Interactions between the South American sea lion (*Otaria flavescens*) and the artisanal fishery off Coquimbo, northern Chile

Sabine Goetz, Matthias Wolff, Wolfgang Stotz, and Mario J. Villegas†

Goetz, S., Wolff, M., Stotz, W., and Villegas, M. J. 2008. Interactions between the South American sea lion (*Otaria flavescens*) and the artisanal fishery off Coquimbo, northern Chile. – ICES Journal of Marine Science, 65: 1739–1746.

The South American sea lion (*Otaria flavescens*) forages in coastal waters, where it interacts with fisheries and causes considerable economic loss by removing some catch and damaging gear. This study describes for the fishery region of Coquimbo (Chile) where, when, and with what type of gear interactions occur, characterizes the animals involved (group size, sex, and age), and derives some management recommendations. The study was based on 55 interviews with fishers and observations aboard fishing vessels in the main fishing sectors between October 2003 and March 2004. Interactions were primarily at night (88% of interviewees fished at night), in the bay ("Bahía") of Coquimbo (81% of interviewees fished in this sector), where shoaling fish were abundant, and with purse-seines (100% of interviewees used this gear). Although some large groups of sea lions were seen, most comprised 1–10 animals. Most animals that interacted with the fishing gear were males (67%), probably because of the different feeding strategies of the two sexes. Management options discussed include the adjustment of fisheries to foraging behaviour of sea lions, and the controlled elimination of conflicting animals.

Keywords: artisanal fishery, Chile, interactions, *Otaria flavescens*, South American sea lion.

Received 5 March 2006; accepted 29 July 2008; advance access publication 22 September 2008.

S. Goetz: Centro Oceanográfico de Vigo, Instituto Español de Oceanografía (IEO), Cabo Estay-Canido, Apartado 1552, 36200 Vigo, Spain. M. Wolff: Charles Darwin Foundation, Santa Cruz, Galapagos, Casilla, 17-01-3891 Quito, Ecuador. W. Stotz: Grupo de Ecología y Manejo de Recursos (ECOLMAR), Departamento de Biología Marina, Universidad Católica del Norte, Casilla 117, Coquimbo, Chile. M. J. Villegas: Departamento de Ciencias del Mar, Universidad Arturo Prat, Casilla 121, Iquique, Chile. Correspondence to S. Goetz: tel: +34 986 492111; fax: +34 986 498626; e-mail: sa.goetz@web.de.

Introduction

The phenomenon of interactions between marine mammals and fisheries is one of great concern to fishers and scientists, not only because of the increasing number of cases reported during the past four decades, but also because of the difficulties in quantifying the animal's impact on the fisheries and in drafting and implementing effective management measures (Harwood, 1983).

In Chile, most information available on interactions between marine mammals and fisheries is related to the South American sea lion (*Otaria flavescens*; Torres, 1979; Oporto *et al.*, 1991; Wickens, 1995; Hückstädt and Antezana, 2003; Oliva *et al.*, 2003; Rodríguez, 2004; Sepúlveda *et al.*, 2007), a species widely distributed along the southern part of the South American continent. The interactions described by the authors listed above are usually referred to as "operational", meaning direct interference of sea lions in the fishing process.

Otaria flavescens has been described as an opportunistic predator (Aguayo-Lobo and Maturana, 1973; George-Nascimento *et al.*, 1985; Arias Schreiber, 2003) that forages in coastal waters near the surface (Vaz-Ferreira, 1981), mainly on fish, cephalopods, and crustaceans. However, considering the highly developed cognitive abilities of these animals (Gentry, 2002), it is not surprising that, when sharing a habitat with fisheries, their natural search and pursuit behaviour changes to one of sitting and waiting for the next "free lunch" (Hückstädt and Antezana, 2003). As *O. flavescens* makes use of a wide range of food items, almost all types of coastal fishery are likely to experience interference from them (Wickens *et al.*, 1992), although set fishing gear is considered to be most vulnerable to depredation activity (Beverton, 1985; DeMaster *et al.*, 1985; Szteren and Páez, 2002). According to Oliva (2004), the large number of artisanal fishers and vessels and the improved technology allied to the decrease in fish stocks, along with the sea lion's distribution, abundance, and feeding habits, have escalated the number of conflicts between South American sea lions and the artisanal fishery in Chile during the past 25 years. In Chile, the population of *O. flavescens* has remained stable over time because it is a protected species and hunting is prohibited (Sepúlveda *et al.*, 2001).

