

SYMPOSIUM TITLE:

Developing Tools for Ecosystem-Based Fishery Management: Incentive Programs, Bycatch Quantification, and Gear Technology

CONTACT:

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DESCRIPTION:

This symposium will address ecosystem-based marine fisheries management through novel incentive programs to reduce bycatch and fishing gear impacts, bycatch quantification, and changes in fishing practices and gear technology to reduce discards, protected species bycatch, and habitat impacts. The effects of bycatch on ecosystems are uncertain in many cases, and bycatch has numerous unintended consequences for fish and fisheries. Thus, this symposium relates directly to the 2007 annual meeting theme.

The objective of this symposium will be to share recent developments in efforts focused on (1) quantifying discards and protected species bycatch during fishing operations, and (2) reducing discards, protected species bycatch, and impacts to habitat. Specifically, this symposium will focus on:

- Novel incentives for minimizing bycatch and the use of cooperative research to include fishermen in bycatch research and monitoring activities;
- Analytical approaches to estimating bycatch, improvements in scientific sampling and monitoring methods, accuracy and precision implications, and use of data in management; and
- Gear selection and escape survival, innovative methods to reduce fish bycatch and protected resources interactions, and assessment and mitigation of gear habitat impacts.

This symposium will be valuable to AFS members and participants who are interested in ecosystem-based marine fisheries management, who have participated in or are interested in cooperative research, and who are involved with observer or other fisheries monitoring programs

ORAL PRESENTATION ABSTRACTS (for exact times and places, please visit <http://www.fisheries.org/sf/>):

Ecosystem effects of bycatch
Steve Murawski, NOAA, National Marine Fisheries Service, 1315 East-West Highway,
Silver Spring, MD 20910

Abstract:

This presentation will discuss the ecosystem effects of bycatch and how the National Marine Fisheries Service works to reduce by catch in our Nation’s fisheries.

Is size selective fishing gear consistent with an ecosystem approach to fishery resource management?
Danielle A. Reich* and Joseph T. DeAlteris, University of Rhode Island, Department of Fisheries and Aquaculture, Kingston, RI 02881

Abstract:

Recent studies have documented the effects of fishing on marine ecosystems reducing overall species diversity and biomass, altering the age distributions of a stock within a species, and reducing the capacity of the ecosystem to support biomass and produce recruits to the fishery. Some researchers have suggested that inefficient, small scale, non-selective fishing gears that capture a relative higher proportion of smaller, lower trophic level fish and a relative lower proportion of larger, higher trophic level fish would be consistent with an ecosystem approach to fishery resource management. A spatially explicit, age-based projection model was developed to investigate the effects of size selective fishing on the yield, spawning stock biomass, and on the age-length structure of the spawning stock biomass. The model allows for the simultaneous evaluation of alternative management strategies to mitigate the effects of fishing by controlling fishing mortality, size selection, and open-closed areas. The model was verified for the Georges Bank Atlantic cod stock. The results of the analyses indicate that control of fishing mortality at low levels and the use of highly size selective harvesting gear matched to an age 4 and 68 cm length of entry into the fishery contributes the most to maximizing yield while preserving the amount and age structure of spawning stock biomass. In comparison the “no selection” scenario produced less than 70% of the yield, and preserves minimal spawning stock biomass at fishing mortality levels of $F=0.2$. Habitat impact did not have a substantial effect on yield and spawning stock biomass age structure of the stock at low levels of fishing mortality, but had a considerable effect at high levels of fishing mortality ($F=1.0$). At low levels of fishing mortality ($F=0.2$) area closures do contribute to the preservation of stock biomass age structure, but yield is reduced proportionally, and spawning stock biomass is increased proportionally, as percent closure increases. At high levels of fishing mortality ($F=1.0$), the effect of area closure becomes minimal.

Can DAPs Reduce Bycatch?

Rod Fujita, Maggie Ost Dahl, Kate Bonzon, Environmental Defense

Abstract:

The use of designated access privileges (DAPs) to manage fisheries is gradually increasing in the US, with a new Individual Fishing Quota program in the Gulf of Mexico and a process underway to establish an IFQ program off the Pacific coast. Among other potential benefits, DAPs are thought to lead to improved fishery sustainability through reduced discards and bycatch. Other researchers have argued the opposite; that DAPs can instead increase discarding by creating incentives to highgrade the catch. However, as experience with DAPs in the US is still relatively limited, there has been a lack of empirical data and analysis comparing bycatch and discards in fisheries before and after implementation of DAP programs with which to test these ideas. A recent extensive and impartial study of DAP fisheries in the US and Canada indicates that DAP programs do result in less bycatch, lower discards, and increased conservation benefits. Bycatch relative to the commercial take in the 10 applicable US federal fisheries decreased on average 30% after 5 years of DAP implementation; commercial discards have also declined. Design elements of DAP programs, such as the nature of the incentives created and the level and nature of monitoring, have and likely will continue to be essential to the effectiveness of DAPs in improving the management of US fisheries.

The Marine Conservation Alliance Foundation’s Vision for Development of Cooperative Research in the North Pacific

Dave Benton, Executive Director, Marine Conservation Alliance Foundation

John Gauvin, Cooperative Research Coordinator, Marine Conservation Alliance Foundation

Abstract:

Alaska leads the nation in management of marine fish resources but has been relatively slow to realize potential for direct engagement of fishermen in development of solutions to pressing management issues. To address this, MCAF is jumpstarting cooperative research in Alaska. MCAF's vision for cooperative research is for equal partnerships based on respect for each participant's specific expertise and perspective. To ensure high standards of scientific work, MCAF's cooperative research advisory panel includes the Alaska Fishery Science Center and the North Pacific Research Board. MCAF has prioritized areas where it believes the involvement of fishermen could lead to vast improvements to fishery management. These include:

