

In this review:

- A. Recent articles – no abstract
- B. Recent publications available online
- C. Recent articles with abstracts

O/A denotes an open access article or journal

A. Recent articles – no abstract available

Browman, H.I., Law, R., and Marshall, C.T. **The role of fisheries-induced evolution.** *Science* 320(5872): 47, 2008.

Kuparinen, A. and Merila, J. **The role of fisheries-induced evolution.** *Science* 320(5872): 47-48, 2008.

Jorgensen, C., Enberg, K., Dunlop, E.S., Arlinghaus, R., Boukal, D.S., Brander, K., Ernande, B., Gardmark, A., Johnston, F., Matsumura, S., Pardoe, H., Raab, K., Silva, A., Vainikka, A., Dieckmann, U., Heino, M., and Rijnsdorp, A.D. **The role of fisheries-induced evolution - *Response*.** *Science* 320(5872): 48-50, 2008.

B. Recent publications available online

Agnew, D., Pearce, J., Peatman, T., Pitcher, T. and Ganapathiraju, P. 2008. ***The Global Extent of Illegal Fishing.*** MRAG, London, U.K. and Fisheries Ecosystems Restoration Research, Fisheries Centre, University of British Columbia.

Available at: <http://www.illegal-fishing.info/uploads/MRAGExtentGlobalIllegalFishing.pdf>

Notes: This report presents the first detailed quantitative analysis of IUU fishing on a global scale. Estimates of illegal fishing from different Exclusive Economic Zones (EEZs) and unregulated and unreported fishing high seas regions were collected through an IUU monitoring network (commissioned directly by the project) and sourced from the available literature and through discussions with monitoring, control and surveillance (MCS) professionals. The combination of information was used to generate a series of in-depth studies detailing the level of illegal fishing for a number of different species in 60 countries (chosen as those with the highest catches in their EEZs) and 17 high seas FAO regions. Overall the estimates of illegal fishing are based on a number of species and areas that constitute 46% of global catches based on FAO catch statistics. The level of IUU catches was calculated on a regional and species group basis. The results demonstrated that there are significant differences in the level of IUU catch and the trends in those catches between regions, being highest in the Eastern Central Atlantic (Area 34) and lowest in the Southwest Pacific (Area 81). Over the last 10 years IUU has declined in 7 areas, increased in one and stayed the same in the remaining 7. We estimate that the overall loss from our studied fisheries is 11-19% of the reported catch in those fisheries, worth some \$5-11bn in 2003. Taking the total estimated value of illegal catch losses within the analysed fisheries and areas and raising by the proportion of the total world catch, the lower and upper estimates of the total value of current IUU losses worldwide were between \$10bn and \$23bn annually, representing between 11.06 and 25.91 million tonnes.

Freitas, B., Delagran, L., Griffin, E., Miller, K.L. and Hirshfield, M. 2008. *Too Few Fish: A Regional Assessment of the World's Fisheries*. Oceana, Washington, DC. 24pp.

Available at: http://oceana.org/fileadmin/oceana/uploads/dirty_fishing/toofewfish4.pdf

Notes: This report concludes that more than 80 percent of the world's fisheries cannot withstand increased fishing activity and only 17 percent of the world's fisheries should be considered capable of any growth in catch at all. Ultimately, the report shows there is very little room for further expansion of global fishing efforts. In addition, it highlights the essential need for limitations on global fisheries subsidies. These subsidies are estimated to be at least \$20 billion annually, an amount equal to approximately 25 percent of the value of the world catch. Fisheries subsidies create strong economic incentives to overfish and undermine good fishery management. The scope and magnitude of these subsidies is so great that reducing them is the single greatest action that can be taken to protect the world's oceans.

C. Recent articles with abstracts

Rouyer, T., Fromentin, J.-M., Ménard, F., Cazelles, B., Briand, K., Pianet, R., Planque, B., and Stenseth, N.C. **Complex interplays among population dynamics, environmental forcing, and exploitation in fisheries.** *Proceedings of the National Academy of Sciences [USA]* 105(14): 5420-5425, 2008.

Notes: The patterns of variations in fisheries time series are known to result from a complex combination of species and fisheries dynamics all coupled with environmental forcing (including climate, trophic interactions, etc.). Disentangling the relative effects of these factors has been a major goal of fisheries science for both conceptual and management reasons. By examining the variability of 169 tuna and billfish time series of catch and catch per unit effort (CPUE) throughout the Atlantic as well as their linkage to the North Atlantic Oscillation (NAO), we find that the importance of these factors differed according to the spatial scale. At the scale of the entire Atlantic the patterns of variations are primarily spatially structured, whereas at a more regional scale the patterns of variations were primarily related to the fishing gear. Furthermore, the NAO appeared to also structure the patterns of variations of tuna time series, especially over the North Atlantic. We conclude that the patterns of variations in fisheries time series of tuna and billfish only poorly reflect the underlying dynamics of these fish populations; they appear to be shaped by several successive embedded processes, each interacting with each other. Our results emphasize the necessity for scientific data when investigating the population dynamics of large pelagic fishes, because CPUE fluctuations are not directly attributable to change in species' abundance.

Acou, A., Robinet, T., Lance, E., Gerard, C., Mounaix, B., Brient, L., Le Rouzic, B., and Feunteun, E. **Evidence of silver eels contamination by microcystin-LR at the onset of their seaward migration: what consequences for breeding potential?** *Journal of Fish Biology* 72(3): 753-762, 2008.

Notes: Thirty migrating silver eels *Anguilla anguilla* were collected in a river system where algal blooms occurred yearly. Fifty per cent of eel livers were contaminated by microcystin-LR (mean \pm S.D. toxin level: 28.1 ± 22.4 ng g⁻¹). Contaminated silver (v. healthy) eels had lower fish condition. Consequences of this impact for the breeding potential of these migrating eels are discussed.