For artisanal fisheries, economic loss is caused when sea lions remove fish post-capture from the fishing gear, disturb the fishing process, or damage fishing gear (Torres, 1979; Oliva *et al.*, 2003; Rodríguez, 2004). In 2003, the estimated economic

†Deceased.

loss suffered by Chilean artisanal fisheries caused through interactions with sea lions was estimated as US$19.3 million (Oliva *et al*., 2003). In Queule, southern Chile, Oporto *et al*. (1991) calculated that the catch lost to sea lion predation accounted for 35% of total catch, corresponding to an annual financial loss of US$120 000. In Coquimbo, Rodríguez (2004) stated that sea lions consumed 13% of the gillnet catch and 22% of the longline catch, resulting in economic losses of 17 and 35%, respectively. Operational interactions were also documented for the Chilean commercial purse-seine fishery by Hückstädt and Antezana (2003); the percentage of the catch taken by sea lions was much lower than for artisanal fisheries (0.4% of the total catch).

Taking into account the complaints by fishers and the losses described by Rodríguez (2004) in Coquimbo, it is evident that better management of the problem is needed. Fishers frequently advocate a catch quota on sea lions as a potential solution (Torres, 1979; SG, pers. obs.), but the killing of marine mammals is broadly unacceptable to the general public, usually provoking political and ethical controversy. Its effectiveness is also not really known. Alternative, non-lethal methods to reduce conflicts with sea lions such as the use of deterrents (Jefferson and Curry, 1996) or changes in fishing modalities, i.e. switching to alternative fishing schedules, locations, and gears (Fertl, 2002; Oliva *et al*., 2003) either provide only short-term solutions or are non-feasible for certain fisheries. In Chile, earlier studies have focused mainly on evaluating the quantitative and economic aspects of the interactions between marine mammals and fisheries. However, when seeking a suitable management strategy, we need to understand the underlying mechanisms of the interactions.

The principal objective of our short study here was to characterize the interactions between sea lions and the artisanal fishery off Coquimbo, with the goal of analysing and suggesting management options. For the purpose, we characterized local fisheries and investigated whether the occurrence of interactions and the number of animals involved were related to spatio-temporal patterns of fishing activity and the specific fishing method applied. We also estimated the size of the local population of sea lions, observed the behaviour of the interacting sea lions, and identified the animals involved in terms of their sex and age.

Material and methods

Study site and interviews

Data collection was in Coquimbo, a port in the so-called region IV of Chile (Figure 1a), between October 2003 and March 2004. The official fishing zone of the fishers discharging in Coquimbo (29°56′S) extends from Punta Choros in the north (29°15′S) to Punta Lengua de Vaca in the south (30°15′S), and it can be subdivided into nine smaller fishing sectors associated with local landing sites (Figure 1b). There are 28 colonies of South American sea lions located within the region (two breeding colonies and 26 haul-out sites) holding some 4200 animals (Oliva *et al*., 2003).

During the study, we sought a broad overview on the characteristics of the Coquimbo artisanal fishery and its interactions with sea lions. Therefore, to gather as much information as possible on different fishing gears and locations, we conducted an interview survey with local fishers, a method that was applied for the same purpose by Oliva *et al*. (2003) and Sepúlveda *et al*. (2007). In all, 55 structured interviews were made with fishers in the Coquimbo harbour, asking them about their fishing schedule and locations, fishing gear used, species captured, and the

