

In this review:

A. Recent articles with abstracts

O/A denotes an open access article or journal

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Goodenough, A.E. **Are the ecological impacts of alien species misrepresented? A review of the "native good, alien bad" philosophy.** *Community Ecology* 11(1): 13-21, 2010.

Notes: The study of invasion ecology usually focuses on the negative impacts of alien species, while potential positive impacts are often overlooked. Understanding of biotic interactions may thus be skewed towards the negative, which could have important implications for ecological management and conservation. This article provides a comprehensive review of all types of impacts, both beneficial and detrimental, that can result from species translocation. An extensive review of literature on species introductions to terrestrial, freshwater and marine ecosystems and involving a wide range of taxa (including microorganisms, parasites, plants, insects, amphibians, reptiles, birds, mammals, fish and crustacea) showed that, despite limited research into facilitative alien-native interactions, such interactions occur surprisingly frequently. Examples were found of introduced species acting as hosts, food sources, pollinators or seed dispersers for native species, as well as providing herbivory, predatory or parasite release. However, research showed that numerous negative interactions also occurred and combination impacts (when an alien benefits some natives but disadvantages others) were common. In many cases, the traditional view that biological invasions constitute a significant threat to native biota is both accurate and appropriate. Efforts to prevent translocation and control non-native species can be vital. However, the "native good, alien bad" maxim does not convey the complexity of invasion ecology; alien species do not axiomatically pose a threat to native biota. In order to move understanding of invasion ecology forward and to develop maximally-effective management strategies, facilitative alien-native interactions need to be added into the alien species debate.

Kasyan, V.V. **Holoplankton of ship ballast water in the Port of Vladivostok.** *Russian Journal of Marine Biology* 36(3): 167-175, 2010.

Notes: Ballast water samples were taken from three ships that arrived at the Port of Vladivostok (Peter the Great Bay, Sea of Japan) from ports of Japan (Sea of Japan and Pacific Ocean) and China (Yellow Sea and Yangtze River). The holoplankton in samples was presented by seven taxonomic groups, among which copepods (subclass Copepoda, 33 species) and cladocerans (subclass Cladocera, 5 species) dominated. In the samples, eight nonindigenous copepod species were revealed. The information contained in this paper may be of importance for the assessment of the risk of subsequent invasion of new species and the development of techniques for monitoring the qualitative and quantitative structures of ballast water.

Gozlan, R.E., Britton, J.R., Cowx, I., and Copp, G.H. **Current knowledge on non-native freshwater fish introductions.** *Journal of Fish Biology* 76(4): 751-786, 2010.

Notes: This review provides a contemporary account of knowledge on aspects of introductions of non-native fish species and includes issues associated with introduction pathways, ecological and economic impacts, risk assessments, management options and impact of climate change. It offers guidance to reconcile the increasing demands of certain stakeholders to diversify their activities using non-native fishes with the long-term sustainability of native aquatic biodiversity. The rate at which non-native freshwater fishes have been introduced worldwide has doubled in the space of 30 years, with the principal motives being aquaculture (39%) and improvement of wild stocks (17%). Economic activity is the principal driver of human-mediated non-native fish introductions, including the globalization of fish culture, whereby the production of the African cichlid tilapia is seven times higher in Asia than in most areas of Africa, and Chile is responsible for c. 30% of the world's farmed salmon, all based on introduced species. Consequently, these economic benefits need balancing against the detrimental environmental, social and economic effects of introduced non-native fishes. There are several major ecological effects associated with non-native fish introductions, including predation, habitat degradation, increased competition for resources, hybridization and disease transmission. Consideration of these aspects in isolation, however, is rarely sufficient to adequately characterize the overall ecological effect of an introduced species. Regarding the management of introduced non-native fish, pre-introduction screening tools, such as the fish invasiveness scoring kit (FISK), can be used to ensure that species are not introduced, which may develop invasive populations. Following the introduction of non-native fish that do develop invasive populations, management responses are typified by either a remediation or a mitigation response, although these are often difficult and expensive to implement, and may have limited effectiveness.

