

Marine Science Review - 187

Fish and fisheries



In this review:

- A. Recent articles – no abstract available
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A. Recent articles – no abstract available

Scales, H., Balmford, A., Liu, M., Sadovy, Y., and Manica, A. **Keeping bandits at bay?** *Science* 313(5787): 612-613, 2006.

Hughes, T.P., Berkes, F., Steneck, R.S., Wilson, J.A., Bellwood, D.R., Crona, B., Folke, C., Gunderson, L.H., Leslie, H.M., Norberg, J., Nystrom, M., Olsson, P., Osterblom, H., Scheffer, M., and Worm, B. **Keeping bandits at bay? Response.** *Science* 313(5787): 614, 2006.

Lackey, R.T., Lach, D.H., and Duncan, S.L. **Policy options to reverse the decline of wild Pacific salmon.** *Fisheries* 31(7): 344-351, 2006.

Sanchez-Alcantara, I., Aburto-Oropeza, O., Balart, E.F., Cupul-Magana, A.L., Reyes-Bonilla, H., and Sanchez-Ortiz, C. **Threatened fishes of the world: *Holacanthus passer* Valenciennes, 1846 (Pomacanthidae).** *Environmental Biology of Fishes* 77(1): 97-99, 2006.

B. Recent publications available online

Roheim, C.A. and Sutinen, J. 2006. **Trade and Marketplace Measures to Promote Sustainable Fishing Practices.** ICTSD Natural Resources, International Trade and Sustainable Development Series Issue Paper No. 3, International Centre for Trade and Sustainable Development and the High Seas Task Force, Geneva, Switzerland. 48pp.

Available at: http://www.ictsd.org/pubs/ictsd_series/nat_res/Roheim_Sutinen_2006.pdf

Notes: This issue paper describes and assesses trade measures currently employed under multilateral fisheries management agreements to promote sustainable fishing, and considers the compatibility of trade measures within fishing agreements with these international obligations. The paper also looks at the role of civil society groups and private sectors in promoting sustainable fishing through marketplace measures.

C. Recent articles with abstracts

Catchpole, T.L., Frid, C.L.J., and Gray, T.S. **Importance of discards from the English *Nephrops norvegicus* fishery in the North Sea to marine scavengers.** *Marine Ecology Progress Series* 313: 215-226, 2006.

Notes: Discards refer to that part of the catch which is returned to the sea during commercial fishing operations. Organisms that do not survive the discarding process can provide an additional food source to scavenging species. The aim of this study was to determine whether the quantity and quality of discarded material from the intensively fished English *Nephrops norvegicus*

fishery is such that it has a positive effect on marine scavenger populations. Field studies were used to identify marine scavenger species and estimate their abundance. Discard experiments combined with data from commercial vessels provided estimates of the partitioning of discards between aerial and marine scavengers and the spatial distribution of discarding. A bioenergetic model was devised to evaluate the importance of discards to marine scavengers. Seabirds utilised an estimated 57% of the discarded material; most discarding (83%) took place over the fishing grounds. Species identified as marine discard scavengers included *Liocarcinus depurator*, *Asterias rubens*, *Neptunea antiqua*, *Pagurus bernhardus*, *Carcinus maenas*, *Cancer pagurus* and *Myxine glutinosa*. The hagfish *M. glutinosa* was the most abundant scavenger, and made up 79% by weight of all identified marine scavengers on the fishing grounds. The energy available from discards could potentially provide the identified marine discard scavengers on the fishing grounds with 37% of their energetic requirements during the fishing season. This level of contribution is probably sufficient to allow larger populations of these scavenging species to exist than would otherwise be possible.

Mangel, M., Levin, P., and Patil, A. **Using life history and persistence criteria to prioritize habitats for management and conservation.** *Ecological Applications* 16(2): 797-806, 2006.

Notes: In many marine and terrestrial systems, individuals of a focal species may be found in habitats that are neither essential nor of particular concern for conservation. For example, finding fish in a location does not make that location essential. This recognition begs the question of how one identifies the most important habitats for a particular species. We introduce new tools for use when prioritizing habitats for conservation and management, with application to Essential Fish Habitat (EFH). If density-dependent effects can be ignored, then elasticities of population growth rate with respect to adult survival, fecundity, and juvenile survival provide a means of identifying how susceptible the growth rate of the population is to perturbations in vital rates of particular life stages. We develop such a theory and apply it to 16 species of commercially harvested *Sebastes* rockfishes. We also show that the conclusions may differ significantly depending upon the estimate of mortality rate that is used. This suggests that although estimating mortality rates of fish in the field is difficult, it is crucial to do so. When density-dependent effects are important, we use a stochastic life history model to compute the moderate-term persistence of the stock, an important metric of population biology, as a function of the demographic parameters determined by the habitat. Although developed with fish in mind, the ideas here also apply to other taxa and systems.

Hart, D.R. and Rago, P.J. **Long-term dynamics of US Atlantic sea scallop *Placopecten magellanicus* populations.** *North American Journal of Fisheries Management* 26(2): 490-501, 2006.

