Pinniped Bycatch Report: Squid & Finfish Trawlers

Preliminary information on the bycatch of pinnipeds in the Falkland Islands

Verónica Iriarte
Joost Pompert

Fisheries Department
Directorate of Natural Resources
Falkland Islands Government
Stanley, Falkland Islands

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Pinniped Bycatch

Participating/Contributing Scientific Staff

Verónica Iriarte (Scientific Fisheries Observer)
Joost Pompert (Observer Coordinator)

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1. INTRODUCTION

In the Falkland Islands (FI) reproductive colonies of three pinniped species can be found: *Arctocephalus australis* (South American fur seal), *Otaria flavescens* (South American sea lion) and *Mirounga leonina* (southern elephant seal) (Strange, 1992). However, *Arctocephalus tropicalis* (subantarctic fur seal) and *Arctocephalus gazella* (Antarctic fur seal) can also breed in the area (White *et al*., 2002), with the latter also a common visitor from South Georgia (White *et al*., 2002). Population sizes of breeding colonies are small and have failed to recover to numbers previous to overexploitation (Baylis *et al*., 2015; Palomares & Pauly, 2015). Available estimations of population sizes are at least 9000 individuals (4500 female-calf pairs) for *O. flavescens* (Baylis et al., 2015), 18,000-20,000 individuals for *A. australis* (Strange, 1992) and low thousands for *M. leonina* (Galimberti & Boitani, 1999). In Southern South America research on the interactions of marine mammals and fishing operations have been mostly carried out in coastal artisanal fisheries (e.g. Szteren & Páez, 2002; De María *et al*., 2013; Machado *et al*., 2015), however scavenging behaviour and incidental mortalities of both pinnipeds and cetaceans (whales, dolphins and porpoises) have been reported for trawlers in Patagonia and Chile (Crespo *et al*., 1997; Reyes *et al*., 2013) with *O. flavescens* being the most affected species (Crespo *et al*., 1997). From 1988, through the deployment of observers, the FIFD has obtained data on the existence of pinniped (particularly the otariids *O. flavescens* and *Arctocephalus sp*.) interactions (i.e. scavenging, incidental live catches, incidental mortalities) in both finfish (e.g. hake *Merluccius hubbsi*, southern blue whiting *Micromesistius australis*, hoki *Macruronus magellanicus*) and short-finned squid (*Doryteuthis gahi*) trawlers. In addition, scavenging by otariids from jigging lines and also one intentional kill have been reported by observers on jigging vessels targeting the squid *Illex argentinus*. Otariid mortalities within the jigging fleet will not be discussed in this report. Since an apparent increase of incidental catches and mortalities on trawlers has been detected, the aim of this short communication is to present FIFD's available data and discuss the current situation.

2. METHODS

All pinniped incidental catches have historically been recorded in the mortality table of the FIFD observer database (obsdta), even if animals survived. Prior to 1998 this recording was perhaps done less diligently, and in any case the interactions were possibly low, so, records of

incidental catches of pinnipeds in observed finfish (FIN) and D. gahi (LOL) trawlers from 1998 to September 2016 only were scrutinized for this paper (Table 1).

In the present work a bycatch event is defined as when a pinniped comes up in a haul inside the net, entangled in any section of the net, or when it is found inside the fish bin, irrespective of whether the individual is dead or alive.

While screening the data on number of pinnipeds caught per year in observed trips, it was noticed that mortality was a multi number event during two trips in August-October 2001 (2 in trip N°436 and 6 in trip N°438) and in one of three trips in August-October 2004 (6 in trip N°578, 1 in trip N°577 and 1 in trip N°583). These peak bycatches were most likely related to the target species (WHI/BLU) on all of these trips. In any case, these peaks somewhat biased the data analyses. So instead the number of observed trips with pinniped bycatch events were plotted by year, without taking into account either further bycatch in the same trip or number of individuals caught.

