Putting Gillnet Bycatch of Seabirds on the Map in Japan

Gillnet Bycatch Mitigation Report

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Introduction

Bycatch in fisheries has been identified as one of the biggest threats to seabird populations globally, with up to 400,000 seabirds killed each year in gillnet fisheries alone[1]. However, no effective mitigation measures have yet been identified for gillnet fisheries. A bycatch mitigation trial in collaboration with a local fisher from Teuri Island, Hokkaido, in 2016 confirmed that seabird bycatch occurs in this fishery, but data on seabird bycatch in Japan are severely limited.

In 2019, we conducted a new series of small-scale at-sea trials of potential mitigation measures in North-western Hokkaido (Figure 1). The core purpose of these trials was to start building collaborations with the local fishers of Haboro and Teuri Island, where seabird bycatch was recorded through the earlier work. It was particularly important to engage with Haboro-based fishers, where there are fewer bycatch records in spite of its proximity to Teuri Island, which hosts a breeding population of around 1 million seabirds of eight species and is managed by the same fisheries association. These small-scale trials sought to introduce mitigation ideas to fishers, identify any potential early issues and allow for a smoother transition to full-scale trials and bycatch data collection in the future. Demonstrating our readiness and ability to respond to the feedback and experience from within the fishing community is a highly effective means of promoting positive larger scale engagement with fishery communities.

In the timeframe of the project, five in-person meetings with fishers and local stakeholders were conducted: three in Haboro and two on Teuri . In relation to the small-scale at-sea trials, 12 fishing trips were conducted; eight from Haboro using traditional gillnets and testing LED lights and high-contrast panels, and four from Teuri Island using trammel nets and testing LED lights.

This report presents the results of these trials and the lessons learned. As these trials were small-scale, the data collected are not sufficient for robust statistical analysis – however, they provide cost-effective indications of the nature and potential impact of the bycatch issue within the local gillnet fishery, the effectiveness in this setting of mitigation measures trialled elsewhere and therefore help inform future mitigation actions. The trials have also served to nurture relations with the gillnet fishery community in northwestern Hokkaido.