Notes: Biomass and commercial catch rates of Atlantic sea scallops *Placopecten magellanicus* in the USA generally declined from the 1960s through the mid-1990s as fishing mortality increased. Sporadic large recruitment events temporarily increased landings but also encouraged higher overall fishing effort and thereby contributed to the long-term declines in resource abundance. In 1994, a number of new management measures were introduced, including a moratorium on new permits, limitations on days at sea, gear and crew restrictions, and year-round closed areas. During 1994-2005, the biomass of sea scallops in the U.S. sector of Georges Bank increased by a factor of about 18, while the biomass of sea scallops in the Middle Atlantic Bight increased by about eight times. These increases were primarily due to the area closures. Biomass in the Georges Bank closed areas was 25 times higher in 2005 than in 1994, and the 2005 level constituted over 80% of the biomass in the U.S. portion of Georges Bank. Substantial increases in sea scallop abundance and biomass also occurred in two of the three areas in the Middle Atlantic Bight that were closed rotationally to sea scallop fishing for 3 years. Mean recruitment on Georges Bank did not significantly increase since the closures there, but very strong recruitment has been observed downstream of one of the mid-Atlantic rotational closures. In the open areas, responses to effort reduction measures were minimal until 1999, but biomass, commercial catch rates, and landings substantially increased during 1999-2005 due to effort controls and increased recruitment in the Middle Atlantic Bight. The recovery of U.S. sea scallop populations demonstrates that the combination of effort controls and area management can rapidly rebuild severely depleted fisheries.

Levin, P.S., Holmes, E.E., Piner, K.R., and Harvey, C.J. **Shifts in a Pacific ocean fish assemblage: the potential influence of exploitation.** *Conservation Biology* 20(4): 1181-1190, 2006.

Notes: As in many regions of the world, marine fishes and invertebrates along the Pacific coast of the United States have long been subjected to over-exploitation. Despite this history, however, we lack basic information on the current status of many fishes along this coastline. We used data from a quarter century of fishery independent, coast-wide trawl surveys to study systematically the demersal fish assemblages along the U.S. Pacific coast. We documented fundamental shifts in this fish assemblage. Average fish size, across a diversity of species, has declined 45% in 21 years. There have been major shifts in the constituent species of the assemblage, with some species achieving annual population growth rates of > 10% and others declining in excess of 10% per year. Annual rate of change in population size appeared to be a function of life history interacting with fishing pressure. Negative trends in population size were particularly apparent in rockfish (*Sebastes* spp.). However across all taxa examined, trends in population size were associated with size of maturity, maximum size, and growth rate. Trends in population size were associated inversely with harvest levels, but stocks that mature late tended to decline faster than would be predicted by catch rates alone. Our results are disquieting because they raise the possibility that fishing-induced phase shifts in fish communities may affect the recovery of fishes, even after the implementation of severe fishing restrictions.

Rosenberg, A.A., Swasey, J.H., and Bowman, M. **Rebuilding US fisheries: progress and problems.** *Frontiers in Ecology and Environment* 4(6): 303-308, 2006.

Notes: The Magnuson-Stevens Fishery Conservation and Management Act of 1996 requires an end to overfishing and the rebuilding of depleted fishery resources. Nine years later, the progress towards rebuilding overexploited marine fisheries in the United States is reviewed here. Despite the statutory mandate, overfishing and depletion of important fish stocks remains a widespread problem in the US. Sixty-seven fish stocks are currently under rebuilding plans mandated by law. Overfishing, where the fishing mortality rate exceeds the level that should support the maximum sustainable yield (F-MSY), continues in 45% of the stocks managed in rebuilding plans. Seventy-two percent of these stocks are still considered overfished, with measurable abundance remaining depleted below a predetermined threshold according to the standards set by the National Marine Fisheries Service and the Regional Fishery Management Councils. Only three stocks have been rebuilt to levels that should produce maximum sustainable yield. However, fish stock abundance appears to be increasing in 48% of the stocks under rebuilding plans. The clearest cause of the lack of progress in rebuilding is the failure of many plans to reduce exploitation sufficiently to end overfishing.

Pederson, H.G. and Johnson, C.R. **Predation of the sea urchin *Heliocidaris erythrogramma* by rock lobsters (*Jasus edwardsii*) in no-take marine reserves.** *Journal of Experimental Marine Biology and Ecology* 336(1): 120-134, 2006.

Notes: The formation of sea urchin 'barrens' on shallow temperate rocky reefs is well documented. However there has been much conjecture about the underlying mechanisms leading to sea urchin barrens, and relatively little experimentation to test these ideas critically. We conducted a series of manipulative experiments to determine whether predation mortality is an important mechanism structuring populations of the sea urchin *Heliocidaris erythrogramma* in Tasmania. Tethered juvenile and adult sea urchins experienced much higher rates of mortality inside no-take marine reserves where sea urchin predators were abundant compared to adjacent fished areas where predators were fewer. Mortality of tagged (but not tethered) sea urchins was also notably higher in marine reserves than in adjacent areas open to fishing. When a range of sizes of sea urchins was exposed to three sizes of rock lobsters in a caging experiment, juvenile sea urchins were eaten more frequently than larger sea urchins by all sizes of rock lobster, but only the largest rock lobsters (> 120 mm CL) were able to consume large adult sea urchins. Tagging (but not tethering) juvenile and adult sea urchins in two separate marine reserves indicated that adult sea urchins experience higher predation mortality than juveniles, probably because juveniles can shelter in cryptic microhabitat more effectively. In a field experiment in which exposure of sea urchins to rock lobster (*Jasus edwardsii*) and demersal reef fish predators was manipulated, rock lobsters were shown to be more important than fish as predators of adult sea urchins in a marine reserve. We conclude that predators, and particularly rock lobsters, exert significant predation mortality on *H. erythrogramma* in Tasmanian marine reserves, and that adult sea urchins are more vulnerable than smaller cryptic individuals. Fishing of rock lobsters is likely to reduce an important component of mortality in *H. erythrogramma* populations.

