Press Release– for immediate release

Fishermen Commit to Responsible Fishing Practices

PUNTARENAS, COSTA RICA (14 November 2007) The Fourth International Fishers Forum, concluded today, was held from 12-14 November in Puntarenas, Costa Rica. The conference co-hosts were the Instituto Costarricense de Pesca y Acuicultura (Costa Rica Fisheries and Aquaculture Institute) and Western Pacific Regional Fishery Management Council.

The international meeting of 250 fishermen, management authorities, seafood retail industry representatives, fishing technology experts, marine ecologists and fisheries scientists facilitated the sharing of information and experiences on sustainable fishery practices and approaches to minimize problematic interactions with sea turtles, seabirds, sharks and cetaceans in longline and gillnet fisheries.

Three previous International Fishers Forums were held in New Zealand, Hawaii and Japan over the past seven years. The Fishers Forum series, hosted by the Western Pacific Regional Fishery Management Council, has brought longline and now also gillnet fishers together to create synergies to improve the sustainability of their fisheries.

Kitty Simonds, Executive Director of the Western Pacific Regional Fishery Management Council, said, “It has been extremely exciting working with positive-minded people who believe in the capacity of humanity and can envision a future where we can have fish forever. Over the years, the IFF community has proven its commitment to responsible fishing in the Pacific and around the globe. We are expanding and growing. We are making a difference. It is truly heartening to welcome fishermen from Central and South America joining us in this endeavor.”

Mr. Carlos Villalobos, Executive Director of the Costa Rica Fisheries and Aquaculture Institute, summarized, “The Forum has been successful in facilitating the active exchange of wide-ranging perspectives and approaches for responsible longline and gillnet fisheries, including minimizing sea turtle, seabird, and marine mammal incidental catch and ensuring that sharks and their relatives receive needed protection. Most importantly, the Forum has identified gaps where priority international attention is warranted and created new industry-to-industry collaborations to continue our progress in resolving fisheries bycatch problems.” Mr. Villalobos continued, “A key outcome was the decision by Central American government representatives and regional non-governmental organizations to join efforts to exchange legal, fishing and scientific information about fisheries for highly migratory and trans-regional fishery resources. Both the Inter-American Tropical Tuna Commission and the Central American Aquaculture and Fishing Sector Organization expressed their will to support this initiative.”

“During the past three days the Forum participants have taken an honest look at the state of our artisanal and industrial fisheries, exchanged ideas on how to improve them and committed to concrete follow-up actions,“ explained Ms. Simonds. Ms. Simonds further explained, “The Forum included a focus on management and sustainability issues faced by Latin American artisanal fishermen. A key outcome was the decision by artisanal fishermen to establish a new international fishery association to provide improved regional collaboration and coordination of Central and South America artisanal fishermen, including the adoption of a Code of Conduct for responsible longline fisheries.”

Mr. Villalobos explained, “The Forum participants adopted the Puntarenas Declaration, to express their agreement and support for the implementation of twelve specific actions to improve the sustainability of artisanal and industrial fisheries, including to address issues related to bycatch, allocation, fishing capacity, ecosystem-based approaches to fisheries management, illegal fishing and compliance.”

For More Information Please Contact

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FOURTH INTERNATIONAL FISHERS FORUM

PUNTARENAS, COSTA RICA • NOVEMBER 12-15, 2007

IFF4 Mission and Objectives

Draft 11 June 2007

Mission

The Mission of the Fourth International Fishers Forum is to convene an international meeting of fishermen; management authorities; seafood retailer industry; experts in fishing technology, marine ecology and fisheries science; and other interested parties to facilitate the sharing of information and experiences on: (i) sustainable fishery practices; and (ii) approaches to minimize problematic interactions with sea turtles, seabirds, sharks and cetaceans in pelagic and demersal longline fisheries.

Objectives

The Forum will pursue the following objectives to achieve its Mission:

- Review
  - Commitments and progress since the Third International Fishers Forum;
  - Status of Latin American and global longline fisheries;
  - Inter-governmental organization initiatives to achieve sustainable and environmentally responsible longline fisheries; and
  - Knowledge for reducing seabird and sea turtle bycatch, unwanted shark bycatch, and shark and cetacean depredation in pelagic and demersal longline gear.

- Share
  - Experiences on effective and ineffective approaches to reduce fisheries bycatch and depredation;
  - Progress and actions to address IUU fishing and initiate and expand observer programs;
  - Anticipated effects of climate change outcomes on pelagic ecosystems and pelagic fisheries; and
  - Industry initiatives and market perspectives to promote sustainable fisheries.

- Identify
  - Effective and collaborative approaches to reduce problematic seabird, sea turtle, shark and cetacean interactions in longline fisheries;
  - Constructive roles for fishers, inter-governmental organizations (including Regional Fishery Management Organizations and other Regional Fishery Bodies), and environmental non-governmental organizations to reduce fisheries bycatch and depredation, and manage tuna, billfish, mahi-mahi, shark and other pelagic target species; and
  - Actions by artisanal and industrial longline industries to achieve sustainable and environmentally responsible fisheries.

FOURTH INTERNATIONAL FISHERS FORUM
PUNTARENAS, COSTA RICA • NOVEMBER 12-15, 2007

PUNTARENAS DECLARATION

Agreed at the Fourth International Fishers Forum
November 12-14, 2007, Puntarenas, Costa Rica

Recalling that, over the past seven years, the International Fishers Forum (IFF) series has brought together large and diverse groups of fishermen and other interested persons who are united in the belief that conserving our fisheries and protecting our ocean environment are not mutually exclusive goals;

Recalling that the First International Fishers Forum held in New Zealand in the year 2000 focused on mitigating interactions between pelagic longline fisheries and seabirds, and that participants acknowledged that an integrated "bottom-up," fishery-specific, and area-specific approach was required and that progress would be determined by individual fishermen's own contribution within their own fisheries, regions or organizations;

Further recalling that at the Second International Fishers Forum, convened in Hawaii in 2002, the theme was expanded to include interactions between pelagic longline fisheries and sea turtles, and that a resulting Forum Resolution was agreed to which contained actions to promote involvement in the IFF initiatives by the Food and Agriculture Organization of the United Nations (FAO), the Convention on Migratory Species, relevant regional fisheries management organizations (RFMOs) and national agencies;

Further recalling that, at the Third International Fishers Forum which was held in 2005 in Japan jointly with the International Tuna Fishers Conference on Responsible Fisheries, the theme was expanded to include interactions of demersal longline fisheries with sharks as well as other non-target species, and to address marketing issues such as eco-labeling, and to consider the potential benefits of changes in fishing gear and techniques, resulting in the adoption of the 12-point Yokohama Declaration;

Having actively exchanged wide-ranging perspectives and approaches at the Fourth International Fishers Forum in Puntarenas, Costa Rica, November 12-15, to promote responsible pelagic and demersal longline fisheries and gillnet fisheries, and to minimize sea turtle, seabird, and marine mammal incidental catch;

Recognizing that additional information has been developed since IFF3 and presented at IFF4 that further demonstrates the need for and availability of measures to ensure maintenance of a healthy marine ecosystem that is necessary to support healthy fisheries;

Reiterating that continued increases in fishing capacity in the Pacific may be preventing the adoption of effective fishery control and management programs and that control of fishing capacity is critical to ensure economic health of all the fisheries that depend on the tuna and tuna-like species of the Pacific;

Noting that many members of RFMOs profess to support capacity management controls and the need to prevent increases in fishery capacity but do not demonstrate the political will to actually prevent capacity growth in fisheries for tuna and tuna-like species, especially with respect to large-scale purse seine fishing with fish aggregating devices that are known to have very large catches of juvenile yellowfin and bigeye tuna with consequent risk to the health of the stocks;

Noting further that, while the problem of illegal fishing (i.e., without requisite permits or licenses) may be diminished, there continue to be serious problems with unreported and unregulated fishing which RFMOs and governments must resolve to ensure full consideration of the impacts of all fishing on the stocks of concern;

Considering that fair and equitable allocation schemes have not been developed by RFMOs and implemented by parties and cooperating non-parties that achieve fair sharing of available resources and protection of the interests of communities and small-scale fisheries with limited alternatives, and that all fishers must be provided information and opportunities to be part of the process when allocations are made;

Acknowledging that the concerns about the status of sea turtles and certain species of seabirds and about the possible negative effects of fishing on these populations are legitimate and warrant further consideration of measures to prevent or mitigate interactions with such species as well as measures to ensure that sensitive other species (such as some species of elasmobranchs) receive needed protection;

Recognizing that some species of sharks are especially vulnerable and are taken in substantial numbers by some fisheries such that their viability may be at risk, and that there is likely no ability to sustain the stocks by culture, and that there are inadequate data collection programs to ensure full records on the take and disposition of sharks caught incidentally in fisheries for tuna, swordfish and other species;

Agreeing that artisanal fisheries are important to the economy and culture of many communities but that artisanal fisheries also can have substantial impacts on both target stocks and related species of interest to fishers and societies of the Pacific;

Recognizing that RFMOs can make substantial contributions to the monitoring, assessment and management of artisanal fisheries, including documentation of catch, effort and bycatch, with the caveat that management of artisanal fisheries must be carried out in coordination with but not dominated by RFMOs, as monitoring and management of artisanal fisheries should be carried out at the local level to the extent practicable;

Emphasizing that measures and programs to prevent adverse impacts of bycatch and takes of sensitive species will be much more likely to be acceptable to and supported by fishers when they assure that the fishers will be no worse off while protection is provided to those sensitive species, and that measures must recognize and be tailored to the specific characteristics of the fishery involved;

Monday, November 12, 2007 - 13:45

Industry Perspectives on the Status of Latin American and Global Longline Fisheries

Session Chair: Dr. Peter Miyake, Organization of Promoting Responsible Tuna Fishery (OPRT) And Japan Tuna Fishermen's Association

Panelists:
Bernal Chavarría National Chamber of Costa Rica Longline
Juan Benincasa, President, National Export Chamber, Ecuador
Scott Barrows, Hawaii Longline Association
Charles Hufflett, Pacific Islands Tuna Industry Association (PITIA)
Wawan Koswara, Indonesia Tuna Association

Lunes 12 de noviembre del 2007 - 13:45

Perspectivas Industriales sobre el Status Global y de Latino América sobre las Pesquerías de Palangre

Dirige la sesión: Dr. Peter Miyake, Asociación promotora de La pesca responsable de atún (OPRT, siglas en ingles) y Asociación De pescadores japoneses de atún.

Panelistas:
Bernal Chavarria, Cámara Nacional de Pesca de Palangre de Costa Rica.
Juan Benincasa, Presidente de la Cámara Nacional de Exportación de Ecuador.
Scott Barrows, Asociación de Pesca de Palangre de Hawai.
Charles Hufflet, Asociación Industrial de Atún, de las Islas del Pacifico (PITIA, siglas en ingles).
Wawan Koswara, Asociación de Atún de Indonesia.

Industry Perspectives

The IATTC maintains a listing of longline vessels authorized to fish by their governments in the eastern Pacific Ocean. We also have a listing of authorized large longline vessels (over 24 meters) on our website at www.iattc.org. The most recent information on longline catches are contained in our latest stock assessment report for the fishing year 2006. The information reported in the stock assessment reports are collected from a variety of sources, such as IATTC staff data collections from industry sources, vessel logbooks, landings data, and country reported catches and landings. The accuracy and amount of information available varies greatly between countries. See SAR-8-05 for data received by country in accordance with IATTC resolution C-03-05.

In addition to the major longline fishing fleets from countries such as Japan, Korea, Taiwan, etc., there are large numbers of semi-industrial, small scale and artesanal longliners targeting a variety of species in the EPO.

Mexico has 133 longline vessels listed on the IATTC vessel registry. The majority of the Mexican longline fleet targets swordfish and shark, with by-catches of tunas, marlins, dorado and other species. A number of the Mexican longliners convert to gillnetters during part of the year.

The numbers of larger scale longliners operating out of Central American ports vary greatly from country to country, but the largest fleets and landings are concentrated in Costa Rica (354 vessels) and Panama (411 vessels). There are also foreign flag longline landings in Costa Rica and Panama from Belize, Honduras, Bolivia, Chinese Taipei and other countries. Many of the Central American longline fleets target shark, but there are also directed fisheries for tunas, dorado, snapper, and corvina. There are also thousands of small-scale or artisanal longline fishing vessels operating from each country in Central America. For example,.Guatemala lists 91 longliners on the IATTC registry, but they have estimated an additional 8,400 launches which employ small-scale longlines with landing sites throughout the country. Most countries do not have the manpower to monitor such widespread landings, and information regarding their catches is very poor for the most part.

We are not aware of any major longline activity in Colombia, but certainly there is small-scale longline operations occurring there. Ecuador has 182 longline vessels on the IATTC vessel registry. The majority of the Ecuadorian vessels target tunas, swordfish and shark, but they also capture large amounts of marlins, dorado, and snapper, in addition to other species. Ecuador also has a great number of small-scale or artisanal longline vessels which also employ handlines. The Ecuadorian fleets also have a great number of mother-ships which carry numerous launches to the fishing grounds and freeze the catch for the smaller vessels. Peruvian catches are reported by IMARPE, but it is difficult to separate the catches by gear type.

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Monday, November 12, 2007 - 15:30

Institutional Frameworks to Produce Sustainable Artisanal Coastal Pelagic Fisheries

Session Co-chairs: Carlos Villalobos, INCOPESCA
Mario Gonzalez, OSPESCA

Panelists: Dr. Hugo Alsina, Universidad Francisco Marroquin, Guatemala
Dr. Guillermo Compean, IATTC

Lunes 12 de noviembre del 2007 - 15:30

Posibles Marcos Institucionales para lograr el Manejo sostenible de Las Pesquerías Artesanales Costeras.

Dirigen la sesión: Carlos Villalobos, INCOPESCA y
Mario González, OSPESCA.

Panelistas. Dr. Hugo Alsina, Universidad Francisco Marroquín, Guatemala.
Dr. Guillermo Compean, IATTC.

Monday, November 12, 2007 - 16:45

State of Knowledge to Reduce Sea Turtle, Marine Mammal And Seabird Interactions in Gillnet Fisheries, and Research Priorities

Session Co-chairs and Panelists:
Dr. Ed Melvin, University of Washington Sea Grant
Dr. Scott Eckert, Wider Caribbean Sea Turtle Conservation Network and Duke University

Panelists:
Dennis Sammy, Nature Seekers, Trinidad
Dr. John Wang, National Marine Fisheries Service Pacific Islands Fisheries Science Center
Tim Werner, New England Aquarium

Lunes 12 de noviembre del 2007 - 16:45

Estado actual del Conocimiento y Prioridades de Investigación sobre La captura incidental de tortugas, aves y mamíferos marinos en Pesquerías de enmalle (con redes agalleras o cortinas).

Dirigen la sesión y panelistas:
Dr. Ed Melvin, Universidad de Washington Sea Grant.
Dr. Scott Eckert, Red de Conservación de la Tortuga Marina Caribeña y la Universidad Duke.

Panelistas:
Dennis Sammy, Investigadores Naturales de Trinidad.
Dr. John Wang, Centro de Ciencia de Pesquerías Marinas Nacionales al Servicio de Pesquerías de las Islas del Pacifico.
Tim Werner, Acuario de Nueva Inglaterra.

Novel Tools to Reduce Seabird Bycatch in Coastal Gillnet Fisheries

Edward F. Melvin, Washington Sea Grant, University of Washington, Seattle, Washington
Julia K. Parrish, School of Aquatic and Fishery Sciences and Zoology Department, University of Washington, Seattle, Washington
Loveday L. Conquest, University of Washington, Seattle, Washington

Abstract

We examined several strategies to reduce seabird bycatch, primarily of Common Murres (Uria aalge) and Rhinoceros Auklets (Cerorhinca monocerata), in a coastal salmon drift gillnet fishery in Puget Sound, Washington (USA). Our goal was a significant reduction in seabird bycatch without a concomitant reduction in target catch or an increase in the bycatch of any other species. We compared fish catch and seabird bycatch in nets modified to include visual alerts (highly visible netting in the upper net) or acoustic alerts (pingers) to traditional monofilament nets set throughout the normal fishing hours over a five-week fishing season. Catch and bycatch varied significantly as a function of gear. With monofilament controls, murres responded to both visual and acoustic alerts; auklets and sockeye salmon responded to deeper visual alerts only. Seabird abundance varied across multiple temporal scales: interannually, within fishing season, and within day. At the interannual level, seabird entanglement was linked to regional abundance on the fishing grounds, a pattern which broke down at the local level. Within season, sockeye and murre abundance were negatively correlated, suggesting that if fishery openings were scheduled on peak abundance of the target species, seabird bycatch would be significantly reduced as a function of increased target fishing efficiency. Finally, both sockeye catch and auklet entanglement were highest at dawn, whereas murre entanglement was high at both dawn and dusk. Our results identify three complementary tools to reduce seabird bycatch in the Puget Sound drift gillnet fishery—gear modifications, abundance-based fishery openings, and time of day restrictions—for a possible reduction in seabird bycatch of up to 70-75% without a significant reduction in target fishing efficiency. Although these tools are based on local conditions and will thus vary among years and locations, all might be exportable to other coastal gillnet fisheries worldwide.

Reducing leatherback sea turtle bycatch in the artisianal surface gillnet fisheries of Trinidad

Dr. Scott Eckert, Wider Caribbean Sea Turtle Conservation Network and Duke University

The Caribbean Island of Trinidad sustains nesting by more than 6,000 of the Critically Endangered leatherback sea turtle each year along its eastern and northern coasts. This nesting population is the second largest in the world, and contains more than 80% of all leatherback nesting in the insular Caribbean. However, the high concentration of these large reptiles in Trinidad's coastal waters from late January – September puts them into direct conflict with artisianal gillnet fishers. According to interview-based studies, corroborated by other lines of evidence, gillnets ensnare more than half of all gravid females each year, comprising the largest single source of leatherback mortality in the Republic and threatening to undermine ongoing conservation efforts at national and international levels. Equally important is that the extensive damage to nets represents a significant economic loss to local fishers arising from the cost of net repair, lost work time, and reduced gear efficiency. The entanglement problem is so severe that many are unable to fish during the sea turtle nesting season.

Resolving the problem of leatherback bycatch in Trinidad has been the focus of a multi-year research program, in which all stakeholders are direct participants. To facilitate this stakeholder driven process of solution-making, a National Consultation was hosted in February 2005 by the Wider Caribbean Sea Turtle Conservation Network (WIDECAST) and the Fisheries Division (Ministry of Agriculture, Land and Marine Resources). Invited participants included fishers drawn from all affected communities; representatives from Tobago, local and national NGOs, the government's primary natural resource management agencies, the Ministry of Foreign Affairs, and a small number of international fishing and conservation experts.

The goal of the meeting was two-fold. To review the problem of sea turtle bycatch in coastal gillnet fisheries, specifically along the north and east coasts of Trinidad where most leatherback nesting takes place and to apply the shared expertise of the forum to devising a series of potential solutions suitable for field-testing and evaluation by fishers and natural resource management professionals. To this end, twin objectives were proposed: fishers must be better off economically as a result of any proposed solution to the bycatch crisis and the incidental capture and mortality of leatherback sea turtles in coastal fisheries must cease.

An output of the consultation was a series of mitigation actions that could be tested by fishers to evaluate these actions feasibility in reducing turtle bycatch. To date, three mitigation experiments have been conducted. The structure of the experiments and how stakeholders have been integrated into these tests, as well as the experimental results will form the basis of this presentation.

The value of the leatherback sea turtle to Trinidadians.

Dennis Sammy, Manager, Nature Seekers

The Republic of Trinidad and Tobago, in the southern Caribbean supports nesting by one of the largest and best managed leatherback sea turtle populations in the world. Management for this vital nesting colony is the responsibility of the Government of Trinidad and Tobago's Department of Forestry Wildlife Section. Active management of the colony began in the early 1990's with efforts to stop rampant killing of adult females on the nesting beaches for sport and meat. However, limited financial and personnel resources meant that most such efforts were incomplete and many hundreds of females were slaughtered each year.

In response, the Wildlife Section initiated the formation of local non-governmental conservation groups, and established co-management of the nesting beaches with those local NGO's. Support for training and scientific oversight has been provided by WIDECAST, at the invitation of the Wildlife Section. Success in almost total elimination of poaching is complete, particularly at the 3 primary nesting colonies of Fishing Pond, Matura, and Grande Riviere.

The success in reducing poaching and monitoring nesting colonies on Trinidad through the establishment of local co-management programs has been a major achievement in preserving these colonies. Furthermore the environmental outreach activities conducted by these village organizations have been extraordinarily successful in elevating the status of sea turtles among Trinidadians.

There are currently four nesting beach management projects coordinated by the Wildlife Section with support of WIDECAST and operated by local non-governmental village-based organizations. On one of these projects (a local village group called Nature Seekers at Matura Beach) there are over 10,000 guided visitors per year to the nesting colony and 70% of those visitors are from Trinidad. While established initially in 1990 as a protection program, Nature Seekers staff have become proficient in all aspects of sea turtle nesting beach management and research. Data collection includes a suite of information including turtle size, location of nests, hatch and emergence success, number of eggs per nest etc. Each female is also flipper or microchip tagged for identification. The program supports a series of research projects into turtle reproduction condition, color vision, hearing sensitivity, post-nesting migration and sea turtle ecotourism management. Finally, Nature Seekers serves as a training facility to other sea turtle management programs on the island and throughout the wider Caribbean.

A critical aspect of the success that the local groups have achieved in managing their sea turtle populations is economic. For two of the groups, Nature Seekers at Matura, and GRNTGA in Grande Riviere, they have become the largest employers in the villages. Each group have been able to use their sea turtle resources for sustained economic gain through eco-guiding, reforestation projects, craft and product sales to tourists and through the development of grant writing skills. This latter aspect of the benefits derived by the co-management arrangements is often overlooked. Turtle groups have learned organizational management skills through the collection and management of nesting data, reporting and writing skills, as well as the capacity to interact with a broad range of people.

Currently the leatherback sea turtle is considered to be a national treasure on Trinidad and is the source of great pride to the island nation.

Developing Strategies to reduce sea turtle bycatch: using lightsticks and shark shapes

John Wang1, Yonat Swimmer2, Shara Fisler3
1 JIMAR – University of Hawaii at Manoa, Honolulu, HI
2 NOAA – Pacific Islands Fisheries Science Center, Honolulu, HI
3 Aquatic Aventures Science Education Foundation, San Diego, CA

Factors that attract sea turtles and target fish species to fishing gear likely include numerous sensory cues. Recent physiology and behavior studies indicate that sea turtles have especially acute visual function and that visual cues most likely play important roles in whether sea turtles interact with fishing gear. Based on these findings, we suggest that modifying the visual environment associated with fisheries can effectively reduce turtles' interaction with fishing gear.

Field experiments in Baja California, Mexico were conducted to determine whether lightsticks and shark shapes had an effect on sea turtle catch rates in modified gillnets typically used by sea turtle monitoring programs. Preliminary trials suggest that the presence of activated lightsticks on the nets reduce the number of turtles caught (Figure 1). One potential reason for this decline in turtle catch is likely a result of the increased visibility of the nets from lightstick illumination. This finding suggests that lightsticks used in a gillnet setting could reduce sea turtle interactions. Whether lightsticks on gillnets have an effect on targeted fish is not yet known. In addition, experimental data with a shark shaped "scarecrow" suggest that the presence of shark shapes near turtle monitoring nets decreases the number of turtles caught (Figure 2). Shark shapes could potentially be used to deter turtles from entering areas of concern.

Figure 1. LED Lightstick experiments suggest a reduction of 31% in turtle CPUE on nets with LED lightsticks.

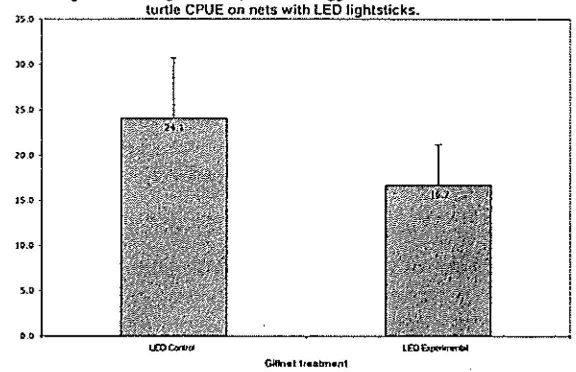
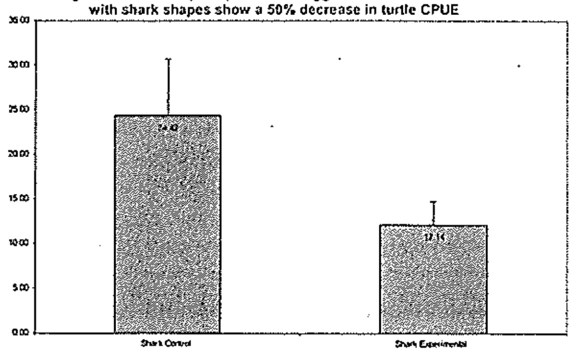


Figure 2. Shark shape experiments suggest that nets associated with shark shapes show a 50% decrease in turtle CPUE



Additionally, behavioral and physiological experiments indicate that turtles can see UV light while certain pelagic fish such as some billfish and mahi mahi cannot. Transparent UV-absorbing plastics could then be used to make shark shaped silhouettes visible to sea turtles, but not to targeted pelagic fish such as mahi mahi.

A re-examination of pingers and the challenge of bycatch in gillnets worldwide

Scott D. Kraus[1] and Timothy B. Werner[2]
[1] 1Vice President for Research, New England Aquarium,
Central Wharf, Boston, MA, 02210-3399 USA. Email: skraus@neaq.org
[2] 2Senior Scientist, and Director, Consortium for Wildlife Bycatch Reduction,
New England Aquarium. Email: twerner@neaq.org.

It has been more than a decade since field experiments determined that underwater battery-operated acoustic deterrents or "pingers" deployed on gillnets greatly reduced harbor porpoise (Phocoena phocoena) bycatch in the northwest Atlantic. Since then, pingers have been tested around the world and adopted as a bycatch mitigation strategy for small cetaceans in several fisheries including the Gulf of Maine groundfish fishery, the California drift gillnet fishery, and some northern European fisheries. Nonetheless, many challenges associated with the use of pingers have prevented or stalled their adoption by fishermen. These include cost, the length of battery life, incidents in which pingers attracted depredating pinnipeds, and concerns that widespread adoption of pingers in a particular area would result in cetaceans becoming excluded from critical habitats. The extent to which these challenges might be overcome by modifications to pingers or in how they are deployed remains poorly investigated. For example, pinniped depredation might be eliminated by increasing pinger frequencies above their hearing range but still within that of cetaceans. Also, at higher frequencies the battery power of pingers is extended and the distance at which they would be audible would decrease, thereby reducing the area ensonified. Gillnets are one of the most widespread fishing gears on earth, and they are often the most prevalent fishing method in developing countries. Gillnet bycatch is high worldwide, not just for cetaceans but for endangered sea turtles, seabirds, sharks, and other marine animals. Unfortunately, techniques for mitigating gillnet bycatch are largely lacking. Given the enormous scale of the problem, we believe there is an urgent need to redouble international efforts to develop practical methods for reducing the bycatch of non-target species in gillnets. The research and development of these techniques should include modifications to pingers, and both fishermen and fisheries managers should give pingers serious consideration at least as a stopgap measure for reducing bycatch of threatened cetaceans, particularly if the only alternative is shutting down the fishery.

Tuesday, November 13, 2007 - 8:00

Cooperation and Regional Integration Towards Fishery Sustainability

Session Chair: Antonio Poras, INCOPESCA

Panelists:
Mario Gonzalez, OSPESCA
Carlos Villalobos, INCOPESCA
Imène Meliane, IUCN
Manny Duenas, The Guam Fishermen's' Cooperative Association
Dr. Takahisa Mituhasi, Overseas Fishery Cooperation Foundation
Samasoni Sauni, Pacific Islands Forum Fisheries Agency

Martes 3 de noviembre del 2007 - 15:30

Cooperación e Integración Regional hacia La sostenibilidad de pesquerías.

Dirige la sesión: Sr. Antonio Porras, INCOPESCA.

Panelistas:
Sr. Mario González, OSPESCA.
Sr. Carlos Villalobos, INCOPESCA.
Sra. Imene Meliane, IUCN.
Sr. Manny Duenas, Asociación Cooperativa de Pescadores de Guam.
Dr. Takahisa Mituhasi, Overseas Fishery Cooperation Foundation.
Sr. Samasoni Sauni, Pacific Islands Forum Fisheries Agency.

Tuesday, November 13, 2007 - 9:45

Proposals of the Industrial and Artisanal Fishing Sectors to Achieve Sustainable Fisheries

A. Industrial group (boat owners, exporters, and processors)
Session Chair: Dr. Peter Miyake (OPRT)

Panelists: Charles Hufflett, Pacific Islands Tuna Industry Association
Rafael Baires El Salvador longline industry, Tiburón Pinto

Martes 3 de noviembre del 2007 - 9:45

Propuestas del sector industrial y artesanal para pesquerías Sostenibles.

