

Marine Science Review - 176

Fish and fisheries

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

Lynam, C.P., Gibbons, M.J., Axelsen, B.E., Sparks, C.A.J., Coetzee, J., Heywood, B.G., and Brierley, A.S. **Jellyfish overtake fish in a heavily fished ecosystem.** *Current Biology* 16(13): R492-R493, 2006.

Corkeron, P.J. **Opposing views of the "ecosystem approach" to fisheries management.** *Conservation Biology* 20(3): 617-619, 2006.

B. Recent articles with abstracts

Kaiser, M.J., Clarke, K.R., Hinz, H., Austen, M.C.V., Somerfield, P.J., and Karakassis, I. **Global analysis of response and recovery of benthic biota to fishing.** *Marine Ecology Progress Series* 311: 1-14, 2006.

Notes: Towed bottom-fishing gears are thought to constitute one of the largest global anthropogenic sources of disturbance to the seabed and its biota. The current drive towards an ecosystem approach in fisheries management requires a consideration of the implications of habitat deterioration and an understanding of the potential for restoration. We undertook a meta-analysis of 101 different fishing impact manipulations. The direct effects of different types of fishing gear were strongly habitat-specific. The most severe impact occurred in biogenic habitats in response to scallop-dredging. Analysis of the response of different feeding guilds to disturbance from fishing revealed that both deposit- and suspension-feeders were consistently vulnerable to scallop dredging across gravel, sand and mud habitats, while the response of these groups to beam-trawling was highly dependent upon habitat type. The biota of soft-sediment habitats, in particular muddy sands, were surprisingly vulnerable, with predicted recovery times measured in years. Slow-growing large- biomass biota such as sponges and soft corals took much longer to recover (up to 8 yr) than biota with shorter life-spans such as polychaetes (< 1 yr). The results give a possible basis for predicting the outcome of the use of different fishing gears in a variety of habitats with potential utility in a management context.

Sartor, P., Francesconi, B., Rossetti, I., and De Ranieri, S. **Catch composition and damage incurred to crabs discarded from the eastern Ligurian Sea "rapido" trawl fishery.** *Hydrobiologia* 557: 121-133, 2006.

Notes: Catch composition and damage incurred to the populations of three crabs (*Liocarcinus depurator*, *Medorippe lanata* and *Goneplax rhomboides*), discarded by the "rapido" trawl fishery of Viareggio (eastern Ligurian Sea), was investigated. Data were collected on a monthly basis (January-December 2001) through embarks on board of a commercial fishing vessel, so as to reflect commercial fishing practice. The three species represented from 7 to 31% of the discarded biomass, varying with season. Density and biomass indices were characterised by a clear seasonality, each species showing a peak in a different period of the year. A six level scale, based on macroscopic external injuries was used to assess the damage sustained by each species after fishing and sorting operations. For the three species, very similar percentages (56-58%) of individuals were

macroscopically intact, while inspection of damaged individuals revealed some differences in the distribution of injuries. *G. rhomboides* showed the highest proportion of serious damage, followed by *L. depurator* and *M. lanata*. The severity and frequency of damage was mainly correlated with interspecific and intraspecific (sexual dimorphism) morphological and behavioural characteristics. For example, specimens with longer and thin appendages, like males of *G. rhomboides*, seemed to be particularly vulnerable to the fishing and sorting operations; this could also explain the positive correlation between damage level and size found in this species. In *M. lanata*, small individuals proved to be more vulnerable, while for *L. depurator* no significant correlation was found between damage and size. Although these estimations did not take other injury typologies into account (e.g. internal and physiological damage), these results can be seen as a first indirect estimation of discard mortality for these species and can represent an important term of reference both for similar studies performed in other areas and for the monitoring of this fishery.

Wilson, J.A. **Matching social and ecological systems in complex ocean fisheries.** *Ecology and Society* 11(1): art. 9, 2006.

Notes: This paper considers ocean fisheries as complex adaptive systems and addresses the question of how human institutions might be best matched to their structure and function. Ocean ecosystems operate at multiple scales, but the management of fisheries tends to be aimed at a single species considered at a single broad scale. The paper argues that this mismatch of ecological and management scale makes it difficult to address the fine-scale aspects of ocean ecosystems, and leads to fishing rights and strategies that tend to erode the underlying structure of populations and the system itself. A successful transition to ecosystem-based management will require institutions better able to economize on the acquisition of feedback about the impact of human activities. This is likely to be achieved by multiscale institutions whose organization mirrors the spatial organization of the ecosystem and whose communications occur through a polycentric network. Better feedback will allow the exploration of fine-scale science and the employment of fine-scale fishing restraints, better adapted to the behavior of fish and habitat. The scale and scope of individual fishing rights also needs to be congruent with the spatial structure of the ecosystem. Place-based rights can be expected to create a longer private planning horizon as well as stronger incentives for the private and public acquisition of system relevant knowledge.

Kumar, A.B. and Deepthi, G.R. **Trawling and by-catch: Implications on marine ecosystem.** *Current Science* 90(7): 922-931, 2006.

