

### In this review:

- A. Recent publications available online
- B. Recent articles with abstracts

## A. Recent publications available online

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Gilman, E., Clarke, S., Brothers, N., Alfaro-Shigueto-J., Mandelman, J., Mangel, J., Petersen, S., Piovano, S., Thomson, N., Dalzell, P., Donoso, M., Goren, M., and Werner, T. 2007. *Shark Depredation and Unwanted Bycatch in Pelagic Longline Fisheries: Industry Practices and Attitudes, and Shark Avoidance Strategies*. Western Pacific Regional Fishery Management Council, Honolulu, USA.

Available at: [www.unep.org/regionalseas/Publications/Shark\\_Depredation.pdf](http://www.unep.org/regionalseas/Publications/Shark_Depredation.pdf)

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

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Lack, M. 2007. **Behind the façade: A decade of inaction on non-target species in southern bluefin tuna fisheries**. WWF International, Gland, Switzerland. 45pp.

Available at: [http://assets.panda.org/downloads/wwf\\_erswg\\_report\\_october\\_2007lores.pdf](http://assets.panda.org/downloads/wwf_erswg_report_october_2007lores.pdf)

**Notes:** This report reviews the Commission for the Conservation of Southern Bluefin Tuna's (CCSBT) experience in the consideration and management of non-target species and identifies a clear lack of progress in achieving positive outcomes. The overwhelming conclusion is that the Ecologically Related Species Working Group (ERSWG) – which is charged with providing the CCSBT with advice on the nature and extent of interactions with ecologically related species in southern bluefin tuna (SBT) fisheries and with recommendations on measures to reduce those interactions – represents little more than a façade from behind which the CCSBT feigns management of ecologically related species. The specific findings of the report are that the CCSBT:

- has little understanding of the nature and scale of the impact of SBT fisheries on non-target species and has failed to adopt data collection and provision protocols that will address this problem;
- has implemented one mitigation measure for seabirds, but that measure has been superseded by developments elsewhere and is no longer regarded as best practice;
- has failed to implement measures to mitigate the impact of SBT fisheries on other non-target species such as sharks, finfish and turtles;

- does not have in place procedures that confirm the level of compliance with its single mitigation measure for seabirds and is yet to agree on the information to be provided by members in respect of compliance with any management measures, for target or nontarget species, imposed by the Commission;
- has failed to take a precautionary or an ecosystem-based approach to management of SBT fisheries; and
- has failed to address the ineffectiveness of the ERSWG in meeting its terms of reference.

As a result of these failures this report concludes that:

- there remains a high level of uncertainty in the level and nature of the impacts on non-target species in all SBT fleets as a result of limited independent observations on bycatch and a lack of co-ordinated and consistent data reporting;
- it is likely that incidental mortalities of protected species of seabirds remain a serious issue for CCSBT's longline fleets and that significant quantities of sharks are being taken in the longline fleets;
- it is possible that, particularly on the SBT spawning grounds, unregulated bycatch of protected species of marine turtles are occurring;
- the CCSBT's lack of action not only jeopardizes the sustainability of these populations, but also undermines the actions of other RFMOs that are seeking to conserve these, often highly migratory, species; and
- the CCSBT is failing to meet the requirements of its own convention or those of international laws and protocols relating to management of ecologically related species.

## B. Recent articles with abstracts

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White, W.T. and Dharmadi. **Species and size compositions and reproductive biology of rays (Chondrichthyes, Batoidea) caught in target and non-target fisheries in eastern Indonesia.** *Journal of Fish Biology* 70(6): 1809-1837, 2007.

**Notes:** Extensive surveys of various fish landing sites in eastern Indonesia, conducted between April 2001 and March 2006, recorded a total of 54 species of batoid rays belonging to 12 families. The Dasyatidae was by far the most speciose family, comprising half of the recorded species, and was also the most abundant, contributing 89 and 44% to the total numbers and total estimated biomass of batoids, respectively. The size and sex compositions of 23 species of rays are described and an accurate size at maturity of males, i.e. with 95% CI, was determined for 13 of these species. The sex ratios were found to be close to parity in the majority of species, however, the landings of the whitespotted guitarfish *Rhynchobatus australiae* consisted of significantly more females than males, a situation also recorded for this species in the by-catch of the northern Australian prawn fishery. Data on aspects of the reproductive biology of three dasyatid species (*Dasyatis cf. kublizi*, *Dasyatis zugei* and *Himantura walga*), which form a substantial component of the by-catch of the bottom trawl fisheries in the region, were collected on most sampling occasions. These small rays, i.e. maximum sizes 243-379 mm disc width, were found to have no distinct seasonal reproductive cycle and small litter sizes, i.e. less than four embryos. Opportunistic reproductive data, e.g. litter size and embryo sizes, were also collected from various other species. The litter sizes of the rhynchobatid and rhinobatid species examined were found to be larger than those of the gymnurid and dasyatid species examined, i.e. seven to 19 and two to 13 v. one to four, respectively. The data presented in this paper for the numerous species of rays which are landed by target and non-target fisheries in Indonesia represent the first such data for the vast majority of these species.