A. Grupo Industrial (propietarios de botes, exportadores y Procesadores).
Dirige la sesión: Dr. Peter Miyake (OPRT).

Panelistas. Sr. Charles Hufflet, Asociación Industrial de Atún de Islas del Pacifico.
Sr. Rafael Baires, Industria salvadoreña de pesca de palangre, Tiburón Pinto.

Pacific Islands Long Line Fishery Perspectives 2008

Paper presented by Charles C Hufflett,
a Director of the Pacific Island Tuna Industry Association (PITIA)
PO Box 2143, Kolonia
POHNPEI FM 96941
Federated States of Micronesia

Good Morning,

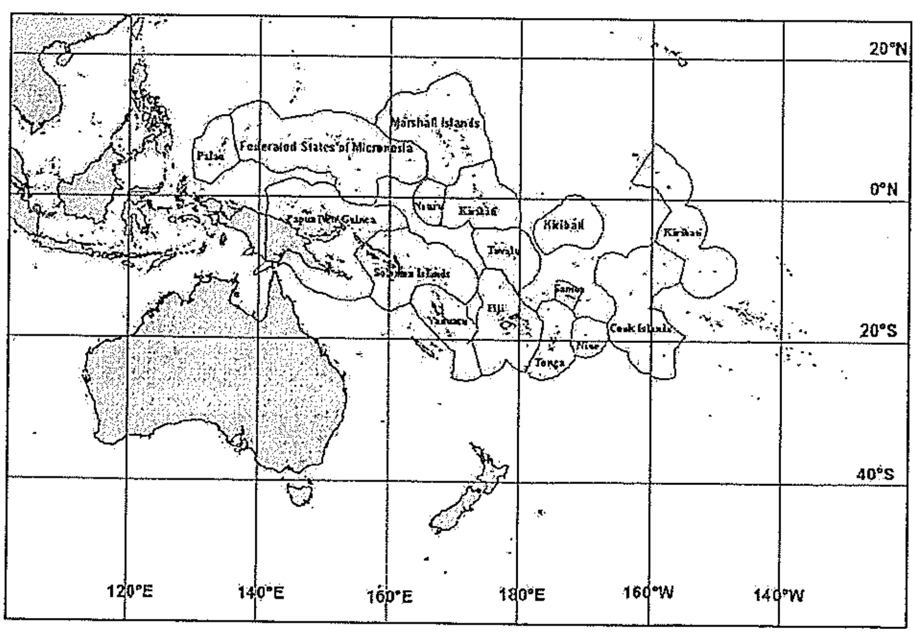
The paper I present today is on behalf of the PITIA and outlines the current developing position of the smaller Pacific States as they seek greater involvement in the commercial property rights of tuna fishing in the Pacific. The concept of our association was established in 2004 and the first annual general meeting held earlier this year. There are 14 Pacific Island Nations involved comprising Palau, Federated States of Micronesia, Marshall Islands, Papua New Guinea, Naru, Kiribati, Tuvalu, Solomon Islands, Vanuatu, Fiji, Tonga, Niue, Cook Islands and Samoa. Currently 11 of these nations have active trade associations or organisations which in turn are members of the PITIA.

It is expected that national associations will be formed in the remaining three countries in the near future.

The PITIA is a trade association of commercial interests and as such takes a more pragmatic approach to the sustainable development of the Fishery. We understand the need for overseas markets and acknowledge the role of the pioneering deepwater nations that have created the Pacific fishery as we know it today.

However, we note with concern, the increasing pressure being put on the Pacific tuna resource by the deployment of additional vessels – both Purse Seine and long line into the region.

EEZ's of the 14 Independent Pacific Island Countries



Source: DEVFISH

As you will well know the Pacific Ocean provides some 60% of the worlds tuna catch and is the very centre of the Global Tuna Industry. In 2005 the Western Central Pacific, home to our PITIA members, produced some 2.16 million tonnes of tuna with 43 % being taken from within the EEZ's of the coastal states. This had an approximate value of US$1 Billion per annum. More than half of which was taken by offshore fishing effort. In the case of Tuna alone the proportion is nearer 80%.

Table 1: Value of Tuna catches in the WCPO by fishing area and gear type in 2005

	All Gear	Purse Seine	Long Line	Other Methods
All WCP	3,080	1,430	1,120	530
PI 14 EEZs	1,090	820	260	10
Other EEZs	1,060	320	370	370
High Seas	930	290	490	150

All values in US$ million

Source: DEVFISH

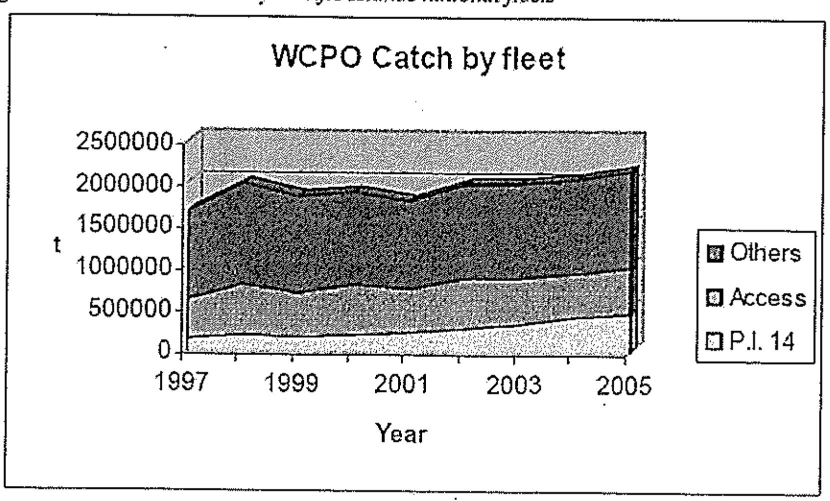
This conference focuses on long line fishing specifically and my observations are germane to this sector only.

It is not practical to generalise on the state of the Pacific Island Industry as a whole – each island state has its different set of circumstances, whether it be attitude to foreign access and/or domestic development.

Some nations, notably Fiji, Cook Islands, Tonga and Somoa have a total domestic long line fishing industry with no foreign licenced access. Others, with little or no domestic industry encourage and rely on foreign licence access. Much is dependent on geographical location and the practicality of operating a domestic fleet. Some see onshore infrastructure as the best solution to creating local involvement and employment. The chartering of foreign flag vessels by companies holding domestic licences is an increasingly used option.

Already, with concerns on the status of the Bigeye and Yellowfin fish stock, some island nations have wisely have placed restrictions on further development. Fiji has reduced its total EEZ long line vessel licences to 60 from 110. Samoa has tried to encourage a small scale Alia Fishery (11m aluminium catamarans) and introduced restricted inshore fishina areas.

Figure 2: Growth in catches by Pacific Islands national fleets

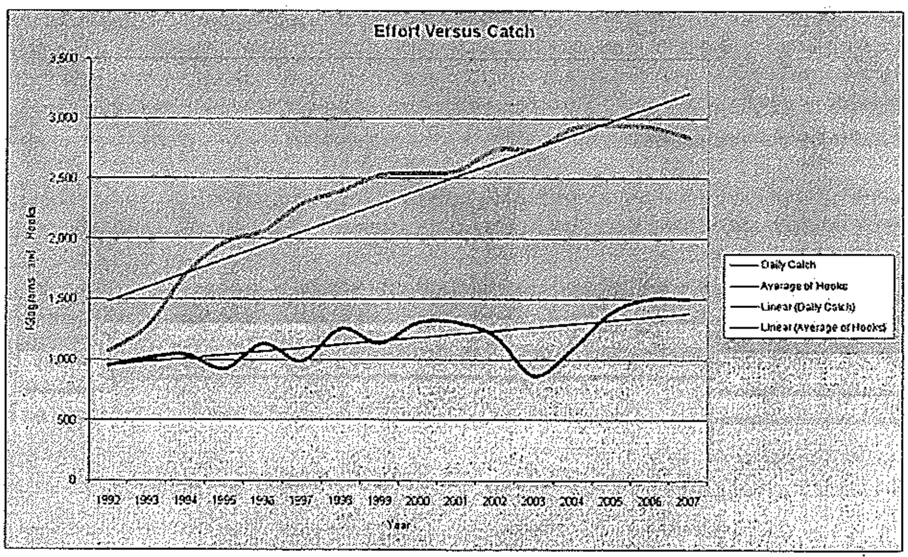


Source: DEVFISH

The graph shows a steady growth in the catches by the Pacific Island fleets over the last 8 years. This position is distorted some what by vessels on Vanuatu's International Registry. Catches of the PNG Purse Seine vessels also add to the impression that there has been a major expansion of the domestic Pacific Island fleet. In respect to long lining this is not the case. This particular sector has struggled to remain viable in recent years.

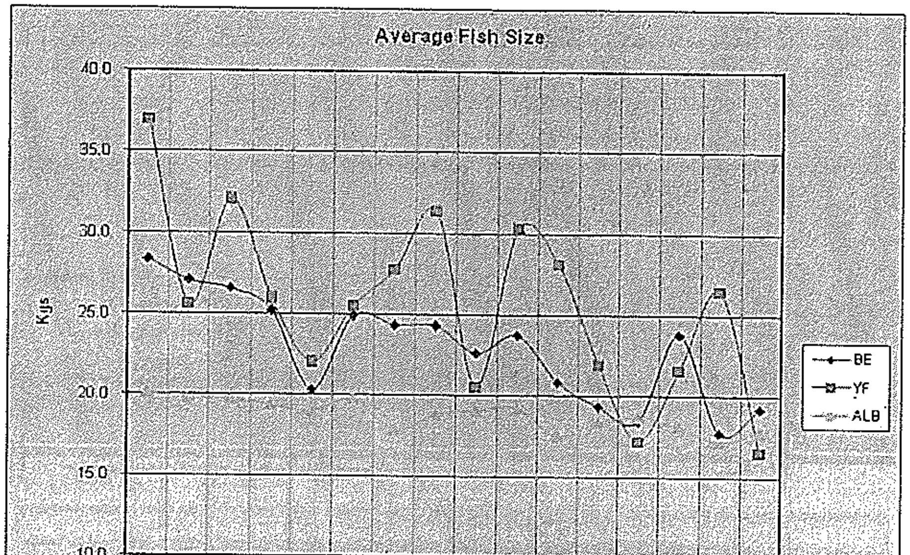
The expansion of the domestic long line fleet is, however, the priority of many of the Pacific Island States. This is seen to more achievable than investing in the Purse Seine fishing fleet. Further more in respect to Bigeye and Yellowfin it is both more sustainable and creates a better fiscal return from the resource. The art of long lining is traditional and suits the skill and knowledge of Pacific Islanders. At the very time when the Pacific Island Nations wish to increase their involvement in the Fishery regulators are calling for a reduction in fishing effort. The sustainability of Bigeye and Yellowfin at current catch levels is in the question. There has increasing levels of fishing effort coming into the region which has decreased local profitability dramatically and there has been a rapid build up of foreign fleets in particular the Chinese Long Line Fleet in the southern Pacific Island regions. Some of which not necessarily operate on a "level playing field" with the domestically based vessels.

The signs of pressure on the resource of large Tunas (Yellowfin and Bigeye) are all too obvious. The following graphs relate to the experience of my own company which fishes in Fiji. The figures and tables that follow in this paper are based on the operation of 11 vessels which annually set approximately 6,000,000 hooks. Whilst the figures are Fiji EEZ specific the trends shown are typical of the entire region. You will see on the next table how increased effort has only marginally improved the daily catch rate and there has been a corresponding drop in CPUE.



Source: SOLANDER

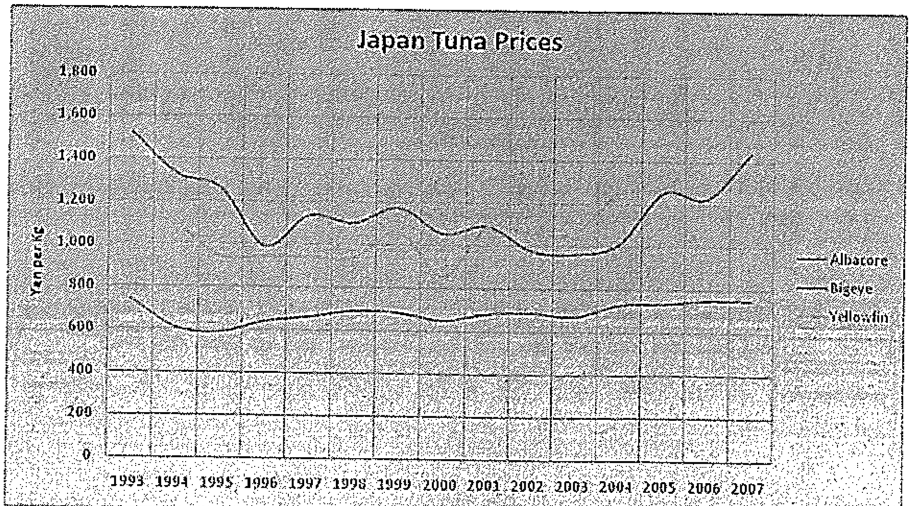
Over the period from 1990-2007 there has been a decline in fish size – particularly that of Bigeye and this is illustrated in the following table.



	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
BE	28.	27.	26.	25.	20.	24.	24.	24.	22.	23.	20.	19.	18.	23.	17.	19.
YF	37.	25.	32.	26.	22.	25.	27.	31.	20.	30.	28.	22.	17.	21.	26.	16.
ALB	20.	19.	19.	19.	19.	19.	17.	18.	19.	19.	17.	18.	18.	18.	17.	17.

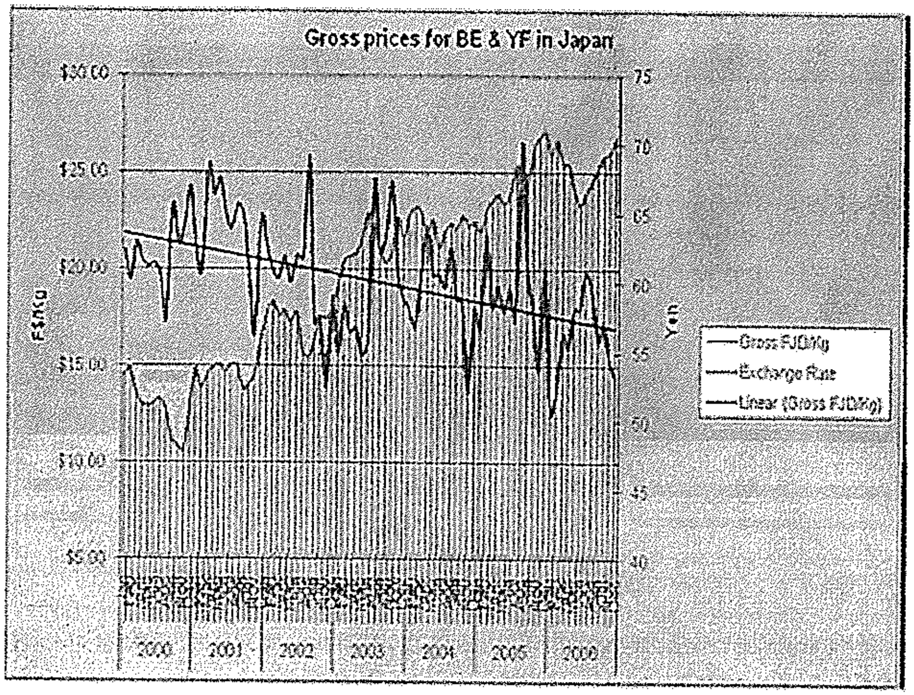
Source: SOLANDER

Whilst there has been some improvement in Japanese prices for the large tunas, the weakness of the Yen and US dollar relative to Pacific Island currencies has resulted in a lower gross return to the vessel operator. This trend has continued in 2007 and the following tables show the gross return to the vessel per kilogram. Over the period the cost of fuel and air freight has doubled and consequently the returns in this fishery have diminished to a position where the business is only marginally profitable and there is no sinking fund for vessel replacement or upgrading.



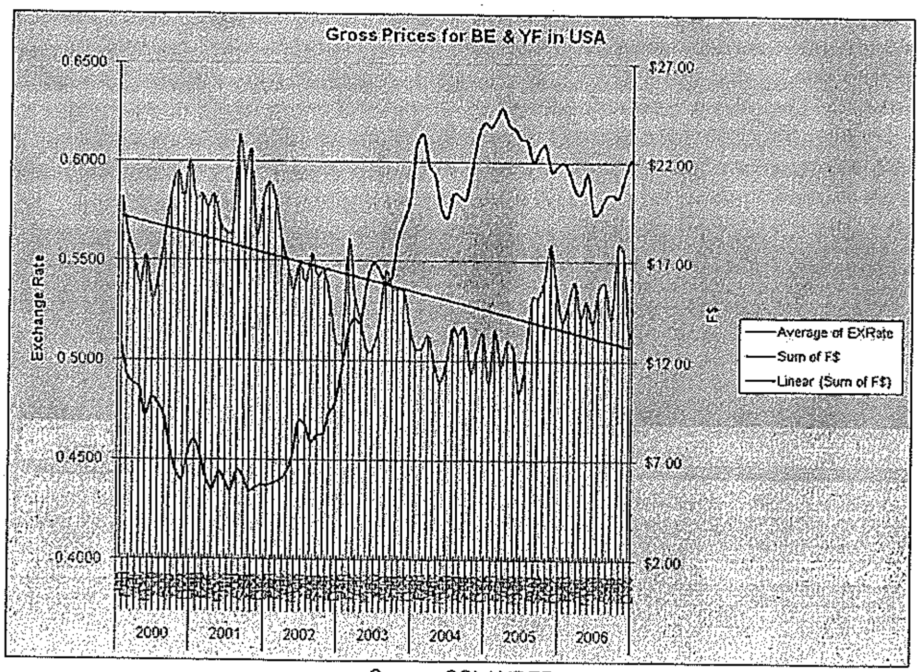
Source: SOLANDER

In "Yen terms" prices for Bigeye and Yellowfin have shown an upward trend.



Source: SOLANDER

Unfortunately the weakness of the Yen against the Fiji dollar has negated the price increase.

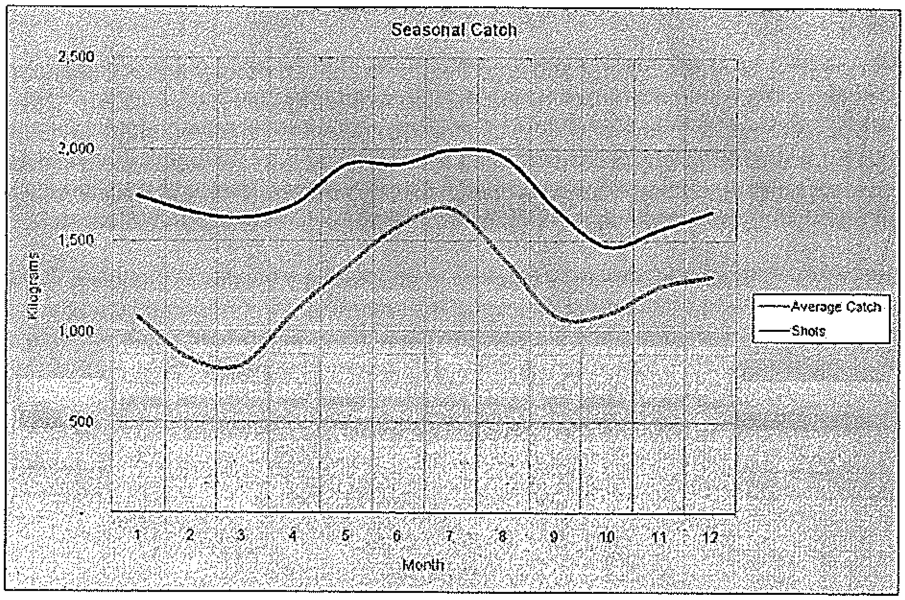


Source: SOLANDER

Similarly the slight increase in USA prices has not compensated for the drop in value of the USD. Of course the scenario I have just presented are not unique to the domestic fleet and deep water vessel owners face similar circumstances – but how more difficult it is for a domestic industry trying to establish itself and have a more physical participation in the industry which is on its doorstep.

The domestic industry long line vessels are smaller than their Deep Water conterparts. They mostly have a "fresh" and freezer configuration. As a consequence of their size the vessels remain locally based in their own and immediately adjacent EEZ's.

This leaves them vulnerable to seasonal change as shown in this table. The Deep Water vessels have the option of "following" the tuna in the quest for a year round fishery.



Source: SOLANDER

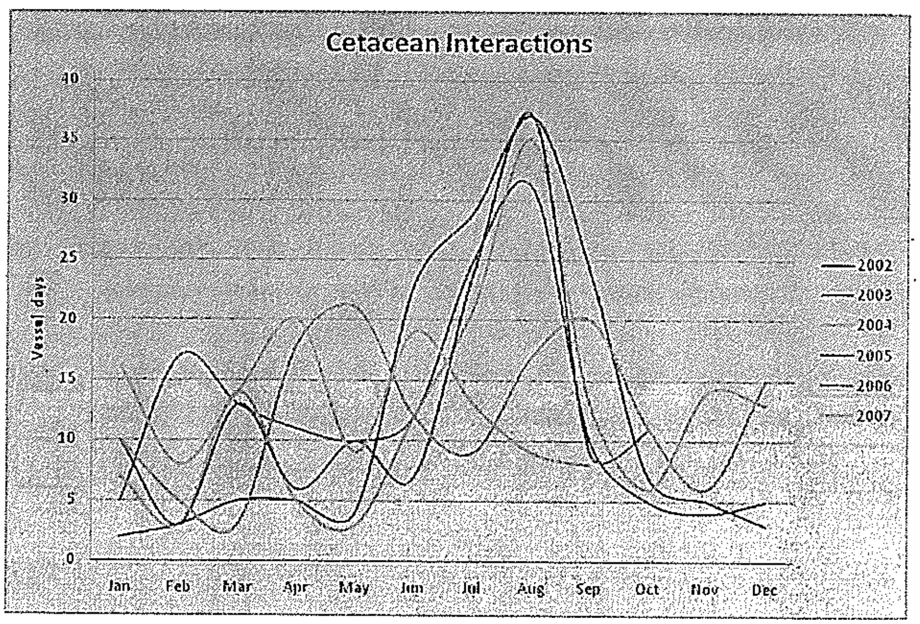
Interactions with Seabirds, Sharks, Turtles and Cetaceans

There is scant data within the region on interactions with non target or ecologically related species. Current logbooks only provide for "sharks" generically and do not list individual species.

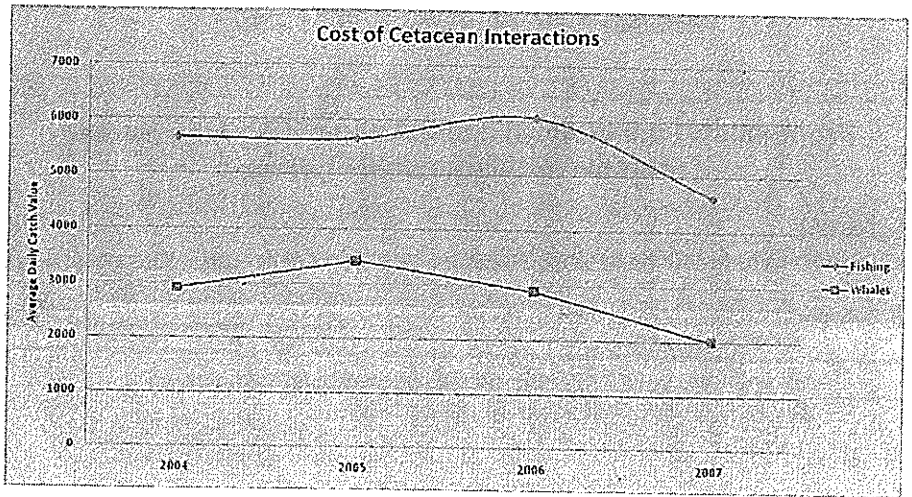
From our own experience interactions with seabirds is almost a rarity. The mitigation methods proposed by the Western Central Pacific Commission apply to areas North of 23°N and South of 30°S – outside the geographical area of the Pacific Island States.

The low price received for shark meat and high freight cost to the market make it uneconomical to land shark bodies. Consequently shark bycatch is landed, for the most part, as fins. Most companies seek to avoid catching of sharks as there is no commercial advantage in doing so.Whilst I cannot speak for all Pacific Island States turtles are rarely caught by commercial vessels in Fiji. A prohibition exists on their landing from commercial fishing vessels. There is a traditional customary take, for ceremonial purposes which are significantly important in Melanesian cultures.

In the Southern Area, loss of commercial catch to interactions by whales is significant. Whales will strip a complete long line of its total catch. All that remains are the heads as evidence of their attack. The tables below show the days of incidences and the effect on the value of catch. The figures are in Fiji dollars (FD = USD0.62) and relate to the operation of 11 vessels.



Source: SOLANDER



Source: SOLANDER

To summarise we have a situation where the host nations of the Pacific are seeking to expand their involvement in the Tuna fishery. This is at a time when the resource is under increasing stress and the economic returns have diminished considerably. Consequently there will be no massive increase in fishing effort by the PIC's. Any increase will be both gradual and measured-failure to do so will result in commercial disaster.

I am reminded of a small chapel in the Ionion Sea that stands at the entrance to the Little Port Vathi on Meganisi Island which barely has room for 6 or 8 worshippers. It is a shrine to the tuna that used to mate annually in the bay. For centuries the tuna sustained the islanders but by the 1960's they were wiped out. Legend has it that two large tuna still sneak in every year to "kiss the feet of the Madonna".

The chapel sits as a timely reminder to regulators to ensure what happened in the Mediterranean we do not repeat in the Pacific.

Thank you.

Acknowledgments:
DEVFISH – Devfish Project FFA Honiara Solomon Islands
SOLANDER – Solander (Pacific) Limited Fiji – www.solander.com.fj

Tuesday, November 13, 2007 - 9:45

Proposals of the Industrial and Artisanal Fishing Sectors to Achieve Sustainable Fisheries

B. Artisanal group
Session Chair / Panelist: Gabriella Cruz, National Federation of Artisanal Fishers of Ecuador

Panelists: Ramon Agama, Federation for the Integration and Unification of the Artisanal Fishers of Peru
Manny Duenas, Guam Fishermen's' Cooperative Association
Wawan Koswara, Indonesia Tuna Association

Martes 3 de noviembre del 2007 - 9:45

Propuestas del sector industrial y artesanal para pesquerías Sostenibles.

B. Grupo Artesanal.
Dirige la sesión y panelista: Gabriella Cruz, Federación Nacional de pescadores artesanales de Ecuador.

Panelistas: Ramón Agama, Federación para la Integración y Unificación de pescadores artesanales de Perú.
Manny Duenas, Asociación Cooperativa de Pescadores de Guam.
Sr. Wawan Koswara, Asociación de Atún de Indonesia.

The Guam Fishermen's Cooperative Association

Presented by Manny Duenas

The Guam Fishermen's Cooperative Association is 30 years old and was organized the summer of 1976 and was incorporated the following year Feb. of 1977. The fishing organization started with about a dozen members to 50 members in 1995. Since, the membership has grown to an annual average of nearly 200 but reached a peak in the year 2000 to nearly 300 members.

The greatest challenge for the Co-op was to educate the community about seafood safety and quality. The federal Hazard Analysis Critical Control Point (HACCP) Program was adopted in 1997 by the Co-op where stringent measures were placed on fishermen to ensure the highest quality product available to our customers. The consumers have embraced this program as evident by their frequent return to the market. The Co-op sponsored the first seafood training program which was attended not only by Co-op staff but representatives from various government agencies involved directly with public health concerns.

The true value of the Guam Fishermen's Cooperative Association in the community is that the members are representatives of the community. The goods and services in our operation benefit the community. We make every attempt to buy Guam first. Our operation is almost entirely supported by local wholesalers (produce to store supplies), farmers, marine stores, tackle shops, grocery stores and many more; combined there are over 50 business entities.

The economic recession had some impact on the fisheries with many fishermen either leaving island or getting full time jobs. Unlike other businesses on Guam the Co-op survived both economic downturns and natural disasters. The growth in membership and the increasing number of fish consumers that rely on the Co-op for the highest quality and freshest fish are factors that lead to a stronger and viable Co-op.

The Co-op has been a highly involved community organization. The Chamorro cultural tradition of fishermen bartering their harvest with others for goods or services in the past has evolved to an economic level with major potential. The Co-op has taken the cultural practice of sharing this economic harvest with the community. Donations were made to various medical referral fundraisers, homeless programs, youth programs, faith-based organizations and many more other community-based programs.

The Co-op is also involved in collaborative programs with such entities as the U.S. Coast Guard on safety at sea issues, U.O.G. Agricultural Extension Program (4-H), Guam Coastal Zone Management Program on environmental issues and other similar types of organizations.

