

# Marine Science Review – 199

## Fish and fisheries



### In this review:

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

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## A. Recent articles – no abstract available

Hilborn, R. **Faith-based fisheries.** *Fisheries* 31(11): 554-555, 2006.

Frid, C.L.J., Paramor, O.A.L., and Scott, C.L. **Ecosystem-based management of fisheries: is science limiting?** *ICES Journal of Marine Science* 63(9): 1567-1572, 2006.

Sheppard, C. **Trawling the sea bed.** *Marine Pollution Bulletin* 52(8): 831-835, 2006.

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## B. Recent articles with abstracts

Christie, K.S. and Reimchen, T.E. **Post-reproductive Pacific salmon, *Oncorhynchus* spp., as a major nutrient source for large aggregations of gulls, *Larus* spp.** *Canadian Field Naturalist* 119(2): 202-207, 2005.

**Notes:** On the Pacific coast of North America, the most abundant vertebrate visitors to estuaries and rivers during salmon migration are gulls, yet the utilization of salmon nutrients by these scavengers, and subsequent ecological impacts are not well documented. On two forested watersheds on the central coast of British Columbia, we tracked gull abundance during the spawning period for two consecutive years, and estimated consumption of post-reproductive salmon carcasses and eggs, as well as guano production. At Clatse River, gulls (*Larus glaucescens*, *L. argentatus*, *L. thayerii*, *L. californicus*, *L. canus*, *L. philadelphia*) consumed 13-26% of total salmon carcass biomass and 29-36% of all salmon eggs deposited in the system. At Neekas River, gulls consumed 11-19% of salmon carcass biomass and 7-18% of total salmon eggs. Local guano production over the 60-day period ranged from 600 kg to 1190 kg at Clatse and from 1200 kg to 2100 kg at Neekas River, and was distributed to marine, estuarine, freshwater and riparian habitats. The large aggregations of gulls and subsequent nutrient cycling observed on our study watersheds may represent a once widespread phenomenon that is now largely reduced due to recent declines in salmon populations.

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Clarke, S.C., McAllister, M.K., Milner-Gulland, E.J., Kirkwood, G.P., Michielsens, C.G.J., Agnew, D.J., Pikitch, E.K., Nakano, H., and Shivji, M.S. **Global estimates of shark catches using trade records from commercial markets.** *Ecology Letters* 9(10): 1115-1126, 2006.

**Notes:** Despite growing concerns about overexploitation of sharks, lack of accurate, species-specific harvest data often hampers quantitative stock assessment. In such cases, trade studies can provide insights into exploitation unavailable from traditional monitoring. We applied Bayesian statistical methods to trade data in combination with genetic identification to estimate by species, the annual number of globally traded shark fins, the most commercially valuable product from a group of species often unrecorded in harvest statistics. Our results provide the first fishery-independent estimate of the scale of shark catches worldwide and indicate that shark biomass in the fin trade is three to four times higher than shark catch figures reported in the only global data base. Comparison of our estimates to approximated stock assessment reference points for one

of the most commonly traded species, blue shark, suggests that current trade volumes in numbers of sharks are close to or possibly exceeding the maximum sustainable yield levels.

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Saunders, R., Hachey, M.A., and Fay, C.W. **Maine's diadromous fish community: Past, present, and implications for Atlantic salmon recovery.** *Fisheries* 31(11): 537-547, 2006.

**Notes:** Co-evolved diadromous fishes may play important roles in key life history events of Atlantic salmon (*Salmo salar*) in northeastern U.S. riverine ecosystems. We reviewed available information on the historic and current abundance of alewives (*Alosa pseudoharengus*), blueback herring (*Alosa aestivalis*), American shad (*Alosa sapidissima*), rainbow smelt (*Osmerus mordax*), and sea lamprey (*Petromyzon marinus*) for several rivers in Maine. Historically, these diadromous fishes were substantially more abundant and were able to travel much farther inland to spawning and rearing areas in comparison to contemporary conditions. At historic abundance levels, these diadromous fishes likely provided several important functions for Atlantic salmon such as providing alternative prey for predators of salmon (i.e., prey buffering), serving as prey for juvenile and adult salmon, nutrient cycling, and habitat conditioning. Restoring the co-evolved suite of diadromous fishes to levels that sustain these functions may be required for successful recovery of the last native Atlantic salmon populations in the United States.

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Sheaves, M. **Is the timing of spawning in sparid fishes a response to sea temperature regimes?** *Coral Reefs* 25(4): 655-669, 2006.

**Notes:** Published spawning seasons of sparid fish were investigated to determine if there were consistent patterns that could be related to large-scale physical variability, and whether these relationships were species-specific or characteristic of higher taxonomic groupings. For individual species, genera and the family Sparidae as a whole, there was a consistent pattern; spawning at lower latitudes was concentrated close to the month of lowest sea surface temperature, while spawning at higher latitudes was more variable with greater deviations from the month of minimum sea surface temperature. The distribution of sparids may be limited by a lack of tolerance of one or more early life-history stage to high water temperatures, so targeting spawning to the coolest part of the year could be a tactic allowing maximum penetration into warmer waters. Such a link between the physiology of early life-history stages and timing of spawning could have direct consequences for patterns of distributions over a number of taxonomic scales. If there are similar constraints on the reproduction of other species, even minor increases in water temperature due to global warming that may be within the tolerance of adults, may impose constraints on the timing of spawning, with flow-on effects for both species and whole ecosystems.