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McShane, P.E., Broadhurst, M.K., and Williams, A. **Keeping watch on the unwatchable: technological solutions for the problems generated by ecosystem-based management.** *Fish and Fisheries* 8(2): 153-161, 2007.

**Notes:** Ecosystem-based management is an emerging paradigm influencing the management of commercial fisheries. Increasingly, developed nations are adopting explicit legislation and policy governing the assessment and management of their fisheries against criteria of ecological sustainability. Yet the ability to evaluate ecosystem impacts of fisheries is compromised by a general lack of understanding of marine ecosystem function (beyond the population level) and a lack of robust and practical indicators for ecosystem health and management. Recent technological advances can assist in developing criteria, including structural analyses of seafloor communities potentially impacted by fishing gears (e.g. demersal trawling). Similarly, advances in fishing gear technology, including improved selectivity and the development of gears which have a more benign environmental impact, can mitigate some of the ecological impacts of fishing. Such technological advances are summarized in the context of contemporary fisheries management.

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Brunel, T. and Boucher, J. **Long-term trends in fish recruitment in the north-east Atlantic related to climate change.** *Fisheries Oceanography* 16(4): 336-349, 2007.

**Notes:** This study investigates the temporal correspondence between the main patterns of recruitment variations among north-east Atlantic exploited fish populations and large-scale climate and temperature indices. It is of primary importance to know what changes in fish stock productivity can be expected in response to climate change, to design appropriate management strategies. The dominant patterns of recruitment variation were extracted using a standardized principal component analysis (PCA). The first principal component (PC) was a long-term decline, with a stepwise change occurring in 1987. A majority of Baltic Sea, North Sea, west of Scotland and Irish Sea populations, especially the gadoids, have followed this decreasing trend. On the contrary, some herring populations and the populations of boreal ecosystems have followed an opposite increasing trend. The dominant signal in north-east Atlantic sea surface temperature, also extracted by a PCA, was highly correlated with the increase in the Northern Hemisphere Temperature anomaly, which is considered to be an index of global warming. The first component of recruitment was inversely correlated with these changes in regional and global temperature. The second PC of recruitment was a decadal scale oscillation, which was not correlated with climate indicators. The analysis of correlations between population recruitment and local temperature also indicated that the dominant pattern of recruitment variation may be related to an effect of global warming. The influence of fishing on recruitment, via its effect on the spawning stock biomass (SSB), was also investigated by the analysis of correlations between fishing mortality, SSB and recruitment. Results indicate that fishing can be another factor explaining recruitment trends, probably acting in combination with the effect of climate, but cannot explain alone the patterns of recruitment variation found here.

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Feyrer, F., Nobriga, M.L., and Sommer, T.R. **Multidecadal trends for three declining fish species: habitat patterns and mechanisms in the San Francisco Estuary, California, USA.** *Canadian Journal of Fisheries and Aquatic Sciences* 64(4): 723-734, 2007.

**Notes:** We examined a 36-year record of concurrent midwater trawl and water quality sampling conducted during fall to evaluate habitat trends for three declining fish species in the San Francisco Estuary, California, USA: delta smelt (*Hypomesus transpacificus*), striped bass (*Morone saxatilis*), and threadfin shad (*Dorosoma petenense*). Generalized additive modeling revealed that Secchi depth and specific conductance were important predictors of occurrence for delta smelt and striped bass, while specific conductance and water temperature were important for threadfin shad. Habitat suitability derived from model predictions exhibited significant long-term declines for each species; the southeastern and western regions of the estuary exhibited the most dramatic changes. Declines in habitat suitability were associated with anthropogenic modifications to the ecosystem. For delta smelt, an imperiled annual species endemic to the estuary, the combined effects of fall stock abundance and water quality predicted recruit abundance during recent years of chronically low food supply. Our results are consistent with existing evidence of a long-term decline in carrying capacity for delta smelt and striped bass and demonstrate the utility of long-term data sets for evaluating relationships between fish and their habitat.

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Marasco, R.J., Goodman, D., Grimes, C.B., Lawson, P.W., Punt, A.E., and Quinn, T.J. **Ecosystem-based fisheries management: some practical suggestions.** *Canadian Journal of Fisheries and Aquatic Sciences* 64(6): 928-939, 2007.

**Notes:** Globally, there is increased scientific and public interest in the concept of ecosystem-based fisheries management (EBFM). This trend is fueled by a widespread perception that large-scale fishing operations are powerful forces altering the structure and function of marine ecosystems. It is acknowledged that management needs to better account for variations in ocean productivity, stock structure, and changing social values. Many countries are contemplating how to improve ocean fishery management. In the United States, fishery management bodies are experiencing pressure to undertake the daunting task of moving from their current single-species management plans to EBFM. Impediments include lack of a clear definition of EBFM, what it entails, or how to proceed. In this paper, characteristics of fishery management that are unique to EBFM are identified. The transition to EBFM needs to be evolutionary rather than revolutionary. A course of action is outlined that can be used to guide this transition. Modeling approaches and metrics useful for planning, implementing, and evaluating EBFM are discussed, with particular emphasis on management strategy evaluation.

