

Marine Science Review 159

Fish and Fisheries



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A. Recent articles – no abstract available

Devine, J.A., Baker, K.D., and Haedrich, R.L. **Deep-sea fishes qualify as endangered.** *Nature* 439(7072): 29, 2006.

B. Recent publications available online

Levy, D. 2006. **BC Sockeye Salmon Population Declines: Probable Causes and Recommended Response Strategies.** Sierra Club of Canada, Victoria, BC. 28pp.

Available at: http://www.sierraclub.ca/bc/aa-bc_upload/fd5c29a62a2f2c66bdb73ed43cec4361/SCBC_sockeye_review.pdf

Notes: Numerous BC sockeye populations are declining in abundance and many small populations have unknown status due to the absence of stock assessment information. Sockeye returning to Cultus and Sakinaw Lakes have been designated as “endangered” by COSEWIC and many other populations are potential candidates for listing. In Northern and Central BC, approximately 75% of sockeye populations are either depressed, declining or unknown status and at least 38 populations coast-wide are below 25% of their historical baseline level. Better stock assessment information is required to determine the actual number of depressed stocks and to inform management decisions.

Environmental Justice Foundation. 2005. **What’s the Catch?: Reducing Bycatch in EU Distant Water Fisheries.** Environmental Justice Foundation, London, UK. 13pp.

Available at: http://www.ejfoundation.org/pdf/whats_the_catch.pdf

Notes: This report considers the ecological, economic and livelihoods impact of the large quantities of non-target fish (bycatch) caught and discarded by EU fishing fleets operating in developing countries fisheries. The EU currently has 17 agreements with developing countries allowing EU fishing vessels access to their waters. As such the EU can play a significant role in minimising bycatch.

High Seas Task Force. 2006. **Closing the Net: Stopping Illegal Fishing on the High Seas.** Governments of Australia, Canada, Chile, Namibia, New Zealand, and the United Kingdom, WWF, IUCN and the Earth Institute at Columbia University. 112pp.

Available at: <http://www.high-seas.org/>

Notes: This report is an attempt by a small group of fisheries ministers, together with partners from the non-governmental sphere, to develop an action plan that will bring practical leverage to bear on the problem of IUU fishing. The objective was to crystallise the international debate on the causes and effects of IUU fishing on the high seas and then to take the lead in promoting a practical, interlinked set of solutions to this complex global issue.

Roheim, C.A. and Sutinen, J.G. 2006. **Trade and Market-Related Instruments to Reinforce Fisheries Management Measures to Promote Sustainable Fishing Practices.** Prepared for Heike Baumuller (International Centre for Trade and Sustainable Development) and Frank Meere - High Seas Task Force (OECD). 63pp.

Available at: <http://www.high-seas.org/>

Notes: The report aims to identify measures and methods that can be applied to strengthen the linkages between trade policy, fisheries management, and sustainable development objectives. The trade and market-place measures examined include policies and practices that are used to monitor and track seafood products from the time the fish are caught through to when it is sold to final consumers, including related border controls that allow countries or territories to regulate, restrict or prohibit trade. The analysis in the report pays particular attention to trade and market place-related measures that shape the incentives faced by illegal, unreported and unregulated (IUU) operators with the goal of minimizing the scope for their operations.

Seward and Associates. 2006. **Turning a Blind Eye:** The 'See No Evil' Approach to Wasteful Fishing. Marine Fish Conservation Network, Washington, DC. 28pp.

Available at: http://www.conservefish.org/site/pubs/network_reports/blindeye_lowres.pdf

Notes: This report on the U.S. government's effectiveness during the last five years to minimize bycatch finds that federal fishery managers: • Have not adequately established bycatch reporting systems as mandated by the 1996 amendments to the Magnuson-Stevens Fishery Conservation and Management Act; • Have taken few steps to minimize bycatch; and • Are not accounting for the number of fish killed as bycatch when setting annual catch limits for fisheries. The report also points out that fishery managers need to increase the number of certified biologists who work aboard fishing vessels as observers to properly document the unwanted fish and other ocean wildlife tossed overboard, often dead or dying. It also charges that fishery managers should increase efforts to reduce this wasteful practice and, where bycatch is unavoidable, must factor in the number of fish killed as bycatch in other fisheries when setting catch limits to avoid taking too many fish out of the ocean. Considering that in 2002 fishermen discarded at least 2.2 billion pounds of bycatch nationally, ignoring bycatch data when setting catch limits could be significantly contributing to the decline of ocean fish populations.

C. Recent articles with abstracts

Coll, M., Palomera, I., Tudela, S., and Sarda, F. **Trophic flows, ecosystem structure and fishing impacts in the South Catalan Sea, Northwestern Mediterranean.** *Journal of Marine Systems* 59(1-2): 63-96, 2006.