Brant, S.V., Cohen, A.N., James, D., Hui, L., Hom, A., and Loker, E.S. **Cercarial dermatitis transmitted by exotic marine snail.** *Emerging Infectious Diseases* 16(9): 1357-1365, 2010. O/A

Notes: Cercarial dermatitis (swimmer's itch) is caused by the penetration of human skin by cercariae of schistosome parasites that develop in and are released from snail hosts. Cercarial dermatitis is frequently acquired in freshwater habitats, and less commonly in marine or estuarine waters. To investigate reports of a dermatitis outbreak in San Francisco Bay, California, we surveyed local snails for schistosome infections during 2005-2008. We found schistosomes only in *Haminoea japonica*, an Asian snail first reported in San Francisco Bay in 1999. Genetic markers place this schistosome within a large clade of avian schistosomes, but do not match any species for which there are genetic data. It is the second known schistosome species to cause dermatitis in western North American coastal waters; these species are transmitted by exotic snails. Introduction of exotic hosts can support unexpected emergence of an unknown parasite with serious medical or veterinary implications.

Gan, X.J., Choi, C.Y., Wang, Y., Ma, Z.J., Chen, J.K., and Li, B. **Alteration of habitat structure and food resources by invasive smooth cordgrass affects saltmarsh birds at Chongming Dongtan, East China.** *Auk* 127(2): 317-327, 2010.

Notes: The exotic smooth cordgrass (*Spartina alterniflora*) has spread rapidly on the east coast of China over the past three decades and has greatly changed the native saltmarsh vegetation. We conducted bird surveys using mist nets in the exotic *Spartina* and native common reed (*Phragmites australis*) habitats at Chongming Dongtan of eastern China in the winters of 2004 and 2005. We related bird capture rates to habitat type (*Phragmites* or *Spartina* habitat), habitat structure (plant height and density), and food availability (densities of seeds and arthropods). The *Spartina* habitat was composed of shorter and denser vegetation and provided fewer food resources for birds than the *Phragmites* habitat. Bird capture rate was lower in *Spartina*, negatively related to plant density in the *Spartina* habitat, and positively correlated with overall arthropod abundance and plant height. Food resources consumed by birds were similar to those found in *Phragmites* habitat, irrespective of capture location. Our results suggest that the alteration of habitat structure and reduction in food resources are probably the proximate causes of lower avian species richness and relative abundance in the exotic *Spartina* than in the *Phragmites* habitat at Chongming Dongtan.

Wang, R.Z., Yuan, L., and Zhang, L.Q. Impacts of *Spartina alterniflora* invasion on the benthic communities of salt marshes in the Yangtze Estuary, China. *Ecological Engineering* 36(6): 799-806, 2010.

Notes: As a species for ecological engineering, *Spartina alterniflora* was introduced to Chongming Dongtan in 1995. And over the last 10 years, this species has rapidly invaded large areas of the Chongming Dongtan nature reserve. In this study, use of a normalized biomass size-spectra (NBSS) approach was explored to evaluate the possible impacts of *S. alterniflora* invasion on the benthic communities along gradients of intertidal zones and the invasion history of *S. alterniflora* within the nature reserve. The results showed that the characteristics of macrobenthic communities and the variation in macrobenthic communities described by the first two CCA axes revealed clearly the gradients of elevation and invasion history of *S. alterniflora*. The differences in the macrobenthic assemblages between the *Spartina alterniflora* marshes and the native *Phragmites australis* marshes decreased with increasing of invasion history of *S. alterniflora*. The macrobenthic biomass showed a decreasing trend, while the meiobenthic biomass showed a reverse trend along the elevation gradient. The macrobenthic biomass of *S. alterniflora* marshes with longer invasion history was higher than that at recently invaded *S. alterniflora* marshes, while the meiobenthic biomass was lower. The slopes of NBSS for the sampling sites showed a trend of steeper slopes with decreasing of elevation and at the recently invaded *S. alterniflora* marshes than that at marshes with longer invasion history, while the differences between the native *P. australis* marshes and the *S. alterniflora* marshes with long invasion history tended to be diminished. The NBSS approach could thus be used more widely to detect possible impacts of *S. alterniflora* invasion on benthic assemblages. This study also indicated the potential for this approach to provide valuable insights into the ecosystem ecology of invasive species, which could be very important for wetland biodiversity conservation and resource management in the Yangtze River Estuary and other such impacted areas.

Fuentes, V.L., Angel, D.L., Bayha, K.M., Atienza, D., Edelist, D., Bordehore, C., Gili, J.M., and Purcell, J.E. Blooms of the invasive ctenophore, *Mnemiopsis leidyi*, span the Mediterranean Sea in 2009. *Hydrobiologia* 645(1): 23-37, 2010.