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Sibert, J., Hampton, J., Kleiber, P., and Maunder, M. **Biomass, size, and trophic status of top predators in the Pacific Ocean.** *Science* 314(5806): 1773-1776, 2006.

**Notes:** Fisheries have removed at least 50 million tons of tuna and other top-level predators from the Pacific Ocean pelagic ecosystem since 1950, leading to concerns about a catastrophic reduction in population biomass and the collapse of oceanic food chains. We analyzed all available data from Pacific tuna fisheries for 1950-2004 to provide comprehensive estimates of fishery impacts on population biomass and size structure. Current biomass ranges among species from 36 to 91% of the biomass predicted in the absence of fishing, a level consistent with or higher than standard fisheries management targets. Fish larger than 175 centimeters fork length have decreased from 5% to approximately 1% of the total population. The trophic level of the catch has decreased slightly, but there is no detectable decrease in the trophic level of the population. These results indicate substantial, though not catastrophic, impacts of fisheries on these top-level predators and minor impacts on the ecosystem in the Pacific Ocean.

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Calado, R. **Marine ornamental species from European waters: a valuable overlooked resource or a future threat for the conservation of marine ecosystems?** *Scientia Marina* 70(3): 389-398, 2006.

**Notes:** The worldwide growth of the marine aquarium market has contributed to the degradation of coral reef ecosystems. Enforcing the legislation on importing ornamental species has led some European traders to concentrate on local species.

Portugal is used as a case study of marine ornamental fish and invertebrate collection in European waters. One hundred and seventy two species occurring in Portuguese waters (mainland, the Azores and Madeira archipelagos) were considered as potential targets for the marine aquarium industry, some of which are already traded on a regular basis (e.g. *Clibanarius erythropus*, *Lysmata seticaudata*, *Cerithium vulgatum*, *Hinia reticulata* and *Ophioderma longicauda*). To ensure appropriate management and conservation of these resources, the following options have been evaluated: banning the harvest and trade of all marine ornamental species from European waters; creating sanctuaries and "no take zones"; issuing collection permits; creating certified wholesalers; implementing the use of suitable gear and collecting methods; setting minimum and maximum size limits, establishing species-based quotas; protecting rare, or "keystone" species and organisms with poor survivability in captivity; establishing closed seasons; culturing ornamental organisms; and creating an "eco-fee" to support research and management. Establishing this sustainable alternative fishery may help minimise the economical and social impacts caused by the crash of important food fisheries in Portugal and other European and West African countries.

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Hsieh, C.H., Reiss, C.S., Hunter, J.R., Beddington, J.R., May, R.M., and Sugihara, G. **Fishing elevates variability in the abundance of exploited species.** *Nature* 443(7113): 859-862, 2006.

**Notes:** The separation of the effects of environmental variability from the impacts of fishing has been elusive, but is essential for sound fisheries management. We distinguish environmental effects from fishing effects by comparing the temporal variability of exploited versus unexploited fish stocks living in the same environments. Using the unique suite of 50-year-long larval fish surveys from the California Cooperative Oceanic Fisheries Investigations we analyse fishing as a treatment effect in a long-term ecological experiment. Here we present evidence from the marine environment that exploited species exhibit higher temporal variability in abundance than unexploited species. This remains true after accounting for life-history effects, abundance, ecological traits and phylogeny. The increased variability of exploited populations is probably caused by fishery-induced truncation of the age structure, which reduces the capacity of populations to buffer environmental events. Therefore, to avoid collapse, fisheries must be managed not only to sustain the total viable biomass but also to prevent the significant truncation of age structure. The double jeopardy of fishing to potentially deplete stock sizes and, more immediately, to amplify the peaks and valleys of population variability, calls for a precautionary management approach.

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Grey, M., Blais, A.M., Hunt, B., and Vincent, A.C.J. **The USA's international trade in fish leather, from a conservation perspective.** *Environmental Conservation* 33(2): 100-108, 2006.

**Notes:** This paper provides the first analysis of imports and exports of fish leather by the USA. Estimates of minimum levels of trade were obtained from the records of the United States Fish and Wildlife Service for 1997-2001, and possible conservation consequences were considered. Data show that imported leather items used the skins of at least 51 types of fish. Of the 41 identified to species level, six were freshwater fish, eight diadromous and 27 were fully marine. Eels and hagfishes (marketed as 'eelskin'; eight named species), stingrays (10 named species) and sharks (15 named species) dominated the trade. An average of 725 000 fish-leather products, worth over US\$ 6 million, was imported each year to the USA. A significant decline in fish leather imports over the five-year period studied derived largely from changes in 'eelskin' imports. Fish leather in the USA was reportedly sourced primarily from the Republic of Korea, mainland China and Thailand, although the records were flawed. About 93% of leather products were obtained from wild fish. Exports from the USA totalled approximately 5% of imports by volume. Many of the fish species comprising the largest imports for leather were characterized by low resilience to exploitation, with one-third of known species considered threatened or near threatened by the World Conservation Union (IUCN). This pilot assessment indicates the need for better record keeping if sustainability of fish exploitation for leather is to be evaluated.