Notes: An exploited ecosystem from the continental shelf and upper slope of the Northwestern Mediterranean Sea was described by means of an Ecopath mass-balance model with the aim of characterising its functioning and structure and describing the ecosystem impacts of fishing. This application included some complexities added to the general modelling methodology due to the high biodiversity of the Mediterranean Sea and the multispecific nature of the fishery, and to the difficulties of working with fishing data which are usually irregularly or imprecisely collected. The model comprised 40 functional groups including primary producers, the main species of benthic, demersal and pelagic invertebrates, fishes and non-fish vertebrates and three detritus groups. In addition, trawling, purse seine, longline and troll bait fishing fleets were

included. Results showed that the functional groups were organized into four trophic levels with the highest levels corresponding to anglerfish, dolphins, large pelagic fishes and adult hake. The system was dominated by the pelagic fraction, where sardine and anchovy prevailed in terms of fish biomasses and catches. Detritus and detritivorous groups also played key roles in the ecosystem and important coupled pelagic-demersal interactions were described. Considering Odum's theory of ecosystem development, the ecosystem was placed on an intermediate-low developmental stage due, at least partially, to the impact of fishing activity. This highlighted the high intensity of fishing in the ecosystem, in accordance with the general assessment of western Mediterranean marine resources, and fishing fleets were ranked as top predators of the system. The low trophic level of the catch was in line with the long history of exploitation in the area. However, the steady decline of pelagic landings between 1994 and 2003, coupled with a decrease of the pelagic biomass within the system, underlined the low resistance of the system in front of perturbations. This decline was reproduced under Ecosim dynamic simulations combining different scenarios of moderate increase of fishing effort and an environmental forcing affecting the availability of preys to small and medium-sized pelagic fishes under wasp-waist flow control.

Fernandez, S.M. **A market approach to sturgeon conservation under the US Endangered Species Act.** *Fisheries* 30(12): 20-27, 2005.

Notes: The U.S. Endangered Species Act represented an extraordinary and unprecedented conservation effort when it was enacted in 1973. Since that time, it has provided significant protection for some of the world's most endangered and threatened species. However, such protection has come at the cost of not utilizing available natural resources to their fullest economic potential. With these two conflicting interests in mind, this article attempts to objectively evaluate the benefits and costs of the current Endangered Species Act and suggests policy and listing changes that could further the conservation purposes of the act while also reducing the economic costs associated with protection. More specifically, this article addresses whether a captive-bred exception for the shortnose sturgeon (*Acipenser brevirostrum*) could help conserve other wild, endangered sturgeon species while also promoting a safe, regulated source of high-value food products to meet an ever-increasing demand.

Klimley, A.P., Richert, J.E., and Jorgensen, S.J. **The home of blue water fish.** *American Scientist* 93(1): 42-49, 2005.

Notes: Little is yet known about the migrations of marine species. Among these deep-sea wanderers are the pelagic fishes, which inhabit the wide expanse of oceanic waters far from the coast. The lack of knowledge about the behavior and ecology of such species has hindered efforts to maintain healthy populations, especially in the face of strong pressure from human fishers. Rather than singly inhabiting the trackless ocean, pelagic fish species travel together in groups, which migrate between hidden, productive oases.

Kieves, N. **Crisis at sea: Strengthening government regulation to save marine fisheries.** *Minnesota Law Review* 89(6): 1876-1915, 2005.

Notes: The health of marine fisheries continues to decline as countries close their most profitable fisheries. In addition to causing economic and social damage to society, this decline raises serious biological and ecological concerns. Because marine fisheries are quintessential examples of open-access common property, limiting use and access to fisheries is necessary to ensure their preservation. This Note analyzes privatization and government regulation as options to limit access and to attain sustainable development of the United States' marine fisheries. In the face of uncertain economics, ecological concerns, and negative political and social implications, privatization is an inadequate management tool for marine fisheries. Instead, governmental regulation and oversight must be used to manage these resources. The United States' current regulatory framework contains several inherent weaknesses that must be addressed to facilitate sustainable development of fisheries. The proposed Fisheries Science and Management Enhancement Act, introduced to the 109th Congress in March 2005, addresses some of the most crucial shortcomings of the current legislation. This Note argues that ultimately new, comprehensive, conservation-focused legislation is necessary to ensure sustainable development of U.S. marine fisheries. New legislation must focus on conservation, revise the current administrative framework of fisheries regulation, separate conservation and allocation decision-making power, mandate an ecosystem approach and the pursuit of sound science, and create meaningful

sanctions that are strictly enforced. Without such a paradigm shift marine fisheries will continue to be harvested into decimation.

Ferrell, J.K. **Controlling flags of convenience: One measure to stop overfishing of collapsing fish stocks.** *Environmental Law* 35(2): 323-390, 2005.

Notes: With fish stocks like the Patagonian Toothfish collapsing worldwide, regional fisheries management organizations (RFMOs) are struggling to conserve marine species. These organizations confront efficient fleets that methodically overfish the oceans. Yet RFMOs have no power to sanction vessels that violate conservation measures, because international law vests exclusive jurisdiction in the flag state that registered the vessel. Flag states that register vessels whose owners may not have a genuine link to the state itself are known to issue "flags of convenience" (FOCs). An FOC vessel may, for instance, be registered and flagged by Liberia, owned by an American, operating for a Uruguayan corporation, and crewed by seafarers of varying nationalities. Vessels flying these flags often have poor environmental, safety, and labor records, either because the flag state is not party to international agreements, or because the flag state does not monitor its vessels. Many FOC states allow vessel owners to remain anonymous, which makes sanctioning unscrupulous fishing operators even more difficult. FOC vessels constitute a large percentage of the world fleet. RFMOs must work around exclusive flag state jurisdiction to control FOC vessels that engage in illegal fishing, because the current international legal framework falls to address the problem adequately. RFMOs and responsible fishing states must promote adoption of international conservation agreements and flag state responsibility. This Comment argues that, in addition, these parties should pursue diplomatic, financial, and litigious means to discourage FOC use that allows owners to remain anonymous and unaccountable for pillaging the seas.

