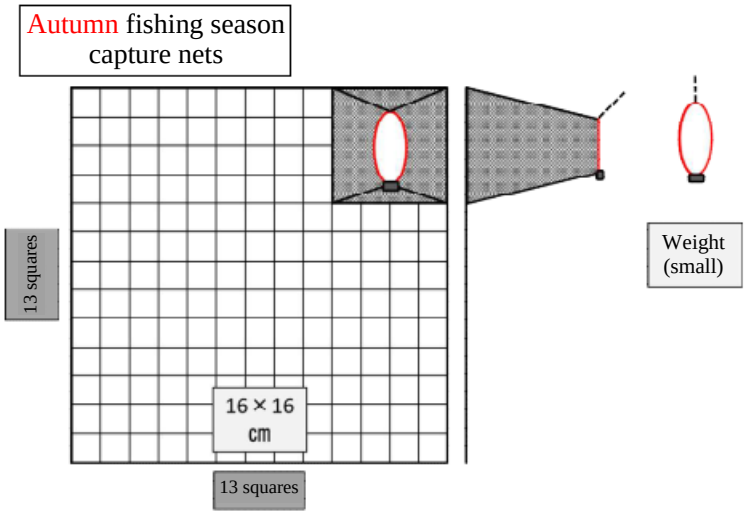




Fig. 14. Structure of tunnel capture nets installed on salmon trap nets (above: spring; below: autumn)

(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 three days between June 19 and July 31, 2019. (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 February 20, 2019. As a result, one adult seal was captured. [Academic investigation implemented in FY2018]

(4) Capture results

Between May and November 2019, a total of 44 seals were captured using salmon trap nets, gillnets, etc. (This number does not include 23 individuals which were fitted with EM transmitter tags/patches and released to investigate the percentage of those hauling out, and two individuals which escaped.) During the emergency capture efforts conducted using three additional salmon trap nets in the autumn fishing season, no Kuril harbor seals were captured; only one spotted seal was bycaught.

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. (The age composition is provisional.) While individuals aged 1 year old and 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 (35 times) | 2 | 3 | 0 | 0 | 0 | 0 | 4 | 4 | 13 |
| Autumn salmon trap nets (26 times) | 1 | 1 | 0 | 0 | 0 | 2 | 6 | 0 | 10 |
| Emergency capture (26 times) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Subtotal | 7 | | 0 | | 2 | | 14 | | 23 |
| Gillnets (3 times) | 8 | 12 | 0 | 0 | 0 | 0 | 0 | 0 | 20 |
| Air guns (once) | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 |
| Total | 27 | | 0 | | 2 | | 15 | | 44 |

*The age composition is provisional.

*The table does not include 23 individuals which were fitted with EM transmitter tags/patches and released and two individuals which escaped.

<Results of the 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 295 individuals on September 30.

<1983 – 2010>

Survey report of one week during molting season (Kobayashi et al. 2014)

<2011 – 2018>

Results of Tokyo University of Agriculture Long-Term Census – July through November (Kobayashi, unpublished data)

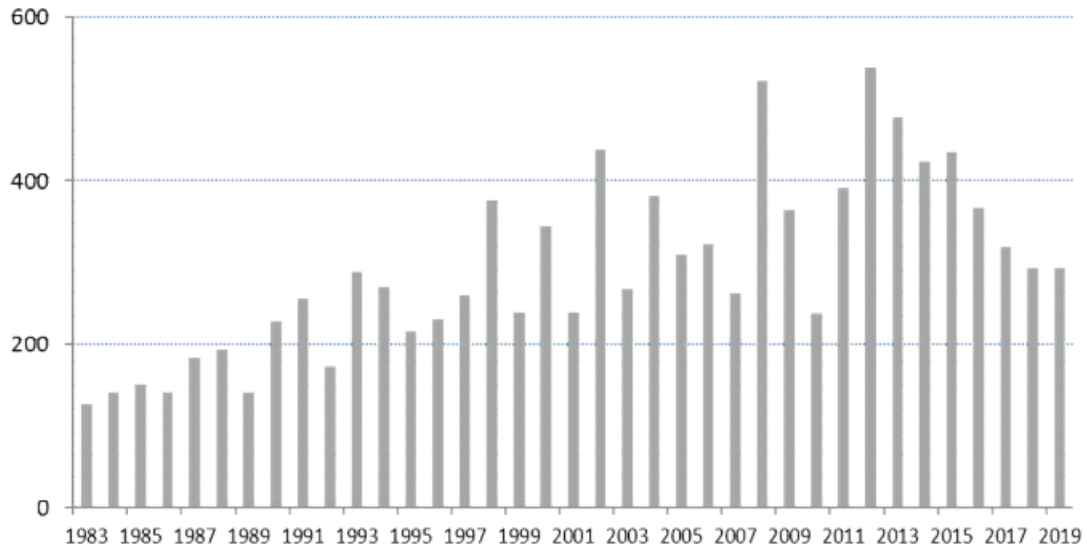
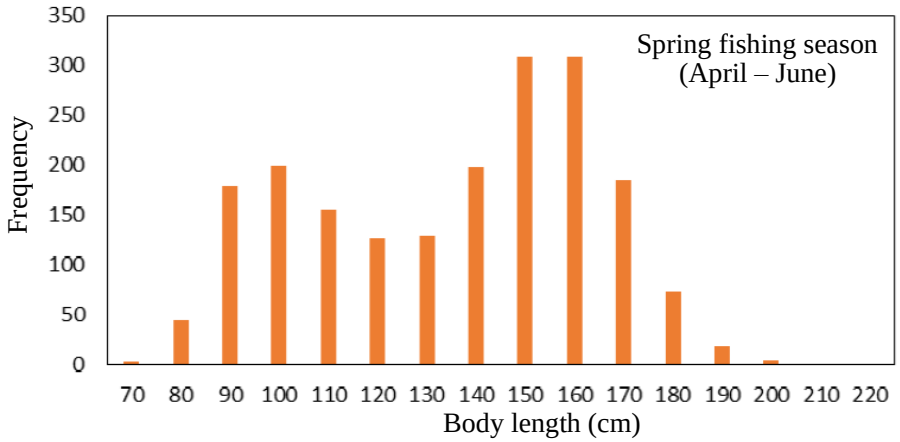
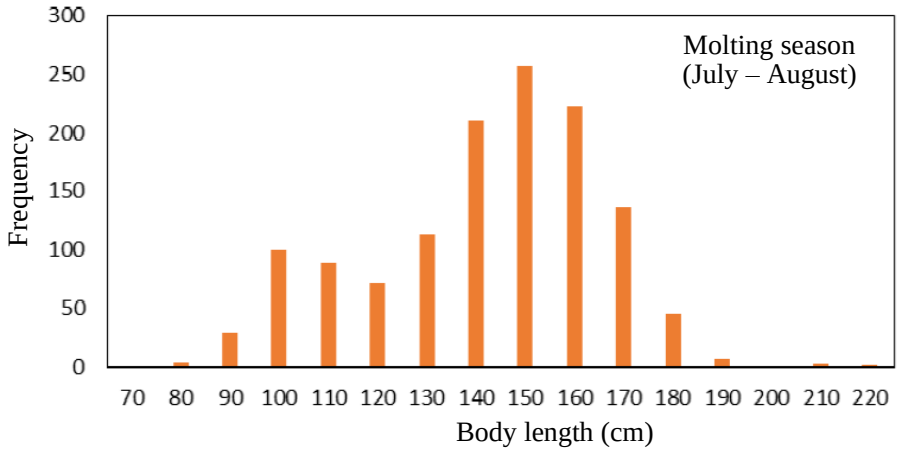



