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Marine Science Review – 244

Fish and fisheries

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In this review:

O/A denotes an open access article or journal

A. Recent articles – no abstract available

Conover, D.O. **Nets versus nature.** *Nature* 450(7167): 179-180, 2007.

Jørgensen, C., Enberg, K., Dunlop, E.S., Arlinghaus, R., Boukal, D. S., Brander, K., Ernande, B., Gårdmark, A., Johnston, F., Matsumura, S., Pardoe, H., Raab, K., Silva, A., Vainikka, A., Dieckmann, U., Heino, M., and Rijnsdorp, A.D. **Managing evolving fish stocks.** *Science* 318(5854): 1247-1248, 2007.

B. Recent publications available online

Cavanagh, R.D. and Gibson, C. 2007. **Overview of the conservation status of cartilaginous fishes (chondrichthyans) in the Mediterranean Sea.** IUCN, Gland, Switzerland and Malaga, Spain. vi + 42 pp.

Located at: http://iucn.org/places/medoffice/documentos/2007/11/med_shark_rep_en.pdf

Notes: This report presents the findings of an expert workshop at which 71 Mediterranean species of sharks, rays and chimaeras (cartilaginous fishes) were assessed using IUCN Red List categories and criteria. Participants deemed 30 species (42%) as threatened with extinction, of which 13 are classified at the highest threat level of *Critically Endangered*, eight as *Endangered* and nine as *Vulnerable*. Another 13 species were assessed as *Near Threatened*, while a lack of information led to 18 species being classified as *Data Deficient*. Only 10 species are considered to be of *Least Concern*. Overfishing, including bycatch (non-target species caught incidentally), is the main cause of decline, according to the research. The report also identifies habitat degradation, recreational fisheries, and other human disturbances as significant threats. There are no catch limits for fished species of Mediterranean sharks and rays. Eight species of sharks and rays have been listed on the four international conventions relevant to Mediterranean wildlife conservation, but only three species have received any protection as a result: white and basking sharks are protected in Croatian and European Community waters, while Malta and Croatia protect the giant devil ray.

C. Recent articles with abstracts

Brierley, A.S. **Hunger for shark fin soup drives clam chowder off the menu.** *Current Biology* 17(14): R555-R557, 2007.

Notes: Removal by fishing of large sharks has reduced predation-pressure on shark prey and, via a trophic cascade, caused clam populations to crash. This indirect response illustrates why fisheries should be managed in a whole-ecosystem context.

Potts, T. and Haward, M. **International trade, eco-labelling and sustainable fisheries - recent issues, concepts and practices.** *Environment, Development and Sustainability* 9(1): 91-106, 2007.

Notes: Certification of where, when and how fish are caught is emerging as an important fisheries management tool. The history of eco-labelling in the fisheries sector is relatively short and actual experiences of eco-labelling are limited, although an emerging trend is shaping in European and US markets. Eco-labelling in fisheries gained increased impetus with the development of the non-government Marine Stewardship Council (MSC) in 1996. This paper reviews the emerging importance of certification and eco-labelling in the fisheries sector, the development and operation of the MSC, identifying particularly the role of 'third party certification' as promoted by the MSC, and notes the opportunities and challenges for the MSC and eco-labelling in general.

Brander, K.M. **Global fish production and climate change.** *Proceedings of the National Academy of Sciences [USA]* 104(50): 19709-19714, 2007. **O/A**

Notes: Current global fisheries production of ~160 million tons is rising as a result of increases in aquaculture production. A number of climate-related threats to both capture fisheries and aquaculture are identified, but we have low confidence in predictions of future fisheries production because of uncertainty over future global aquatic net primary production and the transfer of this production through the food chain to human consumption. Recent changes in the distribution and productivity of a number of fish species can be ascribed with high confidence to regional climate variability, such as the El Niño-Southern Oscillation. Future production may increase in some high-latitude regions because of warming and decreased ice cover, but the dynamics in low-latitude regions are governed by different processes, and production may decline as a result of reduced vertical mixing of the water column and, hence, reduced recycling of nutrients. There are strong interactions between the effects of fishing and the effects of climate because fishing reduces the age, size, and geographic diversity of populations and the biodiversity of marine ecosystems, making both more sensitive to additional stresses such as climate change. Inland fisheries are additionally threatened by changes in precipitation and water management. The frequency and intensity of extreme climate events is likely to have a major impact on future fisheries production in both inland and marine systems. Reducing fishing mortality in the majority of fisheries, which are currently fully exploited or overexploited, is the principal feasible means of reducing the impacts of climate change.