Tyedmers, P.H., Watson, R., and Pauly, D. **Fueling global fishing fleets.** *Ambio* 34(8): 635-638, 2005.

Notes: Over the course of the 20th century, fossil fuels became the dominant energy input to most of the world's fisheries. Although various analyses have quantified fuel inputs to individual fisheries, to date, no attempt has been made to quantify the global scale and to map the distribution of fuel consumed by fisheries. By integrating data representing more than 250 fisheries from around the world with spatially resolved catch statistics for 2000, we calculate that globally, fisheries burned almost 50 billion L of fuel in the process of landing just over 80 million t of marine fish and invertebrates for an average rate of 620 L t(-1). Consequently, fisheries account for about 1.2% of global oil consumption, an amount equivalent to that burned by the Netherlands, the 18th-ranked oil consuming country globally, and directly emit more than 130 million t of CO₂ into the atmosphere. From an efficiency perspective, the energy content of the fuel burned by global fisheries is 12.5 times greater than the edible-protein energy content of the resulting catch.

Walsh, M.R., Munch, S.B., Chiba, S., and Conover, D.O. **Maladaptive changes in multiple traits caused by fishing: impediments to population recovery.** *Ecology Letters* 9(2): 142-148, 2006.

Notes: Some overharvested fish populations fail to recover even after considerable reductions in fishing pressure. The reasons are unclear but may involve genetic changes in life history traits that are detrimental to population growth when natural environmental factors prevail. We empirically modelled this process by subjecting populations of a harvested marine fish, the Atlantic silverside, to experimental size-biased fishing regimes over five generations and then measured correlated responses across multiple traits. Populations where large fish were selectively harvested (as in most fisheries) displayed substantial declines in fecundity, egg volume, larval size at hatch, larval viability, larval growth rates, food consumption rate and conversion efficiency, vertebral number, and willingness to forage. These genetically based changes in numerous traits generally reduce the capacity for population recovery.

Eisenack, K., Scheffran, J., and Kropp, J.P. **Viability analysis of management frameworks for fisheries.** *Environmental Modeling and Assessment* 11(1): 69-79, 2006.

Notes: The pressure on marine renewable resources has rapidly increased over past decades. The resulting scarcity has led to a variety of different control and surveillance instruments. Often they have not improved the current situation, mainly due to institutional failure and intrinsic uncertainties about the state of stocks. This contribution presents an assessment of different management schemes with respect to predefined constraints by utilizing viability theory. Our analysis is based on a bio-economic model which is examined as a dynamic control system in continuous time. Feasible development paths are discussed in detail. It is shown that participatory management may lead to serious problems if a purely resource-based management strategy is employed. The analysis suggests that a less risky management strategy can be implemented if limited data are available.

Vaca-Rodriguez, J.G. and Enriquez-Andrade, R.R. **Analysis of the eastern Pacific yellowfin tuna fishery based on multiple management objectives.** *Ecological Modelling* 191(2): 275-290, 2006.

Notes: Vector optimization techniques were used to generate arbitrary segments of a policy frontier for a dynamic yellowfin tuna (*Thunnus albacares*) fishery model assuming fixed technology and considering four policy objectives: minimizing dolphin mortality, minimizing incidental catch (all species except dolphins), maximizing sustainable yield, and minimizing biological risk for the yellowfin tuna stock. Results show that along the policy frontier: (1) reducing incidental dolphin mortality increases the incidental catch of other species in a nonlinear way; (2) yield increases (subject to a biomass precautionary level) can only be obtained at the expense of higher levels of dolphin mortality and incidental catch; (3) biological risk increases as the level of tunas caught increases, but this increase depends on the type of fishery (longline fishing and three different modes of purse-seining: log-sets, dolphin-sets or school-sets) that dominates the fishing effort; (4) there is an indirect relationship between the dolphin mortality levels and those of biological risk; (5) there is a direct relationship between the incidental catch levels and biological risk. Catch obtained with dolphin-sets dominates the Pareto-optimal solutions with highest dolphin mortality levels but is associated with lower biological risk, whereas catch obtained with log-sets dominates in Pareto-optimal solutions with higher incidental catch and higher biological risk. In general, trade-offs or shadow prices among objectives are not linear, indicating that marginal costs vary along the policy frontier. Results of the trade-off analysis may provide useful information for decision-makers and other policy actors. Complete information about the preferences of the decision-makers regarding the objectives is necessary to recommend a specific management policy.

Bisack, K.D. and Sutinen, J.G. **Harbor porpoise bycatch: ITQs or time/area closures in the New England gillnet fishery.** *Land Economics* 82(1): 85-102, 2006.