Fig. 15. Largest number of Kuril harbor seals hauling out at Cape Erimo

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

The Ministry of the Environment captured drone images of rocky shore reef haul-out sites at Cape Erimo and to its west between April and October 2019, and based on measured data on the head-and-body lengths (from the tip of the snout to the base of the tail) of all individuals confirmed in those images, clarified the body lengths of Kuril harbor seals on the rocky shore reefs of Cape Erimo by season (Fig. 16). For analysis purposes, the Ministry constructed numerical expressions to estimate a body length (from the tip of the snout to the tip of the tail) based on a head-and-body length by using measured data (n = 126) on the body lengths and head-and-body lengths of Kuril harbor seals that were collected in 2019 by the Marine Wildlife Center of Japan. The Ministry then estimated the body lengths of those individuals captured in the drone images based on the measured data on their head-and-body lengths.



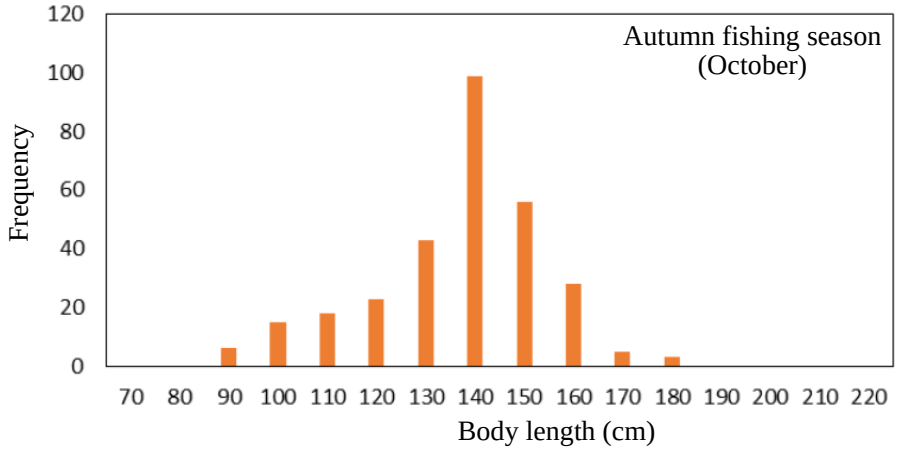




Fig. 16. Comparison of body lengths by season

In the spring fishing season, drone images captured numerous small individuals less than 100 cm in length, which suggests that many individuals born during the breeding season in May and June were hauling out. Further, a large number of individuals considered adults and measuring 140 cm or longer were also hauling out, with the highest proportion of individuals measuring between 140 cm and 160 cm. During the molting season, the proportion of individuals less than 100 cm declined; the proportion of those 140 cm or longer remained high and showed a trend similar to that in the spring fishing season. During the autumn fishing season, the proportion of those less than 100 cm further dropped, and that of those about 140 cm became the highest. The proportion of large individuals 150 cm or longer diminished, suggesting that many medium-sized individuals use the haul-out sites in the autumn fishing season.

Niizuma reported in 1986 that adult females appeared at haul-out sites after the pupping season began and their appearance rate plummeted after the molting season ended, suggesting that the haul-out frequency of adult females varies with season. The Ministry of the Environment surmised that the drop in the proportion of large individuals in the autumn fishing season was due partly to a decline in the haul-out frequency of adult females. The drone images capturing numerous individuals considered newborns, measuring less than 100 cm, during the spring fishing season has led the Ministry to think that drone images of rocky shore reef haul-out sites will likely allow an accurate estimation of the number of Kuril harbor seal births in the Erimo area.

<Census method using an unmanned aerial vehicle>

In conducting censuses by unmanned aerial vehicle (drone) in the Cape Erimo area, the Ministry of the Environment used video recording (ii. below), which enables the effective and efficient measurement of the population size in a short time, in addition to the conventional still image recording (i. below) to generate orthographic images.

Equipment used: DJI Phantom 4 Pro; software used: DJI GS Pro

i. Conventional still image recording settings to generate orthographic images (Measurement of individual sizes is under consideration.):
   In the 3D Map Area mode, still images were recorded with the altitude set at approx. 60 m, the front overlap ratio at 90% and the side overlap ratio at 40%.
   Time required: approx. 1 hour
ii. Simple settings only for population size measurement:
   In the Waypoint Flight mode, videos were recorded with the altitude set at approx. 110 m and the speed at 10.5 m/sec.
   Time required: approx. 8 min.

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 showed a larger number of juveniles (<1 year old) among both captured and bycaught individuals. Further, there was a higher number of male adults among captured individuals (Fig. 17).

*The age composition is provisional.