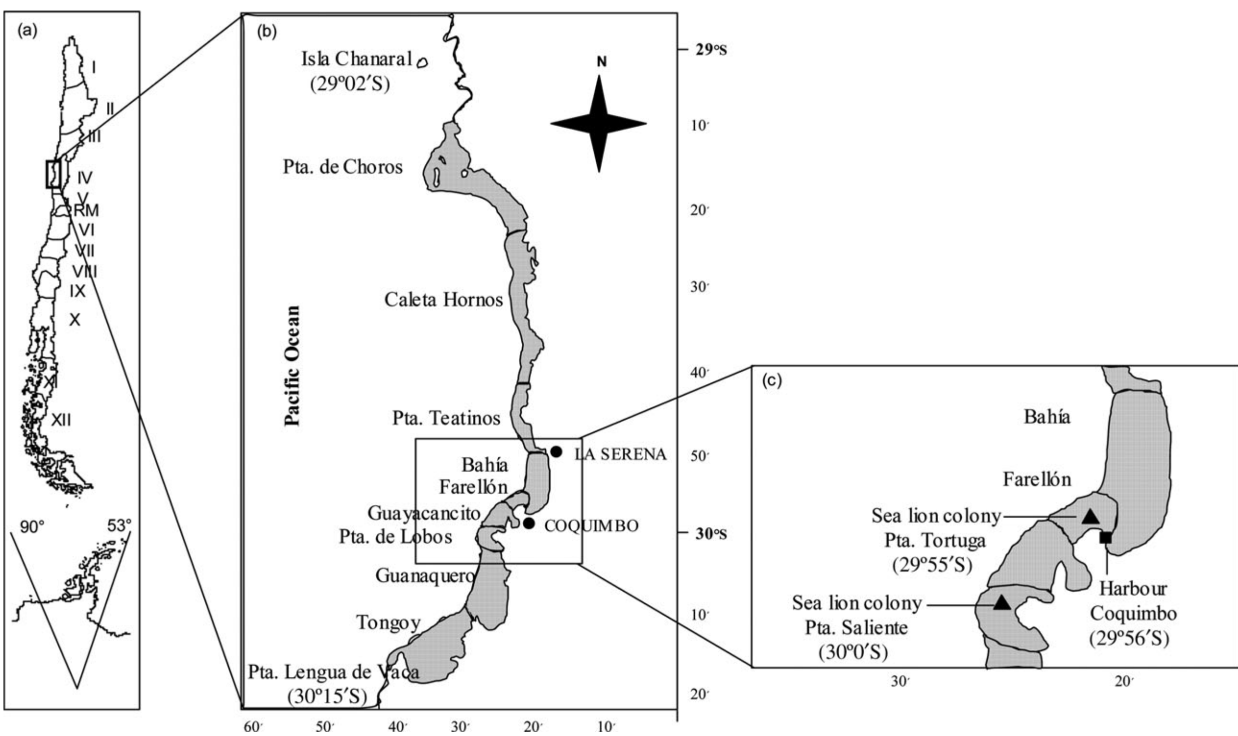

Figure 1. (a) Schematic map of the Chilean coast showing regions I–XII. (b) Fishing zone of the fishers of Coquimbo, showing the different fishing sectors (shaded). (c) Study area, showing Coquimbo harbour and the sea lion colonies.

occurrences of interactions with sea lions. In those cases where there had been interactions with sea lions, fishers were also asked to indicate the number, sex, and age of the animals involved, if they knew them.

In situ observations

To verify the results of the interviews and to obtain information on the abundance, sex/age ratio, and behaviour of the local sea lion population, *in situ* observations were carried out in the two main fishing sectors around Coquimbo, Farellón and Bahía, and on two sea lion haul-out sites near the harbour, Punta Tortuga (29°55′S) and Punta Saliente (30°00′S; Figure 1c).

The size of the local population of sea lions was estimated during five census sets (two for Punta Saliente and three for Punta Tortuga) made in January and February 2004. Sea lions were counted from a boat by two observers, binoculars being used when needed. As recommended by others (Reijnders, 1976; Eberhardt *et al*., 1979; Acevedo *et al*., 2003), we tried to confine our counts to the daily peak haul-out period of the animals, which for *O. flavescens* is in the afternoon (Sepúlveda *et al*., 2001). However, because of unfavourable sea conditions, this was only possible in two cases (Table 1). To estimate the size of the local population, the maximum number of sea lions counted in each of the two colonies was summed.