Notes: The implications of individual transferable quotas (ITQs) for reducing harbor porpoise bycatch in a multi-species fishery are investigated. Our intra-year bioeconomic model incorporates spatial and temporal patterns of abundance and harvest rates of commercial fish species and porpoise. Results indicate that porpoise ITQs, when compared to closures, are more profitable than closures, and distribute effort and profit reductions more evenly across seasons and areas. Price estimates for a unit of porpoise quota ranges from \$1,395 to \$5,782, for total allowable catches ranging from 951 to 209 porpoise, respectively. Total annual willingness to pay for porpoise quota is approximately \$1.25 million.

Essington, T.E., Beaudreau, A.H., and Wiedenmann, J. **Fishing through marine food webs.** *Proceedings of the National Academy of Sciences [USA]* 103(9): 3171-3175, 2006.

Notes: A recurring pattern of declining mean trophic level of fisheries landings, termed "fishing down the food web," is thought to be indicative of the serial replacement of high-trophic-level fisheries with less valuable, low-trophic-level fisheries as the former become depleted to economic extinction. An alternative to this view, that declining mean trophic levels indicate the serial addition of low-trophic-level fisheries ("fishing through the food web"), may be equally severe because it ultimately leads to conflicting demands for ecosystem services. By analyzing trends in fishery landings in 48 large marine ecosystems

worldwide, we find that fishing down the food web was pervasive (present in 30 ecosystems) but that the sequential addition mechanism was by far the most common one underlying declines in the mean trophic level of landings. Specifically, only 9 ecosystems showed declining catches of upper-trophic-level species, compared with 21 ecosystems that exhibited either no significant change ($n = 6$) or significant increases ($n = 15$) in upper-trophic-level catches when fishing down the food web was occurring. Only in the North Atlantic were ecosystems regularly subjected to sequential collapse and replacement of fisheries. We suggest that efforts to promote sustainable use of marine resources will benefit from a fuller consideration of all processes giving rise to fishing down the food web.

Parsons, D.M. and Eggleston, D.B. **Indirect effects of recreational fishing on behavior of the spiny lobster *Panulirus argus*.** *Marine Ecology Progress Series* 303: 235-244, 2005.

Notes: Sublethal disturbance may lead to behavioral modifications that have detrimental consequences for the individual. Sublethal disturbance is an indirect effect of fishing that has seldom been examined. In summer 2003, we conducted surveys on the Caribbean spiny lobster *Panulirus argus* in the Florida Keys, USA, before and after a 2 d mini-season exclusively for recreational sport-divers to assess the frequency of injured lobsters. We also conducted (1) a tethering experiment to assess the influence of disturbance and injury on predation-induced mortality, and (2) Y-maze laboratory experiments to assess the effect of injury and disturbance on the shelter choice of conspecifics. Injury surveys revealed an immediate increase (to 27.16 %) in the percentage of injured lobsters from pre- to post mini-season within patch reef habitats, but only a small increase in injured lobsters amongst patch head habitats. Tethering trials revealed that injured lobsters were more likely to succumb to predation than uninjured controls, while the shelter choice experiments demonstrated that the usual ability to attract conspecifics was altered by injury. Considering the ability of this fishery to unintentionally injure > 25 % of the lobster population in patch reef habitats in just 2 d, the potential population consequences to spiny lobsters must be examined.

ter Hofstede, R. and Dickey-Collas, M. **An investigation of seasonal and annual catches and discards of the Dutch pelagic freezer-trawlers in Mauritania, Northwest Africa.** *Fisheries Research* 77(2): 184-191, 2006.

Notes: The coastal waters of Northwest Africa (Morocco, Mauritania, Senegal) support a large fishery on small pelagic fish. Super-trawlers from the European Union, mainly of Dutch origin, have exploited these resources since 1996, in particular off Mauritania. This paper reports on the catch and discarding of targeted small pelagic fish by these super-trawlers, based on the results of an independent observer programme that covered 16% of the fleets' fishing trips during the period 1999-2003. Throughout this period, the average total catch and effort of the fleet was approximately 176,000 t and 1720 days at sea per year, respectively. The target species were *Sardinella aurita*, *Sardinella maderensis*, *Sardina pilchardus*, *Scomber japonicus* and *Trachurus trecae* representing an annual average of 94% by weight of the total catches. An alternating seasonal pattern of abundance in the catches was shown for *S. aurita* (dominant during summer) and *S. pilchardus* (dominant during winter). The amount of discards on average was less than 10% of the total catch by weight and consisted mainly of commercial species. There was no size selective discarding for the five target species and seasonal changes in discarding were only detected for *S. pilchardus*. This study suggests that there was no wide scale discarding of pelagic fish by the European super-trawlers from fisheries off Mauritania between 1999 and 2003.

Bearzi, G., Politi, E., Agazzi, S., and Azzellino, A. **Prey depletion caused by overfishing and the decline of marine megafauna in eastern Ionian Sea coastal waters (Central Mediterranean).** *Biological Conservation* 127(4): 373-382, 2006.