The Co-op sponsors the Annual Guam Marinas International Fishing Derby fully funded by the Co-op with sponsorships from the community. The annual fishing derby is partnered with the Fisherman's Festival where prepared seafood samples are offered along with exhibits from the various marine related organizations, promoting awareness of the environment and resource.

Today the Co-op continues to offer the fishermen a place they can call home. The membership approved a long-term Master Plan for the Co-op. The projects and programs are: a new Co-op building, a Longline project resulting in a locally based longline fleet, assuming management of the two local marinas from the Port Authority of Guam along with a few more small scale programs over the next ten years. One on-going program has been to replace the local desire for the limited supply reef fish with the more abundant pelagic fish such as mahi-mahi and tunas.

The coastal fishing communities have expanded their horizons by harvesting beyond the reefs. Traditionally the participants were selected by the elders to be trained to become future fishers. Some traditions were passed from father to son, uncle to nephew or elder to young. Guam's fishing industry is small in comparison to other fishing industries but the economic benefits are comparable to mid-scale salary individuals. Most deep-water fishers own their own vessels; a few finance their fishing vessel through commercial lending institutions while others invest their fish earnings from fishing on other vessels...all community based fisheries.

Towards sustainable management of southern tunas and billfish in southern waters of the WCPO[1] : with specific reference to current efforts within the FFC SC-SPTBF[2]

Samasoni Sauni, Sione Vailala Matoto, Moses Amos

Abstract

The recent establishment of the WCPFC Convention provides the platform for the effective management and conservation of highly migratory tuna species in the WCPO convention area. The seventeen FFA Member Countries and Territory actively involved in the initial talks, through the MHLC process to the establishment of the WCPFC in 2001. In the Pacific region, the high dependence on tuna and related species by SIDs for economic benefits and subsistence use is well documented. In its effort towards ensuring sustainability and optimum utilization of tuna resources, the FFA mandated its newly established Sub-Committee to deal directly with the management of southern tunas and billfish fisheries. The key target species include the South Pacific albacore, Southwestern Pacific swordfish and Southwestern Pacific striped marlin. There is also focus placed on bycatches largely in the South Pacific longline fishery. The paper presents current efforts and initiatives by the FFA, through its established FFC Sub-Committee that effectively manage southern tunas and billfish, particularly in relation to the South Pacific Longline fishery amongst its membership

1 Western and Central Pacific Fisheries Commission

2 Pacific Islands Forum Fisheries Agency Sub-Committee on South Pacific Tunas and Billfish Fisheries

Tuesday, November 13, 2007 - 13:45

Status of Sea Turtle Bycatch Initiatives

Session Co-Chairs: Dr. Hiroshi Minami, National Research Institute of Far Seas Fisheries, Japan
Dr. Yonat Swimmer, U.S. National Marine Fisheries Service

Panelists: Dr. Kosuke Yokota, National Research Institute of Far Seas Fisheries, Japan
Dr. Martin Hall, Inter-American Tropical Tuna Commission
Dr. Yonat Swimmer, U.S. National Marine Fisheries Service
Steve Beverly, Secretariat of the Pacific Community

Martes 3 de noviembre del 2007 - 13:45

Estado de las iniciativas de la captura de la tortuga marina

Dirigen la sesión: Dr. Hiroshi Minami, Instituto Nacional de Investigación de pesquerías de mares lejanos en Japón
Dr. Yonat Swimmer, Servicio Nacional de U.S. de pesquerías marinas.

Panelistas: Dr. Kosuke Yokota, Instituto Nacional de pesquerías de mares lejanos en Japón.
Dr. Matin Hall, Comisión Interamericana Tropical de Atún.
Dr. Yonat Swimmer, Servicio Nacional U.S. de pesquerías marinas.
Steve Beverly, Secretaria de la Comunidad del Pacifico

Session: Status of Sea Turtle Bycatch Initiatives

Panelist: Martin Hall, Inter-American Tropical Tuna Commission

Title: The development of the Regional Sea Turtle Program of the Eastern Pacific: results of mitigation activities, achievements, and hurdles.

Co-Authors: Hall, M.A., Mug, M., Lennert-Cody, C., Mituhasi, T., Andraka, S., Barahona, D., Calderon, J., Cruz, A., De Paz, N., Hara, Y., Jolon, M., Kelez, S., Pacheco, L., Parrales, M., Perez, S., Rendon, L., Salaverria, S., Sanchez, R., Sui, S., Segura, A., Valqui, M., Villagran, E., and N. Vogel.

In 2007, the regional sea turtle program continued in the eastern Pacific. As of October of this year, over 1000 observer trips have been made in vessels of the region with the flags of Peru, Ecuador, Colombia, Panama, Costa Rica, El Salvador, and Guatemala. The program is about to start in Nicaragua, and some activities have already started in Mexico.

The observations are allowing us to test the performance of circle hooks of different sizes to mitigate sea turtle bycatches, and to maintain the catch levels for the target species. A database has been created for the region, that includes vessel and gear characteristics, fishing effort, catches, etc. The program has been supported by the Western Pacific Regional Fishery Management Council, the World Wildlife Fund, the Overseas Fishery Cooperation Foundation-Japan, the National Oceanographic and Atmospheric Organization-USA, The Ocean Conservation, and other national and international organizations, and it received technical support from the Inter-American Tropical Tuna Commission, OFCF-Japan, NOAA, and from scientists from the region. This program could not exist without the support of the governments, fishing industry sector, and artisanal fishers cooperatives from the region.

The program includes the following activities:: 1) a voluntary replacement of J hooks by circle hooks in operating fishing boats; 2) training in the use of instruments and techniques to release hooked and entangled turtles; 3) an observer program, and 4) a series of workshops to communicate with the fishing community.

-- Circle hooks of sizes 13/0 to 16/0 were found to produce statistically significant reductions in the hooking rates of sea turtles.
-- Circle hooks were also found to result in significant decreases in the proportions of swallowed hooks, which is considered beneficial for the post-hooking survival of the turtles.
-- With regard to catch rates of the target species, in the tuna fishery the catch rates for the circle hooks were quite similar to those for the J hooks, but in the mahi-mahi fishery in South America, the catch rates for the circle hooks were lower for the smaller sized mahi-mahis, which suggests that the size selectivity of the hooks may affect the yield of the fishery, and that they may have additional management advantages for the target species.

The implementation of a full scale regional mitigation program needs to be discussed, adopting some of these changes, continuing the communication process with the fishing community, and maintaining the participation of all sectors in the search for solutions.

DEEP SETTING LONGLINES TO AVOID BYCATCH

Steve Beverly1, Daniel Curran2, and Michael Musyl3

1. Secretariat of the Pacific Community.
2. NOAA: Pacific Islands Fisheries Science Center.
3. University of Hawaii: Joint Institute for Marine and Atmospheric Research

Secretariat of the Pacific Community
BP D5, 98848 Noumea Cedex, New Caledonia

In 2006 a deep-setting longline experiment was conducted in Hawaii in coordination with the Secretariat of the Pacific Community (SPC), the Pacific Islands Fisheries Science Center (PIFSC), and the University of Hawaii Joint Institute for Marine and Atmospheric Research (JIMAR). Current commercial tuna longline setting techniques were altered to test a method developed by the SPC to eliminate all shallow set hooks (less than 100 m depth) from tuna longline sets. By eliminating all shallow set hooks, researchers hoped to maximize target catch of deeper dwelling species such as bigeye tuna, reduce the bycatch of turtles and other protected species, and reduce the incidental catch of many species of marketable, but less desired fish (e.g., billfish and sharks). The technique was first tested in Mooloolaba, Australia on a commercial tuna longliner (Beverly and Robinson 2004). The technique worked well and the results were promising. Sets on one fishing trip in 2004, using the deep setting technique, caught more bigeye tuna than sets using the boat's normal configuration. However, because of the small amount of data (only 6000 hooks were fished in all) the results of these trials were considered to be anecdotal only. One of the recommendations coming from the project in Australia was that more testing was needed to get a more robust data set and to ascertain whether or not the technique could reduce the catch of bycatch species. Just after the first trials in Australia the deep setting technique won the First WWF Smart Gear Competition as the best bycatch reduction method (Bazilchuk 2005); and SPC produced a brochure in 2005 for fishermen that gives details on how to set a longline deep using the deep setting method (SPC 2005). Figure 1 depicts one basket of deep set gear (from Beverly and Robinson 2004) while Figure 2 depicts deep set gear being set from a longline boat.

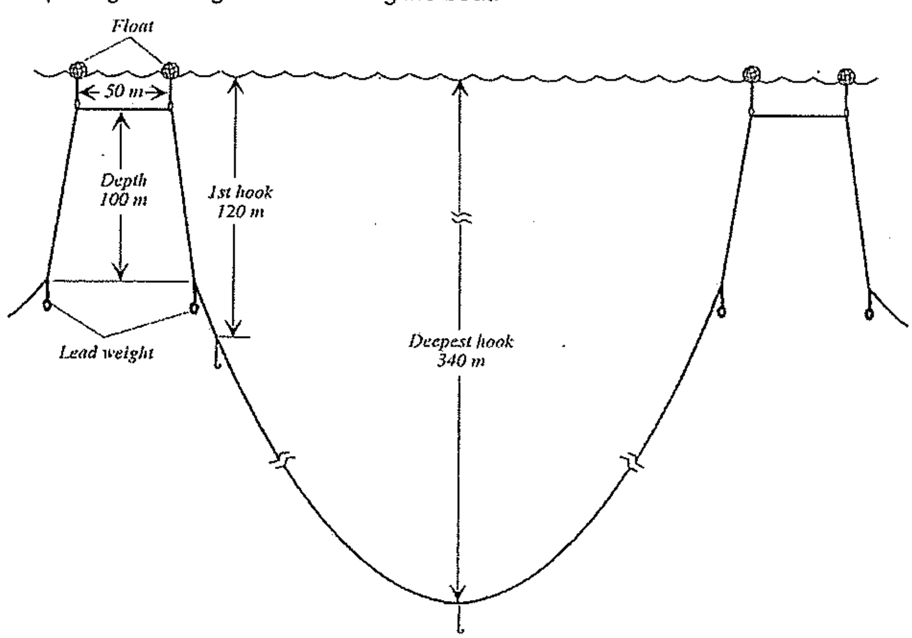


Figure 1. One basket of deep set gear.

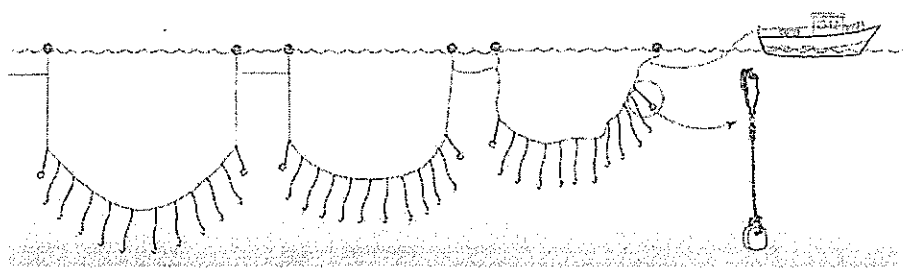


Figure 2. Deep set gear being set from a longline boat – showing position of lead weight.

Subsequently, in 2006, a vessel was contracted from the Hawaii-based tuna longline fleet to perform 90 longline sets (45 sets using the deep setting technique and 45 control sets using standard methods). In the experiment, fishermen were allowed to keep and sell their catch and choose their fishing areas, setting times, and hauling times. A deep set was achieved by attaching paired 3 kg lead weights directly below paired floats on long portions of the mainline, thereby sinking the entire fishing portion of the line below the target depth of the shallowest hook (100 m). Except for additional lead weights, floats, and floatlines which the project provided, only very slight modification of existing longline fishing gear and methods was required. The vessel alternated between the deep setting technique on one day's set and their standard technique (control) on the next day's set. A control set deployed 2000 hooks in 27-hook baskets and a deep set deployed 2000 hooks in 30-hook baskets. A researcher accompanied the vessel on all trips. The researcher documented catch by gear type and attached temperature depth recorders (TDRs) during every set to determine fishing depth of the gear.

The deep set technique was easily integrated into daily fishing activities with only minor adjustments in methodology. The main drawback for the crew was the increase in time to both deploy and retrieve the gear. The deep set technique added about 30 minutes to the deployment operations and approximately 2 hours to the hauling operations. Catch totals on the deep set gear were greater for both bigeye tuna (Thunnus obesus) and moonfish (Lampris guttatus); whereas catch of less valuable incidental fish (e.g., striped marlin (Tetrapturus audax) and wahoo (Acanthocybium solandri) was lower. Figure 3 shows percentages of catch of 14 species on both gear types (Beverly et al. unpublished). TDRs placed on the gear verified that the deep set method did achieve the goal of ensuring that all hooks sink to below 100 m. The first and last hooks of each deep set basket of gear consistently fished at just below 100 m (average 1st hook depth for all sets was 105 m), but control set gear consistently fished from about 40 m of depth. The average middle hook depths (assumed to be maximum depths of gear) of each basket were 251 m for deep set gear and 211 m for control set gear, thus the deep set method does not dramatically change the general vertical sag profile of a basket of gear, but simply shifts the whole profile down about 60 m at the first hook and 40 m at the middle hook (Figure 4). The deep set method effectively placed all of a set's hooks at depths where bigeye tuna were more likely to be encountered. The results have shown that the deep set technique does work and would be practical to incorporate into existing fishing practices in Hawaii's tuna longline fleet without jeopardizing catch rates of bigeye tuna. In fact, the revenue for the deep sets was about 6% higher than the revenue for the control sets, based mostly on the increased catch rate for the higher valued bigeye tuna (Figure 5).

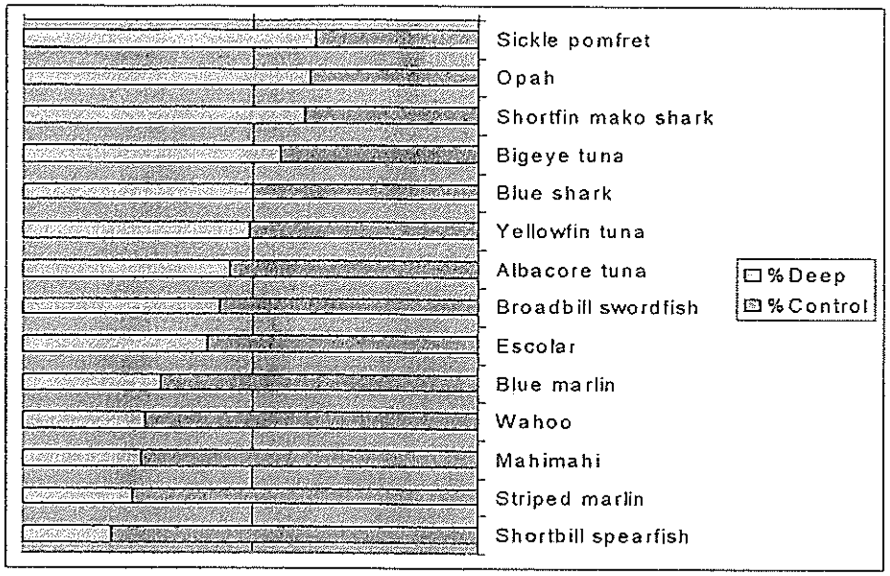


Figure 3. Percentage catch (% total number of fish caught) from 45 deep sets and 45 control sets in the Hawaii tuna longline fishery.

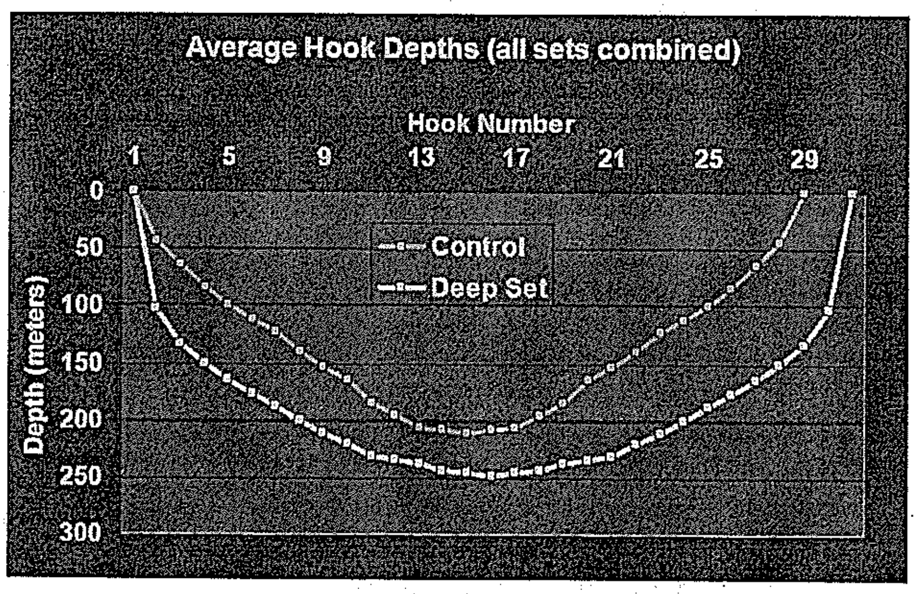


Figure 4. Average hook depths for control baskets and deep set baskets.

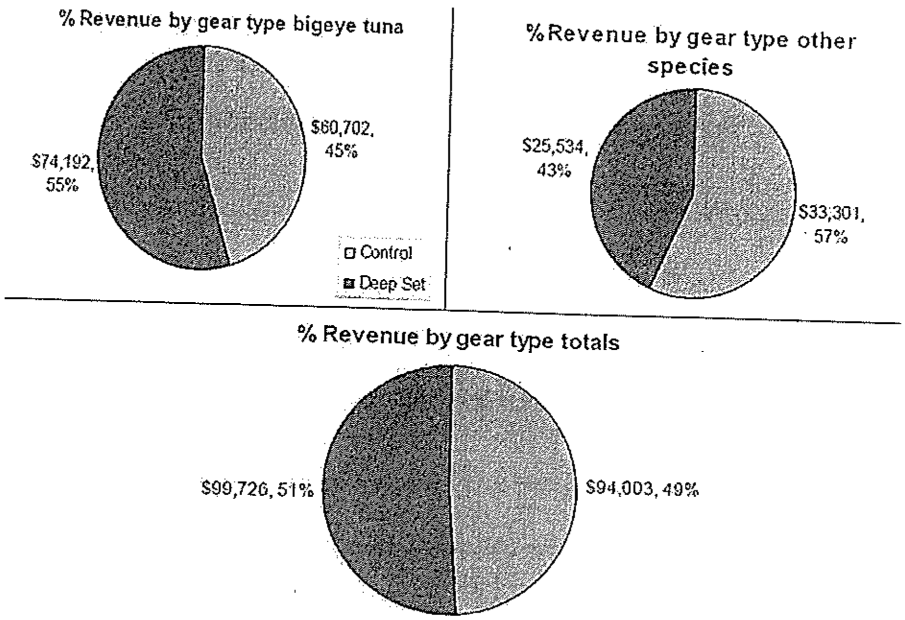


Figure 5. Percent revenue for bigeye tuna and other species for both gear types and for total gear.

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SPC. 2005. Set your longline deep: catch more target fish and avoid bycatch by using a new gear design (brochure). Secretariat of the Pacific Community, Noumea, New Caledonia. Available in English, Spanish, and French. http://assets.panda.org/downloads/smartgear_steveb_eng.pdf
http://assets.panda.org/downloads/smartgear_steveb_esp.pdf
http://assets.panda.org/downloads/smartgear_steveb_fr.pdf

Tuesday, November 13, 2007 - 13:45

Seabird Bycatch and Artisanal Fisheries

Session Chair/Panelist: Dr. Ben Sullivan, Royal Society for the Protection of Birds/BirdLife International

Panelists:
Tatiana Neves, Projeto Albatroz - South Amercian Fishers Forum
Jorge Fernandes De Freitas and Jose Arthur Marquioli, Associacao de Pescadores de Itaipava, Itaipava, Brazil
Esteban Frere, Universidad Nacional de la Patagonia Austral

Martes 3 de noviembre del 2007 - 13:45

Captura del ave marina y pesquerías artesanales

Dirigen la sesión y panelista: Dr. Ben Sullivan, Sociedad Real para Protección de aves.

Panelistas:
Tatiana Neves, Proyecto Albatros, Foro de pescadores de Suramérica.
Jorge Fernández de Freitas y Jose Arthur Marquioli, Associação de pescadores de Itaipava, Brasil.
Esteban Frere, Universidad Nacional de la Patagonia Austral.

BirdLife
INTERNATIONAL

Seabird bycatch and artisanal fisheries

Tuesday 13 November 1345-1600

Chair: Ben Sullivan BirdLife Global Seabird Programme Coordinator

Understandably, to date the focus on reducing seabird mortality in fisheries has been on large industrial vessels operating in EEZs and on the high seas. However, in recent years it has become apparent that coastal artisanal fleets are also responsible for seabird bycatch, and other artisiaal fleets have very low levels of bycatch, because either because of a low level overlap with seabirds that are vulnerable to bycatch and/or the operational nature of the vessels and or fishing gear.

Having IFF 4 in Costa Rica with a focus on artisinal fisheries has provided the impetus to start to compile an encyclopedia of the operational characteristics and degrees of overlap with seabirds of South and Central America and Mexico's artisinal fleets. This information will be a tool to help achieve two primary objectives:

(1) Currently, there are a variety of gear and vessels configurations used to target the same or similar species, some of which have markedly different levels of seabird bycatch. The example that will be discussed in detail in this session when we compare the different modalities of longline fisheries in the region (shallower and deeper, side-setting or not, etc.). By contrasting and comparing these fisheries we aim to identify potential cross-over in fishing methods that can be exchanged/ exported to reduce seabird bycatch, and potentially improve fishing efficiency.

(2) A wide ranging survey of the characteristics (e.g. vessel and gear characteristic) of artisinal fisheries South America, together with information on seabird distribution and interactions with fisheries, would enable us to conduct a preliminary risk assessment of the fisheries most likely to pose a threat to seabirds, and ultimately to target our resources more efficiently. Data from a sub-set of artisinal longline fisheries in South and Central America will be discussed at the session.

Following the presentations on fisheries and the sub-set of data collated to date from around the region a breakout session will be held for one hour to discuss other applications of such a data set, how to most effectively and efficiently collate the data and also to identify potential funding opportunities to support the data collection and compilation process.

Everyone is welcome to attend and play an active role in shaping this product that will have tangible application across the region.

1st. South American Fishers Forum to Reduce Seabird Bycatch

Tatiana Neves[1], Heloisa Azevedo1 and Janice Molloy[2]

The 1st South American Fishers Forum to Reduce Seabird Bycatch was held from 12 to 14 December, 2006, at the Delphin Hotel in Guarujá, Sao Paulo, Brazil. This was modeled on the 1st International Fishers Forum, held in New Zealand in 2000, but had a regional rather than global scope. The event was organized jointly by Projeto Albatroz and Southern Seabird Solutions, sponsored by Care for the Wild International with support of Government State Department of the United States, Brazilian Institute of Environment and Natural Renewable Resources – IBAMA and Ministry of Fisheries from New Zealand. The Forum's main aim was to promote information exchange between fishermen, ship owners, researchers, Governmental and Non-Governmental Organizations to illustrate and talk about the fisheries practices to reduce seabird bycatch in South American countries, especially by longline and trawler fisheries. Sixty participants, including fishermen and researchers from many different countries including Argentina, Uruguay, Peru, Chile, Ecuador, Brazil, Australia, New Zealand, United States and Spain participated in this experience.

The outcomes from the Forum included the identification of fisheries that cause seabird captures in South America, the addition of new information about important artesian fisheries, for example the numerically large fleets that use longlines targeting dolphin fish (mahi mahi). The discussions about different experiences in using mitigation techniques was extremely rich with presentation of new ideas, such as a new fishing method, called the cachaloteras Chilean system, for Patagonian Toothfish that seams very promising. The fishermen were able to present valuable information about their fishing routines in order to make their reality even more present in the discussions. The Forum was a good opportunity to identify the common issues and possibilities for collaboration between the participant countries. The potential for South American countries to take a regional approach to solving seabird bycatch was an important point of agreement. As regards future collaborations, there were common concerns between Brazil and Uruguay in the pelagic fisheries, which needed more joint activities such as data analysis and result-sharing of mitigation measures. Similarly, the conservation of the Galapagos albatross deserved a bi-national approach between Ecuador and Peru to develop a synchronized conservation policy. The input of knowledge from non South American countries was extremely important. Fishermen brought their experiences from New Zealand, Australia, Alaska and CCAMLR fisheries and this helped to feed the discussions. Other important points discussed were the necessity to make fishermen aware of the relevance of observer programs as a means of informing them about conservation issues, the importance of seabird education material for schools, and the use of incentives such as certification processes to encourage fishermen to develop sustainable fisheries as well as increase financial returns.

One of the most important results, however, was the mixing of people from different sectors. During the event, fishermen and representatives from several research institutions, non-governmental organizations and government had the opportunity for dialogue which strengthened relationships and will allow for ongoing collaboration between these sectors into the future.

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Description of dolphinfish fishery by the Itaipava-ES fleet and its interaction with the seabirds in Brazil.

Jorge Freitas[1], José Arthur Marquiole[1], Demétrio de Carvalho[2] and Tatiana Neves[2]

The fleet based at Itaipava harbor, located at Itapemirim city (south of Espírito Santo State - Brazil) as well as the neighbor cities such as Piuma, Anchineta and Guarapari is compound by approximately 500 vessels, and at least 250 vessels are affiliated to the radio station and the Itaipava Fishermen Association. Around 70% of this fleet uses regularly the Itaipava harbor, and this fishing production is responsible by the 50% of the Espírito Santo state total production, with 12.300 tons per year.

Despite of this fleet has its origin from Espírito Santo harbors, the fishing ground is very widely, reaching the Northeast states up to the extreme south of Brazil, being in this way spreaded in almost entire Brazilian coast with more concentration in ports for south and southeast regions. The vessels are from medium to small size and have a low cost of operation, which is boosting the appearance, in other harbors, of new vessels that uses similar fishing methods.

The vessels length varies between 10 and 15 meters, equipped by engineers of 90 – 130 HP, with storage capacity of 12 – 13 tons of fishes. The fishing trips duration is 12 to 20 days at high sea, with a total crew of 6 to 8 fishermen. However when the vessels use the live baits the fishing time varies in 5 up to 10 days. The majority of the vessels is equipped with Global Positioning System (GPS), echosounder and radio. There are six types of fishing gears used by this fleet, all using line and hooks: (1) slow trolling for Bigeye tuna; (2) fast tralling for Yellowfin tuna; (3) surface longoline for the dolphinfish Coryphaena hippurus; (4) pelagic longline for the swordfish and others fishes; (5) vertical bottom longline (pargueira) for snepers, wreckfishes, tilefishes, sandperchs, hakes and groupers and (6) handlining for several species.

Most of the time, such different kind of fishing gear are used at the same time. Even the longline for dolphinfish and swordfish are used by the same vessel in the same fishing cruise, respectively, during night and day.

The dolphinfish fishery is a diurnal fishery where the baited hooks stay floating at the surface, making them available to the seabirds during the fishing operation. They used between 600 – 1200 hooks and the equipment is settled only one time, the vessel sails along the longline and the fishermen take all the fishes hooked and then put new baits. According to the reports from fishermen that use this technique, frequently seabirds are caught what difficult the fishery. Also, generally the seabirds are found alive, struggling at the sea surface trying to escape from the hook. However, considering that it is very difficult to release them from the hook, they are sacrificed.

Thus, it is necessary and urgent to develop new techniques that became less harmful to the seabirds and turn the fishing operation more productive for the fishermen.

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Tuesday, November 13, 2007 - 16:15

Elasmobranchs - Pelagic Longline Interactions

Session Chair: Dr. Miguel Angel Cisneros, Mexican National Fisheries Institute

Presentations:

Dr. Ramon Bonfil, Asociacion MarViva, Global Shark Resources as Related to Target and Incidental fisheries

Dr. Shelley Clarke, Imperial College London, Emerging Global Shark Markets

Eric Gilman, IUCN Global Marine Programme, Industry Practices and Attitudes Towards Shark Interactions in Pelagic Longline

Dr. Jose I. Castro, NOAA Mote Marine Lab, Shark Reproductive Potential and Limitations for Shark Fisheries

Martes 3 de noviembre del 2007 - 16:15

Elasmobranchs- Interacciones pelágicas de palangre

Dirige la sesión: Dr. Miguel Ángel Cisneros, Instituto Nacional Mexicano de pesquerías.

Presentaciones:

Dr. Ramón Bonfil, Asociación MarViva, Recursos Globales de Tiburones, Relacionado con las pesquerías incidenciales y su blanco.

Dr. Shelley Clarke, Imperial Collage Londres, Nuevos Mercados Globales de tiburones.

Eric Gilman, IUCN Programa Marino Global, Practicas Industriales y actitudes hacia las interacciones de tiburón en palangre pelágico.