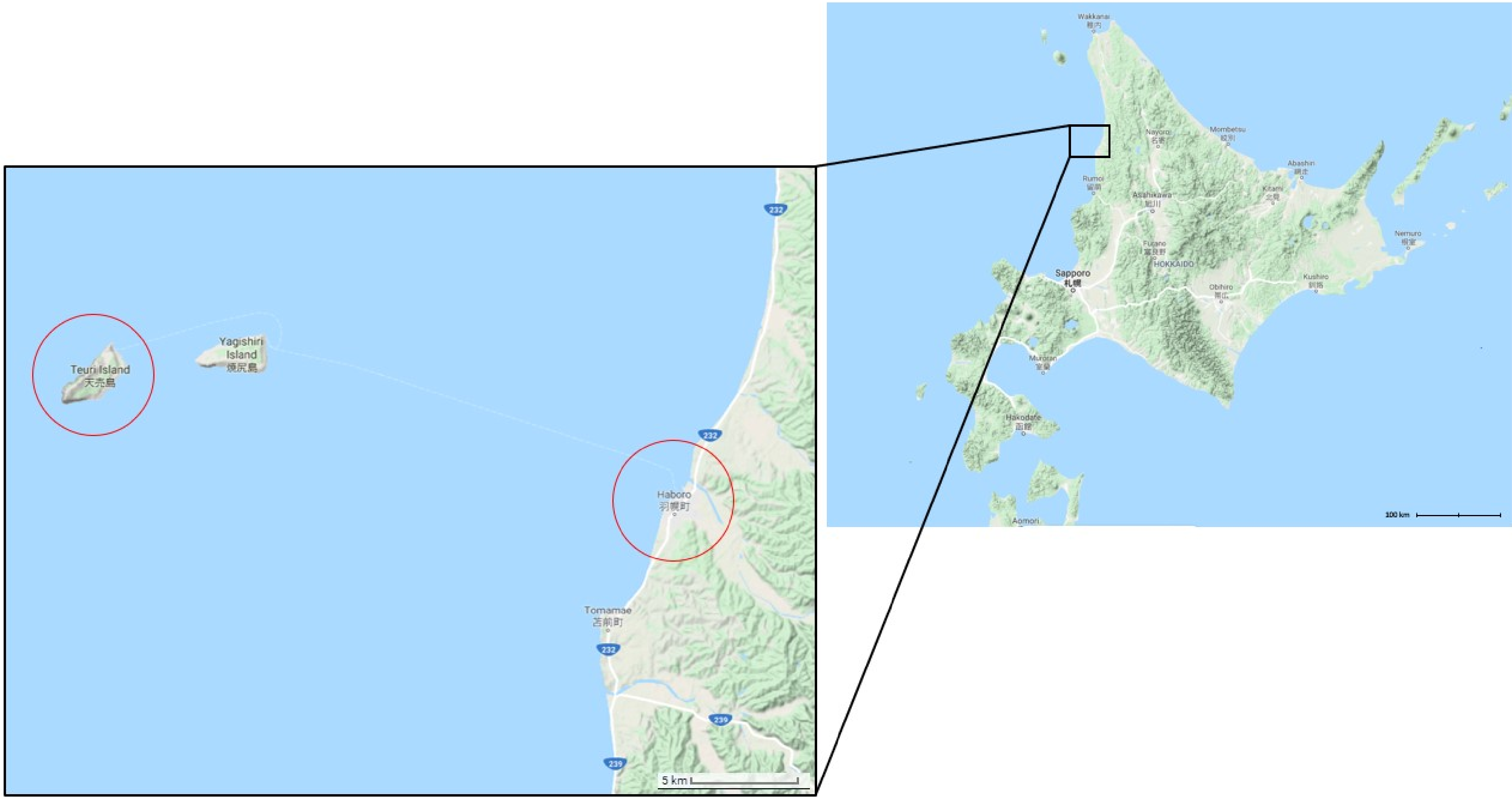

Figure 1 – Sites of fisheries engagement and at-sea trials - Hokkaido.

Building collaborative working relationships with fishers

Initial meetings with three fishers, two branches of Kita-rumoi Fisheries Association, and Haboro town council members were held in Hokkaido in August 2018. The concepts for at-sea trials to test striped fabric panels and LED lights (Figure 2) and trial timelines were discussed. Verbal agreements were secured from two gillnet fishers from Haboro (for panel and LED light trials in January-February 2019) and one trammel net fisher from Teuri Island (for LED light trials in May-July 2019).

Agreements with the Haboro fishers and preparation of gear for at-sea trials were completed by early January 2019 and followed by a site visit for a final check of trial methods with the fishers, local fisheries association, Ministry of Environment (MoE) and Haboro town council members. Discussion items included net configuration options and the data collection method (see Annexes A and B).

Post-trials interviews were conducted in May 2019 with Haboro fishers. Kita-rumoi Fisheries Association, Haboro town council members, and MoE were also present at the meeting. The main purpose of these interviews was to receive fisher's feedback on the deployment of the potential mitigation measures and maintain a collaborative relationship with them.

With support from the local fisheries association and Seabird Center in Haboro, we made tangible progress in developing collaborative working relationships with the fishers. The Teuri Island fisher in particular has been very cooperative since the previous project to trial striped fabric on trammel nets and has expressed interest in engaging on further mitigation trials in the future.

Figure 2 - LED lights and light cases attached to an experimental gillnet (left), Striped fabric panel (center) and panels attached to an experimental net (right).

At-sea trials - Methodology

At-sea trials involved the deployment of potential mitigation measures into two types of nets: "traditional" gillnets (single wall of netting) and trammel nets (three walls of netting). A total of three fishers were collaborating in these tests, two based in Haboro and using "traditional" gillnets (gillnets thereafter) with deployment of high-contrast panels and LED lights, and one fisher based in Teuri Island and using trammel nets with LED lights.

The LED lights used in these trials, known as "net-lights" (Fishtek Marine, Devon, UK) were diffusing a Green continuous light of 520 nm wavelength and outputs of 1.6 lumens. These lights were enclosed on a specifically designed translucent holster (Figure 2), to prevent entanglement in nets and allowing them to go through net hauling systems safely. They were designed to switched on automatically when immersed in water. High-contrast panels were made of 0.6 m squares of vertical black and white nylon stripes (each 60 mm wide), cut into strips to allow the flow-through of water and reduce drag on the net (Figure 2).

Gillnet trials:

Total of eight fishing trips to trial both mitigation measures were conducted between late January and late February 2019 off the coast of Haboro. The target species was Japanese fluvial sculpin, at a water depth of 18-23m. Although fluvial sculpin fishery season in this area usually ends by late January, the duration of the mitigation trials was extended into February due to logistical constrains.