For the years 2015/2016 estimated pinniped incidental catches were calculated for six fishing licence types issued by the FIFD (C, X, A, G, W, E). The number of individuals caught on fishing days observed was extrapolated to the total number of fishing days.

3. RESULTS

In 18¾years (1 January 1998 until 30 September 2016) a total of 482 trips were monitored by observers on bottom trawlers, 292 (69%) of these targeted finfish/*Illex* squid (A/W/G licences: "FIN") and 190 (31%) targeting *D. gahi* (C/X licence: "LOL"). Individual pinniped bycatch events were recorded in twenty-seven of the observed trips (5%) (Fig.1), 9 (33%) on LOL and 18 (67%) on FIN vessels (Table 1, Fig.1).

Forty-five pinnipeds (22 *Arctocephalus sp*., 3 *Mirounga leonina*, 19 *Otaria flavescens*, 1 unidentified species) were caught in the observed trips (Fig.2). Sixty-seven percent of the individuals were incidentally killed (13 *Arctocephalus sp.*, 3 *M. leonina*, 13 *O. flavescens*, 1 unidentified pinniped), and the large majority (77%) of these mortalities occurred in the FIN fishery (23 events) (Fig.3). Whilst the remaining 15 otariids (9 *Arctocephalus sp*., 6 *O. flavescens*) were still alive after the haul, the survival rate of these animals is unknown. At least one individual was observed in trip N°1118 to be severely disorientated and possible physically injured whilst returning to the sea.

Table 1: Incidental pinniped catches in observed trips 1998-Sept2016. ARA=*Arctocephalus sp*., MIL=*Mirounga leonina*, OTB=*Otaria flavescens*, SXX= unidentified pinniped.

Target	Date	Sp.	Killed	Nº indiv.		Target	Date	Sp.	Killed	Nº indiv.
LOL	04.02.98	MIL	Y	1		FIN	22.09.05	ARA	Y	1
LOL	24.10.98	SXX	Y	1		FIN	10.10.05	OTB	Y	1
FIN	01.09.01	OTB	N	1		FIN	21.09.08	OTB	Y	1
FIN	07.09.01	OTB	N	1		FIN	04.10.09	OTB	Y	1
FIN	19.09.01	ARA	Y	2		FIN	21.11.11	OTB	Y	1
FIN	26.09.01	ARA	Y	1		FIN	05.10.12	MIL	Y	1
FIN	01.10.01	ARA	Y	1		LOL	12.09.13	OTB	Y	1
FIN	04.10.01	ARA	N	1		LOL	21.07.15	OTB	Y	1
FIN	04.10.01	ARA	Y	1		FIN	20.09.15	OTB	Y	1
FIN	16.09.02	ARA	N	1		FIN	25.11.15	MIL	Y	1
FIN	20.09.02	ARA	Y	1		FIN	06.02.16	ARA	Y	1
LOL	23.09.02	ARA	Y	1		FIN	14.06.16	OTB	Y	1
FIN	27.08.04	ARA	Y	1		FIN	19.06.16	OTB	Y	1
FIN	28.08.04	OTB	Y	1		LOL	07.08.16	OTB	Y	1
FIN	31.08.04	ARA	Y	1		FIN	24.08.16	ARA	N	1
FIN	10.09.04	OTB	Y	1		LOL	25.08.16	OTB	Y	1
FIN	12.09.04	OTB	N	1		FIN	30.08.16	ARA	N	1
FIN	19.09.04	OTB	N	1		LOL	03.09.16	ARA	N	1
FIN	19.09.04	OTB	Y	1		LOL	11.09.16	OTB	N	1
FIN	31.10.04	ARA	Y	1		LOL	18.09.16	ARA	N	3
FIN	08.09.05	ARA	Y	1		LOL	21.09.16	ARA	N	1

