

LOL 2021-C MMO Monitoring Program Report



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Iriarte V., Arkhipkin A., Blake D. (2018). License X-2017 Pinniped Bycatch Mitigation Report: Implementation of seal exclusion devices (SEDs) in the Loligo (*Doryteuthis gahi*) fishing fleet during the 2nd season 2017. Fisheries Department, Directorate of Natural Resources, Falkland Islands Government, Stanley, Falkland Islands. 28 pp.

Iriarte V., Pompert J. (2016). Pinniped Bycatch Report: Squid & Finfish Trawlers. Preliminary information on the bycatch of pinnipeds in the Falkland Islands. Fisheries Department, Directorate of Natural Resources, Falkland Islands Government, Stanley, Falkland Islands. 13 pp.

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1. Introduction

The Falkland Islands Patagonian squid (*Doryteuthis gahi*) fishery is currently the only bottom-trawl fishery in the Southwest Atlantic with full observer coverage and Seal Exclusion Device (SED) usage (Iriarte *et al.*, 2020). This aligns with the 2030 Agenda and Sustainable Development Goals of the United Nations, and supports the *D. gahi* (hereafter LOL) product potential eco-labelling and its possible expansion to new markets.

The Pinniped Observer Program is a result of a partnership between the Falkland Islands Government (FIG) and the Loligo Producers Group (LPG), with Marine Mammal Observers (MMO) recording South American sea lion (*Otaria flavescens*, hereafter OTB) and South American fur seal (*Arctocephalus australis*, hereafter ARA) abundance, behaviour, net interactions, live deck releases, live SED escapees and incidental mortalities in at least three trawls per day. Following discard management policy that came into effect on 1 January 2021, observations of the discard management plan aboard and monitoring the occurrence of organic material in the water was added to the primary MMO duties. Secondary MMO activities include monitoring bird scaring lines (BSL) efficiency, recording seabird interactions with the fishing gear, mortalities and carcass collection.

Due to COVID-19 pandemics and late vessel arrivals, some flexibility was introduced by FIFD and four vessels were allowed to access the fishing grounds during their 14-day quarantine. As these vessels did not have an MMO aboard, they should use SED from the start of the season. The LOL 2021-C season started on 26 February 2021, with 12 MMO monitored and two unmonitored vessels. The two remaining vessels arrived during the second week of the fishery, beginning their fishing operations straightaway. Full observer coverage was achieved on March 15th.

The 16 MMOs were supplied by MRAG (U.K) and were briefed at the Falkland Islands Fisheries Department (FIFD) on 23 February. The first part of the briefing focused on the Seabird and Marine Mammal Bycatch Mitigation Program, including an introduction to local otariids (eared seals, OTB and ARA) and seabird species, identification, behaviour, types of interactions with fishing vessels and mortality mitigation methods. The second part concentrated on discard management, monitoring interactions, extracting information from carcasses, data gathering and recording, biometrics of LOL and Patagonian toothfish (*Dissostichus eleginoides*, hereafter TOO), and License conditions.

2. Objectives

The objective of this report is to present all the data collected during the 2021-C season regarding marine mammal and seabird interactions with the LOL fleet and to evaluate the

mortality mitigation methods in place and the discard management implementation process. Information includes data and samples collected by the MMOs and collated by the FIFD.

3. Methods

3.1 *Manoeuvre monitoring*

MMOs principal duty is to monitor at least three stations per day (with one station comprised by a shoot and a haul) to record seal abundance and behaviour, and to observe any seal and seabird bycatch. As shoots and hauls represent the most critical moment for both seabird and marine mammal incidental mortality and as seabird bycatch is extremely cryptic and very difficult to detect (Parker *et al.*, 2013a; Iriarte & Pompert, 2016; Küepfer, 2016b), MMOs are required to carry out their observations principally from the gantry. Observer monitoring from the bridge, bridge wings and deck do not provide enough view to properly assess seabird and seal interactions with the fishing gear; however monitoring from the bridge/bridge wings may occur during night hours and unsafe weather conditions.

3.2 *Bird scaring lines monitoring*

The LOL fleet has been directly involved in the development and implementation of both *tori lines* (Sullivan *et al.*, 2006; Snell *et al.*, 2012) and the *fixed aerial array* (Parker, 2012; Parker *et al.*, 2013b). Although *tori line* (TL) requirements are included in the License conditions, specific *recommendations* for the fixed aerial array (FAA) had been produced by the FIFD (Küepfer, 2016a, 2017, 2018) and general FAA conditions were introduced for season 2021-C. As different FAA models have been fitted on vessels, in order to evaluate their performance and to compare them to TL, MMOs are required to carry out one hour of BSL daily observations from the gantry, preferably while the vessel is processing catch. This also allows to monitor discard management and observe discard storage tank performance. At the beginning of the observations the MMO estimates the overall vulnerable seabird abundance within 200 m astern, followed by 40 m estimations in 10 min periods and counting seabird presence within 2 m of the warp-water interface during each period. Vulnerable seabirds comprise species with large wing-span, which are prone to fishing gear entanglement (i.e. albatrosses and big petrels). Although the most common species interacting with the LOL fishery are the black-browed albatross (*Talassarche melanophris*, hereafter DIM), the giant petrel species (*Macronectes giganteus* and *Macronectes halli*, hereafter MAX) and the white-chinned petrel (*Procellaria aequinoctialis*, hereafter PRO), other species can also interact with the vessel, like Wilson's storm petrel (*Oceanites oceanicus*, hereafter OCO), the common diving petrel (*Pelecanoides urinatrix*, hereafter PEL) and the imperial cormorant (*Phalacrocorax atriceps*, hereafter COR).

3.3 *Seabird and marine mammal bycatch mitigation measures*

In order to mitigate seabird and seal mortality in the fishery, Part 2 of the license conditions mandate the use and maintenance of BSL, prohibit discarding during manoeuvres (i.e. shoot, turn, haul), requires to clean the net thoroughly prior to shooting, and establishes parameters for discard management as a long-term seabird bycatch mitigation measure. License conditions also describe three SED models approved by the FIFD, mandating its usage after two seal mortalities within the fleet. Furthermore, license conditions emphasize that “*during the haul crew should make their bests efforts to detect seals trapped in the net and facilitate their escape whilst the SED is still in the water, by working cables/bridles back and forth*”.

As overall compliance to good practices is a key factor to megafauna bycatch mitigation efficiency, good practices aboard are also monitored by the MMOs.

3.4 *Mortalities & necropsies*

Observers must report seal mortalities to the FIFD via WhatsApp as soon as they occur, providing photographs of the head and genital area, and possible cause of mortality. If female, observers are instructed to preserve the carcass for posterior necropsy, while male carcasses are usually marked (partially cut/complete removal of the left pectoral fin) and dumped overboard.

In the case of seabirds, all carcasses recovered should be preserved frozen for posterior necropsy. Collected individuals are then aged following Prince and Rodwell (1994).

3.5 *Data reporting*

Collected data by the observers are daily entered in an excel file which is sent to the FIFD, MRAG and the respective fishing companies twice a week (Mondays and Thursdays). BSL data is entered into a separate file and sent once a week (Fridays).