- Incorporation of fishermen's knowledge into research on gear modifications to effects on benthic habitat
- Research to evaluate how fishermen's knowledge can be used to make habitat mapping and fish association research more effective
- Evaluation of ways to reduce interaction with threatened or endangered species such as North Pacific right whales and short-tailed albatross.
- Collection of temperature/depth data on fishing gear to evaluate utility of temperature data for reducing bycatch
- Development of gear modifications to reduce incidental catch of salmon and halibut in Bering Sea trawl fisheries
- Participation in a study to estimate unobserved mortality of crab in bottom trawl fisheries of the Bering Sea

Shark bycatch reduction using chemical and electrochemical repellent technologies
Eric M. Stroud *, Michael M. Herrmann, Patrick H. Rice, Craig O'Connell,
SharkDefense LLC, PO BOX 2593, Oak Ridge, New Jersey 07438; phone: 877-571-2207; email:
eric@sharkdefense.com

Abstract:

International concerns have been raised about apparent population declines of large pelagic fishes including predatory sharks that are ecologically and commercially important. A major contributor to the international population decline of large pelagic predatory sharks is commercial pelagic longline fishing targeting tuna and swordfish (Faltermann & Graves 2002; Peel et. al. 2003; Uozumi 2003; Kerstetter 2004). Beerkircher et. al. (2002) suggests that Carcharhinid sharks comprise the largest portion of shark bycatch during U.S. commercial pelagic longline fishing with blue sharks, *Prionace glauca*, comprising the greatest biomass of any bycatch species. As a potential means to reduce this shark bycatch, we have evaluated time-release semiochemical shark repellents, permanent magnets, and electropositive metals at South Bimini, Bahamas using demersal longlines. The use of semiochemicals has demonstrated lower shark catches on treatment lines as compared to control lines. A method of securely incorporating the chemical repellent into bait has also been developed. Recent behavioral experiments using permanent magnets have led to the discovery that electropositive metals produce a repellent effect in juvenile sharks. Preliminary studies indicate that high standard oxidation potentials found in electropositive metals are able to terminate tonic immobility in juvenile sharks and hold promise as a selective repellent technology.

Effects of a 40-Year, Fixed Station, Weekly Trawl Survey on the Benthos
Schroeder, Melanie M., Department of Fisheries, University of Rhode Island, Kingston, RI 02881
DeAlteris, Joseph, Department of Fisheries, University of Rhode Island, Kingston, RI 02881
Oviatt, Candace, Graduate School of Oceanography, University of Rhode Island, Narragansett, RI 02881

Collie, Jeremy S., Graduate School of Oceanography, University of Rhode Island, Narragansett, RI 02881

Abstract:

Mobile fishing gear has been shown to adversely affect biological and physical characteristics of the seafloor. A station northeast of Fox Island, Narragansett Bay (41°34'N, 71°24'W) has been sampled weekly by otter trawl for over 40 years by the University of Rhode Island's Graduate School of Oceanography. This fixed-station survey provided a unique research opportunity to study the potential chronic effects of repeated trawling on a soft-bottom habitat. Biotic and abiotic characteristics were examined at three stations inside of the impacted area and compared with three stations in adjacent untrawled control sites. Alterations in benthic composition and signs of disturbance were studied. Several multivariate analyses were carried out using PRIMER-E software including multi-dimensional scaling (MDS) and 2-way nested analysis of similarity (ANOSIM). No significant differences in taxonomic or feeding guilds were detected between impact and control areas. No major trends in species assemblage or substrate composition were identified between areas, making treatment effects undetectable. Within treatment variance exceeded between treatment variance, such that little evidence was found of impacts from repeated trawling. Despite the overall homogeneity of the benthos in the area, this outcome emphasizes localized natural patchiness when the habitat is investigated in sufficient detail.

Evaluating the Cost and Effectiveness of Fixed and Rolling Bycatch Closures in the Bering Sea
Alan Haynie, NOAA Fisheries/NMFS, Alaska Fisheries Science Center – F/AKC2
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Abstract:

Bycatch is repeatedly noted as a primary problem of fisheries management and as the foremost negative impact of commercial fishing. In the Bering Sea pollock fishery, salmon bycatch reduction measures have included gear modifications but have principally consisted of area closures. Bycatch levels of chum and Chinook salmon have risen substantially since the beginning of the decade and significant areas of the pollock fishery have been closed at some points between 2002 and 2006. These closures have consisted of both large long-term Salmon Savings Area closures and short-term voluntary rolling hotspot (VRHS) closures. In this paper, we consider the costs and benefits of spatial closures designed to reduce salmon bycatch in the Bering Sea pollock fishery. Specifically, we estimate the costs of both fixed and VRHS closures and estimate the change in bycatch that has resulted from VRHS closures from 2002-2006. We also briefly discuss the estimation of economic benefits to different communities that depend on salmon, differences in bycatch levels among vessels, and options for individual bycatch incentive programs.

Using Video Monitoring to Audit Fishing Logbooks and Improve Bycatch Accounting
Howard McElderry, R. Stanley, D. N. Edwards, M. J. Pria, Archipelago Marine Research Ltd., Victoria, British Columbia, Canada

Abstract:

British Columbia's 350 vessel groundfish trap and hook fleet has adopted management reforms that include an at-sea monitoring program to verify all retained and discarded catch. The traditional approach using observers was deemed too expensive and impractical for the small vessel fleet. Video-based electronic monitoring (EM) systems as an observer replacement were also dismissed for cost and timeliness issues. An alternative audit-based monitoring approach was developed through pilot studies carried out over the past four years. Under this system, all at-sea fishing activity is recorded using EM but only a portion of data is compared with fishing logbooks. The logbook location and timing of fishing events, at-sea catch (retained

and discarded) and retained catch is compared to the EM sensor data, a random 10% sample of the EM imagery, and the landings data collected by independent offload observers, respectively. The EM audit results provide an independent estimate of total catch, a measurement of logbook data quality and a “radar trap” threat to encourage accurate catch reporting. Audit consequences include feedback for improvement and for “failed” audits, a number of possible corrective measures. This audit approach has significantly improved the quality of information at about a third the cost of at-sea observers.