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Giles, B.G., Ky, T.S., Hoang, D.H., and Vincent, A.C.J. **The catch and trade of seahorses in Vietnam.** *Biodiversity and Conservation* 15(8): 2497-2513, 2006.

**Notes:** Catch monitoring and surveys were used to assess the seahorse trade in Vietnam. Despite low daily catch rates, potentially 6.5 t of dried seahorses (~ 2.2 million seahorses) were taken annually as bycatch by trawlers operating out of five coastal provinces of Vietnam. Individual seahorse catches were collated by a few local buyers, who supplied wholesalers in three major markets: Ho Chi Minh City, Hai Phong City and Da Nang. Domestic consumption was small and most seahorses

were exported, generally through unofficial and unregulated channels across the northern border into Guangxi province of China. Overall, the seahorse trade was of low economic value to Vietnam, but may constitute an important source of income to upper level buyers and exporters. Most fishers and buyers surveyed reported that seahorse catch had declined over time. This paper should help in meeting the new CITES requirements - through implementation of an Appendix II listing in 2004 - that all international trade in seahorses must be monitored and managed for sustainability.

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Grey, M. and Vincent, A.C.J. **Extent and possible conservation implications of fish use for research, testing and education in North America.** *Aquatic Conservation: Marine and Freshwater Ecosystems* 16(6): 569-578, 2006.

**Notes:** 1. Fish species are used globally for fundamental research, product and environmental testing, and education, but this use has not hitherto been documented. The number of fish used for research and education in North America currently represents approximately one-quarter of all animal use for these purposes; only mice are used in higher numbers. Data from the Canadian Council on Animal Care, various animal care committees from Canadian universities, and the United States Fish and Wildlife Service are collated and summarized. 2. In Canada nearly a half a million fish were used for research and education each year from 1996 to 2001. We estimated that the United States used over four times that amount for the same purposes, totalling approximately 2.8 million fish each year. 3. At least 100 fish species, representing 27 taxonomic orders, were used for research and education in North America from 1996 to 2001. Close to one-third of the species had life-history characteristics that might make them particularly susceptible to over-exploitation. This potential vulnerability, coupled with data from animal care facilities in Canada suggesting that nearly half of all fish used for research and education were wild-caught, should prompt further documentation of such fish uses in order to assess their sustainability.

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Hiddink, J.G., Jennings, S., and Kaiser, M.J. **Indicators of the ecological impact of bottom-trawl disturbance on seabed communities.** *Ecosystems* 9(7): 1190-1199, 2006.

**Notes:** The Ecosystem Approach to Fisheries requires that managers take account of the environmental impacts of fishing. We develop linked state and pressure indicators that show the impact of bottom-trawling on benthic communities. The state indicator measures the proportion of an area where benthic invertebrate biomass (B) or production (P) is more than 90% of pristine benthic biomass (B-0.9) or production (P-0.9). The pressure indicator measures the proportion of the area where trawling frequency is sufficiently high to prevent reaching predicted B-0.9 or P-0.9. Time to recovery to B-0.9 and P-0.9 after trawling, depending on the habitat, was estimated using a validated size-based model of the benthic community. Based on trawling intensity in 2003, 53.5% of the southern North Sea was trawled too frequently for biomass to reach B-0.9, and 27.1% was trawled too frequently for production to reach P-0.9. As a result of bottom-trawling in 2003, in 56% of the southern North Sea benthic biomass was below B-0.9, whereas in 27% of the southern North Sea benthic production was below P-0.9. Modeled recovery times were comparable to literature estimates (2.5 to more than 6 years). The advantages of using the area with an ecological impact of trawling as a pressure indicator are that it is conceptually easy to understand, it responds quickly to changes in management action, it can be implemented at a relevant scale for fisheries management, and the necessary effort distribution data are centrally collected. One of this approach's greatest utilities, therefore, will be to communicate to policy makers and fishing enterprises the expected medium- to long-term ecological benefits that will accrue if the frequency of trawling in particular parts of fishing grounds is reduced.

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Bakun, A. and Weeks, S.J. **Adverse feedback sequences in exploited marine systems: are deliberate interruptive actions warranted?** *Fish and Fisheries* 7(4): 316-333, 2006.

**Notes:** Several mechanisms for self-enhancing feedback instabilities in marine ecosystems are identified and briefly elaborated. It appears that adverse phases of operation may be abruptly triggered by explosive breakouts in abundance of one or more previously suppressed populations. Moreover, an evident capacity of marine organisms to accomplish extensive geographic habitat expansions may expand and perpetuate a breakout event. This set of conceptual elements provides a framework for interpretation of a sequence of events that has occurred in the Northern Benguela Current Large Marine Ecosystem (off south-western Africa). This history can illustrate how multiple feedback loops might interact with one another in unanticipated and quite malignant ways, leading not only to collapse of customary resource stocks but also to degradation of the ecosystem to such an extent that disruption of customary goods and services may go beyond fisheries alone to adversely affect other

major global ecosystem concerns (e.g. proliferations of jellyfish and other slimy, stinky, toxic and/or noxious organisms, perhaps even climate change itself, etc.). The wisdom of management interventions designed to interrupt an adverse mode of feedback operation is pondered. Research pathways are proposed that may lead to improved insights needed: (i) to avoid potential 'triggers' that might set adverse phases of feedback loop operation into motion; and (ii) to diagnose and properly evaluate plausible actions to reverse adverse phases of feedback operation that might already have been set in motion. These pathways include the drawing of inferences from available 'quasi-experiments' produced either by short-term climatic variation or inadvertently in the course of biased exploitation practices, and inter-regional applications of the comparative method of science.