Notes: Surveys primarily aimed at determining dolphin encounter rates were conducted from small inflatable craft in eastern Ionian Sea coastal waters between 1997 and 2004. During 633 surveys totalling 21,276 km of effort, observations of cetaceans and other marine species spotted in a study area of 480 km² were systematically recorded. Common dolphin encounter rates declined 25-fold across the study period, steadily decreasing from 2.18 encounters/100 km in 1997 to 0.09 encounters/100 km in 2004. Encounter rates of tuna also declined significantly. Swordfish encounter rates dropped from 1.03 encounters/100 km in 1997 to 0-0.12 in 1998-2004. Encounter rates of bottlenose dolphins did not show significant trends. The decline of high-order marine predators feeding on epipelagic prey was consistent with the hypothesis of prey depletion, likely resulting from

intensive exploitation of local fish stocks, particularly anchovies and sardines. The catholic feeding habits and opportunistic behaviour of bottlenose dolphins may allow them to withstand the effects of overfishing at their present low density.

Richardson, E.A., Kaiser, M.J., and Edwards-Jones, G. **Variation in fishers' attitudes within an inshore fishery: implications for management.** *Environmental Conservation* 32(3): 213-225, 2005.

Notes: Understanding the incentives influencing the attitudes and behaviour of resource users is a crucial input to the design of institutions for resource management. Typically fishers have been expected to exploit resources in an independent profit-maximizing manner, which is in line with common property theory, although these expectations are not always met because fishers' behaviours and attitudes are generally more heterogeneous than previously considered. Attitudinal differences between participants in the inshore commercial fishery of Wales, UK, were investigated. Semi-structured face-to-face interviews were conducted with 161 fishers from the five main sectors, namely mobile gear fishers, crustacean potters, whelk potters, line/net fishers and transient fishers. Unprompted expressions of attitudes and responses to open-ended questions underwent thematic-coding and were analysed with fishers' responses to structured questions. Investigation into whether the incentive to participate in resource stewardship varied between sectors as predicted by common property theory found attitudinal similarities across the sectors, but also certain important differences. Results suggested an attitudinal continuum, with mobile gear fishers and crustacean potters at the two extremes, and intermediate positions occupied by transient fishers, whelk potters and line/net fishers. Mobile gear fishers believed most strongly that their fishery was controlled too tightly and was impacted by other fishers and other anthropogenic influences. Crustacean potters believed most strongly that conservation of stocks was necessary and that minimum landing sizes were not overcautious. The attitudes that characterized each sector were related to the characteristics of the sector and its resource base, and generally concurred with theoretical predictions. In particular, target species' mobility and past sector experiences predicted the inclination of fishers in each sector towards resource stewardship. The observed attitudinal differences implied varying personal discount rates that may affect how respondents respond to and comply with management tools. Furthermore, attitudinal differences among sectors mean that an effective management tool in one sector may be inappropriate or counterproductive in another.

Beamish, R.J., McFarlane, G.A., and Benson, A. **Longevity overfishing.** *Progress in Oceanography* 68(2-4): 289-302, 2006.

Notes: Overfishing is generally considered to be a reduction in biomass below some critical level such that the remaining fish are not able to replenish the population. We propose that the removal of large numbers of older age groups by fishing is also a form of overfishing, which we identify as longevity overfishing. Longevity overfishing is a potentially important consideration for the commercial fisheries off Canada's Pacific coast that are dominated by species that have maximum ages of 30 years or longer. Sablefish is one of the key long-lived species that is managed for biomass and not longevity. An age structured model showed that if younger fish do not have the same productivity per unit biomass as older fish, the population depleted of older fishes would not recover after a shift of carrying capacity from a prolonged period of poor productivity to a more productive ocean ecosystem. Current management of long-lived species implicitly assumes that young fish will have the same productivity as older fishes, an assumption that is not supported by a sparse literature, and is thus not precautionary. We propose that the evolved age structure is an indication that long-lived species must be managed for longevity as well as biomass, which requires a management time frame that is decades and not annual.

Shelton, P.A., Sinclair, A.F., Chouinard, G.A., Mohn, R., and Duplisea, D.E. **Fishing under low productivity conditions is further delaying recovery of Northwest Atlantic cod (*Gadus morhua*).** *Canadian Journal of Fisheries and Aquatic Sciences* 63(2): 235-238, 2006.

Notes: Excessive and unsustainable fishing mortality was the predominant factor in the depletion of Northwest Atlantic cod (*Gadus morhua*) stocks. However, despite imposition of severe catch restrictions for over a decade, stocks have mostly failed to recover at predicted rates. A number of explanations have been considered. Our analysis of demographic characteristics of 12 of these stocks indicates that recent productivity over the northern portion of the range is much lower than 20 years previous when several stocks recovered from less severe declines. Main contributing factors are, in rank order, increased natural

mortality, decreased body growth, and in a few cases, reduced recruitment rates. Continued fishing in directed and bycatch fisheries is also an important factor. Under current conditions, we estimate negative or very low (< 2% per year) average growth rates in eight stocks. If fishing ceases, growth rates of > 5% would be expected in six stocks, with > 10% in four of these. Although productivity is low, we conclude that fishing mortality is further delaying recovery.

Branch, T.A., Rutherford, K., and Hilborn, R. **Replacing trip limits with individual transferable quotas: implications for discarding.** *Marine Policy* 30(3): 281-292, 2006.

Notes: In the British Columbia groundfish fishery (BC fishery), full observer coverage and the accounting of discard mortality of marketable fish in landing limits resulted in low discard fractions. When individual transferable quotas (ITQs) were additionally introduced, total discard fractions declined for most species, and marketable discard fractions declined from 0.20% to 0.10%, after an adjustment period. In contrast, the US West Coast groundfish fishery, which is regulated by 2-monthly landing limits, has higher discard fractions (31-43% vs. 14-19% for BC). The BC experience suggests that full observer coverage, ITQs, and mortality accounting would reduce West Coast discarding fractions, but severe catch restrictions on overfished West Coast species may limit such reductions.