Francis, R.C., Hixon, M.A., Clarke, M.E., Murawski, S.A., and Ralston, S. **Ten commandments for ecosystem-based fisheries scientists.** *Fisheries* 32(5): 217-233, 2007.

**Notes:** In an effort to accelerate the ongoing paradigm shift in fisheries science from the traditional single-species mindset toward more ecosystem-based approaches, we offer the following "commandments" as action items for bridging the gap between general principles and specific methodologies. 1. Keep a perspective that is holistic, risk-averse, and adaptive. 2. Question key assumptions, no matter how basic. 3. Maintain old-growth age structure in fish populations. 4. Characterize and maintain the natural spatial structure of fish stocks. 5. Characterize and maintain viable fish habitats. 6. Characterize and maintain ecosystem resilience. 7. Identify and maintain critical food web connections. 8. Account for ecosystem change through time. 9. Account for evolutionary change caused by fishing. 10. Implement an approach that is integrated, interdisciplinary, and inclusive. Although the shift in worldview embodied in these commandments can occur immediately without additional funding, full implementation of ecosystem-based fisheries science will require an expanded empirical basis as well as novel approaches to modeling. We believe that pursuing these action items is essential for productive marine fisheries to become truly sustainable for present and future generations.

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Sommer, T., Armor, C., Baxter, R., Breuer, R., Brown, L., Chotkowski, M., Culberson, S., Feyrer, F., Gingras, M., Herbold, B., Kimmerer, W., Mueller-Solger, A., Nobriga, M., and Souza, K. **The collapse of pelagic fishes in the Upper San Francisco Estuary.** *Fisheries* 32(6): 270-277, 2007.

**Notes:** Although the pelagic fish community of the upper San Francisco Estuary historically has shown substantial variability, a recent collapse has captured the attention of resource managers, scientists, legislators, and the general public. The ecological and management consequences of the decline are most serious for delta smelt (*Hypomesus transpacificus*), a threatened species whose narrow range overlaps with large water diversions that supply water to over 25 million people. The decline occurred despite recent moderate hydrology, which typically results in at least modest recruitment, and investments of hundreds of millions of dollars in habitat restoration and environmental water allocations to support native fishes. In response to the pelagic fish collapse, an ambitious multi-agency research team has been working since 2005 to evaluate the causes of the decline, which likely include a combination of factors: stock-recruitment effects, a decline in habitat quality, increased mortality rates, and reduced food availability due to invasive species.

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Henriques, M., Gonçalves, E.J., and Almada, V.C. **Rapid shifts in a marine fish assemblage follow fluctuations in winter sea conditions.** *Marine Ecology Progress Series* 340: 259-270, 2007.

**Notes:** Patterns of interannual variation are described for an inshore fish assemblage off the Arrabida rocky coast (Portugal). During an 11 yr period, the fish assemblage showed pronounced changes especially within its tropical, warm-temperate and cold-temperate elements. These changes followed a fluctuating pattern connected with the North Atlantic Oscillation (NAO) with a series of years where the modifications were slight, interspersed with years where faunal changes were very rapid, affecting up to 35% of the total number of species recorded in those years. After a transition year from it cold to a warm period or vice versa, the majority of the newcomers from the preceding phase were eliminated. Winter conditions, but not summer conditions, were good predictors of the observed patterns. Increases in sea surface temperature (SST) were associated with increases in the proportions of tropical and warm-temperate fish and with decreases in the proportion of cold-temperate elements, the reverse being true for decreases in SST. Interannual variation in faunal composition was not simply a consequence of changes in SST. Changes in other factors such as current flow direction and transport mechanisms, capable of bringing fishes from different biogeographical sources, may also play a role in the observed patterns. The influence of the NAO is therefore not only mediated by its effects on SST but also by the changes it induces in wind and current patterns along the Portuguese shore. Long-term trends caused by persistent changes, like those involving global warming, may be masked by the fact that at an intermediate time scale, faunal changes are characterised by a succession of oscillations rather than by a steady modification in a single direction. This outlines the importance of long-term monitoring data, since short-term studies may only capture single phases of a complex oscillation, giving a false picture of the overall pattern of change.

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Bradbury, I.R. and Bentzen, P. **Non-linear genetic isolation by distance: implications for dispersal estimation in anadromous and marine fish populations.** *Marine Ecology Progress Series* 340: 245-257, 2007.