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Tillin, H.M., Hiddink, J.G., Jennings, S., and Kaiser, M.J. **Chronic bottom trawling alters the functional composition of benthic invertebrate communities on a sea-basin scale.** *Marine Ecology Progress Series* 318: 31-45, 2006.

**Notes:** Bottom trawling causes widespread physical disturbance of sediments in seas and oceans and affects benthic communities by removing target and non-target species and altering habitats. One aspiration of the ecosystem approach to management is to conserve function as well as biodiversity, but trawling impacts on benthic community function need to be understood before they can be managed. Here we present the large scale and long term impact of chronic trawling on the functional composition of benthic invertebrate communities using a comprehensive set of functional traits. The effects of chronic trawling disturbance on the functional composition of faunal benthic invertebrate communities, as sampled with a small beam trawl, were investigated at 6 to 13 sites in each of 4 contrasting regions of the North Sea. Each site was subject to known levels of trawling disturbance. Information on the life history and ecological function traits of the taxa sampled was translated into fuzzy coding and used to analyse the relationship between life history and functional roles within the ecosystem. Multivariate analyses were used to examine changes in the distribution of traits over gradients of trawling intensity. Changes in the functional structure of the community due to the effects of long-term trawling were identified in 3 of the 4 areas sampled. Filter-feeding, attached and larger animals were relatively more abundant in lightly trawled areas, while areas with higher levels of trawling were characterised by a higher relative biomass of mobile animals and infaunal and scavenging invertebrates. Univariate analysis of selected traits confirmed the patterns observed in multivariate analysis. These results demonstrate that chronic bottom trawling can lead to large scale shifts in the functional composition of benthic communities, with likely effects on the functioning of coastal ecosystems.

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Kenchington, E.L.R., Gilkinson, K.D., MacIssaac, K.G., Bourbonnais-Boyce, C., Kenchington, T.J., Smith, S.J., and Gordon, D.C. **Effects of experimental otter trawling on benthic assemblages on Western Bank, northwest Atlantic Ocean.** *Journal of Sea Research* 56(3): 249-270, 2006.

**Notes:** The effects of otter trawling on a hard-bottom ecosystem on Western Bank on Canada's Scotian Shelf were examined experimentally from 1997 to 1999 with an asymmetrical BACI design. The site was located within an area that had been closed to fishing since 1987 to protect juvenile haddock. An experimental line was trawled 12-14 times on three separate occasions over a 20 month period. The benthic macrofauna, and megafauna were sampled before and after trawling on both impact and control lines with both a grab and a photographic system. The 100 grab samples collected contained 341 taxa, primarily polychaetes, amphipods and molluscs, the majority (60%) of which were epifaunal. Biomass was dominated by the horse-mussel *Modiolus modiolus*, a long-lived bivalve, while the tube-building amphipod *Ericthonius fasciatus* was the most abundant species. Through the study period the benthos on the control lines showed little qualitative or quantitative change in individual taxa or community metrics. However, the abundance of 24 individual taxa (polychaetes, amphipods, echinoderms and molluscs) changed significantly, with the majority of these increasing. This resulted in a significantly different relative abundance of taxa between years as detected through ANOSIM. A significant change in relative biomass amongst the taxa was also observed. Trawling had few detectable immediate effects on the abundance or biomass of individual taxa and none on community composition. A few taxa, primarily a mixture of polychaetes and amphipods, decreased significantly after trawling and data from fish stomachs collected during the experiment (Kenchington, E.L., Gordon Jr., D.C., Bourbonnais-Boyce, C., MacIsaac, K.G., Gilkinson, K.D., McKeown, D.L., Vass, W.P., 2005. Effects of experimental otter trawling on the feeding of demersal fish on Western Bank, Nova Scotia. *Amer. Fish. Soc. Symp.* 41, 391-409) showed that some of these were scavenged by demersal fish. Fifteen taxa showed significant decreases after trawling when the cumulative effects of trawling were considered. As in the analyses of individual years the species affected were primarily high turn-over species such as polychaetes and amphipods. Dominance curves prepared for both control and impact samples before trawling in 1997 and after trawling in 1999 showed a marked decrease in the biomass values of the highest ranking taxa, particularly of the first species, *M. modiolus*,

only on the impact line at the conclusion of the experiment. The proportion of epifaunal biomass also declined significantly from 90% to 77% on the impact line by the conclusion of the experiment. These changes are in part due to trawl-induced damage and subsequent predation by demersal fish of the top ranking species. Analysis of the photographic images showed that the three top-ranking species in terms of biomass, *M. modiolus*, the tube-building polychaete *Thelepus cincinnatus*, and the brachiopod *Terebratulina septentrionalis*, were visibly damaged more than other species by the trawl gear. Two of these species, *M. modiolus* and *T. cincinnatus*, were preyed upon by scavenging demersal fish. The use of multiple sampling devices at the experimental site (grab, photographic system reported here and trawl and fish stomachs reported by Kenchington, E.L., Gordon Jr., D.C., Bourbonnais-Boyce, C., MacIsaac, K.G., Gilkinson, K.D., McKeown, D.L., Vass, W.P., 2005. Effects of experimental otter trawling on the feeding of demersal fish on Western Bank, Nova Scotia. Amer. Fish. Soc. Symp. 41, 391-409) enabled us to link trawl-induced changes to the benthos to predation by demersal fish.