4. Results

4.1 *Manoeuvre monitoring*

A total of 2341 trawls were carried out by the fleet, of which 2283 (97.5%) were monitored in at least one manoeuvre (i.e. either a shoot or haul). Of a total of 2270 shoots observed, 1801 (79%) were monitored from the gantry, 400 (17%) from the bridge/bridge wings, 21 from the stern deck (1%), and 48 from elsewhere (2%) (Fig.1). Regarding the 2283 hauls observed, 2076 (91%) were monitored from the gantry, 184 (8%) from the bridge/bridge wings and 23 (1%) from elsewhere (Fig.1).

Fishing effort was mostly carried out south of 52°S, with 54% of the trawls taking place in the south and 46% in the north. The most visited grid squares in the south were XVAK (436 shoots; 473 hauls), XVAL (272 shoots; 313 hauls) and XVAJ (276 shoots; 199 hauls), while

in the north most of the fishing activity took place within XPAP (343 shoots; 288 hauls), XNAQ (182 shoots; 199 hauls), XNAP (166 shoots; 178 hauls) and XQAP (138 shoots; 155 hauls) (Fig.2).

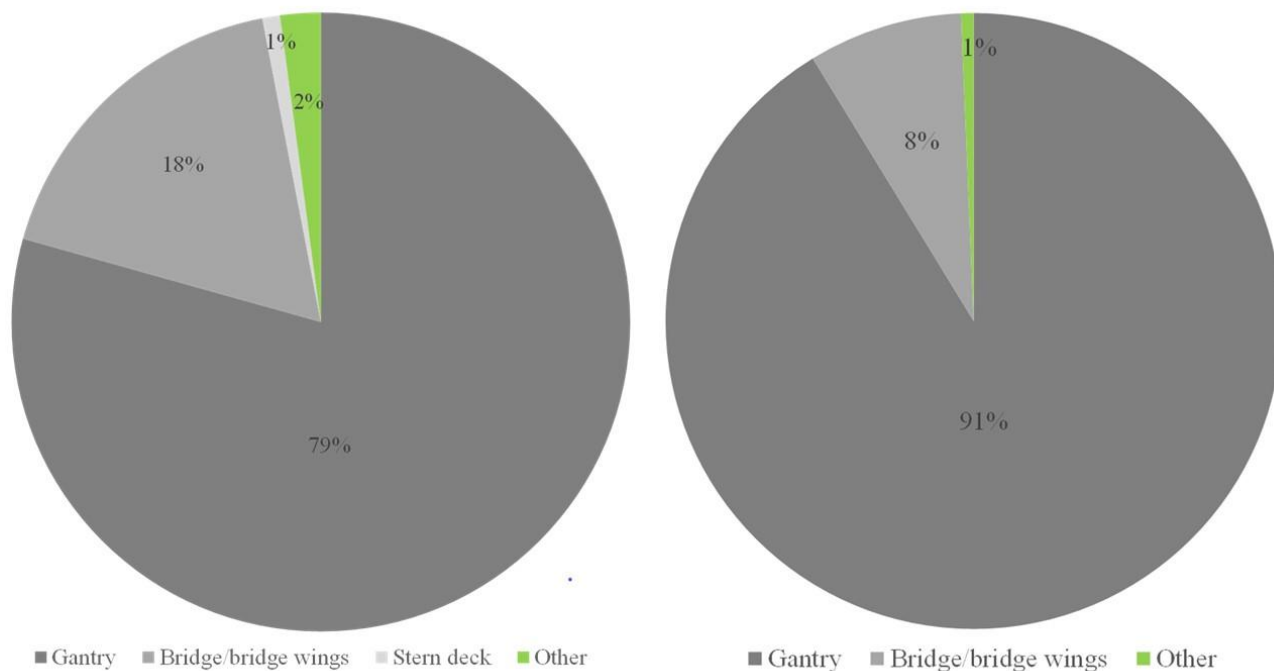


Fig.1. MMO manoeuvre position in shoots (left) and hauls (right).

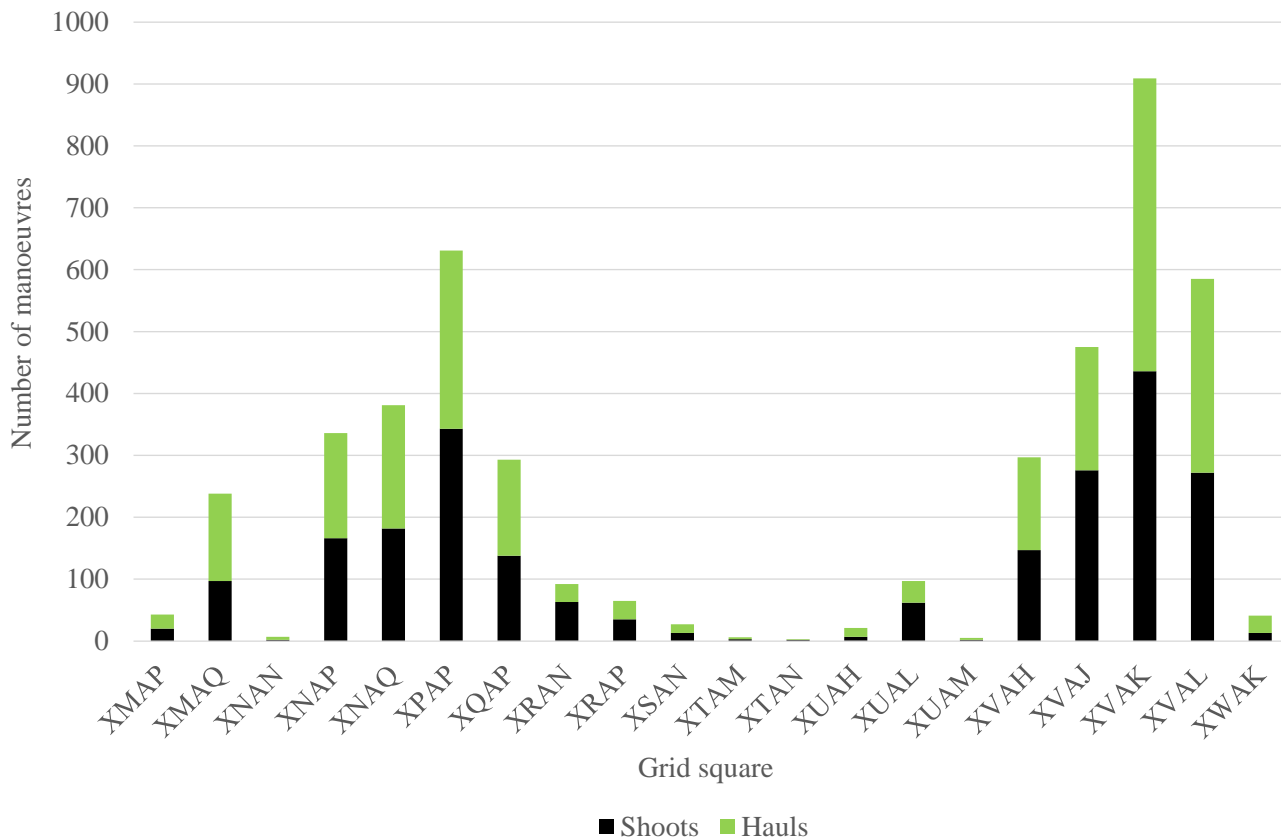


Fig.2. Fishing effort per grid square.

