WORKSHOP ON TECHNIQUES FOR REDUCING MARINE MAMMAL-GILLNET BYCATCH

Woods Hole, MA USA

October 17 – 20, 2011

Presentation Abstracts (10/15/11)

Session: GENERAL CONTEXT

FAO International Guidelines on Bycatch Management and Reduction of Discards. **Dr. F. Chopin, P. Suuronen, and K. Cochrane, FAO, Italy**

International Guidelines on Bycatch Management and Reduction of Discards were drafted and developed through a series of activities, which were undertaken at the request of the Committee on Fisheries (COFI) at its twenty-eighth session (March 2009) and comprised an Expert Consultation to Develop Draft International Guidelines on Bycatch Management and Reduction of Discards (Rome, Italy, 21–23 December 2009); and a Technical Consultation on the International Guidelines on Bycatch Management and Reduction of Discards (Rome, 6–10 December 2010), where they were further developed and adopted. The Guidelines were developed through a participatory process involving fisheries experts, fishery managers from governments, the fishing industry, academia and non- governmental and intergovernmental organizations. The guidelines are voluntary and constitute an instrument of reference to help States and RFMO/As in formulating and implementing appropriate measures for the management of bycatch and reduction of discards in conformity with the FAO Code of Conduct for Responsible Fisheries. They apply to all fisheries and regions of the world. The Committee on Fisheries (COFI) at its twenty-ninth session in February 2011 endorsed the International Guidelines and recommended FAO to provide support in capacity building and their implementation.

Session: ACOUSTIC DETERRENTS – EXPERIENCE TO DATE AND FUTURE PROSPECTS

Experience in implementing acoustic pingers in US and Canadian fisheries
Debra Palka, NEFSC, NOAA, USA

This paper reviews the history of the use of acoustic deterrent (pingers) to reduce marine mammal bycatch in US and Canadian gillnets. During the 1990's, before pingers were used on a regular basic in commercial fisheries, the efficacy of pingers was explored in several small-scale controlled experiments. The results showed that pingers reduced bycatch of cetaceans and pinnipeds by 70-95% in the New England groundfish sink gillnet, Bay of Fundy demersal groundfish gillnet, Washington salmon gillnet, and California drift gillnet fisheries. Based on these

successes, the New England set and California drift gillnet fisheries are now required to use pingers at specified times in selected areas. With the regular use of pingers in these commercial fisheries there has been varied levels of success in reducing bycatch, ranging from eliminating beaked whale bycatch in the California drift gillnet fishery, to substantially reducing harbor porpoise (*Phocoena phocoena*) bycatch in the New England set gillnet fishery, to actually increasing California sea lion (*Zalophus californianus*) bycatch in the California drift gillnet fishery., These results highlight some of the potential drawbacks of pinger usage, which include the "dinner bell effect", in the case of the California sea lion, potential increased depredation and habituation, lack of compliance by the fishers themselves, and not fully being able to predict how pingers reduce bycatch. To investigate some of these potential drawbacks, commercial data were examined for indications of habituation, the "dinner bell effect" and non-compliance. Also, additional experiments were conducted off the coasts of North Carolina, Oregon and Vancouver and Grand Manan Islands in Canada. In addition, theoretical distances that cetaceans should be able to hear the pingers were calculated, and statistical models of varying levels of compliance were developed using social and economic information. The overall conclusion from this work was that pingers reduce the bycatch of marine mammals in US and Canadian gillnets, particularly when used properly. However, the dinner bell effect may be real, at least for a few species. Habituation is theoretically possible, but has not been evident in the commercial fisheries. Depredation of some target fish species may have increased, again, for a few species. Finally, non-compliance by fishers does reduce the effectiveness of pingers. But even after 20 years of using pingers, we still do not have a clear and unambiguous understand of why the pingers work.

Review of the efficacy of acoustic deterrents for reducing marine mammal bycatch in the Baltic region, North Seas and East Africa. **Dr. Per Berggren, University of Newcastle, UK**

This paper assesses the efficacy of acoustic deterrents for reducing marine mammal bycatch in gillnets based on past and present research in the Baltic region, North Seas and East Africa. Results from field trials are used to evaluate the efficacy of pinger-type and acoustic harassments devices as bycatch deterrents. The review includes potential effect on target species and non-target species, and investigates variation due to seasons, habitats, device types, gear types and fishing methods where data are available. Further, the potential for habituation and habitat exclusion are also considered. The most critical research challenges and priorities are discussed for the concerned species in the Baltic region, North Seas and East Africa.