O'Connell, M.T., Shepherd, T.D., O'Connell, A.M.U., and Myers, R.A. **Long-term declines in two apex predators, bull sharks (*Carcharhinus leucas*) and alligator gar (*Atractosteus spatula*), in Lake Pontchartrain, an oligohaline estuary in southeastern Louisiana.** *Estuaries and Coasts* 30(4): 567-574, 2007.

Notes: We analyzed historic and current fishery independent data to determine if the abundance of two apex predators, bull sharks (*Carcharhinus leucas*) and alligator gar (*Atractosteus spatula*), in Lake Pontchartrain had changed significantly over the last half century. Lake Pontchartrain is an environmentally degraded oligohaline estuary in southeastern Louisiana that has experienced considerable changes in fish assemblage composition over this interval. Using gillnet, beach seine, and trawl data collected during three time periods (1953-1955, 1977-1978, and 1996-2005), we analyzed trends in abundance for *C. leucas* and *A. spatula* using generalized linear models with a negative binomial error structure and a log link. Lake Pontchartrain data were divided into four spatial locations (northwest, northeast, southwest, southeast) since each region represents a unique combination of anthropogenic and natural influences that could affect catches. For each species and gear type, we produced log-likelihood profiles for the instantaneous rate of change in relative abundance through time. Raw catches were generally lower for both species in the later surveys. *C. leucas* were not captured in beach seines since the 1950s and *A. spatula* were rarely captured in trawls or seines since the 1970s. Likelihood profiles of changes in abundance for *C. leucas* and *A. spatula* showed very large declines in both species since 1953. *C. leucas* declined by 98.6% (95% Cl: 73.499.9%) in gillnets and became functionally extirpated in beach seines with a decline of 99.9% (95% Cl: 23-99.9%). Among all gears, *C. leucas* declined by the same rate as in gillnets. The decline in *A. spatula* was also large with a decrease of 98.6% (95% Cl: 73.4-99.9%) in beach seines and a decline of 99.2% (95% Cl: 54.8- 99.9%) in trawls since 1953. Catches of *A. spatula* in gillnets did not show a significant

change over the study period. The continued decline of these two apex predators could seriously affect efforts to restore this degraded estuarine ecosystem.

MacKenzie, B.R., Gislason, H., Mollmann, C., and Koster, F.W. **Impact of 21st century climate change on the Baltic Sea fish community and fisheries.** *Global Change Biology* 13(7): 1348-1367, 2007.

Notes: The Baltic Sea is a large brackish semienclosed sea whose species-poor fish community supports important commercial and recreational fisheries. Both the fish species and the fisheries are strongly affected by climate variations. These climatic effects and the underlying mechanisms are briefly reviewed. We then use recent regional-scale climate-ocean modelling results to consider how climate change during this century will affect the fish community of the Baltic and fisheries management. Expected climate changes in northern Europe will likely affect both the temperature and salinity of the Baltic, causing it to become warmer and fresher. As an estuarine ecosystem with large horizontal and vertical salinity gradients, biodiversity will be particularly sensitive to changes in salinity which can be expected as a consequence of altered precipitation patterns. Marine-tolerant species will be disadvantaged and their distributions will partially contract from the Baltic Sea; habitats of freshwater species will likely expand. Although some new species can be expected to immigrate because of an expected increase in sea temperature, only a few of these species will be able to successfully colonize the Baltic because of its low salinity. Fishing fleets which presently target marine species (e.g. cod, herring, sprat, plaice, sole) in the Baltic will likely have to relocate to more marine areas or switch to other species which tolerate decreasing salinities. Fishery management thresholds that trigger reductions in fishing quotas or fishery closures to conserve local populations (e.g. cod, salmon) will have to be reassessed as the ecological basis on which existing thresholds have been established changes, and new thresholds will have to be developed for immigrant species. The Baltic situation illustrates some of the uncertainties and complexities associated with forecasting how fish populations, communities and industries dependent on an estuarine ecosystem might respond to future climate change.

Fleischer, D., Schaber, M., and Piepenburg, D. **Atlantic snake pipefish (*Entelurus aequoreus*) extends its northward distribution range to Svalbard (Arctic Ocean).** *Polar Biology* 30(10): 1359-1362, 2007.

Notes: Ecological forecasts predict the immigration of boreal species into Arctic waters as one consequence of rising sea temperatures. Here, we report the finding of Atlantic snake pipefish (*Entelurus aequoreus*) off the western coast of Spitsbergen at 79ºN in August 2006. This syngnathid fish species, which was presumed to be confined to waters south of Iceland, has dramatically increased in population size in its core distribution area in the northeastern Atlantic since 2002, probably in response to greater reproduction success due to higher water temperatures. We conclude that our finding is an indication of the predicted northward extension of the distribution range of boreal species.