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Espinosa, F., Guerra-Garcia, J.M., Faz, D., and Garcia-Gomez, J.C. **Aspects of reproduction and their implications for the conservation of the endangered limpet, *Patella ferruginea*.** *Invertebrate Reproduction and Development* 49(1-2): 85-92, 2006.

**Notes:** The protandric limpet, *Patella ferruginea* G., is the most endangered marine species in the Western Mediterranean and is at serious risk of extinction. Nevertheless, its biology and ecology are little known. In the present work, several reproductive aspects are studied. Recruitment take place in June and the largest individuals are the most scarce. The sex ratio is slanted towards the largest sizes, and the species seems to show sex change at sizes from 60 mm upwards, although males can be observed up to 80 mm. There is no correlation between size of oocytes and shell length; however, the larger females contribute greatly to the reproductive event, with high fecundity and GSI values. The mean diameter of oocytes was observed to be 149.78  $\mu\text{m}$ , whereas the heads of spermatozoa were 3.78  $\mu\text{m}$  long. The results of the present study increase the maximum length for males by double that cited in previous literature and highlight the importance of strictly protecting females (i.e., most of the largest individuals, > 60 mm), since their population percentage is very low, in order to develop adequate strategies to preserve the species.

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Espinosa, F. and Ozawa, T. **Population genetics of the endangered limpet *Patella ferruginea* (Gastropoda: Patellidae): taxonomic, conservation and evolutionary considerations.** *Journal of Zoological Systematics and Evolutionary Research* 44(1): 8-16, 2006.

**Notes:** The limpet *Patella ferruginea* is the most endangered marine invertebrate in the western Mediterranean rocky shores, whereas *Patella caerulea* is the most common Mediterranean limpet. From Pleistocene to historic age, *P. ferruginea* was distributed around the whole Mediterranean basin, since the shells of this species are a characteristic feature of Palaeolithic and Neolithic deposits in this area. However, its Mediterranean range has progressively contracted to a few restricted areas. The ancient origin of the species (18Ma) and the present geographical isolation among relic populations could have led to a great genetic difference among populations, taking into account the supposedly low dispersal ability of the species. However, we have observed a few genetic differences among populations and a 'star phylogeny' of COI haplotypes from the 41 individuals of *P. ferruginea* analysed; a similar pattern has also been observed for the seven individuals of *P. caerulea* studied. Genetic evidences show a possible bottleneck event on late Pleistocene that affected the two species. The results have an important implication on the future management of this endangered species. Additionally, two different morphological types of *P. ferruginea* have been described by Payraudeau in 1826: *lamarcki* and *rouxi* forms. Clear morphological differences occur between these two types and some authors pointed out the hypothesis about the existence of two different species. The results of the present study conclude that the two different forms of *P. ferruginea* are ecotypes, rather than different species or subspecies, and intermediate steps are an ecological range instead of hybridization events among different species.

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Casu, M., Casu, D., Lai, T., Cossu, P., and Curini-Galletti, M. **Inter-simple sequence repeat markers reveal strong genetic differentiation among populations of the endangered mollusc *Patella ferruginea* (Gastropoda: Patellidae) from two Sardinian marine protected areas.** *Marine Biology* 149(5): 1163-1174, 2006.

**Notes:** The giant Mediterranean limpet *Patella ferruginea* Gmelin, 1791 is an endangered marine gastropod, whose range has progressively shrunk to few, restricted areas, due to intense human exploitation. We have studied the genetic structure of the

species, in order to (1) gather information about the levels of genetic variability within and between natural populations of *P. ferruginea* collected in two Sardinian marine protected areas (MPAs) (Penisola del Sinis-Isola di Mal di Ventre and Isola dell'Asinara), and (2) make an attempt to find relationships between ecological and biological attributes of the species and the genetic differentiation of the populations studied. The genetic study was carried out by means of the analysis of ten inter-simple sequence repeat (ISSR) primers on a total of 40 individuals collected at four localities. Genetic analysis evidenced (1) medium to high levels of within-population genetic variability, (2) a pattern of genetic structuring that varied with spatial scales, and (3) a strong genetic differentiation between the two MPAs. Although preliminary, these results suggest that gene flow may be present only at very small geographic scale, raising concerns on the future of the conservation of the species.

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Griffiths, J., Dethier, M.N., Newsom, A., Byers, J.E., Meyer, J.J., Oyarzun, F., and Lenihan, H. **Invertebrate community responses to recreational clam digging.** *Marine Biology* 149(6): 1489-1497, 2006.

