

Marine Science Review – 202

Miscellaneous publications



In this review:

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

A. Recent articles – no abstract available

Schrope, M. **The real sea change.** *Nature* 443(7112): 622-624, 2006.

Marris, E. **Marine natural products - Drugs from the deep.** *Nature* 443(7114): 904-905, 2006.

Reeburgh, W.S. **Oceanic methane biogeochemistry.** *Chemical Reviews* 107(2): 486-513, 2007.

Eiler, A. **Evidence for the ubiquity of mixotrophic bacteria in the upper ocean: Implications and consequences.** *Applied and Environmental Microbiology* 72(12): 7431-7437, 2006.

Fenical, W. **Marine pharmaceuticals: Past, present, and future.** *Oceanography* 19(2): 110-119, 2006.

B. Recent publications available online

United States Government Accountability Office. 2006. **Endangered Species: Many Factors Affect the Length of Time to Recover Select Species.** GAO-06-730. GAO, Washington, DC. 72pp.

Available at: <http://www.gao.gov/new.items/d06730.pdf>

Notes: Proposed amendments to the Endangered Species Act are under consideration and GAO was asked to provide information to facilitate this effort. In April 2006, GAO issued a report providing high-level information on the extent to which recovery plans contain estimates of when species are expected to be recovered, among other things. This follow-on report provides more detailed information on the factors that affect species recovery and the importance of recovery plans in recovery efforts. For 31 species—selected because they were nearing recovery, or had significant attention devoted to them and thus would be expected to be making progress towards recovery—GAO (1) identifies factors affecting the length of time to recover the species and (2) describes the role recovery plans have played in recovering these species. GAO concludes that recovery plans have played an important role in the recovery efforts of nearly all of the species GAO reviewed by identifying many of the actions the Fish and Wildlife Services' biologists deemed most important to the species' recovery. The services' biologists report that these actions have contributed, at least in part, to the progress made in recovering these species. However, for about one-half of the species GAO reviewed, actions beyond those in the recovery plans also played an important role in progress toward the species' recovery.

C. Recent articles with abstracts

Overland, J.E., Percival, D.B., and Mofjeld, H.O. **Regime shifts and red noise in the North Pacific.** *Deep Sea Research Part I, Oceanographic Research* 53(4): 582-588, 2006.

Notes: Regimes and regime shifts are important concepts for understanding decadal variability in the physical system of the North Pacific because of the potential for an ecosystem to reorganize itself in response to such shifts. There are two prevalent senses in which these concepts are taken in the literature. The first is a formal definition and posits multiple stable states and rapid transitions between these states. The second is more data-oriented and identifies local regimes based on differing average climatic levels over a multi-annual duration, i.e. simply interdecadal fluctuations. This second definition is consistent with realizations from stochastic red noise processes to a degree that depends upon the particular model. Even in 100 year long records for the North Pacific a definition of regimes based solely on distinct multiple stable states is difficult to prove or disprove, while on interdecadal scales there are apparent local step-like features and multi-year intervals where the state remains consistently above or below the long-term mean. The terminologies climatic regime shift, statistical regime shift or climatic event are useful for distinguishing this second definition from the first. To illustrate the difficulty of advocating one definition over the other based upon a relatively short time series, we compare three simple models for the Pacific Decadal Oscillation (PDO). The 104-year PDO record is insufficient to statistically distinguish a single preference between a square wave oscillator consistent with the formal definition for regime shifts, and two red noise models that are compatible with climatic regime shifts. Because of the inability to distinguish between underlying processes based upon data, it is necessary to entertain multiple models and to consider how each model would impact resource management. In particular the persistence in the fitted models implies that certain probabilistic statements can be made regarding climatic regime shifts, but we caution against extrapolation to future states based on curve fitting techniques.

Pitois, S.G. and Fox, C.J. **Long-term changes in zooplankton biomass concentration and mean size over the Northwest European shelf inferred from Continuous Plankton Recorder data.** *ICES Journal of Marine Science* 63(5): 785-798, 2006.

Notes: Data from the Continuous Plankton Recorder (CPR) survey over the past 40 years have shown that the abundance of copepods for many parts of the North Atlantic has declined, indicating geographical shifts in the plankton communities. Because the CPR does not sample all zooplankton species with equal efficiency, these observations may give a biased view of the overall changes. Here, we compensate for CPR undersampling by using previously published species-specific correction factors derived from comparisons of catches made with WP-2 ring-nets and the CPR. Based on such corrected data, the southern North Sea showed the highest concentrations of biomass, in contrast to maps based on uncorrected data, in which the areas of highest biomass were in the northern North Sea. Trend analysis confirmed the previously reported general decrease of total biomass. There has also been a general decrease in the mean size of zooplankton over time in the northern North Sea, but this has not been observed elsewhere. The results indicate the importance of smaller zooplankton species in the ecology of the Northwest European shelf. The changes of community structure may have general implications for energy transfer efficiency to higher trophic levels, and for the sustainability of fisheries resources.