Vessel Incentive Program to Reduce Bycatch in the North Pacific Groundfish Trawl Fisheries –
Considerations for Compliance Monitoring and Enforcement Standards
Susan J. Salvesson, National Marine Fisheries Service, Alaska Region, Sustainable Fisheries Division, 709
W. 9th, Juneau, Alaska, 99801

Abstract:

A vessel incentive program (VIP) was implemented for the North Pacific groundfish trawl fisheries in the early 1990s. The VIP established fishery specific seasonal bycatch rate standards for Pacific halibut and red king crab, which are prohibited species caught incidental to commercial fishing operations. Individual vessels were required to comply with these standards or be subject to prosecution. Observed catch composition data were used to assign vessels to fisheries at the end of each week; a monthly bycatch rate for each fishery a vessel participated in was calculated as a ratio of halibut weight or crab numbers to the total round weight of groundfish. The high standards for supporting an enforcement case against an individual vessel based on observer data, the high level of enforcement and science center staff resources necessary to develop an enforcement case, as well as other competing enforcement priorities led to few cases being forwarded to NOAA General Counsel for prosecution. Eventually, more effective bycatch reduction programs were developed and the VIP was abandoned in favor of sector or fishery cooperative specific allocations of prohibited species. Nonetheless, the VIP was useful to understand the data ramifications and monitoring and enforcement expense of vessel specific incentive programs to reduce bycatch.

Incentives to Reduce Bycatch in Alaska Groundfish Fisheries
Jason Anderson, National Marine Fisheries Service, Alaska Region, Sustainable Fisheries Division, 709 W.
9th, Juneau, Alaska, 99801

Abstract:

NMFS is required by the Magnuson-Stevens Fishery Conservation and Management Act to implement conservation and management measures that, “to the extent practicable, minimize bycatch...” In 1995, the North Pacific Fisheries Management Council adopted the first of several management programs designed to increase retention and utilization in Alaska groundfish fisheries. These regulatory programs include mandatory retention of certain groundfish species, gradual increases in the retention of all groundfish for a fleet with historically low retention rates, and utilization of fishing cooperatives to encourage bycatch avoidance behavior. To help ensure compliance with these regulatory programs, new, novel, and expensive monitoring programs were developed. This presentation will provide a brief history of the regulatory programs that make up the Increased Retention Increased Utilization program, focusing on the development of regulatory incentives to reduce bycatch. Additionally, the presentation will describe the development of, and need for, compliance monitoring tools that include high levels of observer coverage, on-board scales, and observer sampling stations.

Marine Debris in Alaska: Activities by the Marine Conservation Alliance Foundation in 2006 and 2007
Bob King, Marine Debris Coordinator, MCA Foundation, PO Box 20676, Juneau, Alaska, 99802

Abstract:

Marine debris such as discarded plastics and derelict fishing gear has been recognized as serious threat to fishery resources, wildlife and habitat and one of the most pervasive problems plaguing the world's oceans and coastal areas. The Marine Conservation Alliance Foundation, a Juneau-based fishing industry trade group whose members are involved the Alaska groundfish and crab fisheries, has worked since 2003 to remove and dispose of marine debris throughout Alaska. Projects in 2006 removed over 90 tons of debris from the Alaska shoreline, mostly derelict fishing gear. These projects are reviewed along with the results of projects planned in 2007. Debris composition is discussed as well as options for recycling or alternate disposal of this debris.

A Bayesian approach to estimating fish bycatch in the commercial shrimping fleet
Scott Nichols and Kate Siegfried*, NOAA-Fisheries, Pascagoula, MS and NOAA-Fisheries, 3500 Delwood Beach Road, Panama City, FL, 32408

Abstract:

Estimating the fish component of bycatch in the commercial fishing industry is an area of intense research. For the purposes of stock assessment, these estimates are vital, as many times the magnitude of bycatch is significant. A Generalized Linear Model approach (GLM) approach has been used since 1987, and has received a lot of deserved criticisms. The most notable subjects of criticism are the model's inability to define uncertainty and the lack of techniques for dealing with zero observations in a log model. A Bayesian approach is almost certainly a more appropriate method for identifying and quantifying uncertainty. The models developed here are Bayesian models that span the spectrum of analytical possibilities, from the most frequent assumptions in the previously used GLMs, to a full Bayesian model incorporating priors for data sets and the time periods considered. We find the Bayesian approach quantifies uncertainty better and allows us to incorporate prior knowledge of the fishery.

Marine Mammal Bycatch Considerations
Karin A. Forney, NOAA, National Marine Fisheries Service, Southwest Fisheries Science Center, 110 Shaffer Rd, Santa Cruz, CA 95060

Abstract:

Bycatch is a term that has been applied broadly to the unwanted catch of non-target species in fisheries. Issues involved in assessing the magnitude and impacts of such bycatch, however, vary considerably by species group. Bycatch of non-target fish species can be large relative to catches of target species, and impacts are assessed in a maximum sustainable yield context based on total biomass removed. In contrast, bycatch of endangered sea turtles and sea birds is often managed on the basis of annual bycatch quotas, which may be only a few individuals. Although many marine mammals that experience bycatch are globally abundant, aspects of their biology make them uniquely vulnerable to population-level impacts. The relative rarity of marine mammal bycatch events introduces uncertainty in quantifying total bycatch, and limits the available options for assessing potential mitigation measures. Species identification can be difficult at sea, yet is crucial for accurate assessments. Many marine mammals have discrete populations within an apparently continuous range, which can lead to significant population-level impacts from even low levels of localized bycatch. Lastly, marine mammals may be released alive with injuries or gear attached, but little is known about their survival following release.