Finkelstein, M. *et al.* **Evaluating the potential effectiveness of compensatory mitigation strategies for marine bycatch.** *PloS One* 3(6): art. e2480, 2008. **O/A**

Notes: Conservationists are continually seeking new strategies to reverse population declines and safeguard against species extinctions. Here we evaluate the potential efficacy of a recently proposed approach to offset a major anthropogenic threat to many marine vertebrates: incidental bycatch in commercial fisheries operations. This new approach, compensatory mitigation for marine bycatch (CMMB), is conceived as a way to replace or reduce mandated restrictions on fishing activities with compensatory activities (e.g., removal of introduced predators from islands) funded by levies placed on fishers. While efforts are underway to bring CMMB into policy discussions, to date there has not been a detailed evaluation of CMMB's potential as

a conservation tool, and in particular, a list of necessary and sufficient criteria that CMMB must meet to be an effective conservation strategy. Here we present a list of criteria to assess CMMB that are tied to critical ecological aspects of the species targeted for conservation, the range of possible mitigation activities, and the multi-species impact of fisheries bycatch. We conclude that, overall, CMMB has little potential for benefit and a substantial potential for harm if implemented to solve most fisheries bycatch problems. In particular, CMMB is likely to be effective only when applied to short-lived and highly-fecund species (not the characteristics of most bycatch-impacted species) and to fisheries that take few non-target species, and especially few non-seabird species (not the characteristics of most fisheries). Thus, CMMB appears to have limited application and should only be implemented after rigorous appraisal on a case-specific basis; otherwise it has the potential to accelerate declines of marine species currently threatened by fisheries bycatch.

Dankel, D.J., Skagen, D.W., and Ulltang, O. **Fisheries management in practice: review of 13 commercially important fish stocks.** *Reviews in Fish Biology and Fisheries* 18(2): 201-233, 2008.

Notes: This paper comparatively reviews several commercially important fish stocks, their state and their management in various regions of the world including Japanese anchovy, Bay of Biscay anchovy, North Sea sandeel, North Sea herring, Icelandic cod, Barents Sea cod, South African cape hakes, sockeye salmon, chinook salmon, southern bluefin tuna, Pacific halibut, Greenland halibut and Patagonian toothfish. The reviewed fish stocks are systemized in three categories: (1) stock properties and status; (2) management structure and objectives; and (3) management advice. We gather evidence to outline qualities of management regimes that are recommended and highlight those that most often fail. Robust management, biological limits (reference points), implementation and consensus are critical points that separate successful and unsuccessful management regimes. We evaluate each fish stock's management performance relative to its management objectives and current conservation issues. Furthermore, we point out the importance of stakeholder involvement in fisheries management as well as the problems that international fisheries commissions face through examples from the case studies. Management successes tended to be single-nation and single-stock fisheries with capacity control and clear stakeholder involvement. Fisheries with fleet overcapacity, unclear objectives and illegal activity characterized the case studies with management problems.

Ottersen, G. **Pronounced long-term juvenation in the spawning stock of Arcto-Norwegian cod (*Gadus morhua*) and possible consequences for recruitment.** *Canadian Journal of Fisheries and Aquatic Sciences* 65(3): 523-534, 2008.

Notes: The oldest and largest individuals are disappearing from many fish stocks worldwide as a result of overexploitation. This has been suggested to impair recruitment through decreasing the reproductive capacity of the spawners and increasing the mortality rate of the offspring. By using a time series on spawners biomass by age class for Arcto-Norwegian cod (*Gadus morhua*) from 1913-2004, I have documented pronounced changes in the spawning stock, including a trend towards younger fish, a less diverse distribution across ages, and a declining proportion of repeat spawners. Despite the total spawning stock biomass (SSB) being at similar levels now as in 1933, the mean age in the SSB has declined from 10-12.5 years to 7-8 years during the study period, and the percentage of fish of age 10 or above in the SSB has decreased from ~ 97% to ~ 10%. Contrary to earlier theoretical and experimental studies, no clear link between age structure and recruitment was found here. Recruitment to the Arcto-Norwegian cod stock may thus be more robust towards spawner juvenation than expected, possibly because of strong recruitment compensation.

Lozano-Montes, H.M., Pitcher, T.J., and Haggan, N. **Shifting environmental and cognitive baselines in the upper Gulf of California.** *Frontiers in Ecology and Environment* 6(2): 75-80, 2008.

Notes: Local fishers' knowledge (LFK) obtained from 49 fishers in the upper Gulf of California indicates that fishery resources have declined by at least 60% over the past 50 years, most likely due to overfishing and environmental changes associated with upstream damming of the Colorado River. LFK can provide supporting evidence of trends and changes. In marine ecosystems, for example, relative abundances obtained from LFK for several commercial and non-target species are closely correlated with stock assessment biomass, fishing effort, and landings reported by the Mexican Government. Rapid shifts in perception of the degree of degradation of this ecosystem as well as greatly reduced nutrients and river flows (over just a few decades), should act as a red flag to the Mexican Government and management agencies. It is crucial for the

restoration of this ecosystem that young fishers and the Mexican public are able to visualize previous states of their local ecosystems.

Keefer, M.L., Peery, C.A., and Heinrich, M.J. **Temperature-mediated en route migration mortality and travel rates of endangered Snake River sockeye salmon.** *Ecology of Freshwater Fish* 17(1): 136-145, 2008.

Notes: Conservation efforts for endangered Snake River sockeye salmon (*Oncorhynchus nerka*) have been hindered by high en route adult mortality during their ~ 1450 km freshwater spawning migration. Identifying causal factors for this mortality has been difficult given very small (often <10 fish) annual returns in recent decades. However, several hundred hatchery-bred fish returned in 2000 and we intercepted and radio-tagged 31 in mid-migration to monitor behaviours and survival. All fish initially migrated at similar rates, but later-timed fish eventually slowed migration and were far more likely to be unsuccessful. Late-season mortality was strongly associated with water temperatures near tolerance thresholds (21-24°C). The data also suggest increased risk for fish in poor initial condition (i.e., with injuries or parasites) and probable recent selection against late-timed salmon. Results parallel temperature- and condition-related adult mortality in Columbia and Fraser River sockeye salmon populations and demonstrate the potential vulnerability of marginal southern populations to regional climate warming.