Gustafson, R.G., Waples, R.S., Myers, J.M., Weitkamp, L.A., Bryant, G.J., Johnson, O.W., and Hard, J.J. **Pacific salmon extinctions: Quantifying lost and remaining diversity.** *Conservation Biology* 21(4): 1009-1020, 2007.

Notes: Widespread population extirpations and the consequent loss of ecological, genetic, and life-history diversity can lead to extinction of evolutionarily significant units (ESUs) and species. We attempted to systematically enumerate extinct Pacific salmon populations and characterize lost ecological, life history, and genetic diversity types among six species of Pacific salmon (Chinook [*Oncorhynchus tshawytscha*], sockeye [*O. nerka*], cobo [*O. kisutch*], chum [*O. keta*], and pink salmon [*O. gorbuscha*] and steelbead trout [*O. mykiss*]) from the western contiguous United States. We estimated that, collectively, 29% of nearly 1400 historical populations of these six species have been lost from the Pacific Northwest and California since Euro-American contact. Across all species there was a highly significant difference in the proportion of population extinctions between coastal (0.14 extinct) and interior (0.55 extinct) regions. Sockeye salmon (which typically rely on lacustrine habitats for rearing) and stream-maturing Chinook salmon (which stay in freshwater for many months prior to spawning) had significantly higher proportional population losses than other species and maturation types. Aggregate losses of major ecological, life-history, and genetic biodiversity components across all species were estimated at 33%, 15%, and 27%, respectively. Collectively, we believe these population extirpations represent a loss of between 16% and 30% of all historical ESUs in the study area. On the other hand, over two-thirds of historical Pacific salmon populations in this area persist, and considerable diversity remains at all scales. Because over one-third of the remaining populations belong to threatened or endangered species listed under the US.

Endangered Species Act, it is apparent that a critical juncture has been reached in efforts to preserve what remains of Pacific salmon diversity. It is also evident that persistence of existing, and evolution of future, diversity will depend on the ability of Pacific salmon to adapt to anthropogenically altered habitats.

Rogers-Bennett, L. **Is climate change contributing to range reductions and localized extinctions in northern (*Haliotis kamtschatkana*) and flat (*Haliotis walallensis*) abalones?** *Bulletin of Marine Science* 81(2): 283-296, 2007.

Notes: Abalone abundance surveys from the 1970s were repeated 30 yrs later following a period of increased sea surface temperatures along the Pacific coast of the United States. Northern abalone, *Haliotis kamtschatkana* (Jonas, 1845) once abundant enough to support commercial fishing in Washington and Canada, are now extremely rare in the southern portion of their range in southern and central California. They have also declined 10 fold in northern California in the absence of human fishing pressure. In Washington, northern abalone are in decline and exhibit recruitment failure despite closure of the fishery. Flat abalone, *Haliotis walallensis* (Stearns, 1899) no longer occur in southern California, and in central California have declined from 32% to 8% of the total number of abalones, *Haliotis* spp., inside a marine reserve. The distribution of flat abalone appears to have contracted over time such that they are now only common in southern Oregon where they are subject to a new commercial fishery. Given these range reductions, the long-term persistence of flat abalone and northern abalone (locally) is a concern in light of threats from ocean warming, sea otter predation, and the flat abalone fishery in Oregon. The likelihood of future ocean warming poses challenges for abalone restoration, suggesting that improved monitoring and protection will be critical, especially in the northern portions of their distributions.

Olden, J.D., Hogan, Z.S., and Zanden, M.J.V. **Small fish, big fish, red fish, blue fish: size-biased extinction risk of the world's freshwater and marine fishes.** *Global Ecology and Biogeography* 16(6): 694-701, 2007.

Notes: ***Aim*** In light of the current biodiversity crisis, there is a need to identify and protect species at greatest risk of extinction. Ecological theory and global-scale analyses of bird and mammal faunas suggest that small-bodied species are less vulnerable to extinction, yet this hypothesis remains untested for the largest group of vertebrates, fish. Here, we compare body-size distributions of freshwater and marine fishes under different levels of global extinction risk (i.e. listed as vulnerable, endangered or critically endangered according to the IUCN Red List of Threatened Species) from different major sources of threat (habitat loss/degradation, human harvesting, invasive species and pollution). ***Location*** Global, freshwater and marine. ***Methods*** We collated maximum body length data for 22,800 freshwater and marine fishes and compared body-size frequency distributions after controlling for phylogeny. ***Results*** We found that large-bodied marine fishes are under greater threat of global extinction, whereas both small- and large-bodied freshwater species are more likely to be at risk. Our results support the notion that commercial fishing activities disproportionately threaten large-bodied marine and freshwater species, whereas habitat degradation and loss threaten smaller-bodied marine fishes. ***Main conclusions*** Our study provides compelling evidence that global fish extinction risk does not universally scale with body size. Given the central role of body size for trophic position and the functioning of food webs, human activities may have strikingly different effects on community organization and food web structure in freshwater and marine systems.