- **LED lights** - several gillnets were tied together to make a set, as per the normal operation of the fishers, giving a total set length of 910m (Figure 3). The set was divided into 3 sections: 1) a 210m experimental section with 21 LED lights attached every 10m on the headline, 2) a 490m section between the experimental and control sections to avoid light "contamination" of the control section, and 3) a 210m control section without LED lights. The experimental and control sections were identical, except that the size and number of buoys was increased on the experimental sections to compensate for the weight of LED lights. Soak time of the net (amount of time the net was kept under water) varied from 22 to 90 hours/trip depending on weather conditions.

- **Panels –** several gillnets were tied together to make a set, giving a total length of 140-840m (Figure 3). The set was divided into 3 sections: 1) a 70m experimental section with 18 panels attached every 4m on the upper part of the net, 2) a 70m control section without panels, and 3) a 0-700m section to meet fisher's desired net length. Soak duration of the net varied from 20 to 90 hours/trip depending on weather condition. This set-up was slightly different to the light set-up as there was no risk of 'light contamination' into an adjacent control set from net panels.

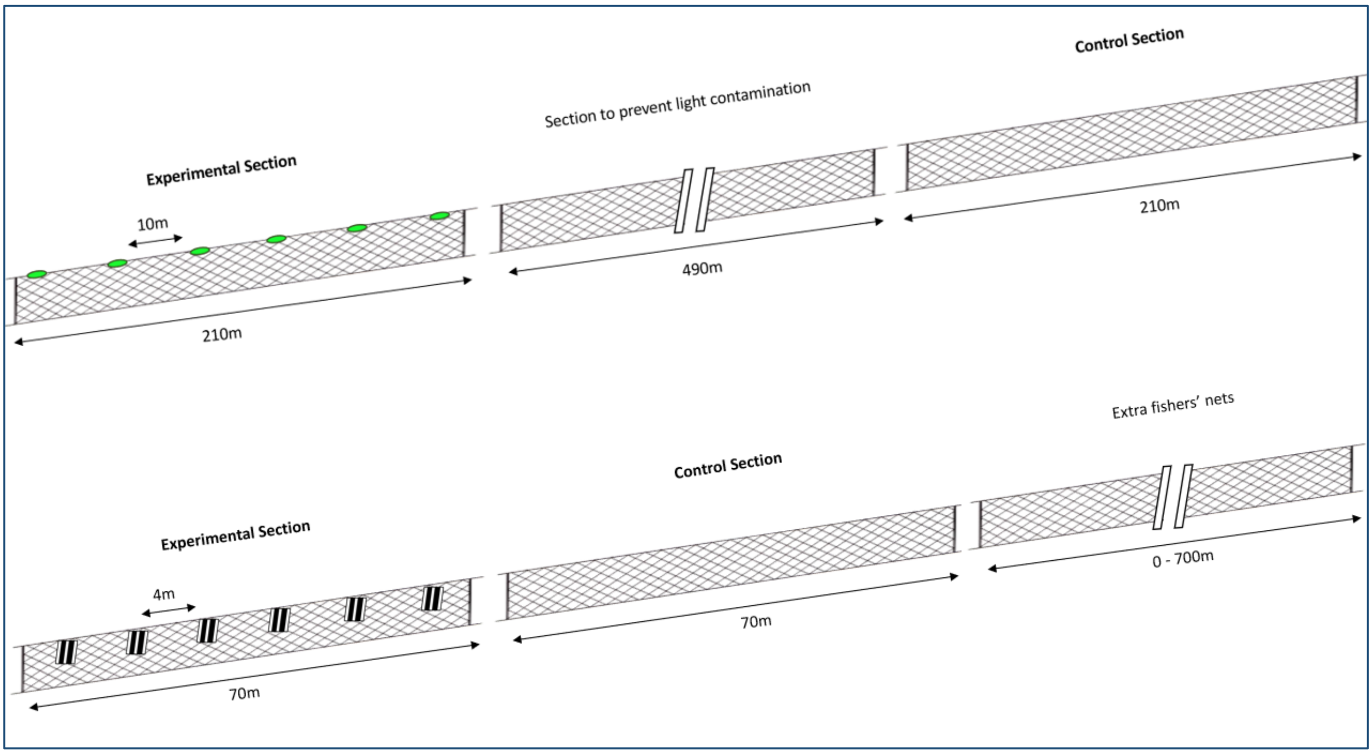

Figure 3 – Experimental set-up for gillnet trials; top diagram shows LED light set-up, the bottom diagram shows the high-contrast panel set-up

Trammel net trials:

Four additional fishing trips off Teuri Island - approximately 28 km northwest of the town of Haboro - were conducted from May to mid-August 2019, involving the deployment of trammel nets with LED lights attached. The targeted species were mostly rockfish, olive flounder, Lindberg skate (ray), and giant Pacific octopus at depths of 18-50 m. One of the project members accompanied the fisher during the first trip in May 2019 (Figure 4 and 5).