4.2 Pinniped sightings

A total of 2820 seals [696 OTB, 2047 ARA, 77 unknown species (UN)] were seen in 1171 occasions, of which 31% occurred north of 52°S and 79% south of 52°S (Table 1). The southern region concentrated 79% of the total seal abundance, with ARA representing 88% of the individuals sighted (Table 1).

Overall pinniped attendance to vessels increased throughout the season, with sighting peaks correlating to increased fishing effort ($\geq 90\%$) south of 52°S. The first peak was recorded on the 2nd fishing week (26 Feb-4 Mar), with 230 seals (167 ARA, 57 OTB, 6 UN). Between the 3rd and 5th fishing weeks (12 Mar-1 Apr) vessels concentrated their activity north of 52°S, which reflected in increased OTB sightings and minimum ARA attendance to vessels (Fig.3). However, in the 6th week (2-8 Apr) 32% of the fishing effort transferred back to the south, ARA becoming the dominant species once again. In the following week (9-15 Apr), 75% of effort was allocated south of 52°S, ARA sightings strongly increased after the closure of the northern fishing grounds on 14 April (Fig.3). The second sighting peak was recorded on the 8th week (16-22 Apr), with 748 seals seen attending vessels (524 ARA, 23 OTB, 19 UN) and slightly decreasing on the last week (Fig.3).

Table 1. Pinniped sighting and abundance per region.

Region	Species	N° sightings	N° individuals
North 52°S	OTB	286	480
	ARA	59	81
	UN	14	19
Sub-total north		359	580
South 52°S	OTB	141	216
	ARA	637	1966
	UN	34	58
Sub-total south		812	2240
TOTAL		1171	2820

4.2.1 Pinniped attendance to vessels and behaviour

Of the 2820 seals sighted, 2023 (1443 ARA, 539 OTB, 41 UN) were observed during hauling, comprising 72% of the individuals recorded. The remaining individuals (797) were seen during trawling (12%), shooting (8%), steaming (4%) and turning (4%). In 91% of the hauling attendance, seal behaviour was strictly related to foraging, with both ARA and OTB directly targeting lost catch around the fishing gear (51%) and eating from the net (39%) (Fig.4).

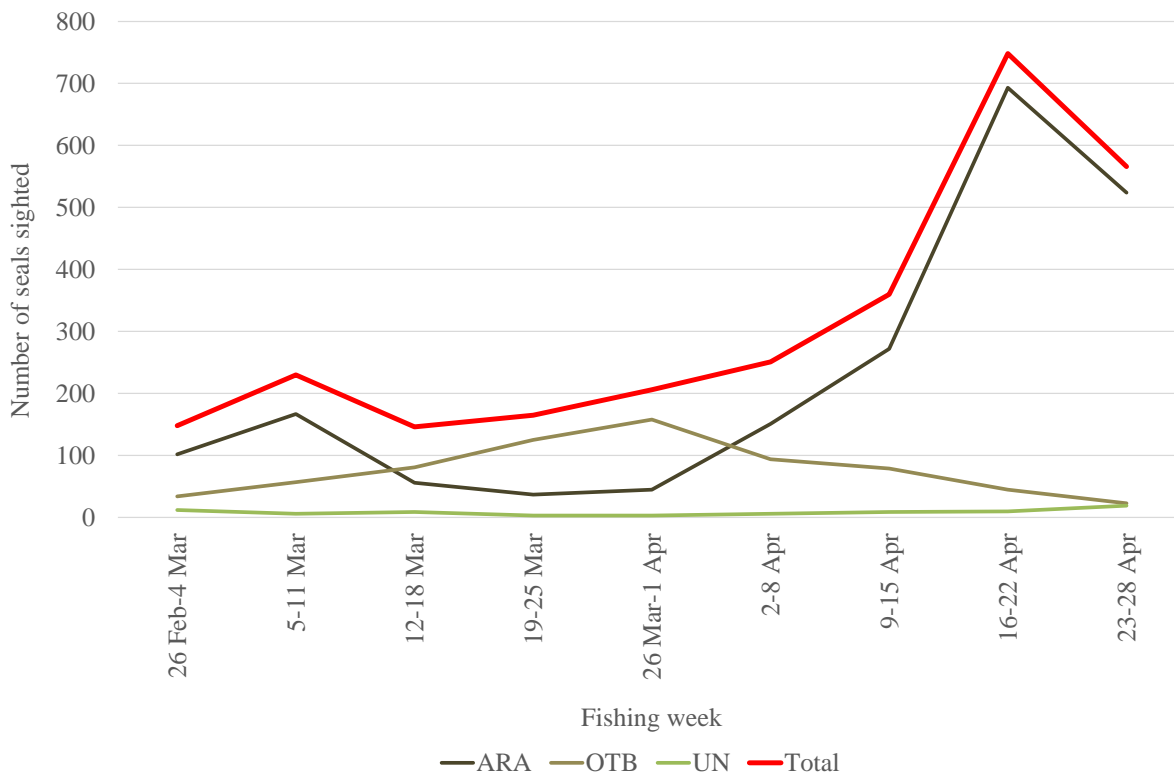


Fig.3. Cumulative pinniped sightings per fishing week.