Wenne, R., Boudry, P., Hemmer-Hansen, J., Lubieniecki, K.P., Was, A., and Kause, A. **What role for genomics in fisheries management and aquaculture?** *Aquatic Living Resources* 20(3): 241-255, 2007.

Notes: The development and application of genomics has been facilitated in a number of fields by the availability of new methodologies and tools, such as high throughput DNA sequencing and complementary DNA (cDNA) microarrays. Genomic tools are already used in research on commercially important fish and shellfish species. Thousands of expressed sequence tags (EST) are now available for some of these species, and the sequencing of complete genomes of tilapia, cod, salmonids, flatfishes, sea bass and Pacific oyster has been proposed. Microarray technology through simultaneous analysis of the expression of thousands of genes allows the identification of candidate genes involved in the function of multiple physiological, morphological and behavioural traits of interests in organisms and populations from different environments. This paper reviews the current development of genomic technologies, and pinpoints their potential beneficial applications as well as implications for fisheries management and aquaculture.

Kenchington, E.L., Kenchington, T.J., Henry, L.A., Fuller, S., and Gonzalez, P. **Multi-decadal changes in the megabenthos of the Bay of Fundy: The effects of fishing.** *Journal of Sea Research* 58(3): 220-240, 2007.

Notes: Analysis of presence / absence records from two comparable megabenthic surveys of scallop grounds in the Bay of Fundy, Canada, in 1966-67 and 1997 showed profound change over three decades. There were no indications that any species were lost and the average number of taxa per station remained steady. However, spatial heterogeneities in the community were reduced and species composition changed significantly. Some taxa widespread in 1966-67 declined while others expanded, with frequencies of occurrence of individual taxa changing by up to 71%. The whelks *Buccinum undatum* and *Colus* spp., the bivalves *Astarte* spp. and *Cylocardia borealis*, the toad crabs *Hyas* spp., the sea urchin *Strongylocentrotus droebachiensis* and the brittle stars (Ophiurida) showed particular increases. Corresponding declines were seen in the boring sponges *Cliona* spp., the horse mussel *Modiolus modiolus*, the scallop *Chlamys islandica*, the fan worm *Pseudopotamilla reniformis* and the stalked tunicate *Boltenia ovifera*. Replacement of attached, fragile, epifaunal, filter-feeding taxa by a combination of motile scavengers, motile filter-feeders and robust, burrowing filter-feeders suggests that the primary cause of the temporal change was physical impacts by fishing gear, even though trawling and scallop dragging in the area were neither intense nor new developments. Secondary causes of change may have included other ecosystem effects of fishing (supply of discards and bait), a mass mortality of scallops and a range expansion of a bryozoan (*Flustra foliacea*).

Kock, K.H., Reid, K., Croxall, J., and Nicol, S. **Fisheries in the Southern Ocean: an ecosystem approach.** *Philosophical Transactions of the Royal Society of London [B]* 362(1488): 2333-2349, 2007.

Notes: The Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) is bound by its Article II, 3 to follow an ecosystem approach to management. This approach has been extended to the application of a precautionary approach in the late 1980s. In our review, we deal primarily with the science-related aspects of CCAMLR and its development towards an ecosystem approach to the management of the living resources of the Southern Ocean. To assist the Commission in meeting its objectives, as set out in Article II, 3, the Scientific Committee established the CCAMLR Ecosystem Monitoring Programme to detect possible effects of krill fishing on the performance of top-level predators, such as albatrosses, penguins, petrels and fur seals. Fisheries in the Southern Ocean followed the fate of other fisheries worldwide in which target species were depleted to low level one after the other. Currently, two types of fisheries are open: the longline fisheries on Patagonian toothfish (*Dissostichus eleginoides*) and Antarctic toothfish (*Dissostichus mawsoni*) and the trawl fisheries on mackerel icefish (*Champsocephalus gunnari*). Both fisheries are managed in a single-species context, however, with conservation measures in place to protect by-catch species, such as rattails (Macrouridae) and skates and rays (Rajidae). Two major problems still exist in fisheries in the Southern Ocean: the by-catch of birds in longline fisheries primarily in the Indian Ocean and the high level of IUU fishing again in the Indian Ocean. Both, the by-catch of birds and high IUU catches undermine the credibility of CCAMLR to safeguard the marine living resources in the Southern Ocean.

Link, J.S. **Underappreciated species in ecology: "ugly fish" in the northwest Atlantic Ocean.** *Ecological Applications* 17(7): 2037-2060, 2007.