Influence of Adaptive Stations in a Transect-Based Sampling Design for a Multispecies Fish Survey
Sarah E. King*, Eric N. Powell, Haskin Shellfish Research Laboratory, Rutgers University, 6959 Miller Ave., Port Norris, NJ 08349

Abstract:

A multispecies transect-based survey with an adaptive sampling design was evaluated to determine the import of adding stations adaptively at sea in order to better resolve the cross-shelf distribution of species in regions of rapid bathymetric change. The transect survey results demonstrate the necessity of high sample density in this region of the continental shelf where fish aggregate patchily over scales of a few kilometers. Species cross-shelf distributions were often bimodal. The adaptive sampling protocol demonstrated the expected tendency of fish to be underestimated or overestimated given inadequate sampling density. However, on average, low sample density led to an underestimation of biomass or abundance. Modeling of the transect design reveals that the overestimates and underestimates originate from variations in patch location and patch shape with the sampling design and that extreme values can occur when patch size is small relative to the distance between stations, but routine underestimates are not so easily explained. It is the improved understanding of patch shape that is the single most important contribution of the adaptive sampling protocol, not a better knowledge of the location of the patches. Patch shape is a principal determinant of the adequacy of sample density.

A method for improved utilization of data from experiments with fishing gear.
René Holst, Danish Institute for Fisheries Research, North Sea Centre, DK-9850 Hirtshals

Abstract:

Advice on gear regulations given to management bodies is often based on a series of similar or related experiments. This presentation demonstrates how data of different origins can be combined and how a proper error structure can be incorporated to provide more realistic uncertainties. The method is demonstrated by an example that includes data collected over 24 cruises and includes 394 hauls.

Protocol utilizing SCUBA techniques to evaluate sea scallop dredge modifications designed to minimize sea turtle mortality
Jeff Gearhart, NOAA Fisheries, Southeast Fisheries Science Center, Harvesting Systems Branch, 202 Delmas Ave., Pascagoula, MS 39568

Abstract:

Based on several years of research, it is known that mid-Atlantic scallop dredge gear has interactions with sea turtles. An unknown percentage of these interactions occur on the sea floor, where the potential for serious turtle injuries are high. In 2005, NOAA fisheries supported the development of a modified dredge designed to act as a wedge and guide turtles encountered on the bottom over the top of the dredge. To evaluate the turtle excluding capabilities of the modified dredge, a protocol was developed to simulate sea turtle interactions and mimic "the worst case scenario" of a dredge overtaking a turtle lying on the bottom. Two NOAA divers deployed either dead or model turtles in the path of the towed dredge at predetermined locations and orientations along the leading edge of the frame to identify potential design flaws. Each interaction was documented by videotaping the event from three different perspectives. Several design flaws were identified and the dredge was reconfigured and retested in 2006. When compared to conducting

evaluations on the fishing grounds and attempting to capture these rare events on video, the dredge evaluation protocol has proven to be a cost effective alternative for assessing these types of gear modifications.

Status of TED Development in Non-Shrimp Trawl Fisheries

John Mitchell, NOAA Fisheries, SEFSC, Harvesting Systems Branch, 202 Delmas Ave., Pascagoula, MS 39568

Abstract:

The use of turtle excluder devices (TEDs) to reduce the incidental trawl capture of marine turtles began in the early 1980's in the penaeid shrimp fishery of the Southeastern U.S. Today, with few exceptions, all shrimp trawlers operating in the Southeast U.S. shrimp fishery must use TEDs. The expansion of the TED requirement to non-shrimp trawl fisheries began in 1992 with the implementation of regulations for the summer flounder fishery (*Paralichthys dentatus*) of Virginia and North Carolina. Trawl fisheries for whelk (*Buscyon* sp.) in Georgia and South Carolina, and scallops in Queensland and Western Australia also have a TED requirement. Gear researchers with NOAA Fisheries and in other parts of the world are investigating the application of TED technology in large trawl fisheries targeting demersal and pelagic fish species. The challenges faced in developing TEDs for these fisheries include ensuring that the device will: effectively exclude sea turtles, have minimal negative effect on target catch retention, and withstand the rigors of at-sea operation. Through the use of underwater camera systems, observations of turtle and fish behavior in the trawl and their interactions with prototype TED designs have been obtained. These observations, along with fishery dependent assessments of the TED-effect on target catch rates are leading toward successful TED development.

An Evaluation of Feasibility and Cost-Effectiveness of Acoustically Released Pop-up Buoys and other Strategies to Reduce Vertical Lines in the Water Column that Potentially Entangle Large Whales in the Northwest Atlantic Lobster Trap Fishery

Richard B. Allen* and Joseph DeAlteris, University of Rhode Island, Dept. of Fisheries, Animal, and Veterinary Sciences, Bldg. 50, East Farm, Kingston, RI 02881

Abstract:

Vertical lines in the water column associated with lobster trap buoy lines have been identified as an entanglement threat to large whales. During the last 18 months we have conducted a cooperative research project with inshore and offshore lobstermen operating in New England waters that has demonstrated that acoustically released pop-up buoys are both technically feasible and reliable as a possible mitigation strategy to reduce vertical lines in the water column. Other options to reduce vertical lines associated with lobster gear include reductions in the number of buoys per trawl of traps, and overall reductions in the number of traps allowed per permitted lobster fisherman. Our current research is assessing the cost effectiveness of alternative mitigation strategies from the individual lobster fisherman perspective, as this will provide insight to fisheries management as to the most appropriate methodology to achieve its objective: that is to reduce the potential for large whale entanglements in lobster fishing gear.