- **LED lights -** several trammel nets were tied together to make a set with a total length of 3,075 – 3,600m (Figure 6). The set was divided into 3-4 sections: 1) a 225m experimental section with 23 LED lights (the same lights used during the trial in Haboro) attached every 10m on the headline, 2) >200m section between the experimental and control sections to avoid light “contamination” of the control section, 3) a 225m control section without LED lights, and 4) additional nets not associated with the trial. Nets used in the experimental and control sections were otherwise identical, except that the size and number of buoys was increased in the experimental section to compensate for the weight of LED lights. During one of the trips, a set of nets was divided into two sets, which the fisher occasionally does depending on the fishing location, tide, and weather.
  In this case, the experimental and control sections were kept >200m apart. The soak time varied from 9 to 11 hours/trip. Nets were set in the early afternoon and retrieved around midnight.

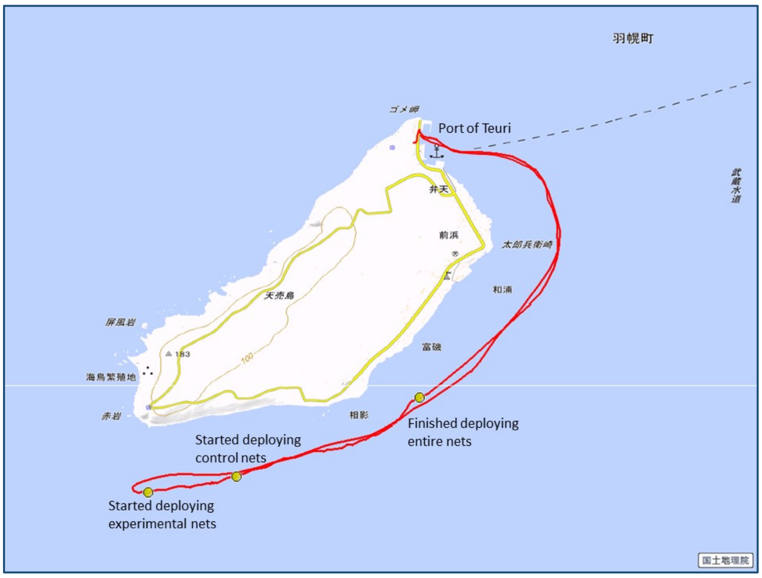

Figure 4 - A track of a trammel fishing trip around Teuri Island, Hokkaido in May 2019.

Figure 5 - A trammel fisher and his assistant sorting nets kept in large baskets. Each basket holds about three nets.