Ottersen, G., Hjermann, D.O., and Stenseth, N.C. **Changes in spawning stock structure strengthen the link between climate and recruitment in a heavily fished cod (*Gadus morhua*) stock.** *Fisheries Oceanography* 15(3): 230-243, 2006.

Notes: Atlantic cod (*Gadus morhua*) is one of the commercially most important fish species in the North Atlantic and plays a central role in several ecosystems. Fishing pressure has been heavy over a prolonged period and the recent decades have shown dramatic decline in abundance of many stocks. The Arcto-Norwegian (or North-east Arctic) cod stock in the Barents Sea is now the largest stock of Atlantic cod. Recruitment to this stock has varied extensively during the last 60 yr. There is evidence for fluctuations in climate, particularly sea temperature, being a main cause for this variability, higher temperatures being favourable for survival throughout the critical early life stages. Our studies of time series present compelling evidence for a strengthening of the climate-cod recruitment link during the last decades. We suggest this is an effect of the age and length composition of the spawning stock having changed distinctly. The age of the average spawner has decreased by more than 3 yr from between 10 and 11 in the late 1940s to 7-8 in the 1990s, average length from just above 90 cm to around 80 cm. The number of age classes contributing to the spawning stock has also decreased, while the number of length groups present increased slightly. Significant decrease in age of spawners has frequently been described for other heavily fished stocks worldwide. We therefore find it likely that the proposed mechanism of increased influence of climate on recruitment through changes in the spawning stock age and size composition is of a general nature and might be found in other systems.

Fox, K.J., Grafton, R.Q., Kompas, T., and Che, T.N. **Capacity reduction, quota trading and productivity: the case of a fishery.** *Australian Journal of Agriculture and Resource Economics* 50(2): 189-206, 2006.

Notes: We present the first *ex post* study that quantitatively analyses the effects of a licence buy-back and enhanced quota trading on the profitability and productivity of individual vessels in a fishery. Using firm-level data and a profit index decomposition method, we find that small and large vessels and three different trawler fleets all experienced substantial productivity gains in the year immediately following a licence buy-back and the establishment of a quota brokerage service. The apparent ongoing benefits of the buy-back and increased quota trading over the sample period are in stark contrast to the generally unfavourable long-term outcomes commonly associated with vessel buy-backs in input-controlled fisheries.

Broadhurst, M.K., Suuronen, P., and Hulme, A. **Estimating collateral mortality from towed fishing gear.** *Fish and Fisheries* 7(3): 180-218, 2006.

Notes: More than 50% of the world's total marine catch (approximately 81 million tonnes) is harvested using towed fishing gears (i.e. Danish seines, dredges and otter and beam trawls). As for all methods, the total fishing mortality of these gears comprises the reported (landed) and unreported catch and other unaccounted, collateral deaths due to (i) avoiding, (ii) escaping, (iii) dropping out of the gear during fishing, (iv) discarding from the vessel, (v) ghost fishing of lost gear, (vi) habitat destruction or subsequent (vii) predation and (viii) infection from any of the above. The inherent poor selectivity of many towed gears, combined with their broad spatial deployment, means that there is considerable potential for cumulative effects of (i)-(viii) listed above on total fishing mortality, and subsequent wide-scale negative impacts on stocks of important species. In this paper, we develop a strategy for minimizing this unwanted exploitation by reviewing all the primary literature studies that have estimated collateral, unaccounted fishing mortalities and identifying the key causal factors. We located more than 80 relevant published studies (between 1890 and early 2006) that quantified the mortalities of more than 120 species of escaping (26 papers) or discarded (62 papers) bivalves, cephalopods, crustaceans, echinoderms, elasmobranchs, reptiles, teleosts and miscellaneous organisms. Seven of these studies also included the estimates of mortalities caused by dropping out of gears, predation and infection [(iii), (vii) and (viii) listed above]. Owing to several key biological (physiology, size and catch volume and composition), environmental (temperature, hypoxia, sea state and availability of light) and technical (gear design, tow duration and speed) factors, catch-and-escape or catch-and-discarding mechanisms were identified to evoke cumulative negative effects on the health of most organisms. We propose that because the mortalities of discards typically are much greater than escapees, the primary focus of efforts to mitigate unaccounted fishing mortalities should concentrate on the rapid, passive, size and species selection of non-target organisms from the anterior sections of towed gears during fishing. Once maximum selection has been achieved and demonstrated to cause few mortalities, efforts should be made to modify other operational and/or post-capture handling procedures that address the key causal factors listed above.

Adjers, K., Appelberg, M., Eschbaum, R., Lappalainen, A., Minde, A., Repecka, R., and Thoresson, G. **Trends in coastal fish stocks of the Baltic Sea.** *Boreal Environment Research* 11(1): 13-25, 2006.