**Notes:** Marine reserves can help in maintaining biodiversity and potentially be useful as a fishery management tool by removing human-mediated impacts. Intertidal, soft-sediment habitats can often support robust recreational and commercial shellfish harvests, especially for clams; however, there is limited research on the effects of reserves in these habitats. In San Juan County, Washington, several reserves prohibit recreational clam digging. We examined the effects of these reserves on infaunal community composition through comparison with non-reserve beaches during a 6-week period. Clam abundance, overall species richness and total polychaete family richness were greater on reserve beaches compared to non-reserve beaches. Additionally, an experiment within a reserve demonstrated negative impacts of digging on non-target infauna. These effects probably resulted from local disruption and disturbance of the sediment habitat and not from increased post-digging predation, which was controlled. Intertidal reserves could play an important role in sustaining local and potentially regional biodiversity.

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Meeuwig, J.J., Hoang, D.H., Ky, T.S., Job, S.D., and Vincent, A.C.J. **Quantifying non-target seahorse fisheries in central Vietnam.** *Fisheries Research* 81(2-3): 149-157, 2006.

**Notes:** Tropical shrimp trawling results in large amounts of highly diverse, non-target bycatch. We assessed the incidental catch of seahorses from shrimp trawls in central Vietnam to investigate the effects of fishing on an example group of small fishes that are potentially vulnerable and economically important. We used logbooks and catch landings surveys to quantify seahorse catches from 1996 to 2000. The majority of the seahorse catch consisted of two species, *Hippocampus spinosissimus* and *Hippocampus trimaculatus*, whose proportions varied by season and year. We found no consistent, directional patterns across years in key biological and fisheries parameters including seahorse size, sex ratio, reproductive state, life-history stage or catch-per-unit-effort but we had no information on distribution of trawl effort. However, there were strong seasonal patterns in reproductive state and catch-per-unit-effort. Overall, we calculated that the total catch was 36,000-55,000 seahorses year<sup>-1</sup> from a fleet of 150-170 trawlers (a small part of the total Vietnamese fleet), even though the catch was only 0.9-1.6 seahorses boat<sup>-1</sup> night<sup>-1</sup>. Other aspects of the trawling process, such as displacement or injury of seahorses, community disruption, and/or habitat damage may still pose a threat to the seahorses, particularly as Vietnam's fisheries intensify.

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Richardson, E.A., Kaiser, M.J., Edwards-Jones, G., and Ramsay, K. **Trends in sea anglers' catches of trophy fish in relation to stock size.** *Fisheries Research* 83(1-3): 253-262, 2006.

**Notes:** Many marine fish stocks worldwide are reported to be in decline and participants in recreational fisheries commonly complain that their catches are declining in size and number as a result. In many fisheries, however, it is difficult to investigate such claims because established data collection programmes are lacking. We sought to investigate perceived and actual trends in anglers' trophy fish catches within a marine recreational fishery, and to investigate whether catches bore any relationship to abundance trends in target stocks. Temporal changes in catches, as perceived by participants in the recreational fishery, were assessed qualitatively using a structured survey. Subsequently we investigated two previously unused sources of sea anglers' trophy fish catch data available for Wales, UK (national angling club and angling magazine reports) and extracted reports for a 27-year period. We assessed species-specific trends in the numbers and sizes of trophy fish reported, and found strong temporal declines in the numbers of trophy thornback ray *Raja clavata* and cod *Gadus morhua* reported, as well as a decline in total reported trophy fish. The weight of the heaviest thornback ray reported each year had also declined significantly with

time. These trends also were most frequently mentioned by participants in the recreational fishery. Significant declines in cod and thornback ray stocks in the region have been reported, which would explain the reduction in anglers' catches of trophy-sized individuals. As fishing pressure has been shown to reduce the numbers and sizes of individuals in a population we hypothesised that the numbers and sizes of trophy fish caught by anglers would correlate positively with stock abundance. In the absence of stock assessment data we used commercial landings-per-unit-effort (LPUE) figures to give a relative indication of stock abundance trends for the region. However, few correlations of trophy fish catch data with commercial LPUE were found, which is likely attributable to limitations of the LPUE data. Nevertheless, the negative trends in catches of trophy fish by anglers are striking and provide an additional means to monitor gross changes in populations of species vulnerable to over-exploitation.

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Gray, J.S., Dayton, P., Thrush, S., and Kaiser, M.J. **On effects of trawling, benthos and sampling design.** *Marine Pollution Bulletin* 52(8): 840-843, 2006.

**Notes:** The evidence for the wider effects of fishing on the marine ecosystem demands that we incorporate these considerations into our management of human activities. The consequences of the direct physical disturbance of the seabed caused by towed bottom-fishing gear have been studied extensively with over 100 manipulations reported in the peer-reviewed literature. The outcome of these studies varies according to the gear used and the habitat in which it was deployed. This variability in the response of different benthic systems concurs with established theoretical models of the response of community metrics to disturbance. Despite this powerful evidence, a recent FAO report wrongly concludes that the variability in the reported responses to fishing disturbance mean that no firm conclusion as to the effects of fishing disturbance can be made. This thesis is further supported (incorrectly) by the supposition that current benthic sampling methodologies are inadequate to demonstrate the effects of fishing disturbance on benthic systems. The present article addresses these two erroneous conclusions which may confuse non-experts and in particular policy-makers.