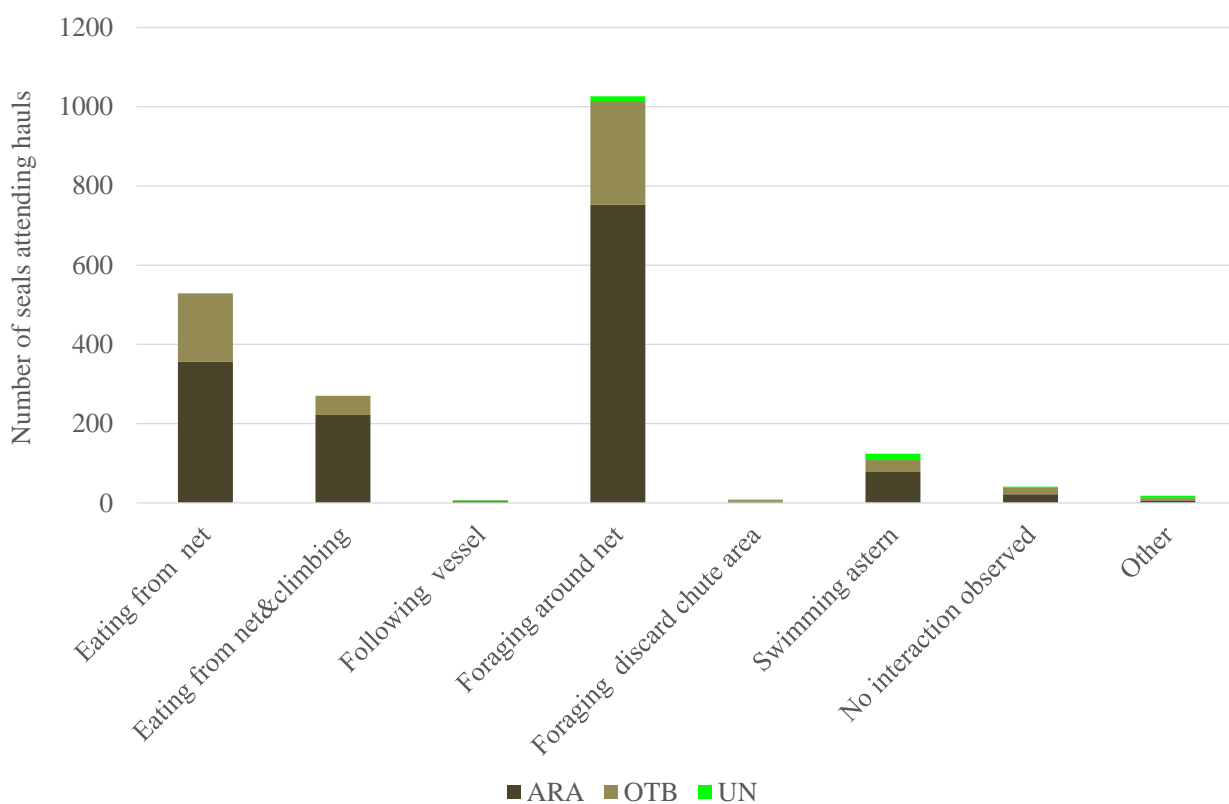


Fig.4. Pinniped behaviour exhibited during hauling.

The most common pinniped behaviour in the remaining vessel activities was to follow the vessel (56%), swim astern (14%) and forage around the net during shoots and turns (13%) (Fig.5). The scarcity of interactions with the discard chute (7%) is result of discard management implementation.

4.3 Pinniped bycatch

Bycatch concentrated south of 52°S (89%), particularly in grid squares XVAK and XVAL, where most of the fishing effort occurred (Fig.2; Table 3). Under MMO monitoring, a total of 19 seals were bycaught, of which five were incidentally killed [3 ARA, 1 OTB, 1 MIL (*Mirounga leonina*, southern elephant seal)], seven ARA were seen escaping during hauling (6 through the SED hatch, 1 through the mouth of the net), and five were brought aboard and released from deck (4 ARA, 1 OTB). In addition, one unmarked OTB carcass in decomposition was recovered during the 3rd week of the fishery.

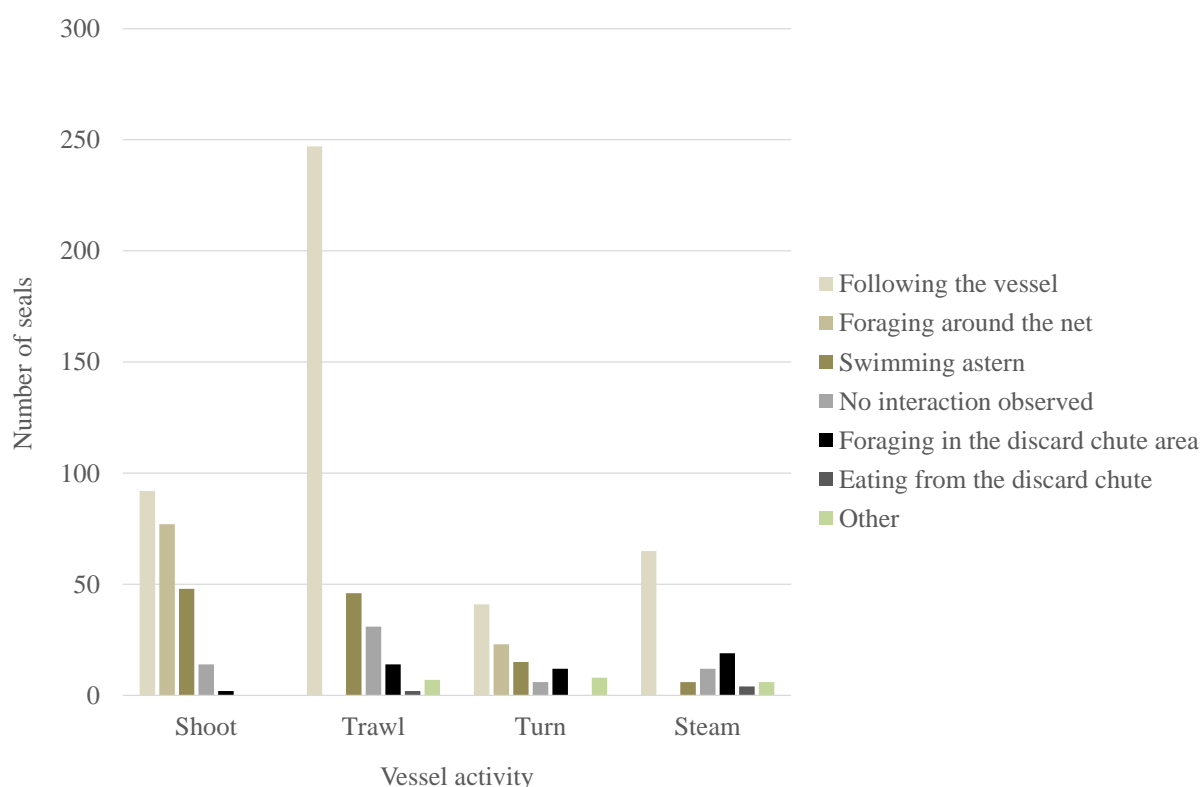


Fig.5. Pinniped behaviour exhibited during the remaining vessel activities.

4.3.1 Incidental mortalities and SED implementation

Due the COVID-19 pandemics, during the first three weeks of the fishery (26 Feb-18 Mar) the number of MMO monitored vessels in the fleet fluctuated (Table 2). Following license conditions, vessels without an MMO aboard were required to deploy a SED since the beginning of the season, while in monitored trawlers SEDs were to be immediately deployed after the mortality of two marine mammals in the fleet. No pinniped interactions (i.e. mortalities, live deck releases, SED escapees) were reported by the unmonitored vessels, while a total of five

mortalities were recorded by the MMOs (Table 3). The first two seal mortalities (1 OTB, 1 ARA) occurred in the 1st week of the fishery (fishing days 6 and 7), FIFD triggering SED mandatory usage south of 52°S from 5 March, being the fleet notified on 4 March at 14:10.

Table 2. Number of operating vessels and MMO coverage.