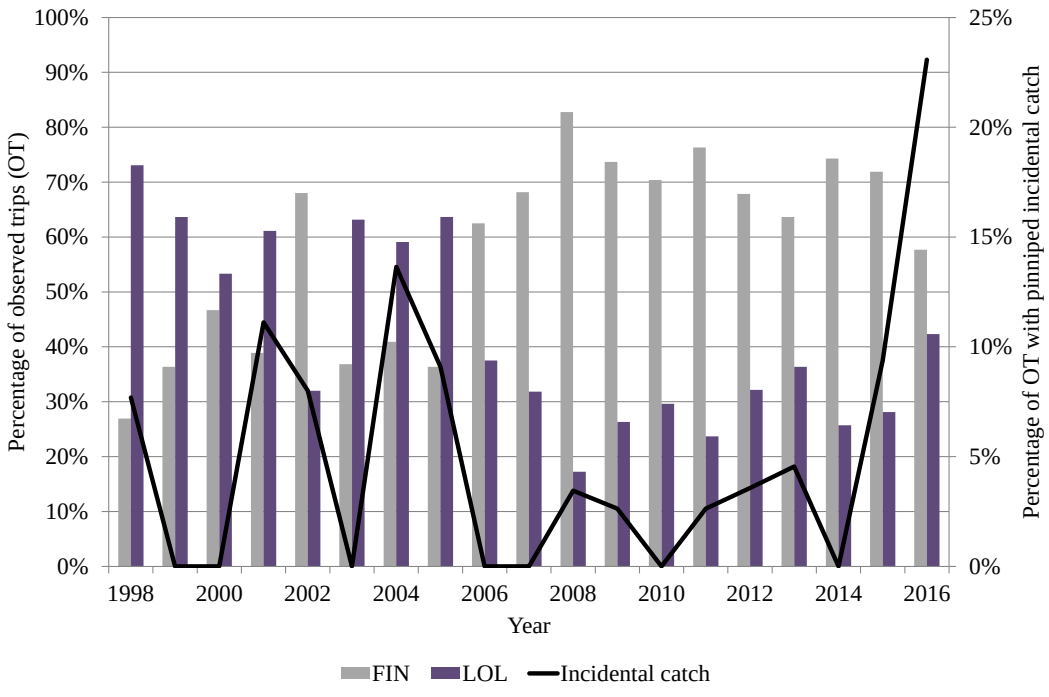

Figure 1: Percentage of pinniped bycatch per year recorded in observed trips 1998-Sept2016.