Munns, W.R. **Assessing risks to wildlife populations from multiple stressors: Overview of the problem and research needs.** *Ecology and Society* 11(1): U581-U592, 2006.

Notes: Wildlife populations are experiencing increasing pressure from human-induced changes in the landscape. Stressors including agricultural and urban land use, introduced invasive and exotic species, nutrient enrichment, direct human disturbance, and toxic chemicals directly or indirectly influence the quality and quantity of habitat used by terrestrial and aquatic wildlife. Governmental agencies such as the U.S. Environmental Protection Agency are required to assess risks to wildlife populations, in its broadest definition, that result from exposure to these stressors, yet considerable uncertainty exists with respect to how such assessments should be conducted. This uncertainty is compounded by questions concerning the interactive effects of co-occurring stressors, appropriate spatial scales of analysis, extrapolation of response data among species and from organisms to populations, and imperfect knowledge and use of limited data sets. Further, different risk problems

require varying degrees of sophistication, methodological refinement, and data quality. These issues suggest a number of research needs to improve methods for wildlife risk assessments, including continued development of population dynamics models to evaluate the effects of multiple stressors at varying spatial scales, methods for extrapolating across endpoints and species with reasonable confidence, stressor-response relations and methods for combining them in predictive and diagnostic assessments, and accessible data sets describing the ecology of terrestrial and aquatic species. Case study application of models and methods for assessing wildlife risk will help to demonstrate their strengths and limitations for solving particular risk problems.

Risgaard-Petersen, N., Langezaal, A.M., Ingvarsdén, S., Schmid, M.C., Jetten, M.S.M., Opden-Camp, H.J.M., Derksen, J.W.M., Pina-Ochoa, E., Eriksson, S.P., Nielsen, L.P., Revsbech, N.P., Cedhagen, T., and van der Zwaan, G.J. **Evidence for complete denitrification in a benthic foraminifer.** *Nature* 443(7107): 93-96, 2006.

Notes: Benthic foraminifera are unicellular eukaryotes found abundantly in many types of marine sediments. Many species survive and possibly reproduce in anoxic habitats, but sustainable anaerobic metabolism has not been previously described. Here we demonstrate that the foraminifer *Globobulimina pseudospinescens* accumulates intracellular nitrate stores and that these can be respired to dinitrogen gas. The amounts of nitrate detected are estimated to be sufficient to support respiration for over a month. In a Swedish fjord sediment where *G. pseudospinescens* is the dominant foraminifer, the intracellular nitrate pool in this species accounted for 20% of the large, cell-bound, nitrate pool present in an oxygen-free zone. Similarly high nitrate concentrations were also detected in foraminifera *Nonionella* cf. *stella* and a *Stainforthia* species, the two dominant benthic taxa occurring within the oxygen minimum zone of the continental shelf off Chile. Given the high abundance of foraminifera in anoxic marine environments, these new findings suggest that foraminifera may play an important role in global nitrogen cycling and indicate that our understanding of the complexity of the marine nitrogen cycle is far from complete.

Huppert, H.E. and Sparks, R.S.J. **Extreme natural hazards: population growth, globalization and environmental change.** *Philosophical Transactions of the Royal Society of London [A]* 364(1845): 1875-1888, 2006.

Notes: Mankind is becoming ever more susceptible to natural disasters, largely as a consequence of population growth and globalization. It is likely that in the future, we will experience several disasters per year that kill more than 10 000 people. A calamity with a million casualties is just a matter of time. This situation is mainly a consequence of increased vulnerability. Climate change may also be affecting the frequency of extreme weather events as well as the vulnerability of coastal areas due to sea-level rise. Disastrous outcomes can only increase unless better ways are found to mitigate the effects through improved forecasting and warning, together with more community preparedness and resilience. There are particular difficulties with extreme events, which can affect several countries, while the largest events can have global consequences. The hazards of supervolcanic eruptions and asteroid impacts could cause global disaster with threats to civilization and deaths of billions of people. Although these are very rare events, they will happen and require consideration. More frequent and smaller events in the wrong place at the wrong time could have very large human, environmental and economic effects. A sustained effort is needed to identify places at risk and take steps to apply science before the events occur.

Sala, E. and Knowlton, N. **Global marine biodiversity trends.** *Annual Review of Environment and Resources* 31: 93-122, 2006.