Dr. José I. Castro, NOAA Mote Marine Lab, Reproducción potencial de tiburones y las limitaciones de pesquerías de tiburones.

Shark Depredation and Unwanted Bycatch in Pelagic Longline Fisheries: Industry Practices and Attitudes, and Shark Avoidance Strategies

Eric Gilman a, Shelley Clarke b, Nigel Brothers c, Joanna Alfaro-Shigueto d, John Mandelman e, Jeff Mangel d, Samantha Petersen f, Susanna Piovano g, Nicola Thomson h, Paul Dalzell i, Miguel Donoso j, Meidad Goren f, Tim Werner e

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c Consultant
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g Università di Torino
h Environment Consultants Fiji
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Abstract

Substantial ecological, economic and social problems result from shark interactions in pelagic longline fisheries. Improved understanding of industry attitudes and practices towards shark interactions assists with managing these problems. Information on fisher knowledge and new strategies for shark avoidance may benefit sharks and fishers. A study of 12 pelagic longline fisheries from eight countries shows that incentives to avoid sharks vary along a continuum, based on whether sharks represent an economic disadvantage or advantage. Shark avoidance practices are limited, including avoiding certain areas, moving when shark interaction rates are high, using fish instead of squid for bait and deeper setting. Some conventionally employed fishing gear and methods used to target non-shark species contribute to shark avoidance. Shark repellents hold promise; more research and development is needed. Development of specifically designed equipment to discard sharks could improve shark post release survival prospects, reduce gear loss and improve crew safety. With expanding exploitation of sharks for fins and meat, improved data collection, monitoring and precautionary shark management measures are needed to ensure shark fishing mortality levels are sustainable.

1. Introduction

Much progress has been made to identify effective, commercially viable, and even operationally beneficial methods to significantly reduce seabird and sea turtle bycatch[1] in longline fisheries [8,12,22-24]. Relatively little progress has been made to reduce cetacean [12] and shark[2] interactions in longline fisheries.

1 'Bycatch' is the retained catch of non-targeted species or 'incidental catch', plus all discards [1,17]. 'Target' catch is the catch of a species or species assemblage primarily sought in a fishery, while 'non-target' catch is the catch of a species or species assemblage not primarily sought. 'Incidental' catch is the portion of non-target catch that is retained, while 'discards' is the portion of non-target catch that is not retained [1,17].

2 The term 'sharks' refers to the Chondrichthyan fishes, which comprise elasmobranchs (sharks, skates and rays) and holocephalans (chimaeroids).

In some pelagic longline fisheries, shark interactions pose substantial ecological, economic and social problems. As demonstrated in some fisheries to address seabird and sea turtle bycatch [8,9,12,25], collaborative approaches, which tap fishers' large repository of knowledge, may likewise successfully reduce unwanted shark interactions. Depredation, the partial or complete removal of hooked fish and bait from fishing gear, is conducted primarily by cetaceans and sharks in pelagic longline fisheries (Fig 1). Economic losses from depredation can be substantial [20,21]. Depredation also raises ecological concerns as these interactions may change cetacean and shark foraging behavior and distribution, increase fishing effort, and confound fish stock assessments, as well as result in deliberate injury and mortality of cetaceans and sharks by fishers to discourage depredation and avoid future interactions [11].

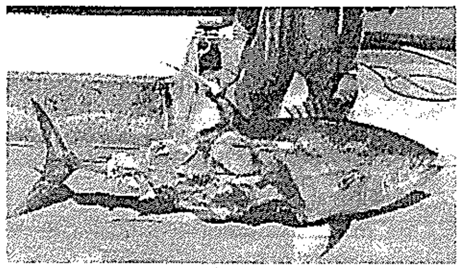

Fig. 1. Shark-damaged yellowfin tuna caught in the Hawaii pelagic longline fisheries (photo courtesy of U.S. National Marine Fisheries Service Hawaii Pelagic Longline Observer Program).

We collect information from longline industries ranging from small-scale artisanal fisheries to large-scale industrial distant water fleets to obtain a more complete understanding of shark-pelagic longline interactions, current fisher attitudes and practices employed in response to shark interactions, identify methods to avoid shark interactions, identify research priorities and assess the effects of legislation that affect longline practices in catching and processing sharks. Information on existing fisher knowledge and new strategies for shark avoidance may benefit sharks and fishers wanting to reduce shark interactions. Improving the understanding of longline industry attitudes and practices towards shark interactions provides industry and management authorities with better information to address these problems. A detailed project report from this study has been produced by Gilman et al. [26].

2. Methods and Overview of Fisheries

Information was collected from the following 12 pelagic longline fisheries from eight countries: (i) Australia longline tuna (Thunnus spp) and billfish (Istiorphoridae spp) fishery, (ii) Chile artisanal mahi mahi (dolphinfish) (Coryphaena spp) and shark fishery, (iii) Chile swordfish (Xiphias gladius) fishery, (iv) Fiji longline tuna fishery, (v) Italy Mediterranean industrial longline swordfish fishery, (vi) Japan distant water longline fishery, (vii) Japan offshore longline fishery, (viii) Japan nearshore longline fishery, (ix) Peru artisanal mahi mahi and shark fishery, (x) South Africa longline tuna and swordfish fishery, (xi) US Hawaii longline tuna fishery, and (xii) US Hawaii longline swordfish fishery. From January - December 2006, 149 vessel captains, fishing masters, crew, vessel and company owners, fishing cooperative staff and port officials from these 12 fisheries were interviewed at 24 fishing seaports (nine seaports in Australia, including the main port of Mooloolabah; Arica, Iquique and Valparaiso, Chile; Suva, Fiji; Sicily, Italy; Kesennuma, Kii-Katsuura, Yaizu and Misaki, Japan; Ilo, Paita and Salaverry, Peru; Cape Town Harbour, Hout Bay Harbour and Richards Bay Harbour, South Africa; and Honolulu, U.S.A.).

Information from the interviews; analyses of available logbook and observer data; and a review of the literature was collected and analyzed to:

- Determine shark catch rates, disposition of caught sharks and costs and benefits from shark inter actions to better understand longline industry interest in reducing shark interactions;
- Describe the range of longline industry attitudes towards shark capture and depredation to under stand the degree of interest in shark avoidance;
- Identify practices employed by longline fishers in response to shark interactions;
- Identify promising concepts not currently practiced to reduce shark capture, reduce depredation and gear damage, improve discard methods, and determine what obstacles must be over come to implement these concepts;
- Identify priority research and development, monitoring and management measures; and
- Identify economic, social and ecological effects of legislation affecting shark practices, assess if the legislation has resulted in reduced interest in capturing and retaining sharks, and discuss how these laws may have affected shark fishing mortality levels.

The 12 fisheries range from small-scale domestic artisanal fisheries to modern mechanized industrial fleets of distant water fishing nations. Distant water vessel fishing grounds range throughout the world's oceans on trips lasting two to three months, while smaller vessels fish in nearshore waters on trips lasting a few days. The number of vessels in each fleet also varies, from the South Africa longline fleet with about 17 vessels, to the Japanese and Peruvian fleets with about 1,500 vessels each. Some of these fisheries never target and rarely retain sharks, while in other fisheries sharks are an important target species.

There are several fishing gear designs and operational characteristics that are likely to affect shark interactions, including the location of fishing grounds, depth of baited hooks, timing of gear deployment and retrieval, use of wire leaders and lightsticks on branch lines and type and size of bait. For example, Peru artisanal longline vessels, which are about 15 m in length, target mahi mahi during the austral summer and target sharks from autumn to spring. Baited hooks are set at depths between 10-16 m. Wire leaders are not typically used during the mahi mahi season but are always used during the shark season to maximize shark retention and reduce gear loss. Giant squid, mackerel and flying fish are used for bait. Lightsticks are not used. Gear soaks during the daytime. Hawaii longline tuna vessels are a bit larger, between 15-31 m in length, set baited hooks deeper at depths between 35-224 m, use a wire trace, use fish for bait, do not use lightsticks, and gear soaks during the day. However, there may be large variability in fishing gear and methods between vessels in a fleet and even for an individual vessel. For instance, some vessels in the Fiji longline tuna fleet fish at grounds within the Fiji Exclusive Economic Zone (EEZ), while larger vessels fish at grounds much more distant from their home port, on the high seas and in other nation's EEZs, and these two categories of vessels have substantially different gear characteristics. In some fisheries, vessels will seasonally substantially alter their gear when they change their primary target species (e.g., Chile and Peru artisanal longline mahi mahi and shark fisheries, Japan offshore and nearshore pelagic longline tuna fisheries). Gear characteristics may also vary substantially between seaports within a fishery.

3. Shark Catch Rates and Disposition

Table 1 summarizes the catch rates and retention of caught sharks, where available. Several of these entries are based on limited data from small sample sizes. For the Japan distant water, offshore and nearshore longline fisheries, the shark catch rates reported in Table 1 are based on logbook data. These figures' relationship to the actual number of sharks caught and retained is expected to vary with logbook recording behavior [27]. The Italy Mediterranean large-scale longline swordfish fishery is the only fishery included in this study where there is a lack of a local market for shark fins, and as a result, fishers do not fin sharks. The shark catch rates for the two Chile fisheries are estimated from fisher interviews.

Shark catch rates for the Chile longline swordfish fishery and artisanal longline mahi mahi and shark fishery are available only in units of weight per unit of effort (0.36 kg/hk and 0.28 kg/hk, respectively [28]), and not as number of sharks per unit of effort. Information on the Fiji longline tuna fishery is based on observer data from 1999 and 2002 to 2005 (Secretariat of the Pacific Community unpublished data). Statistics for the Peru artisanal longline mahi mahi and shark fishery are based on 2004 - 2006 onboard observer data taken only during the mahi mahi season from four ports for a total of 27 trips and 197 sets.

Table 1. Shark catch rate and disposition in 12 pelagic longline fisheries for the most current year for which data are available.

Pelagic Longline Fishery	Shark Catch Rate (Number per 1000 hooks)	Shark Retention (Fins and/or Carcass) (% of Total Number Caught Sharks)
Australia Tuna and Billfish Longline Fishery	5.5 [1]	Not available
Chile Artisanal Mahi Mahi and Shark Longline Fishery	24 [2]	>99 [2]
Chile Longline Swordfish Fishery	8 [2]	>99 [2]
Fiji Longline Tuna Fishery	1.1	78-90
Italy Mediterranean Industrial Longline Swordfish Fishery	0.74	Not available
Japan Distant Water Longline Tuna Fishery	0.021 [3]	Not available
Japan Offshore Longline Fishery	0.175 [3]	Not available
Japan Nearshore Longline Fishery	0.020 [3]	Not available
Peru Artisanal Longline Mahi Mahi and Shark Fishery during mahi season	0.99	84
South Africa Longline Tuna and Swordfish Fishery	4.0	80
USA - Hawaii Tuna	2.2	2.1
USA - Hawaii Swordfish	16.7	0.2

1 Rough estimate based on Australian Commonwealth Scientific and Research Organization unpublished data from a subset of the fleet and time period, possibly not representative.
2 Rough estimate based on interview responses.
3 Based on number of sharks recorded in vessel logbooks [27].

The large number of "not available" entries and entries based on rough estimates in Table 1 suggests either that there is insufficient data collection and management measures for shark species or that relevant data are collected but have not been analyzed. For fisheries where there is high confidence in available shark catch rates, these range from 0.7 to 17 sharks per 1000 hooks. The location of fishing grounds and characteristics of fishing gear and methods are likely primary factors determining a fleet's shark catch rate. Certain gear designs (e.g., use of a wire leader, use of squid for bait, use of lightsticks, and setting baited hooks at shallow depths) contribute to high shark catch rates.

The proportion of total catch comprised of sharks by number varies widely for the fisheries. In the Australia fishery, sharks comprise about 27% of the total catch. Sharks comprised > 25% of the total number of fish caught by Fiji longline tuna vessels based on observer data from 1999 [29], while Secretariat of the Pacific Community observer program data for 1999 and 2002-2005 found that sharks comprised only 5.5% of the total number of caught fish. From 1998-1999, sharks comprised about 18% of the total catch in the Italian longline swordfish fishery [30]. In the Peru artisanal longline fishery, during the mahi mahi season in the port of Ilo for 2005-2006, sharks comprise less than 1% of the total catch by number. In the South Africa longline fishery, from 1998-2005, sharks comprised 16.2% of the total number of caught fish. In 2001, pelagic sharks comprised about 50% of the catch composition of swordfish sets and 16% for tuna sets in the Hawaii longline fishery [31]. However, since 2004 the shark catch rate in the swordfish fishery dropped 36% when the fishery was required to switch from using J hooks with squid bait to wider circle hooks with fish bait [9].

Results are generally consistent with the literature, which shows that a large quantity of pelagic sharks is taken as bycatch in pelagic longline fisheries with tuna and swordfish as their primary target species [29,32-36]. For example, in the western Pacific, shark species account for the highest category of bycatch in tropical fisheries, where sharks comprise 27% of total bycatch, and in subtropical fisheries, where sharks are 18% of total bycatch [32,37]. In the U.S. Atlantic longline swordfish and tuna fisheries, sharks and rays constituted 25% of total catch between 1992 and 2003 [38]. Beerkircher et al. [33] found that sharks comprised 15% of the total catch in the southeastern U.S. pelagic longine swordfish and tuna fisheries. Bonfil [19] found that the same numbers of sharks are caught in directed fisheries as are caught as bycatch mostly in longline tuna fisheries. However, the recent development of longline directed shark fisheries, especially in the Pacific, may mean that directed shark fisheries are now catching more sharks [39-42].

For fisheries where information on shark catch composition is available, blue sharks comprise the largest proportion of shark catch. Blue sharks comprise 47% of total shark catch by number of fish in the Australia longline tuna and billfish fishery; 49% in the Fiji longline tuna fishery; >70% in Japan longline fisheries; 57% for the Peru artisanal mahi mahi and shark longline fishery (Pro Delphinus, unpublished data); 69% for the South Africa longline tuna and swordfish fishery; and 82% and 92% for the US Hawaii longline tuna and swordfish longline fisheries, respectively.

Identifying effective and commercially viable methods to reduce unwanted shark bycatch in longline fisheries would contributes to reducing shark fishing mortality. Increasing the proportion of caught blue sharks that are discarded in pelagic longline fisheries would likely reduce fishing mortality of this species, as blue sharks are usually alive when hauled to the vessel. Beerkircher et al. [33] found that the condition of sharks caught in pelagic longline gear (dead versus alive when hauled to the vessel) varied widely by species, where for example, blue sharks had a relatively low 12.2% mortality, while silky sharks (the most dominant species of shark by number caught in the observed southeastern U.S. pelagic longline swordfish and tuna fisheries, 31.4% of elasmobranch catch) had a 66.3% mortality. Over 89% of sharks caught in the Hawaii-based longline swordfish fishery and over 93% of sharks caught in the Hawaii-based longline tuna fishery are alive when the gear is retrieved. Eighty-seven percent of sharks caught in the Peru artisanal mahi mahi and shark longline fishery were alive when gear was retrieved. An analysis of Secretariat of the Pacific Community observer program data from 2002-2005 for the Fiji longline tuna fishery indicates that over 94% of blue sharks and over 84% of combined species of sharks were alive when hauled to the vessel.

4. Summary and Effects of National/EC Legislation on Shark Interactions

Table 2 summarizes legally binding measures that influence longline industry practices and attitudes towards shark bycatch and depredation. The two Chile longline fisheries, Fiji longline fishery, and three Japan longline tuna fisheries are not subject to legally binding measures that manage shark interactions, and are not included in Table 2. Japan and Fiji distant water vessels may comply with voluntary measures adopted by Regional Fishery Management Organizations, and vessels operating in EEZs of other nations through foreign license access agreements may be required to comply with restrictions on shark catch, retention and use under these agreements.

Table 2. Legal framework that influence practices and attitudes towards shark bycatch and depredation in six pelagic longline fisheries [43-46].

	Legal Constraints [1]				
Pelagic Longline Fisheries by Flag State	Retention of Fins Requires Retention of Corresponding Carcass [2]	Shark Retention Limit [3]	Prohibit Wire Trace	Prohibit Retention of Specified Shark Species	Size Limit
Australia tuna and billfish	X	X	X	X	
Italy Mediterranean industrial swordfish	X				
Peru artisanal mahi mahi and shark					X
South Africa tuna & swordfish	X	X	X		
USA - Hawaii tuna	X				
USA - Hawaii swordfish	X				

1 Japan and Fiji distant water longline tuna vessels may comply with voluntary measures adopted by Regional Fishery Management Organizations, and vessels operating in EEZs of other nations through foreign license access agreements may be required to comply with restrictions on shark catch, retention and use under these access agreements.
2 U.S.A., Italy (European Union), and South Africa require the total weight of retained shark fins to be < 5% of the total dressed 'live' weight of shark carcasses. Australia requires fins to be attached to the shark carcass when landed.
3 Australia has a 20 shark carcass per trip retention limit for longline tuna and billfish fisheries. South Africa has a shark landing limit of 10% of the total swordfish and tuna catch.

Legislation prohibiting the removal of shark fins and tail and discarding the remainder of the shark at sea in pelagic longline fisheries exists in four of the eight countries included in this study (Australia, Italy, South Africa, and U.S.A.) [43-46]. In the Australia longline tuna and billfish fishery, a rule that disallows possession, carrying and landing of shark fins unless attached to the trunk of the shark has likely substantially reduced shark fishing mortality, as finning was a widespread practice before this measure was instituted, while about 75% of caught sharks are now released alive [47-48]. In the Hawaii longline tuna and swordfish fisheries, observer data indicate that the restriction on shark finning, which requires the retention of shark carcasses for corresponding retained fins, has likewise substantially reduced shark fishing mortality. As many as 76% and 64% of caught sharks were finned in the Hawaii tuna and swordfish fisheries, respectively, prior to this rule, while in 2006 91% and 93% of caught sharks were released alive in the tuna and swordfish fisheries, respectively. Revenue from shark fins had comprised 10-11% of Hawaii longline crew salaries [49]. In the South Africa longline tuna and swordfish fishery, all interviewed fishers stated that prior to the finning restriction, they would fin and discard the carcass of all caught sharks excluding makos, which were retained for the sale of both fins and meat. Thus, the restriction on finning in South Africa has also substantially reduced shark retention and increased discards. In these fisheries, shark finning restrictions have caused substantial reductions in revenue to industry.

All 17 interviewed owner-operators from the Italy Mediterranean industrial longline swordfish fishery were unaware of a restriction on shark finning practices: the legislation does not affect their practices. However, no shark finning is reported to occur in the fishery due to the lack of a local market for fins.

Japan does not have legislation restricting shark finning practices, however, the distant-water fleet fishes in EEZs of nations that do have finning restrictions (e.g., South Africa, Brazil, Costa Rica). Vessels in the Japan distant-water longline tuna fishery will likely fin caught sharks and discard the carcass unless they are fishing in the EEZ of a nation that prohibits this practice, in which case the vessel may choose to retain the whole shark carcass and land the carcass in ports where there are markets for shark meat. Thus, Japanese longline fishermen have adapted to finning regulations applicable in some areas by landing sharks in recently developed local markets. In waters without finning regulations, including Japanese waters and the North Pacific, sharks are either finned or landed whole, and in either case the ability to sell shark products has contributed to a lack of interest in reducing shark bycatch.

A 20 shark carcass per trip limit for the retention of sharks in the Australia East coast longline tuna and billfish fishery has not altered the number of sharks retained by fishers, as fewer than 20 sharks are typically caught during an average length trip, and only a small proportion of the sharks caught on a trip are of species (makos and threshers) for which there is sufficient value for their meat. Furthermore, many operators only retain a shark of a marketable species if it is dead or dying when hauled to the vessel, which can be safely and easily landed.

The South Africa longline tuna and swordfish fishery is subject to a shark landing limit of 10% of the total swordfish and tuna catch. In theory, this has been economically detrimental to the industry. From 1998-2005, the total number of caught sharks was 18% of the total number of caught swordfish and tunas. Thus, vessels would need to discard about 44% of caught sharks to comply with the shark limit. Because only about 18% of caught blue sharks and 10% of makos have been observed to be released alive in this fishery, and the literature demonstrates that a much larger proportion of these shark species (> 85%) are likely alive when hauled to the vessel (e.g., [33]), it is likely that fishers are not complying with this measure.

A prohibition on the use of a wire trace in the Australian longline tuna and billfish fishery and South Africa longline tuna and swordfish fishery has likely resulted in an increased economic cost from shark interactions as this has likely caused an increase in the loss of terminal tackle to sharks. A substantially larger number of hooks, bait and line are likely now bitten off of branch lines compared to when wire trace was used. However, fishers generally do not consider this to be a large concern. It is not known how the injury to sharks from retaining hook and trailing monofilament line affects their survival prospects. This is a research priority. This may be an improvement to their previous fate when caught on lines with wire trace when they would soak on the gear for hours, be gaffed and hauled onboard the vessel and then have hooks removed by cutting with a knife or pulled out by force. Available but limited information indicates that a large proportion of sharks caught in longline gear that are released after removal of the hook will survive (Section 7.4; [50]). In fisheries where a large proportion of caught sharks is killed either for retention or discarding, prohibiting the use of wire leaders will reduce shark fishing mortality. Prohibiting wire leaders may exacerbate seabird bycatch problems: Fishers will be less likely to attach weights close to hooks on branch lines lacking a wire leader due to safety concerns, thus, reducing the baited hook sink rate, and increasing seabird catch rates.

Shark fisheries in Peru are regulated by the Ministry of Fishery through size limits for certain elasmobranch species. However, there is little enforcement of these regulations and few fishers are aware of the regulations. Of the few interviewed fishers who reported that they were aware of the regulations (5%), all report that they still retain sharks that are under the minimum size limit.

5. Economic, Practical, Ecological and Social Problems from Shark – Longline Interactions

5.1. Economic and Practical Concerns
Shark interactions in pelagic longline fisheries result in substantial inconveniences and adverse economic effects, including:

(i) Depredation. Lost revenue from shark damage to target species can amount to several thousand U.S. dollars in a single set in some fisheries.

(ii) Damage and loss of gear. Sharks bite off terminal tackle (e.g., baited hook, leader, weighted swivel, and line) from branch lines, stretch and chafe branch lines, break the main line, and some shark species will pull the gear down causing branch lines to entangle.

(iii) Reduced catch of marketable species. When baited hooks are occupied or re moved by sharks, fewer hook are available to catch marketable non-shark species;

(iv) Risk of injury. It is dangerous to handle caught sharks and there is a risk of being hit by weights when branch lines containing sharks break during gear retrieval; and

(v) Expenditure of time. Substantial time is spent removing sharks from gear, retrieving terminal tackle and repairing and replacing gear due to shark interactions.

In fisheries with a demand for shark products, where vessels continuously or periodically target sharks, fishermen generally perceive these costs to be a minor inconvenience and are not problematic enough to create an incentive to avoid sharks. However, in fisheries with restrictions on finning, a lack of market for shark meat or a per-trip limit on shark retention, where shark catch rates are relatively high, shark interactions are perceived to be a major inconvenience and can represent a substantial economic cost.

In the Australia longline tuna and billfish fishery, fishermen estimate that they lose 20% of their catch of target species due to shark damage, while damage and loss of gear from shark interactions amounts to a loss of about AUD 100 per set. Considerable time is also expended to discard caught sharks. The average catch rate of sharks is about 5.5 sharks per 1000 hooks compared to the catch rate of target and incidental fish of about 20.5 fish per 1000 hooks. However, on a given set, the shark catch can be extremely high (hundreds of sharks).

Fishers in the Chile mahi mahi and shark fishery and swordfish fishery report that sharks are an important target or incidental catch species. Fishers perceive that revenue from catching sharks exceeds costs from shark interactions. In a typical mahi mahi set, costs from the loss and damage to gear is about USD 18.5 and in the swordfish fishery 50-100 branch lines are damaged from shark interactions on a typical set. Fishermen reported having an average of six mahi mahi and three swordfish damaged from shark depredation on a typical set in the artisanal mahi mahi fishery and swordfish fishery, respectively. This represents a loss of about USD 146 per mahi mahi set and USD 1,063 per swordfish set.

In the Fiji longline tuna fishery, almost all caught sharks are finned (Table 1) and carcasses are usually discarded due to the low value of shark meat. Fishers generally perceive that costs from shark interactions, including economic costs and time spent to deal with the interactions, exceed the benefit from revenue to crew from fins.

In the Italian Mediterranean industrial longline swordfish fishery, where the shark catch rate is low and sharks are occasionally retained for the sale of meat, fishermen find the costs from shark interactions to be a minor inconvenience. Few (0 - 10) branch lines are damaged or lost to sharks on a typical set, and very rarely is a target species damaged by sharks. At most, two target species are damaged by sharks per set. However, despite the perceived low frequency of shark interactions and nominal economic cost from shark interactions, fishermen perceive that the revenue from catching sharks is exceeded by costs from shark interactions, and there is concern over the safety risk of handling caught sharks. As a result, fishers are interested in reducing shark interactions as long as this does not adversely affect their catch rate of target species.

In Japanese longline fisheries, where fins are retained from the majority of caught sharks and in some cases carcasses are retained for their meat, costs of shark interactions are perceived to be minor. Gear damage and loss from shark interactions is considered a much less important problem than shark damage to hooked tunas and billfishes, which can result in the damage of as many as three fish per set, where shark depredation of one fish every 3-5 sets is more typical.

Fishers in the Peru artisanal mahi mahi and shark longline fishery report that the revenue from catching sharks exceeds costs from shark interactions. Sharks are an important incidental catch species during the mahi mahi season and the main target species the remainder of the year. Fishers estimate that they incur a cost of USD 11 per set due to damage and loss of gear, and incur a loss of about USD 30 from 7-8 mahi mahi being damaged from sharks on a typical set during the mahi mahi season.

In the South Africa longline tuna and swordfish fishery, fishers are concerned over shark damage to their gear and the loss of bait from shark interactions. On average, they lose the terminal tackle of 10-30 branch lines, although this is highly variable from set to set. On typical sets, 2 - 5 marketable fish are damaged or lost to sharks.

In the U.S. Hawaii longline swordfish fishery, > 99% of caught sharks were discarded in 2006 when the shark catch rate was 16.7 sharks per 1000 hooks and the catch rate of retained fish was 23 fish per 1000 hooks. In the Hawaii longline tuna fishery, > 97% of caught sharks were discarded in 2006 when the shark catch rate was 2.2 sharks per 1000 hooks and the catch rate of retained fish was 13 fish per 1000 hooks [9]. In these fisheries, fishers perceive the time required to remove sharks from gear and to rebuild damaged and lost gear to be a substantial inconvenience. Risk of injury from caught sharks is also a substantial concern. Economic costs from the damage and loss of gear is nominal, costing an estimated USD 19 and USD 50 per typical tuna and swordfish set, respectively. Fishers report having an average of three marketable fish species damaged from sharks on a typical longline tuna set and five damaged on a typical swordfish set. This can represent a loss of several thousand dollars. This is a much higher rate of depredation of caught fish than reported by Lawson [21] for Western and Central Pacific Ocean pelagic longline tuna fisheries, where 1.8% (46 of 2,555) of caught tunas were discarded due to shark damage. On an especially bad set, as many as 50% of target species may be damaged to a degree that they cannot be sold.

Many pelagic longline fisheries targeting species other than sharks, when not prevented by regulation, will retain the fins of captured sharks, which fetch a high value in the Asian dried seafood trade, and occasionally will retain meat and other parts (cartilage, liver oil, skin) from marketable species of sharks when markets for these products are available (e.g., [34,36,49,51]. High demand for shark fins in Asia means that few sharks caught in pelagic longline fisheries, where finning is not prohibited or resources for enforcement are scarce, are released alive [34,36]. For instance, from 1995-1999, before restrictions on shark finning were instituted, the Hawaii-based longline swordfish fishery finned 65% of caught sharks, when about 50% of the catch by number was elasmobranch bycatch. In the Fiji longline tuna fishery, 78-90% of caught sharks are finned (Secretariat of the Pacific Community, unpublished data).

Francis et al. [34] found that about half of the catch by number on New Zealand tuna longlines was elasmobranch bycatch, from which usually only the fins were retained. Williams [36] found that in western and central Pacific longline tuna fisheries, the fate of shark bycatch was species-specific: Certain species, such as pelagic stingray, were always discarded, trunks of silky and blue shark were occasionally retained (45.8% and 5.4% of the time, respectively), fins of blue sharks were retained 84.1% of the time, and fins of silky sharks were retained 47.5% of the time. Crew in many pelagic longline fisheries have a strong economic incentive to catch sharks and fin as many of the sharks that are caught as possible as they receive the proceeds from shark fins [36,49]. For instance, Williams [36] reported that crew of some longline tuna vessels operating in the western and central Pacific obtain half of their wage from shark fin revenue. McCoy and Ishihara [49] estimated that Hawaii longline crew had obtained over 10% of their annual wage from shark fin sales, prior to the promulgation of rules restricting finning practices. In some fisheries, shark discarding and retention practices are also a result of the value of the species of caught shark, whether the shark is caught at the beginning or end of a fishing trip, how much hold space remains, whether or not the shark is alive or dead when hauled to the vessel and the size of the shark.