**Notes:** Indirect genetic approaches such as those based on the association between genetic and geographic distance (isolation by distance, IBD) may provide one of the best means of estimating dispersal in marine systems. We evaluated the scale-dependency and the ecological covariates of the IBD relationship through a combined modeling and meta-analytical approach. Using Wright's fixation index  $F_{ST}$ , simulations were used to generate IBD relationships,  $F_{ST}/(1-F_{ST})$  and geographic distance, for various combinations of average dispersal distance and number of generations. IBD linearity increased with time since colonization and dispersal distance, although the effect of dispersal distance predominated after initial colonization. Simulations suggest that declines in the IBD slope were associated with increases in the spatial scale of observation, suggesting that the IBD pattern is non-linear at very short and long average dispersal distances. We hypothesized that non-linear IBD would be common in marine populations, and apparent through a biologically significant non-zero intercept and decreasing slope with increasing geographic scale. Predictions of common non-linearity were examined through IBD relationships (i.e. slope, intercept,  $R^2$  of the regression) and life history parameters from the published literature for 18 species of anadromous/philopatric fishes. As predicted, IBD parameters (intercept and slope) were consistently correlated with many life history traits (e.g. fecundity, egg size). However, the statistical removal of adult size eliminated most significant life history-IBD correlations. Increases in IBD slope were associated with decreasing gene flow ( $p = 0.014$ ,  $R^2 = 0.33$ ), and decreasing migration distance ( $p = 0.039$ ,  $R^2 = 0.23$ ). Non-linearity was further supported by consistent declines in the IBD slope with increased geographic scale in anadromous fish as well as several marine species, suggesting the ubiquity of this phenomenon. We conclude that isolation by distance patterns may reflect dispersal phenotype and are biologically significant. Nonetheless, non-linearity in IBD pattern is probably the norm in aquatic organisms, resulting from large ranges and limited dispersal. Accordingly, approximations of demographic parameters based on the IBD must be made cautiously, taking into account possible non-linearity, scale dependencies, and assumptions of genetic drift-dispersal equilibrium.

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Hilborn, R. **Moving to sustainability by learning from successful fisheries.** *Ambio* 36(4): 296-303, 2007.

**Notes:** There are two diverging views of the status and future of the world's fisheries. One group represented largely by academic marine ecologists sees almost universal failure of fisheries management and calls for the use of marine-protected areas as the central tool of a new approach to rebuilding the marine ecosystems of the world. The scientists working in fisheries agencies and many academic scientists see a more complex picture, with many failed fisheries but also numerous successes. This group argues that we need to apply the lessons from the successful fisheries to stop the decline and rebuild those fisheries threatened by excess fishing. These lessons are stopping the competitive race to fish by appropriate incentives for fishing fleets and good governance. The major tool of resetting incentives is granting various forms of dedicated access, including community-based fishing rights, allocation to cooperatives, and individual fishing quotas. Many of the failed fisheries of the world occur in jurisdictions where central governments are not functional, and local control of fisheries is an essential part of the solution.

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Walters, C.J. **Is adaptive management helping to solve fisheries problems?** *Ambio* 36(4): 304-307, 2007.

**Notes:** Adaptive management has been widely recommended as a way to deal with extreme uncertainty in natural resource and environmental decision making. The core concept in adaptive management is that policy choices should be treated as deliberate, large-scale experiments; hence, policy choice should be treated at least partly as a problem of scientific experimental design. There have now been upwards of 100 case studies where attempts were made to apply adaptive management to issues ranging from restoration of endangered desert fish species to protection of the Great Barrier Reef. Most of these cases have been failures in the sense that no experimental management program was ever implemented, and there have been serious problems with monitoring programs in the handful of cases where an experimental plan was implemented. Most of the failures can be traced to three main institutional problems: i) lack of management resources for the expanded monitoring needed to carry out large-scale experiments; ii) unwillingness by decision makers to admit and embrace uncertainty in making policy choices; and iii) lack of leadership in the form of individuals willing to do all the hard work needed to plan and implement new and complex management programs.

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Savenkoff, C., Swain, D.P., Hanson, J.M., Castonguay, M., Hammill, M.O., Bourdages, H., Morissette, L., and Chabot, D. **Effects of fishing and predation in a heavily exploited ecosystem: Comparing periods before and after the collapse of groundfish in the southern Gulf of St. Lawrence (Canada).** *Ecological Modelling* 204(1-2): 115-128, 2007.

**Notes:** Mass-balance models, using inverse methodology, were applied to the southern Gulf of St. Lawrence for the mid-1980s and the mid-1990s to describe ecosystem structure, trophic group interactions, and the effects of fishing and predation on the ecosystem for periods preceding and following the collapse of groundfish stocks in this area. These models were used to determine how the ecosystem changed, and whether its structure and functioning were affected by the observed changes in key species between the two time periods. Our analyses indicate that the ecosystem structure shifted dramatically from one previously dominated by piscivorous groundfish and small-bodied forage species (e.g., capelin, herring, and shrimp) in similar proportions to one now dominated by small-bodied forage species. Overfishing removed a functional group, large-bodied demersal predators that has not been replaced 12 years after the cessation of heavy fishing, and left marine mammals such as seals and cetacea as top predators of many species (especially fishes) during the mid-1990s. Predation by marine mammals on fish increased from the mid-1980s to the mid-1990s while predation by large fish on fish decreased. A change in the prey of seals from juvenile cod to capelin occurred between the models for the mid-1980s and the mid-1990s consistent with observed shifts in the abundance of the two prey species between the two time periods. These major changes were accompanied by a decrease in total catches and a transition in landings from long-lived and piscivorous groundfish toward planktivorous pelagic fish and invertebrates.