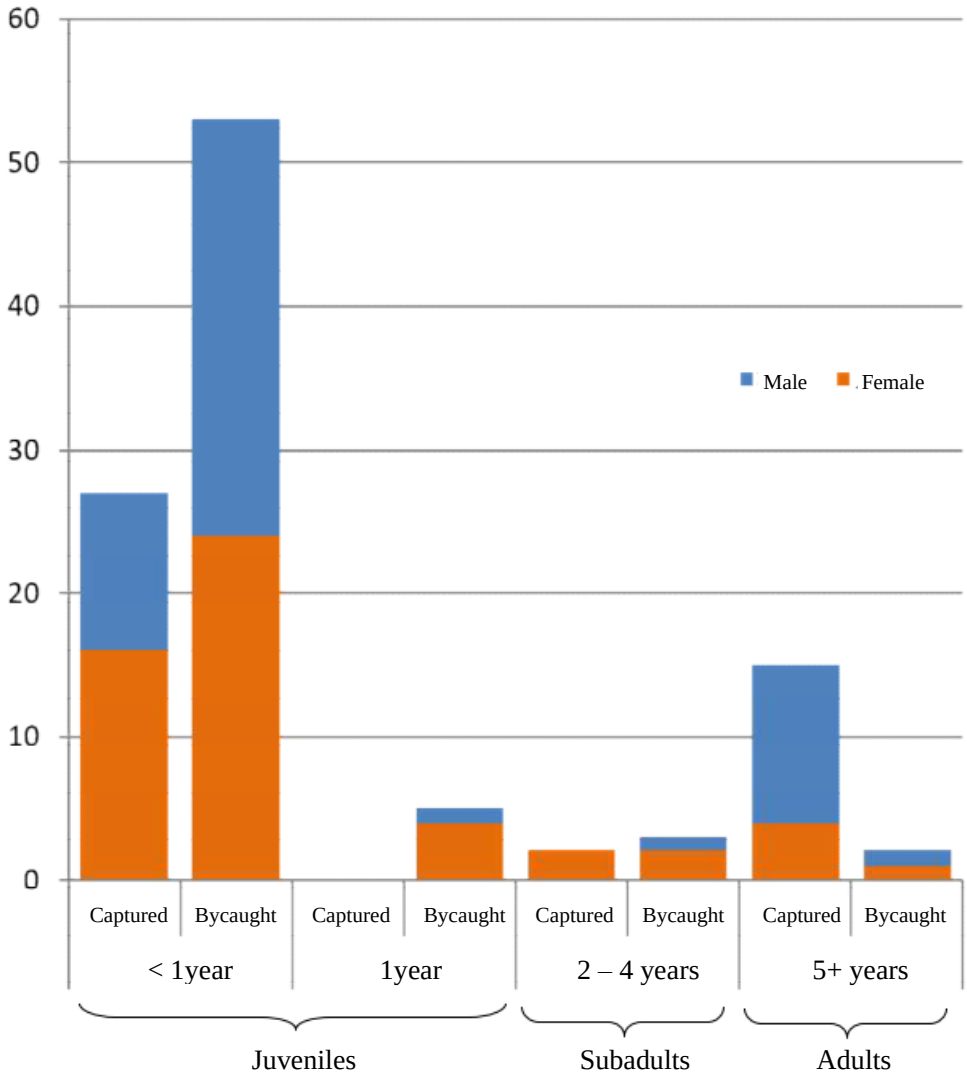



Fig. 17. Estimated age and sex of captured and bycaught individuals in 2019

○ Individuals were fitted with EM transmitters, and a survey of their areas of activity, etc. was conducted. EM transmitters were attached to 15 captured individuals, from 12 of which data was obtained. The longest data collection period was for 115 days, and the shortest for 2 days.

③ Survey of the stomach contents of captured and bycaught individuals

○ Overall results

The top five prey organisms in terms of the Proportion of Index of Relative Importance (IRI %) were *Octopodidae spp.* (80.1%), *Pseudopleuronectes herzensteini* (15.5%), *Hypomesus japonicus* (0.8%), *Cleisthenes pinetorum* (0.7%) and *Verasper moseri* (0.6%) (Fig. 18).

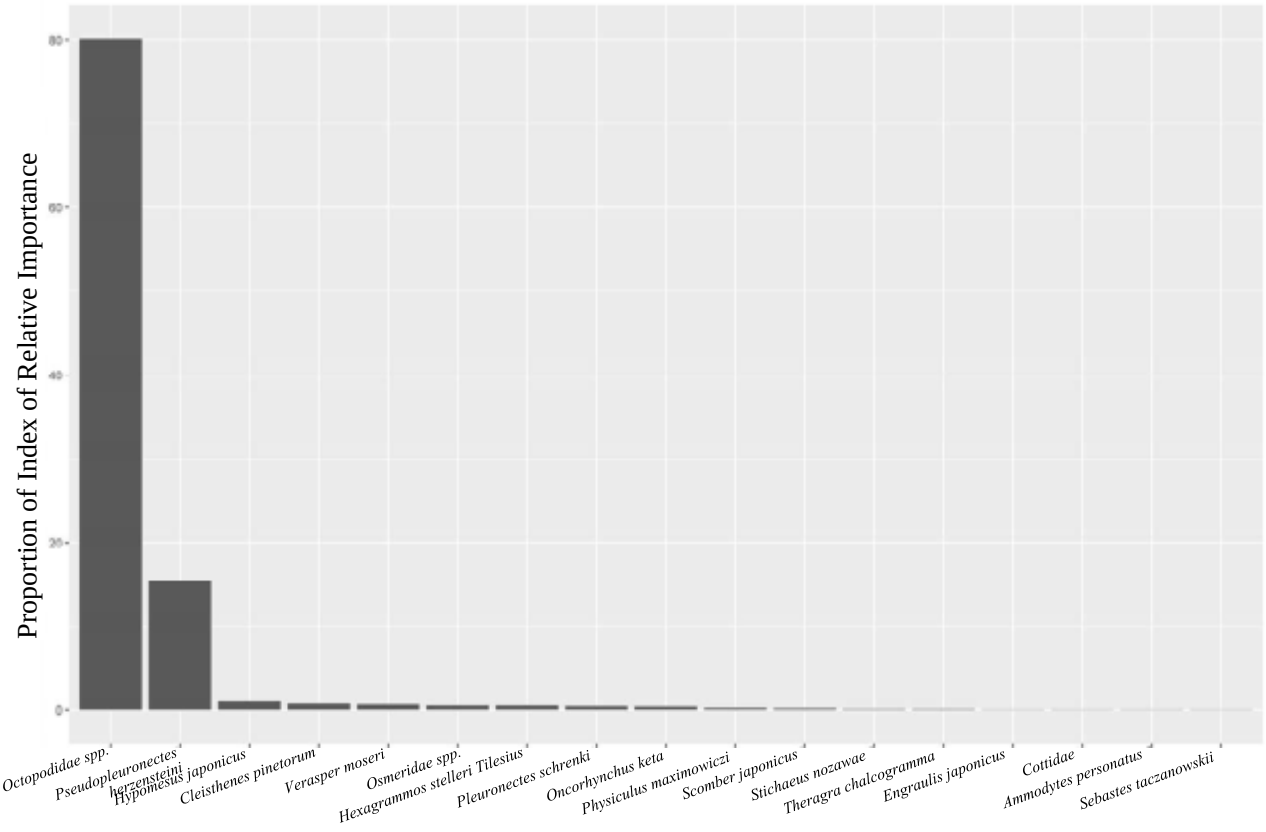



Fig. 18. Proportion of Index of Relative Importance (IRI %) of prey organisms among all the captured and bycaught