Notes: Trawling remains a controversial method of fishing due to the perceived lack of selectivity of the trawl net and the resultant capture of a huge quantity and diversity of non-target species, including endangered species such as sea turtles, coupled with its effect on the marine ecosystem. The impacts of trawling on the physical, chemical and biological environment of the marine ecosystem and the diversity and quantity of by-catch and discards remain poorly documented for tropical waters. In India, the by-catch landed at fishing harbours are used mainly for the production of manure and animal feed. Further, by-catch reduction devices have not been implemented in the field. This review article, besides analysing the impact of trawling, highlights the need for adopting policies and practices that reduce the level of by-catch, the need for ecosystem-based management to ensure long-term sustainability of oceanic resources, and the adoption of a precautionary approach with emphasis on reducing, and if possible avoiding discards.

Dulvy, N.K., Jennings, S., Rogers, S.I., and Maxwell, D.L. **Threat and decline in fishes: an indicator of marine biodiversity.** *Canadian Journal of Fisheries and Aquatic Sciences* 63(6): 1267-1275, 2006.

Notes: Recent policy commitments aim to reduce biodiversity loss and integrate environmental concerns into fisheries management. However, there are few operational indicators for reporting biodiversity trends and judging progress in relation to management objectives. Here we develop a threat indicator based on the population status of a suite of 23 North Sea fishes from 1982 to 2001 estimated using World Conservation Union (IUCN) Red List decline criteria. The composite indicator was calculated from the weighted average of the threat scores of individual species in each year and varies from 0 to 3, where a score of 3 is equivalent to each species qualifying as "critically endangered". The proportion of threatened fishes, their degree of threat, and the composite indicator value increased steadily over time. The composite indicator value has been > 1 since the late 1990s, equivalent to all species meeting the "vulnerable" criterion. A suitable reference trajectory, consistent with the World Summit on Sustainable Development commitment to "achieve by 2010 a significant reduction of the current rate of

biodiversity loss" would be a significant reduction in the rate of increase in this indicator before 2010, a limit reference point could be 1 (all species vulnerable) and a target reference point could be 0 (no threatened species).

Baum, J.K. and Vincent, A.C.J. **Magnitude and inferred impacts of the seahorse trade in Latin America.** *Environmental Conservation* 32(4): 305-319, 2005.

Notes: Seahorses (genus *Hippocampus*) are traded globally for use in traditional medicines, souvenirs and as aquarium fishes. Indications that the trade was expanding geographically in response to increasing demand in consuming nations prompted this first study of the seahorse trade in Latin America. In 2000, over 400 people related to the seahorse trade in Mexico, Central America, Ecuador and Peru were interviewed. Customs data and other trade records from these and five additional countries or regions trading seahorses from Latin America were obtained. Dried seahorses were exported by almost every surveyed country at some point in the 1990s, with Ecuador, Peru and Mexico exporting hundreds of kg per year over multiple years, and the latter two nations both exporting tonnes of seahorses at least twice. The live seahorse trade was confined to Costa Rica, Mexico, Panama and Brazil; the last dominating this trade and exporting several thousand seahorses annually. Substantial declines in seahorse abundance, attributed primarily to incidental catches in shrimp trawl fisheries, were reported consistently by respondents in many regions. These data contributed to an Appendix II listing on the Convention on International Trade in Endangered Species of Wild Fauna and Flora of all seahorses, thereby requiring that the trade be monitored and controlled. Additional conservation measures are needed to address fishing pressure on seahorse populations.

Martin-Smith, K.M. and Vincent, A.C.J. **Exploitation and trade of Australian seahorses, pipehorses, sea dragons and pipefishes (Family Syngnathidae).** *Oryx* 40(2): 141-151, 2006.

Notes: Seahorses and their syngnathid relatives have provided a focus for efforts to ensure sustainable use of marine resources, with new international trade controls (CITES Appendix II) implemented in May 2004. We demonstrate how a study of international trade can be used to assess relative levels of threat and set domestic research and conservation priorities. Australia has remarkably high syngnathid biodiversity with at least 14 seahorse species, two endemic sea dragon species, and 90 species of pipefishes and pipehorses found in its territorial waters. Our objectives were to quantify species, trade routes, volumes, values and temporal trends in syngnathid trade to and from Australia. We found that Australia is probably the major global supplier of dried pipehorses *Solegnathus* spp.. These fishes, including at least one endemic species, are sourced from trawl bycatch and comprise Australia's largest syngnathid export, by both volume and value. Research is urgently needed to evaluate the impacts and sustainability of trawling on pipehorse populations. Australia is also the sole supplier of two sea dragon species, *Phycodurus eques* and *Phyllopteryx taeniolatus*, for the live aquarium trade. Although lucrative, the number of wild-caught individuals involved in this trade was relatively low and probably of low conservation risk relative to habitat loss. Exports of seahorses and other pipefish species, and imports of all syngnathid species, are minor on a global scale, although the burgeoning aquaculture industry for seahorses requires careful evaluation for its potential impacts on wild populations.

Rosa, I.L., Sampaio, C.L.S., and Barros, A.T. **Collaborative monitoring of the ornamental trade of seahorses and pipefishes (Teleostei: Syngnathidae) in Brazil: Bahia State as a case study.** *Neotropical Ichthyology* 4(2): 247-252, 2006.