Acoustic characterization of bycatch mitigation pingers. **Dr. Christine Erbe, Jasco Research, Australia**

The acoustic characteristics of pingers deployed on Queensland shark nets were measured in the field. Frequency, level, directivity, tone duration and duty cycle

were measured for multiple pingers showing significant variability. Sound propagation was modelled and acoustic footprints of pingers were computed. Ambient noise in shark net areas was recorded over a period of 1 year, and pinger contribution to ambient noise budgets was determined. Based on assumptions about marine mammal hearing and swim speeds, a minimum pinger spacing was recommended.

***Acoustic deterrents in UK gillnet fisheries*. Dr. Simon Northridge, University of St. Andrews, UK**

The use of pingers in the EU is mandated by Council Regulation 812/2004. This regulation applies only to certain specific fisheries variously defined by gear type, area fished, mesh size, months, and net length. Only vessels over 12m are included in the regulation. Smaller vessels are deemed the responsibility of member states as they mainly fish within territorial waters (12nm). Adherence to the regulation has been poor since it came into force 6 years ago, and in several countries the fishing industry has complained that the pingers specified in the regulation are insufficient for the task. In the UK industry asked for a louder device so that the number of pingers required per boat could be reduced from the hundreds to a few tens of devices. A suitable device was identified (STM DDD-02, DDD-03) and has been tested for three years in the UK set net fisheries for hake, monkfish and cod/pollock. Fishery trials were preceded in 2007 and 2008 with an experiment to try to determine the effective deterrent distance of a single device deployed on a short tier of tangle netting. Although the results were somewhat equivocal, these trials suggested that DDDs have a decreasingly aversive effect on porpoises and dolphins that does not disappear to around 2 or 3 km from source. Fishery trials involved pingers being deployed at each end of tiers of nets that varied in total length from a few hundred metres to over 7km in length. Nearly 2000 fishing operations were reported on. Fleets with DDDs had 66% lower porpoise bycatch rates than fleets without DDDs, but fleets of 4km or less in length caught only 1 porpoise compared with 13 taken in unpingered nest of similar length. It appears that keeping fleets to a maximum of 4km and using DDDs at each end would reduce porpoise bycatch by 95%. The management implications will be discussed.

***Catch rates and the effectiveness of pingers in reducing Indo-Pacific bottlenose dolphin (*Tursiops aduncus) *incidental capture in the protective nets off KwaZulu-Natal, South Africa.* Dr. Vic Peddemors[1,2], Sheldon Dudley[1], Dave Schoeman[3], Sabine Wintner[1] and Geremy Cliff[1]**

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Bottlenose dolphin catches in the KwaZulu-Natal shark nets showed no significant trend for the period 1980 to 2009. The geographical distribution of bottlenose dolphin catches was not uniform. Catch rates in the southern region tended to be higher with a marked increase in the cooler months potentially linked to greater dolphin abundance following the annual migration of sardines into coastal waters. In an attempt to reduce the influence of this seasonal variation, pingers were introduced into north coast shark nets. Beaches with pinger deployment were interspersed with control beaches. Using an MBACI design with three factors and two covariates, we tested the efficacy of pingers in reducing bottlenose dolphin captures by comparing catch rates before their deployment (1993-1999) with those afterwards (2000 –2006). There was no difference in sex or age categories for captures before or after pinger deployment. Investigation of catch position in relation to the pinger shows no trend, with all dolphin size and sex categories captured haphazardly in relation to the pinger. Catch rates at both impact (pinger) and control beaches increased during the seven years before treatment period, with catch rates at control beaches higher than at impact beaches. After pinger deployment, catches at the impact (pinger) beaches remained stable at the level they had reached in 1999, whereas those at control beaches fell sharply. Our data suggest that differences in catch rates between treatments were not influenced by inter-annual catch trends and support the assertion that pingers at best do not reduce incidental capture of bottlenose dolphins in coastal set nets.