Notes: Coastal fish monitoring with multi-mesh gill nets and gill net series is carried out in eleven areas around the Baltic Sea. The purpose of the monitoring is to reveal population status and elucidate long-term trends of fish population and community development. Time series cover 9-20 years of annual monitoring, the last year being 2002. Significant increasing trends of perch and roach catches were observed in the archipelago region of the Sea of Aland and Archipelago Sea. A possible reason for these trends was ongoing coastal eutrophication. Significant trends with opposite directions appeared in two areas in the Gulf of Bothnia and two areas at the Swedish coast of the Baltic Proper. The Curonian Lagoon is severely affected by anthropogenic impact, structuring the local fish community. Indications of decreased eutrophication were noted in the Gulf of Riga. High fishing pressure during the 1990s in the West-Estonian archipelago and the following collapse of coastal fish stocks was apparent in the monitoring catches.

Naegel, L.C.A. and Lopez-Rocha, J.A. **Can the collection of "Tyrian Purple" from *Plicopurpura pansa* (Gould, 1853) (Prosobranchia, Muricidae) be blamed for its declining population?** *Journal of Shellfish Research* 25(2): 395-398, 2006.

Notes: Marked, sized and sex determined purple snails *Plicopurpura pansa*, (Gould, 1853) were distributed randomly among other snails in crevices of an intertidal rocky island splashed during high tides by high impact waves. After 89 days 18%, after 117 days 12%, after 145 days 8% and after 183 days only 3% of the marked snails could be recovered. There was no statistically significant difference between size and sex and the recovery rate. In the laboratory we determined the time needed for reattachment to the surface under different situations. Snails placed with the aperture down on a wet surface or in water reattached themselves after about 20 min, snails placed in water on their backs; in about 40 min, and snails left on a wet surface on their backs after 2 hours. After 4 hours only 50% of the snails placed on their backs in a wet surface were found to be reattached. Great differences were noticed in the period needed for reattachment among individual snails. The time needed for the snails to overcome the stress of being detached from the surface and to reattach themselves again can be blamed for the loss of animals during the increasing incoming tides combined with the high impact wave actions. The prohibition of "milking" *P. pansa* to obtain "Tyrian Purple" and to collect the snails as a bait for fishery or as a special food for foreigners should be enforced and should be extended to the removal the snails from the crevices of intertidal rocks.

Hiddink, J.G., Hutton, T., Jennings, S., and Kaiser, M.J. **Predicting the effects of area closures and fishing effort restrictions on the production, biomass, and species richness of benthic invertebrate communities.** *ICES Journal of Marine Science* 63(5): 822-830, 2006.

Notes: To effectively implement an Ecosystem Approach to Fisheries (EAF), managers need to consider the effects of management actions on the fishery and the ecosystem. Methods for assessing the effects on target stocks are generally well developed, but methods for assessing the effects on other components and attributes of the ecosystem are not. Area closures and effort controls are widely used fishery management tools that affect the distribution of fishing effort and may therefore have consequences for a range of species and habitats. An approach is developed to predict the effects of area closures and effort control on the biomass, production, and species richness of benthic communities in the North Sea. The redistribution of beam trawling effort as a result of management action was modelled with a random utility model, assuming that fishers selected fishing grounds on the basis of their knowledge of past catch rates. The effects of trawling on benthic invertebrates were predicted using a size-based model that accounted for differences in habitat among fishing grounds. Our simulations demonstrated that closures of different sizes and in different locations could have positive or negative effects on benthic communities. These predicted effects resulted from the trade-off between recovery in the closed areas and additional trawling effects in the open areas that arose from displaced fishing activity. In the absence of effort controls, closure of lightly fished areas had the strongest positive effect on benthic communities. Effort reduction also had a positive effect. Therefore, area closures in lightly fished areas, coupled with effort reduction, are expected to minimize the effects of fishing on benthic communities. As it was not possible to access full international data for the North Sea beam trawl fleet, the results of the analyses are illustrative rather than complete. Nevertheless, what is demonstrated is an effective approach for assessing the environmental consequences of fishery management action that can be used to inform management decision-making as part of an EAF.

Horwood, J., O'Brien, C., and Darby, C. **North Sea cod recovery?** *ICES Journal of Marine Science* 63(6): 961-968, 2006.

Notes: Recovery of depleted marine, demersal, commercial fish stocks has proved elusive worldwide. As yet, just a few shared or highly migratory stocks have been restored. Here we review the current status of the depleted North Sea cod (*Gadus morhua*), the scientific advice to managers, and the recovery measures in place. Monitoring the progress of North Sea cod recovery is now hampered by considerable uncertainties in stock assessments associated with low stock size, variable survey indices, and inaccurate catch data. In addition, questions arise as to whether recovery targets are achievable in a changing natural environment. We show that current targets are achievable with fishing mortality rates that are compatible with international agreements even if recruitment levels remain at the current low levels. Furthermore, recent collations of data on international fishing effort have allowed estimation of the cuts in fishing mortality achieved by restrictions on North Sea effort. By the beginning of 2005, these restrictions are estimated to have reduced fishing mortality rates by about 37%. This is insufficient to ensure recovery of North Sea cod within the next decade.

de Roos, A.M., Boukal, D.S., and Persson, L. **Evolutionary regime shifts in age and size at maturation of exploited fish stocks.** *Proceedings of the Royal Society B* 273(1596): 1873-1880, 2006.