Notes: Many species of seahorses and pipefishes (family Syngnathidae) are traded for medicinal purposes and aquaria; some are also sold as souvenirs or curiosities. Brazil is one of the main suppliers of seahorses for the international aquarium trade, nevertheless, little is known about the magnitude of that trade in the country. With regards to pipefishes, virtually nothing is known about their captures for ornamental purposes in Brazil. The present study assesses the magnitude of captures and trade of seahorses and pipefishes, based on data obtained through a collaborative monitoring program established with the main retailer of marine ornamental organisms in the State of Bahia. The syngnathid fishery is conducted in shallow waters never exceeding 7 m, generally by breathhold diving. Both seahorses and pipefishes are mostly caught by hand, and only rarely hand-nets or plastic bags are used. From January/1997 to June/2005, 152 fishers recorded their daily catches of syngnathids. Two species of seahorses, *Hippocampus reidi* and *H. cf. erectus* (9,793 specimens captured from 1997 to 2005) and three species of pipefishes, *Cosmocampus albirostris*, *Micrognathus* sp. and *Syngnathus* sp. (143 specimens captured from 1999 to 2005) were traded. *H. reidi* was the most heavily exploited species.

Riddle, K.W. **Illegal, unreported, and unregulated fishing: Is international cooperation contagious?** *Ocean Development and International Law* 37(3-4): 265-297, 2006.

Notes: Illegal, unreported, and unregulated (IUU) Fishing is considered a major threat to high seas fish stocks. Each of the international regional fishery management organizations (RFMOs) are combating some form of IUU fishing and this led the Food and Agriculture Organization of the United Nations (FAO) to adopt the International Plan of Action to Deter, Prevent and Eliminate IUU Fishing (IPOA-IUU). This article will analyze the issues involved with IUU fishing, examine the recommendations in the IPOA, and consider examples of successful management and enforcement measures in use by states and RFMOs. Finally, recent developments in China will be viewed as an example of how international cooperation is contagious.

Shannon, L.J., Cury, P.M., Nel, D., Van der Lingen, C.D., Leslie, R.W., Brouwer, S.L., Cockcroft, A.C., and Hutchings, L. **How can science contribute to an ecosystem approach to pelagic, demersal and rock lobster fisheries in South Africa?** *African Journal of Marine Science* 28(1): 115-157, 2006.

Notes: South Africa is committed to moving towards an Ecosystem Approach to Fisheries (EAF) and has laid the foundations for this using a three-pronged approach: through a project (EAF Feasibility Study) under the Benguela Current Large Marine Ecosystem Programme; through a dedicated scientific working group established by the Marine and Coastal Management branch of South Africa's Department of Environmental Affairs and Tourism; and through collaborative scientific and modelling studies within the joint French-South African 'Upwelling Ecosystems' Programme. This contribution provides an overview of the progress made towards developing an EAF in South Africa, both on the scientific front in terms of improved understanding of the functioning of the Benguela ecosystem and the ways in which its ecosystem components interact, and regarding the practical ways being explored to enable scientific advice to feed into South African fisheries management while taking into account broad stakeholder concerns. The paper focusses particularly on the role played by scientific contributions (research and monitoring) to address these ecosystem issues in three important South African fisheries - pelagic, demersal and rock lobster - so that the appropriate management measures can be put into place. Socio-economic concerns are included for the rock lobster fishery.

Lenhardt, M., Jaric, I., Kalauzi, A., and Cvijanovic, G. **Assessment of extinction risk and reasons for decline in sturgeon.** *Biodiversity and Conservation* 15(6): 1967-1976, 2006.

Notes: Sturgeon populations in the Danube River have been affected by a combination of hydropower development, over-harvesting, habitat degradation from agricultural and industrial practices and from urbanization. The effects of these changes have been monitored on six sturgeon species inhabiting the Danube River. Two of them are resident species, while the other four migrate to the river for spawning. Atlantic sturgeon (*Acipenser sturio*) has completely disappeared from this region. Ship sturgeon (*Acipenser nudiiventris*) is very rare in professional fishing catches. Beluga (*Huso huso*), Russian sturgeon (*Acipenser gueldenstaedtii*), stellate sturgeon (*Acipenser stellatus*) and sterlet (*Acipenser ruthenus*) are endangered with different levels of extinction risk. Here, we model the time dependence of the beluga and Russian sturgeon catch in the Serbian part of the Danube River. Predicted extinction of Russian sturgeon was estimated to fall around the middle of the century, and for beluga approximately at middle of the millennium. Suggestions for sturgeon conservation measures on a national level and coordination of all relevant institutions in Serbia are also presented.

Dadswell, M.J. **A review of the status of Atlantic sturgeon in Canada, with comparisons to populations in the United States and Europe.** *Fisheries* 31(5): 218-229, 2006.