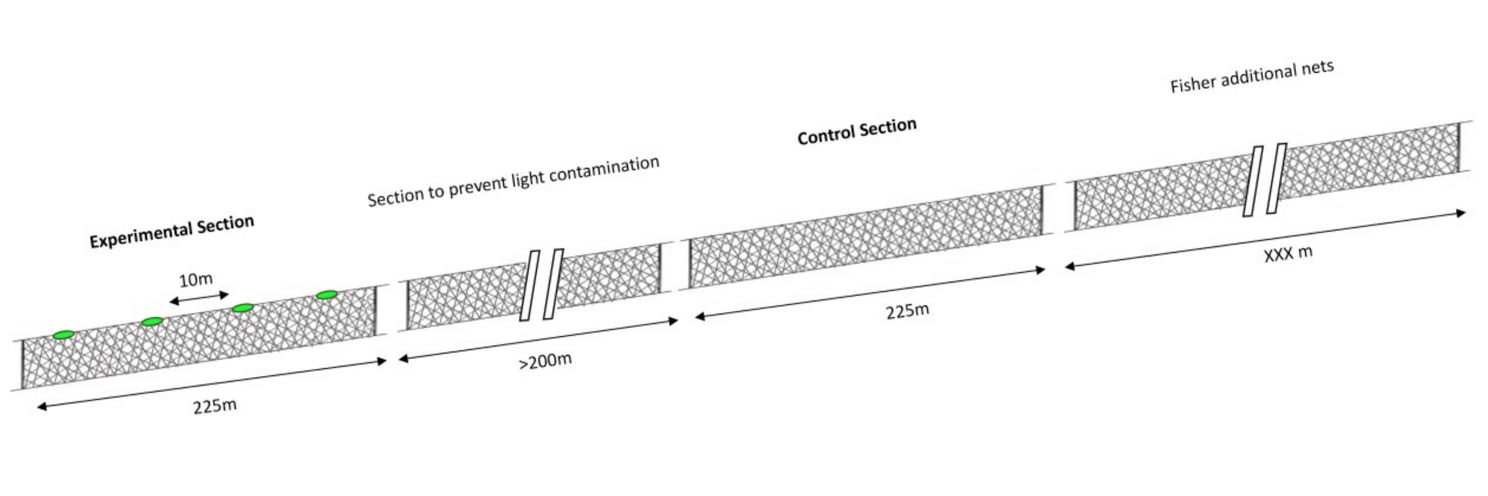

Figure 6 – Trammel net trials' setting.

At-sea trials - Results

In the Haboro gillnet trials, seabirds were bycaught in both the experimental and control sections of the net, with no apparent effect of the mitigation measures on bycatch levels (5 birds bycaught in the net with LED lights attached and 7 in the control section; 4 with panels attached and 3 in control, Table 1). Bycaught species included spectacled guillemot, pelagic cormorant, arctic loon and Pacific loon. For trammel nets, no seabird was bycaught in either the experimental or control section of the net during the four trips.

In nets provided by the fishers (additional to the paired treatment/control trials), a total of further 15 birds were bycaught in Haboro and Teuri. The fishers noticed the experimental section sometimes caught more fish, suggesting LED lights might attract certain fish species.

Due to the small-scale nature of these trials, the results are only for illustration purposes and cannot be extrapolated to the wider fishery. Bycatch rates presented here are limited to the specific times of year. Thus data collection with longer timeline (e.g. throughout a year) would be desirable for better assessment of bycatch rates.

Table 1 – Seabird bycatch rates recorded during our small-scale trials.

Net type	Treatment	Bycaught number	Seabird bycatch rate [birds/km net/24 hrs]
Gillnet	LED lights	5	0.68
	Control	7	0.96
Gillnet	High contrast Panels	4	1.66
	Control	3	1.24
Trammel net	LED lights	0	0
	Control	0	0

At sea trials - practical lessons

According to the fishers, the LED lights did not cause major problems during setting or hauling the net, though the trammel fisher did intentionally run his vessel slower when setting the experimental nets in an attempt to reduce the risk of lights being damaged by hitting the stern of the vessel. The lights were quite bulky and heavy, which made folding the experimental section of the net harder than the control section. As noted above, the extra weight of the lights also meant fishers had to add extra buoys to their net, to maintain the appropriate hanging ratio (Figure 7).

There were some technical issues with the lights: some lights did not turn off until long after some of the fishing trips (Figure 7), suggesting problems with the light sensor, or potentially because the lights froze due to the low ambient temperature (average was below -4°C in Haboro). Although the expected battery life of the LED lights is 1000 hours in water, the batteries ran out after only two fishing trips, which required battery replacement to complete the trial. After replacing batteries again, all the lights seemed to work, but some lights occasionally stopped working. The fisher noticed that non-functioning LED lights were rusty and metal parts touching the batteries were corroded, suggesting some of the light units were not completely watertight (Figure 8). This led the fishers to conclude that these lights would require some improvements for further experiments or for actual fishing operations. The preference would be for alternative or improved LED lights if/when more light trials were conducted.

Fishers that trialled the striped fabric panels thought they were easy to use, with no entanglement issues or issues relating to the absorption of too much water making net handling difficult. The fisher wondered if the fabric panels were effective in attracting fish since some fish were caught in sections where the fabric panels were attached. The trial was, however, too small scale to determine if the fabric panels resulted in improved catch rates. In Haboro, the high-contrast panels sometimes froze before reaching fishing grounds. Thus, the fisher had to pour sea water on the panels to thaw them. No other issues with the panels were reported by the fisher.

A B

Figure 7 - A: An LED light and a buoy attached to the top of a trammel net. B: An LED light towards the bottom of a basket, still lit after more than one hour from hauling the net from the water.

Figure 8 – One of the non-functioning LED lights with rust visible inside the unit. When it was opened, some water ingress was apparent.

Conclusions

Although the results of these small-scale at-sea trials cannot be extrapolated to the wider fishery, they do validate the belief that bycatch from gillnet fishing in the study area is of concern in terms of potential impacts to seabirds - including a number of threatened species. This substantiates the focus of our wider project to identify and increase our understanding of key potential hotspots for bycatch in Japan, and the collection of further data in these areas.