The sex/age ratio and the behavioural patterns of the interacting sea lions were determined during two gillnet operations in the Farellón fishing sector and during three purse-seine sets for anchovy in the Bahía fishing sector. During each trip, all animals approaching the fishing gear were counted, and notes on their behaviour were made. All animals counted were classified as male adult, male subadult, female, or juvenile. Classification by sex and age was done by visual observation according to morphological characteristics (body size, fur colour, and the shape of the head, snout, and neck), as described by Hamilton (1934), King (1954), and Aguayo-Lobo *et al*. (1998).

Data analysis

For the interview data, all response options chosen by fewer than 10% of the interviewees were excluded from the analysis, assuming them to have little relevance in the context of the specific question. The time intervals of main fishing activity were grouped into day and night, the former consisting of fishers leaving harbour at dawn and the latter those leaving at dusk or in the hours of darkness. Only the two main fishing sectors, Farellón and Bahía, and the fishing gears most commonly used (purse-seines, gillnets, squid jigs, and longlines) were considered in the data analysis. In addition, the number of animals counted around the fishing gear was assigned to intervals of 1–10, 10–20, and 20+.

Statistical analysis was performed using Microsoft Office Excel 2003 and Minitab 14 software. The relative frequency of occurrence of interactions and the different group sizes were compared between day and night, different fishing gears, and the Farellón and Bahía fishing sectors, applying cross tabulation and a Chi-squared test. We further compared the number of male/female and adult/juvenile sea lions observed in the Bahía fishing sector using a paired t-test (Zar, 1999).

Results

Characteristics of the artisanal fishery

According to the interview data, the fishers of Coquimbo fished between 20:00 and 04:00 and between 06:00 and 10:00 local time, with a peak around dawn. The fishing sectors mostly frequented were Farellón and Bahía (49 and 29% of the interviewees, respectively) the former primarily to capture South Pacific hake (*Merluccius gayi gayi*) and giant squid (*Dosidicus gigas*; 74 and 11% of the fishers in Farellón, respectively) and the latter to target Peruvian anchovy (*Engraulis ringens*) and South Pacific hake (50 and 25% of the fishers in Bahía, respectively). The fishing gear used by the interviewees were gillnets (42% of the interviewees), purse-seines (24%), longlines (18%), and squid jigs (11%). Longlines and gillnets were used primarily at night (90 and 87% of the interviewees using longlines/gillnets, respectively), generally targeting South Pacific hake (78 and 70%, respectively), and purse-seines by day (54% of the interviewees using purse-seines) and night (46%) generally targeting Peruvian anchovy and jack mackerel (*Trachurus murphyi*; 69 and 31% of the interviewees using purse-seines, respectively). Squid jigs were set exclusively by night to target giant squid.

The local sea lion population

The number of sea lions counted during the five census sets ranged between 95 and 126 animals at Punta Saliente and from 15 to 80 animals at Punta Tortuga (Table 1), a minimum population estimate of ~206 sea lions around Coquimbo.

Frequency of occurrence of interactions and the number of sea lions involved

Interactions with sea lions were observed by 65% of all fishers interviewed. When there had been interactions, the number of animals present ranged between 1 and 10 (in 72% of all observed interaction events). Interactions with sea lions were more frequent at night (88% of the interviewees fishing at night) than by day (55%; $\chi^2 = 5.07$; $p = 0.024$). By both day and night, however, the groups approaching the fishing gear were usually small (<10 animals; 71 and 73% of the interaction events by day and night, respectively), although no significant difference was found between the different group sizes ($\chi^2 = 0.17$; $p = 0.919$; Figure 2).

Table 1. Census data for the colonies of sea lions at Punta Saliente and Punta Tortuga (maximum counts emboldened).