Notes: Anadromous Atlantic sturgeon (*Acipenser oxyrinchus*) occur in most large rivers and in the sea of Atlantic Canada. They are recorded as far north as George River, Labrador, but spawning is unknown north of the St. Lawrence River. In Canada, spawning is in freshwater, usually close to tidehead, during June-July. To maintain a population, this iteroparous species requires access to rivers with medium to large estuaries and the sea. Juveniles inhabit the mesohaline region of estuaries (5-25

ppt satinity), usually over a mud-sand bottom. After 1-12 years, they migrate to sea where they spend another 5-10 years before reaching sexual maturity, after which they return to rivers to spawn every 1-5 years depending on sex and latitude of the natal stream. Migration is extensive, north and south on the Atlantic coast, and seaward to the edge of the continental shelf. There are five known spawning populations in Canada and probably numerous unknown ones. Spawning populations in the United States occur from Maine to Florida and into the Gulf of Mexico. Populations of *A. oxyrinchus* in Europe are extinct. The size of Canadian populations is unknown but recent studies suggest there are 500+ adults in the St. Lawrence River. In Canada, Atlantic sturgeons are fished commercially and catches of 20-140 metric tons have been taken annually during the last 20 years in the St. Lawrence and St. John rivers.

Parsons, D.M. and Eggleston, D.B. **Human and natural predators combine to alter behavior and reduce survival of Caribbean spiny lobster.** *Journal of Experimental Marine Biology and Ecology* 334(2): 196-205, 2006.

Notes: Fishing disturbance can have indirect negative effects on animal behavior and survival, but receives little attention compared to measures of direct fisheries extraction. We quantified changes in the density of Caribbean spiny lobster *Panulirus argus* when exposed to experimental human disturbance and injury typical of sport-diver harvest attempts in the field. A complementary study in a large seawater arena quantified lobster sheltering behavior and survival when exposed to the single and combined effects of human disturbance and triggerfish *Balistes caprisicus* predators. Human disturbance and injury of lobsters in the field caused lobsters to emigrate from shelters that had been typically occupied over successive days. Similarly, both the presence of triggerfish predators and human disturbance promoted decreased lobster shelter fidelity to individual shelters in the arena. Overall shelter use and gregariousness increased in the presence of natural triggerfish predators but not as a function of human disturbance. Decreased shelter use and gregariousness by lobsters when exposed to human disturbance may have contributed to their decreased survival when exposed simultaneously to triggerfish. These results highlight how human disturbance and injury of lobsters can alter their behavior and reduce subsequent survival in the presence of their natural predators, and illustrate the need to incorporate the negative effects of sport-divers into models that estimate population demographic rates.

Queiros, A.M., Hiddink, J.G., Kaiser, M.J., and Hinz, H. **Effects of chronic bottom trawling disturbance on benthic biomass, production and size spectra in different habitats.** *Journal of Experimental Marine Biology and Ecology* 335(1): 91-103, 2006.

Notes: Bottom trawling has widespread impacts on benthic communities and habitats. It is argued that the impact of chronic bottom trawling on benthic infauna depends on the natural disturbance levels to which benthic communities are adapted. We analysed biomass, production and size structure of two communities from a muddy and a sandy habitat, in relation to quantified gradients of trawling disturbance on real fishing grounds. We used an allometric relationship between body mass and individual production to biomass ratio to estimate community production. Chronic trawling had a negative impact on the biomass and production of benthic communities in the muddy habitat, while no impact was identified on benthic communities from the sandy habitat. These differences are the result of differences in size structure within the two communities that occur in response to increasing trawling disturbance.

Kelly, C.J., Codling, E.A., and Rogan, E. **The Irish Sea cod recovery plan: some lessons learned.** *ICES Journal of Marine Science* 63(4): 600-610, 2006.

Notes: Historically, cod has been one of the most important fish stocks in the North Atlantic. Recent stock collapses have been attributed to overfishing, and in February 2000 the European Commission established a closed area in the Irish Sea as part of a general recovery plan. The recovery plan was further revised and implemented between 2001 and 2005. However, the recovery plan has not provided the expected benefit, and the stock is still thought to be below the safe limit of $B_{lim} = 6000$ t. We use stochastic simulations to investigate possible stock trajectories over a seven-year period from 1999 to 2005 under various scenarios of fishing mortality. Comparing the results of simulations with reality, it is clear that more drastic action is required if the stock is to recover in the medium term. The recovery plan was not explicitly designed to deal with uncertainty in the system, and this, we believe, resulted in the failure to meet the recovery plan objectives.

Link, P.M. and Tol, R.S.J. **Economic impacts of changes in the population dynamics of fish on the fisheries of the Barents Sea.** *ICES Journal of Marine Science* 63(4): 611-625, 2006.

Notes: A bioeconomic simulation model of the two interacting fish species cod (*Gadus morhua*) and capelin (*Mallotus villosus*) and their fisheries is presented and applied to assess the consequences of changes in the population dynamics of these important fish stocks in the Barents Sea. In each scenario, the population dynamics of the fish species are changed by reducing the reproduction-induced productivities and/or the carrying capacities. Stock sizes and landings of fish are calculated for each fishing period, and the net present values of profits from fishing are determined for time periods prior to and after the change in population dynamics. Results show that reduced growth rates or carrying capacities lead to lower stock levels and consequently to smaller catches. There is only a small short-term economic impact on the fisheries, but the long-term consequences are pronounced. In some cases, greater fishing activity in the first few years after the change in population dynamics causes harvests to remain stable despite diminishing stock sizes. This stabilizes the returns from fishing in the short term, but veils the apparent negative long-term impact on the fisheries resulting from adversely affected stock dynamics.

Greenstreet, S.P.R. and Rogers, S.I. **Indicators of the health of the North Sea fish community: identifying reference levels for an ecosystem approach to management.** *ICES Journal of Marine Science* 63(4): 573-593, 2006.