The lack of positive indications of effectiveness from the trialled mitigation measures (which confirms findings from Baltic Sea[2]), as well as the technical issues experienced during the LED trials, calls for further research, development and testing of novel technical measures for gillnet fisheries in Japan and elsewhere.

While this project did not support the identification of an effective technical mitigation solution to the bycatch issue, it does help to narrow down potential solutions and, crucially, has created fertile ground for further collaboration with Japanese coastal fishing communities. It is appropriate and timely to build on this momentum and to propose new actions to tackle seabird bycatch in Japanese coastal gillnet fisheries. We believe the following actions would greatly contribute to identify effective mitigation measures and build wider engagement with industry on gillnet bycatch:

- Explore the underwater behavior of seabirds in a controlled environment to identify potential gillnet deterrent devices: This would be informed by the recently produced RSPB report "A cognitive approach to reduce seabird bycatch in gillnets" as well as ongoing research on effective above-water mitigation approaches, which have shown promising outcomes (based on effective bird deterrents deployed at airports[3]) but never been explored with auk species. We have identified an aquarium as an interested partner for this action.

- Conduct full at-sea trials of the most promising mitigation measures: This would be informed by the above, as well as our developing mitigation work elsewhere (notably in the Baltic Sea). Choice of test sites would be informed by the hotspot map analysis (see Hotspot Map Report for details) and our existing ties with local fishers. We hope to test the mitigation measure through paired trials on commercial gillnet vessels. Number of paired trials would be of sufficient scale to establish (statistically) the effectiveness of mitigation.

- Collect baseline data of gillnet fisheries in collaboration with fishers: Basic fisheries data (target species, location, depth, catch) and information on seabird bycatch throughout fishing seasons would be very valuable to evaluate geographical and temporal patterns of bycatch.

- Engagement with fishing communities: Strengthen our collaboration with north-western Hokkaido fishers, and engage in further grassroots activities with new fishing communities in areas identified in the bycatch hotspots analysis.

Acknowledgement

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Annex - Sample Forms in Japanese for at-sea data collection & net deployment planning

Annex A. At-sea trial data collection form with example data. It was shown to the fishers in Haboro to explain how the data form should be filled out.

LEDライト実験データ記入シート（記入例）

実験No. 3

氏名

1. 網の設置日時	2月12日16時	7. 船の大きさ	15 m
2. 網の引揚日時	2月13日10時	8. 出航した港	羽幌漁港
3. 網を設置した水深	20－30 m	9. 漁業対象種	カジカ

4. 水揚げ開始時の緯度・経度

N43°. 25.77, E142°.21.06

5. 水揚げ終了時の緯度・経度

N43°. 25.70, E142°.21.03

6. とれた海鳥の写真 （ある・ない）

実験網 （パネルあり）		コントロール網 （パネルなし）	
網の高さ	目の大きさ	網の高さ	目の大きさ
5 m	5寸	5 m	5寸
1反の網の長さ	設置数	1反の網の長さ	設置数
70 m	3 反	70 m	3 反
対象魚種1	対象魚種2	対象魚種1	対象魚種2
カジカ		カジカ	
水揚げ量	水揚げ量	水揚げ量	水揚げ量
10 kg	kg	20 kg	kg
その他捕れた魚種と重量(kg)		その他捕れた魚種と重量(kg)	
・海鳥は とれなかった ・とれた → 生 ・ 死		・海鳥は とれなかった ・とれた → 生 ・ 死	
・とれた場合、 網の（ 上・ 真中 ・下 ）にかかっていた		・とれた場合、 網の（ 上・ 真中 ・下 ）にかかっていた	
・とれた海鳥種と数		・とれた海鳥種と数	
ウミウ 2羽		ウミウ 1羽	
ウトウ 3羽		ウトウ 5羽	

実験・コントロール網以外の網について（反数、位置、とれた海鳥種と数など）

・実験網とコントロール網の間に1反 70 mの網を 3 反取り付けた。

・海鳥は とれなかった ・ とれた → 生 ・ 死 ・とれた場合、 網の（ 上・ 真中 ・下 ）

・とれた海鳥種と数 ウミウ4羽

Annex B. Configuration options of experimental and control nets for the small scale at-sea trials in Haboro, Hokkaido. The diagrams were shown to the fishers to explain how exactly the nets should be tied to fishers nets.