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Andersen, K.H., Farnsworth, K.D., Thygesen, U.H., and Beyer, J.E. **The evolutionary pressure from fishing on size at maturation of Baltic cod.** *Ecological Modelling* 204(1-2): 246-252, 2007.

**Notes:** Recent observations suggest fishing pressure is driving the evolution of smaller female maturation size in some fish stocks. We construct a general size-based theoretical framework to derive the rate and ultimate destination of this evolution based on life-history, community ecology and evolutionary theory. For Baltic cod (*Gadus morhua*), we find a maximum evolutionary rate of approximately -36 g/generation (-0.072 Haldanes) and optimum maturation size < 250 g (mean approximate to 50 g). Whilst this is consistent with many previous observations, it is substantially less than observed in rapidly declining cod stocks, suggesting additional evolutionary processes may affect them. Analysis of management remedies finds only an effective ban on fishing will halt the evolution. Unable to maximise fitness, the fish will remain under evolutionary stress for the foreseeable future.

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Paulsen, C.M., Hinrichsen, R.A., and Fisher, T.R. **Measure twice, estimate once: Pacific salmon population viability analysis for highly variable populations.** *Transactions of the American Fisheries Society* 136(2): 346-364, 2007.

**Notes:** Because many stocks of Pacific salmon *Oncorhynchus* spp. are listed under the U.S. Endangered Species Act (ESA), research has focused on predicting the future population dynamics for these low-abundance stocks. One method used to make predictions is known as population viability analysis. Pacific salmon populations exhibit much higher apparent variability than other ESA-listed vertebrates, and high variability increases the probability of extinction. If the high variability is primarily due to counting methods, it could be reduced in model predictions by using methods that correct for measurement error, sampling error, or both. Using data from British Columbia pink salmon *O. gorbuscha* and Snake River spring- or summer-run Chinook salmon *O. tshawytscha* and several modeling approaches (Ricker, Dennis, and state-space models), we compared repeated counts of the same population (e.g., spawner and fry, dam and redd counts). We applied the methods to the first half of the time series and compared the predictions with the last half of the time series. The results demonstrated that having counts of all life stages of a Pacific salmon population is no guarantee that variability will be markedly reduced. Measurement error is not the primary cause of high variability in empirical estimates of abundance or in predicted future abundance for the stocks analyzed. The very wide bounds on predicted abundance limit the utility of the model predictions for making management decisions. Furthermore, obtaining more accurate or complete measurements of population abundance is unlikely to reduce the wide error bounds in predictions of future abundances.

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Selbie, D.T., Lewis, B.A., Smol, J.P., and Finney, B.P. **Long-term population dynamics of the endangered Snake River sockeye salmon: Evidence of past influences on stock decline and impediments to recovery.** *Transactions of the American*

**Notes:** Declines in populations of Pacific salmon *Oncorhynchus* spp. have been most pronounced in the southern extent of their range, and numerous anthropogenic stressors and natural drivers have been identified as potential causes. Using a paleolimnological approach, we have reconstructed the natural variability in the population dynamics of endangered Snake River sockeye salmon *O. nerka* over approximately the past 1,370 years. The rearing habitat ecology of their main production system, Redfish Lake, Idaho was also assessed over the past 500 years. Siliceous algal remains (diatoms and chrysophytes), stable nitrogen isotope  $\delta^{15}\text{N}$ , cladoceran zooplankton subfossils, and other proxy indicators archived in dated lake sediment cores were employed in this analysis. The inferred natural salmon production was much higher than that recorded in fisheries escapement data. Unprecedented declines in Snake River sockeye salmon production and changes in rearing system ecology were inferred over the past 150 years. The early, negative influences of the Columbia River commercial salmon harvest (in the 1860s) and sustained interruption of migration access (1910-1934) from hydroelectric damming were evident. Enhanced zooplanktivory, associated with normative stocking and possible expansion of kokanee (lacustrine sockeye salmon) beginning in the 1920s and 1930s, appear to have altered the forage base for juvenile sockeye salmon, probably contributing to further declines. Lake nutrient enrichment since the 1950s was inferred, which changed nursery lake nutrient and trophic dynamics. This study highlights both site-specific and regional influences on declines in past Snake River sockeye salmon population abundance and changes in rearing system ecology for these fish over the past 150 years. Such a long-term ecological perspective is important to the continued conservation and management of this endangered species and has broader applications for other sockeye salmon runs at risk throughout their range.