Date	Monitored vessels	Unmonitored vessels
26/02	13	2
27/02-3/03	14	1
4-5/03	14	2
6/03	13	3
7-11/03	14	2
12-14/03	15	1
15/03-28/04	16	0

Following one MIL mortality and the recovery of an unmarked OTB carcass in the north during the 3rd fishing week, on 18 Mar at 19:51 FIFD communicated to the industry about SED mandatory use in the whole LOL Box from 00:01 on 19 March. After SEDs were fully employed in the fishing area, two additional mortalities occurred during hauling (Table 3). These mortalities were possibly related to manoeuvring that led to the blockage of the SED escape passage (Table 3). Of the six carcasses recorded, five were marked by the MMOs and dumped overboard, while one was frozen for later necropsy ashore (Table 3).

4.3.2 *SED escapees and live deck releases*

During hauling six ARA were seen escaping from the fishing gear through the SED hatch (Table 3, cover photo), while one escaped through the mouth of the net (Table 3). The number of individuals that escaped when the SED was below the surface during both shooting and hauling remains unknown.

Regarding deck releases, five individuals (4 ARA, 1 OTB) were brought to deck, two ARA inside the net wings and the remaining inside the SED net extension, being the former safely released after cutting the net, while two of the latter were smashed in the net (Table 3). As during hauling the SED net extension supports high tension exerted by the full cod-end, two ARA arrived on deck under huge stress, showing signs of suffocation and no response to crew's stimuli. Although in one of the vessels the ARA was left to rest on deck for more than two hours, on the other trawler the seal reacted just before a strap was going to be tied around its posterior limbs, which would have caused vertebral column permanent injury and posterior death.

Table 3. Pinniped interactions recorded by MMOs.

Date	SED	Grid	Activity	Spp.	# Individ.	Interaction
03/03/21	NA	XVAL	Shoot	OTB	1	Male mortality; inside cod-end.
04/03/21	NA	XVAK	Haul	ARA	1	Male mortality; killed during hauling.
SED implemented south of 52°S						
05/03/21	B	XVAK	Haul	ARA	1	Brought aboard inside net extension; seal in bad condition after being smashed during hauling; released alive.
07/03/21	A	XVAK	Haul	ARA	1	SED live escapee.
09/03/21	A	XVAK	Haul	ARA	1	SED live escapee.
16/03/21	NA	XNAQ XNAP	Trawl	MIL	1	Female mortality; inside cod-end. Year one juvenile; presumably killed while diving. Carcass preserved and necropsy performed ashore.
18/03/21	NA	XNAP	Haul	OTB	1	Unmarked male carcass in decomposition (≤ 15 post-mortem days).
SED implemented north of 52°S						
01/04/21	B	XVAK	Haul	ARA	1	SED live escapee.
01/04/21	B	XVAK	Haul	OTB	1	Brought aboard inside net extension; handled with winch twice; net shot again with seal on top; released alive but presumably injured.
08/04/21	B	XVAH	Haul	ARA	1	SED live escapee.
12/04/21	B	XUAL	Haul	ARA	1	Brought aboard inside net extension; safely released from deck.
15/04/21	B	XVAL	Haul	ARA	1	SED live escapee.
17/04/21	B	XVAL	Haul	ARA	2	Post-SED mortalities; inside body of the net; presumably killed during hauling.
22/04/21	B	XVAJ	Haul	ARA	1	SED live escapee.
25/04/21	B	XVAK	Haul	ARA	1	Inside net wing; escaped through mouth of the net.
28/04/21	B	XVAL	Haul	ARA	3	1 SED live escapee; 2 brought aboard inside net extension - 1 big male in bad condition after being smashed during hauling; released alive after >2h rest on deck.

Poor handling was also observed with an OTB juvenile, which was brought aboard after no effort in manoeuvring was made to facilitate its escape whilst the SED was in the water (Table 3). After the catch was discharged into the fish bin, the fishing gear was arranged for the next shoot while the net-trapped sea lion crawled towards the mouth of the net. Instead of cutting the net to release the sea lion, crew used the crane to displace it back to the SED net extension. Despite the animal came out through the SED's hatch, it remained sitting on top of the SED's grid, which laid on deck. Although a water hose was used to encourage it to move away, the animal exhibited signs of confusion and remained in the same position. The crane was used for a second time to lift the SED's grid for approximately 2 m, with the falling sea lion impacting on deck with all its body weight focused on its pelvic area. The water hose was used again, however the seal was disorientated and the ready-to-shoot net blocked its vision to the escape path towards the sea. In consequence, the seal moved towards the bow, not showing any response to the water hose and staying on top of the mouth of the net, which was immediately

shot. At this point the seal became wrapped in the gear, freed itself, and then was seen limping, indicating a possible injury on its it left posterior hind limb. After the manoeuvre finished, crew insisted in using the water hose, even when the seal’s response was not the desired one. The MMO then intervened and guided the seal towards the ramp, which slid back to the sea.

4.4 Seabird bycatch

Seabird interactions involved 167 individuals, of which 153 were ACAP vulnerable species (139 DIM, 6 MAX, 8 PRO) (Fig.6). Eighty-three percent of the interactions were recorded south of 52°S, particularly in grid squares XVAK (41%), XVAJ (20%), XVAL (16%), and while the fishing gear was being hauled (Fig.7).

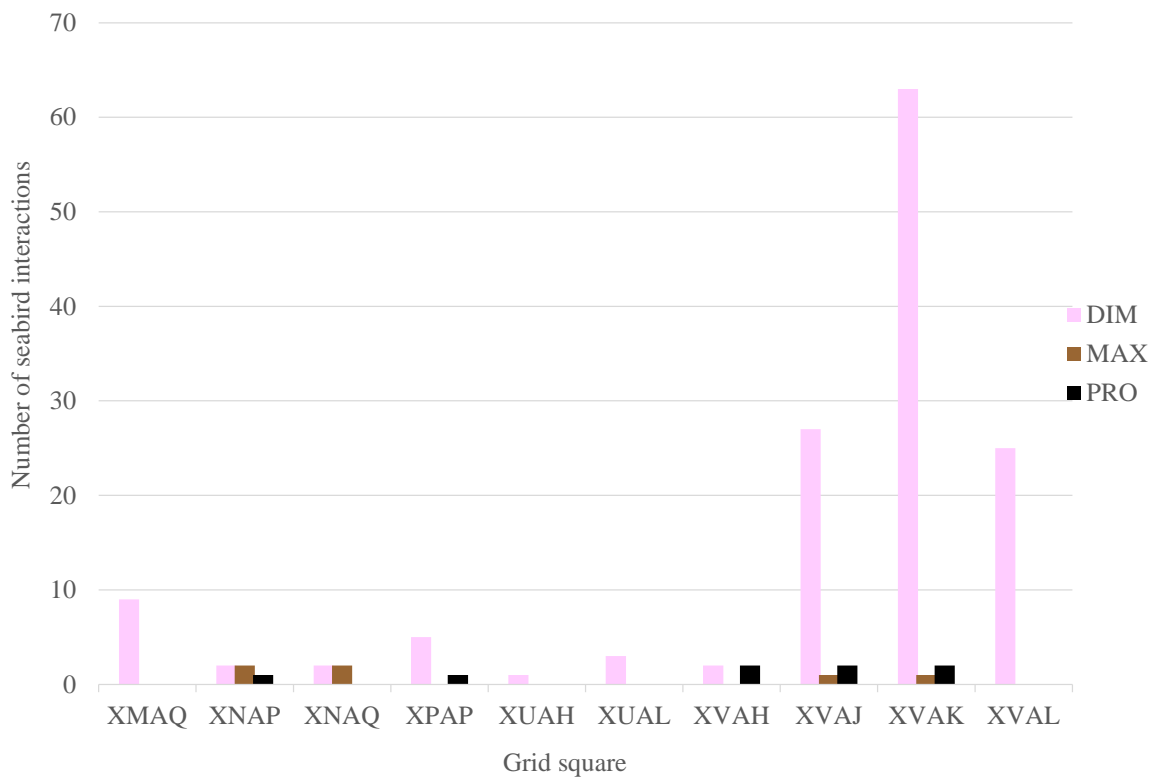


Fig.6. Interaction of ACAP vulnerable species per grid square.