Frid, A., Baker, G.G., and Dill, L.M. **Do shark declines create fear-released systems?** *Oikos* 117(2): 191-201, 2008.

Notes: We illustrate the theoretical plausibility that fishery removal of sharks can indirectly alter predation pressure on different fish species via the behavioural responses of mesoconsumers released from predator intimidation. Our dynamic state variable model of foraging decisions by harbour seals, a mesopredator, predicted indirect effects of the removal of Pacific sleeper sharks on two species consumed by seals, Pacific herring and walleye pollock, as mediated by seal behaviour. Herring, a fatty fish, form near-surface aggregations that often are ephemeral and widely dispersed. Pollock are found in the deeper strata preferred by sharks and have lower energy density than herring, but also are larger and their more continuous distribution potentially makes them the more predictable resource for seals. During simulations, predation risk from sharks produced an asymmetric trophic cascade mediated by the seal's underutilisation of deeper, riskier strata. Risk management by seals reduced mortality on pollock, which required riskier access in deep strata, while increasing mortality on herring, which could be accessed with less risk in shallow strata. This effect, however, attenuated if herring were scarcer and seal energy state was poor. During shark removal scenarios, seals shifted to deeper strata, increasing pollock consumption and substantially decreasing use of herring; the proportional change was greatest if seals were in good energy state. Prior studies have addressed how shark declines might affect community structure through density responses by species consumed by sharks; earlier models incorporating antipredator behaviour of the mesopredator (i.e. Ecosim/Ecospace) allow for activity reduction but not for the spatial shifts that altered the asymmetric trophic cascade in our simulations. Our results suggest that shark declines might have stronger ecological consequences than previously recognised if we account for spatial and diet shifts by mesoconsumers released from shark intimidation.

Huse, G. and Ellingsen, I. **Capelin migrations and climate change - a modelling analysis.** *Climatic Change* 87(1-2): 177-197, 2008.

Notes: The capelin is a small pelagic fish that performs long distance migrations. It is a key species in the Barents Sea ecosystem and its distribution is highly climate dependent. Here we use an individual based model to investigate consequences of global warming on capelin distribution and population dynamics. The model relies on input on physics and plankton from a biophysical ocean model, and the entire life cycle of capelin including spawning of eggs, larval drift and adult movement is simulated. Spawning day and adult movement strategies are adapted by a genetic algorithm. Spawning has to take place in designated near-shore spawning areas. The output generated by the model is capelin migration/distribution and population dynamics. We present simulations with present day climate and a future climate scenario. For the present climate the model evolves a spatial distribution resembling typical spatial dynamics of capelin with the coasts of Northern Norway and Murman as the main spawning areas. For the climate change simulation, the capelin is predicted to shift spawning eastwards and also utilize new spawning areas along Novaya Zemlya. There is also a shift in the adult distribution towards the north eastern part of the Barents Sea and earlier spawning associated with the warming.

Eide, A. **An integrated study of economic effects of and vulnerabilities to global warming on the Barents Sea cod fisheries.** *Climatic Change* 87(1-2): 251-262, 2008.

Notes: The Barents Sea area is characterised by a highly fluctuating physical environment causing substantial variations in the ecosystems and fisheries depending upon this. Simulations assuming different management regimes have been carried out to study how physical and biological effects of global warming influence the Barents Sea cod fisheries. A regional, high-resolution representation of the B2 world region (OECD90) scenario from the Intergovernmental Panel on Climate Change was used to calculate water temperatures and plankton biomasses by hydrodynamic modelling. These results were included in simulations performed by a multi-fleet, multi-species model, by which a fully integrated model linking to the global circulation model to the Barents Sea fisheries through a regional downscaling to the Barents Sea area is constructed. One factor of particular importance for the natural annual biological variations is the occasional inflow of young herring into the Barents Sea area. The herring inflow is difficult to predict and links to dynamical systems outside the Barents Sea area, complex recruitment mechanisms and oceanographic conditions. These processes are in the study represented by a stochastic representation of herring inflow based on historical observations. According to the performed simulations the biomass fluctuations may slightly increase over the next 25 years, possibly caused by changes in temperature patterns. Six different management regimes have been included in the study and the results support earlier studies claiming that the choice of management regime potentially has a greater importance for biological and economic performance in the Barents Sea fisheries than impacts which derive from global warming over the next 25 years. A basic assumption for this conclusion is however that the Barents Sea ecosystem essentially preserves its structure and composition of today. Possible, unpredictable significant shifts in the ecosystem structure are not considered.

Hallier, J.P. and Gaertner, D. **Drifting fish aggregation devices could act as an ecological trap for tropical tuna species.** *Marine Ecology Progress Series* 353: 255-264, 2008.

Notes: Purse seine fishing on fish aggregating devices (FADs) has expanded considerably during the last 15 yr in tropical tuna purse seine fisheries, and FADs currently account for about 70 % of their reported tuna catches. The scientific community has expressed concern over the consequences of this fishing practice in terms of yield per recruit and suspected detrimental effects on FAD-associated tunas. To explore possible detrimental effects, we compared stomach fullness, fish plumpness, growth rate, and migration behaviour between free school and drifting FAD-associated tunas for skipjack tuna *Katsuwonus pelamis* and yellowfin tuna *Thunnus albacares* caught in the Atlantic and Indian Oceans. Significant differences in fish plumpness and individual growth rates were found, suggesting that individuals associated with drifting FADs were less healthy than those in free schools. Since stomach fullness indicated that tunas associated with FADs eat less than those in free schools, the difference in growth rate and condition could be the consequence of altered feeding patterns. For each species, significant changes in migratory direction and displacement rates were observed in the presence of drifting FADs. These findings support the hypothesis that FADs act as a super-stimulus, misleading tunas to make inappropriate habitat selection. However, further studies are required to investigate the long-term effect of FADs on the entire life cycle of tunas.