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Rothschild, B.J. **Coherence of Atlantic cod stock dynamics in the Northwest Atlantic Ocean.** *Transactions of the American Fisheries Society* 136(3): 858-874, 2007.

**Notes:** The stocks of Atlantic cod *Gadus morhua* in the Northwest Atlantic Ocean declined in abundance from 1965 to 2003; the declines in spawning stock biomass (SSB) have been temporally coherent. A coherent, sharp increase in SSBs from 1975 to 1985 and a subsequent decrease from 1985 to 1992 are superimposed on the general decline. The coherence suggests that cod stock variability in the Northwest Atlantic Ocean is driven by a common set of causes or that the linkages among the nominal stocks are stronger than was previously thought. The coherent increases in cod SSB from the mid-1970s to 1985 occurred under relatively low fishing mortalities. The declines in SSB beginning in 1985 began during a period of low fishing mortalities. During the 1985-1992 period the declines in Atlantic cod abundance were coupled with greatly reduced growth rates, increased natural mortality rates, and a lack of response to reduced fishing mortality. This suggests that the 1985-1992 decreases were driven by a strong negative environmental signal, implying that the environment had a stronger role in affecting cod abundance than had been previously thought. It appears that the decline in SSB over most of the range of the cod was coupled with a major perturbation in the forage available to cod. Inasmuch as this perturbation involved seemingly disparate groups, such as capelin *Mallotus villosus*, euphausiids, and Atlantic herring *Clupea harengus*, it appears that the change in the environment was associated with the dynamics of the plankton.

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Rogan, E. and Mackey, M. **Megafauna bycatch in drift nets for albacore tuna (*Thunnus alalunga*) in the NE Atlantic.** *Fisheries Research* 86(1): 6-14, 2007.

**Notes:** In this study, results from an observer programme on a drift net fishery in the eastern North Atlantic are presented. Observers recorded all fish, marine mammals, seabirds and turtles caught and discarded and coverage ranged from 47.8% of the fleet ( $n = 7$  vessels) in 1996, to 2.2% ( $n = 21$  vessels) in 1998. A minimum of seven fish species were caught and landed during the fishing period; albacore tuna (*Thunnus alalunga*) comprised approximately 99% of the total landings (by number) in both years. Eleven fish species were discarded, of which blue shark (*Prionace glauca*) was the most frequently recorded representing 68% of all fish discarded by number. At least four species of seabird (Northern Gannet *Morus basanus*, Northern Fulmar *Fulmarus glacialis*, Manx shearwater *Puffinus puffinus*, Atlantic Puffin *Fratercula arctica*) and two species of turtle, including the leatherback turtle (*Dermochelys coriacea*), were also entangled. Eight species of Cetacea were recorded as bycatch during these fishing operations, including common dolphins *Delphinus delphis* and striped dolphins *Stenella coeruleoalba*. Length-frequency distributions for both these dolphin species suggest that age segregation occurs. Using landings of albacore tuna as an indicator of effort, the extrapolated decadal scale data from Irish and other driftnet fleets operating in this area suggest that during the period 1990-2000, a minimum (95% confidence intervals) of 778,452 (622,520-934,384) blue sharks were caught, with a substantial proportion discarded. An estimated 24,358 dolphins were killed during these years by these fleets, of which

11,723 (7670-15,776) were common dolphins and 12,635 (10,009-15,261) were striped dolphins. Although this type of fishing was effective at catching the target species, it removed a large biomass of megafauna and likely accelerated the decline of blue sharks in this area.

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Walmsley, S.A., Leslie, R.W., and Sauer, W.H.H. **Bycatch and discarding in the South African demersal trawl fishery.** *Fisheries Research* 86(1): 15-30, 2007.

**Notes:** Observers aboard commercial trawlers collected data on the total catch composition of 614 and 479 hauls made by vessels operating off the south and west coasts of South Africa, respectively. On the south coast, four fishing areas were identified on the basis of target species and fishing depth. On the west coast, hauls were separated into those targeting hake *Merluccius* spp. in four depth ranges (0-300, 301-400, 401-500, and >500 m) and those targeting monkfish *Lophius vomerinus*. For each area, the catch composition was calculated and the species assemblages were investigated using cluster analysis and multi-dimensional scaling. Finally, for each coast, the weight of fish discarded annually was estimated. On the south coast, although hake dominated, between 21% and 47% of the catch was not hake, depending on the fishing area. In comparison, hake dominated west coast catches, the proportion of hake increasing with depth. For each fishery investigated, approximately 90% of the catch was processed and landed. However, estimates of annual discards indicate that the south and west coast fisheries may annually discard 9000 or 10,000 t and 17,000 or 25,000 t, of undersized and unutilizable fish and offal, respectively, depending on the estimation method used. When developing strategies to limit or enhance utilization of bycatch, cognisance should be taken of the differences in catch composition between the south and west coasts and of the importance of bycatch revenue to south coast fishing companies.