Notes: Blooms of the invasive ctenophore, *Mnemiopsis leidyi*, occurred in 2009 along the Mediterranean Sea coasts of Spain and Israel. This voracious zooplanktivore spread throughout the Black Sea basin after its introduction in the early 1980s, throughout northern European coastal waters, and now occurs throughout the Mediterranean Sea. *M. leidyi* occurred throughout the summer along the entire Catalan Spanish and Israeli coasts in 2009. Those locations had high temperatures (18-26 °C) and salinities (37-38) during the blooms. The patterns of abundance of large jellyfish along the Catalan coast were unusual in 2009, with low numbers during July, August, and September when ctenophores were abundant. Small populations of those potential predators and food competitors of *M. leidyi* could have contributed to the ctenophore bloom. The identity of the ctenophores from Spain and Israel was confirmed as *M. leidyi* by molecular analysis based on DNA sequencing of the nuclear internal transcribed spacer (ITS) regions. This is the first molecular confirmation of *M. leidyi* in the Mediterranean Sea. Most ctenophores had an ITS genotype previously found in *M. leidyi* from other invaded regions (the Black, Azov, and Mediterranean seas), as well as native regions in the United States, suggesting common ancestry. Based on the circulation patterns of Mediterranean surface waters and shipping activities, we conclude that the spread of *M. leidyi* in the Mediterranean probably resulted from re-introductions by ballast water transport and subsequent distribution by currents. We also conclude that the near-simultaneous blooms in opposite ends of both the Mediterranean basins indicate that *M. leidyi* is resident around the Mediterranean. We discuss environmental conditions, food, and predators of *M. leidyi* in both regions that would influence the future effects of this voracious consumer on the pelagic food web of the Mediterranean Sea.

Dumont, Y., Russell, J.C., Lecomte, V., and LeCorre, M. Conservation of endangered endemic seabirds within a multi-predator context: The Barau's petrel in Reunion Island. *Natural Resource Modeling* 23(3): 381-436, 2010.

Notes: Seabirds breeding on islands are vulnerable to introduced predators, such as rats and cats, and the removal of such predators is generally viewed as a priority for seabird conservation and restoration. However, multiple invasive mammal species interacting may generate unexpected outcomes following the removal (eradication) of one species.

Generally these indirect interactions are not well understood or demonstrated. We propose and study a prey (seabird)-mesopredator (rat)-superpredator (cat) model, taking into account the juvenile stages in the prey population, in order to direct conservation management for seabird conservation. We give a more biologically realistic differential system than those studied before (Courchamp et al. [1999]; Fan et al. [2005]), in particular for long-lived seabird species. We present a theoretical study and show existence and uniqueness of a positive solution as well as a qualitative study of the equilibria that may appear. Because standard numerical methods, usually implemented in scientific softwares, can fail to give the right biological approximations (Anguelov et al. [2009]), we propose a reliable algorithm that preserves most of the qualitative properties of the continuous system, using the theory of nonstandard finite difference methods. Finally, we use biologically realistic parameters available for the representative Barau's petrel (Pinet et al. [2008]), an endemic species from Reunion island, to present numerical simulations that support the theoretical study. Cats play the major role in seabird prey population dynamics. Seasonality in seabird breeding delays but does not prevent extinction. In all scenarios, cat control (or preferably eradication) is imperative to prevent extinction of vulnerable long-lived seabirds, like the Barau's petrel.

Hilton, G.M. and Cuthbert, R.J. **The catastrophic impact of invasive mammalian predators on birds of the UK Overseas Territories: a review and synthesis.** *Ibis* 152(3): 443-458, 2010.

Notes: The UK has sovereignty over 16 Overseas Territories, which hold some of the world's great seabird colonies and collectively support more endemic and globally threatened bird species than the whole of mainland Europe. Invasive alien mammalian predators have spread throughout most of the Territories, primarily since European expansion in the 16th century. Here we review and synthesize the scale of their impacts, historical and current, actions to reduce and reverse these impacts, and priorities for conservation. Mammalian predators have caused a catastrophic wave of extinctions and reductions in seabird colony size that mark the UKOTs as a major centre of global extinction. Mammal-induced declines of threatened endemics and seabird colonies continue, with four Critically Endangered endemics on Gough Island (Tristan da Cunha), St Helena and Montserrat directly threatened by invasive alien house mice **Mus musculus**, feral cats **Felis catus** and rats **Rattus** spp. Action to reduce these threats and restore islands has been modest in comparison with other developed countries, although some notable successes have occurred and a large number of ambitious eradication and conservation plans are in preparation. Priority islands for conservation action against mammalian predators include Gough (which according to one published prioritization scheme is the highest-ranked island in the world for mammal eradication), St Helena and Montserrat, but also on Tristan da Cunha, Pitcairn and the Falkland Islands. Technical, financial and political will is required to push forward and fund the eradication of invasive mammalian predators on these islands, which would significantly reduce extinction risk for a number of globally threatened species.