Date	Punta Saliente		Punta Tortuga	
	Number of sea lions	Local time of census	Number of sea lions	Local time of census
12 January 2004	**126**	15:00–16:00	**80**	17:00–18:00
15 January 2004	–	–	15	11:00–12:00
13 February 2004	95	10:00–11:00	–	–
14 February 2004	–	–	30	12:00–13:00

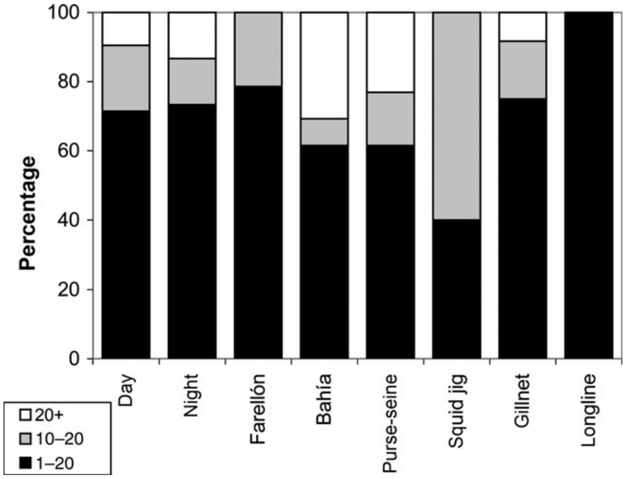

Figure 2. Frequency of occurrence (%) of small (1 – 10), intermediate (10 – 20), and large (20+) groups of sea lions at different times (day and night), in different fishing sectors (Farellón and Bahía), and deploying different fishing gears (purse-seine, squid jig, gillnet, and longline).

Of the interviewees fishing in the Bahía fishing sector, 81% reported interactions with sea lions, but in the Farellón fishing sector, interactions were only recorded by 52% of the interviewees, the differences between the two areas being close to significant ($\chi^2 = 3.716$; $p = 0.054$). In both fishing sectors, sea lions generally interfered in group sizes of <10 animals (79 and 62% of the interaction events in Farellón and Bahía, respectively), and large groups (>20 animals) were only observed in the Bahía fishing sector ($\chi^2 = 17.574$; $p << 0.001$; Figure 2).

Sea lions most often interacted with purse-seines (100% of the interviewees using this gear), followed by squid jigs (83%), gillnets (52%), and longlines (40%; $\chi^2 = 12.729$; $p = 0.024$). For all types of gear, however, most of the groups of sea lions encountered during interactions were <10 animals (100, 75, 62, and 60% of the interaction events with longlines, gillnets, purse-seines, and squid jigs, respectively). Large groups of >20 animals were most common during fishing operations with purse-seines (23%). Differences between group size were, however, not significant ($\chi^2 = 8.801$; $p = 0.066$; Figure 2).

Behaviour and sex/age ratio of interacting sea lions

Because gillnets are usually set at considerable depth, it was not possible to observe interactions directly. Interactions became more prevalent, however, when the gear was retrieved from the water and several of the fish caught in the net were seen being grabbed at or already displayed bite marks.

During direct observations around purse-seines, we encountered several small groups of sea lions swimming around the fishing area, probably searching for food. Realizing that a fishing boat was arriving, sea lions frequently barked and started to follow the boat. When the fishers started to encircle the fish shoal with the purse-seine, the sea lions waited a small distance away, not entering the net before it was pursed. Once the net had been pursed, they jumped over the float line into the net and dived around in it for 1–2 min, leaving the net and entering it again shortly thereafter (Figure 3). This scenario recurred several times until the net was pursed tight and sea lions could not enter it any more. At that moment, the animals left the fishing vessel and remained in the vicinity waiting. When the boat left the site, the animals often followed it and, if a second haul was performed, the animals showed the same sequence of behaviour again. On one occasion, sea lions seemingly followed the fishing vessel for the whole trip, although no fish shoal was detected and no haul was made.

Figure 3. A sea lion entering a purse-seine.