Notes: Worldwide declines of fish stocks raise concerns about deleterious consequences of harvesting for stock abundances and individual life histories, and call for appropriate recovery strategies. Fishes in exploited stocks mature earlier at either larger or smaller sizes due to both genetic and plastic responses. The latter occur commonly when reduced competition for food leads to faster growth. Using a size-structured consumer-resource model, which accounts for both genetic and plastic responses, we show that fisheries-induced evolutionary changes in individual life history and stock properties can easily become irreversible. As a result of annual spawning, early maturation at small sizes and late maturation at large sizes can become alternative, evolutionarily and ecologically stable states under otherwise identical environmental conditions. Exploitation of late-maturing populations can then induce an evolutionary regime shift to smaller maturation sizes associated with stepwise, 1-year decreases in age at first reproduction. Complete and early fishing moratoria slowly reverse this process, but belated or partial closure of fisheries may accelerate or even instigate further evolution to smaller sizes at maturation. We suggest that stepwise decreases in maturation age can be used as early warnings of upcoming evolutionary changes, and should inspire timely restrictions of fisheries.

Enberg, K., Fowler, M.S., and Ranta, E. **The impacts of different management strategies and environmental forcing in ecological communities.** *Proceedings of the Royal Society B* 273(1600): 2491-2499, 2006.

Notes: Understanding the effects of population management on the community a target species belongs to is of key importance for successful management. It is known that the removal or extinction of a single species in a community may lead to extinctions of other community members. In our study, we assess the impacts of population management on competitive communities, studying the response of both locally stable and unstable communities of varying size (between four and 10 species) to three different management strategies; harvesting of a target species, harvesting with non-targeted catch, and stocking of the target species. We also studied the consequences of selecting target species with different relative abundances, as well as the effects of varying environmental conditions. We show here how the effects of management in competitive communities extend far beyond the target population. A crucial role is played by the underlying stability properties of the community under management. In general, locally unstable communities are more vulnerable to perturbation through management. Furthermore, the community response is shown to be sensitive to the relative density of the target species. Of considerable interest is the result that even a small (2.5%) increase in the population size of the target species through stocking may lead to extinction of other community members. These results emphasize the importance of considering and understanding multi-species interactions in population management.

Holland, D.S. and Schnier, K.E. **Protecting marine biodiversity: a comparison of individual habitat quotas and marine protected areas.** *Canadian Journal of Fisheries and Aquatic Sciences* 63(7): 1481-1495, 2006.

Notes: Fisheries managers in the United States are required to identify and mitigate the adverse impacts of fishing activity on essential fish habitat (EFH). There are additional concerns that the viability of sessile noncommercial species, animals that are habitat dependent and (or) are themselves constituents of fishery habitat, may be threatened by fishing activities. We propose a system of individual habitat quotas (IHQ) to achieve habitat conservation and species protection cost effectively. Individual

quotas of habitat impact units would be distributed to fishers with an aggregate quota set to maintain a target habitat "stock". Using a dynamic, spatially explicit fishery simulation model, we explore the efficiency and effectiveness of an IHQ policy versus marine protected areas (MPAs) for conserving habitat-dependent, sessile species of unknown spatial distributions. Our findings indicate that an IHQ policy with a conservatively established habitat target is better suited to the protection of sessile nontarget species than a rotating or fixed MPA policy.

Branch, T.A., Hilborn, R., Haynie, A.C., Fay, G., Flynn, L., Griffiths, J., Marshall, K.N., Randall, J.K., Scheuerell, J.M., Ward, E.J., and Young, M. **Fleet dynamics and fishermen behavior: lessons for fisheries managers.** *Canadian Journal of Fisheries and Aquatic Sciences* 63(7): 1647-1668, 2006.

Notes: We review fleet dynamics and fishermen behavior from an economic and sociological basis in developing fisheries, in mature fisheries near full exploitation, and in senescent fisheries that are overexploited and overcapitalized. In all cases, fishing fleets behave rationally within the imposed regulatory structures. Successful, generalist fishermen who take risks often pioneer developing fisheries. At this stage, regulations and subsidies tend to encourage excessive entry and investments, creating the potential for serial depletion. In mature fisheries, regulations often restrict season length, vessel and gear types, fishing areas, and fleet size, causing or exacerbating the race for fish and excessive investment, and are typically unsuccessful except when combined with dedicated access privileges (e.g., territorial rights, individual quotas). In senescent fisheries, vessel buyback programs must account for the fishing power of individuals and their vessels. Subsidies should be avoided as they prolong the transition towards alternative employment. Fisheries managers need to create individual incentives that align fleet dynamics and fishermen behavior with the intended societal goals. These incentives can be created both through management systems like dedicated access privileges and through market forces.

Schindler, D.E., Leavitt, P.R., Johnson, S.P., and Brock, C.S. **A 500-year context for the recent surge in sockeye salmon (*Oncorhynchus nerka*) abundance in the Alagnak River, Alaska.** *Canadian Journal of Fisheries and Aquatic Sciences* 63(7): 1439-1444, 2006.