Bycatch mitigation of harbour porpoise (*Phocoena phocoena*) in Dutch set net fisheries: A pilot to study the workability and efficiency of several pinger types.
Dr. Marije Siemensma, IVN, Holland

In The Netherlands, bycatch of harbour porpoises (Phocoena phocoena) occurs in set nets, although the scale is yet unknown, due to lack of proper monitoring. In order to mitigate bycatch, the Coastal & Marine Union (EUCC) started a pilot study to investigate the workability and efficiency of two acoustic devices (DDD02 and Bananapinger). This pilot is part of a larger project aiming to mitigate bycatch of harbour porpoises, the smallest cetacean inhabiting Dutch coastal waters, in the winter set net fishery on mainly cod, turbot and brill. Monitoring bycatch and facilitating landing bycaught porpoises; the exchange of knowledge and experience with parallel pinger trials and the exploration of innovative methods to reduce bycatch are part of this project. The project is a close collaboration between the Dutch Fisheries Association, the expert group on set net fishery and Dutch winter season set net fishermen.

First preliminary results show that fishermen are positive about the practical workability of a new pinger type, the BananaPinger (Fishtek Ltd / Chelonia Ltd.). In September and October 2011 the pingers will be tested in vitro, to investigate the effect of the acoustic output on harbour porpoises.

In cooperation with research institute IMARES porpoise detectors are installed on the fishing nets to measure the efficiency of the pingers. These data will be analysed in September and October 2011.

The study is funded by the Dutch Ministry of Economics, Agriculture and Innovation (EL&I) and the European Fisheries fund, investment in sustainable fisheries.

Efficacy of pingers in North Pacific salmon and squid gillnet fisheries. **Dr. Tomonari Akamatsu, National Research Institute of Fisheries Engineering, Japan**

Reactions of bottlenose dolphins, Pacific white-sided dolphins, false killer whales, Risso's dolphins, Dall's porpoises to underwater sounds were observed for countermeasures to reduce damages to long line fisheries and by-catch on gill nets. Various sound projectors having dominant frequencies from 2 kHz to 200 kHz with source levels reached up to 200dB re 1μPa. Reactions of dolphins and porpoises to the sounds were observed in a pool, a net enclosure or an open sea. Clear escaping reactions from a sound source were observed by sounds with exposed level above 170dB at the subject animal. Reactions to sounds below 160dB were not stable. The dolphins got accustomed to the sound after multiple projections. On the other hand, frequency and amplitude modulated sounds seemed to be effective even if the sound pressure level was about 120dB. Efficacy of acoustic pingers to control wild dolphins and porpoises were limited. The effective range was estimated above 170dB exposure level that depends on the source level of a device and sound propagation. Acclimation for the sounds by dolphins and porpoises were not negligible. Avoiding successive transmission and amplitude/frequency modulations were recommended.

To ping or not to ping; the use and abuse of active acoustic devices in mitigating interactions between small cetaceans and gill net fisheries**. Dr. Steve Dawson Otago University, New Zealand**

Active sound emitters ("pingers") are used in several gillnet fisheries to reduce bycatch of small cetaceans, and/or to reduce depredation by dolphins. Here we review studies conducted to determine whether these devices could be effective. Significant reductions in bycatch of three cetacean species (harbour porpoise, common dolphin, and franciscana) have been demonstrated. For harbour porpoise this result has been replicated in nine controlled experiments in North America and Europe, and appears to be the result of porpoises avoiding the area ensonified by pingers. Two gillnet fisheries (California-Oregon driftnet fishery for swordfish; New England groundfish fishery) in which pinger use has been mandated have now been studied for over a decade. Pingers have reduced dolphin/porpoise bycatch by 50-60%, and there is no evidence of an increase in bycatch over time due to habituation. Both fisheries show significantly higher bycatch in nets in which pingers have failed or were spaced further apart than mandated. Studies of pinger use to reduce depredation by bottlenose dolphins generally show small and

inconsistent improvements in fish catches and somewhat reduced net damage. Dolphin bycatch in these fisheries is rare, but still occurs in nets with pingers. Taken together, these studies suggest the most promising candidates for bycatch reduction via pinger use will be gillnet fisheries in developed countries in which the bycaught cetaceans are generally neophobic, behaviourally inflexible species and have large home ranges. We offer a set of lessons learned from the last decade of bycatch management.