Most sea lions interacting with the fishing gear were male, indeed males were significantly more numerous at the gear than females ($t = -3.37$; $p = 0.020$). Additionally, the difference

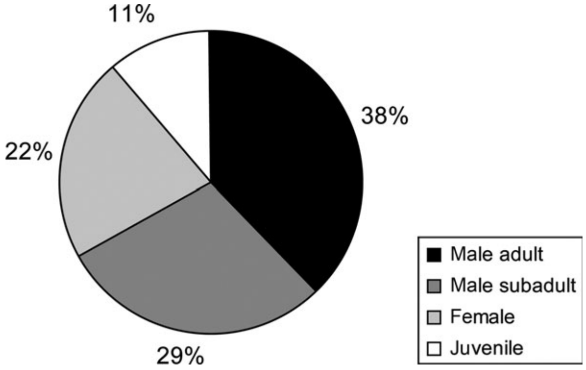

Figure 4. Sex/age composition of interacting sea lions in the "Bahía" fishing sector.

between the number of adult and juvenile animals was highly significant ($t = 14.53$; $p < 0.001$; Figure 4).

Discussion

Characteristics of the interactions

Interactions between sea lions and fisheries have been described for several parts of the distribution range of the South American sea lion (Uruguay—Szteren and Páez, 2002; Argentina—Koen Alonso *et al.*, 2000; Chile—Oporto *et al.*, 1991; Oliva *et al.*, 2003; Rodríguez, 2004; Sepúlveda *et al.*, 2007; Peru—Arias Schreiber, 1993). In our study, some two-thirds of fishers interviewed in Coquimbo had experienced interactions with sea lions, consistent with the results of Rodríguez (2004) for the same location, but considerably fewer than the numbers reported by Oliva *et al.* (2003) and Sepúlveda *et al.* (2007) for the same region of Chile. This can be explained by the fact that the colonies of sea lions around Coquimbo are relatively small, consisting of just ~200 animals. The region's large breeding colony, Punta Lobería (~1800 animals; Sielfeld *et al.*, 1997), is some 200 km south of Coquimbo, and extensive migration of animals from that colony to the feeding grounds around Coquimbo is unlikely. Therefore, the number of sea lions potentially interfering with fisheries in our study area is fairly low. We stress, though, that our counts represent minimum abundance rather than absolute population size, because animals at sea could not be included into our counts. However, our numbers are similar to those reported by Sielfeld *et al.* (1997; 231 animals at both sites) and, according to Sepúlveda *et al.* (2007), the population size of *O. flavescens* in Chile has probably remained approximately constant over the past 30 years.

South American sea lions are nocturnal feeders (Sepúlveda *et al.*, 2001), which is associated with the vertical migration of their prey towards the surface at night (Thompson *et al.*, 1998). Our finding that interactions were most frequent at night is therefore unsurprising, though it contradicts the results of Hückstädt and Antezana (2003), who failed to find a significant difference in the frequency of interactions between sea lions and purse-seiners between day and night. Those authors noted, however, a possibility that the number of sea lions counted at night might be underestimated owing to the lack of sufficient light for observations to be made.

Both passive and active fisheries offer sea lions the opportunity to obtain food with minimum metabolic expense compared with pursuing and catching prey individually. When capturing fish, the purse-seine acts as an active predator (Beverton, 1985), encircling and concentrating shoaling fish. Hückstädt and Antezana (2003) state that some behavioural displays of sea lions at a purse-seine revealed a degree of specialization in collecting the fish entrapped in the net, with very little investment of energy. Gillnets and longlines, in contrast, are usually set at dusk and retrieved at dawn; by night, when fish accumulate in the gear, the sea lions have the opportunity to feed on the catch without being disturbed by fishers.

In our study, interactions with sea lions were more frequent for purse-seines and the Bahía fishing sector than for passive gear, such as gillnets and longlines, and the Farellón fishing sector. One possible explanation for this could be that prey moving naturally, such as anchovy encircled by a purse-seine, may be more attractive to sea lions than dead fish trapped in a net, considering their natural search and pursuit behaviour (Hückstädt and Antezana, 2003). Nevertheless, it is also likely that the number of sea lions interacting with passive gear is underestimated in our study, for two reasons: first, because interactions with set fishing gear were mainly at night when fishers are absent and sea lions were not observed directly, and second, because passive fishing gear is usually set at considerable depth, so sea lions would not be visible from the surface.