*IRI:

$$IRI_i(\%) = \frac{\{I_i(\%) + W_i(\%)\} \times Fo_i(\%)}{\sum[\{I_i(\%) + W_i(\%)\} \times Fo_i(\%)]} \times 100$$

Frequency of occurrence (Fo%): an index showing prey organisms being consumed at a high frequency = (number of stomachs in which organism was found / number of individuals checked, excluding individuals with no stomach contents) × 100

Proportion of all prey represented by a particular species of prey organism (I%): an index showing prey organisms being consumed in large numbers = (number of particular organisms found / total number of organisms found) × 100

Weight ratio (W%): an index showing prey organisms being consumed in large amounts = (weight of particular organisms found / total weight of organisms found) × 100

○ Capture results by capture method

- Capture using gillnets

Mother's milk was found among the stomach contents of three individuals in their first year of life. Prey organisms were found among the stomach contents of only one individual, and the organisms found were of the *Octopodidae* family and weighed 276 g.

- Capture using salmon trap nets

Mother's milk was found among the stomach contents of one individual in its first year of life. The prey organisms found among the stomach contents of the individuals, in order of their frequency of occurrence, were: *Octopodidae spp.* (60.0%), *Oncorhynchus keta* (20.%), *Scomber japonicus* (20.0%) and *Verasper moseri* (20.0%).

The Proportion of Index of Relative Importance (IRI %) of those prey organisms was as follows: *Octopodidae spp.* (47.2%), *Verasper moseri* (27.0%), *Oncorhynchus keta* (17.1%) and *Scomber japonicus* (8.6%) (Fig. 19).

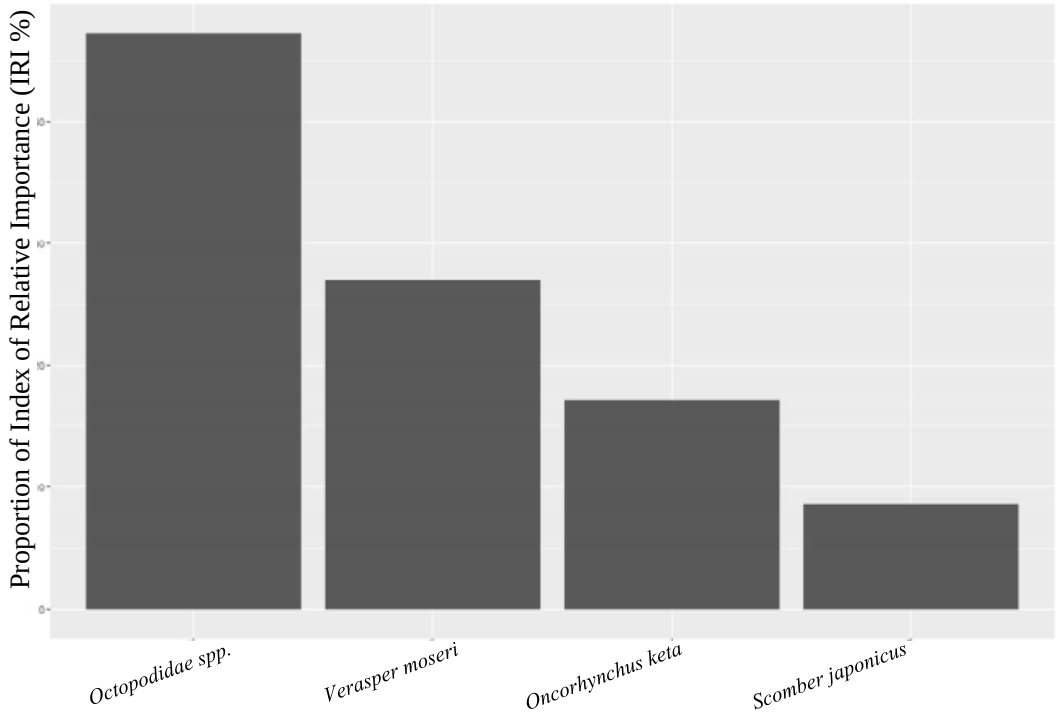



Fig. 19. Proportion of Index of Relative Importance (IRI %) of prey organisms among captured individuals

- Results of bycaught individuals

No mother's milk was found among the stomach contents of bycaught individuals. The top five prey organisms in terms of the Proportion of Index of Relative Importance (IRI %) were *Octopodidae spp.* (75.1%), *Pseudopleuronectes herzensteini* (20.5%), *Hypomesus japonicus* (1.2%), *Cleisthenes pinetorum* (0.8%) and *Osmeridae spp.* (0.6%) (Fig. 20).