Notes: The shift in emphasis away from the single-species focus of traditional fisheries management towards an ecosystem approach to management requires application of indicators, of ecosystem state. Further, an ecosystem approach to management requires the identification of ecological reference points against which management objectives might be set. In applying indicators, identifying reference points, and setting objectives, an obvious requirement is that the indicators respond primarily to the anthropogenic activity being managed and are sufficiently sensitive that impacts of the activity and the responses to management action are clearly demonstrable. Here we apply a suite of 12 indicators to Scottish August groundfish survey data collected in the northern North Sea over the period 1925-1997. These include indicators of size structure, life-history character composition, species diversity, and trophic structure within the community. Our choice of analytical design has two purposes; first to show that fishing has unequivocally affected these various aspects of the structure of the groundfish community, and second to illustrate an approach by which long time-series data sets might be used to identify possible management reference points. The results are discussed in the context of selecting ecological indicators in support of an ecosystem approach to management and determining appropriate reference points for objective-setting.

Hilborn, R., Parrish, J.K., and Litle, K. **Fishing rights or fishing wrongs?** *Reviews in Fish Biology and Fisheries* 15(3): 191-199, 2005.

Notes: Increasing attention is being paid to overfishing and the biological, economic, and social implications of persistent mismanagement of aquatic natural resources. In this chorus of concern, little attention is focused on sustainable fisheries, and the lessons to be learned from management systems that produce these successes. Although there is no one prescription for sustainability, a range of quota-based management tools have been used to eliminate the race for fish, increasing the incentives for long-term investment and efficiency. Various referred to as fishing rights, tenure rights, or dedicated access privileges, quota-based fisheries confer a percentage (or quota) of the total allowable catch to named entities over some predetermined period, from short-term auction systems to intergenerational customary sea tenure. Whether a rights-based system stems from a traditional fishing rights system or has been recently introduced into modern commercial fisheries, achieving sustainability in the fishery is dependent on incentivizing the collective - from local communities to national fleets - to actively participate in self-regulation of the resource. Thus criticism of the approach often stems from the observation of the potential for cheating at the individual level (e.g., high grading, excessive discards), and the necessary exclusivity that accompanies any transition in management from open access to club membership. It is also worth noting that the resource in question - the fish - remain a public good, and as such, the public should be compensated - or at least not taxed - for their use. Thus the cost of fishery management, and the windfall profits of fishery conversion, should be shared. Rights-based management is not a silver bullet, and is probably not appropriate for all fisheries; however, the successes of the longline fisheries for Pacific halibut and sablefish in Alaska, the artisanal fisheries for loco in Chile and for spiny lobster in Mexico, and the Australian fisheries for Northern prawns and rock lobster, all clearly indicate that fishing rights should have a central place in the fisheries management toolbox.

Huppert, D.D. **An overview of fishing rights.** *Reviews in Fish Biology and Fisheries* 15(3): 201-215, 2005.

Notes: Coastal state management of marine harvests within 200-mile Exclusive Economic Zones was a new and innovative process during the period from the late 1970s through the 1980s. The spread of conservation-focused harvest management was a key step in the evolution of fishing rights, followed in some nations by a second step of creating more exclusive, individual or group fishing rights. The three main forms of more exclusive fishing rights - limited entry permits, individual fishing quotas (IFQs), and local community-based or co-operative harvesting - vary widely in content and detail. But, when successful, they all increase the economic efficiency of fisheries, and they reshape the economic and political landscape of fisheries. All three types, but particularly IFQs, may initiate radical changes in the economic organization of the fishery, ultimately changing who fishes, where and when they fish, the products sold, the balance of power among industry sectors, incentives to support conservation, the size of incomes from fishing, and the location of shore-side economic activity. Changes of this sort are bound to provoke controversy. The controversies over fishing rights take three forms: disagreements over the meaning and intent of fishing rights, disputes over the distribution of rights and associated economic gain, and concern for disruptions imposed on people who are dependent on the "old order". This paper provides a short review of the underlying concepts, rights systems, and current controversies concerning fishing rights.

Bromley, D.W. **Purging the frontier from our mind: Crafting a new fisheries policy.** *Reviews in Fish Biology and Fisheries* 15(3): 217-229, 2005.

Notes: American fishery policy is imprisoned by mental models that defeat coherence concerning the formulation of promising management futures. The idea of the frontier is at the core of current policy incoherence. Images - and specious accounts - of: (1) unowned fish; (2) IFQs/ITQs as property rights; (3) private ownership as necessary and sufficient for individuals (called owners) to suddenly become far-sighted stewards of nature; and (4) rights-based fisheries combine to defeat innovative thought about how to extricate ourselves from deep conceptual confusion. Until we purge the frontier - with its associated images - from our mind it will be difficult to undertake ecosystem management. More seriously, it will be impossible to rectify existing governance and management arrangements that are responsible for the degraded state of America's fisheries.

Hannesson, R. **Rights based fishing: Use rights versus property rights to fish.** *Reviews in Fish Biology and Fisheries* 15(3): 231-241, 2005.