However, to address the social concern that shark finning is wasteful when a large portion of the shark is discarded, and ecological concerns over the sustainability of shark exploitation in fisheries, there have been several recent international initiatives[3] and adoption of national legislation addressing shark finning (Section 4, Table 2). Fisheries that are required to retain and land entire shark carcasses if they wish to retain the fins have a high economic incentive to avoid shark bycatch in areas where there is a lack of markets for shark meat. Some fisheries may lack access to markets for shark products, as documented in Italy, creating an incentive to avoid catching sharks.

There are pelagic longline fisheries where revenue from sharks exceeds costs from shark interactions, a large proportion of caught sharks are retained, and sharks are either always an important target species, are targeted seasonally or at certain fishing grounds proximate to ports where there is demand for shark fins and meat, or are an important incidental catch species. For instance, sharks comprised 70% of landings by the Spanish North Atlantic and Mediterranean longline swordfish fishery in 1991-1992 based on sampling at the Algeciras fish market in southern Spain [52]. While the majority of pelagic longline fisheries target tunas and billfishes [53], as documented in this study (Chile, Peru, Japan) there are a growing number of pelagic longline fisheries where the main target species are pelagic or coastal sharks [19,39,40-42]. While some directed shark fisheries are large industrial practices, the majority of shark catches comes from small-scale primarily gillnet fisheries [19,54]. Chondrichthyan fisheries have substantially grown in developing countries over the past several decades. Developing countries' shark catches increased from 76,000 to 575,031 metric tons from 1950 to 2000 for a value in the year 2000 of USD 515 million [39,41]. From 1985 to 2000, elasmobranch catches reported to the Food and Agriculture Organization of the United Nations increased annually by an average of 2% [55]. However, actual elasmobranch catches are likely much higher than reported due to a lack of accurate data collection programs and to purposeful underreporting [51,56].

3 For instance, the International Commission for the Conservation of Atlantic Tunas, Inter-American Tropical Tuna Commission and North Atlantic Fisheries Organization have adopted legally binding measures to prohibit shark finning practices.

Results from this study reveal that there has been a large increase in the demand for shark fins and meat and catch of sharks over the past several decades [36,41,49]. For instance, shark catch by weight in Chile fisheries has increased an order of magnitude from about 1000 tons in 1950 to over 10,000 tons in 2005 [41]. Also, the shark catch in Peruvian fisheries and export market for frozen shark meat has grown, where the revenue from shark meat exceeds revenue from fins on a per-trip basis for a vessel in the Peru artisanal mahi mahi and shark longline fishery. From 2000 to 2005, exports of shark meat from Peru tripled, with main export markets including Uruguay, Spain, Brazil and Colombia [57]. The Japan component of this study has identified a trend in expanding demand for shark meat in a few regions in Japan where offshore and nearshore vessels land their catch as well as at several foreign seaports where distant water longline vessels land their catch, including Cape Town (South Africa), Callao (Peru), Las Palmas (Spain), Balboa (Panama), Cartagena (Venezuela) and Port Louis (Mauritius), and a concomitant increase in retention and landing of shark carcasses by the Japan longline fisheries. The shark meat landed in Callao, Cape Town and Las Palmas may be exported to European markets in Italy and Spain.

5.2. Ecological Concerns

There is an ecological basis for concern over shark interactions in pelagic longline fisheries. In the last decade, as elasmobranch catches have increased in both directed and incidental fisheries, there has been increasing concern about the status of some shark stocks, the sustainability of their exploitation in world fisheries, and ecosystem-level effects from shark population declines [4,19, 58-60].[4] Most shark species are predators at the top of the food chain and characterized by relatively late maturity, long life, slow growth, low fecundity and productivity (small and infrequent litters), long gestation periods, high natural survivorship for all age classes, and low abundance (K-selected life history strategies) relative to bony fish such as tunas and billfishes and to organisms at lower trophic levels [66]. Some shark species may also aggregate by sex, age and reproductive stage [37,67]. These life history characteristics make sharks particularly vulnerable to overexploitation and slow to recover from large population declines [20,67]. Directed shark fisheries in North America provide examples of overfishing and population declines, such as occurred in directed fisheries for the porbeagle (Lamna nasus) [68], soupfin shark (Galeorhinus zyopterus) [69], and spiny dogfish (Squalus acanthias) [70]. Also, for example, the lack of monitoring of primarily discarded bycatch of the barndoor skate (Dipturus laevis) in the western North Atlantic bottom trawl fisheries resulted in a large population decline [71].

The main threats faced by chondrichthyans are various fishing activities and habitat degradation and loss [72]. Reviews of assessments of the threatened status of sharks and related taxa undertaken to date indicate that the taxa at highest risk include commercially exploited species of deepwater sharks, species restricted to freshwater and brackish water habitats and coastal endemics whose entire range overlaps with fishing effort [73]. However, a lack of both fundamental biological information and fishery-dependent data for most shark species [67,71] means that there is a high degree of uncertainty in the status of these species. The biology of the chondrichthyan fishes is the least understood of all the major marine vertebrate groups, where detailed information on life history and reproductive dynamics is not available for all but a few of species important for directed fisheries [67]. There is a general lack of reliable and sufficiently detailed fishery-dependent data on shark species to enable sustainable management [71,74]. Pelagic longline fisheries operating on the high seas are not likely interacting with these shark species identified as highest-risk, while some coastal pelagic longline fleets could be catching at-risk coastal endemics.

4 Atlantic blue sharks are among those species reported to have undergone considerable population declines [58]. Consistent with previous arguments against treating CPUE as an index of abundance [61], the reported blue shark decline (~60% since 1986) postulated by Baum et al. [58] has been questioned by several authors (e.g. [62-64] on the basis that potential reasons for drops in CPUE aside from abundance declines were not accounted for, such as underreporting, changes in fishing grounds and changes in fishing gear such as not using wire leaders [65]. It is acknowledged, however, that the species has likely endured some level of decline in recent years [64-65].

In particular, blue sharks (Prionace glauca), the dominant species of shark caught in most pelagic longline fisheries operating on the high seas (e.g., [34,36]), are less vulnerable to overfishing relative to other shark species due to their being relatively prolific and resilient [75,76]. Blue sharks comprise the largest proportion of shark species caught in all 12 of the fisheries included in this study, ranging from 47% - 92% of shark catch in fisheries where this information is available. Kleiber et al. [77] conducted a stock assessment of blue sharks in the North Pacific and concluded that blue sharks are not being overfished in the North Pacific. However, more recent research by Clarke et al. [51] suggests that blue sharks globally are being captured at levels close to or possibly exceeding maximum sustainable yield. Clarke et al. [51] estimated global shark catches using shark fin trade records, and found that shark biomass in the fin trade is three to four times higher than shark catch figures reported by the Food and Agriculture Organization of the United Nations, which is the sole existing global database. Additional stock assessments for other pelagic sharks have been conducted only by the International Commission for the Conservation of Atlantic Tunas for blue and shortfin mako sharks in the North and South Atlantic.

5.3. Social Concerns

Shark finning, where fins from caught sharks are retained and the remainder of the carcass is discarded, raises the social issue of waste. This has received recent international and national attention (Section 4). Concern has also been raised that finning practices are cruel to sharks based on the presumption that fishers remove fins and discard sharks alive. However, results from this study document that, in all fisheries where shark finning occurs, to avoid injury and increase efficiency, crew first kill the fish before removing fins, and do not remove fins from live sharks . Also, discarded bycatch in general raises the social issue of waste [2,5], however, in the case of shark discards, available information suggests that in pelagic longline fisheries, shark post release survival prospects are high [50] and most sharks caught in pelagic longline fisheries are alive when hauled to the vessel [36].

6. Industry Attitudes

Table 3 summarizes predominant attitudes related to shark interactions held by fishers of 12 pelagic longline fisheries. The existence of restrictions on shark finning and shark retention limits (Table 2) has a large influence on industry attitudes towards shark interactions in the Australia, South Africa and Hawaii longline fisheries, where legal constraints have caused shark interactions to be an economic disadvantage. In these fisheries, fishers have a large incentive to avoid shark interactions. In the Italy longline fishery, despite a lack of market for shark products, low shark interaction rates result in low incentive to reduce shark interactions. The predominant attitude in the Fiji longline fishery towards shark interactions is unexpected. In this fishery, where almost all caught sharks are finned and carcasses discarded, fishers perceive that costs from shark interactions exceed the economic benefit. In the Chile, Japan and Peru longline fisheries, where restrictions on shark finning and retention are lacking, there is no incentive to reduce shark interactions, as revenue from sharks exceeds costs.

Table 3. Industry attitudes towards shark bycatch and depredation prevalent in each of 12 pelagic longline fisheries.

	Longline Industry Attitude								
Pelagic Longline Fishery	Want to minimize shark interactions due to time required to repair gear and discard sharks	Want to minimize shark interactions because revenue from catching sharks is exceeded by costs from shark interactions	Little incentive to reduce shark interactions because they are infrequent and result in nominal costs	Want to maximize shark catch because revenue exceeds economic costs from shark interactions	Want to minimize shark catch to avoid injuring crew when landing sharks from projectile swivels and shark bites	Want to minimize shark fishing mortality because are concerned with overfishing	Want to minimize shark catch to make more baited hooks available to more valuable fish species	Shark interactions are an expected and unavoidable part of longline fishing	No incentive to reduce shark interactions because revenue from sharks exceeds costs from shark interactions
Australia Tuna and Billfish Fishery	X	X			X		X	X	
Chile Artisanal Mahi Mahi and Shark Fishery				X					X
Chile Swordfish Fishery									X
Fiji Tuna Fishery	X	X							
Italy Mediterranean Industrial Swordfish Fishery			X						
Japan Distant Water, Offshore and Near-shore Tuna Fisheries			X					X	X
Peru Artisanal Mahi Mahi and Shark Fishery				X					X
South Africa Tuna and Swordfish Fishery	X	X					X	X	
U.S. Hawaii Tuna Fishery	X	X			X		X	X	
U.S. Hawaii Swordfish Fishery	X	X			X		X	X	

7. Industry Shark Avoidance and Discarding Practices

Table 4 identifies practices in use by longline fishers in response to shark interactions with longline gear. A practice is checked for a fishery only when it is employed predominantly for the purpose of addressing shark interactions, and not if the practice is employed primarily as a normal part of fishing operations to maximize catch rates of non-shark target species.

Fishers identified numerous fishing methods and gear characteristics that they employ to maximize catch rates of non-shark target species, which may contribute to reducing shark catch rates. For instance, the depth of baited hooks; timing of gear setting, soak and hauling; location of fishing grounds in relation to topographic and oceanographic features as well as sea surface temperature; type and size of bait and hook; selection of material for the leader on branch lines; use of lightsticks; and other fishing methods and gear designs selected to maximize non-shark target species catch rates may be effective shark avoidance strategies. More research is needed to improve the understanding of the shark avoidance efficacy of many of these practices.

7.1. Avoid peak areas and periods of shark abundance

In fisheries where there is an incentive to avoid shark interactions, common practices are to avoid areas known to have high shark abundance and move position when shark interaction rates are high and the non-shark target species catch rates are not particularly high. Because there is high spatial and temporal variability in shark catch rates (e.g., [78,79]), in addition to fishing gear characteristics, the location of fishing grounds to target non-shark species and perhaps the capability of a vessel captain to avoid areas where sharks are abundant appear to be important factors determining a vessel's shark catch rate.

Fishing position in relation to (i) certain sea surface temperatures, (ii) topographic features such as shelf breaks and sea mounts, and (iii) oceanographic features such as currents, fronts, and gyres, may affect shark interaction rates. Australian fishermen identified setting on the colder side of fronts in order to reduce shark catch levels. Catch rates of blue sharks have been found to decline by 9.7-11.4% in response to only a 0.6o C increase in sea surface temperature [25]. Not surprisingly, it has also been shown that blue sharks tend to prefer sub-surface depths that possess cooler temperatures (e.g. [80]). However, more comprehensive studies on blue shark distribution according to full water column temperature profiles and thermocline dynamics are necessary before amending fishing practices in accordance with patterns in sea-surface temperatures.

7.2. Reduce shark detection of baited hooks

Very few interviewed fishers believe that refraining from chumming during the set and refraining from discarding offal and spent bait during the haul will affect shark interactions. Chumming during setting is not a common practice. Offal and spent bait are typically discarded during hauling operations. Many respondents explained that it would be impractical to retain spent bait and offal to discard at the end of hauling due to limited space. Some Australian fishers avoid using lightsticks because they believe lightsticks increase shark catch rates.

Table 4. Prevalent industry practices employed to address shark interactions in 12 pelagic longline fisheries.

	Pelagic Longline Fishery									
Practice	Australia tuna and billfish fishery	Chile artisanal mahi mahi and shark fishery	Chile sword-fish fishery	Fiji tuna fishery	Italy Medi-terr-anean industrial swordfish fishery	Japan distant water, offshore and nearshore fisheries	Peru artisanal mahi mahi and shark fisherys	South Africa tuna and swordfish fishery	U.S. Hawaii tuna fishery	U.S. Hawaii swordfish fishery
Move position if shark interactions are high and target species CPUE is low	X		X	X			X	X	X	X
Avoid fishing grounds with high shark abundance from past experience or communication from other vessels	X			X		X			X	X
Reduce shark detection of baited hooks										
Set gear deeper	X									
Use or avoid type of bait or hook	X									
To discard sharks, cut branch line or remove hook by making cut in shark mouth	X				X			X	X	X
No wire trace to reduce retention of sharks	X									
Do not use lightsticks	X									
Avoid setting in specific sea surface temperature	X									
Set during daytime	X									
Minimize gear soak time	X									
Kill sharks before discard-ing to avoid re-catching	X									
Do nothing to reduce shark catch because shark catch is desirable or shark interactions are rare		X			X		X			

7.3. Reduce shark catch rate through deeper setting, leader material and type of bait or hook
Some fishers avoid using certain types of bait to reduce shark interactions, or perceive that avoiding certain bait types will reduce shark capture rates (e.g., Italy and Japan, avoid squid; Australia, avoid oily pilchard and squid). Few fishers believe that hook shape has a large effect on shark catch rates. Furthermore, some fishers indicated that they set their gear at a certain depth or perceive that setting deeper would contribute to reducing shark interactions.

Most fishers believe that the depth of baited hooks and timing of the gear soak influence shark catch rates. The deployment depth of hooks and timing of the soak and haul (day versus night) can have an influence on fish species CPUE, including sharks, perhaps due to different water temperature preferences by each species [36,81,82]. For example, Rey and Munoz-Chapuli [82] found higher mako shark (Isurus oxyrinchus) CPUE on shallower set hooks, and no mako capture on the three deepest hooks in a basket, which were estimated to be set to between 370-460 m deep, in a Spanish tropical eastern Atlantic surface longline swordfish and mako shark fishery. Williams [36] found that main pelagic shark species, with the main exception being the mako sharks, tend to be taken at a higher rate in more shallow-set gear than vessels setting gear deeper in central and western Pacific pelagic longine tuna fisheries. Blue shark, silky shark, pelagic stingray, and oceanic whitetip CPUE were 2.7, 6.4, 1.1, and 2.8 times higher, respectively, in shallow vs. deep set gear. Setting baited hooks below a threshold depth may reduce bycatch and depredation by certain species of sharks in certain areas, but shark interaction rates may also depend on when it is that the hooks are at these depths.

One fisher in the Hawaii-based longline tuna fishery tried various types of artificial baits to determine their ability to catch target species and to reduce shark capture. He found that the artificial baits did not catch tuna well and that they were not durable enough as he lost about 90% of the artificial baits after one trip. One fisher in the Peru artisanal mahi mahi and shark longline fishery tried an artificial bait, which did not reduce shark interactions. An artificial bait was tested in the Alaska demersal longline sablefish (Anoplopoma fimbria) and Pacific halibut (Hippoglossus stenolepis) fishery. Results indicated that the artificial bait caught as many or more target species and reduced bycatch of spiny dogfish shark (Squalus acanthias), skate (Raja spp.), arrowtooth flounder (Atheresthes stomias), and Pacific cod (Gadus macrocephalus) by more than ten times compared to a control of fishing with herring bait, the conventional bait used in this fishery [83].

The type of hook and natural bait used might affect shark CPUE and depredation rates [9,36]. Results from controlled experiments in the Azores and U.S. North Atlantic longline fisheries indicate that fishing with fish instead of squid for bait causes a significant decrease in shark CPUE, while using a wider circle hook instead of a narrower J hook may cause a significant but small increase in shark CPUE. Research in the Azores longline swordfish and blue shark fishery, during a year when blue sharks were not being targeted due to low market demand, found that non-offset 16/0 circle hooks had a significantly higher blue shark CPUE than a non-offset 9/0 J hook [84]. In another study in the Azores fishery, during a year when blue sharks were being targeted, non-offset 16/0 and non-offset 18/0 circle hooks caught significantly more blue sharks than a non-offset 9/0 J hook [85]. A study conducted in the U.S. North Atlantic longline swordfish fishery found that a non-offset and 10o offset 18/0 circle hook with squid bait resulted in a small but significant increase in blue shark CPUE (8% and 9% increases, respectively) compared to a 9/0 J hook with squid [25]. Watson et al. [25] also found that a 10o offset 18/0 circle hook with mackerel bait and a 9/0 J hook with mackerel bait resulted in a significant and large reduction in blue shark CPUE by 31% and 40%, respectively, compared to a 9/0 J hook with squid. Research in an experimental Japanese North Pacific longline fishery found no difference in the capture rate of blue sharks between a circle and Japan tuna hook [86,87].

An assessment of observer data from the Hawaii-based longline swordfish fishery is consistent with results from these controlled experiments [9]. Shark combined species CPUE was significantly lower by 36% after regulations came into effect, which required the fishery to switch from using a 9/0 J hook with squid bait to using a 10o offset 18/0 circle hook with fish bait [9].

Retention of sharks on branch lines with wire leaders or other durable material is substantially higher than in gear where nylon monofilament is connected directly to the hook (Section 4) (e.g., [36]). Several fishermen who target sharks seasonally use a wire leader when they wish to maximize their shark catch rates and do not use a wire leader when they are targeting non-shark species. Avoiding certain material for branch lines could also reduce shark depredation and catch rates. For instance, the use of rope/steel ("Yankee") gangions resulted in lower juvenile sandbar shark catch rates than when using monofilament gangions [88]. In another study, percent-capture of blue shark with the use of monofilament gangions (66%) exceeded that when employing multifilament gangions (34%) [89]. Shortfin mako shark catches adhered to the same pattern (60% and 40%) for 'mono' and 'multi' line, respectively. Stone and Dixon [89] hypothesized that the aversion to the multifilament gangion was a function of strong visual acuity.

7.4. Shark Discard Practices

A large proportion of pelagic shark species are alive when gear is retrieved (Section 3), suggesting that improved shark handling and release methods may reduce fishing mortality of discarded sharks. While some fishers report routinely killing caught sharks to retrieve terminal tackle and to avoid the inconvenience of recapture, empirical information from Australia, Hawaii and Peru show that a very small proportion of caught sharks that are alive when hauled to the vessel are killed before discarding. When a caught shark is discarded, the majority of fishers indicate that most of the time they cut branch lines, cut the hook out of the shark's mouth with a knife or pull the hook out by force in order to retrieve the terminal tackle before discarding the shark. It is uncommon for fishers to kill a shark to retrieve terminal tackle or to prevent future shark interactions.

The survival of sharks that are not finned, that are deeply hooked (where the shark has swallowed the hook) and have hooks removed by fishers pulling the hook out likely depends on where they were hooked and how much damage is done by pulling out the hook. For deeply hooked sharks, as is believed to be the case for sea turtles [9,10], prospects for post release survival might be improved by having fishers cut the line as close to the shark as safely possible. A large proportion of sharks caught in longline gear that is released after removal of the hook from the mouth are expected to survive. Research using pop-up satellite archival tags found that 97.5% of pelagic sharks released after capture in longline gear survived (1 of 40 captured sharks died), while another study found that 94% of 17 tagged shorfin mako sharks survived beyond two months after release from being caught in longline gear [50]. While shark post-release survival prospects are high, and while many fishers do not see a need for new hook removal methods, development of especially designed equipment to discard sharks could improve shark post release survival prospects, reduce the loss of terminal tackle and improve crew safety.

None of the interviewed pelagic longline fishermen use dehookers to discard live sharks. Only two fishers, one from the Chile artisanal mahi mahi and shark longline fishery and one from the Peru artisanal mahi mahi and shark longline fishery, report that they use a dehooker to recover hooks from sharks when these are onboard and already dead. Most fishers perceive commercially available de-hooker devices to be impractical and potentially dangerous for use with sharks. Some caught sharks will twist and spin when hauled to the vessel, which could cause the dehooker to be lost overboard and be a hazard for crew to handle before being lost overboard. Because sharks may be on the sea surface when being hauled, some fishers were concerned that the incidence of having branch lines break if a shark pulls the line would increase with use of a dehooker because use of a dehooker requires bringing the shark close to the vessel.

8. Promising New Strategies for Shark Avoidance

8.1. Shark Repellents

For fisheries with an incentive to reduce shark interactions, chemical, magnetic, electropositive rare earth metal and electrical repellents are promising shark deterrents. Some of these strategies are concepts requiring substantial investment to develop the technology for application in longline gear. Research and commercial demonstrations are needed to assess their efficacy at repelling sharks and effects on target and incidental species. Research and development is also needed to reduce the per-unit cost of these repellents to make them economically viable for use in pelagic longline fisheries.

Chemical deterrents, including a protein extract called 'pardaxin' from an excretion from the moses sole (Pardachirus marmoratus), sodium and lithium lauryl sulfate (components of common soap and shampoo) and sodium dodecyl sulfate, a related compound, have been found to repel some species of sharks under certain conditions [90]. Some fishers from the Peru artisanal mahi mahi and shark fishery report retain all shark offal until the end of a haul because they believe that discharging offal during the haul would repel sharks and reduce their shark catch rate. The U.S.-based company Shark Defense LLC has identified a semiochemical-based shark repellent, which in preliminary trials caused six shark species to leave an area after the chemical was disbursed without repelling teleost fish [91]. Presumably, this can be ascribed to an apparent aversion in sharks to certain chemicals, including ammonium acetate (a major component in decaying shark flesh) and other semiochemicals emitted from predators [92]. When mixtures of semiochemicals were introduced into feeding aggregations of sharks and teleost fish in reef habitat, sharks quickly left the feeding area while bony fish stayed in the area and continued feeding [50].

A preliminary study was conducted by the U.S. National Marine Fisheries Service Pacific Islands Fisheries Science Center in Hawaii in early 2005 to compare the catch of target species and sharks in sets using bait injected with synthetic shark semiochemicals produced by Shark Defense LLC to catch rates in sets using untreated bait. Results were inconclusive, in part, because the research design prevents conclusions to be drawn on the single factor effect of the presence or absence of semiochemicals in the bait, and because it was not possible to confirm that bait injected with semiochemicals retained the chemical throughout the gear soak [50].

Since conducting this 2005 trial in Hawaii, the chemical is now available in a hydroxypropyl cellulose and glycol ether ester gel matrix [91]. In current ongoing trials the gel is placed in biodegradable, porous muslin bags filled with 100 ml of the gel at 30.5 cm above a bait. The gel has been observed to dissolve evenly over an 8-hour period while the fishing gear soaks. The gel could also be syringed directly into a bait or a bag of the gel could be stuffed into a bait [91]. One bag filled with 100 ml of the gel matrix would cost about USD 1.05. Pre-treated baits may be a less expensive option.

Shark Defense is also conducting preliminary trials of neodymium-iron-boride ($Nd_2Fe_{14}B$) magnets as a possible shark deterrent in longline gear. It is hypothesized that a 10 cm x 4 cm NdFeB magnet's field would be effectively detected by sharks up to a 0.3 m range. Preliminary research conducted in 2005 on the effect of $Nd_2Fe_{14}B$ magnets by the Inter-American Tropical Tuna Commission on captive yellowfin tuna and by the University of Miami on cobia indicates that the presence of the magnet versus a control produced no significant difference in feeding behavior [91]. Preliminary research in a demersal longline fishery in the Bahamas is underway. A 2.5 cm x 2.5 cm $Nd_2Fe_{14}B$ nickel-coated cylinder with a center bore costs about USD 300 for 100 magnets.

SharkDefense is also exploring the shark deterrent efficacy of electropositive metals (e.g. Neodymium, Praseodymium, early Lanthanide metals, Mischmetal, and Magnesium). These metals, which are also present in rare earth magnets, may be responsible for some of the repellency effect seen with permanent magnets and present a more practical alternative to the magnets. A correlation has been found between standard oxidation potential of these metals and their behavioral response using immobilized sharks [91].

An electrical shark avoidance device was tested in a coastal midwater trawl fishery in the Sea of Japan (Ishikawa Prefecture) in 2004. The purpose of the device was to deter predation by sharks on the cod end of the trawl during hauling. The device, mounted on the fishing vessel, emitted an electrical pulse into the waters in the immediate vicinity. It was believed by fishermen to be effective based on qualitative observations of sharks suddenly moving away from the cod end and the vessel once the electrical pulse was emitted.

The Shark Protective Ocean Device is a device designed to be worn by scuba-divers that emits an electrical field with a radius of 4-6 m to repel sharks from divers. The device costs about USD 700. This technology theoretically could be modified to deter sharks from foraging on bait and catch on longline hooks.

Acoustic deterrents may reduce shark-longline interactions, but have not been tested in longline fisheries for any shark species.

8.2. Hotspot Avoidance through Fleet Communication and Protected Areas
The distribution of sharks, as well as other species groups such as seabirds, sea turtles and cetaceans, is often unpredictable, and may be spatially contagious or aggregated. Consequently, fleet communication programs may be employed by a fishing industry to report near real-time observations of hotspots to substantially reduce fleet-wide depredation and bycatch of sharks [11]. In addition, fleet coordination of daily fishing positions and times, a current practice in many fleets, may minimize per vessel shark interaction levels relative to vessels that fish in isolation [11].

Area and seasonal closures can also contribute to reducing shark-longline interactions. Establishing protected areas within a nation's Exclusive Economic Zone is potentially a expedient method to reduce shark-longline interactions. However, establishing and managing high seas marine protected areas to protect sharks, which would require extensive and dynamic boundaries and extensive buffers, may not be a viable short-term solution. This is due in part to the extensive time anticipated to (i) resolve legal complications with international treaties, including creating legally binding mechanisms for multilateral designation and management of high seas protected areas;[5] (ii) achieve international consensus and political will; (iii) provide requisite extensive resources for surveillance and enforcement, in part, to control illegal, unreported and unregulated fishing activities; and (iv) improve the scientific basis for designing high seas marine protected areas, which can be effective at reducing shark interactions only where the location and times of occurrence of shark hotspots are known and predictable. However, establishing and managing a representative system of protected area networks on the high seas to contribute to the management of interactions between marine capture fisheries and highly migratory sensitive species groups, including sharks, may eventually be realized.

5 It is already possible to establish high seas MPAs for discrete areas by agreement by individual countries. However, there remains a need for an international framework with specific language to identify the criteria to establish a representative system of high seas MPA networks, and management and enforcement measures for the individual MPAs. Several RFMOs are updating their scope and legal mandate to include ecosystem-based management and biodiversity conservation under the auspices of the Fish Stocks Agreement. The Commission for the Conservation of Antarctic Marine Living Resources has made some preliminary progress towards establishing a system of MPAs in the Southern Ocean.

Consequences of establishing a protected area need to be carefully considered, as resource use restrictions of a marine protected area may displace effort to adjacent and potentially more sensitive and valuable areas, where weaker management frameworks may be in place [58,93]. Also, measures adopted by regional fishery management organizations and other international bodies are only binding to parties to the Convention that established the organization, and will not control activities by non-party States. Thus, another consideration for employing high seas marine protected areas to manage problematic fisheries bycatch is that closing areas to fisheries only of party States could result in increased effort in this area by fleets from non-party States with fewer or no controls to manage bycatch, exacerbating the problem for which the MPA was established to address.

9. Conclusions

Incentives for pelagic longline fishers to reduce shark interactions vary along a continuum, based on whether sharks represent an economic disadvantage or advantage. On one extreme, there are pelagic longline fisheries with a regulatory framework limiting shark catches or placing restrictions on shark handling, or lack of markets for shark products, resulting in negligible retention of sharks. In these fisheries, the costs from shark interactions exceed benefits from revenue from sharks. On the other extreme, there are pelagic longline fisheries where revenue from sharks exceeds costs from shark interactions, a large proportion of caught sharks are retained, and sharks are either always an important target species, are targeted seasonally or at certain fishing grounds proximate to ports where there is demand for shark products, or are an important incidental catch species.

In fisheries where there is an incentive to avoid shark interactions, predominant shark avoidance practices are to:

(i) Avoid fishing in areas known to have high shark interactions; and
(ii) Change fishing grounds when shark interactions are high but the target species catch rate is low.