Notes: Marine biodiversity encompasses all levels of complexity of life in the sea, from within species to across ecosystems. At all levels, marine biodiversity has naturally exhibited a general, slow trajectory of increase, punctuated by mass extinctions at the evolutionary scale and by disturbances at the ecological scale. In historical times, a synergy of human threats, including overfishing, global warming, biological introductions, and pollution, has caused a rapid decline in global marine biodiversity, as measured by species extinctions, population depletions, and community homogenization. The consequences of this biodiversity loss include changes in ecosystem function and a reduction in the provision of ecosystem services. Global biodiversity loss will continue and likely accelerate in the future, with potentially more frequent ecological collapses and community-wide shifts. However, the timing and magnitude of these catastrophic events are probably unpredictable.

Eiler, A., Johansson, M., and Bertilsson, S. **Environmental influences on *Vibrio* populations in northern temperate and boreal coastal waters (Baltic and Skagerrak Seas).** *Applied and Environmental Microbiology* 72(9): 6004-6011, 2006.

Notes: Even if many *Vibrio* spp. are endemic to coastal waters, their distribution in northern temperate and boreal waters is poorly studied. To identify environmental factors regulating *Vibrio* populations in a salinity gradient along the Swedish coastline, we combined *Vibrio*-specific quantitative competitive PCR with denaturant gradient gel electrophoresis-based genotyping. The total *Vibrio* abundance ranged from 4×10^3 to 9.6×10^4 cells liter⁻¹, with the highest abundances in the more saline waters of the Skagerrak Sea. Several *Vibrio* populations were present throughout the salinity gradient, with abundances of single populations ranging from 5×10^4 to 7×10^4 cells liter⁻¹. Clear differences were observed along the salinity gradient, where three populations dominated the more saline waters of the Skagerrak Sea and two populations containing mainly representatives of *V. anguillarum* and *V. aestuarianus* genotypes were abundant in the brackish waters of the Baltic Sea. Our results suggest that this apparent niche separation within the genus *Vibrio* may also be influenced by alternate factors such as nutrient levels and high abundances of dinoflagellates. A *V. cholerae* / *V. mimicus* population was detected in more than 50% of the samples, with abundances exceeding 10^3 cells liter⁻¹, even in the cold (annual average water temperature of around 5°C) and low-salinity (2 to 4 parts per thousand) samples from the Bothnian Bay (latitude, 65°N). The unsuspected and widespread occurrence of this population in temperate and boreal coastal waters suggests that potential *Vibrio* pathogens may also be endemic to cold and brackish waters and hence may represent a previously overlooked health hazard.

Dentener, F. and et al. **Nitrogen and sulfur deposition on regional and global scales: A multimodel evaluation.** *Global Biogeochemical Cycles* 20(4): art. GB4003, 2006.

Notes: We use 23 atmospheric chemistry transport models to calculate current and future (2030) deposition of reactive nitrogen (NO_y, NH_x) and sulfate (SO_x) to land and ocean surfaces. The models are driven by three emission scenarios: (1) current air quality legislation (CLE); (2) an optimistic case of the maximum emissions reductions currently technologically feasible (MFR); and (3) the contrasting pessimistic IPCC SRES A2 scenario. An extensive evaluation of the present-day deposition using nearly all information on wet deposition available worldwide shows a good agreement with observations in Europe and North America, where 60-70% of the model-calculated wet deposition rates agree to within $\pm 50\%$ with quality-controlled measurements. Models systematically overestimate NH_x deposition in South Asia, and underestimate NO_y deposition in East Asia. We show that there are substantial differences among models for the removal mechanisms of NO_y, NH_x, and SO_x, leading to $\pm 1 \sigma$ variance in total deposition fluxes of about 30% in the anthropogenic emissions regions, and up to a factor of 2 outside. In all cases the mean model constructed from the ensemble calculations is among the best when comparing to measurements. Currently, 36-51% of all NO_y, NH_x, and SO_x is deposited over the ocean, and 50-80% of the fraction of deposition on land falls on natural (nonagricultural) vegetation. Currently, 11% of the world's natural vegetation receives nitrogen deposition in excess of the "critical load" threshold of 1000 mg(N) m⁻² yr⁻¹. The regions most affected are the United States (20% of vegetation), western Europe (30%), eastern Europe (80%), South Asia (60%), East Asia (40%), southeast Asia (30%), and Japan (50%). Future deposition fluxes are mainly driven by changes in emissions, and less importantly by changes in atmospheric chemistry and climate. The global fraction of vegetation exposed to nitrogen loads in excess of 1000 mg(N) m⁻² yr⁻¹ increases globally to 17% for CLE and 25% for A2. In MFR, the reductions in NO_y are offset by further increases for NH_x deposition. The regions most affected by exceedingly high nitrogen loads for CLE and A2 are Europe and Asia, but also parts of Africa.

Venter, O., Brodeur, N.N., Nemiroff, L., Belland, B., Dolinsek, I.J., and Grant, J.W.A. **Threats to endangered species in Canada.** *BioScience* 56(11): 903-910, 2006.