Integrated Weight Longlines with Paired Streamer Lines – Best Management Practice for Seabird Mitigation in Demersal Longline Fisheries

Dietrich, Kimberly S., Washington Sea Grant, University of Washington, 3716 Brooklyn Ave NE, Seattle, WA 98105

Melvin, Edward F., Washington Sea Grant, University of Washington, Box 355020, Seattle, WA 98195
Conquest, Loveday, School of Aquatic and Fishery Science, University of Washington, Box 355020, Seattle, WA 98195

Abstract:

The incidental catch of seabirds in fisheries is an international marine conservation problem. One method to effectively reduce seabird catch rates is to increase the sink rate of longlines; thus minimizing the time gear is available to seabirds at the surface. We fished standard unweighted (UW) and integrated weight longlines (IW-50 g/m) with and without paired streamer lines (PS) in seabird mitigation trials during the 2005 Bering Sea Pacific cod fishery. All mitigation technologies significantly decreased seabird bycatch rates while having little to no effect on fish catch rates. The dramatic reductions in seabird mortality when using IW alone (88% for shearwaters and 91% for surface foragers) occurred despite the lack of a concomitant decrease in seabird attack rate or abundance. Seabird attack rates were significantly reduced within 60 m – the aerial extent of streamer lines – when paired streamer lines were used. Functionally, IW line reduced the 2-m access window by nearly half compared to UW line. Sink rates and access windows varied between vessels. Based on this study and evidence from other fisheries world wide, we conclude that IW longlines deployed with paired streamer lines is the best mitigation practice available for autoline longline systems in fisheries with seabird conservation imperatives.

Bycatch Reduction and gear development in the Mid-Atlantic: Evaluation of optimal codend mesh size in the Loligo fishery

Eleanor A. Bochenek*, Sarah E. King, Eric N. Powell, Haskin Shellfish Research Laboratory, Rutgers University, 6959 Miller Ave., Port Norris, NJ 08349

Abstract:

Discard reduction is a component of the statutory requirements implemented by the “Sustainable Fisheries Act” Amendments to the Magnuson Stevens Fishery Conservation and Management Act. For several Mid-Atlantic trawl caught species, targeting of mature adult fish and the avoidance of juvenile fish have been identified as a primary tool in achieving the rebuilding and mortality objectives of current fishery management plans. Among the highest discards in the Loligo squid otter trawl fishery is Loligo itself and most of these discards are below market size. Therefore, we evaluated the performance of increasing codend mesh size from the industry standard 1.875" mesh to 2.5" to address the need to reduce discards of submarket size Loligo and other juvenile fish, such as butterfish. Catch of submarket (<10 cm) Loligo and market-size (10-13 cm) Loligo was significantly reduced by 84% and 79%, respectively, indicating that a 2.5" mesh is too large. For large squid (>13 cm) and butterfish, significant differences were not detected between codends. Thus, increasing mesh size is unlikely to provide a viable option for reducing butterfish discards in the offshore Loligo trawl fishery because the mesh sizes needed to exclude butterfish reduce catchability of Loligo squid to levels below economic viability.

Using Bycatch Reduction Panels to Conserve Fishes and Increase CPUE in Weirs

Christian Hager, Virginia Sea Grant, College of William and Mary, Virginia Institute of Marine Science, 1208 Grete Road, Gloucester Point, Va. 23062

Abstract:

Retention of undersized fishes is inherent to weir/poundnet gear due to small mesh construction in head/pocket section. Previous investigations demonstrated that this mesh size cannot be increased to augment release without compromising the gear's efficiency and CPUE. In the Chesapeake Bay, a significant number of undersized fishes are captured in weirs and due to harvest methods high mortality results. These fish include *Paralichthys dentatus* and *Cynoscion regalis*, for which minimum harvest sizes are established, as well as, *Micropogonias undulatus*, *Leiostomus xanthurus* and *Pomatomus saltatrix*, for which no food market exists for smaller fish. From 1998-2001 various investigations were undertaken to engineer an effective device that could provide both active and passive release for these fishes. Assuming equal percentages of undersized fishes on consecutive days the final version of the bycatch reduction panels, released 81% of sublegal flounder, 73% of sublegal trout, 28% of the spot <6 inches, 100% of the croaker <9 inches, and 66% of the bluefish <10 inches were released. Legal versus illegal ratio comparisons (Chi – Square test) between consecutive days revealed sublegal flounder and weakfish release was significant.

Evaluation of a turtle excluder device (TED) in the scallop trawl fishery of the mid-Atlantic
Daniel Lawson and Joseph DeAlteris, University of Rhode Island Dept. of Fisheries, Animal and Veterinary Science, Building 50, East Farm, Kingston, RI 02881
Jeff Gearhart, National Marine Fisheries Service Southeast Fisheries Science Center, 202 Delmas Ave., Pascagoula, MS 39567
Henry Milliken, National Marine Fisheries Service Northeast Fisheries Science Center, 166 Water St., Woods Hole, MA, 02542-1026
Eddie Newman, FV Captain Dell, 462 Main St., Swanquarter, NC, 27885

Abstract:

Turtle excluder devices (TEDs) have been demonstrated to be effective in reducing sea turtle interactions in the shrimp trawl fisheries in the south Atlantic and Gulf of Mexico, and therefore have been proposed as a mitigation strategy for the mid-Atlantic trawl fisheries. An evaluation of the performance of a TED in the scallop trawl fishery of the mid-Atlantic was conducted in July and August of 2006 aboard a commercial fishing vessel comparing the catch of the target and bycaught species for two different commonly used types of trawl nets in this region equipped with and without a TED. For both nets, use of a TED resulted in a significant reduction in the total weight of in-shell scallops. There was no indication of a change in the size selection in the scallop catch of the TED net, indicating that the loss of scallops is a function of decreased efficiency. Video was able to confirm that scallops were lost from the net out of the TED escape opening, which could explain the difference observed. The reduction in catch efficiency between the control and TED nets increased as a function of catch size.