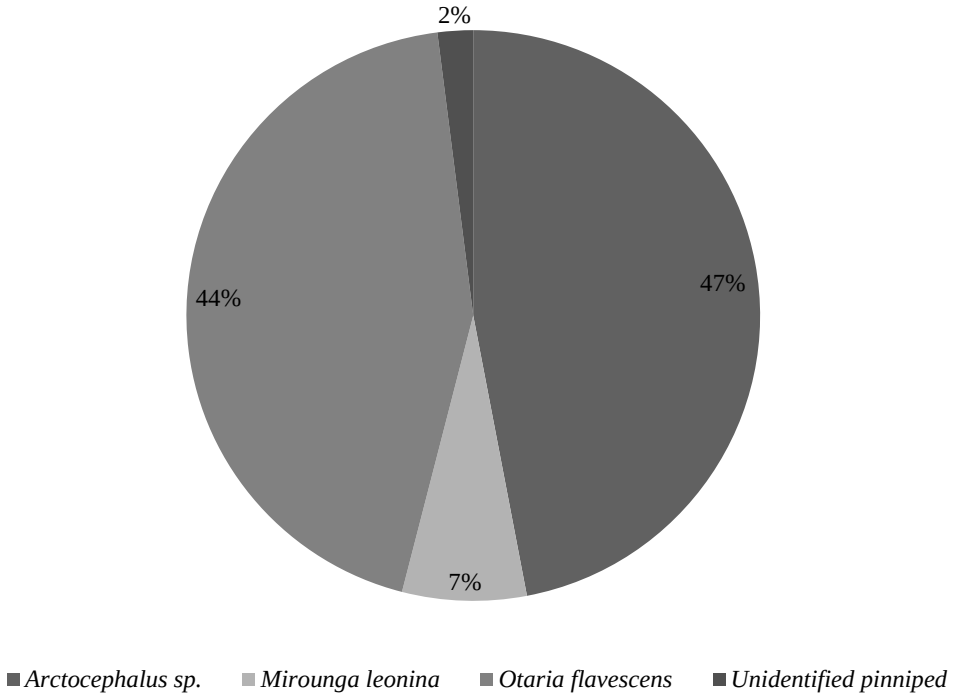

Fig.2: Observed bycatch per species (N=45).

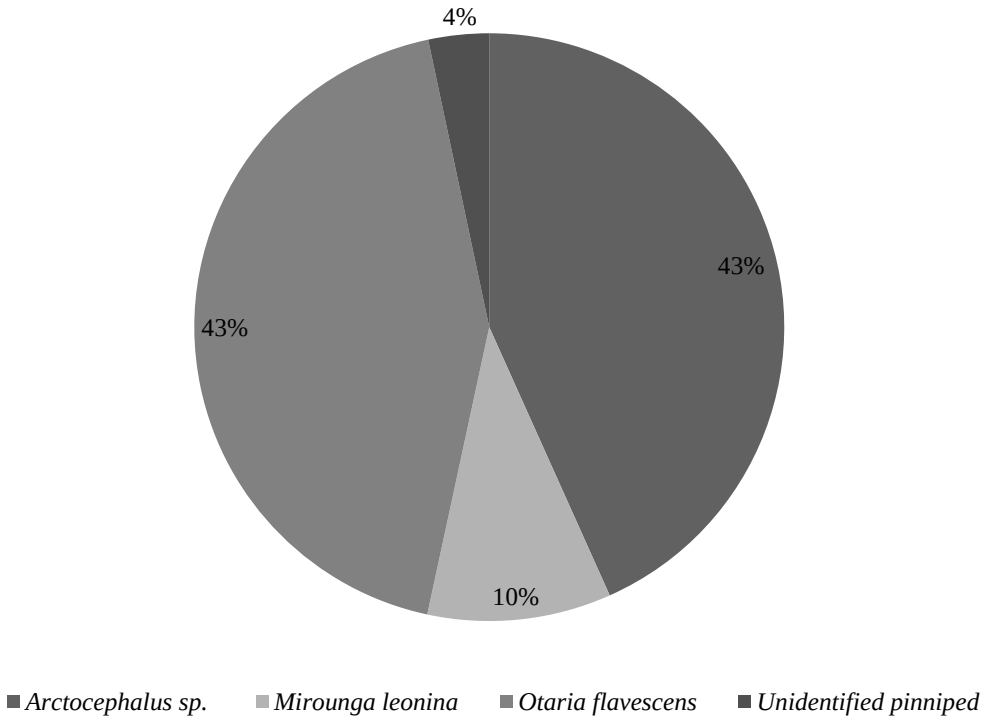

Fig.3: Observed individuals killed per species (N= 30).

From 1998 to 2014 pinniped bycatch were recorded in three periods: late August-early September (late winter), in October-November (spring) and February (summer). Between 1998 and 2014 bycatch events occurred only once or twice a year. However, both in 2001 and 2004 higher bycatch rates were related to single FIN trips targeting BLU (*M. australis*) (trips N^{o} 436, 438, 578). Fishing grounds for BLU have previously been reported as an important foraging area for *A. australis* (Thompson *et al.*, 2003), which coincides with mortality data of the species presented here (Fig.4,5).