Notes: We quantified the threats facing 488 species in Canada, categorized by COSEWIC (Committee on the Status of Endangered Wildlife in Canada) as extinct, extirpated, endangered, threatened, or of special concern. Habitat loss is the most prevalent threat (84%), followed by overexploitation (32%), native species interactions (31%), natural causes (27%), pollution (26%), and introduced species (22%). Agriculture (46%) and urbanization (44%) are the most common human activities causing habitat loss and pollution. For extant species, the number of threats per species increases with the level of endangerment. The prevalence of threat types varies among major habitats, with overexploitation being particularly important, and introduced species particularly unimportant, for marine species. Introduced species are a much less important threat in Canada than in the United States, but the causes of endangerment are broadly similar for Canadian and globally endangered species.

Olden, J.D. **Biotic homogenization: a new research agenda for conservation biogeography.** *Journal of Biogeography* 33(12): 2027-2039, 2006.

Notes: *Aim* Biotic homogenization describes the process by which species invasions and extinctions increase the genetic, taxonomic or functional similarity of two or more biotas over a specified time interval. The study of biotic homogenization is a young and rapidly emerging research area in the budding field of conservation biogeography, and this paper aims to synthesize our current knowledge of this process and advocate a more systematic approach to its investigation. *Methods* Based on a comprehensive examination of the primary literature this paper reviews the process of biotic homogenization, including its definition, quantification, underlying ecological mechanisms, environmental drivers, the empirical evidence for different taxonomic groups, and the potential ecological and evolutionary implications. Important gaps in our knowledge are then identified, and areas of new research that show the greatest promise for advancing our current thinking on biotic homogenization are highlighted. *Results* Current knowledge of the patterns, mechanisms and implications of biotic homogenization is highly variable across taxonomic groups, but in general is incomplete. Quantitative estimates are almost exclusively limited to freshwater fishes and plants in the United States, and the principal mechanisms and drivers of homogenization remain elusive. To date research has focused on taxonomic homogenization, and genetic and functional homogenization has received inadequate attention. Trends over the past decade, however, suggest that biotic homogenization is emerging as a topic of greater research interest. *Main conclusions* My investigation revealed a number of important knowledge gaps and priority research needs in the science of biotic homogenization. Future studies should examine the homogenization process for different community properties (species occurrence and abundance) at multiple spatial and temporal scales, with careful attention paid to the various biological mechanisms (invasions vs. extinctions) and environmental drivers (environmental alteration vs. biotic interactions) involved. Perhaps most importantly, this research should recognize that there are multiple possible outcomes resulting from the accumulation of species invasions and extinctions, including biotic differentiation whereby genetic, taxonomic or functional similarity of biotas decreases over time.

Curtis, T.P., Head, I.M., Lunn, M., Woodcock, S., Schloss, P.D., and Sloan, W.T. **What is the extent of prokaryotic diversity?** *Philosophical Transactions of the Royal Society of London [B]* 361(1475): 2023-2037, 2006.

Notes: The extent of microbial diversity is an intrinsically fascinating subject of profound practical importance. The term 'diversity' may allude to the number of taxa or species richness as well as their relative abundance. There is uncertainty about both, primarily because sample sizes are too small. Non-parametric diversity estimators make gross underestimates if used with small sample sizes on unevenly distributed communities. One can make richness estimates over many scales using small samples by assuming a species/taxa-abundance distribution. However, no one knows what the underlying taxa-abundance distributions are for bacterial communities. Latterly, diversity has been estimated by fitting data from gene clone libraries and extrapolating from this to taxa-abundance curves to estimate richness. However, since sample sizes are small, we cannot be sure that such samples are representative of the community from which they were drawn. It is however possible to formulate, and calibrate, models that predict the diversity of local communities and of samples drawn from that local community. The calibration of such models suggests that migration rates are small and decrease as the community gets larger. The preliminary predictions of the model are qualitatively consistent with the patterns seen in clone libraries in 'real life'. The validation of this model is also confounded by small sample sizes. However, if such models were properly validated, they could form invaluable tools for the prediction of microbial diversity and a basis for the systematic exploration of microbial diversity on the planet.

Davies, R.G., Orme, C.D.L., Olson, V., Thomas, G.H., Ross, S.G., Ding, T.-S., Rasmussen, P.C., Stattersfield, A.J., Bennett, P.M., Blackburn, T.M., Owens, I.P.F., and Gaston, K.J. **Human impacts and the global distribution of extinction risk.** *Proceedings of the Royal Society B* 273(1598): 2127-2133, 2006.