Session: NON-ACOUSTIC GEAR TECHNIQUES FOR MARINE MAMMAL-GILLNET BYCATCH MITIGATION

Review of European trials of barium sulphate and metal oxide nets. **Finn Larsen, Technical University of Denmark, and Dr. Simon Northridge, University of St. Andrews, UK**

In the late 1990s a private manufacturer designed a high-density monofilament, where a metal compound is added as filler in the polymer to increase the acoustic reflectivity and thus the detectability for echo locating odontocetes. Nets made from such monofilaments were tested in the Bay of Fundy, Canada, in 1998 and 2000 showing a significant reduction in bycatches of harbour porpoise (*Phocoena phocoena*) when compared to control nets. Such nets were also tested in gillnet fisheries with bycatch of harbour porpoises in European waters, but results were quite different from the Canadian results. This presentation reviews the research carried out in Europe with metal oxide and barium sulphate nets and their potential as a deterrent to marine mammal bycatch in gillnets.

Results from Argentinean trials of barium sulphate and stiff nets on bycatch rates of Franciscana dolphins. **Pablo Bordino, Aquamarina, Argentina and Dr. Alice Mackay, UK**

The incidental capture of Franciscana dolphins (*Pontoporia blainvillei*) in gillnet fisheries of Argentina, Uruguay and Brazil represents a major threat to the survival of this species. One bycatch mitigation strategy is to increase the acoustic reflectivity of gillnets to echolocating cetaceans by impregnating the nylon twine with denser materials such as barium sulphate. While such nets have previously shown promise at reducing bycatch rates of harbour porpoises it remains unclear whether this was as a result of the acoustic or mechanical (stiffness) properties, or both, of the modified nets. Therefore the objective of this study was to compare bycatch rates of Franciscana dolphins in standard gill nets and two types of modified gill net; $BaSO_4$ (10% by weight) and chemically stiffened nets. Field trials were conducted in association with artisanal fishermen in Bahia Samborombon, Argentina between October 2009 and March 2010. Depth sensors were also deployed on some sets in order to record the underwater fishing behaviour of the three net types. Results showed that both of the modified nets performed comparatively well at catching target fish species relative to the standard net. However, there was no significant

difference in Franciscana bycatch rates between net types, with a total of 25, 22, and 16 dolphins caught in standard, $BaSO_4$ modified, and stiff gillnets (n-298, 291, and 294 sets respectively). Results from depth sensor data showed that the $BaSO_4$ net fished with a significantly lower mean float line height than either the control or chemically stiffened net.

***The affects of hanging ratio on the catch of harbor porpoise and targeted finfish species*. Dr. Henry Milliken, NEFSC, NOAA, and Gwynne Schnaittacher, AIS, USA**
Based on analysis of data collected by fisheries observers in the area south of the Cape Cod South management area, we found that gillnets with a hanging ratio of 0.33 tend to have a greater harbor porpoise bycatch than nets hung with a ratio of 0.50. However, this finding was not consistent in all areas, was based on few (and unequal) observations (n=21 with a hanging ratio of 0.33 and n=125 with hanging ratio = 0.55), and the analytical result was not derived from a comparative experiment designed to evaluate the two hanging ratios. We therefore conducted a study that compared the catch of targeted species and incidental marine mammal bycatch between gillnets with a hanging ratio of 0.50 vs. gillnets with a hanging ratio of 0.33. A total of 159 hauls were conducted and 40 marine mammals were captured. No statistical difference was detected between the two net hanging configurations in the catch of marine mammals but there was a significant increase in the catch of targeted species when the nets were hung at 0.33. When the fisheries observer data were analyzed at larger spatial and temporal scales (beyond the Cape Cod South management area) marine mammal bycatch differences between the hanging ratios were not evident suggesting that the Cape Cod South management area result is probably an artifact of low sample size.

***Evaluating the impact of gillnet soak durations on bycatch of small cetaceans in the Northwest Atlantic, USA*. Marjorie Rossman and Debi Palka, NOAA Northeast Fisheries Science Center Protected Species Branch, USA**
Incidental bycatch in gillnet fishing operations is a widespread problem threatening the survival of cetacean populations in many of the world's oceans. The US National Marine Fisheries Service has implemented several approaches to reducing cetacean bycatch in gillnets ranging from acoustic deterrents to modification of gear and fishing practices. Focusing on non-acoustic mitigation measures could be more desirable because it does not exclude from habitat animals avoiding acoustic devices. This paper focuses on how modifications to soak duration have been utilized as a mitigation measure to reduce bycatch of harbor porpoises and coastal bottlenose dolphins within the mid-Atlantic (MA) region of the Northwest Atlantic (NWA) Ocean. Expected reductions in gillnet bycatch of harbor porpoise and coastal bottlenose dolphins were quantified using fishery observer data and regression correlation analyses, and pre-mitigation and post- mitigation bycatch rates were compared. Regression models showed a significant positive correlation between harbor porpoise bycatch and gillnet soak durations. One model predicted harbor porpoise bycatch rates in the New Jersey region may be reduced by 81% if soak