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Seitz, J.C. and Poulakis, G.R. **Anthropogenic effects on the smalltooth sawfish (*Pristis pectinata*) in the United States.** *Marine Pollution Bulletin* 52(11): 1533-1540, 2006.

**Notes:** Bycatch mortality in net fisheries was the major reason for the decline of the endangered smalltooth sawfish, *Pristis pectinata*, in the United States. These fisheries have been reduced or eliminated in some states including Florida - where most smalltooth sawfish are currently found in the United States. To determine whether other factors are still affecting this species, we obtained non-net fishery entanglement, injury, and mortality data by soliciting information from anyone who may have encountered this species. Smalltooth sawfish were damaged by marine pollution (e.g., polyvinyl chloride pipe, monofilament line, non-monofilament line) and injured by humans. Examples of injuries caused directly by humans include removal of rostra, shooting an individual with a powerhead, and shooting another with arrows. Many people are aware that the smalltooth sawfish is protected by state and federal laws, but some are still not aware of (or willing to accept) this status. The impacts of marine pollution and injuries directly caused by humans on this endangered species can be ameliorated by incorporating fisher education into the conservation and management processes.

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Rostad, A., Kaartvedt, S., Klevjer, T.A., and Melle, W. **Fish are attracted to vessels.** *ICES Journal of Marine Science* 63(8): 1431-1437, 2006.

**Notes:** Fish rapidly accumulated below research vessels (RVs) at anchor, kept stationary by dynamic satellite positioning, or freely drifting. This happened by day and night, beneath vessels with different noise levels, in fjords and the open ocean, comprised different species assemblages of fish, and spanned depths of several hundred metres. Acoustic backscatter (fish abundance) increased by more than an order of magnitude in less than an hour. One of the study sites was characterized by much ship traffic, and intermittent, strong decreases in the local fish aggregation beneath the RV were caused by fish swimming towards passing commercial vessels, before returning to the stationary RV. The study suggests more complex relationships between fish, vessels, and noise than previously anticipated. If fish are commonly attracted to vessels, this has implications for fish abundance estimates and basic ecological research.

Simpson, A.W. and Watling, L. **An investigation of the cumulative impacts of shrimp trawling on mud-bottom fishing grounds in the Gulf of Maine: effects on habitat and macrofaunal community structure.** *ICES Journal of Marine Science* 63(9): 1616-1630, 2006.

**Notes:** The cumulative impacts (i.e. collective, multi-year effects) of seasonal commercial shrimp trawling on habitat and macrofaunal community structure were investigated for two mud-bottom fishing grounds and adjacent untrawled areas in the Gulf of Maine. Habitat structure on mud-bottom fishing grounds did not differ significantly from that in similar untrawled areas. Moreover, sediment resuspension associated with shrimp trawling did not appear to result in net loss of deposited material on fishing grounds, but there is evidence that trawling may alter sediment mixing regimes. Visual inspection of the sediment surface in trawled areas revealed minimal evidence of fishing gear disturbance (such as door, bobbin, or net marks), but biological disturbance features including numerous large burrows, pits, and dense aggregations of the brittle star *Ophiura sarsi*, were present in both trawled and untrawled areas. Macrofaunal communities on the two fishing grounds exhibited different responses to shrimp trawling, which were attributed to disparities in levels of fishing activity during the 2000-2001 shrimp season. The results suggest that seasonal shrimp trawling produced at least short-term changes (< 3 months) in macrofaunal community structure, but did not appear to result in long-term cumulative changes. Resilience to trawling disturbance may be due in part to high levels of biological disturbance generated by benthic megafauna, such as lobsters and fish. By burrowing, pit-digging, and possibly foraging, these animals rework sediments to a depth of 16-17 cm, creating a natural level of disturbance that appears to maintain macrofaunal communities in a perpetually low successional state, so potentially minimizing trawling impacts.

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Merz, J.E. and Moyle, P.B. **Salmon, wildlife, and wine: Marine-derived nutrients in human-dominated ecosystems of central California.** *Ecological Applications* 16(3): 999-1009, 2006.

**Notes:** Pacific salmon transfer large quantities of marine-derived nutrients to adjacent forest ecosystems with profound effects on plant and wildlife production. We investigated this process for two highly modified California wine country rivers, one with consistent salmon runs (Mokelumne River) and one without (Calaveras River). Mokelumne River Chinook salmon transported biomass and N comparable to Pacific Northwest salmon streams. Calaveras River levels were much less. Scavenger numbers correlated with salmon carcass counts over time on the Mokelumne River but not the Calaveras River. Likewise, salmon carcasses were consumed significantly faster on the Mokelumne River. Native riparian vegetation as well as cultivated wine grapes adjacent to Mokelumne River spawning sites received 18-25% of foliar N from marine sources, significantly higher than vegetation along the Calaveras River. These data suggest that robust salmon runs continue to provide important ecological services with high economic value, even in impaired watersheds. Loss of Pacific salmon can not only negatively affect stream and riparian ecosystem function, but can also affect local economies where agriculture and salmon streams coexist.

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Harvey, C.J., Tolimieri, N., and Levin, P.S. **Changes in body size, abundance, and energy allocation in rockfish assemblages of the Northeast Pacific.** *Ecological Applications* 16(4): 1502-1515, 2006.