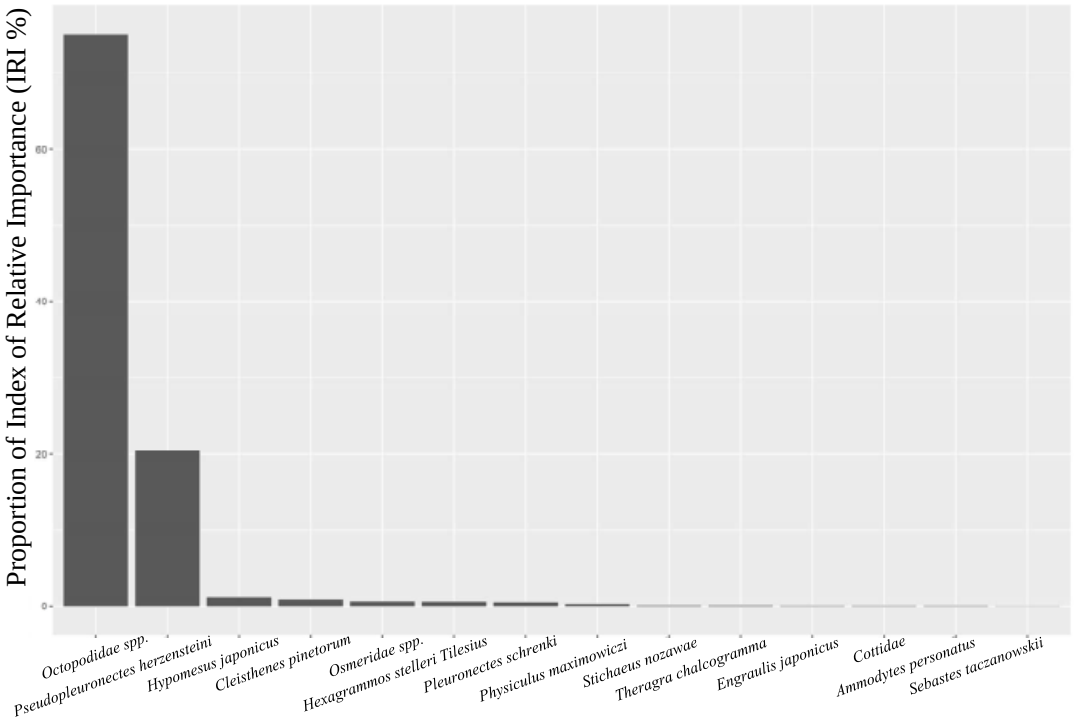



Fig. 20. Proportion of Index of Relative Importance (IRI %) of prey organisms among bycaught individuals

<Assessment of population management>

① Capture results

○ Similar to 2019, the number of individuals captured in salmon trap nets was relatively low, and the majority of these were larger individuals. Conversely, in gillnets, the number of individuals captured was high, but many smaller individuals were captured. Monitoring results to date show that many large individuals attack salmon trap nets, with a tendency for the same individuals to persistently attack trap nets. For this reason, it is necessary to continue to conduct population management centering around capture using salmon trap nets. Further, caution is needed in order to avoid reductions in capture efficiency due to seal learning.

The number of individuals captured in 2019 was 44, which was far below 80, the predetermined goal at the time of the Implementation Plan's revision in August. In response to doubling of the goal from 40 to 80 in the revised Implementation Plan, emergency capture was carried out using three additional trap nets, but no Kuril harbor seals were captured. This failure of capture is considered attributable to the relatively low frequency of Kuril harbor seal visits because those three additional nets were set farther away from the rocky shore reefs than the salmon trap nets that had been used to capture seals every autumn. That said, there is room for discussion on the installation of capture nets going forward because those trap nets installed on an emergency basis also sustained a certain amount of damage despite limited salmon catches.

② Population 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 over 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, both of which are currently insufficient, it is necessary to continue monitoring and fully understand any variation in seal activity accompanying population management.

## 3. Survey of the Damage Done to the Fishing Industry

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

○ An understanding of the damage done to the fishing industry was gained through the 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. While record poor catches have continued since 2016, the damage-to-catch ratio in 2019 stood at 1.69%, which was lower than in the previous year (Fig. 21).

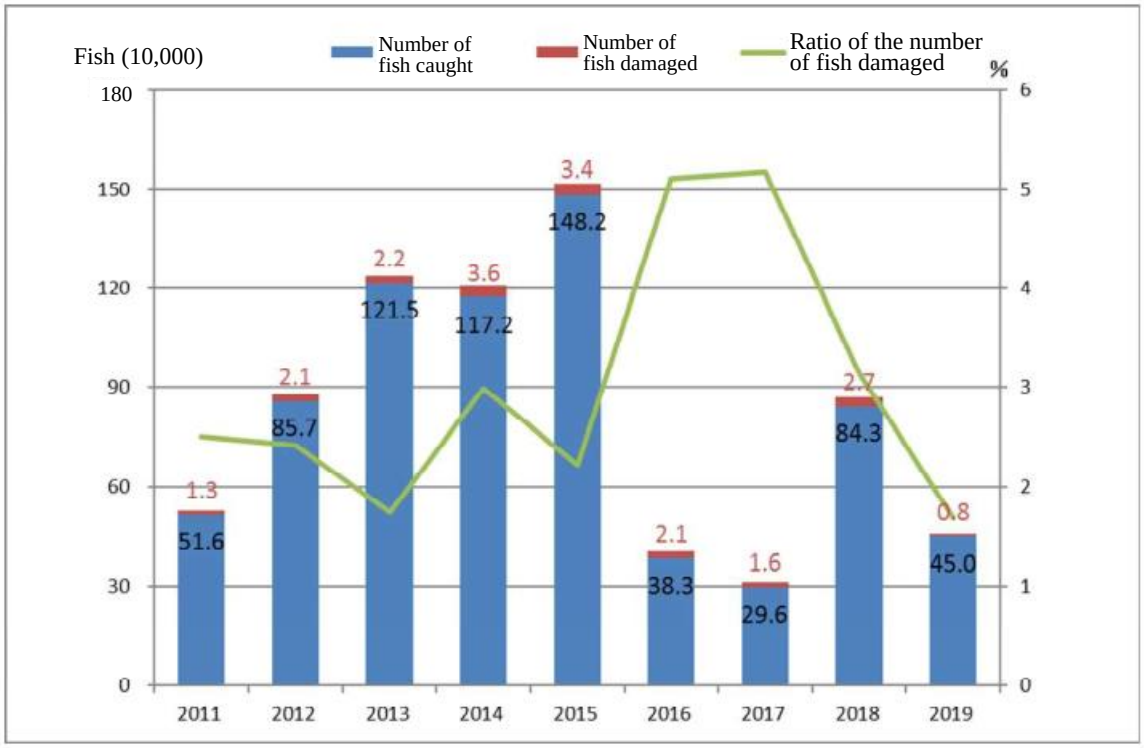



Fig. 21. Changes in damage-to-catch ratio across the Erimo area

○ Comparison of the damage in each sector showed that among the Toyo, Cape Erimo and Shoya sectors, which have had high damage-to-catch ratios to date, the Toyo sector had about the same damage-to-catch ratio as in the previous year, whereas the Cape Erimo and Shoya sectors witnessed lower ratios (Fig. 22).

○ The Ministry of the Environment conducted field studies of the damage done to the longline octopus fishing industry using boats.