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Longhurst, A. **Doubt and certainty in fishery science: Are we really headed for a global collapse of stocks?** *Fisheries Research* 86(1): 1-5, 2007.

**Notes:** A recent article discusses the consequences for fisheries of the relationship between taxonomic diversity, productivity and the resistance of marine ecosystems to disturbance; this study is based on an examination of historical catch and abundance data, together with experimental studies and surveys. It leads the authors to suggest that all sea fisheries could collapse by the middle of this century unless action is taken to prevent this from happening: this extrapolation has been taken seriously by the news media and the general public, though not by fisheries scientists. The authors draw what appear to be inappropriate conclusions from experimental studies, and from public data bases of global catch and taxonomic diversity. Nevertheless, the doubtful conclusions reached by the authors are less important to the proper functioning of fisheries science than is the apparent failure of the peer review process in the influential journal in which the results were published.

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Garcia, S.M. and Charles, A.T. **Fishery systems and linkages: from clockworks to soft watches.** *ICES Journal of Marine Science* 64(4): 580-587, 2007.

**Notes:** The complex systemic nature of fisheries has been recognized for many decades, but attempts to include this reality in day-to-day management have been slow, patchy, and of limited effectiveness. The topic is reviewed again here, with a focus on new directions. After a brief introduction, an historical review is provided of the evolution of fisheries assessment and modelling highlighting the growing complexity resulting from changing societal demands. The "complexity syndrome" is described in terms of scope, boundaries, scales, components, and linkages, and is demonstrated as reducing understanding, predictability, and controllability, attributable to the effects of delays, teleconnections, scale dependence, and self-organizational capacity. Key issues relate to systemic aspects of fisheries governance and the research needed to support it. Special reference is made to the changes needed to adapt to the newly emerging relationships between science, policy-making, and society within complex fishery systems, and between those systems and their environment. A range of concepts and approaches, such as Integrated Assessment, are elaborated as epistemological and operational frameworks to support the transition process. The conclusion addresses the evolution of the global fishery system and briefly reviews the challenges faced by science, governance, and society.

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Punt, A.E. and Donovan, G.P. **Developing management procedures that are robust to uncertainty: lessons from the International Whaling Commission.** *ICES Journal of Marine Science* 64(4): 603-612, 2007.

**Notes:** Traditionally, fisheries management advice has been based on stock assessments that considered merely the "best" set of assumptions while uncertainty arising only from observation and process error was quantified, if considered at all. Unfortunately, uncertainty attributable to lack of understanding of the true underlying system and to ineffective implementation may dominate the sources of error that must be accounted for if management is to be successful. The management procedure approach is advocated as the appropriate way to develop management advice for renewable resources. This approach, pioneered by the International Whaling Commission (IWC) Scientific Committee, takes politically agreed management objectives and incorporates all scientific aspects of management including data collection and analysis, development of robust harvest control laws or effort regulations, and monitoring. A primary feature is that uncertainty (including that arising from sources conventionally ignored) is taken into account explicitly through population simulations for a variety of scenarios. The nature of the management procedures developed for commercial and aboriginal subsistence whaling and the processes by which they have been developed is highlighted. We also identify lessons that have been learned from two decades of IWC experience and suggest how these can be applied to other fishery situations.

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Smith, A.D.M., Fulton, E.J., Hobday, A.J., Smith, D.C., and Shoulder, P. **Scientific tools to support the practical implementation of ecosystem-based fisheries management.** *ICES Journal of Marine Science* 64(4): 633-639, 2007.

**Notes:** Ecosystem-based fisheries management (EBFM) has emerged during the past 5 y as an alternative approach to single-species fishery management. To date, policy development has generally outstripped application and implementation. The EBFM approach has been broadly adopted at a policy level within Australia through a variety of instruments including fisheries legislation, environmental legislation, and a national policy on integrated oceans management. The speed of policy adoption has necessitated equally rapid development of scientific and management tools to support practical implementation. We discuss some of the scientific tools that have been developed to meet this need. These tools include extension of the management strategy evaluation (MSE) approach to evaluate broader ecosystem-based fishery management strategies (using the Atlantis modelling framework), development of new approaches to ecological risk assessment (ERA) for evaluating the ecological impacts of fishing, and development of a harvest strategy framework (HSF) and policy that forms the basis for a broader EBFM strategy. The practical application of these tools (MSE, ERA, and HSF) is illustrated for the southern and eastern fisheries of Australia.

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Sparholt, H., Bertelsen, M., and Lassen, H. **A meta-analysis of the status of ICES fish stocks during the past half century.** *ICES Journal of Marine Science* 64(4): 707-713, 2007.