Notes: The basic economic problem of commercial fisheries can be seen as the absence of property rights to the fish stocks. There are, however, both practical and principal obstacles to applying that solution. Instead, the preferable arrangement appears to be stock control by public agencies, combined with exclusive use rights granted, leased or sold to the fishing industry in order to achieve economic efficiency. Incentives to establish such rights can be found both in government circles and in the industry. Both have a vital role to play; plans to establish use rights such as ITQs have run aground on more than one occasion because of opposition from the industry. Use rights can be seen as a tool for government agencies to achieve economic efficiency in the industry. If desired, these gains can be distributed over a wider public through user fees of some kind. There are few examples, however, of substantial user fees, and the industry has been successful in getting such schemes abolished when they have been put into effect. The experience of Russia and, in particular, Estonia is discussed. The absence of user fees can be explained by the need to obtain support for use right schemes from the industry, and the windfall gains from gratis use rights are vehicles for this. Norway and Iceland are two countries which have put in place use rights, but they have done so in different ways. Iceland has an ITQ system while Norway has fishing concessions combined with individual vessel quotas. Some success appears to have been achieved in both countries with these systems.

Arnason, R. **Property rights in fisheries: Iceland's experience with ITQs.** *Reviews in Fish Biology and Fisheries* 15(3): 243-264, 2005.

Notes: The fundamental problem of economic inefficiency in fisheries, the so-called common property problem, may be seen to be caused by inadequate or lacking property rights in the underlying natural resources. The introduction of Individual Transferable Quotas (ITQs) into fisheries represents an attempt to correct this failure. ITQs, however, are not property rights in the relevant natural resources, i.e. the fish stocks and their habitat. They are merely harvesting rights and thus far from ideal as property rights. Nevertheless, ITQs have been introduced in numerous fisheries around the world, apparently with generally, even consistently, good economic results. This paper outlines the basic theory of property rights and the strengths and weaknesses of ITQs as property rights in fisheries. The paper goes on to discuss the Icelandic ITQ system and compares its property rights value with that of the New Zealand ITQ system and the Norwegian IQ system. Finally, the paper reviews some measures of the economic outcomes of the ITQ system in Iceland.

Fujita, R. and Bonzon, K. **Rights-based fisheries management: An environmentalist perspective.** *Reviews in Fish Biology and Fisheries* 15(3): 309-312, 2005.

Notes: Fisheries management regimes take many forms, but most fail to designate shares of the catch. This failure creates strong incentives for individuals to maximize their share without regard to long-term sustainability, because the benefits of conservation actions do not accrue to individuals. The competition to maximize catch usually entails excessive capital investments in fishing vessels and gear and intense fishing pressure, resulting in overfishing, high by-catch rates, and the use of large, efficient types of gear that can harm habitat. Managers respond by increasing regulations, but this often exacerbates perverse incentives. In addition, many fisheries could be producing more value than the current system permits, i.e. large quantities of fish are landed during short seasons, forcing fishermen to sell for low prices. Conservation and economic problems facing fisheries can be addressed in an integrated way, by designating access privileges (specifying shares of the catch) to individuals, harvest cooperatives, fishing sectors, communities, or other appropriate entities. Designated Access Privilege (DAP) systems demonstrably end the competition to maximize catch and often result in better conservation and financial performance. The cost of implementing these systems can be relatively high and has been a barrier to better management. However, this doesn't have to be so. Fisheries could accept investments from a variety of sources and use a portion of the increased financial performance to repay recoverable grants and loans. The key to protecting fish stocks, habitats, and the communities that depend on them will be to implement DAPs that are appropriate for each fishery or community, making investments in sustainability, and creating financing mechanisms that are themselves sustainable, drawing on the increased value that DAP fisheries can produce.

Defeo, O. and Castilla, J.C. **More than one bag for the world fishery crisis and keys for co-management successes in selected artisanal Latin American shellfisheries.** *Reviews in Fish Biology and Fisheries* 15(3): 265-283, 2005.

Notes: Global concerns about the depletion of marine stocks have been widely documented in industrial fisheries. However, small-scale artisanal fisheries constitute a second component for the world fishery crisis, normally ignored or erroneously lumped into the industrial component. In this paper we first present a brief comparison between industrial and artisanal fisheries, highlighting the differences between them and the differential feasibility for implementing management options. We propose that industrial and artisanal fishery problems have to be treated separately and thus cannot be lumped into a single "fishing bag". Among artisanal fisheries, we focus on coastal benthic shellfisheries, highlighting that their sedentary or sessile nature make them amenable to implement spatially-explicit management tools such as rotation of areas and territorial user rights (TURFs). Then, using long-term catch trends and selected examples, we demonstrate the power and validity of co-management for some Latin American shellfisheries, notably in Chile and Mexico, and stress the need to institutionalize the existent fishery knowledge. Several idiosyncratic properties of co-management in our Latin American examples have been useful to sustain the resources over time, including: (a) allocations of TURFs, (b) Community Fishery Quotas, which may be sub-allocated to families, (c) community-based and family-oriented sociological and organizational context of co-management, which may drive short and long-term market forces.

Trondsen, T., Matthiasson, T., and Young, J.A. **Towards a market-oriented management model for straddling fish stocks.** *Marine Policy* 30(3): 199-206, 2006.