Longline fishers identified numerous fishing methods and gear characteristics that they conventionally employ to maximize catch rates of non-shark target species, which may contribute to reducing shark catch rates. For instance, experimental trials have shown that using fish instead of squid as bait results in a significant and large decrease in shark catch rates [25,84,85]. Also, deeper setting helps reduce catch rates of most pelagic shark species [36]. Research is needed to improve the understanding of the shark avoidance efficacy of some of these other practices.

Beyond these strategies, the state of knowledge for shark avoidance in pelagic longline fisheries is poor. Chemical, magnetic, electropositive rare earth metals and electrical shark deterrents hold promise. Research is needed to assess their efficacy at repelling sharks, effect on target species catch rates and reduce the cost for commercially viable employment in longline fisheries. Fleet communication programs and marine protected areas also hold promise to reduce unwanted shark-longline interactions.

A large proportion of pelagic shark species are alive when gear is retrieved. Most sharks that are alive when hauled to the vessel and will be discarded are released alive. When a caught shark is discarded, most of the time fishers either cut branch lines, cut the hook out of the shark's mouth or pull the hook out by force in order to retrieve the terminal tackle before discarding the shark. It is uncommon for fishers to kill a shark to retrieve terminal tackle or to prevent future shark interactions. Most fishers perceive commercially available de-hooker devices to be impractical and potentially dangerous for use with sharks. Development of especially designed equipment to discard sharks could improve shark post release survival prospects, reduce the loss of terminal tackle and improve crew safety. In fisheries where shark finning occurs, to avoid injury and increase efficiency, crew first kill the fish before removing fins, and do not remove fins from live sharks.

The Japan, Chile and Peru components of this study documented growing markets for shark meat at several ports worldwide. This trend toward more utilization of shark meat may be beneficial in the short term in that fully utilized sharks are more likely to be reported in logbooks and landings statistics than are the retention and landing of just shark fins. However, if the shark meat market continues to grow, this could increase shark catch rates and fishing mortality. This study shows that fishers possess the knowledge to modify their fishing gear and methods to maximize shark catch. There are few fisheries with measures to manage shark catch levels. Thus, to prepare for a possible increase in demand for shark meat fishery management authorities are encouraged to institute data collection, monitoring and precautionary management measures to ensure that shark catches are sustainable.

Most national fishery management authorities of the 12 fisheries included in this study demonstrate a low priority for monitoring and managing chondrichthyan fishes, consistent with the results of a global review by Shotton [74]. Few regional fishery management organizations are using fishery-dependent data to conduct shark stock assessments (only the International Commission for the Conservation of Atlantic Tunas, for blue and shortfin mako sharks in the North and South Atlantic). Sustainable management of chondrichthyan populations is hampered by this general lack of fishery-dependent data and management measures for sharks [71]. The expanding exploitation of sharks, for their fins as well as meat, largely in the absence of management frameworks and the lack of reliable fishery-dependent data and fundamental understanding of the biology of most shark species' warrant concern for the health of shark populations as well as ecosystem-level effects from population declines. Approaches to sustainably manage cartilaginous fishes will necessarily differ from traditional fishery management methods for teleosts due to cartilaginous fishes' relatively low reproductive potential [72].

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Tuesday, November 13, 2007 - 16:15

Cetacean Interactions in Longline Fisheries, Industry Attitudes and Practices, and Mitigation Methods

Session Co-Chairs: Paul Dalzell, WPRFMC
Dr. Eduardo Secchi, Fundacao Universidade Federal do Rio Grande

Presentations: Tom Nishida, National Research Institute of far Seas Fisheries, Japan, Report of the IOTC tuna Longline Depredation Workshop
Geoff McPherson, OceanWatch Australia Ltd
T. Aran Mooney, University of Hawaii, Acoustic Deterrents Reduce False Killer Whale (Pseudorca crassidens) Echolocation Abilities, but only so much

Martes 13 de noviembre del 2007 - 16:15

Interacciones cetáceas en pesquerías de palangre, Actitudes de la industria, prácticas y métodos de mitigación

Dirigen la sesión: Sr. Paul Dalzell, WPRFMC y Dr. Eduardo Secchi, Fundação Universidade Federal do Río Grande.

Presentaciones: Tom Nishida, Instituto Nacional de Investigación de pesquerías de mares lejanos, Japón, Reporte de la IOTC del Taller de Trabajo de depredación de pesca de palangre de atún.
Geoff McPherson, Ocean Watch Australia Ltd.
T Aran Mooney, Universidad de Hawaii, Acoustic Deterrents reduce false Killer Whale (Pseudorca crassidens) Echolacation Abilitéis, but only so much.

Approaches to mitigation of toothed whale depredation on the longline fishery in the eastern Australian Fishing Zone

Geoff McPherson1, Craig McPherson2, Phil Turner2, Owen Kenny2, Andrew Madry3, Ian Bedwell4, Gary Clarke5 and Dave Kreutz6.

(1Marine Acoustic Biodiversity Systems, 2Electrical Engineering James Cook University, 3Madry Technologies, 4Thales Underwater Systems, 5RSM Systems and 6SeaNet (Australia.)

In the Coral Sea, short-finned pilot whales and false killer whales are the main species responsible for depredation. Recognising that there would be no single effective method to provide relief from depredation, a range of strategies are under continual development. Early International depredation mitigation Symposia were directed more to marine mammal conservation with little focus to the fishing industry. However, recent Symposia such as the October 2006 Pender Island Symposium and the July 2007 IOTC Depredation Symposium, and initiatives of the Western Pacific Regional Fishery Management Council have placed more attention toward the capability of the fishing industry to cope with depredation.

Risks to depredating toothed whales should be minimised; however, depredation should also be considered in the light of possible marine mammal population enhancements using appropriate Ecosystems Modelling analyses. Fisheries agencies are increasingly considering cryptic mortality from depredation into target fish mortalities and quotas, while the July 2007 IOTC Symposium considered the ecosystem effects of depredation.

This project evolved a dual mitigation strategy utilising acoustic techniques to avoid depredation on a broad scale, and to minimise the problem on a close-in scale. Techniques are still under development for toothed whales in the longline fishery, other techniques trialled have evolved for use into other fisheries where depredation and bycatch are of concern and the techniques have proved to be more effective for those species involved.

Avoidance strategy

To meet depredation avoidance objectives, two variants of acoustic localisation of vocalising toothed whales were achieved. The initial system was developed to localise whales in 3D space using two totally different acoustic sound types such as social whistles associated with depredation (3DLOC; Craig McPherson, Phil Turner, Owen Kenny and Geoff McPherson) and hunting echolocation clicks (Sonamon©; Andrew Madry). Both systems were best suited to monitoring toothed whales swimming close around gear and although feasible for indicating bearings to toothed whale concentrations, the range of detection likely to be in the order of 10 km was insufficient to provide an effective mammal standoff capability for the longline industry and suffered from logistical issues associated with effective hydrophone deployment from commercial fishing vessels. Sonamon© offered feasible and real-time tracking capability for sperm whale clicks from fishing vessels. Both 3DLOC and Sonamon© now offer near real-time capability at ranges to detect whales before whales detected vessels, and are being utilised to track small toothed whales around sardine purse seine nets in South Australian waters .

The project variant best suited to longline fishing operations is the toothed whale depredation proximity detection system proposed by RSM Systems (Gary Clarke of RSM Systems, Geoff McPherson and Dave Kreutz). Radio direction finding buoys used to locate segments of longline gear have been experimentally fitted with acoustic sensors to detect the presence of vocalising toothed whales within a pre-established radius of longline segments and transmit the information to the fishing vessel utilising modified RDF hardware in order that a fishing master could take appropriate action to avoid depredation during all stages of longline setting and hauling to minimise losses. Sounds associated with toothed whale depredation are likely to be broadly species specific, however, with minimal ground-truth data and given the acoustic processing data modifications essential to permit transmission of sounds up to 100 nmiles, species vocalisation differences are considered to be minimal for proximity detection.

Minimisation strategy
To meet depredation minimisation objectives, active and passive acoustic mitigation methods were trialled.

An acoustic pinger (Seamaster, Taiwan) at <2 kgs in weight evoked a range of avoidance reactions with toothed whales around longline fishing gear. With industry assessed results suggesting an extremely short range of effectiveness, the device has further evolved toward a signal output that has an immediate effect of keeping bottlenose dolphins from purse seines, and with further development is demonstrating required responses from common dolphin.

Japanese observations (Tom Nishida, Japan Fisheries) and those of Australian domestic fishermen have been that fish entangled in fishing gear are invariably spared depredation though species differences of prey hook-up and marine mammal species involved complicate this assessment. A passive acoustic depredation mitigation system (Geoff McPherson and Ian Bedwell) based on combinations of fishing gear components with high target echo strength to mammal biosonar is being trialled to induce uncertainty into the terminal echolocation stages of depredating toothed whales. The system device is as much a visible deterrent to depredation as it is a reflector of toothed whale echolocation clicks designed to highlight potential threats to depredation behaviour. Deployment of depredation mitigation gear (when required) to longline scale hook type numbers is the greatest challenge. The system offers a logistically simpler method for longline operation than the physical 'sock or cone' protection methods under consideration from demersal fishing operations effected by depredation. The ability of individual vessels to construct potential gear components that would suit their operation, and the basis for their function, was discussed.

Appreciation is extended to the US Western Pacific Regional Fisheries Management Council in Hawaii, Australia's Fisheries Research and Development Corporation and Australia's east coast longline fishermen for support and encouragement.

KEYWORDS: Longline, toothed whales, false killer whales, short-finned pilot whales, depredation, mitigation, acoustics.
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Acoustic deterrents reduce false killer whale (Pseudorca crassidens) echolocation abilities but only so much

T. Aran Mooney, Paul E. Nachtigall, Aude Pacini, and Marlee Breese
Department of Zoology and Hawaii Institute of Marine Biology
University of Hawaii

Throughout the central Pacific, false killer whales, (Pseudorca crassidens), are known to remove, or depredate, tuna from longlines within longline fisheries. This has become a serious issue for two reasons. First, the extent of fish removed from longlines is costly and decreases take of longline fisherman. This has obvious economic impacts on the tuna longline fisherman of the region. The second concern regarding false killer whale depredation is these odontocetes are often incidental catch or bycatch within longline fisheries. Because relatively little known about size and status of false killer whale Pacific stocks, removal of animals has been considered deleterious to the stocks and based on current estimates, incidental take currently exceeds what is considered sustainable. Thus, for both economic and biological reasons, mitigation and reduction of false killer whale depredation within longline fisheries has been deemed necessary.

One method shown to reduce odontocete depredation and bycatch has been acoustic deterrents. These devices typically emit a sound designed to alert marine mammals of the presence of fishing gear and potentially drive them from the area. Acoustic deterrents have been hypothesized to work in tuna longline fishing by potentially driving false killer whales from the location where the lines are set or hauled in, and thus reduce false killer whale depredation. We tested an acoustic deterrent device that was designed in such as manner but was also recommended, by the manufacturer, to reduce false killer whale echolocation abilities as well, making it difficult for the whales to detect and remove the tuna from longlines. We investigated this device, known as the SaveWave Long Line Saver, to determine:

1) What are the actual acoustic characteristics of this Long Line Saver?
2) Does it actually disrupt or reduce the echolocation abilities of a false killer whale while it is echolocating?
3) Might this be an effective product to test in the field in reducing false killer whale depredation and bycatch rates? Does this equipment hold sufficient promise to warrant the expenditure of additional funds in a real-life fishing situation?

Methods

In order to determine the acoustic characteristics of the Long Line Saver, baseline measurements were conducted in the open water of Kaneohe Bay and recording the sound produced in water with a calibrated recording hydrophone and acoustic recording equipment.

We also evaluated the performance of a false killer whale to echolcate and detect a know target with and without the Save Wave device on in the water. To do this we use Kina, a false killer whale housed at the Hawaii Institute of Marine Biology, previously trained in echolocation tasks. Kina was trained to station in a hoop, echolocate, and if she detects a cylinder target, hits a paddle. If there is no cylinder was detected she was to stay still. We then evaluated the animal's detection performance of the cylinder target with and without the Long Line Saver playing sounds. During the initial echolocation task, both the Long Line Saver and the cylinder target were placed 8 m (26.25 ft) from Kina. In a follow-up experiment, we moved the Long Line Saver 40 m (131 ft) from the animal but kept the cylinder target and animal in the same position. All experimental sessions and animal behavior were recorded by notes and video tape.

Results and Discussion

Kina's baseline performance level to detect a standard cylinder was 96% correct on a standard 50 trial session. Initially, when the Long Line Saver as turned 'on' her performance dropped to chance (50%). The device was then turned off for a session and the whale's performance immediately recovered to her normal baseline standard near 100%. Because of these initial results we changed the design to incorporate the SaveWave within the session. We ran 4 sessions: Each 60 trial session was made up of: 15 trials no sounds, 20 trials SaveWave on, 15 trials no sound. We got the same sort of performance on the first session. Good baseline performance, bad performance with sound on, good performance with sound off. She showed some improvement, but was no longer improving at the fourth session. On the last two of the four sessions her performance was:

100% sound off
80% sound on
100% sound off.

So, it would appear as though the SaveWave disrupts our very practiced false killer whale's echolocation. We measured both spectral and intensity characteristics of the sound before presenting it to our whale. We also measured the device two additional times to see whether the sounds were changing. The device produced a variety of upward and downward frequency sweeps that are very loud which were up to 160 dB re: 1 μPa peak energy.

So our question then was what is the disruptive effect caused by? Is it caused by a masking effect of loud sound? If it must be loud to have the effect, then if it is to be used by the fishermen, it must also have some limitations. So, we hung the device about 40 meters away to dramatically lower the intensity of the sound and did an entire session with the sound on. We found that it did not disrupt the animal at all. Her performance was at 100%. It was obviously much quieter.

There are two concerns about sound intensity and these devices: (1) If sound intensity is important, and it appears to be, the devices must be loud, and close by, to operate to disrupt whale echolocation, and (2) the sound intensity of the device itself appears to decrease with time (perhaps due to battery drainage?). Given that the sound decreased across time we do not know whether our whale was adapting her performance to the sound or if the sound level itself was decreasing. Either may have caused the change in the whale's performance from near chance up to 80 %.

We find these results very intriguing because there seems to be some decrease in echolocation performance due to the SaveWave Long Line Saver device. It would be important to tease out the differences between adaptation and intensity. If the animals adapt to the sound and just continue on then the device has a limited effect. If the sound is in fact decreasing in intensity across time and the whale is therefore improving because there is just less sound, then a fully charged sound source may have a stronger effect without the 'difficulty' of adaptation.

Wednesday, November 14, 2007 - 8:30

Approaches to Reduce Bycatch: Initiatives to Promote Bycatch Experimentation and Industry-lead Initiatives

Session Co-Chairs: Sean Martin, Hawaii Longline Association
Steven Kennelly, Australia New South Wales Department of Primary Industries

Presentations: Tim Werner, New England Aquarium, Consortium for Wildlife Bycatch Reduction, Science-Industry Approaches to Bycatch Reduction in Non-targeted Species
Dr. Hiroshi Minami, National Research Institute of Far Seas Fisheries, Japan, OPRT Grant Program for Distributing Circle Hooks to Japanese Longline Fishers
Robin Davies, WWF-International, The International Smart Gear Competition – Inspiring Innovation by Capitalizing Creativity

Miércoles 14 de noviembre del 2007 - 8:30

Acercamientos para reducir la captura incidentales: Iniciativas Para promover la experimentación sobre captura incidentales Y el rol de la industria

Dirigen la sesión: Sean Martin, Asociación de palangre de Hawai,
Steven Kennedly, Departamento de Industrias Primarias de Ballenas del Nuevo Sur de Australia.

Presentaciones: Tim Werner, Acuario de Nueva Inglaterra, Asociación para la reducción De la captura de la vida salvaje. Ciencia Industria Acercamientos para reducción en especies no apetecibles.
Dr. Hiroshi Minami, Instituto de Investigación de pesquerías de mares Lejanos, Japón OPRT Programa para la distribución de círculos de anzuelos para las pesquerías de palangre en Japón.
Robin Davies, WWF- Internacional, Competencia Internacional de Equipo Inteligente – Inspiración para innovación por Capitalizing Creativity.

Science-Industry Approaches to Bycatch Reduction in Non-target Species.

Timothy B. Werner, Senior Scientist, and Director, Consortium for Wildlife Bycatch Reduction, New England Aquarium, Central Wharf, Boston, MA, USA.
Email: twerner@neaq.org.

Changes in fishing methods intended to reduced bycatch generally result from pressures exerted on the industry from outside agents, though examples in which fishermen have taken the initiative to develop effective techniques also exist. In the northwest Atlantic, as in many parts of the world, the two main agents pursuing fishing reforms are government fisheries agencies and environmental organizations. The Consortium for Wildlife Bycatch Reduction, a partnership between scientists and the fishing industry, is engaged in a different model in which fishermen, engineers, and marine biologists collaborate in the research and development of techniques to reduce the bycatch of threatened non-target species. The inspiration for this model was an informal regional collaboration among fishermen and scientists during the 1990s that first developed and evaluated acoustic pingers as a deterrent to harbor porpoise bycatch in gillnets. It also builds on the observation that some changes to fishing methods can simultaneously reduce bycatch while providing other incentives (e.g., reduced cost or increased target catch) to the industry. The projects that the Consortium administers fall within three categories: (1) Understanding interactions between threatened non-target species and fishing operations; (2) Research and development of bycatch reduction approaches; and (3) Facilitating global exchange of information on bycatch reduction technologies. The Consortium has focused primarily on two types of gear: fixed (gillnets and pot fisheries) and longlines. The non-target species bycatch of principal concern include large whales (mainly the North Atlantic right whale, Eubalaena glacialis), pilot whales (Globicephala macrorhyncus and G. melas), sharks, and sea turtles. Among the innovative devices undergoing evaluation are fishing lines that have increased visibility to cetaceans underwater, and sinking groundlines that are more durable than what is currently available in the marketplace. During its annual meeting and periodic gear workshops, bycatch experts from around the world convene in Boston, USA to exchange information on what techniques are proving effective, and which are not. Participants at these events also contribute to defining critical research priorities in bycatch research. As a result of this international collaboration, a catalogue of studies in bycatch reduction has been compiled and is being migrated to the worldwide web as a searchable database. Although the strategic approach of the Consortium has some inherent challenges in carrying out its bycatch reduction objectives, its direct involvement of fishermen increases the probability of developing fishing methods that are practical and carry industry incentives to promote their sustained use.

Consortium Members:
Blue Water Fishermen's Association
Duke University (http://moray.ml.duke.edu/faculty/read/)
Maine Lobstermen's Association (http://www.mainelobstermen.org/)
New England Aquarium (www.neaq.org)
University of New Hampshire (http://www.unh.edu/oe/)

The International Smart Gear Competition: Inspiring Innovation by Capitalizing Creativity

Robin Davies, WWF-International

WWF's International Smart Gear Competition awards cash prizes for innovative ideas to make fishing more selective. The competition is intended to inspire, reward and promote practical fishing gear designs to reduce fisheries bycatch and to encourage creative thinkers everywhere to share their ideas. Now in its third year, the competition continues to draw significant attention and received 70 entries from 22 countries. The first competition drew 50 entries from 16 countries; the second drew 83 from 26 countries. Entrants have included fishermen, students, gear technologists, engineers, chemists, and inventors. Entries are judged by an international panel made up of gear technologists, fisheries experts, seafood industry representatives, fishermen, scientists, researchers and conservationists. WWF and our Smart Gear Partners invite you to visit www.smartgear.org to learn about winning ideas and the 2007 Competition!

Wednesday, November 14, 2007 - 9:15

Development of Incentives: The Role of Seafood Retailers and Eco-Labels on Bycatch Mitigation

Session Co-Chairs: Nigel Edwards, Seachill, Division of Icelandic Group UK Ltd)
Katherine Short, WWF-International

Presentations:
Nigel Edwards, Seachill, Introduction, Responsible Buying of Safe, Legal, and Sustainable Seafood
Peter Hajipieris, Tesco Stores, UK, Role of Seafood Retailers and Ecolabels on By-Catch Mitigation
Guillermo Cañete, Fundación Vida Silvestre Argentina, Geographic-based Ecolabeling Initiative
Henk Brus, Atuna
Philip Fitzpatrick, Marine Stewardship Council

Miércoles 14 de noviembre del 2007 - 9:15

Desarrollo de Iniciativas: Rol de los vendedores al por mayor De mariscos y del eco-etiqueta en la mitigación de la captura Incidental

Dirigen la sesión: Nigel Edwards, Seachill, Division of Icelandic Group UK Ltd.
Katherine Short WWF – Internacional.

Presentaciones:
Nigel Edwards, Seachill, Introducción para la compra de legal Seguro y sostenible mariscos.
Mr. Peter Hajipieris, Tiendas Tesco, UK, Rol de los vendedores Al por mayor de mariscos y la mitigación de la captura incidental.
Guillermo Canete, Fundación Vida Silvestre Argentina, Geographic Based ecolabeling initiative.
Sr. Henk Brus, Atún.
Sr. Philip Fitzpatrick Marine Stewardship Council

Development of incentives: The role of Seafood Retailers and Eco-Labels on bycatch mitigation

Introduction and background to the session from a European industry perspective

Title: Responsible Buying of Safe, Legal, and Sustainable Seafood

Presented by Co-Chair of the session:
Nigel Edwards, Technical Director, Seachill (Division of Icelandic Group UK)

Background

Taking responsibility for the sustainability of the seafood we buy is not a new phenomenon. The large processors and retailers have had responsible sourcing policies in active use for decades. We knew that wild caught seafood is a finite resource and selected the fisheries we purchased from. Many of us have been actively involved in the establishment of the MSC since the mid 90's and have been promoting demonstrably sustainable fish and fishing methods for much longer periods.

However a step change has occurred in recent years. The issues in many fisheries are huge and urgent and are widely reported by the media. The regulators and NGO's are asking the 'trade' to take an active role in fishery sustainability. We recognize that not all fisheries are adequately regulated and/or policed and we can choose to support the better ones while encouraging the others to improve.

The role of seafood professionals in the large commercial organisations is an increasingly complex one. We are developing ever more sophisticated buying decision processes and following a 'due diligence approach' to ensure our seafood is legally caught, sustainable, and responsibly farmed. To do this we need to be educated in the science and well informed by the experts.

The advantage to commercial organisations from an active cooperation with governments and NGO's is that it gives us a licence to trade in the seafood that is mutually considered to be sustainable or well farmed. Being chosen as suppliers by the major retailers and foodservice groups rewards the seafood processors that make the effort to select their wild and farmed seafood suppliers on sustainability criteria, and work with them to improve the status quo.

Use of Independent Standards

The food industry has long established and well defined standards covering food safety, quality and legal (food trading) compliance, such as the UK BRC standard. These are audited by independent 3rd party bodies and were developed by cooperation between competitive companies to reach a common benefit. This spirit of cooperation has been recently extended to the issues of seafood sustainability and the exclusion of Illegally caught fish from our markets. The levels of agreement and cooperation have pleasantly surprised the NGO's and we are making good progress. An example is the AIPCE-CEP member companies across Europe agreeing protocols to exclude illegally caught Russian cod from the Barents se. Another is the UK rays group that has set up a national database to record all landings of rays by species and size to provide the fishery scientists and NGO's with much improved data on which to make decisions.

We are already using independent standards of sustainability and best farming practices. These are used both as a business-to-business tool and for consumer product ecolabelling. The MSC is the best-established standard for wild caught species with GlobalGAP and the Global Aquaculture Alliance leading in Europe for aquaculture. These standards are important tools but the proliferation of schemes is starting to lead to confusion. There is a need for common standards covering local and global certification.

The FAO would like to encourage standards to agree mutual equivalence. We are calling for the minimum acceptable standard to be in compliance with the FAO guidelines for ecolabelling and for there to be robust policing of ecolabels so there is no short cut available to certification.

It is important for us to able to reward fisheries and fishermen that are working towards certification by the MSC. We welcome the discussions within the MSC that should lead to recognition for fisheries reaching milestones on the way to certification.

Initiatives demonstrating cooperation between stakeholders in Europe

- The UK Common Language Group (CLG) was set up in 2006 to bring together fishermen, processors, retailers, food service groups,, government scientists, and NGO's working together on common issues. The main group has started to set up species and fishery specific working groups addressing issues such as bycatch and discards. A series of buyers guides are being produced by the UK Seafish Authority in consultation with the group. These can be found at www.seafish.org/b2b/rss. The next guide to be written will be for large pelagic fish and will focus on the line fisheries for tuna.

- The UK Food and Drink Federation (FDF) seafood group (whose members include the major seafood processors in the UK) have agreed common positions on seafood issues. We are able to give support to the campaigns run by the NGO's and start initiatives improve the sustainability of our common supply chains. We have recently supported the WWF call for the cut in quota of bluefin tuna in the Mediterranean and we are cooperating to encourage tuna fisheries in the Indian Ocean to seek MSC certification.

- The UK Responsible Fishing Scheme is a recent program operated by the UK Seafish Authority to set standards for fishing vessels including controlling their individual impact on the environment. It has already certified more than 100 vessels, initially within the UK but it is being expanded in Europe. The buyers of large pelagic fish within FDF have obtained funding for the development of a responsible fishing standard for line caught pelagic fish. The standard is already in preparation and will be trialed initially in Sri Lanka. The scope will include by-catch reduction methods and the outcome from this conference will be fully considered by the team writing the standard. Once it is completed the standard will be 3rd party audited in compliance with ISO 65.

- A new standard is in development to certify that fish is legally caught. It will be third party audited to prove that individual supply chains are excluding potential inputs of illegally caught fish. This is partly UK government funded but will be available to any seafood chain. It will use the principles of risk assessment and Chain of Custody auditing. The increasing use of electronic traceability systems will help processors such as Seachill to demonstrate compliance with this new standard. These are web based systems that collate information on batches of fish as they move down the supply chain. At its most complex the systems allow catching vessels to log individual large pelagic fish at the point of catch. One of our tuna suppliers is using this system in Sri Lanka.

• Chatham house is funded by the UK government to coordinate the international effort to control IUU via better regulation, data collection and industry initiatives. They are holding update conferences twice a year to bring the organizations together that are working on IUU controls. Having this central source of information will allow us to risk assess individual fisheries for IUU and put in place the appropriate controls in the supply chains to ensure legal origin. For full information go to www.illegal-fishing.info

Conclusions

• There is a synergy between fisheries wanting to clean up issues of sustainability and the buyers need to demonstrate due diligence in sourcing.

• Processors and retailers are working together with the other stakeholders in the fisheries on the common goal of delivering long term sustainability.

• We are acting to provide due diligence that we are buying responsibly and seeking the advice of good science. To do thus we need to share the science and get our facts right. That is why we are here and why we will continue to support initiatives to improve fishery sustainability locally, regionally and globally. Controlling bycatch is an issue that can be addressed in the short term by individual fishermen.

• European processors have the traceability in place to ensure the fish that comply with best practices can be kept separate and the end customer can be given a real choice between sources.

• We welcome dialogue with NGO's and will support their agendas where the facts are clear.

Looking ahead

• How do we communicate the work we do on local fisheries. Would a Fairtrade program would be welcomed by the producers and what would the challenges be to setting one up? Is this a role for the Seafood Choices Alliance?

Title: Role of Seafood Retailers and Ecolabels on By-Catch Mitigation

Presenter: Peter Hajipieris, UK Policy Manager – Seafood, Tesco Stores Ltd, United Kingdom.

Introduction

At a corporate level, Tesco recognise the importance of sourcing and selling seafood in a manner that demonstrates brand integrity and corporate responsibility.

To deliver this at an operational level, we are engaged in a 'sustainable fisheries development programme' that requires a range of inter-dependent challenges to be addressed within the value chain.

The presentation summarises how we are striving to tackle our seafood sustainability challenges. The work we are currently engaged in and how we are continually evolving our sourcing and value chain management frameworks so that we incorporate the most up to date information to enable us to deliver our Responsible Fisheries aims and meet our customer's needs.

How do we address the challenges at Tesco?

- Overview of Tesco management tools and how this drives our seafood business.
- Tesco Seafood Sustainability Policy – key features.
- Examples of work we are in engaged in and how this relates to policy and by-catch mitigation.
- Meeting our customers needs - what are they telling us?
- Industry Challenges.
- Looking forward at Tesco.

Clase Magistrale SpecialSession

Francisco Chavez, Monterrey Bay Aqurium Research Intitue
"From anchovies to Sarindes and back: Mulitdecadal change in the Pacific Ocean"

REVIEW

CLIMATE

From Anchovies to Sardines and Back: Multidecadal Change in the Pacific Ocean

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In the Pacific Ocean, air and ocean temperatures, atmospheric carbon dioxide, landings of anchovies and sardines, and the productivity of coastal and open ocean ecosystems have varied over periods of about 50 years. In the mid-1970s, the Pacific changed from a cool "anchovy regime" to a warm "sardine regime." A shift back to an anchovy regime occurred in the middle to late 1990s. These large-scale, naturally occurring variations must be taken into account when considering human-induced climate change and the management of ocean living resources.