Bouchard, C. and Fortier, L. **Effects of polynyas on the hatching season, early growth and survival of polar cod *Boreogadus saida* in the Laptev Sea.** *Marine Ecology Progress Series* 355: 247-256, 2008. **O/A**

Notes: Based on the analysis of otolith microstructure, polar cod larvae and pelagic juveniles (20 to 55 mm standard length) sampled in September in the Laptev Sea (Siberian Arctic Ocean) hatched under sea-ice cover from mid-March to early July in 2003, and from early January to early July in 2005. During the polar night in January and February 2005, frequent winter polynyas (mesoscale areas of open water amidst ice cover) likely provided the first-feeding larvae with the minimum light necessary to detect and capture plankton prey. The absence of survivors from January to mid-March 2003 coincided with a low occurrence of polynyas. On average, polar cod 59 to 171 d old were 4 mm. longer at a given age in 2005 than in 2003, a difference arising early in larval life and reflecting faster growth and more frequent winter-spring polynyas in 2005. Earlier hatching and faster growth resulted in young-of-the-year polar cod on average 8.6 mm longer in September 2005 (34.8 mm) than in September 2003 (26.2 mm). Assuming that a larger pre-winter size provides protection against predation, the increasing frequency of winter-spring polynyas on the immense Siberian shelves could improve early survival and population size in polar cod.

Taylor, S.G. **Climate warming causes phenological shift in pink salmon, *Oncorhynchus gorbuscha*, behavior at Auke Creek, Alaska.** *Global Change Biology* 14(2): 229-235, 2008.

Notes: Thirty-four years (1972-2005) of water temperature data and extensive biological observations at Auke Creek, Alaska indicate a general warming trend that affected the native pink salmon (*Oncorhynchus gorbuscha*) population. Serial environmental records at nearby Auke Bay, Alaska over 46 years show trends of increasing air and sea surface temperatures. Trends of increased total precipitation and earlier date of ice out on nearby Auke Lake also occurred, but not at significant rates. Average water temperatures during the incubation of pink salmon in Auke Creek increased at a rate of 0.03°C yr⁻¹ over the 34-year period. For the 1972-2005 broods, midpoints of fry migrations from Auke Creek ranged between April 2 and May 7, and there was a trend of earlier migration of pink salmon fry at a rate of -0.5 days yr⁻¹. The migration timing of adult salmon into Auke Creek also showed a trend toward earlier timing. The earlier adult migration combined with warmer incubation temperatures are related to earlier migration of pink salmon fry. If the observed warming trend continues, Auke Creek may become unsuitable habitat for pink salmon. Given the trend for salmon fry to migrate earlier, a larger portion of the population may become mismatched with optimum environmental conditions during their early marine life history. If salmon adults continue to migrate into the creek earlier when water temperatures are commonly high, it will result in increased prespawning mortality.

Crozier, L.G., Zabel, R.W., and Hamlett, A.F. **Predicting differential effects of climate change at the population level with life-cycle models of spring Chinook salmon.** *Global Change Biology* 14(2): 236-249, 2008.

Notes: Habitat conditions mediate the effects of climate, so neighboring populations with differing habitat conditions may differ in their responses to climate change. We have previously observed that juvenile survival in Snake River spring/summer Chinook salmon is strongly correlated with summer temperature in some populations and with fall streamflow in others. Here, we explore potential differential responses of the viability of four of these populations to changes in streamflow and temperature that might result from climate change. First, we linked predicted changes in air temperature and precipitation from several General Circulation Models to a local hydrological model to project streamflow and air temperature under two climate-change scenarios. Then, we developed a stochastic, density-dependent life-cycle model with independent environmental effects in juvenile and ocean stages, and parameterized the model for each population. We found that mean abundance decreased 20-50% and the probability of quasi-extinction increased dramatically (from 0.1 - 0.4 to 0.3 - 0.9) for all populations in both scenarios. Differences between populations were greater in the more moderate climate scenario than in the more extreme, hot/dry scenario. Model results were relatively robust to realistic uncertainty in freshwater survival parameters in all scenarios. Our results demonstrate that detailed population models can usefully incorporate climate-change predictions, and that global warming poses a direct threat to freshwater stages in these fish, increasing their risk of extinction. Because differences in habitat may contribute to the individualistic population responses we observed, we infer that maintaining habitat diversity will help buffer some species from the impacts of climate change.

Sanchirico, J.N., Smith, M.D., and Lipton, D.W. **An empirical approach to ecosystem-based fishery management.** *Ecological Economics* 64(3): 586-596, 2008.

Notes: Marine scientists and policymakers are encouraging ecosystem-based fishery management (EBFM), but there is limited guidance on how to operationalize the concept. We adapt financial portfolio theory as a method for EBFM that accounts for species interdependencies, uncertainty, and sustainability constraints. Illustrating our method with routinely collected data available from the Chesapeake Bay, we demonstrate the gains from taking into account variances and covariances of gross fishing revenues in setting species total allowable catches. We find over the period from 1962-2003 that managers could have increased the revenues from fishing and reduced the variance by employing EBFM frontiers in setting catch levels.

LeGallic, B. **The use of trade measures against illicit fishing: Economic and legal considerations.** *Ecological Economics* 64(4): 858-866, 2008.

Notes: Illegal, Unreported and Unregulated (IUU) fishing activities are a threat for both the marine environment and society. By undermining effective management systems, IUU fishing activities affect economic performance, social welfare and compliance decisions. So far, "traditional" control and surveillance-like measures have had a limited success in deterring IUU fishing, so this paper aims at throwing light on several forms of trade-related initiatives that can be more effective. The paper suggests that both the effectiveness and further development of such measures strongly depend on the way they are designed, especially with respect to their trade-law compatibility. However, current discussions on future trade-based policy developments within some key economic areas suggest that trade measures are a sound option for policy makers. While the paper focuses on fisheries issues, it is also expected to inform the international debate surrounding the sustainable use of natural resources in general, as many sectors face similar biodiversity and trade challenges (e.g. tropical forest, mangroves, etc.).