Designing Gear Solutions for Rare Events: Interactions with Threatened or Endangered Protected Species
Ronald Smolowitz, Coonamessett Farm, 277 Hatchville Road, East Falmouth, MA 02536
Henry Milliken, National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543

Abstract:

Developing, testing, and evaluating gear-based solutions to mitigating the bycatch of protected species is usually challenging as fishery interactions with protected species are generally rare events. In the Northeast Region, the successful development of gear-based solutions has involved close collaboration with the commercial fishing industry in both the design and experimental testing of bycatch reduction technologies (BRTs), and in subsequent field evaluations of BRTs in the commercial fishery. Without industry involvement in all phases of the gear-based work, any bycatch reduction technology may be met with industry skepticism, possibly leading to non-compliance, political intrusion, and non-acceptance.

Evaluation of Injury Potential in Incidentally Captured Loggerhead Sea Turtles (*Caretta caretta*) Relating to Hook Size and Baiting Techniques

Dominy Hataway, Charles Bergmann, John Watson, NOAA Fisheries, Southeast Fisheries Science Center, Pascagoula, MS Laboratory

Lesley Stokes, Sheryan Epperly, Lisa Belskis, NOAA Fisheries, Southeast Fisheries Science Center, Miami, FL Laboratory

Ben Higgins, NOAA Fisheries, Southeast Fisheries Science Center, Galveston, TX

Abstract:

In an effort to understand the interaction between sea turtles and baited hooks, we conducted controlled feeding trials to investigate methods to reduce post-hooking injury in sea turtles incidentally captured in pelagic longline gear. We examined effects of hook and animal size, behavior, bait type, and technique as these relate to the loggerhead sea turtles' ability to swallow a baited hook. Researcher modified 14/0, 16/0, 18/0, and 20/0 circle hooks by removing the barb and wrapping the end with heat shrink tubing to make the hooks safer for the turtles. Hooks were baited with squid or sardines and either single baited or threaded. Baited hooks were offered to captive reared loggerheads (n=20 per size class) in three trials (45, 55, and 65 cm SCL). Turtles' reactions were recorded and videotaped to confirm details of the interaction. Results indicated that as hook size increased, the potential for full ingestion decreased. Larger turtles were more likely to attempt ingestion of larger hooks. Turtles were less likely to attempt to ingest hooks baited with sardines than squid, and single hooked rather than threaded. Larger hooks or hooks modified with appendages likely will reduce the risk of serious injury or mortality for sea turtles.

Reducing ecosystem impacts in Australian prawn-trawl fisheries: innovative approaches to reduced bycatch and seabed impact

Steve Eayrs, Gulf of Maine Research Institute, 350 Commercial St, Portland, ME, 04107

John Wakeford, Australian Maritime College, PO Box 21, Beaconsfield, Tasmania, Australia, 7270

David Sterling, Sterling Trawl Gear Services, 27 Cobble St, The Gap, Queensland, Australia, 4061

Abstract:

We present an update of research in Australian prawn-trawl fisheries to reduce bycatch and seabed impact. This includes the use of a multi-level beam trawl to assess prawn and bycatch behaviour. The implications of this study for the use of lower-headline trawls are discussed, including a reduction of fish bycatch of at least 10% with minimal impact on prawn catches. We used a flume tank to assess water-flow characteristics in and around a codends and several bycatch reduction devices. The aim of this work was to identify water-flow regions that might be attractive to fish, why some devices reduce higher volumes of bycatch than others, and how subtle modification to some devices may improve their performance. We also evaluated the performance a soft-brush ground gear and a so-called batwing otter board to reduce benthic impact and fuel consumption. Underwater video observations indicated that the new ground gear and otter board were operating in the desired way, and both modifications reduced trawl drag by 3% and 13% respectively and increased wingend spread by 4% and 5% respectively. There was a reduction in the catch of some species of commercial importance, but an increase in others. The cause of the loss is explained.

Using a DIDSON Ultrasonic Imaging Sonar in a Groundfish Trawl

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Abstract:

Underwater observations of fish behavior, in proximity to fishing gear, submersibles, ROVs, and other research tools, may be confounded by the presence of artificial visible light. The DIDSON, ultrasonic imaging system provides an image of both fish and surrounding structure without the use of artificial light in live-viewing or autonomous modes. We tested a DIDSON sonar in a selective flatfish bottom trawl to learn whether it could provide a clear view of fish behavior and net structure. A novel mounting frame design provided a stable platform for ultrasonically imaging areas in front of and in the mouth of the trawl (e.g., footrope, headrope, wings, mud cloud). We obtained images of large portions of the trawl, and of fish movements in relation to the gear, up to 17 m from the sonar. Video cameras were used simultaneously, and the resulting paired images were used to confirm which species were observed on the sonar. The strengths of the new sonar are increased viewing range and the ability to see beyond moderate turbidity and obstacles. The weaknesses are insufficient resolution to reliably identify species and the limited ability to distinguish fish in close proximity to the bottom when both are in relative motion.

Development of a Salmon Excluder for Alaska's Pollock Fisheries: Cooperative research to address a pressing fishery management issue

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Abstract:

In recent years, salmon bycatch in the pollock fishery has increased. To supplement the extensive salmon hot-spot avoidance efforts of the pollock fishery, we are working with fishermen and gear designers to develop a "salmon excluder". Our device is based solely on exploiting differences in swimming behavior between salmon and pollock in response to a change in water flow in the trawl. The flow change is created by a tapered square mesh funnel inserted into the intermediate to create an area of slower water flow adjacent to large escapement portals. Such a device could supplement salmon bycatch avoidance as well as reducing fuel costs from continually having to move vessels to areas with lower salmon bycatch rates. Field trials have evaluated a series of excluder designs using a recapture net. Chinook salmon escapement is consistently 35% in recent trials and pollock loss is well under 2%. Trials have indicated, however, that a "bulge" problem can occur as pollock become pinned against the webbing ahead of the funnel. Once started, the tendency to bulge can increase until door spread is reduced or the net is damaged. Design changes have reduced the problem but it still occurs when pollock catch rates are high.