Landings of sardines show synchronous variations off Japan, California, Peru, and Chile (*1*). Populations flourished for 20 to 30 years and then practically disappeared for similar periods. Periods of low sardine abundance have been marked by dramatic increases in anchovy populations (*2–5*). Several important conclusions can be drawn from this. First, the mechanism responsible for the variability must have been similar in all cases and, some argue, relatively simple and direct (*6*). Second, the variability is difficult to explain on the basis of fishing pressure. Third, the variability must be linked to large-scale atmospheric or oceanic forcing.

The discovery of these so-called biological regime shifts preceded the description of the underlying physical variability. A decade or more after the observations of sardine variations (*1*), scientists discovered fluctuations in air temperatures, atmospheric circulation and carbon dioxide (*7–9*), and ocean temperatures (*10*) that were remarkably similar in phase and duration to the biological records (Fig. 1). As a result, it has been suggested (*11*) that a regime or climate shift may even be best determined by monitoring marine organisms rather than climate. Recent theoretical work supports the idea that complex food webs can undergo substantial changes in response to subtle physical forcing (*12*). Here, we review physical and biological fluctuations with periods of about 50 years that are particularly prominent in the Pacific Ocean. We also highlight the evidence for a change in the middle to late 1990s.

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Climate Indices and Regime Shifts

The sardine and anchovy fluctuations are associated with large-scale changes in ocean temperatures (Fig. 2); for 25 years, the Pacific is warmer than average (the warm, sardine regime) and then switches to cooler than average for the next 25 years (the cool, anchovy regime). Instrumental data provide evidence for two full cycles: cool phases from about 1900 to 1925 and 1950 to 1975 and warm phases from about 1925 to 1950 and 1975 to the mid-1990s (Fig. 1). A wide range of physical and biological time series in the Pacific Ocean basin show systematic variations on this same time scale. Anomalies, representing deviations from the mean value, were negative from about 1950 to 1975 and positive from about 1975 to the middle to late 1990s (Fig. 1). Because each index or parameter is influenced by forcings that act on multiple time scales, differences are expected in the timing of index sign changes and in the duration of the negative and positive phases. The mid-1970s change has been widely recognized in a myriad of North Pacific climatic (*13*) and biological (*11, 14*) time series and has been referred to as the 1976–1977 regime shift (*15, 16*), even though its precise timing is difficult to assess. Some indices suggest that the shift occurred rapidly whereas others suggest a more gradual change, though all indicate a shift in the 1970s.

The "sardine regime" of the 1930s and 1940s (Fig. 1E) (*5*) was most notable for the sardine fishery off California and its collapse, the subject of a memorable novel by Steinbeck (*17*). From the 1950s through the early 1970s, an "anchovy regime" led to the establishment of the largest single-species fishery in the world, the Peruvian anchoveta fishery (*18*). To extend the southeastern Pacific anchoveta time series, we constructed an ecosystem index (Fig. 1F) from seabird abundance data (*19*) and anchovy and sardine landings off Peru (Fig. 1G). The seabird record, compiled from guano harvest and direct bird counts, extends back to the early 1900s. The seabirds are represented primarily by a single species, the cormorant (*Phalacrocorax bougainvillii*), which feeds almost exclusively on anchoveta (the anchovy, *Engraulis ringens*). The ecosystem index suggests a regime shift in the mid-1990s (Fig. 1F); the sardine catch decreased from 4 million metric tons in the late 1980s to 40,000 metric tons in 2001. At the same time, anchovy populations recovered (Fig. 1G).

The Big Picture

In a simplified conceptual view of the Pacific, the trade winds set up a basin-wide slope in sea level, thermal structure, and, importantly for biology, nutrient structure (Fig. 2). The shallow thermocline in the eastern Pacific leads to enhanced nutrient supply and productivity (*20*). Higher sea level in the western Pacific leads to a deep thermocline and nutricline and to lower productivity. These basin-scale east-west gradients are disrupted by large-scale climatic phenomena like El Niño and its counterpart, La Niña (*20*), which affect not only eastern boundary systems but also the western boundaries, subtropical gyres, and equatorial upwelling systems, leading to the concept of a "basin-wide ecosystem" (*21*).

The multidecadal fluctuations have basin-wide effects on sea surface temperature (SST) and thermocline slope that are similar to El Niño and La Niña but on longer time scales; El Niño occurs more frequently, once every 3 to 7 years. During the cool eastern boundary anchovy regime, the basin-scale sea level slope is accentuated (lower in the eastern Pacific, higher in the western Pacific). A lower sea level is associated with a shallower thermocline and increased nutrient supply and productivity in the eastern Pacific; the inverse occurs in the western Pacific. In addition to thermocline and SST, there are regime shift changes in the transport of boundary currents, equatorial currents, and of the major atmospheric pressure systems. Changes in the abundance of anchovies and sardines are only a few of many biological perturbations associated with regime shifts (Fig. 3), and these are reflected around the entire Pacific.

Northeast Pacific. The northeast Pacific may be the most studied area in terms of regime shifts (*10, 11, 13, 14*). Only a few of the most notable changes are highlighted here. An important change for this region is an intensification (sardine) or relaxation (anchovy) of the Aleutian Low (*15*). During the sardine regime from the late 1970s to the early 1990s, zooplankton and salmon declined off Oregon and Washington but increased off Alaska (*11, 14*). Seabird populations decreased off California (*22*) and Peru. The California Current weakened and moved shoreward at this time, as evidenced by warmer temperature and lower salinity near the coast (*23*). A stronger and broader California Current, brought about during the anchovy regime, is associated with a shallower coastal thermocline from California to British Columbia, leading to enhanced primary production (Fig. 2). Off Peru, biological variability is similar to that observed off California.

Equatorial Pacific. El Niño dominates the conditions in the upper ocean of the equatorial Pacific. During El Niño, the surface waters of the central and eastern equatorial Pacific warm, and upwelling and primary productivity decrease (*24*). However, recent evidence suggests that the equatorial Pacific is also subject to multidecadal fluctuations in upwelling and water mass transport (*25*) that are superimposed on the higher frequency El Niño pattern. The meridional overturning circulation associated with equatorial upwelling has slowed by about 25% since the 1970s (Table 1).

The equatorial Pacific is a strong natural source of carbon dioxide (CO_2) to the atmosphere because of upwelling of high-CO_2 waters from depth (*26*). A reduction in upwelling during the sardine regime would decrease the flux of CO_2 to the atmosphere from this region (*25, 27*). Data collected in the equatorial Pacific since 1981 show a strong correlation between surface nitrate content, supplied by upwelling, and chlorophyll ($r = 0.86$, $P < 0.001$); both of these properties decreased between the 1980s and 1990s in concert with the meridional overturning and upwelling (Table 1). The circulation patterns (Fig. 3) are consistent with a mechanism recently proposed to explain multidecadal fluctuations in ocean temperatures (*28*). Further similarities to El Niño are the strong ocean-atmosphere interactions; multidecadal changes in circulation are intimately tied to changes in the wind field (*25*).

North Pacific subtropical gyre. The depths of the thermocline and mixed layer in the North Pacific subtropical gyre change on a multidecadal scale. The thermocline is shallower and the mixed layer deeper during the sardine regime, resulting in increases in primary production. Karl and co-workers (*29*) suggested that phytoplankton biomass and primary productivity in the north Pacific subtropical gyre were lower before the mid-1970s than during the 1980s and 1990s. They also suggested that

Fig. 1. Anomalies of (A) global air temperature, with the long-term increase removed (*8*); (B) the Pacific decadal oscillation (PDO) index (°C), derived from principal component analysis of North Pacific SST (*10*); (C) the atmospheric circulation index (ACI), which describes the relative dominance of zonal or meridional atmospheric transport in the Atlantic-Eurasian region (*9*); (D) atmospheric CO_2 measured at Mauna Loa (parts per million) with the long-term anthropogenic increase removed (*7*); (E) the regime indicator series (RIS) that integrates global sardine and anchovy fluctuations (*5*); and (F) a southeastern tropical Pacific ecosystem index based (*19*) on (G) seabird abundance and anchoveta and sardine landings from Peru. All series have been smoothed with a 3-year running mean.

Table 1. Comparison of upwelling (sverdrup) (*25*), transport convergence (sverdrup) (*25*), surface nitrate (μM), and chlorophyll (from 5°N to 5°S and from 95°W to 140°W) (μg L^{-1}) for the equatorial Pacific. The means and standard errors are shown for two 10-year periods.

	1980–1989	1990–1999	Ratio
Equatorial upwelling	42.1 ± 4.2	35.4 ± 4.0	0.84
Transport convergence	20.5 ± 1.6	14.0 ± 1.5	0.68
Surface nitrate	5.41 ± 0.10	3.76 ± 0.34	0.70
Surface chlorophyll	0.22 ± 0.008	0.16 ± 0.005	0.73

increase in ocean chlorophyll off California (Fig. 2). These results are consistent with a return to a cool, anchovy regime (*11, 39*). The changes occurred about 25 years after the regime shift in the mid-1970s. Along with the physical and primary productivity changes, dramatic increases in baitfish (including northern anchovy) and salmon abundance off Oregon and Washington have been reported since 1999 (*40, 41*). Concurrently there have been increases in zooplankton abundance and changes in community structure from California to Oregon and British Columbia (*42, 43*), with dramatic increases in northern or cooler species. Recent changes off Peru are similar, with species that are normally restricted to the cooler Chilean coasts now commonly found off Peru (*44*).

The changes in fish abundance off Peru (Fig. 1G) are perhaps the most convincing evidence for a long-term, late-1990s regime shift. Sardine abundance off Japan and California displays similar changes (*9*). As during the mid-1970s shift, it appears as though the coast of Peru leads changes in the North Pacific. Does the southeastern Pacific really lead, or did the 1997–98 El Niño obscure changes in the northeastern Pacific? Reports off Oregon (*45*) and California (*46*) seemed to indicate that the warm anomalies in SST during 1997–98 were just as strong as during the 1982–83 El Niño but that the biological responses were not, as though the biological effects of El Niño were dampened by the onset of an anchovy regime. A change in the composition and abundance of organisms in the eastern North Pacific in 1989 has also been reported (*11, 14*). It is uncertain whether the 1989 shift is related to the 1925, 1950, 1976, and late-1990s shifts, but, curiously, 1989 is the approximate midpoint of a regime that began in 1976 and ended in the late 1990s (Fig. 2).

The Future

The longest instrumental series (rather than reconstructions based on proxies) cover the past ~140 years (*6*); many are shorter than a century. These series are often used in climate change projections (*47*). They are, however, strongly influenced by multidecadal variability of the sort described here, creating an interpretive problem that is amplified for biological time series (which rarely span more than a few

Fig. 3. Synthesis of Pacific conditions during the (A) sardine and (B) anchovy regimes. Physical changes are in blue, and biological and chemical changes are in red.

community structure shifted and that the cyanobacteria *Prochlorococcus* increased in particular. The concentration of dissolved phosphorus in the surface ocean also declined gradually in the late 1980s and early 1990s, possibly as a result of utilization by nitrogen-fixing organisms. Because denitrification along the eastern boundary increases phosphorus relative to nitrate, phosphorus supply to the subtropical gyre may increase during the cool, anchovy regime as a result of spillover from more vigorous eastern Pacific upwelling (*30*). The transition-zone chlorophyll front (TZCF) marks the boundary between the subtropical gyre, where productivity is low, and the high-latitude ecosystems, where increased productivity is driven by deep winter mixing (*31*). Variations in the position of the TZCF can have important ecological consequences because many fish and marine mammals forage along the front. The position of the TZCF changes during El Niño and may also vary on multidecadal time scales (*31*).

Northwest Pacific. In the northwest Pacific off Japan, the depths of the thermocline, the nutricline, and the winter mixed layer have followed changes similar to those in the subtropical gyre (*15*). During the sardine regime, sea level dropped, the thermocline and nutricline shoaled, mixed layers deepened (Figs. 2 and 3), and the Kuroshio Current weakened (*32*). Primary production increased, and sardine populations expanded from coastal waters eastward across the North Pacific to beyond the International Date Line (*33*). It remains unclear why sardines increase off Japan when local waters cool and become more productive, whereas they increase off California and Peru when those regions warm and become less productive (*34*).

Warm pools of the tropical Pacific. In the open ocean waters of the northeastern tropical Pacific, physical variability is harder to elucidate, partly because temperatures are warm and homogeneous there. However, there is evidence of lower recruitment of yellow-fin tuna during the anchovy regime (*35*). The area is surrounded by regions with strong multidecadal fluctuations (California Current, Peru Current, equatorial Pacific, and subtropical gyre). Tuna in the warm waters of the western Pacific must be similarly affected. Populations of yellow-fin tuna in the western Pacific may have increased during the cool regimes (*36*). Highly mobile organisms like the bluefin tuna migrate on basin scales, spending periods in areas altered by these large-scale climate and ocean changes. These organisms must respond in complex ways to regime shifts.

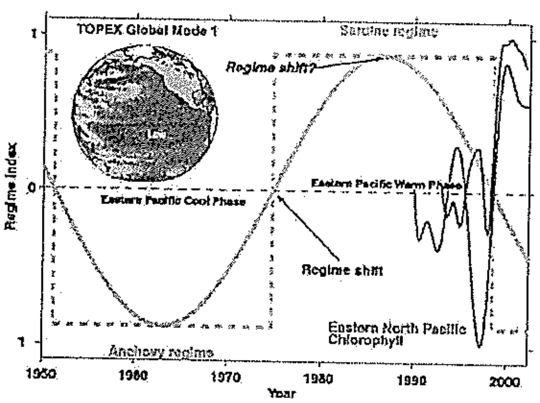

Fig. 2. Hypothetical oscillation of a regime index with a period of 50 years. From the early 1950s to about 1975, the Pacific was cooler than average, and anchovies dominated. From about 1975 to the late 1990s, the Pacific was warmer, and sardines dominated. The spatial patterns of SST and atmospheric circulation anomalies are shown for each regime (*10*). The spatial pattern shows that warming and cooling are not uniform and that the eastern Pacific is out of phase with the central North and South Pacific. Some indices suggest that the shifts are rapid (dashed), whereas others suggest a more gradual shift (solid). Regime shifts are commonly associated with a change in index sign, but populations may also exhibit changes in abundance when the index stops increasing or decreasing. The first empirical orthogonal function (EOF) of global TOPEX sea surface height (SSH) is shown above the cool, anchovy regime. It accounts for 31% of the variance in 18-month low-pass filtered SSH from 1993 through 2001. Low SSH implies a shallow thermocline and nutricline when the coefficient (blue line) is positive. The coefficient is shown in blue together with surface chlorophyll anomalies (mg m^{-3}) for the eastern margin of the California Current system from 1989 to 2001 (*45*), also low-pass filtered. The high chlorophyll after 1997–98 is consistent with the shallow thermocline of the eastern Pacific. Changes in the circulation of the subtropical gyre and its boundary currents are also indicated by the first EOF. This basin-scale anticyclonic (clockwise spinning in the northern hemisphere) gyre maintains a positive gradient in SSH from its center to its periphery. The changes described by the first EOF after 1997–98 can be interpreted as (i) stronger positive gradients in SSH between the gyre center and its eastern and southern boundaries that would be associated with stronger anticyclonic flow (stronger southward flow along the eastern gyre boundary and stronger westward flow along the southern gyre boundary) and (ii) weaker positive gradients in SSH between the gyre center and its western and northern boundaries that would be associated with weaker anticyclonic flow (weaker northward flow along the western gyre boundary and weaker eastward flow along the northern gyre boundary). Thus, after the recent shift evident after 1997–98, a stronger California Current and a weaker Kuroshio Current are indicated.

Atmospheric CO_2

In the previous sections, we focused primarily on ecological consequences of multidecadal variability, but there must be carbon cycle effects associated with the fluctuations in nutrients, primary production, and ecosystem structure as well. Atmospheric CO_2 measurements have been made at Mauna Loa since 1958. This record also shows evidence for multidecadal fluctuations, with CO_2 accumulating more slowly in the atmosphere during the anchovy than during the sardine regime (Fig. 1). This is at odds with the expectation of a stronger CO_2 flux to the atmosphere due to enhanced equatorial upwelling (*25, 27*) during the cool, anchovy regime. Perhaps the slower growth in atmospheric CO_2 is associated with an enhanced coastal and equatorial biological pump of carbon into the ocean interior. If a stronger biological pump is implicated, then there must be an imbalance between carbon and other nutrients supplied by upwelling and those exported by the biological pump. A small deviation from the Redfield ratio (106 C:16 N:1 P) could account for the variability shown in Fig. 1 (*37*). Terrestrial biota may also be implicated in long-term fluctuations of atmospheric CO_2. A North American carbon sink, presumably resulting from changes in land use, has recently been suggested (*38*). The terrestrial uptake is of similar magnitude to the fluctuations shown in Fig. 1. Determining what drives multidecadal fluctuations in atmospheric CO_2 will necessarily require an interdisciplinary approach.

A Recent Regime Shift?

Satellites have recorded an increase in the basin-wide sea-level slope after the 1997–98 El Niño that was coincident with a dramatic decades). Studies of anthropogenic effects and management of ocean resources must consider these natural, multidecadal oscillations. Anthropogenic influences may in turn influence the character of regime shifts. For example, overfishing or global warming may alter the response of populations to natural multidecadal change.

It took well over a decade to determine that a regime shift had occurred in the mid-1970s. If a regime shift is confirmed for the late 1990s, it will have been identified much earlier. However, identifying a regime shift is much easier than understanding the process determining it. Unraveling the processes behind multidecadal variability and how they affect ocean ecosystems and biogeochemical cycling will require a concerted and integrated observational and modeling effort. Such efforts are under way for developed countries (*48*), but they must be expanded to global scales. Measurement networks, analogous to those established by meteorologists, will be required for ocean physics, ecology, and biogeochemistry.

As longer time series are collected and integrated into a basin-scale or global view, longer period fluctuations may be uncovered. These time series will help answer many of the fundamental questions associated with regime shifts. For example, what is the underlying physical forcing behind these shifts? How do they influence fish populations—through changes in nutrient supply or through more direct climate links? Do the shifts between regimes occur rapidly, gradually, or both? How are they related to El Niño and La Niña (*49*)? Because of the similarity to El Niño and La Niña, the use of El Viejo (the old man) for the warm eastern boundary "sardine regime" and La Vieja (the old woman) for its counterpart are suggested.

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Sustainable Tuna Market in Europe?!

Presenter: Henk Brus, ATUNA

Although European consumers are exposed now almost daily to news reports about dwindling tuna catches - the collapse of the Atlantic bluefin tuna stocks and illegal tuna fishing , they hardly know what to do this kind of information. A tiny group asks questions to their supermarket, but although most consumers would say they are concerned, the majority of them do not change their buying behavior.

Consumers have delegated the task of determining if it is all right to eat seafood to their favorite supermarket. They feel that the supermarket should sell them fish that is caught in a responsible way, so they can shop there without being bothered with moral issues about the environment and the future of the world fish stocks. The majority of consumers do not have the slightest idea what fish they buy is wild or farmed, is it a bluefin or a skipjack , let alone that he would know how and where it was caught.

However once they would learn that their trusted supermarket is selling tuna which has been caught illegally - or obtained by a method harming dolphins, sharks, or turtles they will be fast to blame the supermarket for providing them such an "immoral" product, and making them an accomplice. This potential lost of trust is very bad news for retailers.

While most retailers are becoming aware of the environmental problems surrounding tuna, most of their purchasing and quality departments do not have a clear idea yet on how to approach this problem. Recent increased pressure by WWF and Greenpeace is only making this an even more urgent issue to them.

Besides the recently MSC certified Pacific Albacore fisheries on the US west Coast, no other tuna fisheries around the world have received the MSC accreditation yet. With skipjack being the most consumed tuna species, and supply coming from Asia, Africa and S- America , and mostly caught by purse seiners , retailers have a hard time determining which way to go. Should they switch to switch sustainable caught pole and line caught tuna ? And what to do with yellowfin - should it be caught by longliners or hand-liners ? etc.

The complexity of answering these questions is putting most supermarkets for a very difficult task. At the same time it makes them very receptive to any initiatives which show a sustainable approach and can assure them a constant supply at a acceptable price.

This presentation will sum up the most recent movements and initiatives in the European tuna market by companies and governments towards a sustainable approach , and where the focus areas are.

Marine Stewardship Council

Presenter: Philip Fitzpatrick, Marine Stweardship Council

In this presentation, I will outline the progress that the Marine Stewardship Council is making globally with fishery engagements and new fisheries coming forward for either pre-assessment leading to full assessment and eventual certification as well as global view of the level of commercial engagement. Further an update will be provided and discussed as to the influence the market place is having on fishery engagement. Specific reference and examples will be made on the impact of the commercial sector in upgrading their procurement policies including their requirements on bye catch mitigation gear types and overall impacts on bio-diversity leading to more sustainable practices.

GLOBAL INTERACTIONS BETWEEN CETACEANS AND PELAGIC LONGLINE FISHERIES: PERSPECTIVES TO MINIMIZE BYCATCH AND DEPREDATION

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Pelagic longlining is the most widespread type of fishing. Its rapid growth has been, in part, due to the global ban on large-scale high-seas driftnetting. Records of interactions between cetaceans and pelagic longlining occur worldwide and are growing due to increases in fishing effort, population size of some species as well as due to changes in gear characteristics (for example replacement of cotton to monofilament longline). Although longlining has generally been regarded as benign toward cetaceans, increased monitoring of fishing operations has demonstrated that the interactions may be mutually detrimental. Although most of the reported interactions between cetaceans and longline fisheries has consisted of depredation by cetaceans on the fish catch, several cetacean species, large or small (*e.g.* Risso's, rough-toothed, pantropical spoted, spinner, striped and common dolphins, killer, false killer, pilot and humpback whales) have been incidentally hooked or entangled in pelagic longline fisheries targeting mostly tuna and billfish in tropical, subtropical and temperate oceans. As no information is available concerning most of the affected cetacean populations, the scale of mortality from hooking or entanglement, alone or in combination with other sources of non-natural mortality, is cause for concern as longline fisheries grow and expand worldwide. This concern may be greatest for some pelagic species or populations that are not abundant and occupy narrow ecological niches. Environmental concerns are not regarded only to cetacean mortality. Catch losses caused by cetaceans constitute 'hidden mortality' and are not accounted for in tuna/billfish stock assessment. The effects of such are unknown but should not be ignored. Attempts to mitigate depredation are restricted to individual efforts by fishermen to minimize their losses, often with little or no consideration for the welfare of the cetaceans. Methods have varied from harmless (*e.g.* changes in fishing area/time and gear/vessel modifications) to lethal (*e.g.* shooting, harpooning and using explosives). Outcomes of such efforts have been unsuccessful or uncertain. It may have happened because the main factors determining the interactions, both hooking/entanglement and depredation remain poorly understood. Studies to identify variables (environmental, geographic and gear/vessel related) that better explain interactions between cetaceans and longline fisheries should be encouraged on a fleet basis. Three important points deserve consideration in planning such and other studies aiming at mitigating interactions: 1) There is much overlap in the species that interact with the various longline fleets; 2) Interactions seem to be most frequent in areas close to shelf-break in various fisheries; 3) Nature of interactions seems to be species depend [killer, false killer and pilot whales depredate the catch and are, occasionally, entangled or hooked. Risso's dolphins entanglement/hooking are suspected to have occurred during species attempts of bait stealing]. Perspectives to find potential solutions to this issue are likely related to modification in gear/vessel characteristics and fishery practice. Therefore, pro-active participation of the industry and fishers are crucial.

Acercamientos a una mitigación de depredación de Ballenas con Dientes en la pescería palangrera en la Zona Pecera del Oeste Australiano

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En el Mar de Coral, Ballenas Pilotos de Aleta Corta y Falsas Ballenas Asesinas son las especies responsables para la depredación. Reconociendo que no hay ningún método efectivo que genera una mitigación de depredación, una serie de estrategias se están desarrollo continuamente. Anteriores Simposios Internacionales sobre el tema de la mitigación de depredación han sido dirigidos a la conservación de mamíferos marinos y con poco enfoque a la industria pesquera. Sin embargo Simposios más recientes, como la de Octubre 2206 en Pender Island y el Simposio IOTC sobre depredación en Julio 2007, así como iniciativas del Consejo Regional de Pesquerías del Pacifico Oeste, han puesto mucho más atención hacia la capacidad de la industria pesquera de tratar con el tema de la depredación.

Los riesgos de depredación de Ballenas con Dientes debe ser minimizado; sin embargo, depredación debe ser considerado en la luz de aumentar la populación de mamíferos marinos usando un análisis apropiados de las ecosistemas. Agencias pesqueras han considerando cada vez más mortalidad oculta de depredación en las cuotas metas de mortalidad, mientras que el Simposio IOTC de Julio 2007 consideró los efectos de depredación en los ecosistemas. Técnicas están siempre en desarrollo para Ballenas con Dientes en la pesca palangrera, otras técnicas probados han evolucionado para usar en pesquerías donde depredación y captura incidental son una preocupación y técnicas han sido probados para ser más efectivos para los especies involucrados.

Estrategias de evasión

Para llegar a cumplir objetivos de evasión, dos variantes de localización acústica de Ballenas con Dientes han sido alcanzados. El sistema inicial ha sido desarrollado para localizar ballenas en 3 dimensiones, utilizando dos tipos de sonidos acústicos totalmente diferentes, tal como los silbas sociales asociados con depredación (3DLOC; Craig McPherson, Phil Turner, Owen Kenny and Geoff McPherson) y la caza Ecolocación CLICKS (Sonamon©; Andrew Madry). Ambos sistemas son aptos para monitorear Ballenas con Dientes nadando en las cercanias del equipo de pesca, pero aunque viable para indicar el comportamiento de concentraciones de Ballenas con Dientes, en una área de 10 kilómetros han sido insuficientes para proveer una capacidad efectiva de evitar mamíferos marinos para la industria palangrera y ha sufrido de temas logísticas asociados al efecto al Despliegue de hydrofonos efectivo de embarcaciones comerciales. Sonamon© ha ofrecido un rastreo por embarcaciones pesqueros en tiempo real de liberación de esperma de Ballenatos liberando esperma. Ambos 3DLOC y Sonamon© ofrecen capacidad de detecta ballenas casi en tiempo real antes de que embarcaciones son detectados por las Ballenas, y son utilizados para rastrear pequeñas Ballenas con Dientes en las cercanías de redes de cerco para Sardinas en Aguas del Sur Australiano.

El variante del proyecto más apto para la pesca palangrera es el sistema de rastreo de cercania de Ballenas con Dientes propuestas por RSM Systems (Gary Clarke of RSM Systems, Geoff McPherson y Dave Kreutz). Dirección radiofónica encontrando BUOYS usado para localizar segmentos del equipo de pesca palangrero han sido equipados con sensores acusticos experimentales para detectar la presencia de Ballenas con Dientes vocalizandos dentro de una area pre-establecida y transmitir información a la embarcación usando equipo de RDF adaptado para que el pescador puede hacer las acciones para evitar depredación durante todas las etapas. Sonidos asociados a depredación de Ballenas con Dientes son probables de depender de la especie. Sin embargo, con información mínima y dado los datos acústicos modificados para procesar, esenciales para permitir una transmisión de sonido hasta a 100 millas, las diferencias acústicas entre especias son considerados que deben ser mínimas para detectar la proximidad.

Estrategias de minimización

Para alcanzar objetivos de depredación, métodos de mitigación activos y pasivos fueron probados. Un "pinger" acústico (Seamaster, Taiwán) a 2 Kg. de peso indujo una serie de reacciones de evasión por parte de Ballenas con Dientes alrededor de equipo de pesca. Con resultados evaluadas por la industria, sugiriendo una área muy reducido de efectividad, el equipo ha evolucionado hacia una señal que ha tenido un efecto directo a Delfines Nariz de Botella de redes de cerco, y con desarrollos más recientes ha probado respuestas de delfines comunes.

Observaciones Japoneses (Tom Nishida, Japan Fisheries) y los hechos por pescadores Australianos han enseñado que peses enredados en las redes y la variación de especies complicada esta tarea Un sistema acustica de mitigación pasiva (Geoff McPherson and Ian Bedwell) basados en las combinaciones de componentes de equipo de pesca con un objectivo **ECHO** alto a mamíferos **biosonar** esta siendo probado para inducir inseguridad en las etapas finales de Ecolocación de ballenas con dientes. El equipo que usa esta sistema es una limitación visual para depredación y es un reflecor de Ecolocación de Ballenas con Dientes diseñados para alertar sobre posibles amenazas de depredación. Usar equipo de mitigación de depredación (cuando necesario) en operaciones Anzuelos de palangre es el desafío más grande. El sistema ofrece un método logisticamente mucho menos complicado para operaciones palangreras. La habilidad de embarcaciones individuales para construir componentes al equipo que seran aptos para sus operaciones fue discutido. Apreciación es extendido al Consejo Regional de Pesquerias del Pacifico Oeste en Hawai, La Corporación Australiana de Investigación y Desarollo Pesquera y los pescadores de la costa Este de Australia por su apoyo.