Notes: Returns of sockeye salmon (*Oncorhynchus nerka*) to the Alagnak River in Bristol Bay, Alaska, during the last 3 years were unprecedented in the last five decades. Enumerated run sizes averaged about 1 million fish from 1955 to 2002 but surged unexpectedly to average 5.4 million fish in 2003-2005. These huge returns currently pose a challenge to management of Bristol Bay sockeye for several reasons, including that it is unclear whether the recent surge in abundance is a new phenomenon or if it has arisen as part of interdecadal population variability. To answer this question we used changes in lake sedimentary delta N-15 coupled with an isotope-mixing model to estimate historical abundances of sockeye salmon populations in this ecosystem. Our analyses show that periods of high salmon abundance have occurred every similar to 100 years during the last five centuries, interspersed by prolonged periods of substantially lower abundance. We suggest that the recent high returns are an expression of the long-term variability that is characteristic of this stock and will be a relatively transient phenomenon.

Apostolaki, P., Babcock, E.A., and McAllister, M.K. **Contrasting deterministic and probabilistic ranking of catch quotas and spatially and size-regulated fisheries management.** *Canadian Journal of Fisheries and Aquatic Sciences* 63(8): 1777-1792, 2006.

Notes: Large uncertainties over the dynamics of resource systems have increasingly led to the use of probabilistic modeling in the provision of model-based fishery management advice. However, deterministic analysis still remains the easiest and quickest approach to formulate model-based management advice. Here, we contrast deterministic and probabilistic modeling methods in evaluations of the potential consequences of alternative fishery management measures such as spatial and temporal closures and size-specific regulations. We thereby assess how model-based fishery management advice may vary between deterministic and probabilistic analyses of system dynamics. Using data for the sandbar shark (*Carcharhinus plumbeus*) population off the eastern coast of the USA, it is shown that under a variety of conditions, the use of management measures that provide protection to specific age groups of a population, such as size limits, might be less effective in achieving stock recovery of slow-growing, late-maturing, highly mobile species than catch quotas. It is also shown that management approaches that, according to deterministic calculations, appear to be the most effective are not so when uncertainty in the population dynamics is taken into account.

Olson, R.J., Roman-Verdesoto, M.H., and Macias-Pita, G.L. **Bycatch of jumbo squid *Dosidicus gigas* in the tuna purse-seine fishery of the eastern Pacific Ocean and predatory behaviour during capture.** *Fisheries Research* 79(1-2): 48-55, 2006.

Notes: Squid were recorded by observers in 192 (1.9%) of 9928 purse-seine sets in the tuna fishery in and near the Gulf of California, Mexico (north area) and off Peru and Ecuador (south area) during 1997-2002. The squid were identified as jumbo squid (*Dosidicus gigas*) in 19% of the positive sets, and it was assumed that the squid in the other sets were also *D. gigas* because it is the only large squid that occurs in great numbers in these areas. The total bycatch recorded during 1997-2002 was estimated to be about 50 tonnes in the north area and 435 tonnes in the south area, and total removals may have been more than 600 tonnes. Five or more tonnes (maximum 100 tonnes) of squid were reported in 22 purse-seine sets, demonstrating that aggregations of hundreds of *D. gigas* sometimes occur near the surface during the daytime. The probability of squid bycatch varied significantly with year and set type in the north area and with time of day and year in the south area. Squid bycatch was observed most frequently in sets on unassociated tunas, and less often in mammal and floating-object sets in both the north and south areas. The probability of catching squid was lower at midday than in the morning or afternoon in the south area. Three accounts of squid attacks on skipjack (*Katsuwonus pelamis*) and yellowfin tuna (*Thunnus albacares*) inside the purse seine, and bite damage to the tuna, are described. This study provides the first account, to the authors' knowledge, of interactions between jumbo squid and tunas, and demonstrates considerable plasticity in the schooling behaviour of *D. gigas*.

Watson, R., Revenga, C., and Kura, Y. **Fishing gear associated with global marine catches II. Trends in trawling and dredging.** *Fisheries Research* 79(1-2): 103-111, 2006.

Notes: A new method for associating global marine catch statistics with fishing gears has allowed the creation of maps which detail the changing use of fishing gears such as trawls and dredges from the 1950s to the present. These gears, often associated with high impacts on benthic communities, are associated with a wide range of demersal fish, molluscan and crustacean catch. The use of these gears has increased globally since the 1950s when it accounted for more than 40% of reported catches to a peak in most areas such as North America and Europe in the 1980s. This increase extended into the 1990s along the coast of Argentina particularly for squid. Dredging, usually associated with the catch of bivalves, often peaked later than trawling but had begun to decline in most areas by the 1990s.

Perez-Espana, H., Abarca-Arenas, L.G., and Jimenez-Badillo, M.D. **Is fishing-down trophic web a generalized phenomenon? The case of Mexican fisheries.** *Fisheries Research* 79(3): 349-352, 2006.

Notes: There is a consensus that fisheries around the world have reached their maximum levels of capture, and, in many cases, overexploitation is apparent. On the basis of FAO data, it has been found that overexploitation can be detected as a decrease in the trophic levels of the fisheries due to the greater energetic cost that maintaining high trophic levels implies. After analyzing data from Mexican fisheries on both littorals, no decrease in the trophic level was observed even though catches have reached stable levels since the 1980s. This result is probably due to the multi-species fishery characteristic of the area and the low technological level, rather than to a healthy fishery. Mexican fisheries, being tropical, are mainly multi-specific, implying the capture of several trophic levels at the same time and avoiding, in this way, a single trophic level decrease typical of temperate and mono-specific fisheries.

Bell, J.D., Bartley, D.M., Lorenzen, K., and Loneragan, N.R. **Restocking and stock enhancement of coastal fisheries: Potential, problems and progress.** *Fisheries Research* 80(1): 1-8, 2006.