Notes: Species shifts and replacements are common in ecological studies. Observations thereof serve as the impetus for many ecological endeavors. Many of the species now known to dominate ecosystem functioning were largely ignored until studies of those underappreciated species elucidated their critical roles. Recognizing the potential importance of underappreciated species has implications for functional redundancies in ecosystems and should alter our approach to long-term monitoring. One example of an applied ecological system containing species shifts, underappreciated species, and potential changes in functional redundancies is the topic of fisheries. The demersal component of many fish communities usually consists of high-profile and commercially valuable species that are targets of fisheries, plus a diverse group of lesser known species that have minimal commercial value and focus. Yet ecologically these traditionally nontargeted species are often a major biomass sink in marine ecosystems and can also be critical in the functioning of bentho-demersal food webs. I examined the biomass trajectories of several species of skates, cottids, lophiids, anarhichadids, zooarcids, and similar species in the northeast U.S. Atlantic ecosystem to determine whether their relative abundance has changed across the past four decades. Distribution and stomach contents of these species were also evaluated over time to further elucidate the relative importance of these species. Landings of these underappreciated bentho-demersal fish were also examined in comparison to those species that historically

have been commercially targeted. Of particular emphasis was the evaluation of evidence for sequential stock depletion and the ramifications for functional redundancy for this ecosystem. Results indicate that some of these fish species are now the dominant piscivores, benthivores, and scavengers in this ecosystem. These formerly under-studied species generally have either maintained a consistent population size or have increased in abundance (and expanded in distribution) over the past several decades. Nontraditionally targeted fish species are an often overlooked but important component of bentho-demersal fish communities. Implications for the energy flow and resilience specifically for future fisheries and generally for harvesting biological resources are significant, remaining critical issues for the world's ecosystems.

Hoekstra, J.M., Bartz, K.K., Ruckelshaus, M.H., Moslemi, J.M., and Harms, T.K. **Quantitative threat analysis for management of an imperiled species: Chinook salmon (*Oncorhynchus tshawytscha*).** *Ecological Applications* 17(7): 2061-2073, 2007.

Notes: Chinook salmon (*Oncorhynchus tshawytscha*) have declined dramatically across the Pacific Northwest because of multiple human impacts colloquially characterized as the four "H's": habitat degradation, harvest, hydroelectric and other dams, and hatchery production. We use this conceptual framework to quantify the relative importance of major threats to the current status of 201 Chinook populations. Current status is characterized by two demographic indices: population density and trend. We employ path analytic models and information theoretic methods for multi-model inference. Our results indicate that dams most strongly affect variation in population density, while harvest and hatchery production most strongly affect variation in population trend. Comparable results arise when the sample size of the analysis is reduced to 22 Chinook populations within a smaller region typical of the scale at which salmon recovery planning is conducted. Results from these threat analyses suggest that recovery strategies targeting specific demographic indices, and those considering natural and human-mediated interdependencies of major threats, are most likely to succeed.

Lercari, D. and Chavez, E.A. **Possible causes related to historic stock depletion of the totoaba, *Totoaba macdonaldi* (Perciformes: Sciaenidae), endemic to the Gulf of California.** *Fisheries Research* 86(2-3): 136-142, 2007.

Notes: *Totoaba macdonaldi* is the largest sciaenid fish. It is endemic to the Gulf of California within a protected area and listed as threatened by the IUCN red list. The history of the totoaba fishery begun around 1920 and formally finished in 1975, when an official ban was established as a result of the collapse of the fishery. Several previous studies had mentioned the decrease in Colorado River flow and overfishing as possible reasons of the catch and stock reduction. This paper extends the exploration of the causes of the collapse analyzing the co-variation of the trends in catch, biomass, abundance, and fishing mortality with the Colorado River flow, diverse climatic indexes as well as the reconstructed fishing effort. Our results confirm the important role of the Colorado River flow cessation on the decrement of the catch, and the simultaneous increase of the fishing effort during 1940-1954. A new and stronger correlation was unveiled between catch, abundance and stock biomass with the Pacific Decadal Oscillation Index (PDOI). This fact points out the influence of large temporal and spatial scale processes and stresses the importance of the interaction of anthropogenic and natural factors when exploring the historical causes of a population decline and in planning stock recovery actions. The relative role of each of the factors analyzed as well as the possible mechanisms involved is briefly discussed.

Enever, R., Revill, A., and Grant, A. **Discarding in the English Channel, Western approaches, Celtic and Irish seas (ICES subarea VII).** *Fisheries Research* 86(2-3): 143-152, 2007.