Milanese, M., Sara, A., Manconic, R., Abdalla, A., and Pronzato, R. **Commercial sponge fishing in Libya: Historical records, present status and perspectives.** *Fisheries Research* 89(1): 90-96, 2008.

Notes: Natural bath sponges (genera *Spongia* and *Hippospongia*, Porifera, Demospongiae) have been harvested for millennia to be used as aids to beauty and body tools, in traditional and modern medicine as well as in painting. Recently, a series of severe epidemics have affected Mediterranean commercial sponges fostering the overexploitation of remaining fishing grounds. Furthermore, Mediterranean bath sponges attain the highest prices compared to Caribbean or Indo-Pacific ones but little or no correct information on origin is transferred to the final buyer. A complex network of re-selling activities and the lack of labelling make it almost impossible to track the pathway of sponge trade. Some of the finest Mediterranean natural bath sponges come from Libya. Nevertheless, little information on Libyan sponge banks and trade have been available mostly given the former international ban. Under an Italian-Libyan joint-project it was possible to assess the past and present situation of sponge fishing in Libya, roughly covering a period of 150 years. After rather low production in years 1860-1879, average crop exceeded 40 t/year between 1880 and 1929. The peak was recorded in years 1920-1929 (almost 70 t/year on average). Today Libyan sponge fishery and trade are mostly confined to the eastern area of the country. Less than 10 t/year are currently harvested. According to a preliminary SCUBA diving survey along the Libyan coasts, sponges belonging to the order Dictyoceratida appear to be the most conspicuous sessile invertebrates in the investigated areas. Here, sponges belonging to the genera *Ircinia* and *Sarcotragus* (commonly defined "wild sponges" with no commercial value) appear to be more abundant than those belonging to the genera *Spongia* and *Hippospongia*. Sustainable approaches to the exploitation of this valuable natural resource such as sponge farming are proposed and discussed.

Tonks, M.L., Griffiths, S.P., Heales, D.S., Brewer, D.T., and Dell, Q. **Species composition and temporal variation of prawn trawl bycatch in the Joseph Bonaparte Gulf, northwestern Australia.** *Fisheries Research* 89(3): 276-293, 2008.

Notes: The Joseph Bonaparte Gulf (JBG) banana prawn subfishery is an important component of Australia's Northern Prawn Fishery (NPF). However, the species composition of the large volumes of bycatch caught in this region is poorly known. We sampled the prawn trawl bycatch of the JBG from 53 commercial trawls over two years. These samples contained 195 taxa from 85 families; 117 teleost taxa contributing 90.9% of the total biomass, 68 invertebrate taxa (7.7% of biomass), six species of elasmobranchs (1.3% of biomass) and three species of sea snakes (< 1 % of biomass). The species composition of this bycatch is distinctly different from that of other tropical regions, including the neighbouring Gulf of Carpentaria in the NPF. The estimated 4934 t of bycatch taken annually in the JBG consists mainly of teleosts (4486 t), invertebrates (382 t) and small elasmobranchs (66t), with around 4000t (81.6% of the total biomass) coming from just six teleost families: Synodontidae (17.7%), Rhinoprenidae (15.9%), Trichiuridae (14.1%), Sciaenidae (12.3%), Engraulidae (10.9%) and Polynemidae (10.7%). Of the other taxa, around 58% occurred in less than 10% of trawls and 28% occurred in only one trawl. Eight species have never been recorded from other bycatch studies in northern Australia. The total bycatch take and its teleost component varied seasonally, while some abundant species also showed seasonal and diel differences in their catch rates and size composition. The data collected in this study will be the basis for a long-term bycatch monitoring program in the region. This will improve the accuracy of quantitative risk assessments used to demonstrate the sustainability of bycatch populations impacted by fishing in northern Australia.

Chen, X.J., Liu, B.L., and Chen, Y. **A review of the development of Chinese distant-water squid jigging fisheries.** *Fisheries Research* 89(3): 211-221, 2008.

Notes: China has developed a major fishing fleet for oceanic squid since 1989, currently having more than 400 squid jigging boats with an annual catch of 250-300 thousand metric tonnes and accounting for about one-sixth of the global oceanic squid production. The main fishing target species include *Ommastrephes bartramii* in the northwestern Pacific, *Illex argentinus* in the southwestern Atlantic, *Dosidicus gigas* in the southeastern Pacific, *Sthenoteuthis oualaniensis* in the northwestern Indian, and *Todarodes pacificus* in the Sea of Japan. The ommastrephidae squid is an opportunist species and vulnerable to environmental fluctuations, making its abundance difficult to assess, forecast and manage. This calls for sharing of scientific information worldwide for better understanding and management of squid fisheries. This study reviews biology, fisheries and resource status of important commercial oceanic squid for the Chinese squid jigging fisheries with a focus on recent literatures published in China.

Nøstbakken, L. **Fisheries law enforcement - A survey of the economic literature.** *Marine Policy* 32(3): 293-300, 2008.

Notes: The paper reviews and summarises the literature on regulatory enforcement in fisheries. The focus is on the theoretical literature. First, some of the main contributions from the general economic literature of law enforcement are presented, along with extensions that are considered relevant to the study of fisheries law enforcement. Second, a review of the economic literature of law enforcement applied to the study of fisheries is provided. Finally, the paper presents gaps in the fisheries economics literature on regulatory enforcement and offers some possibilities for future work.

Jacquet, J.L. and Pauly, D. **Trade secrets: Renaming and mislabeling of seafood.** *Marine Policy* 32(3): 309-318, 2008.