Notes: Management of straddling fish stocks has been noted for its political complexity. Negotiations frequently falter as each party seeks to focus upon their own individual and shorter-term goals than the collective interest of the sector. Entrenched positions are often only deepened as new entrants participate to establish their own claims to any emergent share of resource. Unsurprisingly, deadlocks are common and typically compromises are reached only after the real period of biological then economic crisis has passed. Examples to illustrate this tendency can be found in most of the world's oceans and is writ large within the current impasse over blue whiting (*Micromesistius pontassou*) in the North Atlantic. The development of this fishery is discussed and it is shown that despite the scope to add value to the resource base through a pattern of exploitation focussed more upon human consumption than fish meal and oil, there seems little incentive to extricate participants from the cycle of demise that has engulfed negotiations so far. In an attempt to consider how such seemingly intractable problems might be resolved, attention is next turned to the construction of a new model for resource management specifically intended to contend with the problems thrown up by straddling stocks. Central to this is the need to ensure motivation and incentivisation of value chain members in both national economic zones and international waters. It is proposed that a Multinational Resource Cooperative (MRC) is established and would be the key element in the management model. The MRC, on behalf of the national stakeholders, would auction quota so that fish enterprises can purchase quota units defined in terms of species, quantity, catch area and the time of catch. The MRC would also be financed through a quota auction fee as explained below and arrange its own quota control and enforcement services. By auctioning rights to stakeholders the MRC will enable control and enforcement of the TAC; allocations of fair national shares of resource and critically, motivate fish enterprises to devise and implement market-oriented value adding strategies. Adoption of such a scheme should result in a more efficient use of the remaining straddling stocks whilst there is still time to do so. Importantly, the proposed rent distribution mechanism would also shift the focus of negotiations from being dominated by quotas and access rights to more evident pecuniary metrics.

Degnol, P., Gislason, H., Hanna, S., Jentoft, S., Nielsen, J.R., Sverdrup-Jensen, S., and Wilson, D.C. **Painting the floor with a hammer: Technical fixes in fisheries management.** *Marine Policy* 30(5): 534-543, 2006.

Notes: Fisheries management benefits from the contribution of several academic disciplines, each with their own perspectives, concerns and solutions. In this essay we argue that the contribution of biology, economics, sociology and other relevant disciplines to fisheries would be improved if they originated from broader, more integrated analytical perspectives that are attuned to the empirical realities of fisheries management. Today, disciplinary boundaries narrow the perspectives of fisheries management, creating tunnel vision and standardized technical fixes to complex and diverse management problems. Having worked separately and together for a number of years in fisheries research and consultancy in many parts of the world we, as a group of biologists, economists and sociologists, feel that the time to rid ourselves from disciplinary dogmatism is long overdue. We claim that improvements in fisheries management will be realized not through the promotion of technical fixes but instead by embracing and responding to the complexity of the management problem.

Utne, I.B. **Systems engineering principles in fisheries management.** *Marine Policy* 30(6): 624-634, 2006.

Notes: Fisheries management receives valuable, but often fragmented information from academic disciplines such as biology, economics, and social sciences. A multi-disciplinary perspective seems to be necessary if the fisheries are to become sustainable. Globally, overcapacity is considered as the most serious threat to sustainable fisheries, which indicates the need for a stronger integration of technological aspects into fisheries management. This paper discusses application of systems engineering principles and integration of technology into fisheries management. The systems engineering process facilitates implementation of multi-disciplinary information from researchers to fisheries managers in the decision-making towards sustainable fisheries, but may also be used to overcome multi-disciplinary obstacles among scientists. The article concludes that use of systems engineering principles may become a valuable contribution to fisheries management because of increased transparency and reduced risk associated with the decision-making process.

Le Gallic, B. and Cox, A. **An economic analysis of illegal, unreported and unregulated (IUU) fishing: Key drivers and possible solutions.** *Marine Policy* 30(6): 689-695, 2006.

Notes: The fight against illegal, unreported and unregulated (IUU) fishing activities has recently become a high priority in the international fisheries management agenda. While a number of academic contributions have sought to improve the

understanding of the problem, most remain limited in scope. To help policy makers obtain a more comprehensive picture of the situation, the OECD Committee for Fisheries recently completed a study addressing the full economic dimensions of IUU fishing in an integrated manner. This paper presents the analytical framework developed by the OECD as well as some of the key results of the study regarding the causes of and the potential solutions to this widespread problem.

Sumaila, U.R., Alder, J., and Keith, H. **Global scope and economics of illegal fishing.** *Marine Policy* 30(6): 696-703, 2006.

Notes: We present a conceptual model for the analysis of the costs and benefit aspects of the risk inherent in illegal, unreported and unregulated (IUU) activity. We then develop and present a map of IUU incidences as reported in the Fisheries Centre's *Sea Around Us project* IUU global database. This map shows that IUU activities are quite widespread geographically. We next present an analysis of the cost and benefit aspects of risks of IUU fishing. A key result of the study is that for the cases analyzed as a group, the expected benefits from IUU fishing far exceed the expected cost of being apprehended. For an assumed 1 in 5 chance of being apprehended, our calculations show that reported fines for the vessels apprehended will have to be increased by 24 times for the expected cost to be at least as much as the expected benefits.