Notes: Discarding is a common feature throughout global fisheries and of widespread management concern. The Centre for Environment, Fisheries and Aquaculture Science (CEFAS) catch and discard data collection programme has been conducting sampling operations on English and Welsh registered fishing vessels in the International Council for the Exploration of the Sea (ICES) subarea VII since 2002. Within this subarea, these vessels were found to mainly operate in the English Channel, Western approaches, Celtic and Irish sea. We present the findings of this work and estimate the annual quantities of discards (fish and cephalopods) in terms of numbers and weights between 2002 and 2005. Our analysis was conducted on 3643 hauls from 306 trips aboard commercial fishing vessels (142 different boats). An estimated 186 million (72,000t) fish and cephalopods were caught every year of which 117 million (24,500 t) were discarded. Beam trawlers and otter trawlers were together responsible for more than 90% of these discards. In all, 182 fish and cephalopod species were caught, yet just 10

species constituted more than 50% (61.5 million) of the annual discards. We estimate that discarding levels in the region are higher (1.5 x) than recently reported by the FAO.

Sonnenholzner, J.I., Ladah, L.B., and Lafferty, K.D. **Cascading effects of fishing on Galapagos rocky reef communities.** *Marine Ecology Progress Series* 343: 77-85, 2007. **O/A**

Notes: A replicated comparison of heavily and lightly fished areas in the Galapagos suggested that fishing predators led to an increase in herbivores and a dramatic shift in the algal community toward crustose barrens. We sampled 10 highly fished and 10 lightly fished shallow rocky reefs in the southeastern area of the Galapagos Marine Reserve, Ecuador. Negative associations between consumers and resources suggested top-down control. At cold sites, there was a negative association between slate-pencil urchins *Eucidaris galapagensis* and non-coralline algae. In addition, at cold sites, pencil urchins were less abundant where there were many predators. An indirect positive association between predators and non-coralline algae occurred at warm and cold sites. Fishing appeared to affect this trophic cascade. The spiny lobster *Panulirus penicillatus*, the slipper lobster *Scyllarides astori*, and the Mexican hogfish *Bodianus diplotaenia* were significantly less abundant at highly fished sites. Urchin density was higher at highly fished sites. Non-coralline algae were nearly absent from highly fished sites where a continuous carpet of the anemone *Aiptasia* sp. was recorded and the algal assemblage was mainly structured by encrusting coralline and articulated calcareous algae.

Oguz, T. **Nonlinear response of Black Sea pelagic fish stocks to over-exploitation.** *Marine Ecology Progress Series* 345: 211-228, 2007.

Notes: A 3-trophic level prey-predator model investigated the underlying nonlinear dynamics governing long-term (1960 to 1999) changes in pelagic fish stocks in the Black Sea. The model first explored the steady state dynamics under various combinations of consumption, harvesting and mortality rate values, and identified the critical parameters and their ranges that control equilibrium characteristics of fish stocks in the pristine state of the ecosystem. This knowledge was then used to describe progression of the stocks under temporally varying harvesting regimes. Although idealized within the structure of the model, the simulations reproduced empirical observations reasonably well. The model possesses different single equilibrium solutions during different phases of the system and associated regime shift dynamics. The late 1960s represented the disruption period of heavily-exploited top predator stock and the successive proliferation of weakly-exploited small and medium pelagic stocks. The high stock regime of small pelagics persisted for a decade and then rebounded back and forth between the low and high abundance regimes. The 1990s ecosystem represented a gradual switch of small pelagics to a high stock regime, whereas other groups preserved their low stock regimes. Simulations further explored optimum harvesting conditions for balanced stocks of small and medium pelagics by the end of next decade. The present study highlights how a simple model, when carefully tuned, may provide detailed information on fish stock dynamics and realistically reproduce the empirical observations. The model also illustrates the value of a minimalist deterministic approach for multi-species fishery management strategy development

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Callaway, R., Engelhard, G.H., Dann, J., Cotter, J., and Rumohr, H. **A century of North Sea epibenthos and trawling: comparison between 1902-1912, 1982-1985 and 2000.** *Marine Ecology Progress Series* 346: 27-43, 2007. **O/A**

Notes: The effects of towed fishing gear on benthic fauna are under intense scrutiny and evidence is growing that trawling may significantly affect benthic communities in the North Sea. Most studies explore the current fauna or compare today's situation with that of 2 or 3 decades ago, when North Sea-wide information on benthos and fishing became available. However, in the North Sea, extensive mechanised trawling began more than a century ago. This study compared historical and recent records in order to explore potential long-term links between changes in the epibenthos and fishing. Based on reconstructed species lists from museum specimens, we compared epibenthos data from 1902 to 1912 with those from 1982 to 1985 and 2000. We analysed changes in average taxonomic distinctness (AvTD), a biodiversity indicator, and changes in biogeographical species distributions. Landings data were collated for round- and flatfish caught in the northern, central and southern North Sea from 1906 to 2000 as proxies for total otter and beam trawl effort, respectively. These indicate that the southern and much of the central North Sea were fished intensively throughout the 20th century, whilst the northern North Sea was less exploited, especially in earlier decades; exploitation intensified markedly from the 1960s onwards. For epibenthos,