Notes: As the global trade and market for seafood has grown, so have the twin problems of renaming and mislabeling. Resource scarcity, the potential for greater profits, and weak legislation have all encouraged incorrect labeling, the results of which include consumer losses, the subversion of eco-marketing, further degradation of fisheries resources, and even adverse effects on human health. This paper examines the extent and consequences of renaming and mislabeling seafood, the state of current legislation, and the importance of future policies, with particular attention to the US, where 80% of the seafood is imported and more than one-third of all fish are mislabeled. Policy recommendations include governments' support for a global mandate to label species, country of origin, and catching or production method on all seafood with high penalties for infractions. Chain of custody standards, such as those recently implemented by the Marine Stewardship Council (MSC), should also be considered for adoption worldwide. To garner support for this legislation, consumers must become better acquainted and concerned with their seafood and its origins.

Gaichas, S.K. **A context for ecosystem-based fishery management: Developing concepts of ecosystems and sustainability.** *Marine Policy* 32(3): 393-401, 2008.

Notes: Ecosystems have been viewed both as chaotic, untamed nature, and as mechanical systems with predictable equilibrium states. A developing concept of ecosystems as "complex adaptive systems" lies between these extreme concepts, with recognizably patterned but not fully predictable behavior. Sustainability has also been redefined as humans have exploited and often depleted desirable natural resources. Fisheries management desires sustainable yield, but must rethink this concept within the ecosystem context. The most powerful union of "ecosystem" and "sustainability" acknowledges the defining characteristics of complex adaptive systems with the objective of identifying and sustaining healthy relationships within and between ecosystems, economies, and society.

Levesque, J.C. **International fisheries agreement: Review of the International Commission for the Conservation of Atlantic Tunas: Case study—shark management.** *Marine Policy* 32(3): 528-533, 2008.

Notes: To properly manage world fisheries, especially highly migratory species, there are numerous treaties that have been implemented by specialized international fishery commissions. One of the oldest organizations is the International Commission for the Conservation of Atlantic Tunas (ICCAT). The main focus of this review was to summarize the history, roles and responsibilities of ICCAT, and to evaluate ICCAT's management of sharks in general and specifically for shortfin mako (*Isurus oxyrinchus*) shark. This review found that the Convention was established 40 years ago, but it was not until 2004 that the commission conducted its first population assessment on pelagic sharks.

Hutchings, J.A. and Rowe, S. **Consequences of sexual selection for fisheries-induced evolution: an exploratory analysis.** *Evolutionary Applications* 1(1): 129-136, 2008. O/A

Notes: Reproductive behaviour and mating system complexity may influence fisheries-induced evolution. Mate choice and intrasexual competition might favour late-, large-maturing genotypes in contrast to the selection imposed by many fisheries. Here, we simulate changes to the mean and variance in body size of Atlantic cod (*Gadus morhua*) concomitant with increased fishing intensity. Comparing selection differentials (S) for length under the assumptions that size does and does not affect reproductive success, we find that the strength of selection for smaller body size associated with increased fishing pressure depends on: (i) the initial variance in body size; (ii) changes to the variance in size with increasing fishing intensity; and (iii) the influence of size on reproductive success. If the initial variability in length is sufficiently high and its coefficient of variation (CV) increases with fishing intensity, the predicted evolutionary shift towards smaller size generated by fishing is less than that expected under the assumption that reproductive success is independent of size. However, if size influences reproduction and if the CV in body size declines as fishing pressure increases, a trend that may be characteristic of many intensively exploited populations, the strength of selection for smaller size is predicted to be comparatively rapid. We conclude that fisheries-induced evolution can be influenced by changes to the mean and variance of traits under sexual selection, and that the benefits of maintaining broad phenotypic variability in traits such as body size may be greater than previously thought.

Waples, R.S. and Hendry, A.P. **Special Issue: Evolutionary perspectives on salmonid conservation and management.** *Evolutionary Applications* 1(2): 183-188, 2008. O/A

Notes: This special issue of *Evolutionary Applications* comprises 15 papers that illustrate how evolutionary principles can inform the conservation and management of salmonid fishes. Several papers address the past evolutionary history of salmonids to gain insights into their likely plastic and genetic responses to future environmental change. The remaining papers consider potential evolutionary responses to climate warming, biological invasions, artificial propagation, habitat alteration, and harvesting. All of these papers consider how such influences might alter selective regimes, which should then favour plastic or genetic responses. Some of the papers then go on to document such responses, at least some of which are genetically based and adaptive. Despite the different approaches and target species, all of the papers argue for the importance of evolutionary considerations in the conservation and management of salmonids.

Waples, R.S., Pess, G.R., and Beechie, T. **Evolutionary history of Pacific salmon in dynamic environments.** *Evolutionary Applications* 1(2): 189-206, 2008. O/A

Notes: Contemporary evolution of Pacific salmon (*Oncorhynchus* spp.) is best viewed in the context of the evolutionary history of the species and the dynamic ecosystems they inhabit. Speciation was complete by the late Miocene, leaving c. six million years for intraspecific diversification. Following the most recent glacial maximum, large areas became available for recolonization. Current intraspecific diversity is thus the product of recent evolution overlaid onto divergent historical lineages forged during recurrent episodes of Pleistocene glaciation. In northwestern North America, dominant habitat features have been relatively stable for the past 5000 years, but salmon ecosystems remain dynamic because of disturbance regimes (volcanic eruptions, landslides, wildfires, floods, variations in marine and freshwater productivity) that occur on a variety of temporal and spatial scales. These disturbances both create selective pressures for adaptive responses by salmon and inhibit long-term divergence by periodically extirpating local populations and creating episodic dispersal events that erode emerging differences. Recent anthropogenic changes are replicated pervasively across the landscape and interrupt processes that allow natural habitat recovery. If anthropogenic changes can be shaped to produce disturbance regimes that more closely mimic (in both space and

time) those under which the species evolved, Pacific salmon should be well-equipped to deal with future challenges, just as they have throughout their evolutionary history.