durations were restricted to less than one week. In the case of coastal bottlenose dolphins off North Carolina (NC), regression models predicted bycatch rates could be reduced by 66% if medium (>5" to <7") mesh gillnet soak durations were reduced to <12 hours. Coincidentally, a directed NC medium mesh gillnet fishery which had long soak durations was eliminated by a fishery resource management action and was subsequently followed by a mammal resource management restriction codifying a limitation on soak durations to less than 12 hours in case the directed medium mesh fishery returned in the future. Since these measures were implemented, observed bycatch rates in NC medium mesh gillnets were reduced by nearly 100%. Results from these experiences demonstrate that modifying a fishing practice (i.e. soak duration) can be an effective mitigation tool for reducing bycatch of harbor porpoises and coastal bottlenose dolphins. These results may not be applicable to all species in other gillnet fisheries because of differences in species behavior and other fishing practices. In addition, enforcement and monitoring issues for mitigation measures need to be considered.

Mitigation Strategies for Mysticete Gillnet Entanglements in the Western North Atlantic. Scott Landry[1] and Dr. Scott D. Kraus[2]
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While gillnet entanglement of baleen whales along the East Coast of North America has been recorded in most commonly seen species (right, fin, minke and humpback whales) the relative occurrence and impact of this interaction type is poorly understood. Assessing entangling gear type, especially for animals at sea, is complicated by many factors, including shedding of identifying features over time (such as marker buoys and tackle), inadequate photo-documentation of pertinent features and a relative lack of gear samples gathered during disentanglement. Johnson et al. (2005) summarized gear removed from humpback and right whales through 2002, and found that gillnet entanglements represented 28.8% of identifiable gear samples, suggesting that gillnet is well represented in large whale entanglements. Both buoy line and net panel components from gillnet were removed from entangled whales and 23% of identified gillnet entanglements resulted in known or presumed mortalities. The Atlantic Large Whale Take Reduction Team (ALWTRT) working with NMFS has instituted a variety of mitigation strategies over the last 12 years in an effort to reduce gillnet-related mortalities. We re-evaluated the sightings and retrieved gear data for the presence or absence of evidence of gillnet. This analysis does not include stranding data, and so underestimates both entanglements and mortality. For right whales and humpbacks, the number of cases confirmed (by NMFS from disentangled samples) or inferred (based on photographic evidence of mesh and/or floatline floats) to involve gillnet: (9 right whales, 27 humpbacks). At least two right whales and XX humpbacks are known to have died due to gillnet entanglements. This number is a minimum as we could not confirm or infer gillnet from entanglements that had been reduced to rope only. Gillnet involved all body areas, from head, mouth, flippers body and flukes. All gillnet gear components have been taken off whales (net panels, head ropes, buoy lines, and anchor lines), and both buoy line and panel components

have been removed from the mouths of hw's and rw's. Given the paucity of data, and a recent surge in gillnet entanglements, it is impossible to tell if any of the ALWTRT strategies have been effective at mitigating mysticete entanglements from this gear type.

Session: TIME-AREA CLOSURES

How effective are protected areas in reducing Hector's dolphin bycatch? **Dr. Liz Slooten, Otago University, New Zealand**

New Zealand's endemic Hector's dolphins overlap with gillnet and trawl fisheries throughout their geographic range. Estimates of catch rates in commercial gillnets from an observer programme (there are no quantitative estimates of bycatch by amateur gillnetters or in trawl fisheries) were used to estimate the effectiveness of new protection measures introduced in 2008. Future population size depends strongly on the extent to which fishing effort removed from protected areas is displaced to unprotected or poorly protected areas. Without fisheries mortality, all Hector's dolphin populations are predicted to increase, with the total population approximately doubling by 2050 and reaching half of its 1970 population size in just under 40 years. Under the current protection measures, most populations are predicted to either continue declining or take more than 1000 years to recover to half of their original population size.