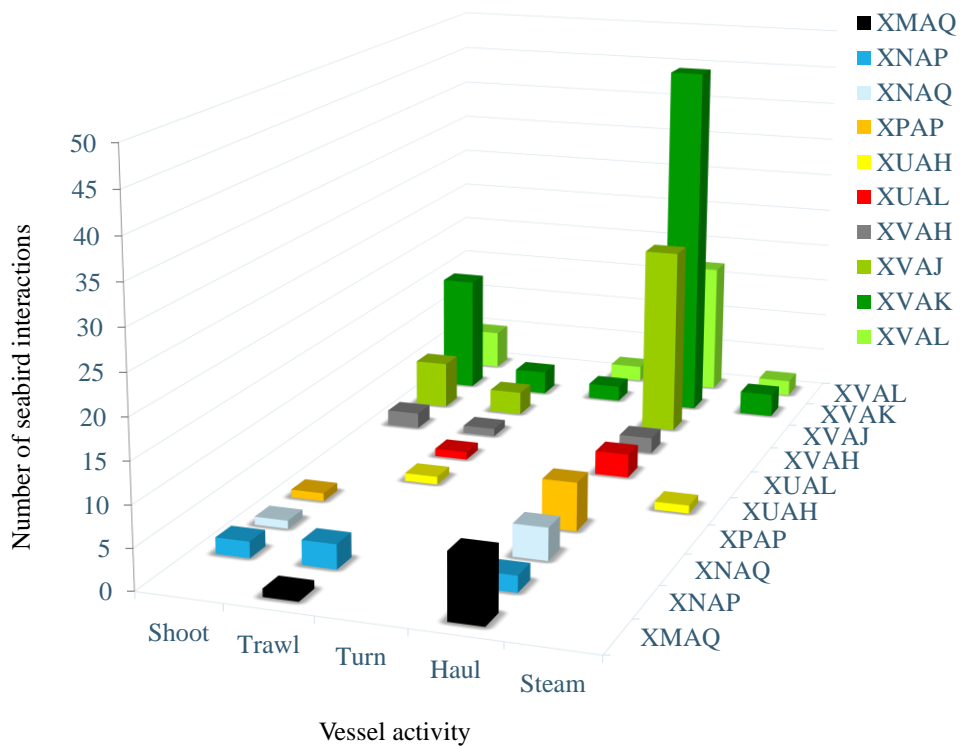


Fig.7. Seabird interactions per vessel activity and grid square.

4.4.1 Live interactions

Seabird live interactions involved 113 individuals, of which 89% comprised vulnerable species (90 DIM, 6 MAX, 5 PRO); the remaining species included 7 OCO (*Oceanites oceanicus*, Wilson’s storm petrel), 2 PEL (*Pelecanoides spp.*, diving petrel), 1 GAN (*Garrodia nereis*, grey-backed storm petrel), 1 PAX (*Pachyptila spp.*, prion), 1 COR (*Phalacrocorax atriceps*, imperial cormorant) (Table 4). Of these, 65 (56%) comprised FAA’s streamers entanglements, 22 (19%) net entanglements, and 5 (4%) SED entering; 92 (81%) of these interactions took place when the vessel was hauling (Table 4). Thirty-seven (32%) of these events were recorded during the 2nd fishing week, with the period 26 Feb-11 Mar concentrating 49% of the live interactions, which occurred south of 52°, principally around Beauchêne Island (grid squares XVAK, XVAL, XVAJ) (Fig.8).

4.4.2 Incidental mortalities

A total of 53 seabird mortalities were recorded, DIM representing 91% (Table 5). Of these, 48 mortalities occurred south of 52°S (45 DIM, 3 PRO) (Fig.9). The cause of death was mostly related to net entanglements (64%), warp cables (17%), FAA streamers (11%) and the SED (6%) (Table 5). More than half of the mortalities (30 individuals) took place during the 1st week of the fishery, dropping in the 2nd week (8 individuals) and maintaining below 5 individuals per week for the rest of the season (Fig.9). Mortalities were recorded during shooting (47%), hauling (38%), trawling (11%) and turning (6%) (Table 5).

Table 4. Seabird live interactions.

Interaction	Spp.	#Indiv.	Fate	Comments
BSL	DIM	58		Interaction occurrence: -Shoot=62 -Haul=3
	MAX	5	Escaped alive	
	PRO	1	Released alive	
FAA	DIM	2	Escaped alive	Collision with a stern boom.
LAV	DIM	5	Released alive	Interaction occurrence: -Shoot=2 -Trawl=7 -Turn=2 -Haul=3 -Steam=7
	MAX	1	Released alive	
	PRO	1	Released alive	
	OCO	7	Released alive	
	PEL	2	Released alive	
	GAN	1	Released alive	
	PAX	1	Released alive	
	COR	1	Escaped alive	
NET	DIM	20	7 Escaped alive 13 Released alive	Entangled during hauling.
	PRO	2	Released alive	
SED	DIM	5	Escaped alive	Entered the SED during hauling.
Total		113	Live escapes/releases	

BSL=FAA streamers; FAA=stern booms; LAV= landed on vessel; NET=net entanglement; SED=seal exclusion device.