Reducing bycatch in U.S. west coast recreational groundfish fisheries: evaluation of the effects of increased bait height above bottom on the catch of demersal rockfishes (Sebastes)

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Abstract:

This study evaluated whether increasing the elevation of angled baits above the bottom could be useful in reducing the bycatch of demersal rockfishes such as yelloweye rockfish (*Sebastes ruberrimus*) in

recreational fisheries. Angling gear equipped with 3.0 and 4.6 m leaders (long leaders) separating the terminal weight from the lowermost bait reduced catch rates of large (>29 cm) yelloweye rockfish by 100% ($P < 0.10$) in nearshore fishing and 79% ($P < 0.05$) in offshore fishing in comparison to control gear. Long leaders also reduced catch rates of large canary rockfish (*S. pinniger*), lingcod (*Ophiodon elongatus*), and other demersal rockfish. Long leaders reduced the catch of many small rockfish likely to be discarded by anglers. Target species catch rates were not significantly reduced for Pacific halibut (*Hippoglossus stenolepis*) or large black rockfish (*S. melanops*) and were increased for yellowtail rockfish (*S. flavidus*), widow rockfish (*S. entomelas*) and blue rockfish (*S. mystinus*). Replicate drifts over the same habitat with and without long leaders showed that gear interactions were not the cause of reductions in yelloweye rockfish bycatch and also suggested that bycatch reduction for canary rockfish may be density-dependent.

Improving the species-selectivity of longlining with fabricated baits

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Abstract:

Although longlining offers multiple benefits to the environment and the economy, it is criticized and sometimes banned for its lack of selectivity. However, the use of appropriate bait(s) can greatly decrease longline bycatch, particularly in groundfisheries. Historically, this meant choosing preferred natural baits. More recently, researchers have utilized the methods of food technology to manufacture baits that offer the potential for very high levels of selectivity in certain fisheries. We discuss fabricated baits in three situations: selecting among Alaskan groundfish; differentiating between cod and haddock in the northwest Atlantic; and attempting to deter blue sharks from taking pelagic swordfish baits. A successful bait must offer attraction, taste, duration of fishability, ease of handling, and the ability to stay on the hook. When selectivity is added to these functions, it is not surprising that success in designing manufactured baits is elusive. We will discuss both successes and failures. The science/art of developing species-selective baits is very new, and the potential for engineering specific features into these baits is vast. Despite the recent tendency to condemn longlining, this ancient technology has the potential to be the most environmentally benign, in fisheries where species-selective baits are feasible.

Fish Behavior and Species Separation in Gulf of Maine Multispecies Trawls

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Abstract:

New England Fisheries Management Council reported substantial increases in overall biomass of twelve managed groundfish species in the northeast United States, even though the growth was not uniform among managed species. Among those species, haddock (*Melanogrammus aeglefinus*) spawning biomass showed the greatest increase. As a result, haddock stocks have been considered as “not experiencing overfishing”. Cod (*Gadus morhua*) on the other hand, are still being “overfished” and experiencing “overfishing”. Various management measures implemented and/or being considered are aimed at reducing the mortality of cod to foster recovery of this important species. This presentation describes the design and sea trials of a trawl targeting haddock and releasing cod and other demersal species in the Gulf of Maine multispecies trawl fishery. The key feature of the new trawl is the use of ropes, instead of netting, for the horizontal separator. The new trawl reduced cod catch by 61% to 82%, with an associated reduction in haddock of 16 to 38%, both in numbers. Catch of flounders was virtually nil in the new trawl. There was also substantial reduction in other commercial and discard species such as dogfish (*Squalus acanthias*), wolffish (*Anarhichas lupus*), lobsters (*Homarus americanus*), and skates (*Raja* spp), using the new rope separator trawl. On average, 85%

of all catch in numbers were haddock when using the new trawl compared with 52% when using the commercial (control) trawl. Fish behavioral observations revealed that the rope panel enhanced species separation by allowing haddock to swim up and cod to swim down the rope panel. The new gear was practical in terms of handling and operation. It has potential for use in Special Access Programs targeting haddock with much reduced cod catch and eliminated flounder catch.

The Performance of a Haddock-Separator Trawl on Georges Bank
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Abstract:

Separator trawls have been shown to effectively separate cod and haddock in the northeast Atlantic, but information on the performance of separator trawls is relatively limited in U.S. Northwest Atlantic waters. The haddock resource on Georges Bank has undergone rapid rebuilding but the recovery of Georges Bank cod has been slow, in part because of the difficulty in avoiding cod in multispecies fisheries. Development of a more selective fishing gear is necessary to harvest haddock without jeopardizing the recovery of cod. A field experiment was designed to examine the feasibility of using a net panel or "haddock separator" placed inside a trawl to reduce the bycatch of cod in the Georges Bank haddock fishery. The expected behavioral pattern of the two species, in which haddock rise when encountering the separator panel and cod swim down, was examined using video technology. The field results showed a significantly reduced cod-to-haddock ratio (11%) in the experimental trawl compared to the control net (43%). However, there was also a concurrent 42% reduction in the catch of haddock in the separator trawl which represents an important economic loss, and is an industry concern.

Evolution of Gear Design to Improve the Size Selectivity of Black Sea Bass, *Centropristis striata*, Habitat Traps
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Abstract:

Fish traps are widely used in the black sea bass, *Centropristis striata*, fishery. Despite the use of escape vents in the traps, the capture of sub-legal fish (<28 cm TL) continues to be problematic. Discard mortality from traps operating at depths of up to 40 meters can be the result of physiologic complications due to rapid ascent, decompression, thermal differences (Collins et. al., 1999) as well as increased predation. In an attempt to reduce discard mortality, modified sea bass trap designs were tested that would facilitate the release of sub-legal sea bass prior to haul-back. Habitat traps (unbaited traps with long soak times) were fit with two escape vents of multiple shapes (circle and square) and sizes. Results indicate that while escape vents are effective in allowing some modest escapement, significant numbers of sub-legal fish were still retained. A second study evaluated the effectiveness of a drop pot (baited trap with short soak time) constructed with large mesh panels that provided multiple escape avenues. Results from this study indicate that by providing the fish with multiple escape routes the efficiency of escapement can be significantly increased without concomitant reduction in the CPUE of legal size sea bass.