Notes: Understanding the global geographical distribution of extinction risk is a key challenge in conservation biology. It remains controversial, however, to what extent areas become threat hotspots simply because of high human impacts or due to predisposing ecological conditions. Limits to the taxonomic and geographical extent, resolution and quality of previously available data have precluded a full global assessment of the relative roles of these factors. Here, we use a new global database on the geographical distributions of birds on continents and continental islands to show that, after controlling for species

richness, the best predictors of the global pattern of extinction risk are measures of human impact. Ecological gradients are of secondary importance at a global scale. The converse is true for individual biogeographic realms, within which variation in human impact is reduced and its influence on extinction risk globally is therefore underestimated. These results underline the importance of a global perspective on the mechanisms driving spatial patterns of extinction risk, and the key role of anthropogenic factors in driving the current extinction crisis.

Hey, J. **On the failure of modern species concepts.** *Trends in Ecology and Evolution* 21(8): 447-450, 2006.

Notes: The modern age of species concepts began in 1942, when Ernst Mayr gave concept names to several different approaches to species identification. A long list of species concepts then followed, as well as a complex literature on their merits, motivations and uses. Some of these complexities arose as a consequence of the semantic shift that Mayr introduced, in which procedures for identifying species were elevated to concepts. Much of the debate in recent decades over concepts, and over pluralism versus monism, can be seen as an unnecessary consequence of treating species identification criteria as if they were more fundamental concepts. Recently, biologists have begun to recognize both the shortcomings of a lexicon of multiple species concepts and a common evolutionary idea that underlies them.

Kunze, E., Dower, J.F., Beveridge, I., Dewey, R., and Bartlett, K.P. **Observations of biologically generated turbulence in a coastal inlet.** *Science* 313(5794): 1768-1770, 2006.

Notes: Measurements in a coastal inlet revealed turbulence that was three to four orders of magnitude larger during the dusk ascent of a dense acoustic-scattering layer of krill than during the day, elevating daily-averaged mixing in the inlet by a factor of 100. Because vertically migrating layers of swimming organisms are found in much of the ocean, biologically generated turbulence may affect (i) the transport of inorganic nutrients to the often nutrient-depleted surface layer from underlying nutrient-rich stratified waters to affect biological productivity and (ii) the exchange of atmospheric gases such as CO₂ with the stratified ocean interior, which has no direct communication with the atmosphere.

Pavelsky, T.M. and Smith, L.C. **Intercomparison of four global precipitation data sets and their correlation with increased Eurasian river discharge to the Arctic Ocean.** *Journal of Geophysical Research* 111(D21): art. D21112, 2006.

Notes: Recent increases in Eurasian river discharge to the Arctic Ocean have attracted considerable scientific attention but remain poorly understood. Previous studies have examined fire frequency, permafrost thaw, and dam construction as potential mechanisms. Here we focus on precipitation as a driver, using 198 dam-free Eurasian river basins ranging from 151 to 897,000 km². Using R-ArcticNet monthly discharge data and four observational and reanalysis precipitation products from the University of Delaware (UDel), University of Washington (UW), NCEP/NCAR (NCEP), and ECMWF (ERA-40), we (1) assess which precipitation data sets best capture spatially realistic patterns as inferred from agreement with river discharge (198 basins; 1958-1989); and (2) determine to what extent observed discharge trends follow Udel precipitation changes (66 basins; 1936-1999). Results from the precipitation intercomparison show for the 74 (of 198) basins displaying statistically significant discharge trends (24 positive, 50 negative; -74% to +89%, mean = -1%), interpolated precipitation products significantly outperform reanalysis data sets, perhaps owing to the fine-scale resolutions examined here. Agreement between discharge and precipitation is 42-86% and 42-97% for UDel and UW, respectively, but approaches zero for NCEP and ERA-40. Comparison of precipitation and discharge trends suggests that precipitation increases play a significant role in observed long-term discharge increases. For the 40 (of 66) basins displaying statistically significant trends in discharge (32 positive, 8 negative; -23% to +50%, mean = +11%), 29 display corresponding trends in precipitation with 35-62% agreement between discharge and precipitation trend. Comparison of discharge trends with basin permafrost properties indicates a possible, but not strong role for permafrost thaw in the observed increases.

Rothley, K.D. and Dutton, G. **Behavioral responses to environmental change alter direct and indirect trait-mediated interactions.** *Canadian Journal of Zoology* 84(7): 1053-1058, 2006.

Notes: We used a field-based experiment to explore the consequences of altered environmental conditions on a predator-prey-resource system. The foraging choices of grasshoppers on plant resources were measured in the presence and absence of predator spiders and in shaded and unshaded conditions. We show that shading conditions affected the spiders, their direct behavioral interactions with the grasshoppers, and the indirect behaviorally mediated interactions between the spiders and the plants. In unshaded conditions in response to spiders, grasshoppers reduced their energy intake by 90%, reduced their time spent feeding by 68%, and switched to a largely grass diet that should increase mortality, while in shaded conditions spiders induced no behavioral shift. In no shade, spiders had an indirect positive effect on forb plants as evidenced by a trophic cascade pattern in plant biomass in the one-, two-, and three-trophic-level communities. But in shade, there was no indirect interaction of the spiders on the plants. Our results demonstrate the challenge of predicting the effects of environmental change on complex, real-world ecosystems and highlight the critical need for conducting experimental manipulations in the proper context with full complements of species.