**Notes:** Fish body size, a key driver of many aspects of fish population biology and ecology, is affected by fisheries that deplete the largest individuals. Rockfish (genus *Sebastes*) are a diverse group that has been heavily fished on the U.S. west coast in recent decades. We examined trawl survey data from 1980 to 2001 to determine spatial and temporal trends in body size and density of 16 shelf rockfish species, including six that are considered overfished. Mean individual mass and maximum observed mass declined in the majority of species in one or more zoogeographic regions between central California and Washington. Density changes were far more variable in time and space, but in all regions, density declines were most often associated with large-bodied rockfish. We next estimated the impact of size and density changes on energy consumption and fecundity in a five-species rockfish assemblage that includes bocaccio (*S. paucispinis*), a large-bodied, overfished species. Indexes of both consumption and fecundity by the assemblage increased in the southern portion of the study area between 1980 and 2001 but decreased in the northern portion. Allocation of energy and reproductive potential within the assemblage shifted dramatically: relative to bocaccio, total energy consumption and fecundity indexes for the other four species increased by orders of magnitude from 1980 to 2001. These changes in community structure may affect the ability of bocaccio and other large rockfish species to recover from overfishing, especially in light of long-term declines in zooplankton production that may also be affecting rockfish size and production. Addressing these issues may require a regional, multispecies management approach.

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Gibbs, M.T. **Lesser-known consequences of managing marine fisheries using individual transferable quotas.** *Marine Policy* 31(2): 112-116, 2007.

**Notes:** Managing marine fisheries using output controls in the form of individual transferable quotas (ITQs) can be an attractive alternative to more traditional input controls. There are now a number of examples of where ITQ-managed fisheries have been able to reduce the impact of the major management problems in global fisheries, namely, gross over-capitalisation and effort. However, ITQs are not the perfect management tool and one of the lesser known consequences of ITQ-managed fisheries where ITQs consist of a harvest right is the implicit relationship between ITQ property rights and rights of access to the fishing grounds. This implicit spatial right to the grounds can provide obstacles in the way of allocating water-space within fishing grounds for alternative uses such as marine-protected areas, large-scale aquaculture, and wind farms. These lesser-known consequences of ITQ-managed fisheries are discussed here.

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Griggs, L. and Lugten, G. **Veil over the nets (unravelling corporate liability for IUU fishing offences).** *Marine Policy* 31(2): 159-168, 2007.

**Notes:** The illegal plundering of fishing stocks worldwide is masked behind a maze of corporate structures that makes discovery of the beneficiaries of such activity, difficult, if not impossible to identify. This paper outlines the problem of illegal fishing and then develops a multi-layered response to avert the veil of corporate entity being used as a means of preventing domestic States from answering the principal thematic question-who is the true beneficiary of this illegal behaviour, and who should be held responsible.

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Christie, P., Fluharty, D.L., White, A.T., Eisma-Osorio, L., and Jatulan, W. **Assessing the feasibility of ecosystem-based fisheries management in tropical contexts.** *Marine Policy* 31(3): 239-250, 2007.

**Notes:** This analysis documents the reasons for emerging interest in ecosystem-based fisheries management (EBFM) and relates this management model to others. It highlights the central challenges to EBFM in the tropical context and examines an ongoing project, Fisheries Improved for Sustainable Harvest (FISH), in the Philippines-likely the first EBFM project in the tropics. The Philippine legal and institutional context provides major governance challenges to EBFM, especially as management is scaled up. A monitoring framework with process and output criteria is applied to FISH to establish progress to date. Major institutional and governance challenges for EBFM will require monitoring, evaluation, and adaptation.

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Jacquet, J.L. and Pauly, D. **The rise of seafood awareness campaigns in an era of collapsing fisheries.** *Marine Policy* 31(3): 308-313, 2007.

**Notes:** The human appetite for seafood has intensified and so has overfishing and damage to marine ecosystems. Recently, the response to the fisheries crisis has included a considerable effort directed toward raising the seafood awareness of consumers in North America and Europe. The resulting campaigns aim to affect the seafood demand and to lead to a sustainable seafood supply. Though there are indicators of some regional successes, lack of support by the Asian market and the proliferation of self-serving seafood labels are but two of the many significant limitations of these campaigns. This contribution investigates the difficulties and successes of seafood awareness campaigns, as well as the need for indicators of campaign effectiveness.

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Schrank, W.E. **Is there any hope for fisheries management?** *Marine Policy* 31(3): 299-307, 2007.

**Notes:** Fisheries is not the only discipline where models have been used in attempts to fine tune an aspect of the economy. Such fine-tuning can prove ineffective because of the uncertainties in the scientific underpinnings of the models and because

of the omission of critical elements. In fisheries, the biological goal is to set allowable catches so that the harvest is not so large that it endangers the future health of the fish stock while it is not so low as to waste food, while the economic goal is to maximize the net economic rent generated by the fishery. It has long been recognized that the science underlying the setting of the total allowable catch is often too uncertain to justify such fine tuning, and that attempts to achieve that delicate balance has helped lead to crises in fisheries. One solution is to abandon such marginalism in favor of seriously reducing current catches.

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