Szteren and Páez (2002) stated that the number of interacting sea lions should increase with proximity to the sea lion colony. In our study, the greatest interaction frequency would, according to that criterion, be expected in the Farellón fishing sector, close to the known haul-out site, and not in the Bahía fishing sector. However, in our study, shoaling fish such as anchovy and pilchard are very abundant in the Bahía fishing sector, drawing sea lions particularly to that area.

The number of sea lions interfering with fishing gear mostly ranged between one and ten, as also found by Szteren and Páez (2002) in Uruguay, and Oliva *et al.* (2003), Rodríguez (2004), and Sepúlveda *et al.* (2007) in Chile. Large groups of sea lions with >20 animals were almost exclusively observed during purse-seining, a fact that might be linked to the species and quantity of fish captured by that gear. Hückstädt and Antezana (2003) counted similar numbers of animals for the same fishing method. Purse-seiners can catch up to 80 t, whereas passive gears concentrate much smaller quantities of fish. Therefore, in the longline and gillnet fishery, there may not be sufficient potential food available to attract larger groups of sea lions. Another explanation for this finding might be the natural foraging behaviour of sea lions. According to Riedmann (1990), the presence of large, patchily distributed shoals of pelagic fish favours the formation of cooperative foraging groups, whereas non-shoaling fish are most efficiently exploited by an animal operating alone. The fact that purse-seiners operate primarily where shoaling species are abundant helps to explain the greater frequency of large groups of sea lions associated with that fishing technique.

The results we have described add weight to the hypothesis that sea lions learn to associate the presence of fishing boats with the availability of food. An example, of course, is the behavioural observations made in the Bahía fishing sector of one group of sea lions apparently following the boat throughout a whole trip despite no fish shoal being detected and no haul being made. It seems, therefore, that the presence of a boat itself represents a stimulus sufficiently strong to attract sea lions, an interpretation also proposed by Hückstädt and Antezana (2003).

Sex/age ratio

The fact that it is mostly adult male individuals that participate in interactions with fisheries, a finding also reported by Oliva *et al.* (2003), can probably be attributed to different feeding strategies between sexes. *Otaria flavescens* is a polygamous species, and each sex has different ecological constraints. Koen Alonso *et al.* (2000) found that male and female South American sea lions in Patagonia fed on different types of prey, and they associated this finding with the different utilization of common and frequent food resources. Females had coastal and benthic predation habits, whereas males were more pelagic and forage in the water column (Crespo *et al.*, 1997; Koen Alonso *et al.*, 2000). Moreover, male pinnipeds do not provide parental care (Le Boeuf, 1991), and females nursing pups may have to limit the distance they can travel to feeding grounds. Off Argentina, male South American sea lions travelled twice as far as females during foraging trips (Campagna *et al.*, 2001) and did not display a circadian foraging rhythm (Pérez and Cappozzo, 2002). Certainly, such foraging restrictions are only true for breeding females, but considering the annual reproductive cycle of this species (Campagna, 1985) and the duration of lactation of up to 24 months (Vaz-Ferreira, 1981), most females are engaged in maternal care throughout their whole period of sexual maturity.

Management options and recommendations

In our study area, damage caused to fisheries by sea lions included the loss of catch and damage to gear, although catches did not differ significantly in the presence and absence of interaction (Rodríguez, 2004). The average catch lost to sea lion depredation was estimated to account for 16.5% of the total catch, resulting in an average economic loss of 27.7% of income of fishers (Rodríguez, 2004). To reduce these losses, appropriate management action is required in Coquimbo. If the same animals consistently cause the problem, the removal of such rogue animals might be considered. At Ballard Locks, Seattle, for instance, the displacement of three troublesome sea lions to a captive facility appears to have reduced depredation by sea lions on steelhead trout (NOAA, 1996). In Sweden, however, the killing of seals around salmon traps did not result in significant reduction of damage to fish and gear (Sand and Westerberg, 1998). It is evident that the success of such a strategy depends on the accurate identification of animals responsible for depredation, which in practice is not easy. Tagging programmes to identify particular animals could help to solve this problem.