Time-area closures for critically endangered species: A recipe for extinction or survival? The case of the vaquita. **Dr. Lorenzo Rojas-Bracho and Dr. Armando Jaramillo-Legorreta, Coordinación de Investigación y Conservación de Mamíferos Marinos, Instituto Nacional de Ecología (INE), México**

Is Time Area Closure (TAC) the appropriate management tool for critically endangered species recovery programs? The case of the vaquita represents two extremes of implementing TACs for Critically Endangered Species. The first is the Biosphere Reserve of the Upper Gulf of California and Colorado River Delta created in 1993 to protect, among several species, the vaquita. Fishing was banned in the Nuclear Zone and allowed in the Buffer Zone. However, the estimated bycatch from 1993-95 was 39 vaquitas/yr from only one fishing port. The key failure in this case was a lack of pre-closure data for both fisheries and vaquita distribution and population size, and a lack expertise to contrast sighting and bycatch data. As a consequence the population had an average rate of decline of 7.6% in the past 11 years. The second case is the Vaquita Refuge declared in 2005 established in following the recommendations of the International Committee for the Recovery of Vaquita (CIRVA). In contrast to the Biosphere Reserve there was better pre-closure data, particularly regarding vaquita distribution. In 2004 CIRVA recommended that as an absolute minimum, immediate action should be taken to prevent any net fishing within the area where the vaquita population was densest. This recovery team stressed that this alone would not guarantee the recovery of the vaquita, but that this interim action was necessary to reduce the possibility of further population decline and for buying time to allow for the development

of alternative fishing gear, as well as socio-economic initiatives to eliminate all gillnets throughout vaquita's range. In 2008 as part of the Mexican government's conservation plan for this porpoise, a voluntary buyout program was implemented and all net fishing was banned and enforced in the Vaquita Refuge. However, the Refuge has turned out not to be an interim measure and remains in force even though gillnets continue to be used within it. At best the Refuge has slowed down the population decline. Among the problems faced with this TAC are illegal fishing within the Refuge, even with strong enforcement, "edge effect" and bycatch outside the refuge. If protection remained as it is at present, limited to the vaquita Refuge Area, the chance of population abundance increasing over the next decade is only 8%. Bearing in mind this case and the number of small cetacean populations at risk, TACs should be very carefully analyzed before considering it as a management option and should only be used in combination with other management tools (alternative gear, alternative livelihoods, education, etc).

Impact and mitigation of Australian sea lion bycatch using spatial closures in the shark gillnet fishery off South Australia. **Dr. S.D. Goldsworthy [*1]., DAJ Hamer [1,2,3], B Page[1], AD Lowther [2,1], PD Shaughnessy[4], M Hindell[5], P Burch[1], DP Costa[6], SL Fowler[6], K Peters[2,1], and R McIntosh[1]**

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Assessing the impacts of fishery bycatch on populations of threatened and protected species is challenging but of critical importance. Fishery observer data are typically used to assess rates of bycatch per unit of fishing effort, and then extrapolated across the fishery. However, bycatch rates provide an imprecise estimate of bycatch number as observer programs generally monitor a fraction of total fishing effort, are difficult to replicate and the underlying encounter probabilities (which determines bycatch rates) are generally highly heterogeneous and not known for marine species. Australian sea lions (*Neophoca cinerea*) (ASL) are a threatened species endemic to southern Australia, and subject to incidental mortality (bycatch) in demersal gillnet shark fisheries. Bycatch has been identified as the key threatening factor for the species, and recently fishery closures have been introduced to mitigate bycatch impacts. To assess the risks to ASL subpopulations from bycatch mortality data from four main sources were integrated and modelled: i) satellite tracking data to estimate distribution of foraging effort ; ii) survey data on ASL subpopulation size; iii) data from a dedicated ASL bycatch observer program and iv) detailed spatial data on the distribution of fishing effort. Satellite telemetry data from 210 individual ASL (157 adult females, 31 adult males, 22 juveniles), from 17 subpopulations, in conjunction with depth and distance from colony data, were used

to develop statistical models of the distribution of foraging effort across the population of ASL. Bycatch mortality rates based on observer data were highly correlated with sea lion foraging density, enabling levels of bycatch mortality that would result from different distributions and levels of fishing effort to be estimated with confidence limits. We use this approach to estimate the impacts the current fishery is having on populations of ASL, and provide closure options required to mitigate bycatch threats to ASL populations. A range of management measures to mitigate bycatch have been introduced into the fishery, and these will be discussed.