Notes: The demand for fish is expected to rise substantially by 2020. Although aquaculture must provide much of the additional fish, it remains to be seen whether restored or enhanced capture fisheries can also help fill the projected gap in supply. The key challenges for capture fisheries involve reducing fishing effort, removing excess fishing capacity and building the institutional arrangements needed to restore spawning biomass to more productive levels, and to reverse degradation of

the supporting habitats. Two interventions, based largely on hatchery technology, have the potential to reduce the time needed to rebuild some severely over-exploited fisheries, or improve the productivity of other 'healthy' fisheries. These interventions are 'restocking', which involves releasing cultured juveniles to restore spawning biomass to levels where the fishery can once again support regular harvests, and 'stock enhancement', which involves release of cultured juveniles to overcome recruitment limitation. However, despite the potential of these interventions, few restocking and stock enhancement programmes have met expectations. The main problems have been a pre-occupation with bio-technical research at the expense of objective analysis of the need for the intervention, and failure to integrate the technology within an appropriate management scheme that has the participation and understanding of the users. The papers presented at the Special Symposium on this subject at the Seventh Asian Fisheries Forum provide a series of valuable lessons to guide objective assessment of the potential for restocking and stock enhancement. They also show how to implement these interventions responsibly and effectively where they are deemed to add value to other forms of management. Above all, these studies demonstrate that restocking and stock enhancement programmes are applied in complex human-environment systems, involving dynamic interactions between the resource, the technical intervention and the people who use it.

Kerstetter, D.W. and Graves, J.E. **Effects of circle versus J-style hooks on target and non-target species in a pelagic longline fishery.** *Fisheries Research* 80(2-3): 239-250, 2006.

Notes: The U.S. Atlantic coastal pelagic longline fishery that targets tunas and swordfish also interacts with a wide range of non-target species including billfishes and sea turtles. Preliminary studies indicate that a change in terminal gear from J-style hooks to circle hooks may reduce bycatch mortality, but the effects of this change on catch rates of target species are unclear. To evaluate this, we monitored catch composition, catch rates, hooking location, and number of fish alive at haulback during 85 sets in the fall and spring seasonal fisheries from a commercial vessel operating in the western North Atlantic. Circle (size 16/0, 0° offset) and J-style (size 9/0, 10° offset) hooks were deployed in an alternating fashion. Hook-time recorders were used to assess time at hooking and temperature-depth recorders to measure gear behavior. Catch rates for most species categories were not significantly different between hook types ($P < 0.05$), although circle hooks generally had higher tuna catch rates in the fall and lower swordfish catch rates in the spring. In the fall, both total catches and catches of pelagic rays were significantly higher on J-style hooks. Yellowfin tuna in the fall and dolphinfish in the spring caught on circle hooks were significantly larger than those caught on J-style hooks. In both seasonal fisheries, circle hooks caught fishes in the mouth more frequently than J-style hooks, which hooked more often in the throat or gut, although these differences between hook types were not statistically significant. Yellowfin tuna in the fall fishery were over four times more likely to be hooked in the mouth with circle hooks than with J-style hooks. Several target and bycatch species showed higher rates of survival at haulback with circle hooks, although only for dolphinfish in the fall fishery was this difference statistically significant. Our results suggest that the use of 0° offset circle hooks in the coastal pelagic longline fishery will increase the survival of bycatch species at haulback with minimal effects on the catches of target species.

Parma, A.M., Hilborn, R., and Orensanz, J.M. **The good, the bad, and the ugly: Learning from experience to achieve sustainable fisheries.** *Bulletin of Marine Science* 78(3): 411-427, 2006.

Notes: A broad range of fisheries-management approaches has been used around the world with varying degrees of success. The Fifth International Mote Symposium focused on contrasting strategies and contexts associated with successful experiences with others associated with management failures. A number of general principles for successful fisheries management emerged. These principles emphasize the need to address the causes of management failures directly by creating institutional structures that provide incentives to stop the race for fish and to increase responsibility and accountability of all stakeholders—fishers, scientists, and managers.

Rice, J.C. **Every which way but up: The sad story of Atlantic groundfish, featuring Northern cod and North Sea cod.** *Bulletin of Marine Science* 78(3): 429-465, 2006.

Notes: The histories of the collapses of Northern cod (eastern Canada) and North Sea cod (northern Europe) are reviewed, on the basis of a chronology of the events and themes discussed during the science advisory meetings on the stocks and the subsequent management decisions. Although some important biological details of the collapses differed, the science and

management activities conducted during the declines showed both a number of similarities and some key differences in process. From these similarities and differences several lessons emerge. In particular, science advice is unbiased but uncertain, management responses to advice are asymmetric and favor good news, response time of the full science-management process is too slow to prevent major declines, uncertainty increases during the onset of declines, only swift management action can stem declines at their onset, the process is highly vulnerable to politicization, and poor fishing practices increase just when the stock is most vulnerable. Each of these problems could be addressed, but little evidence indicates that the lessons have yet been learned.

Wilén, J.E. **Why fisheries management fails: Treating symptoms rather than the cause.** *Bulletin of Marine Science* 78(3): 529-546, 2006.