An alternative, and probably more appropriate, solution would be for fishers to try to understand sea lion foraging behaviour better, then adjust their fishing activity to it. A possible way to do so would be to reduce the soak time of set gear, and to set the gear when sea lions are less active, i.e. by day, or to remove the catch from the gear more frequently. This might give sea lions less opportunity to take fish from catches. Moreover, it might be advisable to avoid fishing areas within known foraging routes of sea lions and close to their breeding and haul-out sites. The use of stronger nets, less vulnerable to seal attack, might further help to reduce damage to fishing gear. In purse-seining, where the number of interacting animals is relatively high, a cooperative fishery could be a good solution to reduce the amount of catch lost by each vessel (Oliva *et al.*, 2003). Instead of trying to "fight off" the sea lions, an alternative could be to find a way to make use of their existence and presence. Wildlife tourism, such as whale and dolphin watching, has become increasingly attractive during the past 20 years (UNEP/CMS, 2006). Sea lion watching could have major potential, creating an additional source of income for fishers which could perhaps partially compensate for the economic loss they suffer from sea lion depredation. However, implementation of any of these measures depends on the willingness of fishers to cooperate; some of these approaches might not be acceptable to them, or even feasible.

It is important to note that a holistic management plan needs to take into account the interests of all groups involved in the conflict, i.e. those of the sea lions (represented by the animal welfare lobby) and those of the fisheries and associated sectors. Scientists can help local decision-makers by giving scientific advice or by identifying relevant research needs. A good way to bring conflicting groups together is to create a stakeholder forum to debate, make decisions, and enhance the potential for community management. In Finland, for instance, where grey seals interact with coastal fisheries, the establishment of such a forum helped to mitigate conflicts between different groups, facilitating the development of a broadly acceptable management plan (Varjopuro, 2004).

Usefulness and validity of interview data

Questionnaires are particularly suitable tools for approaching certain topics in ecology. In studies of the interactions between humans and wild species, for instance, interviews often provide the best means of obtaining quantitative data from a large number of sites (White *et al.*, 2005). Our study covered a wide range of sampling sites and fishing gears. Direct observation as the only means of data gathering would have been too costly and logistically infeasible. Interviews also offer a possibility of obtaining valuable information from fishers, many of whom have extensive traditional knowledge of the marine system in which they are operating and can help the scientist in formulating solutions by stating a fisher perspective. Among the most cited criticisms of interview surveys is the presumed lack of validity, i.e. the ability to obtain correct answers. There is no doubt that fishers can lose objectivity when it comes to topics that threaten their livelihood, such as sea lions damaging their catch and gear, so we acknowledge that the frequency of interactions and the number of sea lions observed may be overestimated in our study. Lien *et al.* (1994), however, state that face-to-face interviews are more reliable if the interviewer and the fisher already know each other. In our study, the interviewer had extensive contacts with fishers, hence, in our opinion, maximizing the reliability of the data.

Future studies

We believe that future studies need to focus on identifying the foraging areas of sea lions to define hotspots of potential conflict. Additionally, tagging programmes should be encouraged to assess whether the animals in conflict are always the same. If animals are killed for management purposes, the trajectories of the local population, and population parameters such as sex/age ratio and the rates of birth and mortality, should be analysed through regular population census to avoid negative effects on the stability of the sea lion population.

Acknowledgements

This article is dedicated to the memory of our friend and co-author MJV, who unexpectedly passed away in March 2008 and without whose dedication and insights this work would not have been possible. We thank the fishers of Coquimbo, especially

Renato Laferte, Juan Arenas, the crew of FVs "Don Gustavo" and "Vicho", the working group ECOLMAR (Grupo de Ecología y Manejo de Recursos), and the staff of the University Católica del Norte for technical support and cooperation. We also appreciate the help of Gerardo Cerda from SERNAPESCA in providing us up-to-date fisheries statistics, the DAAD (German Academic Exchange Service) for financial support, and Walter Sielfeld, Graham Pierce, and Begoña Santos for suggestions and corrections on the draft manuscript.

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doi:10.1093/icesjms/fsn152