Pedros-Alio, C. **Genomics and marine microbial ecology.** *International Microbiology* 9(3): 191-197, 2006.

Notes: Genomics has brought about a revolution in all fields of biology. Before the development of microbial ecology in the 1970s, microbes were not even considered in marine ecological studies. Today we know that half of the total primary production of the planet must be credited to microorganisms. This and other discoveries have changed dramatically the perspective and the focus of marine microbial ecology. The application of genomics-based approaches has provided new challenges and has allowed the discovery of novel functions, an appreciation of the great diversity of microorganisms, and the introduction of controversial ideas regarding the concepts of species, genome, and niche. Nevertheless, thorough knowledge of the traditional disciplines of biology is necessary to explore the possibilities arising from these new insights. This work reviews the different genomic techniques that can be applied to marine microbial ecology, including both sequencing of the complete genomes of microorganisms and metagenomics, which, in turn, can be complemented with the study of mRNAs (transcriptomics) and proteins (proteomics). The example of proteorhodopsin illustrates the type of information that can be gained from these approaches. A genomics perspective constitutes a map that will allow microbiologists to focus their research on potentially more productive aspects.

O'Grady, J.J., Brook, B.W., Reed, D.H., Ballou, J.D., Tonkyn, D.W., and Frankham, R. **Realistic levels of inbreeding depression strongly affect extinction risk in wild populations.** *Biological Conservation* 133(1): 42-51, 2006.

Notes: The role of inbreeding depression in the extinction of wild populations is controversial, largely because there are no quantitative estimates of its impact using realistic levels of inbreeding depression. To address this deficiency, this study (1) provides a comprehensive estimate of the impact of inbreeding depression on wild, mammalian and avian species via a meta-analysis, and (2) determines the impact of this level of inbreeding depression on extinction risk over a broad taxonomic range via stochastic computer projections with and without inbreeding depression for populations with carrying capacities of 100, 500 and 2000 individuals. An average overall effect of 12 diploid lethal equivalents was found across the life-history of the species in the meta-analysis. In the stochastic computer projections, 12 diploid lethal equivalents of inbreeding depression (with purging) decreased median times to extinction by an average of 37%. These decreases were significant and of very similar magnitude, regardless of the carrying capacity modelled. Disregarding the influence of inbreeding depression on extinction risk will lead to serious overestimates of the survival prospects of threatened mammalian and avian taxa. Further, inappropriate recovery plans may be instituted if the causes of extinction risk and their relative contributions are not recognized.

Lam, K.S. **Discovery of novel metabolites from marine actinomycetes.** *Current Opinion in Microbiology* 9(3): 245-251, 2006.

Notes: Recent findings from culture-dependent and culture-independent methods have demonstrated that indigenous marine actinomycetes exist in the oceans and are widely distributed in different marine ecosystems. There is tremendous diversity and novelty among the marine actinomycetes present in marine environments. Progress has been made to isolate novel actinomycetes from samples collected at different marine environments and habitats. These marine actinomycetes produce different types of new secondary metabolites. Many of these metabolites possess biological activities and have the potential to be developed as therapeutic agents. Marine actinomycetes are a prolific but underexploited source for the discovery of novel secondary metabolites.

Balvanera, P., Pfisterer, A.B., Buchmann, N., He, J.S., Nakashizuka, T., Raffaelli, D., and Schmid, B. **Quantifying the evidence for biodiversity effects on ecosystem functioning and services.** *Ecology Letters* 9(10): 1146-1156, 2006.

Notes: Concern is growing about the consequences of biodiversity loss for ecosystem functioning, for the provision of ecosystem services, and for human well being. Experimental evidence for a relationship between biodiversity and ecosystem process rates is compelling, but the issue remains contentious. Here, we present the first rigorous quantitative assessment of this relationship through meta-analysis of experimental work spanning 50 years to June 2004. We analysed 446 measures of biodiversity effects (252 in grasslands), 319 of which involved primary producer manipulations or measurements. Our analyses show that: biodiversity effects are weaker if biodiversity manipulations are less well controlled; effects of biodiversity change on processes are weaker at the ecosystem compared with the community level and are negative at the population level; productivity-related effects decline with increasing number of trophic links between those elements manipulated and those measured; biodiversity effects on stability measures ('insurance' effects) are not stronger than biodiversity effects on performance measures. For those ecosystem services which could be assessed here, there is clear evidence that biodiversity has positive effects on most. Whilst such patterns should be further confirmed, a precautionary approach to biodiversity management would seem prudent in the meantime.