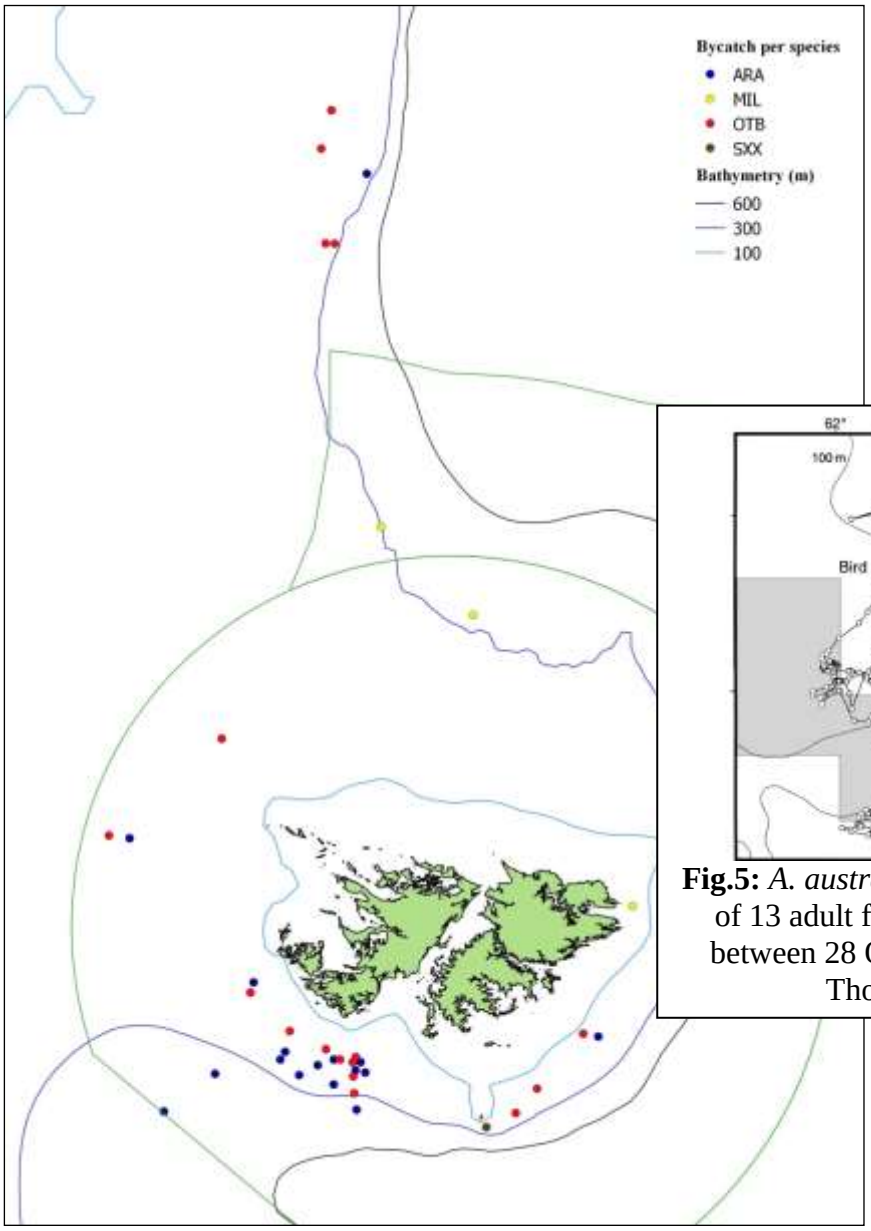

Fig.4: Pinniped bycatch 1998-Sept2016 per species.