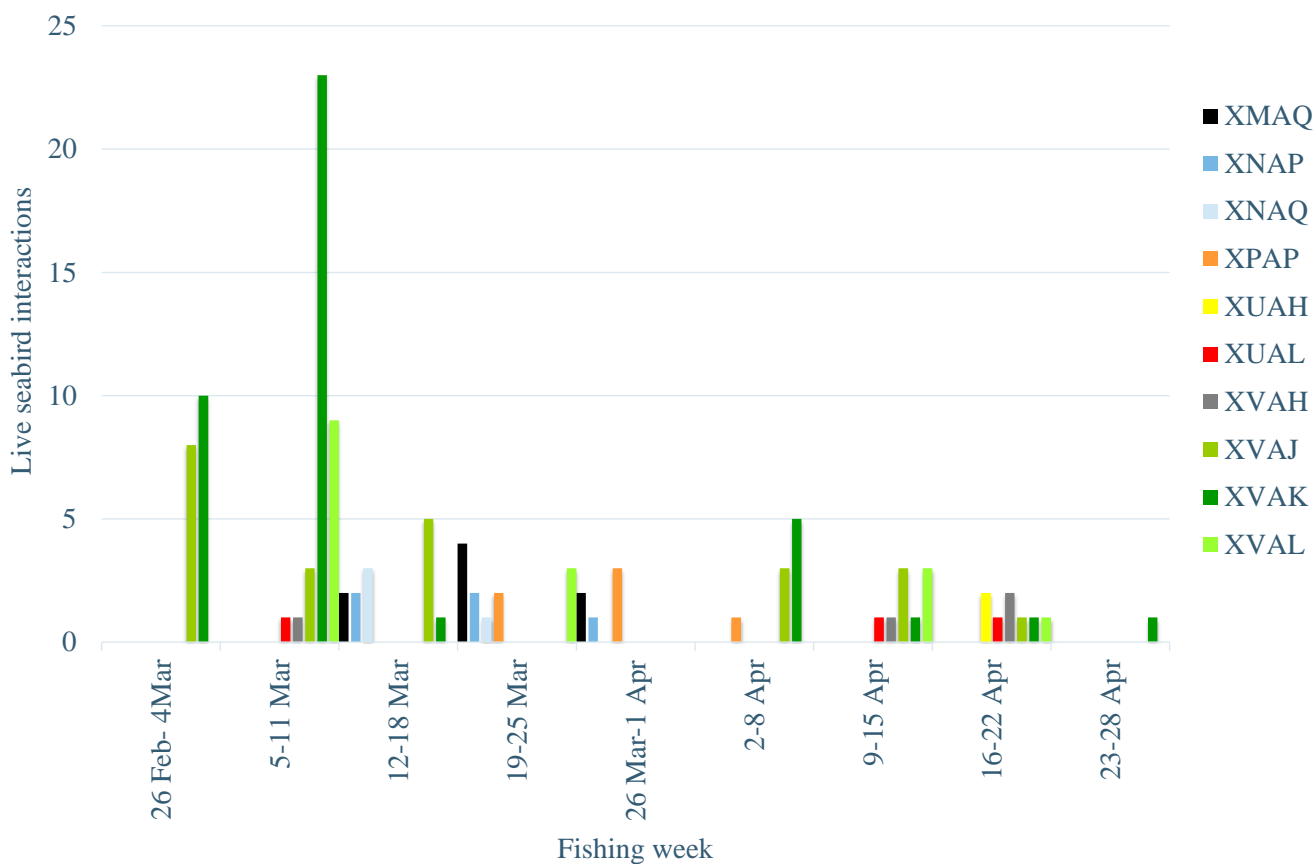


Fig.8. Live seabird interactions per fishing week.

Table 5. Seabird mortality.

Interaction	Spp.	#Indiv.	Mortality	Comments
BSL	DIM	5	2 Confirmed	Entangled in the greaser portion of the streamers. Mortality occurrence: shoot=1; haul=3; turn=1; trawl=1.
			2 Post-escape 1 Post-release	
	UN	1	Confirmed	
NET	DIM	31		Entangled in different parts of the net.
	PRO	3	Confirmed	Mortality occurrence: shoot=20 (17 DIM, 3 PRO); haul=14 (DIM)
WARP	DIM	9	Confirmed	3 Caught by warp splices; 6 hit the cable. Mortality occurrence: shoot=2; haul=1; turn=2; trawl=4
SED	DIM	3	Confirmed	Entered the SED during manoeuvres. Mortality occurrence: shoot=1; haul=2.
COL	PEL	1	Confirmed	Crashed against the vessel during trawling.
Total		53		

BSL=FAA streamers; NET=net entanglement; WARP=warp cables/bridles/splices; SED=seal exclusion device; COL=collision.

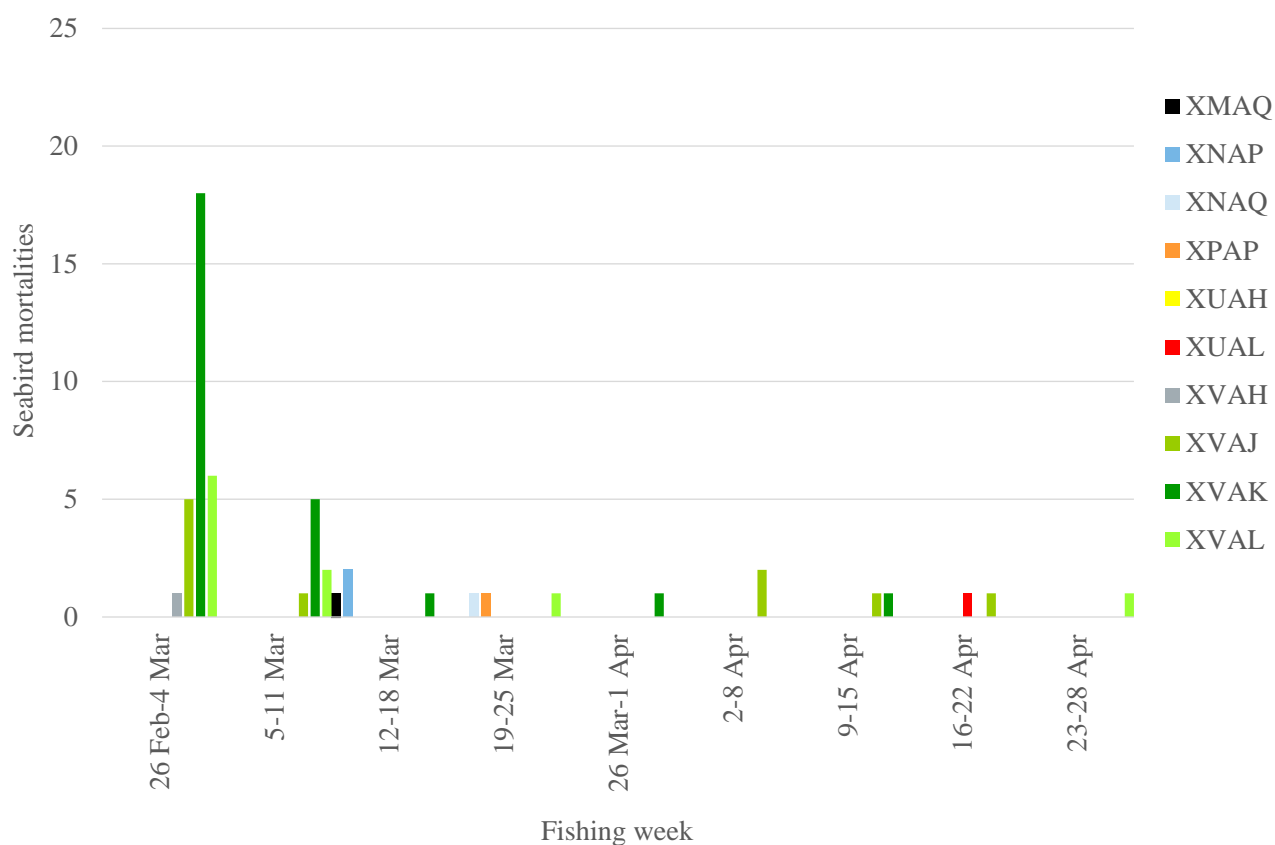


Fig.9. Seabird mortality per fishing week.