Frank, K.T., Petrie, B., Shackell, N.L., and Choi, J.S. **Reconciling differences in trophic control in mid-latitude marine ecosystems.** *Ecology Letters* 9(10): 1096-1105, 2006.

Notes: The dependence of long-term fishery yields on primary productivity, largely based on cross-system comparisons and without reference to the potential dynamic character of this relationship, has long been considered strong evidence for bottom-up control in marine systems. We examined time series of intensive empirical observations from nine heavily exploited regions in the western North Atlantic and find evidence of spatial variance of trophic control. Top-down control dominated in northern areas, the dynamics evolved from bottom-up to top-down in an intermediate region, and bottom-up control governed the southern areas. A simplified, trophic control diagram was developed accounting for top-down and bottom-up forcing within a larger region whose base state dynamics are bottom-up and can accommodate time-varying dynamics. Species diversity and ocean temperature co-varied, being relatively high in southern areas and lower in the north, mirroring the shifting pattern of trophic control. A combination of compensatory population dynamics and accelerated demographic rates in southern areas seems to account for the greater stability of the predator species complex in this region.

Kohn, M.H., Murphy, W.J., Ostrander, E.A., and Wayne, R.K. **Genomics and conservation genetics.** *Trends in Ecology and Evolution* 21(11): 629-637, 2006.

Notes: In large part, the relevance of genetics to conservation rests on the premise that neutral marker variation in populations reflects levels of detrimental and adaptive genetic variation. Despite its prominence, this tenet has been difficult to evaluate, until now. As we discuss here, genome sequence information and new technological and bioinformatics platforms now enable comprehensive surveys of neutral variation and more direct inferences of detrimental and adaptive variation in species with sequenced genomes and in 'genome-enabled' endangered taxa. Moreover, conservation schemes could begin to consider specific pathological genetic variants. A new conservation genetic agenda would utilize data from enhanced surveys of genomic variation in endangered species to better manage functional genetic variation.

Kellogg, C.A. and Griffin, D.W. **Aerobiology and the global transport of desert dust.** *Trends in Ecology and Evolution* 21(11): 638-644, 2006.

Notes: Desert winds aerosolize several billion tons of soil-derived dust each year, including concentrated seasonal pulses from Africa and Asia. These transoceanic and transcontinental dust events inject a large pulse of microorganisms and pollen into the atmosphere and could therefore have a role in transporting pathogens or expanding the biogeographical range of some organisms by facilitating long-distance dispersal events. As we discuss here, whether such dispersal events are occurring is only

now beginning to be investigated. Huge dust events create an atmospheric bridge over land and sea, and the microbiota contained within them could impact downwind ecosystems. Such dispersal is of interest because of the possible health effects of allergens and pathogens that might be carried with the dust.

Moulin, C. and Chiapello, I. **Impact of human-induced desertification on the intensification of Sahel dust emission and export over the last decades.** *Geophysical Research Letters* 33(18): art. L18808, 2006.

Notes: Human-induced soil degradation in Sahel is a major concern for regional climate change. A significant increase in long-range atmospheric dust transport due to human activities would indeed modify the radiative budget and the water cycle over both Africa and the tropical Atlantic. Here we use two independent long-term datasets, i.e., surface concentration measurements at Barbados between 1965 and 2000 and maps of TOMS dust optical thickness between 1979 and 2000, to evidence an increase of a factor of two of background dust loads over the Atlantic since the mid 60's, independently of any climatic phenomenon. Satellite imagery suggests that this trend can be attributed to an intensification of dust emissions in a Sahel region centered on southern Mali. The desertification caused by the doubling of the population in Sahel over the last 40 years likely explains the observed intensification of the Atlantic dust export.

Brodeur, R.D., Ralston, S., Emmett, R.L., Trudel, M., Auth, T.D., and Phillips, A.J. **Anomalous pelagic nekton abundance, distribution, and apparent recruitment in the northern California Current in 2004 and 2005.** *Geophysical Research Letters* 33(22): art. L22S08, 2006.

Notes: Although the California Current has undergone substantial environmental shifts in the past few decades, the summer of 2005 exhibited highly anomalous conditions relative to all previous recorded summers in terms of late initiation of upwelling and the resulting elevated surface temperatures and depressed productivity through July. The response of pelagic nekton to these anomalous conditions was widespread and included onshore and poleward displacement of taxa to new geographic areas, population changes within the normal range, and reduced productivity of early life stages based on larval and juvenile surveys. Some nekton exhibited anomalous distributions in 2004. Many ecologically important species were affected. The response of the nektonic community off California was greater than during El Niño conditions.