An examination of the impact of time-area closures on harbor porpoise bycatch in the US Northwestern Atlantic Gillnet Fishery. **Christopher D. Orphanides, NEFSC, NOAA, USA**

One of the primary methods used to reduce harbor porpoise (*Phocoena phocoena*) bycatch in the US Northwestern Atlantic gillnet fishery is time-area closures. The impact of time-area closures on harbor porpoise bycatch was examined by comparing vessel behavior 5 years before and after the enactment of the 1998 Harbor Porpoise Take Reduction Plan (HTPRP) time-area closures. Specifically, bycatch rates, fishing locations, and target catch of vessels that had fished in time-areas closures prior to the closure were compared to values for the same vessels after the time-area closures were put in place. Prior to the enactment of the HPTRP closures (1994 through 1998), hauls in times and areas that were later closed to fishing had a bycatch rate of 0.228 harbor porpoise per mton of landings. After the HPTRP closures were in place, those same vessels that had fished in the closure areas were not observed incidentally catching any harbor porpoise from 1999 through 2003, resulting in a 100% reduction in observed bycatch on these vessels. Prior to the enactment of the closures, fishing in the closure times and areas accounted for 57% of the effort (mtons landed) on those vessels that fished in the closed area. However, after the closures were in effect, combined total effort observed on those vessels dropped 77% because many vessels were not observed after the HPTRP, resulting in a smaller sample size with which to compare pre- and post-closure bycatch rates. Presumably several of these vessels dropped out of the gillnet fishery. When evaluating landings for vessels that previously fished in areas that are now closed, vessels in New England continued to focus on the same groundfish species assemblages before and after the closures, whereas vessels operating off New Jersey and in the Mid-Atlantic shifted effort away from monkfish and generally toward groundfish after the closures. After the enactment of the HPTRP, very few hauls were observed in closed areas on vessels that had fished there within the preceding 5 years, with the exception of the Southern Mid-Atlantic large mesh closure where 72% of mtons landed on these vessels came from the closed time areas.

Session: GEAR SWITCHING

***Switching gillnets by handlines: a strategy to reduce the bycatch of franciscana dolphins (*Pontoporia blainvillei*).* Pablo Bordino, AquaMarina-Centro de Estudios en Ciencias Marinas, Chicago Zoological Society, and EcoHealth Alliance, Argentina**

From October to February, 2004-2006 efforts to mitigate the incidental mortality of Franciscana dolphins in coastal gillnets were under taken in northern Buenos Aires. The experiment tested the use of bottom hand-lines as an alternative fishing practice to replace gillnets in Bahia Samborombon and Cabo San Antonio. These areas present the highest CPUE for Franciscana dolphins in Argentina. Ten local fishermen were randomly selected to use handlines and gillnets, and landings of both fishing gear were compared. Fishing boats carried independent observers recording geographic position, depth, and biomass of fish categorized by species and size. Landings of bottom hand-lines and gillnets were similar in terms of targeted species. However, handlines targeted commercial species with highest prices in the local market. Selectivity and comparable fishing efforts for both fishing gears were evaluated. The marine mammal interactions and damage to fishing gear were substantially lower in handlines than gillnets. The handlines could be an additional conservation tool to reduce the bycatch of Franciscana dolphins, and could be implemented as a precautionary fishery management strategy in the study area. However, efforts to develop a new fishing market should be evaluated and questions still remain on social, cultural, and economic aspects if handlines are implemented on a larger scale.

***Cod Pots-An alternative fishing gear to gillnets?* Sara Königson, Sven-Gunnar Lunneryd, Mikael Ovegård and Fredrik Ljunghager, Institute of Coastal Research, Swedish University of Agricultural Sciences**

The Swedish Board of Fisheries has, during the past 15 years, worked with developing alternative fishing gear as a way to mitigate an increasing severe conflict with seals and fisheries. In many different small-scale fisheries alternative fishing gear has been developed such as trap-net fisheries for salmon and gillnet fisheries for herring and whitefish. During recent years SBF has worked on developing pots as an alternative fishing gear to gillnet cod fisheries in south and central Baltic. In this area, the seal-fisheries conflict has increased dramatically during the past five years. During a development of alternative fishing gear, many factors had to be taken into concern such as: preventing seals to get hold of the catch, decreasing by-catch of non-target species such as birds, mammals and undersized fish as well as the fishing gears practicality on board and catch efficiency. Catches from a commercial cod pot fisheries compared to a commercial gillnet fisheries in the same area showed that cod pots can be regarded as an alternative fishing gear. However pots do by-catch non-target species such as seals and small sized cod. On the other hand by using seal exclusion grids and selectivity panels, by-catch of non-target species and undersized fish is prevented without decreasing the catch of the target species.