Wood, C.C., Bickham, J.W., Nelson, R.J., Foote, C.J., and Patton, J.C. **Recurrent evolution of life history ecotypes in sockeye salmon: implications for conservation and future evolution.** *Evolutionary Applications* 1(2): 207-221, 2008. O/A

Notes: We examine the evolutionary history and speculate about the evolutionary future of three basic life history ecotypes that contribute to the biocomplexity of sockeye salmon (*Oncorhynchus nerka*). The 'recurrent evolution' (RE) hypothesis claims that the sea/river ecotype is ancestral, a 'straying' form with poorly differentiated (meta)population structure, and that highly structured populations of lake-type sockeye and kokanee have evolved repeatedly in parallel adaptive radiations between recurrent glaciations of the Pleistocene Epoch. Basic premises of this hypothesis are consistent with new, independent evidence from recent surveys of genetic variation in mitochondrial and microsatellite DNA: (1) sockeye salmon are most closely related to pink (*O. gorbuscha*) and chum (*O. keta*) salmon with sea-type life histories; (2) the sockeye life history ecotypes exist as polyphyletic lineages within large drainages and geographic regions; (3) the sea/river ecotype exhibits less genetic differentiation among populations than the lake or kokanee ecotypes both within and among drainages; and (4) genetic diversity is typically higher in the sea/river ecotype than in the lake and kokanee ecotypes. Anthropogenic modification of estuarine habitat and intensive coastal fisheries have likely reduced and fragmented historic metapopulations of the sea/river ecotype, particularly in southern areas. In contrast, the kokanee ecotype appears to be favoured by marine fisheries and predicted changes in climate.

Carlson, S.M. and Seamons, T.R. **A review of quantitative genetic components of fitness in salmonids: implications for adaptation to future change.** *Evolutionary Applications* 1(2): 222-238, 2008. O/A

Notes: Salmonine fishes are commonly subjected to strong, novel selective pressures due to anthropogenic activities and global climate change, often resulting in population extinction. Consequently, there is considerable interest in predicting the long-term evolutionary trajectories of extant populations. Knowledge of the genetic architecture of fitness traits is integral to making these predictions. We reviewed the published, peer-reviewed literature for estimates of heritability and genetic correlation for fitness traits in salmonine fishes with two broad goals in mind: summarization of published data and testing for differences among categorical variables (e.g., species, life history type, experimental conditions). Balanced coverage of variables was lacking and estimates for wild populations and behavioral traits were nearly absent. Distributions of heritability estimates were skewed toward low values and distributions of genetic correlations toward large, positive values, suggesting that significant potential for evolution of traits exists. Furthermore, experimental conditions had a direct effect on h^2 estimates, and other variables had more complex effects on h^2 and r_G estimates, suggesting that available estimates may be insufficient for use in models to predict evolutionary change in wild populations. Given this and other inherent complicating factors, making accurate predictions of the evolutionary trajectories of salmonine fishes will be a difficult task.

Einum, S., Robertsen, G., and Fleming, I.A. **Adaptive landscapes and density-dependent selection in declining salmonid populations: going beyond numerical responses to human disturbance.** *Evolutionary Applications* 1(2): 239-251, 2008. O/A

Notes: Theory suggests an important role for population density in shaping adaptive landscapes through density-dependent selection. Here, we identify five methodological approaches for studying such selection, review the existing empirical evidence for it, and ask whether current declines in abundance can be expected to trigger evolutionary responses in salmonid fishes. Across taxa we find substantial amounts of evidence for population density influencing the location of adaptive peaks for a range of traits, and, in the presence of frequency dependence, changing the shape of selection (stabilizing versus disruptive). For salmonids, biological and theoretical considerations suggest that the optimal value of a number of traits associated with juvenile competitive ability (e.g. egg size, timing of emergence from nests, dominance ability), may depend on population density. For adults, more direct experimental and comparative evidence suggest that secondary sexual traits can be subject to density-dependent selection. There is also evidence that density affects the frequency-dependent selection likely responsible for the expression of alternative male reproductive phenotypes in salmon. Less is known however about the role of density in

maintaining genetic variation among juveniles. Further efforts are required to elucidate the indirect evolutionary effects of declining population abundances, both in salmonids and in other anthropogenically challenged organisms.

Crozier, L.G., Hendry, A.P., Lawson, P.W., Quinn, T.P., Mantua, N.J., Battin, J., Shaw, R.G., and Huey, R.B. **Potential responses to climate change in organisms with complex life histories: evolution and plasticity in Pacific salmon.** *Evolutionary Applications* 1(2): 252-270, 2008. **O/A**

Notes: Salmon life histories are finely tuned to local environmental conditions, which are intimately linked to climate. We summarize the likely impacts of climate change on the physical environment of salmon in the Pacific Northwest and discuss the potential evolutionary consequences of these changes, with particular reference to Columbia River Basin spring/summer Chinook (*Oncorhynchus tshawytscha*) and sockeye (*Oncorhynchus nerka*) salmon. We discuss the possible evolutionary responses in migration and spawning date egg and juvenile growth and development rates, thermal tolerance, and disease resistance. We know little about ocean migration pathways, so cannot confidently suggest the potential changes in this life stage. Climate change might produce conflicting selection pressures in different life stages, which will interact with plastic (i.e. nongenetic) changes in various ways. To clarify these interactions, we present a conceptual model of how changing environmental conditions shift phenotypic optima and, through plastic responses, phenotype distributions, affecting the force of selection. Our predictions are tentative because we lack data on the strength of selection, heritability, and ecological and genetic linkages among many of the traits discussed here. Despite the challenges involved in experimental manipulation of species with complex life histories, such research is essential for full appreciation of the biological effects of climate change.