Jones, H.P. **Prognosis for ecosystem recovery following rodent eradication and seabird restoration in an island archipelago.** *Ecological Applications* 20(5): 1204-1216, 2010.

Notes: Invasive species are widespread and can have devastating effects on biota, especially insular biota. Invasive species eradications are increasingly employed to promote island recovery to preinvasion states. However, it remains unclear if additional restoration actions may be required on islands that were once heavily reliant on seabird guano for ecosystem functions. Active seabird augmentation has been suggested as necessary to exact ecosystem recovery on contemporary timescales in some cases. I use two experiments on offshore islands in Cook Strait, New Zealand, to test the hypothesis that seabird restoration will restore island ecosystem functioning following invasive rodent removal. The first is a small-scale single-island fertilization experiment that simulates seabird recovery. This experiment tested the recovery potential of offshore islands and was used to infer the density of seabirds needed to elicit ecosystem recovery. The second is a large-scale natural experiment that takes advantage of eight islands with differing rodent eradication and seabird restoration histories. I compared ecosystem functioning variables ($\delta^{15}\text{N}$, C:N ratios in soil, plants, and spiders, as well as arthropod abundance and diversity) on two islands that had rodents eradicated and two islands undergoing seabird augmentation with two control islands (never invaded by rodents) and two positive control islands (currently invaded by rodents). The results suggest that islands do have the potential for recovery given nutrient amendments, but that islands with rodents eradicated and islands undergoing seabird augmentation have not recovered most of their

ecosystem function. Finer, intra-island analysis showed that seabird restoration projects have the potential to speed the recovery process, but that the projects on the studied seabird restoration islands were not advanced enough to produce island-wide recovery. The results suggest that high seabird densities (5-10 burrows/m²) are needed to promote recovery to never-invaded control levels. Seabird augmentation, through chick translocation and/or social facilitation with decoys, vocalization playbacks, and/or mirrors can supplement passive seabird recovery on islands where seabirds have been extirpated or extremely reduced by invasive predators. Such restoration efforts may be necessary to promote ecosystem recovery on contemporary timescales.

Capizzi, D., Baccetti, N., and Sposimo, P. **Prioritizing rat eradication on islands by cost and effectiveness to protect nesting seabirds.** *Biological Conservation* 143(7): 1716-1727, 2010.

Notes: To prioritize conservation actions on Italian islands we used the case study of the eradication of the black rat *Rattus rattus* to protect Cory's shearwater *Calonectris diomedea* and Yelkouan shearwater *Puffinus yelkouan*. We evaluated for each island the effectiveness of rat eradication by means of two different indices, both based on the relative importance of the island's nesting population of the two species at the national and regional scale, but differing in the parameters set at the divisor, i.e., respectively, the number of nesting pairs in rat-free islands and the number of islands occupied by shearwaters. We estimated analytically the monetary costs of rat eradication on each island. Islands at high risk of recolonization were excluded from further analyses, while costs and effectiveness of rat eradication were compared for the remaining islands. Rat eradication was most cost-effectively carried out on the island hosting the largest colony of *P. yelkouan*. Eradicating rats from all the islands in the ranking provided benefits to 63.9% of the Italian population of *P. yelkouan*, but only to 7.1% of that of *C. diomedea*. Comparing costs and effectiveness of all possible island combinations, ranging from a minimum budget of 50,000 € and a maximum of 1,600,000 € (i.e. the cost for eradicating rats from all the listed islands), the maximum increase in effectiveness (marginal effectiveness) fell around a relatively small budget (200,000 €). For both species, when adopting the cost/effectiveness rankings, the number of pairs protected for 1000 € of investment was significantly higher than adopting rankings of effectiveness alone, demonstrating that conservation priorities are more efficiently identified by including monetary costs in the analysis.

Cook, A.J., Poncet, S., Cooper, A.P.R., Herbert, D.J., and Christie, D. **Glacier retreat on South Georgia and implications for the spread of rats.** *Antarctic Science* 22(3): 255-263, 2010.