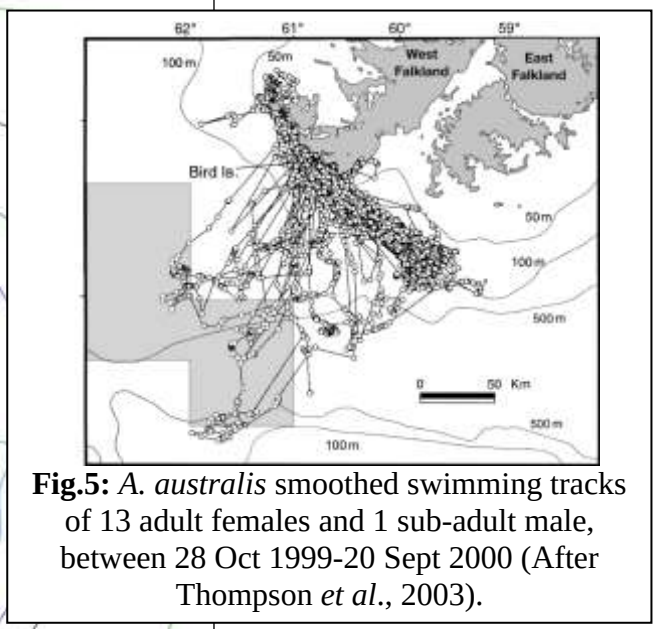

Fig.5: *A. australis* smoothed swimming tracks of 13 adult females and 1 sub-adult male, between 28 Oct 1999-20 Sept 2000 (After Thompson *et al.*, 2003).

From 2015 onwards, single pinniped bycatch events also started to be recorded in winter months (June, July and early August). In 2016 pinniped bycatch not only occurred throughout the year, but two trips in September 2016 (FIN trip N^{o}1113; LOL trip N^{o}1118) also contained more than one bycatch event. Of the total number of pinnipeds incidentally caught, 3 (7%) were caught in 2015 and 13 (29%) in 2016.

3.1 Estimated bycatch-FIN 2015/2016

Although data for 2016 is not yet complete, estimated incidental pinniped catches have nearly tripled from 2015 to 2016 (Table 2), from 17 (8.28 *O. flavescens*; 8.28 *M. leonina*) to 47 individuals (28.39 *A. australis*; 18.92 *O. flavescens*) in the finfish fleet. The absence of observer recorded mortality data for G-licensed vessels in 2015 does not rule out bycatch occurrence in unmonitored ships. When pinnipeds were caught, principal catch of trawlers were common hake (*M. hubbsi*, A-licence), southern blue whiting (*M. australis*, W-licence) and red cod (*Salilota australis*, E-licence, i.e. Castelo research survey).

Table 2: FIN effort per Licence type 2015-2016.

Year	Licence	Fishing days (FD)	FD obs.	% FD obs.	# Bycaught pinnipeds	By-catch est.
2015	A	732	68	9.28	1	10.7
	W	1342	229	17	1	5.86
	G	905	57	6.29	0	0
	E	50	50	100	0	0
2015	**TOTAL**	3029	404	132.57	2	**16.56**
2016	A	783	68	8.68	2	23.02
	W	758	65	8.57	2	23.3
	G	533	97	14.25	0	0
	E	21	21	100	1	1
2016	**TOTAL**	2095	251	131.5	5	**47.32**

3.2 Estimated bycatch-LOL 2015/2016

In the period 1998-2014 only four pinniped bycatch events were recorded by observers on LOL trawlers, while in 2015/2016 eight otariids (3 *O. flavescens*, 5 *Arctocephalus sp*.) were incidentally caught in the LOL fishery, all during the second squid harvesting season (X-licence). Fishing effort in 2015 was smaller due to early depletion of the squid biomass and early closure (6 September) of the fishery. Although there was no bycatch during observed trips in the first squid season (C-licence), *O. flavescens* were seen feeding on discards or following the vessels in between hauls (i.e. while trawling).

Whilst 12 pinnipeds were estimated to have been incidentally caught in 2015, for 2016 this increased by almost 6 times, with 71 individuals (44.6 *Arctocephalus sp.*; 26.7 *O. flavescens*) estimated to have been caught in the second LOL season. This equates to a rate of 1.15 seals per calendar day for the entire LOL fleet. A daily pinniped bycatch rate for the second season in 2015 might have been around 0.28 pinnipeds per calendar day.