Williams, J.G., Zabel, R.W., Waples, R.S., Hutchings, J.A., and Connor, W.P. **Potential for anthropogenic disturbances to influence evolutionary change in the life history of a threatened salmonid.** *Evolutionary Applications* 1(2): 271-285, 2008. **O/A**

Notes: Although evolutionary change within most species is thought to occur slowly, recent studies have identified cases where evolutionary change has apparently occurred over a few generations. Anthropogenically altered environments appear particularly open to rapid evolutionary change over comparatively short time scales. Here, we consider a Pacific salmon population that may have experienced life-history evolution, in response to habitat alteration, within a few generations. Historically, juvenile fall Chinook salmon (*Oncorhynchus tshawytscha*) from the Snake River migrated as subyearlings to the ocean. With changed riverine conditions that resulted from hydropower dam construction, some juveniles now migrate as yearlings, but more interestingly, the yearling migration tactic has made a large contribution to adult returns over the last decade. Optimal life-history models suggest that yearling juvenile migrants currently have a higher fitness than subyearling migrants. Although phenotypic plasticity likely accounts for some of the change in migration tactics, we suggest that evolution also plays a significant role. Evolutionary change prompted by anthropogenic alterations to the environment has general implications for the recovery of endangered species. The case study we present herein illustrates the importance of integrating evolutionary considerations into conservation planning for species at risk.

Angilletta, M.J., Ashley S.E., Bartz, K.K., Kingsolver, J.G., Scheuerell, M.D., Beckman, B.R., and Crozier, L.G. **Big dams and salmon evolution: changes in thermal regimes and their potential evolutionary consequences.** *Evolutionary Applications* 1(2): 286-299, 2008. **O/A**

Notes: Dams designed for hydropower and other purposes alter the environments of many economically important fishes, including Chinook salmon (*Oncorhynchus tshawytscha*). We estimated that dams on the Rogue River, the Willamette River, the Cowlitz River, and Fall Creek decreased water temperatures during summer and increased water temperatures during fall and winter. These thermal changes undoubtedly impact the behavior, physiology, and life histories of Chinook salmon. For example, relatively high temperatures during the fall and winter should speed growth and development, leading to early emergence of fry. Evolutionary theory provides tools to predict selective pressures and genetic responses caused by this environmental warming. Here, we illustrate this point by conducting a sensitivity analysis of the fitness consequences of thermal changes caused by dams, mediated by the thermal sensitivity of embryonic development. Based on our model, we predict Chinook salmon likely suffered a decrease in mean fitness after the construction of a dam in the Rogue River.

Nevertheless, these demographic impacts might have resulted in strong selection for compensatory strategies, such as delayed spawning by adults or slowed development by embryos. Because the thermal effects of dams vary throughout the year, we predict dams impacted late spawners more than early spawners. Similar analyses could shed light on the evolutionary consequences of other environmental perturbations and their interactions.

McClure, M.M. *et al.* **Evolutionary consequences of habitat loss for Pacific anadromous salmonids.** *Evolutionary Applications* 1(2): 300-318, 2008. O/A

Notes: Large portions of anadromous salmonid habitat in the western United States has been lost because of dams and other blockages. This loss has the potential to affect salmonid evolution through natural selection if the loss is biased, affecting certain types of habitat differentially, and if phenotypic traits correlated with those habitat types are heritable. Habitat loss can also affect salmonid evolution indirectly, by reducing genetic variation and changing its distribution within and among populations. In this paper, we compare the characteristics of lost habitats with currently accessible habitats and review the heritability of traits which show correlations with habitat/environmental gradients. We find that although there is some regional variation, inaccessible habitats tend to be higher in elevation, wetter and both warmer in the summer and colder in the winter than habitats currently available to anadromous salmonids. We present several case studies that demonstrate either a change in phenotypic or life history expression or an apparent reduction in genetic variation associated with habitat blockages. These results suggest that loss of habitat will alter evolutionary trajectories in salmonid populations and Evolutionarily Significant Units. Changes in both selective regime and standing genetic diversity might affect the ability of these taxa to respond to subsequent environmental perturbations. Both natural and anthropogenic and should be considered seriously in developing management and conservation strategies.

Fukuwaka, M. and Morita, K. **Increase in maturation size after the closure of a high seas gillnet fishery on hatchery-reared chum salmon *Oncorhynchus keta*.** *Evolutionary Applications* 1(2): 376-387, 2008. O/A

Notes: Gillnet fisheries are strongly size-selective and seem to produce changes in size at maturity for exploited fishes. After World War II, large-scale gillnet fisheries targeted Pacific salmon (*Oncorhynchus* spp.) in the high seas area of the North Pacific and the Bering Sea, but these fisheries were closed in 1993. To assess the effects of this high seas gillnet fishery (and its closing) on size at maturity, we examined long-term trends in size at 50% probability of maturing (L50) for chum salmon (*O. keta*) from three populations in Hokkaido, Japan. The L50 trends were statistically different among rivers, but showed similar temporal patterns with decreases in the 1970s and early 1980s and increases after the 1985 brood year. While fishery-induced evolution seemed largely responsible for this temporal change in L50 during the fishing period, natural selection and phenotypic plasticity induced by environmental changes could contribute to the increases in L50 after the relaxation of fishing pressure.

Hard, J.J., Gross, M.R., Heino, M., Hilborn, R., Kope, R.G., Law, R., and Reynolds, J.D. **Evolutionary consequences of fishing and their implications for salmon.** *Evolutionary Applications* 1(2): 388-408, 2008. O/A

Notes: We review the evidence for fisheries-induced evolution in anadromous salmonids. Salmon are exposed to a variety of fishing gears and intensities as immature or maturing individuals. We evaluate the evidence that fishing is causing evolutionary changes to traits including body size, migration timing and age of maturation, and we discuss the implications for fisheries and conservation. Few studies have fully evaluated the ingredients of fisheries-induced evolution: selection intensity, genetic variability, correlation among traits under selection, and response to selection. Most studies are limited in their ability to separate genetic responses from phenotypic plasticity, and environmental change complicates interpretation. However, strong evidence for selection intensity and for genetic variability in salmon fitness traits indicates that fishing can cause detectable evolution within ten or fewer generations. Evolutionary issues are therefore meaningful considerations in salmon fishery management. Evolutionary biologists have rarely been involved in the development of salmon fishing policy, yet evolutionary biology is relevant to the long-term success of fisheries. Future management might consider fishing policy to (i) allow experimental testing of evolutionary responses to exploitation and (ii) improve the long-term sustainability of the fishery by mitigating unfavorable evolutionary responses to fishing. We provide suggestions for how this might be done.