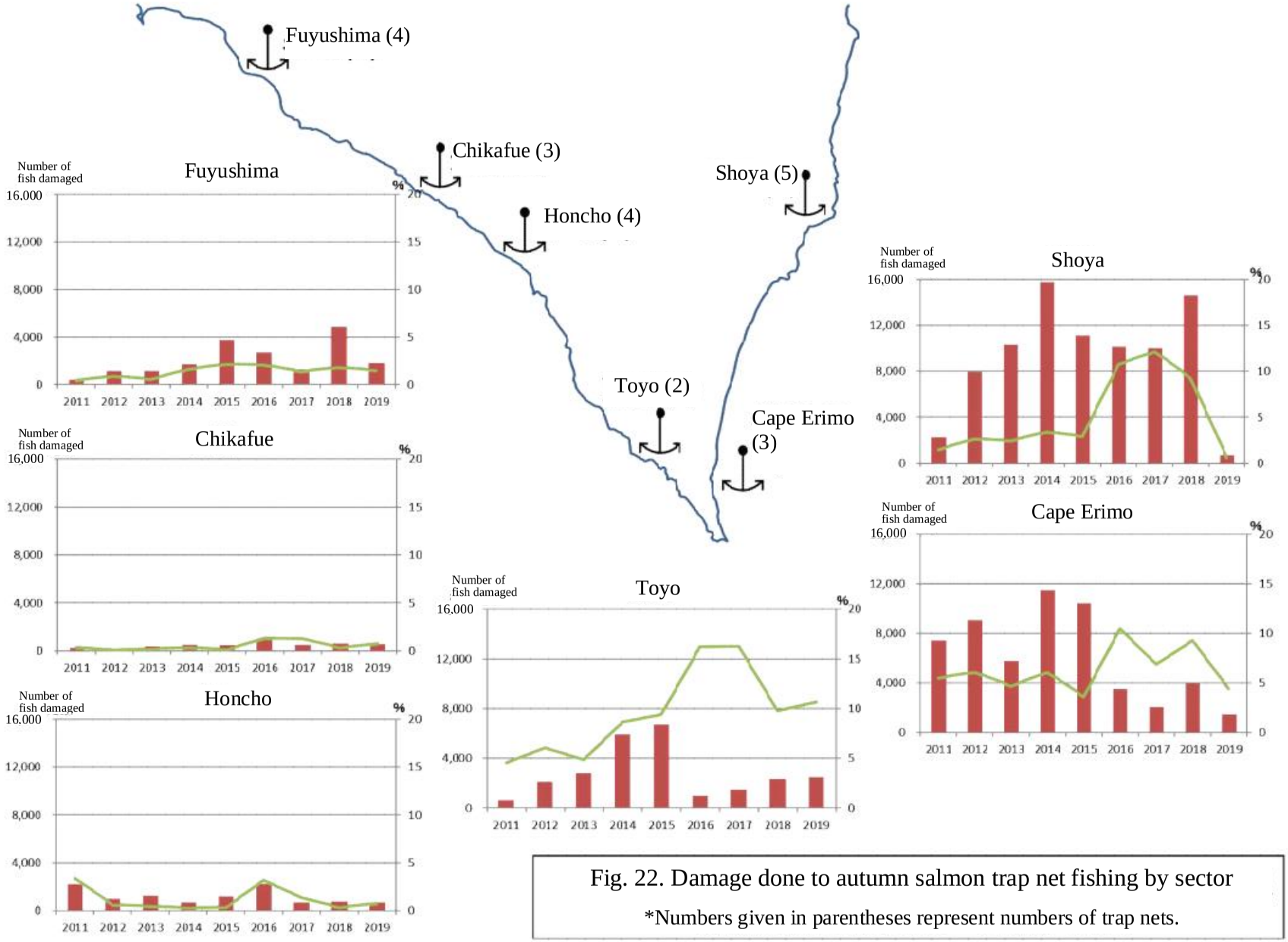



Fig. 22. Damage done to autumn salmon trap net fishing by sector

*Numbers given in parentheses represent numbers of trap nets.

<Other>

In recent years, there has been a trend towards fish other than salmonids being captured in the salmon trap net fishing in the Toyo and Cape Erimo sectors where the Ministry of the Environment has conducted surveys. Figures 23 to 25 show changes in catch by species (in the spring and autumn fishing seasons) from one trap net installed in the Toyo sector in the spring fishing season. Caught in large numbers other than salmonids were *Cleisthenes pinetorum* and mackerel in the spring fishing season and yellowtail in the autumn fishing season. No clear correlation has been found between their catch sizes and the days when seals were captured or bycaught (Figs. 23 and 24).

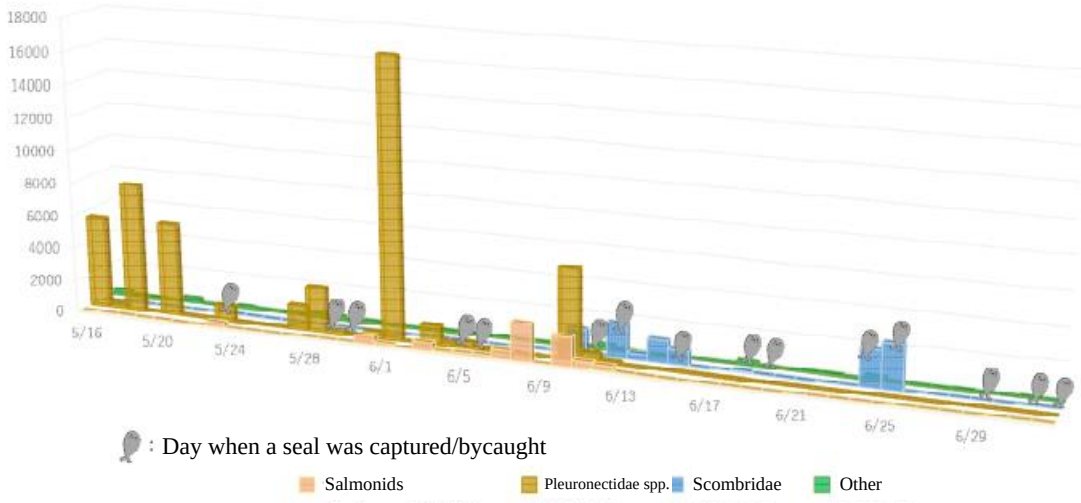



Fig. 23. Changes in catch by species in the spring fishing season (one salmon trap net in the Toyo sector)

*"Scombridae" were mostly dominated by mackerel although they also include other species statistically. "Other" refers to *Gadus macrocephalus*, *Theragra chalcogramma*, herring, sharks, etc.