Kawahara, M., Uye, S., Ohtsu, K., and Iizumi, H. **Unusual population explosion of the giant jellyfish *Nemopilema nomurai* (Scyphozoa: Rhizostomeae) in East Asian waters.** *Marine Ecology Progress Series* 307: 161-173, 2006.

Notes: A population explosion of the giant jellyfish *Nemopilema nomurai* (Scyphozoa: Rhizostomeae) occurred in the Sea of Japan in 2002 and 2003, causing severe damage to fisheries. There was a further population explosion in 2004, but on a much smaller scale. In both years, young medusae began to appear in the Tsushima and Korea Strait in July and August, followed by a northward expatriation in the Tsushima Current to the northern Sea of Japan. We obtained scyphistomae of this species by artificial fertilization, and reared them to the young medusa stage in the laboratory. Asexual reproduction of scyphistomae occurred by means of podocyst formation. A thermal increase from 13 to 23°C induced strobilation, followed by liberation of 3 to 7 ephyrae from a strobila. The ephyrae developed to metephyrae having a complex canal system and characteristically possessing long reddish purple filiform appendages. By 40 d post-liberation, the metephyrae had grown to medusae in which the central mouth had closed and been replaced by numerous mouthlets on both oral wings and scapulets. The results from both laboratory-rearing experiments and field investigations were combined to construct the seasonal life cycle and geographical distribution of *N. nomurai* in eastern Asian waters. Possible causes for the mass occurrence of *N. nomurai*, which has tended to be more frequent in the last decade, are discussed.

Link, J.S. and Ford, M.D. **Widespread and persistent increase of *Ctenophora* in the continental shelf ecosystem off NE USA.** *Marine Ecology Progress Series* 320: 153-159, 2006.

Notes: Changes in the prey composition of the stomachs of opportunistic-feeding fishes can provide information on various ocean-ecosystem dynamics. From 1981 to 2000, stomach samples of the spiny dogfish *Squalus acanthias* showed a major

increase in the overall occurrence (and hence implied abundance) of *Ctenophora*, gelatinous zooplankton that range throughout the ecosystem, There have been a few such major increases in ctenophores in enclosed (e.g. Caspian Sea) and semi-enclosed (e.g. Mediterranean Sea) ecosystems, with concomitant significant effects on those ecosystems and the productivity of their fishery resources. We show the first such increases in ctenophores in an open ecosystem, persistent over 2 decades, with implications for the productivity of the fishery resources in any large marine ecosystem.

Angly, F.E., Felts, B., Breitbart, M., Salamon, P., Edwards, R.A., Carlson, C., Chan, A.M., Haynes, M., Kelley, S., Liu, H., Mahaffy, J.M., Mueller, J.E., Nulton, J., Olson, R., Parsons, R., Rayhawk, S., Suttle, C.A., and Rohwer, F. **The marine viromes of four oceanic regions.** *PLoS Biology* 4(11): art. no. e368, 2006.

Notes: Viruses are the most common biological entities in the marine environment. There has not been a global survey of these viruses, and consequently, it is not known what types of viruses are in Earth's oceans or how they are distributed. Metagenomic analyses of 184 viral assemblages collected over a decade and representing 68 sites in four major oceanic regions showed that most of the viral sequences were not similar to those in the current databases. There was a distinct "marine-ness" quality to the viral assemblages. Global diversity was very high, presumably several hundred thousand of species, and regional richness varied on a North-South latitudinal gradient. The marine regions had different assemblages of viruses. Cyanophages and a newly discovered clade of single-stranded DNA phages dominated the Sargasso Sea sample, whereas prophage-like sequences were most common in the Arctic. However most viral species were found to be widespread. With a majority of shared species between oceanic regions, most of the differences between viral assemblages seemed to be explained by variation in the occurrence of the most common viral species and not by exclusion of different viral genomes. These results support the idea that viruses are widely dispersed and that local environmental conditions enrich for certain viral types through selective pressure.

Courchamp, F., Angulo, E., Rivalan, P., Hall, R.J., Signoret, L., Bull, L., and Meinard, Y. **Rarity value and species extinction: The anthropogenic Allee effect.** *PLoS Biology* 4(12): art. no. e415, 2006.

Notes: Standard economic theory predicts that exploitation alone is unlikely to result in species extinction because of the escalating costs of finding the last individuals of a declining species. We argue that the human predisposition to place exaggerated value on rarity fuels disproportionate exploitation of rare species, rendering them even rarer and thus more desirable, ultimately leading them into an extinction vortex. Here we present a simple mathematical model and various empirical examples to show how the value attributed to rarity in some human activities could precipitate the extinction of rare species—a concept that we term the anthropogenic Allee effect. The alarming finding that human perception of rarity can precipitate species extinction has serious implications for the conservation of species that are rare or that may become so, be they charismatic and emblematic or simply likely to become fashionable for certain activities.