the mean AvTD decreased significantly from the 1980s to 2000, when it was below expected values in 4 ICES rectangles, 3 of these located in heavily trawled areas. Biogeographical changes from the beginning to the end of the century occurred in 27 of 48 taxa. In 14 taxa, spatial presence was reduced by 50% or more, most notably in the southern and central North Sea; often these were long-lived, slow-growing species with vulnerable shells or tests. By contrast, 12 taxa doubled their spatial presence throughout the North Sea. Most biogeographical changes had happened by the 1980s. Given that other important environmental changes, including eutrophication and climate change, have gained importance mainly from the 1980s onwards, we have concluded that the changes in epibenthos observed since the beginning of the 20th century have resulted primarily from intensified fisheries.

Adams, P.B., Grimes, C., Hightower, J.E., Lindley, S.T., Moser, M.L., and Parsley, M.J. **Population status of North American green sturgeon, *Acipenser medirostris*.** *Environmental Biology of Fishes* 79(3-4): 339-356, 2007.

Notes: North American green sturgeon, *Acipenser medirostris*, was petitioned for listing under the Endangered Species Act (ESA). The two questions that need to be answered when considering an ESA listing are; (1) Is the entity a species under the ESA and if so (2) is the "species" in danger of extinction or likely to become an endangered species in the foreseeable future throughout all or a significant portion of its range? Green sturgeon genetic analyses showed strong differentiation between northern and southern populations, and therefore, the species was divided into Northern and Southern Distinct Population Segments (DPSs). The Northern DPS includes populations in the Rogue, Klamath-Trinity, and Eel rivers, while the Southern DPS only includes a single population in the Sacramento River. The principal risk factors for green sturgeon include loss of spawning habitat, harvest, and entrainment. The Northern DPS is not considered to be in danger of extinction or likely to become an endangered species in the foreseeable future. The loss of spawning habitat is not large enough to threaten this DPS, although the Eel River has been severely impacted by sedimentation due to poor land use practices and floods. The two main spawning populations in the Rogue and Klamath-Trinity rivers occupy separate basins reducing the potential for loss of the DPS through catastrophic events. Harvest has been substantially reduced and green sturgeon in this DPS do not face substantial entrainment loss. However there are significant concerns due to lack of information, flow and temperature issues, and habitat degradation. The Southern DPS is considered likely to become an endangered species in the foreseeable future. Green sturgeon in this DPS are concentrated into one spawning area outside of their natural habitat in the Sacramento River, making them vulnerable to catastrophic extinction. Green sturgeon spawning areas have been lost from the area above Shasta Dam on the Sacramento River and Oroville Dam on the Feather River. Entrainment of individuals into water diversion projects is an additional source of risk, and the large decline in numbers of green sturgeon entrained since 1986 causes additional concern.

Artyukhin, E.N., Vecsei, P., and Peterson, D.L. **Morphology and ecology of Pacific sturgeons.** *Environmental Biology of Fishes* 79(3-4): 369-381, 2007.

Notes: The six North Pacific members of the genus Acipenser have generally similar environmental requirements and share several specific morphological features. This Pacific group consists of green sturgeon, *Acipenser medirostris*, Sakhalin sturgeon, *A. mikadoi*, white sturgeon, *A. transmontanus*, Chinese sturgeon, *A. sinensis*, Dabry's sturgeon, *A. dabryanus* and Amur sturgeon, *A. schrenkii*. A qualitative morphological examination of these species revealed synapomorphic characters that suggest close phyolgenetic relationships resulting from common ancestry of eastern and western species within the Pacific Rim. An evolutionary taxonomic approach, considering a reduction of characters from east to west, would suggest an Asian ancestry for all Pacific sturgeons. In contrast however, a phylogenetic approach using derived character states suggests a North American ancestry. Besides a common ancestry for Chinese and American sturgeons, the taxonomic status of *A. mikadoi* is discussed.

Shmigirilov, A.P., Mednikova, A.A., and Israel, J.A. **Comparison of biology of the Sakhalin sturgeon, Amur sturgeon, and kaluga from the Amur River, Sea of Okhotsk, and Sea of Japan biogeographic Province.** *Environmental Biology of Fishes* 79(3-4): 383-395, 2007.