Notes: Most fisheries management controls fishing mortality directly with top-down measures like time and area closures and gear restrictions. Decisions about these measures take place in adversarial, politically charged arenas. Scientists criticize conventional methods, mostly arguing for more draconian applications of the same tools. Economists also criticize them, but because they believe such methods focus on the symptom rather than the cause of problems. From the perspective of economists, the race to fish, the drive to increase fishing power, and the perversion of the politics of the management process are all driven by the insecurity of access faced by fishermen under most systems. Economists believe that fishermen's incentives are distorted by insecure harvest privileges, leading them to compete wastefully with each other and with managers for fish. Alternatives they recommend include "rights-based" harvest privileges. Although the shortcomings of these institutions have been argued about for over two decades, enough evidence has accumulated for a focus on consequences rather than speculation. Virtually all such experience shows that rights-based management institutions alter incentives in ways favorable to conservation and stewardship. An important inducement for behavioral changes is the wealth that is capitalized into the values of permits in rights-based systems.

Hanna, S. **Will structural reform fix fishery management? Commission policy recommendations and the US regional fishery management council system.** *Bulletin of Marine Science* 78(3): 547-562, 2006.

Notes: The regional fishery management councils, under which federal U.S. fisheries are managed, have been the subject of criticism for both their structure and their processes. Many fisheries under their management face overfishing, discards, high management costs, and low industry profitability. Two recent national commissions have recommended structural reforms to address these performance problems. I describe these recommendations and question the sufficiency of these reforms to improve management performance. I call attention to the institutional problems that must also be addressed if the structural reforms are to be effective: the absence of property rights in fishery use and the poor incentive structures facing fishery users and managers. Together these would provide the institutional support needed for fishery management to improve performance.

Newkirk, S.G. **Property rights in fisheries.** *Bulletin of Marine Science* 78(3): 563-573, 2006.

Notes: Fishery managers are increasingly touting the usefulness of market-based management systems like Individual Fishing Quotas (IFQs) and fishery cooperatives, but market-based systems rely on transferability of a share in the fish resource and accordingly imply some form of ownership by the quota holder. Other government policies, such as fishery buy-outs and natural-resource damages after oil spills, also imply some form of ownership of the fish resource by fishermen, but a conflicting perception exists that fish are subject to the Public Trust doctrine, according to which ownership of the fish themselves would be inalienably vested in the government to manage on behalf of the people. The legal basis for this extension of the Public Trust doctrine is tenuous, and case law suggests that one of the necessary characteristics - government ownership - is not possible under current law. Nevertheless, such an extension of the Public Trust doctrine would be desirable because it would permit the government to retract any rights to the resource that it granted - even incidents of ownership - in the event that the public interest called for it. Congress should, by legislation, clarify that the scope of the Public Trust doctrine is intended to cover fishery resources.

Steneck, R.S. **Is the American lobster, *Homarus americanus*, overfished? A review of overfishing with an ecologically based perspective.** *Bulletin of Marine Science* 78(3): 607-632, 2006.

Notes: The American lobster, *Homarus americanus* Milne Edwards, 1837, has been intensely fished for over 150 yrs, but its stocks and landings are greater now than ever before. In the Gulf of Maine, over the past two decades, abundance, landings, spawning potential, and catch per unit effort (CPUE) have increased and fishing mortality rate decreased. Maine's lobster densities are the world's highest (> 1 m² for much of the coast), and trawl surveys over the past two decades reveal a fivefold increase in large, reproductive-phase population densities throughout the region. Nevertheless, the official ("legal") eggs-per-recruit-based overfishing definition indicates that this species is now and has been overfished. Because populations cannot increase when reproductively limited, surplus reproductive capacity must have been available 20 yrs ago to initiate the recent population explosion. A recent review of the eggs-per-recruit biological reference point found it is neither robust nor appropriate for assessment data currently used. The unique biological efficiency of this species and its complex, ontogenetically segregated spatial distribution, together with harvesting inefficiency, make the American lobster fishery resilient but difficult to characterize with a single overfishing index. New and simpler ecologically based indices are needed to gauge and monitor trends toward overfishing of this species.

Ault, J.S., Smith, S.G., Bohnsack, J.A., Luo, J.G., Harper, D.E., and McClellan, D.B. **Building sustainable fisheries in Florida's coral reef ecosystem: Positive signs in the Dry Tortugas.** *Bulletin of Marine Science* 78(3): 633-654, 2006.

Notes: In a series of synoptic research cruises including 4000 research dives, we surveyed reef-fish populations and habitats before and 3 yrs after 2001 implementation of no-take marine reserves covering approximately 566 km² in the Dry Tortugas, Florida. Species richness and composition of 267 fishes remained stable between 1999-2000 and 2004 within the overall survey domain. Reef-fish biodiversity was highest in the more rugose habitats. Domain-wide abundances of several exploited and nonexploited species increased; no declines were detected. In the Tortugas Bank reserve, we found significantly greater abundances and shifts in length composition toward a higher proportion of exploited-phase animals in 2004 than in 1999-2000 for some species. Consistent with marine reserve theory, we detected no declines in exploited species in the reserve, whereas we detected both increases and declines in nontarget species, but the increases in exploited populations may also have been influenced by factors other than protected status. Although the recovery process is still in an early stage, our results after 3 yrs are encouraging and suggest that no-take marine reserves, in conjunction with traditional management, can help build sustainable fisheries while protecting the Florida Keys coral-reef ecosystem.