Malaquias, M.A.E., Bentes, L., Erzini, K., and Borges, T.C. **Molluscan diversity caught by trawling fisheries: a case study in southern Portugal.** *Fisheries Management and Ecology* 13(1): 39-45, 2006.

Notes: The effects of commercial trawling on the malacological communities (except for the Cephalopoda) were examined, based on a study undertaken between 1996 and 2000 on the continental shelf and slope of southern Portugal. More than 50% of species caught by trawling in southern Portugal were discarded, with molluscs representing about 19%. Forty-four species of molluscs (15 bivalves, 28 gastropods and one polyplacophoran) were identified from the discarded specimens. Crustacean trawlers accounted for 34 mollusc species, and fish trawlers for 24. Twenty species were only caught by the crustacean trawl, compared with 10 species by the fish trawl, and 14 species were common to both trawls. The bivalve *Venus nux* Gmelin was the most numerous species discarded in the fish trawl, accounting for 42.0% of the total number of individuals, followed by the gastropods *Ampulla priamus* (Meuschen) (7.8%) and *Ranella olearium* (L.) (7.3%). In the crustacean trawl, the most numerous species discarded were the bivalve *Anadara diluvii* (Lamarck) (19.4%), the gastropod *Calliostoma granulatum* (Born) (15.5%), and the bivalve *V. nux* (15.1%). The third most discarded species from fish trawls in Algarve waters, the gastropod species *R. olearium*, is a species listed in Annex II of the Bern Convention. The difficulties of managing the real impact of fisheries on the molluscan populations and in defining a conservation strategy are discussed.

Morato, T., Cheung, W.W.L., and Pitcher, T.J. **Vulnerability of seamount fish to fishing: fuzzy analysis of life-history attributes.** *Journal of Fish Biology* 68(1): 209-221, 2006.

Notes: Despite rather broad definitions, global analysis showed that seamount fishes, particularly seamount-aggregating fishes, had higher intrinsic vulnerability than other groups of fishes. The pattern was similar when considering only commercially exploited species. Biological characteristics leading to greater vulnerability included a longer life span, later sexual maturation, slower growth and lower natural mortality. The results supported the contention that seamount fishes, especially those that aggregate on seamounts, are highly vulnerable to exploitation and that fishing on seamounts may not be sustainable at current levels and with current methods. A number of seamount populations have already been depleted; more depletion, extirpations, and even species extinctions may follow if fishing on seamounts is not reduced.

Watanuki, N. and Gonzales, B.J. **The potential of artificial reefs as fisheries management tools in developing countries.** *Bulletin of Marine Science* 78(1): 9-19, 2006.

Notes: There is a growing need for international cooperation among developing countries in order to increase the contribution of artificial reefs to reverse the trend of fisheries resource depletion. To establish desirable directions for future cooperation in this field, we analyzed three recent artificial reef projects in the Philippines and Senegal. Past experience has begun to teach us that artificial reef deployment alone does not produce clear, positive effects in enhancing fisheries resources, but rather leads to the opposite effect of attracting fishing activities in protected areas. As poverty among fishermen lies behind this problem, it is imperative to include economic activities, such as commercialization of highly valued fish in artificial reef projects. Income from such activities can be used to compensate for the decline of income due to reduction of catch and to raise funds for sustainable surveillance of undesirable fishing practices on the artificial reefs. Furthermore, artificial reef projects must be integrated in a broader fisheries management plan in order to be effective. Unless the positive impacts of artificial reefs are clearly established, they should not be overestimated. While a participatory approach is desirable for an artificial reef project, the ideal outcome should be co-management by fishing communities and the government.

Morato, T., Watson, R., Pitcher, T.J., and Pauly, D. **Fishing down the deep.** *Fish and Fisheries* 7(1): 24-34, 2006.

Notes: Global landings of demersal marine fishes are demonstrated to have shifted to deeper water species over the last 50 years. Our analysis suggests deep-water fish stocks may be at serious risk of depletion, as their life histories render them highly vulnerable to overfishing with little resilience to over-exploitation. Deep-sea fisheries are exploiting the last refuges for commercial fish species and should not be seen as a replacement for declining resources in shallower waters. Instead, deep-water habitats are new candidates for conservation.

Mansfield, B. **Assessing market-based environmental policy using a case study of North Pacific fisheries.** *Global Environmental Change* 16(1): 29-39, 2006.

Notes: This paper uses a case study to provide a critical assessment of arguments underlying market-based environmental policy. Market approaches, which rely on economic incentives and property rights to achieve environmental goals, have become increasingly popular in the past two decades. Proponents argue that market approaches should replace "command and control" regulation, which works by penalizing environmentally harmful behavior. Synthesizing results of previous research on political economy of the North Pacific pollock fishery, this paper provides evidence that contradicts hypotheses derived from the logic of market approaches. First, a lack of property rights is not the underlying cause of problems in this fishery, but instead problems were created by the institutional context of fishery development. Second, market and regulatory approaches to this fishery are not necessarily contradictory and inherently incompatible. Both markets and regulation create both economic opportunities and constraints. Markets alone are not enough to protect the environment, and markets require regulation to function. Because the market approach is based on a general logic that is supposed to be universally applicable, results from this case reveal potential flaws in the market approach more generally.