Cod traps as an ecologically sound fishing gear in the German waters of the Baltic Sea. **Dr. Christian Pusch, Federal Agency for Nature Conservation, Germany**

Gillnets are one of the most important fishing methods in the Baltic Sea fishery including the German sector, targeting cod, herring, garfish, flounder and other species. The results of the research project "Environmentally Sound Fishery Management in Protected Areas (EMPAS) have shown that gill net fisheries in the German Exclusive Economic Zone of the Baltic Sea is one of the most conflicting fishing activities due to high by-catch rates of harbour porpoises and seabirds. Harbour porpoises in the Baltic Sea have been assessed as in unfavourable conservation status and the subpopulation in the Central Baltic (ca. 600 individuals) is threatened by extinction. Even though by-catch rates are not well known, it is estimated that about 50 % of all stranded dead harbour porpoises have been bycaught in gillnets. Additionally it is estimated that annually 17-20.000 seabirds die in the German gill net fishery in Mecklenburg Western Pomerania.

One management option to reduce the bycatch of marine mammals and seabirds that was advised by ICES is the mandatory use of ecologically sound fishing technologies in areas of high conflict potential.

In the Baltic Sea (mainly coastal waters in Mecklenburg Western Pomerania) a series of small-scale feasibility studies were conducted in cooperation with commercial fishermen to find out if cod traps can potentially fully or partly replace gillnets. In these studies no-bycatch of seabirds and marine mammals has been recorded, and the impact on the seafloor and benthic fauna was assessed to be negligible.

Regarding the catch efficiency of cod traps the results have been variable and reached an average of 10.5 kg cod/10 traps/day and have been significantly lower than in gillnets (length = 200 m), which have been applied as a reference. Cod traps showed a higher species selectivity (biomass of non target species = 4 % of total catch) compared to gillnets (biomass of non target species = 19 % of total catch). A disadvantage of cod traps was the high proportion (up to 42.5 %) of cod below minimum landing size (38 cm).

In summary, cod traps can therefore be at this stage assessed as an ecologically but not yet fully economically sustainable alternative to gillnets. In future projects the size selectivity and catch efficiency of cod traps should be optimized.

Mexican efforts to save **Phocoena sinus** ***from extinction through sustainable fisheries.*** **Daniel Aguilar-Ramirez, Instituto Nacional de Pesca, México**

The *vaquita* (Phocoena sinus) is the smallest living cetacean. With a maximum length of 1.5 m, it is one of six extant species of the family Phocoenidae, the so-called *true porpoises.* Found in an area of roughly 5,000 square kilometers in the

uppermost Gulf of California, it is the only cetacean endemic to Mexico. About 150 *vaquitas* survive to date. Their greatest known threat is death by entanglement in gill nets used in small, artisanal fishing boats (*pangas)*. In the past four years, the Mexican government has made an unprecedented commitment to save the *vaquita* putting an end to the gillnet mortality and offering fishermen viable alternative livelihoods. To date, the government has invested over US$ 20 million in an ambitious integral program to bring the gill nets out of the water through buy-outs, swap-outs, and rent-outs. *Buy-outs* offer compensation to fishermen surrendering their gear and licenses to enable them to transition into alternative livelihoods. *Rent-outs* are agreements whereby fishermen are compensated for taking their gillnets out of the water for a specified period of time thus reducing gillnet mortality immediately while giving fishermen time to choose among more permanent alternatives. *Swap-outs* offer compensation and technical assistance to those fishermen willing to change to alternative, vaquita-friendly, fishing gear and methods. This latter alternative has been the responsibility of Mexico's National Fisheries Institute (Instituto Nacional de Pesca, INAPESCA). In order to develop fishing gear alternatives to gill nets, in 2004 INAPESCA tested several prototypes which included pots, modified cast nets (*suriperas*), trawl nets, fish aggregation devices, and hooks and lines. Species targeted were shrimp, finfish, sharks, rays and other crustaceans and mollusks with some degree of success. In the case of shrimp there is now an opportunity to switch from gill nets to a prototype trawl net to catch blue shrimp (*Litopenaeus stilyrostris*) and brown shrimp (*Farfantepenaeus californiensis*). Work is underway seeking best fishing alternatives for the other species.