4.4.3 Seabird necropsies

Of the 53 incidental mortalities recorded, 34 carcasses were collected and preserved (31 DIM, 3 PRO), with necropsies performed on 29 DIM and 2 PRO (Table 6). Of the DIM, 16 were male (11 confirmed breeding adults) and 13 female (11 confirmed breeding adults) (Table 6).

Table 6. Seabird collected carcasses and post-mortem observations.

Date	Grid	Activity	Spp.	#	Interaction	Comments
26/02/21	XVAK	Haul	DIM	1	NET	5+ years-old male; brood patch fully grown; bill and left leg broken; entangled close to the headline.
26/02/21	XVAK	Shoot	DIM	1	NET	5+ years-old male; brood patch growing; both legs broken; entangled outside cod-end.
26/02/21	XVAK	Haul	DIM	1	NET	5+ years-old female; brood patch growing.
26/02/21	XVAK	Haul	DIM	1	NET	5+ years-old female; brood patch growing.
27/02/21	XVAH	Shoot	DIM	1	NET	Pending necropsy.
01/03/21	XVAJ	Haul	DIM	1	NET	5+ years-old male; brood patch grown; bill, legs and wings broken; exposed organs; entangled in net wing.
01/03/21	XVAJ	Shoot	DIM	1	NET	Male; brood patch grown; bill and legs broken; inside net wing.
02/03/21	XVAL	Haul	DIM	1	NET	5+ years-old female; brood patch growing.
02/03/21	XVAJ	Haul	DIM	1	NET	5+ years-old female; brood patch growing; left wing broken; entangled in net wing.
02/03/21	XVAK	Shoot	DIM	1	NET	5+ years-old female; brood patch growing; right leg +wing broken; entangled in net wing.
02/03/21	XVAL	Shoot	DIM	1	NET	Left on the vessel.
03/03/21	XVAJ	Haul	DIM	1	NET	5+ years-old male; brood patch growing; right leg broken.
03/03/21	XVAL	Haul	DIM	1	NET	5+ years-old female; brood patch grown; entangled under cod-end.
03/03/21	XVAL	Haul	DIM	1	NET	5+ years-old female; both legs broken.
03/03/21	XVAK	Haul	DIM	1	NET	5+ years-old male; brood patch growing; entangled near the headline and the floats.
03/03/21	XVAK	Shoot	DIM	1	NET	5+ years-old male; brood patch growing; left leg broken with exposed muscle.
03/03/21	XVAK	Shoot	DIM	1	NET	5+ years-old male; brood patch growing; entangled close to the net mouth.
03/03/21	XVAK	Haul	DIM	1	NET	5+ years-old male; brood patch grown; left wing with exposed fracture; chest muscle exposed; entangled in cod-end.
04/03/21	XVAK	Shoot	DIM	1	NET	5+ years-old male; brood patch growing; left wing broken; chest without feathers; entangled in net wing.
05/03/21	XVAK	Trawl	DIM	1	WARP	5+ years-old male; brood patch growing; wings, chest and tail covered in grease; carcass retained inside SED.
07/03/21	XVAK	Haul	DIM	1	SED	5+ years-old male; brood patch growing; entered the SED to scavenge.
08/03/21	XVAL	Haul	DIM	1	WARP	5+ years-old female; brood patch growing; broken legs; left wing with exposed fracture; chest muscle exposed; entangled in warp splice.
08/03/21	XVAL	Shoot	DIM	1	SED	5+ years-old male; brood patch growing; entered the SED to scavenge.
09/03/21	XVAK	Haul	DIM	1	NET	5+ years-old female; brood patch growing; wings and right leg broken; entangled in net wing.
10/03/21	XVAK	Trawl	DIM	1	WARP	5+ years-old female; brood patch growing; left wing full of oil; exposed muscle; hit warp cable, dragged down and recovered from the door.
16/03/21	XNAP	Shoot	DIM	1	NET	5+ years-old female; brood patch growing; entangled near the middle part of the headline.
17/03/21	XMAQ	Trawl	DIM	1	WARP	5+ years-old female; brood patch growing; left wing broken, right leg missing, exposed chest muscle, feathers covered in grease; hit by warp cable and dragged down, retained in a warp splice and passed through the pulley.
22/03/21	XPAP	Shoot	DIM	1	NET	2 years-old male; entangled close to the mouth of the net.
29/03/21	XVAK	Shoot	PRO	1	NET	Presumably mature female; entangled in the net, dragged down and recovered at the haul.
08/04/21	XVAJ	Haul	DIM	1	NET	5+ years-old male; brood patch growing; left leg broken; entangled in a net wing.
08/04/21	XVAJ	Haul	DIM	1	NET	5+ years-old female; brood patch growing.
09/04/21	XVAJ	Shoot	PRO	1	NET	Pending necropsy.
10/04/21	XVAK	Shoot	PRO	1	NET	Female; brood patch grown; exposed intestines; entangled in the mouth of the fishing net.
27/04/21	XVAL	Shoot	DIM	1	NET	5+ years-old male; brood patch growing.

5. Conclusions

5.1. As in previous seasons, both pinniped and seabird interactions with the fleet were more abundant south of 52°S, attending the vessels to directly depredate from the net or forage around the fishing gear during manoeuvres.

5.2. The high proportion of seabird mortalities recorded during the first two weeks supports future research on net binding trials and further crew efforts towards good standards in net cleaning, particularly south of 52°S.

5.3. In comparison to 2020-C, seal attendance to the vessels increased by 59%, seabird mortality increased by 66%, and bird live interactions increased by 1030%, which supports an increasing trend in interactions of megafauna with the fishing activity since 2018-C.

5.4. In addition to the above, in comparison to 2020-C, SED implementation dates were triggered earlier, south of 52°S on fishing day 8 (2020-C on fishing day 24) and north of 52°S on fishing day 22 (2020-C on fishing day 12).

5.5. Failure to comply with item B1.d of Part II of Licence Conditions (*“all warp splices must be covered”*) resulted in three seabird mortalities. In addition, although seal bycatch mitigation measures have been in place since 2017, a few vessels did not comply with item C3.d of Part II Licence Conditions (*“during the haul, the deck crew should make their best efforts to detect seals trapped in the net and facilitate their escape whilst the SED is still in the water, by working cables/bridles back and forth”*). This non-compliance not only added an unnecessary safety risk for crew, but could have caused avoidable seal mortalities.

5.6. Data collected by MMOs evidenced a good general adherence to net cleaning (51%), however it is expected to improve.

5.7. Regarding discard management implementation, overall discard storage tank usage was very good, with vessels discharging tanks mostly while the gear was aboard.

5.8. The MMO Program comprises a unique asset to support FIG’s best fishery management and industry’s efforts towards fishery’s excellence.

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