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Mercado sostenible de Atún en Europa?!

Henk Brus, ATUNA

Aunque consumidores europeos están expuestos casa diariamente a reportes noticieros sobre la ___ captura de atún – el colapso del remanente de Atún con Aleta Azul Atlántico y captura ilegal de atún, y no saben que hacer con tal información. Un grupo pequeño hace preguntas a su supermercado, pero aunque la mayoría de las consumidores dirá que está preocupado, la mayoría de ellos no cambia su comportamiento de compra.

Consumidores han delegado la tarea de determinar si es correcto de comer mariscos a su supermercado preferido. Ellos se sienten que el supermercado debería vender solo pescado capturada en una manera responsable, asi que no se tendrán que preocupar ellos mismos de consideraciones morales y el futuro del remanente de pesca en el mundo. La mayoría de los consumidores no tienen ni la menor idea si el pescado que compran es cultivado o capturado, si es una aleta azul o **SKIPJACK**, y menos sabrá como o donde es capturado.

Aunque una vez que su supermercado de confianza esta vendiendo Atún cuál ha sido capturado de forma ilegal – o obtenido de una manera causando daño a delfines, tiburones o tortugas – serán rápidos en acusar el supermercado por proveerlos con un producto tan "inmoral" y hacerlos cómplice, Esta perdida de confianza es muy negativo para los vendedores.

Mientras la mayoría de los vendedores han vuelto consientes de los problemas ambientales acerca del atún, la mayoría de sus departamentos no tienen una idea clara en como acercar esta problema. La presión por parte de la WWF y Greenpeace es de hacer de este tema algo incluso más urgente.

Además de la Pescerías Albacore en la Costa Oeste de los Estados Unidos, recientemente certificados con la MSC, ninguna otra pescería alrededor del mundo ha recibido esta acreditación MSC. Con **SKIPJACK** siendo la especie de atún más consumida, llegando de Asia, Afrika y América del Sur, y por lo general capturado por redes de cerca, vendedores lo tienen en identificar cual camino ir. Tendrán que cambiar a Atún capturado de una forma sostenible? Y que hacer con las Aletas Amarillas - Debería ser capturado por palangreros o pescadores usando líneas duras? Etc.

La complejidad de responder todas esta cuestiones pone a los supermercados en una posición difícil. Al mismo momento los hace muy receptivos por iniciativas mostrándoles un acercamiento sostenible y asegurándoles una oferta constante a un precio aceptable.

Esta presentación sumira a los movimientos más recientes e iniciativas de empresas y gobiernos en el mercado Atunera Europea para alcanzar un acercamiento sostenible.

El Sr. Henk Brus nació en Los Países Bajos en 1957. El ha trabajado para mas de 20 años en el negocio de la importación de Atún, en venta, mercadeo, compra y posiciones de gerencia. El ha sido un panelista en muchas conferencias Atuneras en la ultima década. Por medio de su experiencia, ha ganado un conocimiento extenso en muchos ámbitos del negocio mundial de Atún.

En 1998 el ha fundado ATUNA b.v., una empresa en el negocio del Atún.
ATUNA b.v. es activamente involucrado en el negocio internacional de Atún congelado y el gamma entero de Atún preservado. La empresa vende en Europa con su propia marca Natura y con marcas privados de supermercados y ofrece una serie amplia de servicios a sus clientes, las cuales incluyen: producción de bistec, mayoritarios, procesadores de comida, cadenas para supermercados y restaurantes, ...

Su empresa también es propietario del portal de Internet www.atuna.com, la cual es enfocada exclusivamente en el mercado atunera global. Durante los años atuna.com se ha convertido en la fuente mas confiable de noticias diarias para profesionales, pescadores, negociadores,, empacadoras e importadores en todo el mundo.

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Robin Davies, WWF Internacional

La competición Internacional en Smart Gear: Innovación inspirador, capitalizando creatividad

La Competencia Internacional de Smart Gear de la WWF da premios en contado para ideas innovadores en hacer la pesca más selectiva. La competición es hecho para inspirar, reconocer y promover equipo de pesca practica diseñado para minimizar la captura incidental y estimular pensadores creativos en compartir sus ideas. Ahora en su tercer año, la competencia continua de recibir importante atención y recibió 70 aplicaciones de 22 países.. La primera competencia contaba con 50 aplicaciones de 16 países; la segunda 83, de 26 países. Concursantes han incluido tanto a pescadores, como a estudiantes, técnicos en equipo, ingenieros, científicos e inventores. Aplicaciones son juzgados por un panel internacional compuesta por representantes de la ciencia, expertos pesqueros, técnicos en equipos, la industria de mariscos, pescadores, investigadores y conservacionistas. WWF y nuestros socios Smart Gear te invitan a visitar www.smartgear.org para informarse acerca sobre ideas galardones y la competencia 2007.

Philip Fitzpatrick, Marine Stewardship Council

En esta presentación, explicaré el progreso que el Marine Stewardship Council esta logrando a nivel global con acciones pesqueras y nuevas pesquerías saliendo para ya sea asesoría preliminar o asesoría completa y eventualmente certificación tanto como una vista global al nivel de acciones comerciales. Además una actualización será proveído y discutido acerca de la influencia del lugar de mercado en la acción pesquera. Referencia especial y ejemplos serán usados sobre el impacto de actualizar procedimientos, incluyendo relacionado con la captura incidental y el equipo de mitigación, en el sector comercial, tanto como impacto general en practicas más sostenibles y positivas para la biodiversidad.

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(ESPAÑOL) Geoff McPherson Marine Acoustic Biodiversity Solutions, es un Biólogo Pesquero con un historial en el sector del Atún y con experiencia con Atún Aleta Amarilla y Ojo Grande en Aguas Marinas con Corales. El ha manejado programas de clasificación en aguas Australianas con la CSIRO y la Secretaria de la Comunidad Pacifica, incluyendo un estudio con CSIRO sobre mitigar captura incidental de Marlín Negro en la industria palangrero del Mar de Coral.

Trabajo Reciente para mitigar depredación por Ballenas Con Dientes en la captura palangrero de Atún en el Mar de Coral incluye trabajar con ingenieros electromecánicos en sistemas pasivas de Rastreo acústico adaptados para embarcaciones palangreros comerciales para monitorear la dirección y distancia de mamíferos marinos cerca de cualquier tipo de equipamiento de pesca y el desarrollo de sistemas acústicos pasivos y mecánicos para disuadir depredación. Trabajo actual también incluye sistemas para reducir captura incidental de mamíferos marinos en redes de arrastre en la zona costera de Queensland utilizando "pingers" acústicos activos.

Geoff es un miembro del Comité Asesor de Mamíferos Marinos para Ballenas Con Dientes del Consejo Regional de Pesca del Pacifico Este y esta atendiendo el IFF4 con su conocimiento.

COMISION INTERAMERICANA DEL ATUN TROPICAL
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La CIAT mantiene una lista de embarcaciones palangreros autorizados para pescar por sus gobiernos en el Océano del Pacifico Oriental. También tenemos una lista de grandes embarcaciones palangreros (de más de 24 metros) en nuestro sitio web www.iattc.org.

La información más reciente sobre la captura palangrero están contenidos en nuestro ultimo reporte de asesoria del año pesquero 2006. En la Información reportado en los reportes ha sido recolectado de una variedad de fuentes, tal como la recolección de data de embarcaciones, industria, arribo, y reportes por país hecho por el personal del CIAT. La precisión y la cantidad de la información depende de país a país. Vea SAR-8-05 para data recibido por país de acuerdo con la resolución de la CIAT C-03-05.

En adición a los mayores flotas de pesca palangrera de países como Japón, Corea, Taiwán, etc. Aquí están números grandes de palangreros semi-industriales, artesanales, y de escala reducido, enfocando una variedad de especies en la EPO.

México tiene 133 embarcaciones palangreras enlistados en el registro de embarcaciones de la CIAT. La mayoría de la flota palangrera Mexicana pesca a tiburón y Pez espada, con captura incidental de Atún, Marlín, dorado y otros especies. Un numero de palangreros Mexicanos se convierte en pescadores usando redes de arrastre durante un parte del año.

El numero más grande de palangreros operando en Puertos Centroamericanos depende mucho de país a país, pero la flota más grande esta concentrado en Costa Rica (354 embarcaciones) y Panamá (411 embarcaciones). Hay también llegadas de embarcaciones palangreras bajo banderas foráneos en Costa Rica y Panamá de Belice, Honduras, Bolivia, Taiwán y otros países. Muchos de los palangreros centroamericanos pescan a Tiburón, pero también hay que buscan Atún, Dorado, [redacted] y corvina. Hay miles de pequeñas embarcaciones palangreros operando desde cada uno de los países Centroamericanos. Par ejemplo Guatemala registro 91 palangreros en el registro de la CIAT, pero estimo unos adicionales 8400 lanchas empleando pequeñas palangres en su país. La mayoría de los países no tienen suficiente capacidad de monitorear estas llegadas y información acerca de captura es muy pobre.

Nosotros no conocemos de alguna actividad palangrera en Colombia, pero recientemente operaciones palangreras en pequeña escala ocurren aquí. Ecuador tiene 182 embarcaciones palangreros en el registro de la CIAT. La mayoría de estas capturan Atún, Pez Espada y tiburón, paro también grandes cantidades de Marlín, dorado y Pargo. Ecuador tiene un gran numero de embarcaciones palangreros artesanales de pequeña escala. La flota Ecuatoriana tiene un numero grande de Embarcaciones madres, llevando consigo diferentes lanchas para terrenos de pesca y congelar la pesca de embarcaciones más pequeñas. Captura Peruviana es reportado por IMARPE, pero es difícil separar capturas por tipo de equipo.

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Novel Tools to Reduce Captura Incidental en Pesquerías GILLNET Costeras

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Abstracto

Hemos examinado diferentes estrategias para reducir captura incidental de pájaros marinos, primarias y Common Murres (Uria aalge) and Rhinoceros Auklets (Cerorhinca monocerata) en una (redes de salmón costero de agallera de flote Pesquerías en Puget Sound, Washington, USA. Nuestra meta es de reducir consideradamente la captura incidental de pájaros marinos, sin una reducción concomitante en captura meta o un incremento en captura incidental de otras especies. Hemos comparado captura de peses y captura incidental de pájaros marinos en redes modificados para incluir alertas visuales (redes altamente visibles en el red superior) o alertas acústicas (pingers) a redes tradicionales monofilamentos puestos durante horas normales para la pesca en un periodo de 5 semanas. Captura y captura incidental han variado consideradamente dependiendo del equipo. Con controles monofilamentos, [redacted] han respondido tanto a las alertas visuales como acústicas; [redacted] y salmones [redacted] respondieron solamente a alertas visuales más profundas. Abundancia de pájaros marinos ha variado en diferentes escalas temporales: interanualmente, dentro de la época pesquera, y en el día. En el nivel internacional, captura incidental de pájaros marinos ha sido relacionado con la abundancia regional de terrenos pesqueros, un patrono que ha sido quebrado al nivel local. Dentro de la época, la abundancia de [redacted] y [redacted] han sido correlacionados negativamente, sugiriendo que cuando pesca a ciertas especies ha sido planificado en momentos de abundancia, captura incidental ha sido más bajo, aumentando la efectividad. Finalmente, tanto captura de [redacted] y [redacted] han sido más altos en las madrugadas, mientras que captura de murre ha sido alto tanto en madrugada como a la atardecer. Nuestros resultados identifican tres ayudas complementarias para reducir la captura incidental de pájaros marinos en Puget Sound drift gillnet fishery – modificaciones de equipo, aperturas de pesca basados en la abundancia y restricciones en cuanto a la hora del día – para un reducción posible de captura incidental de pájaros marinos hasta un 70-75% sin una reducción considerable de la efectividad pesquera. Aunque estos métodos han sido basados en condiciones locales y por lo tanto variaran dependiendo de año y locación, todos pueden ser exportables a otros Pesquerías Costeras usando redes de arrastre en todo el mundo.

Prevenciones acústicos reducen habilidades de ecolocación de falsas ballenas asesinas (Pseudorca crassidens), pero no tanto

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En el Pacifico Central, Falsas Ballenas Asesinas (Pseudorca crassidens), son conocidos por quitar y depredar Atún de la Pesca Palangrera. Esto ha sido un tema serio por dos razones. Primero, la cantidad de peses removido de la pesca palangrera es costoso y incrementa la captura para pescadores palangreros de la región. Esto obviamente ha tenido su impacto económico para estos pescadores de atún en la región. La segundo preocupación relacionado con la depredación de Falsas Ballenas Asesinas es que estos son en muchos casos capturados incidentalmente para las pesquerías. Ya que solo se sabe poco sobre el tamaño y el estatus de la populación de estas ballenas, removerlos ha sido considerado como negativo a la populación y estimaciones recientes nos confirman que captura incidental de estos animales exceda lo que será sostenible. Entonces, tanto por razones económicos como biológicos, mitigación y reducción de depredación de Falsas Ballenas Asesinas en Pesquerías Palangreros es considerado como necesario.

Un método para reducir depredación y captura incidental ha sido el uso de alertas acústicas. Estos dispositivos típicamente emiten un sonido diseñado para alertar Mamíferos Marinos de la presencia de equipo de pesca y estimularlos de que salgan de esta área. Alertas acústicas han sido analizados para trabajar en la pesca Palangreras de Atún, impulsando Falsas Ballenas Asesinas de la área donde han sido colocado las líneas de pesca y reducir la depredación por estas Ballenas. Hemos probado un dispositivo acústico en tal manera, pero también fue recomendado por el productor para reducir las habilidades de ecolocación de estas ballenas, haciéndolo difícil de detectar líneas palangreras. Hemos investigado este dispositivo, conocido como SaveWave Long Line Saber, determinando:

1) Que son las características actuales de este dispositivo acústico, Long Line Saver?
2) Realmente reduce o disturbe las habilidades de ecolocación por parte de las Falsas Ballenas Asesinas?
3) Podría esto ser un producto efectivo para probar en el campo la reducción de depredación y captura incidental de Falsas Ballenas Asesinas? Promete este equipo lo suficiente para garantizar el gasto de fondos adicionales en una situación real de pesca?

Métodos

Para determinar las características acústicos del Long Line Saver, mediciones fueron hechos en aguas abiertas de la Bahia Kaneohe y fue grabado el sonido producido en el agua con un hydrofono y equipo acústico de grabación. También hemos evaluado la performancia de Falsas Ballenas Asesinas de ecolocar y detectar una presa sin y con el dispositivo Save Wave. Para usar esto hemos usado a Kina, una Falsa Ballena Asesina previamente entrenado en pruebas de ecolocación que vive en el Instituto Hawaiano de Biología Marino. Kina ha sido entrenado para estacionar un aro, ecolocarlo y si encuentra un objeto cilíndrico pegar una aleta. Si no hay ningún objeto cilíndrico tenia quedar quieto. Hemos evaluado la performancía de detección de un objeto cilindrico por este animal con y sin sonidos del Long Line Saver. Durante la tarea inicial de ecolocación, tanto el Long Line Saver, como el objeto cilíndrico fueron colocados a 8 mts (26,25 pies) de Kina. En un experimento de seguimiento, hemos movido el Long Line Saver a unos 40 mts (131 pies) del animal pero dejemos el cilindro en la misma posición. Todas las sesiones experimentales y el comportamiento del animal fueron grabados por notas y video.

Resultados y discusión

El nivel de performancía de Kina de detectar el cilindro fue en 96% correcto en una sesión de prueba 50. Inicialmente, cuando el Long Line Saver fue conectado su performancía bajo a 50%. Luego el dispositivo fue desconectado para una sesión y inmediatamente la performancía de la Ballena se recupero a su nivel normal, cerca de 100%. Por estos resultados iniciales cambiamos el diseño, incorporando el Save Wave en una sesión. Hemos hecho 4 sesiones: Cada sesión de prueba 60 fue compuesta de: 15 pruebas sin sonido, 20 son el Save Wave, 15 sin sonido. Hemos tenido el mismo tipo de performancía que con la primera sesión. Buena performancía en la línea básica, mala con el sonido, buena sin sonido. Mejoro un poco, pero detuvo este mejoramiento después de la cuarta sesión. En los últimos dos de las 4 sesiones su performancía fue:

100% sin sonido
80% con sonido
100% sin sonido

Entonces aparece como el Save Wave disturbe nuestra Falsa Ballena Asesina en la ecolocación.

Hemos medido tanto las características de intensidad y espectrales del sonido antes de presentarlo a la ballena. También medimos el cambio en los sonidos del dispositivo dos veces adicionales. El dispositivo produjo una variedad de frecuencias altas y bajas claras que eran de muy alto volumen hasta 160 dB re: energía pico1 µpa.

Entonces la pregunta era si fue causado un efecto de disturbio? Es causado por un efecto del sonido alto? Si debe ser a volumen alto para tener efecto, entonces cuando usado por pescadores tendrá algunas limitaciones. Entonces hemos colocado el dispositivo 40 mts de largo para bajar dramáticamente la intensidad del sonido y hicimos toda la sesión con el sonido puesto. Hemos encontrado que no disturbe al animal de todo. Su performancía fue 100%. Fue obviamente mucho más silencioso.

Hay dos preocupaciones sobre la intensidad de estos dispositivos: (1) Si la intensidad del sonido es importante, y parece así, el dispositivo tiene que usar un volumen alto, y cerca operar para disturbar ecolocación y (2) la intensidad del sonido producido por el dispositivo parece de disminuir con el tiempo (tal vez por drenamiento de la batería?). Dado la disminución del sonido en el tiempo no sabemos si las ballenas han adaptado su performancía con el sonido o si fue el nivel del sonido mismo que causo esto. Ambos pudieron haber causado el cambio en la performancía de la Ballena cerca de los 80%.

Consideramos que estos resultados son fascinantes, ya que parece que algunos disminuyen la performancía de ecolocación gracias al dispositivo Save Wave Long Line Saver. Podrá ser importante de probar las diferencias entre adaptación e intensidad. Si estos animales se adaptan al sonido y simplemente continúen, el dispositivo tendrá un efecto limitado. Si el sonido al contrario esta disminuyendo en intensidad a lo largo del tiempo y por esto las ballenas mejoran su performancía, entonces un dispositivo con el sonido constante no tendría dificultades de adaptación.

Acercamientos de la Industria de científica
Acerca de la reducción de la captura incidental de especies no meta

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SPA

Cambios en los métodos de pesca para reducir la captura incidental generalmente son impulsionados por la industria, fuera de los agentes, ejemplos fuertes en las que pescadores han tomado la iniciativa en encontrar técnicas eficientes también existen. En el Noroeste Atlántico, tal como en otras partes del mundo, los dos agentes más importantes persiguiendo cambios en la pesca son agencias pesqueras estatales y organizaciones ambientales. El *Consortium for WIldlife Bycatch Reduction*, una alianza entre científicos y la industria pesquera, esta involucrado en un modelo diferente en la cual pescadores, ingenieros y biólogos marinos colaboran en la investigación y desarrollo de técnicas para reducir la captura incidental de especies no meta en peligro de extinción. La inspiración de este modelo fue una colaboración entre pescadores en científicos durante los años 90, cuando se desarrolló y evaluó primero "pingers" acústicos como alerta en captura incidental en redes agalleras en los puertos. También ha construido sobre la observación que algunos cambios en métodos pesqueros utilizados simultáneamente pueden reducir la captura incidental, mientras genera otros incentivos (ej. Reducir costos en el incremento de captura meta) para la industria. El proyecto administrado por el *Consortium* se divide en tres categorías: (1) Entender las interacciones entre especies no meta en peligro de extinción y las operaciones pesqueras, (2) El desarrollo y la investigación de acercamientos a la reducción de la captura incidental, y (3) facilitar el intercambio global de información en tecnologías reductoras de captura incidental. El Consortium se ha enfocado especialmente en dos tipos de equipo: fijo (Pesquerías de arrastre y poteras) y palangreros. La captura incidental de especies no meta es una preocupación grande, incluyendo ballenas grandes (especialmente Ballena Recta en el Atlántico Norte, *Eubalaena glacialis*), Ballenas pilotos (*Globicephala macrorhyncus* y *G. Melas*), Tiburones y Tortugas Marinas. Entre los dispositivos inovadores bajo evaluación están líneas pesqueras que tienen una visibilidad más grande para cetaceans bajo el agua, y líneas de tierra para hundir que son más duraderos de los actualmente en el mercado. Durante su reunión anual y grupos de trabajo organizados periódicamente en equipos, expertos en captura incidental de todo el mundo vienen a Boston, EE.UU, intercambian información sobre cuales técnicas son efectivas y cuales no. Participantes en estos eventos también contribuyen en definir prioridades de investigación de métodos para reducir captura incidental. Como resultado de esta colaboración internacional, un catalogo de estudios en reducción de captura incidental ha sido compilado y ha sido puestos en el Internet como una base de datos. Aunque acercamientos estratégicas del *Consortium* tiene algunos retos inherentes en traspasar estas objetivos en reducción de la captura incidental, su involucramiento directo de pescadores, aumenta la probabilidad de desarrollar métodos pesqueros que son practicas y cuentan con incentivos de la industria

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Una re-reexaminación de "pingers" y el reto de captura incidental en redes de arrastre, mundialmente.

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Ha sido mas de una década de experimentos en el campo determinando equipos acústicos subacuaticos que usan baterías o "pingers" utilizados en redes de arrastre han reducido altamente captura incidental de harbor porpoise (*Phocoena phocoena*) en el Atlántico Noroeste. Desde entonces, pingers han sido probados en todo el mundo y han sido adaptados como una estrategia de mitigación de la captura incidental para pequeñas cetaceans en diferentes pesquerías incluyendo el Gula of Maine groundfish fishery, the California drift gillnet fishery, y algunas Pesquerías del Norte Europeo. Sin embargo muchos retos asociados con el uso de pingers han impedido el uso por pescadores. Esto incluye el costo, la duración de la batería entre otras. Como podrán ser resueltos estas problemas o como pueden ser modificados los pingers, es pobremente investigado. Par ejemplo, depredación de pinpinados podría ser eliminado incrementando frecuencias arribo de su alcance de escucharlo. También en frecuencias más altas la vida útil de la batería es extendida y la distancia en lo que serian oídos seria aumentados. Redes de agallera son unos de los redes más usados en el mundo y especialmente en países en vias de desarrollo son el método de pesca más utilizando, no solo para cetáceos, pero también para Tortugas Marinos, Pájaros Marinos, Tiburones y otros Mamíferos Marinos en peligro de extinción. Desafortunadamente, técnicas de mitigaciones de captura incidental en redes de arrastre son altamente ausentes. Dado la escala del problema, creemos que es urgente la necesidad de aumentar esfuerzos internacionales para desarrollar practicas reduciendo captura incidental en estas redes. La investigación y el desarrollo de estas técnicas deberían incluir modificación de "pingers", y ambos pescadores y Gerentes de Pesquerías deberían dar una serie consideración al uso de "pingers", por lo menos como una solución temporal para reducir esta captura incidental de cetáceos en peligro de extinción, especialmente si la única otra opción es abolir la industria pesquera.

The Hawaii Longline Fishery History, Regulations, Production

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Abstract

HLAs' presentation discusses three points regarding the Hawaii Longline Fishery. The first point is the history of the fishery itself. We examine the types of vessels and gear used in the fishery from the 1950's to today and the cultural changes that have occurred over time.
Next we discuss the introduction of Federal Regulations into the fishery and the creation of the Hawaii Longline Association. It shows the positive and negative impacts of regulations on the fishery. It also shows that fishermen working in conjunction with fishery managers, scientist and NGOs', is the only way to accomplish a positive effect on resources and help reduce interactions with threatened or endangered species. Some of the examples we use are the introduction of side setting, observers, , use of circle hooks, dyed bait, and standard buoy line lengths, limits on interaction.
Finally the presentation briefly describes the Hawaii longline fisheries production from 1991 through 2006. The data used is from the National Marine Fisheries Service, Pacific Island Science Center and includes effort, (hooks fished), catch, and revenue.

Report of the IOTC workshop on tuna longline fisheries depredation in the Indian Ocean

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Workshop Convener

A workshop on tuna longline fisheries depredation in the Indian Ocean was held at the Seychelles Fishing Authority, Victoria, Seychelles for two days from July 9-10, 2007. There were 52 participants from 16 countries and 2 international organizations including 36 attendees and 16 paper contributors without participations.

The workshop comprised four main agenda items: (1) national and regional reports, (2) impacts on catch statistics, (3) mitigation and (4) ecosystem interactions. There were 23 national and regional reports under the first agenda item describing depredation by toothed whales on longline catches. Under the second agenda item, the impacts on catch statistics due to incomplete reporting through depredation loss were discussed. In the third agenda item, traditional and recent mitigation methods were reported and discussed. Finally, under the fourth agenda item, the interactions between tuna longline fisheries and predators were discussed. During these discussions, the workshop recognized mitigation methodology was the most important issue, which was summarized as follows:

Based on the reviews and discussion on mitigation methods, it was recognized that practical methods were classified into three categories, i.e., operational, physical and acoustical methods.

Operational methods include shifting patterns in gear deployment to disrupt learned behavior. There are seven approaches to using operational methods: (a) evasion of whale pods, (b) utilization of whale pods to catch more tuna, (c) decoys, (d) no discards or left-over food for whales, (e) drifting without lights, (f) line alternations and (g) deep setting.

The physical method is to minimize attacks on hooked fish by deploying a protective cover around the captured tuna. This method is similar to one developed in Chilean bottom longline fisheries to protect catches of Patagonian toothfish. This is a new method for pelagic longline fisheries and it will be tested in November in Seychelles.

Acoustic methods include both passive and active approaches. The passive acoustic detection method is to avoid setting near pods, while active acoustic methods are used to harass approaching whales. The passive acoustic detection method employing hydrophones is currently under development. As for active acoustic methods such as pingers, the sizes of these devices tend to be small and only work at very close range. To be effective, pingers need to be large enough to emit loud signals and the signals should be varied to avoid whale pods learning the signal patterns. Such pingers are now under development.

It was concluded that presently, the most practical and effective approach to mitigate depredation was the combination of the seven operational strategies. If effective acoustic devices and/or catch protection devices are successfully developed, these should be included along with the current operational mitigation approaches.

Development of incentives: The role of Seafood Retailers and Eco-Labels on bycatch mitigation
Introductory Notes

Katherine Short, Manager, Network Initiative Support, WWF International

Thank you to the organizers for the opportunity to Co-Chair this Sustainable Seafood Session at this important and useful conference. Thank you also to my fellow panelists and to you for coming this morning. Thank you particularly to Mr Nigel Edwards, the Technical Director for Seachill, a British processor and division of the Icelandic Group, the biggest seafood company in Europe, by turnover.

My background in sustainable seafood started in 1999, leading projects for WWF in the Asia-Pacific region and fostering the growth of seafood work in WWF worldwide from the fisheries position at WWF International since 2004. There are now thirty WWF offices investing in this work and our reach from the water to the waiter, fisher to retailer and consumer continues to grow. Most well known in this respect is the partnership WWF had with Unilever to develop the Marine Stewardship Council which also continues to grow.

Tools and tactics vary as I'm sure you're aware, from quite forthright campaigning and highlighting of critical issues, such as the state of Atlantic Bluefin tuna through to the more informed and gradual momentum built using a step wise approach with retailers and raising consumer awareness. Of note is a recent significant development to bring consistency to the information given to consumers through wallet cards. WWF, Greenpeace International and the Dutch and British NGOs, the North Sea Foundation and Marine Conservation Society have recently concluded an in depth technical project to develop a consistent methodology for these guides. This is will be formally launched in early 08.

So to the topic of this Panel, the Development of incentives: The role of Seafood Retailers and Eco-Labels on bycatch mitigation; we are delighted to have a panel representing the cutting edge of this area internationally along the supply chain including; on the water experience of Guillermo Canete from Fundacion Vida Silvestre in Argentina, a European tuna trader, Mr Henk Brus who runs the useful Atuna.com tuna information service, to the large processor experience of Nigel Edwards. Nigel is also a leading figure in many of these initiatives in Europe to a truly global retailer, Peter Hajiperis from Tesco's and lastly, Phil Fitzpatrick, the Commercial Director for the Americas from the Marine Stewardship Council.

I welcome a presentation from Mr Nigel Edwards, Technical Director, Seachill.

Artisanal Longline Fisheries in South and Central America: A preliminary evaluation of its by-catch on seabirds

Esteban Frere.
Global Seabird Programme BirdLife International, Universidad Nacional de la Patagonia Austral

A wide ranging survey of the characteristics (e.g. vessel and gear characteristic) of artisanal fisheries South America, together with information on seabird distribution and interactions with fisheries, would enable us to conduct a preliminary risk assessment of the fisheries most likely to pose a threat to seabirds, and ultimately to target our resources more efficiently. Data from a sub-set of artisinal longline fisheries in South and Central America will be discussed at the session.

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