Notes: Three Acipenseridae species live in the rivers and marine waters of the Khabarovsk Territory, Russia: Sakhalin sturgeon, *Acipenser mikadoi*, Amur sturgeon, *A. schrenckii*, and kaluga, *Huso dauricus*. We review the general biology and life

history of each species, including their historic and current distributions, and examine current paleogeographic theories to outline the possible origin and evolution of these three species in the Amur River, Sea of Okhotsk, and Sea of Japan biogeographic province. Apparently, these species have evolved during distinct geologic time periods, which has reinforced the reproductive isolation of these species although hybridization does occur. They have convergently adapted to the unique environmental conditions of the Amur River and Russian Maritime regions, and yet developed behavioral adaptations to reduce competition between species. Sakhalin sturgeon is the least studied species among anadromous sturgeon in the world. This species is highly migratory and spends the majority of its life in the ocean only returning to natal rivers to spawn. Amur sturgeon and kaluga are distributed throughout the Amur River basin and the estuary and share many life history traits. They are both represented by distinct morphs. Additionally, we present size and weight relationships to estimate the growth of Amur sturgeon and kaluga. All three species have suffered declines in abundance due to over fishing and their contemporary distributions have contracted compared to their historic ranges. We identify gaps in knowledge and suggest further research useful for guiding management of each species.

Gessner, J., Van Eenennaam, J.P., and Doroshov, S.I. **North American green and European Atlantic sturgeon: comparisons of life histories and human impacts.** *Environmental Biology of Fishes* 79(3-4): 397-411, 2007.

Notes: Green and European Atlantic sturgeon are listed as a vulnerable and a critically endangered species, respectively. These anadromous species inhabit different continents but have many similar life history traits and demographic characteristics, including wide geographic ranges, similar migratory and foraging behavior, age and size structures of reproductive stocks and, historically, diverse population structures. The differences are limited to tetraploid genome and much larger egg size and lower fecundity in green sturgeon, reflecting the adaptations to different geomorphology and biota of the Pacific region. Both species have been affected by over-harvest and habitat losses but the severity of these impacts have been greater and lasted longer for the European Atlantic sturgeon, resulting in loss of diversity and extirpation of all but one stock. From the comparison of human impact on two species we conclude that preventive actions should be taken at the early warning signs of changes in population and recruitment. These should mitigate multiple factors of human activity affecting sturgeon stocks and their habitats.

Klimley, A.P., Allen, P.J., Israel, J.A., and Kelly, J.T. **The green sturgeon and its environment: past, present, and future.** *Environmental Biology of Fishes* 79(3-4): 415-421, 2007.

Notes: Much new information about the biology of the green sturgeon (*Acipenser medirostris*) was presented during the symposium "The green sturgeon and its environment" at the 39th Annual Meeting of the California-Nevada Chapter of the American Fisheries Society on 19 March 2005, in Sacramento, California. This was the first time authorities from North America, Europe, and Asia had gathered to talk about the biology of this threatened species. Many of the presenters at this conference prepared articles that are included in this issue. Other scientists who attended the symposium were inspired to prepare additional articles containing their own observations about the biology of the species for inclusion in this volume. Thus, this issue contains sixteen original articles on the physiology, movements, population biology, and distribution of the green sturgeon, and provides the most up-to-date description of the biology of this species. Yet, as occurs so often in science, the sweat and toil of research that drives scientists to publish the results of their studies reveals more unanswered questions. We briefly summarize the findings of the authors published in this special issue, and offer some suggestions for future research, particularly in the context of the imperative need to develop effective regulations and actions to enable recovery of the threatened southern distinct population segment (DPS) of green sturgeon inhabiting the Sacramento-San Joaquin watershed and to conserve this species across its range.

Ebert, D.A. and Compagno, L.J.V. **Biodiversity and systematics of skates (Chondrichthyes: Rajiformes: Rajoidei).** *Environmental Biology of Fishes* 80(2-3): 111-124, 2007.

Notes: Skates (Rajiformes: Rajoidei) are a highly diverse fish group, comprising more valid species than any other group of cartilaginous fishes. The high degree of endemism exhibited by the skates is somewhat enigmatic given their relatively conserved body morphology and apparent restrictive habitat, e.g. soft bottom substrates. Skates are primarily marine benthic dwellers found from the intertidal down to depths in excess of 3,000 m. They are most diverse at higher latitudes and in

deepwater, but are replaced in shallower, warm temperate to tropical waters by stingrays (Myliobatodei). The number of valid skate species has increased exponentially, with more species having been described since 1950 (n = 126) than had been described in the previous 200 years (n = 119). Much of the renaissance in skate systematics has largely been through the efforts of a few individuals who through author-coauthor collaboration have accounted for 78 of the 131 species described since 1948 and for nine of 13 genera named since 1950. Furthermore, detailed regional surveys and accounts of skate biodiversity have also contributed to a better understanding of the diversity of the skates. A checklist of the living valid skate species is presented.