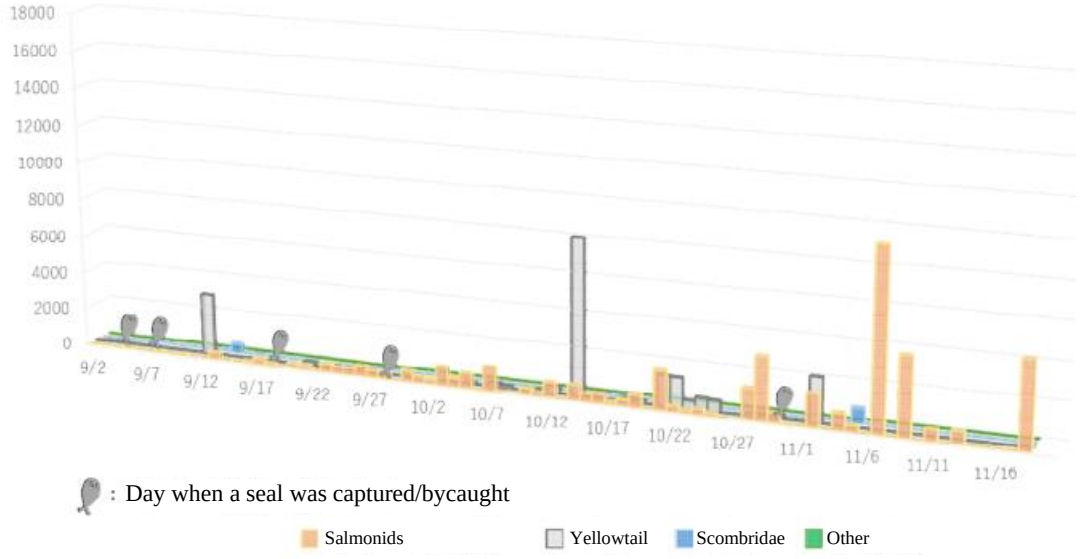
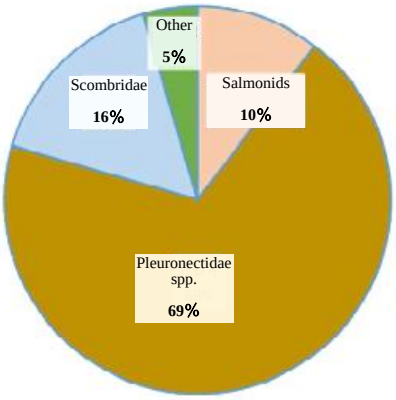



Fig. 24. Changes in catch by species in the autumn fishing season (one salmon trap net in the Toyo sector)

*"Other" refers to sharks, *Verasper moseri*, etc.

2019 spring fishing season




2019 autumn fishing season

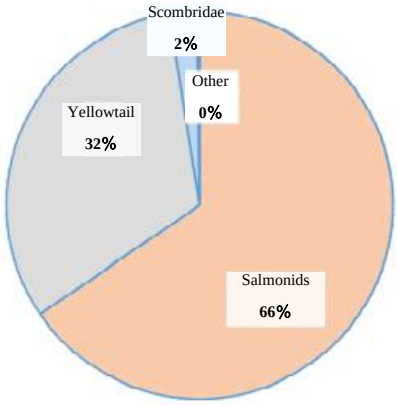



Fig. 25. Percentage of gross weight by species (one salmon trap net in the Toyo sector)
(Left: entire spring fishing season, Right: entire autumn fishing season)

<Assessment of the damage done to the fishing industry>

- Record poor autumn salmon catches that have continued since 2016 make it difficult to compare the catch size in 2019 with those in other years when the catch was good and to make a definitive assessment. However, the decline in damage-to-catch ratio in 2019 in areas that had been subjected to heavy damage, namely, the Cape Erimo and Shoya sectors, may be an indication of the effectiveness of the population management and damage prevention measures that have been implemented thus far. For this reason, it is necessary to continue to perform monitoring while adopting damage prevention measures to make a long-term assessment.

## 4. Public Awareness

(1) Transferring seals to aquariums and zoos

- In 2019, no seals were transferred, due to a lack of requests.

Table 4. Kuril harbor seals transferred to date

| | Institution | Number of individuals transferred |
|---|---|---|
| 2016 | Noboribetsu Marine Park Nixe (Noboribetsu City, Hokkaido) | 1 (1 female juvenile) |
| | New Yashima Aquarium (Takamatsu City, Kagawa) | 4 (3 female juveniles and 1 male juvenile) |
| | Ueno Zoological Gardens (Taito City, Tokyo) | 1 (1 female juvenile) |
| | Kamogawa Seaworld (Kamogawa City, Chiba) | 1 (1 male juvenile) |
| | Yokohama Hakkeijima Sea Paradise (Yokohama City, Kanagawa) | 3 (3 female juveniles) |
| 2017 | Yokohama Hakkeijima Sea Paradise (Yokohama City, Kanagawa) | 2 (1 female juvenile and 1 male juvenile) |
| 2018 | None | 0 |
| 2019 | 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, and public awareness

- In partnership with the Erimo Town Board of Education and as part of the regional study curriculum, the Ministry of the Environment offered classroom and extracurricular lessons at Hokkaido Erimo High School on topics including measures to prevent damage to the fishing industry caused by Kuril harbor seals (three times between September 2019 and January 2020).
- In addition to participating in the Hokkaido Seal Management Study Group hosted by the Hokkaido Government, a representative of the Ministry of the Environment made a presentation on Kuril harbor seal management in the Erimo area at the Hokkaido Seal Workshop held in Wakkanai City and Rebun Town on October 7 and 8, 2019.
- A skeletal specimen was provided to the National Museum of Nature and Science, Tokyo.
- In order to disseminate accurate information abroad, the FY 2019 Implementation Plan was translated into English and made available on our website: http://hokkaido.env.go.jp/post_34.html.

<Assessment of public awareness>

- With regard to the transfer of Kuril harbor seals to aquariums and zoos, it is considered difficult to transfer a large number of individuals due to institutional issues including the conditions of individuals to be transferred and limits to the number of individuals that can be accepted by host institutions. However, it is necessary to continue working to raise public awareness in partnership with related organizations.
- 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 for information exchange with experts and others. It is necessary to continue to find good opportunities for communicating information in the future.