Hentrich, S. and Salomon, M. **Flexible management of fishing rights and a sustainable fisheries industry in Europe.** *Marine Policy* 30(6): 712-720, 2006.

Notes: Although overexploitation of commercial fish stocks in European waters has been in the public debate now for more than 20 years, the European Union has so far failed to implement sustainable fisheries management. Millions in subsidies paid to the fishing industry have led to significant excess capacity in the fishing fleet. Various feeble attempts to stop overexploitation of marine resources have failed. The cause is that fishing policy is highly dominated by short-term socioeconomic interests. There is an urgent need for a new fisheries management system in Europe that supports reductions in the fishing fleet, increases responsibility among fishers and guarantees long-term conservation of natural marine resources. Transferable rights to fish have proved a reliable and effective means of creating incentives to conserve marine resources. By strengthening individual fishing rights under flexible quota management systems, the EU Member States could, within the Common Fisheries Policy, make a significant contribution to conserving fish stocks, to reducing excess capacity and to raising the profitability of the fisheries industry. A closer look at existing reservations against a flexible management system shows most of the objections to be overstated or capable of resolution.

Kristofersson, D. and Anderson, J.L. **Is there a relationship between fisheries and farming? Interdependence of fisheries, animal production and aquaculture.** *Marine Policy* 30(6): 721-725, 2006.

Notes: Fishmeal is a critically important feed ingredient for use in animal (e.g., poultry and pigs) and aquaculture production (e.g., salmon, trout and shrimp). There is great concern that increasing demand for fishmeal will place stress on the world's pelagic fisheries and may undermine the sustainability of aquaculture systems. Our research shows that after 1998 the fishmeal sector changed. The change has increased costs for animal and fish producers, which seems to have acted as a stimulus for innovation. The results have considerable implications for the management and health of pelagic fisheries.

Sanchirico, J.N., Holland, D., Quigley, K., and Fina, M. **Catch-quota balancing in multispecies individual fishing quotas.** *Marine Policy* 30(6): 767-785, 2006.

Notes: Individual fishery quotas (IFQs) are an increasingly prevalent form of fishery management around the world, with more than 170 species currently managed with IFQs. Yet, because of the difficulties in matching quota holdings with catches, many argue that IFQs are not appropriate for multispecies fisheries. Using on-the-ground-experience with multispecies IFQ fisheries in Iceland, New Zealand, Australia, and Canada, we assess the design and use of catch-quota balancing mechanisms. Our methodology includes a mix of interviews with fishery managers, industry representatives, and brokers, literature review, and data analysis. We find that a combination of incentives and limits on use rates for the mechanisms provide sufficient flexibility to the quota owner without the fishery manager incurring excessive levels of overexploitation risk. Contrary to some

opinions, these programs are evidence that it is possible to implement IFQ programs for multispecies fisheries and that they can be profitable and sustainable.

Ovetz, R. The bottom line: An investigation of the economic, cultural and social costs of industrial longline fishing in the Pacific and the benefits of sustainable use marine protected areas. *Marine Policy* 30(6): 809-820, 2006.

Notes: Industrial longline fishing can be understood as a case study of the cultural, economic, environmental and social impacts of unsustainable fishing technology. While much attention has been attributed to the impact of industrial longlines on the marine ecosystem, little is known about the impact of longline fishing on local food security, employment, cultural belief systems and traditions, revenue generation from marine tourism and climate change. New data demonstrate that the contributions of Marine Protected Areas, marine tourism and recreational fishing to local coastal economies dwarf the contributions of longline fishing. When combined with the impact of overfishing on coastal fishing communities and fish consumers, policies promoting sustainable fisheries must be expanded to take these other factors into account along with issues of biodiversity.

Catchpole, T.L., Frid, C.L.J., and Gray, T.S. Resolving the discard problem - A case study of the English *Nephrops* fishery. *Marine Policy* 30(6): 821-831, 2006.

Notes: The phenomenon of discarding was studied using a multidisciplinary approach to allow the integration of biological, social and economic data. The research aimed to evaluate the strength of the case to reduce discarding in a single case study fishery, the English *Nephrops* fishery; to identify specific objectives for discard reduction; to identify factors that inhibit discard reduction and to determine the best means of achieving those objectives. Changes in trawl structure offered the best solution while having the least impact on fishing opportunities. However, the inadequate level of incentive was identified as the main impediment to discard reduction rather than the lack of technical ability. To implement effective measures to reduce discarding in this fishery, an increased level of incentive is required. Three measures are identified as a means to achieve this.

da Silva, P. and Kitts, A. Collaborative fisheries management in the Northeast US: Emerging initiatives and future directions. *Marine Policy* 30(6): 832-841, 2006.

Notes: The nature of participation by fishing organizations in fisheries management in the Northeast US is changing. Evidence of this is the number of groups that are actively seeking opportunities for group governance of marine resources. This article explores emerging collaborative or co-management arrangements in this region (a process whereby decision-making is shared between federal/council level and fishery stakeholder groups) and the shift towards an ecosystem-based approach to the management of marine fisheries. This research suggests that it is an opportune time for the development of a regional policy in the Northeast that provides an enabling environment in support of decentralized governance of federally managed marine fisheries. It also suggests that these initiatives can play a key role in operationalizing ecosystem-based management.