Effectiveness of Selective Flatfish Trawls in Reducing Rockfish (*Sebastes*) Bycatch in the U.S. West Coast Nearshore Groundfish Trawl Fishery

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Abstract:

We evaluated the effectiveness of selective flatfish trawls, first required for the U.S. west coast nearshore groundfish trawl fishery (north of 40° N. latitude) in 2005, using data from Oregon vessels sampled by the NMFS West Coast Groundfish Observer Program and Oregon logbook and landing receipt data. Landing receipt and logbook data were utilized to evaluate the level of utilization of selective flatfish trawls by west coast vessels. Bycatch rates (kg bycatch/kg of northern target) were also estimated for the nearshore trawl fishery for bimonthly limit periods between January 2005 and April 2006 and compared with bycatch rates from research trials on the continental shelf (King et al. 2004) and those measured in a large-scale fishery test conducted in 2004 (Parker et al. 2004) to evaluate whether or not bycatch reduction targets have been met by the fishery.

Development and Fishery-Scale Test of a Selective Flatfish Trawl off the U.S. West Coast

Parker, S.J., Hannah, R.W., Matteson, K.M., King, S.E., and Buell, T.V., Oregon Department of Fish and Wildlife, Hatfield Marine Science Center, Newport, OR 97365

Abstract:

The Oregon Department of Fish and Wildlife, along with NOAA NWFSC, and industry participation by Foulweather Trawl designed a flatfish-selective bottom trawl. The trawl was loosely modeled after a Faroe Islands design in that it utilized a low-rise, severely cut back headrope, and the natural tendency for some species of fish to rise off bottom when reacting to an approaching bottom trawl. An alternate-haul experimental design on the continental shelf and slope showed significant reductions in the catch rates for many rockfish species, Pacific hake, and Pacific halibut. The essential characteristics of the trawl were then defined in rule and eight vessels were allowed to commercially fish with an observer on board to test the trawl's performance over a broad geographic area, and to develop bycatch rates for several overfished species. The trawl's performance was consistent in all tests. Reduced catch rates of canary rockfish lowered constraints on target flatfish catch limits. However, darkblotched rockfish catch was not reduced, suggesting that use of the selective flatfish trawl from shore out to depths of 183 m was optimal to minimize rockfish bycatch and maximize flatfish catch. The trawl was implemented as mandatory gear shoreward of the Rockfish Conservation Area in 2005.

Application of the Juvenile and Trash Excluder Device in Southeast Asia

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Abstract:

Since 1998, SEAFDEC/TD has completed numerous experimental trials on the release of juveniles and trash fish from trawl fishing gear through the use of JTEDs in the Southeast Asian water. TD has compiled all information data from the experiments on JTEDs in SEAFDEC member countries in order to present the efficiency of these devices. Besides, the demonstration and experiment in the waters off member countries, the JTEDs have been experimented in the flume tanks of several education institutes in order to improve its performance, especially the Semi-curved rigid sorting grid. The SEAFDEC member countries have continued their implementation of JTEDs in their home countries. The JTEDs have recently been adopted in

waters of Calbayog City in the Philippines. A pilot project on their use has also been launched in waters of Kadah State, west Malaysia. SEAFDEC Training Department will continue to promote the use of JTEDs in Southeast Asian region and other non-member countries under the Project on Responsible Fishing Technologies and Practices with the support of Japanese Trust Fund and the fund provided by GEF/UNEP/FAO under an agreement on the support to activities which is part of the global project for the "Reduction of Environment Impact from Tropical Shrimp Trawling through the Introduction of By-catch Reduction Technologies and Change of Management".

Gear Modifications to Reduce Finfish Bycatch and Small Shrimps in the Gulf of Maine Shrimp Trawl Fishery

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Vincent Balzano, F/V "North Star", Saco, ME

David Goethel, F/V "Ellen Diane", Hampton, NH

Abstract:

The mandatory use of the Nordmore Grid in the Gulf of Maine pink shrimp fishery since early 1990s has greatly reduced finfish bycatch. However, the Nordmore grid can not reduce small fish and small shrimp that pass through the 25 mm grid spacing. As a result, small fish are still being caught and discarded. Capture and landing of small shrimps wastes resources without added to the landed value. This presentation will report devices and designs which reduces finfish bycatch and small shrimps in the pink shrimp fishery. The devices tested include duel grid systems for reducing small shrimps, rope grid for reducing finfish, and toplless trawl for reducing pelagic species.

The effect of codend mesh size on the escapement of juvenile red snapper in the Gulf of Mexico shrimp trawl fishery

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Abstract:

Two experiments were conducted to evaluate the relative efficiency of conventional codends in excluding juvenile red snapper (*Lutjanus campechanus*) in the Gulf of Mexico shrimp trawl fishery. A conventional codend, constructed of 44-mm diamond mesh was tested against a fine mesh codend in a paired comparison. The conventional codend significantly reduced the capture of juvenile red snapper by 65% without affecting the capture of targeted shrimp. Based on these results, the 44-mm mesh codend was tested against a 51-mm codend of the same design. As compared to the 44-mm codend, the larger mesh codend significantly reduced juvenile snapper capture by 24% without experiencing a significant reduction in shrimp. The diamond mesh codends were estimated to be inefficient in allowing other finfish species to escape through the latterly compressed openings of diamond shaped meshes. However, the compressiform morphology of juvenile red snapper appears suitable for escapement through the orientation of diamond meshes. It was concluded that increasing the mesh size of conventional diamond-mesh codends to 51-mm could augment the juvenile red snapper escapement observed with existing bycatch reduction technology without compromising shrimp harvest.