**Notes:** Based on a meta-analysis of time-series of stock size, recruitment, and fishing mortality, the general status of fish stocks within the ICES Area (i.e. the Northeast Atlantic) is evaluated. The analysis is based on data for 34 (7 pelagic, 27 demersal) commercial stocks. The stocks were selected based on the quality of the data and the length of the time-series. The analysis indicates that most pelagic stocks recovered to sustainable levels with high productivity after several had collapsed in the 1960s and 1970s. In contrast, most demersal stocks have continued to decline over the past half century and are now recruitment-overfished. By reducing fishing mortality on demersal stocks on average by half and building up the stocks by a factor of about two, management could be brought in line with international agreements. If recruitment-overfishing is avoided for all demersal stocks and discarding is minimized, their yield might be almost doubled over the current yield. Among the major management initiatives during the past half century, only the closure of the pelagic fisheries in the mid-1970s can be clearly identified in the time-series as having had a direct effect on stock status.

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Rice, J.C. and Legace, E. **When control rules collide: a comparison of fisheries management reference points and IUCN criteria for assessing risk of extinction.** *ICES Journal of Marine Science* 64(4): 718-722, 2007.

**Notes:** The quantitative criteria used by the International Union for the Conservation of Nature (IUCN) to assess risk-of-extinction are compared with reference points used by ICES and other fisheries organizations for advising on fisheries management. Criteria based on numbers of individuals and geographic range appear to be in harmony with limit reference

points and control rules used in fisheries management, with reference points indicating that fisheries should be closed well before there is any risk of extinction. However, there is huge potential for conflict between fisheries and risk-of-extinction approaches when considering the extent of population declines. Of 89 species examined, the decline criterion suggested a serious risk-of-extinction in 87%, whereas most of the stocks were still within a zone that allowed fisheries management reference points to indicate that exploitation could continue. Much of the conflict seems rooted in different types of tolerance to risk between the two disciplines. The conservation-biology community acknowledges a high tolerance for "false alarms", to keep the probability of a "miss" very low, whereas tolerance in fisheries management is comparable for both types of error.

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Shelton, P.A. **The weakening role of science in the management of groundfish off the east coast of Canada.** *ICES Journal of Marine Science* 64(4): 723-729, 2007.

**Notes:** The link between science and decision-making for groundfish fisheries off Canada's east coast has weakened during the past two decades. The demand for a large degree of flexibility in the decision-making process by both the Department of Fisheries and Oceans and the Northwest Atlantic Fisheries Organization, as well as the perceived low credibility of scientific knowledge, has resulted in an underutilization of science capacity to provide risk-based assessments and to evaluate management strategies for robustness to uncertainty and compliance with the precautionary approach. The transition from science-based to ad hoc fisheries management is described, and the potential impact of two new approaches, ecosystem-based fisheries management and shared stewardship, is considered.

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Van Densen, W.L.T. and McCay, B.J. **Improving communication from managers to fishers in Europe and the US.** *ICES Journal of Marine Science* 64(4): 811-817, 2007.

**Notes:** Communication problems need to be solved if managers are to be more persuasive about the need for limitations on fishing, to protect and restore fish populations. The context is widespread scepticism about the effectiveness of management on both sides of the Atlantic. That scepticism is fuelled by assessment bias as seen in the case of the northern cod of Newfoundland, and by failure to take into account differences in perceptions of stock size and fishing mortality, differences in causal reasoning about fishing pressure and environmental factors influencing stock size, and differences in the capacity to read and understand the mostly graphic information that underlies and is often used to explain management decisions. This analysis is based on interviews and observations in the European Union and the northeastern USA.

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Duineveld, G.C.A., Bergman, M.J.N., and Lavaleye, M.S.S. **Effects of an area closed to fisheries on the composition of the benthic fauna in the southern North Sea.** *ICES Journal of Marine Science* 64(5): 899-908, 2007.

**Notes:** The effects of fishery exclusion on the composition of the macrofauna were determined by comparing the fishery-exclusion zone around a gas production platform in the southern North Sea (Frisian Front) with nearby regularly fished areas. A Triple-D dredge was used, in addition to a standard box corer, to collect the relatively rare and larger species. Multivariate analysis showed greater species richness, evenness, and abundance of mud shrimps (*Callinassa subterranea*, *Upogebia deltaura*) and fragile bivalves (*Arctica islandica*, *Thracia convexa*, *Dosinia lupinus*, *Abra nitida*, *Cultellus pellucidus*) in the Triple-D samples from the exclusion area. Although box cores did confirm the higher abundance of both mud shrimps in the exclusion zone and demonstrated greater densities of the brittlestar *Amphiura filiformis*, they did not clearly reveal the distinctness of the exclusion zone. This is attributed to the large proportion of small, short-living species in the samples and the relative scarcity of vulnerable larger species common to all the box core samples. There was no evidence of greater recruitment in the relative small exclusion zone, despite its positive effect on adult survival. The observation that the fishery affects deep-living mud shrimps may point to consequences for the functioning of the benthic ecosystem other than simple loss of biodiversity.

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