Lupes, S.C., Davis, M.W., Olla, B.L., and Schreck, C.B. **Capture-related stressors impair immune system function in sablefish.** *Transactions of the American Fisheries Society* 135(1): 129-138, 2006.

Notes: The sablefish *Anoplopoma fimbria* is a valuable North Pacific Ocean species that, when not targeted in various commercial fisheries, is often a part of discarded bycatch. Predictions of the survival of discarded fish are dependent on understanding how a fish responds to stressful conditions. Our objective was to describe the immunological health of sablefish exposed to capture stressors. In laboratory experiments designed to simulate the capture process, we subjected sablefish to various stressors that might influence survival: towing in a net, hooking, elevated seawater and air temperatures, and air exposure time. After stress was imposed, the in vitro mitogen-stimulated proliferation of sablefish leukocytes was used to evaluate the function of the immune system in an assay we validated for this species. The results demonstrated that regardless of fishing gear type, exposure to elevated seawater temperature, or time in air, the leukocytes from stressed sablefish exhibited significantly diminished proliferative responses to the T-cell mitogen, concanavalin A, or the B-cell mitogen, lipopolysaccharide. There was no difference in the immunological responses associated with seawater or air temperature. The duration and severity of the capture stressors applied in our study were harsh enough to induce significantly elevated levels of

plasma cortisol and glucose, but there was no difference in the magnitude of levels among stressor treatments. These data suggest that immunological suppression occurs in sablefish subjected to capture-related stressors. The functional impairment of the immune system after capture presents a potential reason why delayed mortality is possible in discarded sablefish. Further studies are needed to determine whether delayed mortality in discarded sablefish can be caused by increased susceptibility to infectious agents resulting from stressor-mediated immunosuppression.

Clarke, S.C., Magnussen, J.E., Abercrombie, D.L., McAllister, M.K., and Shivji, M.S. **Identification of shark species composition and proportion in the Hong Kong shark fin market based on molecular genetics and trade records.** *Conservation Biology* 20(1): 201-211, 2006.

Notes: The burgeoning and largely unregulated trade in shark fins represents one of the most serious threats to shark populations worldwide. In Hong Kong, the world's largest shark fin market, fins are classified by traders into Chinese-name categories on the basis of market value, but the relationship between market category and shark species is unclear, preventing identification of species that are the most heavily traded. To delineate these relationships, we designed a sampling strategy for collecting statistically sufficient numbers of fins from traders and categories under conditions of limited market access because of heightened trader sensitivities. Based on information from traders and morphological inspection, we hypothesized matches between market names and shark taxa for fins within 11 common trade categories. These hypotheses were tested using DNA-based species identification techniques to determine the concordance between market category and species. Only 14 species made up approximately 40% of the auctioned fin weight. The proportion of samples confirming the hypothesized match, or concordance, varied from 0.64 to 1 across the market categories. We incorporated the concordance information and available market auction records for these categories into stochastic models to estimate the contribution of each taxon by weight to the fin trade. Auctioned fin weight was dominated by the blue shark (*Prionace glauca*), which was 17% of the overall market. Other taxa, including the shortfin mako (*Isurus oxyrinchus*), silky (*Carcharhinus falciformis*), sandbar (*C. obscurus*), bull (*C. leucas*), hammerhead (*Sphyrna* spp.), and thresher (*Alopias* spp.), were at least 2-6% of the trade. Our approach to marketplace monitoring of wildlife products is particularly applicable to situations in which quantitative data at the source of resource extraction are sparse and large-scale genetic testing is limited by budgetary or other market access constraints.

Buonaccorsi, V.P., Kimbrell, C.A., Lynn, E.A., and Vetter, R.D. **Limited realized dispersal and introgressive hybridization influence genetic structure and conservation strategies for brown rockfish, *Sebastes auriculatus*.** *Conservation Genetics* 6(5): 697-713, 2005.

Notes: Understanding patterns of connectivity among marine fish populations with demersal adults and pelagic larvae is critical for effective conservation of west coast rockfishes. The brown rockfish (*Sebastes auriculatus*) occurs in nearshore habitat and is common from northern Baja California, Mexico to northern California, rare off the outer coast of Oregon and Washington and again common in the inland waters of Puget Sound, Washington. Here we examine patterns of microsatellite DNA diversity from throughout the species' range as an indirect measure of long-term trends in larval dispersal. Genetic divergence was large and highly significant over all populations ($F_{ST}=0.056$, $P < 0.0001$), and was significantly correlated with geographic distance when considering coastal populations. The best estimates of mean coastal dispersal distance were on the order of 10 km or less per generation. Diversity was relatively low in the Puget Sound, suggesting that Puget Sound rockfish populations experienced a post-glacial founder effect followed by genetic isolation and low effective population size. Puget Sound individuals appeared to have recent mixed ancestry as a result of introgression with *S. maliger* and *S. caurinus*. Genetic isolation of Puget Sound fish provides a basis for consideration as a Distinct Population Segment (DPS) under the provisions of the Endangered Species Act. We recommend that coastal brown rockfish fisheries be managed at regional rather than coast-wide scales, and that design of marine reserve networks considers the surprisingly low realized dispersal distance of some species with high dispersal potential.