Table 3: LOL effort per Licence type 2015-2016.

Year	Licence	Fishing days (FD)	FD obs.	% FD obs.	# Bycaught pinnipeds	By-catch est.
2015	C	951	81	8.51	0	0
	X	655	55	8.39	1	11.9
	E	15	15	100	0	0
2015	**TOTAL**	1621	151	116.9	1	**11.9**
2016	C	1017	97	9.53	0	0
	X	1000	112	11.2	8	71.428
	E	30	30	30	0	0
2016	**TOTAL**	2047	239	50.73	8	**71.428**

4. DISCUSSION

4.1 Sustainability of the bycatch-2016

The combined estimated otariid bycatch for all fisheries in 2016 (until 30 September) are 119 individuals, 73 *Arctocephalus sp.* and 46 *O. flavescens*. Although these numbers represent less than the 1% of the current breeding populations in the Falkland Islands, it is important to recognize that these are already depleted populations, with sea lions below 95% of its 1930s estimated population size (Wade *et al.*, 1998; Thompson *et al*., 2005; Baylis *et al*., 2015).

4.2 Status of the otariids

The South American fur seal *Arctocephalus australis* is classified by the IUCN as of LC (least concern) due to its abundance and increasing population trends along its distribution range (Cárdenas-Alayza *et al*., 2016a). However, in the South Atlantic it breeds only in Uruguay, Tierra del Fuego/Isla de los Estados and in the Falkland Islands. Like other marine mammal species, it is threatened by increasing industrial offshore development and commercial activity (i.e. oil & gas, fisheries). Although population numbers previous to the exploitation period (18^{th} and 19^{th} centuries) are not available, it is known by that by 1822 they were almost extirpated from the Falkland Islands (Otley, 2008; Baylis *et al*., 2013). Recent research indicates that in the South Atlantic there is a single stock with individuals migrating up to 1000 km before returning to their natal rookery to breed (Crespo *et al*., 2015). The recovery of the Uruguayan population may be the cause of the increase of sightings off the Argentine coast and the increase of individuals in rookeries in Tierra del Fuego (Crespo *et al*., 2015). In the Falkland Islands the current population size is unknown, it reproduces on only 10 sites and has not recolonized historical main breeding areas (Baylis *et al*., 2013). Female foraging areas may change throughout the year depending on pup independence and environmental and ecological variabilities (e.g. prey availability, competition with penguins, ENSO) (Thompson *et al*., 2003; Laptikhovsky, 2009; Baylis *et al*., 2012, 2013). Research has shown female *A. australis* are central foragers, using coastal areas close to breeding sites from October to January, while using more offshore areas from February to September (Thompson *et al*., 2003; Crespo *et al*., 2015), which makes them more vulnerable to interact with fisheries. This should be of concern, as the incidental kill of a female might imply the death of three individuals, as she may be lactating and already pregnant. The principal prey items for males and juveniles of the species in the Falkland Islands are Falkland herring (*Sprattus fuegensis*), *D. gahi* and notothenids (*Patagonotothen spp.*) (Baylis *et al*., 2013). These authors found that both the squid and *Patagonotothen* sizes consumed by the otariids

was comparable to the sizes caught by the targeted fisheries (Baylis *et al*., 2013). While the rock cod (*Patagonotothen ramsayi)* has been described as the most important planktivorous fish in the Falkland Islands (Laptikhovsky *et al*., 2013), the pinniped's preferred size (18-22cm) is currently not processed but represents an important component of the squid fishery discards (Roux & Winter, 2013; Iriarte, 2016a,b).