**FY 2020 Project Implementation Plan**

**1. Damage Prevention Measures**

Based on results of the various damage prevention measures that have been implemented to date, the following initiatives 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, and 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 of the effects of ultrasonic wave repellent equipment

Experiments conducted until 2019 showed no noticeable effects of ultrasonic wave repellent equipment. The Ministry of the Environment needs to verify the effects of the equipment on factors such as a reduction in damage and the seal's risk-avoidance behavior based on results of the experiments, and to promptly decide how to use the equipment in consideration of its practicality in the fishing industry.

**2. Population Management**

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

(1) Because damage prevention alone is not enough to prevent increases in the scope of damage, Kuril harbor seals will be captured in cooperation with members of the fishing industry, with the aim of mitigating damage to the fishing industry (preventing increases in the scope of the damage, reducing the severe damage to salmon trap nets, etc.), while also preserving the sustainability of the seal population.

Furthermore, because research performed to date has clarified that not juvenile seals, which are susceptible to bycatch, but particular subadults and adults cause damage to salmon trap nets, the following methods will be employed toward establishing techniques to preferentially capture subadult and adult individuals that persistently attack trap nets and to reduce 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 preferentially 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.).
- ○ Depending on the population management situation, individuals hauling out on rocky shore reefs in the Cape Erimo area will be captured, as a supplementary measure, 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 preferentially capture damage-causing individuals, methods for distinguishing individuals that persistently attack salmon trap nets will be considered.
- ○ Implementation of capture experiments using small trap nets or gillnets by fisheries organizations in the Cape Erimo fishing port 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) The number of individuals to be captured will be determined based on the following considerations.

<Current habitat situation>

In recent years, the largest number of Kuril harbor seals hauling out at a single time 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 at a single time corrected using the haul-out ratio and discovery rate, is approximately 1,000 individuals. Further, the average population growth rate over the past 30 years has been 5% (Matsuda et al. 2015).

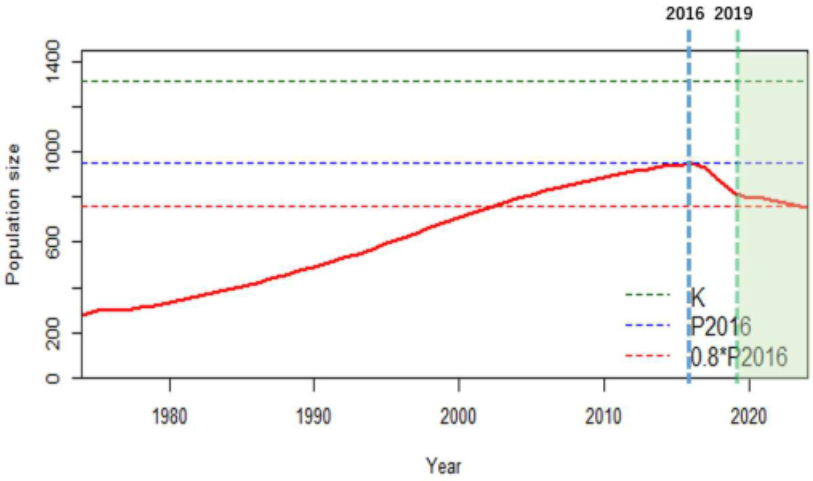
<Considerations essential for determining the number of individuals to be captured>

- ○ Examination will be conducted based on the number of individuals captured over the course of four years from 2016 to 2019, and the number of individuals to be captured will be determined based on the findings.

- The following will be considered when determining the number of individuals to be captured: mitigating damage to the fishing industry, while also guaranteeing population sustainability so 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 number of individuals to be captured must be adjusted flexibly in consideration of 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 number of individuals to be captured>

- In the current resource management simulation, which takes the number of bycaught individuals, infectious disease outbreaks and the like into account, the probability of extinction within the next 100 years is nearly 0% if the population in 2024—when Phase II of the Management Plan ends—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 2024 onward (Kitakado 2019). Therefore, the Ministry of the Environment has determined, through an estimation of population dynamics taking the population growth rate and other factors into account, that 50 seals are to be captured annually during Phase II of the Management Plan (Fig. 26. Results of the reassessment of the number of individuals caught). 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.
- Approximately 86 seals (excluding bycaught individuals) are to be captured in 2020. This number was calculated by adding to the annual 50 seals a shortfall of 36 from the 80 which had been estimated for 2019.
- The number of individuals to be caught by capture method will be adjusted flexibly depending on the seal capture situation; the shortfall in the past year, approximately 36 individuals, is to be captured using gillnets and the remaining 50 using salmon trap nets.




| Year | Number of seals caught | Number > 1 year old | Comparison with initial 2016 number |
|---|---|---|---|
| 2016 | 45 | 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 |

Fig. 26. Results of the reassessment of the 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). The number in and after March 2019 are estimates.

- Because there have been few successful captures made to date, and there is not sufficient data to show the effectiveness of damage reduction through seal capture, the Ministry of the Environment aims to gather the information necessary to establish monitoring procedures in order to gain a grasp of the effects of seal capture on the Kuril harbor seal population and on the reduction of damage to the fishing industry while also working toward improving seal capture techniques.

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

- The number of individuals to be captured in 2021 and beyond will be approximately 50 per year, in principle, and adjusted according to the excess or deficiency in the number of individuals captured in the previous year.
- The maximum number of individuals to be captured each year will be reexamined after hearing the opinion of the Science Committee.
- From a viewpoint of adaptive management, the information necessary for reexamining the plan will be gathered, a sustainability assessment will be performed, and a new Implementation Plan with the number of individuals to be captured will be established every year.
- During the five-year Management Plan period (at the end of roughly three years), the Ministry of the Environment will make an interim assessment of project implementation based on scientific knowledge and perform population management that fits the population’s situation.

(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 number of individuals to be captured may be flexibly 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 by verifying project implementation effectiveness and reflecting feedback about the population's situation into 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 drone or other unmanned aerial vehicles (UAVs). 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 the 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 to clarify 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, through gathering information about the installation times and duration of installation of rope grids in trap nets, and through the verification of persistent attacks on trap nets by individual identification and of changes in seal appearance rate due to capture.
- 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 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 conducted on Kuril harbor seal range, etc., using EM transmitters.
- ○ Specimens necessary for the analysis of infectious diseases, the population's genetic diversity and the like will be collected.

(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 to gain a complete understanding of coastal ecosystems, including fish fauna as the seal's food sources.

(5) Assessment of sustainability

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

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