Abercrombie, D.L., Clarke, S.C., and Shivji, M.S. **Global-scale genetic identification of hammerhead sharks: Application to assessment of the international fin trade and law enforcement.** *Conservation Genetics* 6(5): 775-788, 2005.

Notes: The future status of sharks is an issue of widespread conservation concern due to declines in many species in the face of high levels of exploitation to satisfy market demands for products, especially fins. Substantial declines in the large-bodied hammerhead sharks, *Sphyrna lewini*, *S. mokarran* and *S. zygaena*, even in regions where some management occurs, indicate that informed conservation measures are warranted for these circumglobally distributed species. Despite the importance of assessing shark catch and trade on a species-specific basis to detect potential overexploitation of individual species, achieving this goal for hammerheads has proven elusive due to difficulties in identification of their products. Here, we present the development and application of a diagnostic, streamlined, five-primer multiplex polymerase chain reaction assay utilizing species-specific primers based on nuclear ribosomal ITS2 for the three hammerhead species throughout their global distribution. Application of this assay to investigations of the fin market confirmed the presence of hammerhead fins in the international trade. A study of the world's largest fin market in Hong Kong revealed a high concordance between specific Chinese-name trade categories and fins from these three species ("Bai Chun" with *S. lewini*, "Gui Chun" with *S. zygaena* and "Gu Pian" with *S. mokarran*), and clear species preferences. This concordance information allows the use of market records for monitoring species-specific trends in trade and exploitation rates. The assay is also proving useful for identification of shark body parts in U.S. fisheries law-enforcement activities. Screening of morphologically identified "*S. lewini*" from globally distributed areas using this assay with subsequent whole ITS2 sequencing suggests a cryptic species closely related to *S. lewini* occurs off the SE USA coast.

Hixon, M.A. and Jones, G.P. **Competition, predation, and density-dependent mortality in demersal marine fishes.** *Ecology* 86(11): 2847-2859, 2005.

Notes: The relative roles of competition and predation in demographic density dependence are poorly known. A tractable experimental design to determine such effects and their interactions for demersal (seafloor oriented) fishes and similar sedentary species is cross-factoring multiple densities of new recruits with the presence and absence of predators. This design allows one to distinguish between density-dependent mortality due to competition alone, predation alone, or an interaction between the two, especially when supplemental field observations are available. To date, 14 species of marine fish have been examined with some variant of this design, and for 12 species predation was demonstrated to be the sole or major cause of density dependence. However, as competition may be slow acting relative to predation, the importance of competition can be underestimated in short-term experiments. On the Great Barrier Reef, we conducted a long-term field experiment in which multiple densities of new recruits of a planktivorous damselfish were cross-factored with the presence or absence of resident piscivorous fish on patch reefs. During the first 10 months, no density-dependent mortality was detected, regardless of whether resident predators were present or absent. By the end of the experiment at 17 months, per capita mortality was strongly density dependent and highly compensatory in both predator treatments; all reefs ultimately supported nearly the same adult density regardless of experimental treatment. Examination of treatment effect sizes suggested that competition was the main source of density-dependent mortality, with predation being merely a proximate agent of death. We hypothesize that predators were ineffective in this system compared with similar studies elsewhere because prey density was low relative to ample prey refuges provided by highly complex corals. Combined with previous studies, these findings indicate that density-dependent mortality in demersal marine fishes is often caused by interplay of predation and competition, whose roles may be altered by variation in habitat complexity and larval supply. These conclusions are relevant to marine fisheries models, which typically assume that density dependence is due solely to intraspecific competition.

Schindler, D.E., Leavitt, P.R., Brock, C.S., Johnson, S.P., and Quay, P.D. **Marine-derived nutrients, commercial fisheries, and production of salmon and lake algae in Alaska.** *Ecology* 86(12): 3225-3231, 2005.

Notes: For decades ecologists have recognized the potential importance of marine-derived nutrients (MDN) deposited in freshwater ecosystems by spawning anadromous salmon. Previous studies have shown that some MDN are retained in freshwater ecosystems. A popular hypothesis linking MDN to salmon population productivity posits that MDN provided by post-spawning mortality of salmon are critical for salmon population dynamics because they enhance prey populations in the freshwater ecosystems used as nursery habitats. We tested this hypothesis by reconstructing historical sockeye salmon populations for the last 300 years in Bristol Bay, Alaska. Stable nitrogen isotope chronologies in lake sediments and sockeye catch and escapement histories show that commercial fisheries intercepted about two-thirds of MDN bound for freshwater spawning grounds since about 1900. Reconstruction of lake algal production using, fossil pigments shows that this loss of

MDN has reduced lake algal productivity to about one-third of its level before commercial fishing. However, contrary to expectation, recent sockeye population sizes (sum of spawning escapement and fishery catch) in the last century were equivalent to those before the advent of commercial fishing. These data demonstrate that the MDN subsidy is important for the productivity of coastal lakes but that some sockeye salmon populations are limited by other features of ecosystems such as the amount of suitable spawning habitat.