The South American sea lion *Otaria flavescens* is also classified by the IUCN as of LC (least concern) as most of its populations have increased and are now stable (Cárdenas-Alayza *et al*., 2016b). However, in the Falkland Islands recovery has been very slow and the population remains below 95% of its historical size (371,500 individuals in the 1930s) (Thompson *et al*., 2005; Baylis *et al*., 2015). Baylis and colleagues (2015) suggested that this dramatic population decrease may be more related to changes in sea surface temperature in the 1900s than to past sealing, however they do not rule out a combination of different factors (e.g. sealing, climate change, emigration, predation by other top predators [i.e. killer whale *Orcinus orca* and leopard seal *Hydrurga leptonix*]) (Baylis *et al*., 2015). The recovery of the population in the Falkland Islands may also be currently affected by reduced prey availability, spatial overlapping/ competition with fisheries (e.g. Romero *et al*., 2011; Riet-Sapriza *et al*., 2013) and other upper-trophic predators (i.e gentoo penguins *Pygoscelis papua* and fur seal *Arctocephalus australis*) (Thompson *et al*., 1998; Baylis *et al*., 2013). It is believed that the South Atlantic sea lion population is genetically healthy and connected by adult male migrants, with females being phylopatric (Feijoo *et al*., 2011; Giardino *et al*., 2015). Like in the Falkland Islands, threats elsewhere include climate change, bycatch and trophic overlapping with fisheries (Romero *et al*., 2011; Riet-Sapriza *et al*., 2013; Baylis *et al*., 2015). Comparable to *A. australis*, sea lions are central foragers, with females exploiting coastal areas while lactating and moving further offshore when the calf becomes more independent (Thompson *et al*., 1998; Baylis *et al*., 2016a). However, recent data indicates that in the Falkland Islands there is not a clear pattern in niche use among sexes/age classes, with pregnant females also exploiting offshore resources (Baylis *et al*., 2016b). In this case, the incidental mortality of a female might also imply the death of three individuals. Diet/foraging area differences probably exist throughout the year, as occurs elsewhere (Baylis *et al*., 2016b; Riet-Sapriza *et al*., 2013; Rodríguez *et al*., 2013). Diet studies indicate that in the Falkland Islands notothenids (*Patagonotothen sp*.), common hake (*M. hubbsi*) and commercial size of *D. gahi* are the most important prey for *O. flavescens*, suggesting a possible competition with the squid fishery (Thompson *et al*., 1998).

4.3 Increases in pinniped bycatch

The recent increase in the number of incidental catches of pinnipeds in observed trips may be related to:

i) changes in the fishing fleet that may increase the probability of marine mammal bycatch (e.g. the use of new fishing grounds or the trawling/hauling speed);

ii) competition for the resources, particularly *D. gahi*;

iii) rise in the presence of migrant individuals from elsewhere (i.e. *A. australis* from Uruguay);

iv) ecological changes resulting in a shift of pinniped foraging grounds;

v) increase of discards of preferred species/size.

As the current information on Falkland Islands' pinnipeds is scarce, the precautionary principle should be followed, as the PBR (potential biological removal) could be unsustainable (Wade *et al*., 1998).

5. RECOMMENDATIONS

1. Develop a specific protocol for Scientific Fisheries Observers to obtain critical biological data from bycaught pinnipeds and to quantify interactions. This should include information on feeding from discards, net depredation, following of vessel in between hauls, in FIN and LOL trawlers. Furthermore, interaction such as depredation/scavenging from jigging vessels should be also recorded.

2. Develop guidelines for fishing vessels to free live pinnipeds. Companies and ITQ holders should be reminded that marine mammals are protected species and that when a live pinniped comes on a haul the net must be cut and the animal be freed in the safest possible way. Incidents with live animals and incidental kills should be reported by fishing vessels at all times.

3. Enforce compliance to licence regulations for bird protection (i.e. net cleaning, no discarding during manoeuvres). Like birds, otariids scavenge during hauls and remain with the ship to directly feed from discards. Pinnipeds can be caught during shoots, as they scavenge from remains left on the gear, becoming entangled and drowning when the net sinks. During hauls they may enter the partially open net mouth, with a possibility of arriving alive on deck.

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