Notes: Using archival photography and satellite imagery, we have analysed the rates of advance or retreat of 103 coastal glaciers on South Georgia from the 1950s to the present. Ninety-seven percent of these glaciers have retreated over the period for which observations are available. The average rate of retreat has increased from 8 Ma⁻¹ in the 1950s to 35 Ma⁻¹ at present. The largest retreats have all taken place along the north-east coast, where retreat rates have increased to an average of 60 Ma⁻¹ at present, but those on the south-west coast have also been steadily retreating since the 1950s. These data, along with environmental information about South Georgia, are included in a new Geographic Information System (GIS) of the island. By combining glacier change data with the present distribution of both endemic and invasive species we have identified areas where there is an increased risk of rat invasion to unoccupied coastal regions that are currently protected by glacial barriers. This risk has significant implications for the surrounding ecosystem, in particular depletion in numbers of important breeding populations of ground-nesting birds on the island.

Carboni, M., Thuiller, W., Izzi, F., and Acosta, A. **Disentangling the relative effects of environmental versus human factors on the abundance of native and alien plant species in Mediterranean sandy shores.** *Diversity and Distributions* 16(4): 537-546, 2010.

Notes: **Aim** Mediterranean coastal sand dunes are characterized by both very stressful environmental conditions and intense human pressure. This work aims to separate the relative contributions of environmental and human factors in determining the presence/abundance of native and alien plant species in such an extreme environment at a regional scale. **Location** 250 km of the Italian Tyrrhenian coast (Region Lazio). **Methods** We analysed alien and native plant

richness and fitted generalized additive models in a multimodel-inference framework with comprehensive randomizations to evaluate the relative contribution of environmental and human correlates in explaining the observed patterns. **Results** Native and alien richness are positively correlated, but different variables influence their spatial patterns. For natives, human population density is the most important factor and is negatively related to richness. Numbers of natives are unexpectedly lower in areas with a high proportion of natural land cover (probably attributable to local farming practices) and, to a lesser degree, affected by the movement of the coastline. On the other hand, alien species richness is strongly related to climatic factors, and more aliens are found in sectors with high rainfall. Secondly, alien introductions appear to be related to recent urban sprawl and associated gardening. **Main conclusions** Well-adapted native species in a fragile equilibrium with their natural environment are extremely sensitive to human-driven modifications. On the contrary, for more generalist alien species, the availability of limited resources plays a predominant role.

Smith, K.F., Acosta, H., Broom, J.E., and Rhodes, L.L. **Identification of non-indigenous marine macroalgae from New Zealand aquaria outlets.** *New Zealand Journal of Marine and Freshwater Research* 44(1): 29-37, 2010.

Notes: Most vector management and research on marine bioinvasions has focused on shipping-related pathways. More recently, less obvious mechanisms, such as the aquarium trade, have been recognised as important mechanisms for marine invasions, such as for the alga *Caulerpa taxifolia*. In this study, macroalgal specimens were collected from aquarium shops in Auckland and Nelson. Specimens were initially identified morphologically as *C. taxifolia*, *C. racemosa*, *Coelarthrum* sp. and *Cryptonemia* sp. DNA sequencing corroborated the identification of the *Caulerpa* specimens. DNA sequencing also revealed that a specimen identified as *Coelarthrum* sp. by morphological features was in fact most probably *Chamaebotrys* sp. because of the small number of *Cryptonemia* sequences in GenBank for comparison, only a tentative identification for this red alga could be made. Our findings of non-native macroalgae, including *C. taxifolia*, in aquarium shops in New Zealand show that even strict quarantine procedures cannot completely prevent the importation of non-indigenous species. Therefore, early detection, which begins with species identification, is essential to design effective control and eradication programmes.

Martinez-Luscher, J. and Holmer, M. **Potential effects of the invasive species *Gracilaria vermiculophylla* on *Zostera marina* metabolism and survival.** *Marine Environmental Research* 69(5): 345-349, 2010.

Notes: The potential threat to seagrasses of the invasive algae, *Gracilaria vermiculophylla* was assessed through metabolic indicators under experimental conditions. Net leaf photosynthesis (LNP) and dark respiration (LDR) were measured from leaf segments of *Zostera marina* shoots under different loads of *G. vermiculophylla* (control, low 2.2 kg FW m⁻² and high 4 kg FW m⁻²) in mesocosm experiments separated in tanks at four temperatures (19, 23.5, 26 and 30 °C). LNP decreased in the presence of the high density *G. vermiculophylla* mat (25% on average), being the most severe reductions at 30 °C (35% less in high). LDR did not respond significantly to differences in algal biomass, whereas a progressive increase was found with increasing temperatures (3.4 times higher at 30 °C than at 19 °C). Sulphide in porewater was measured weekly in order clarify the role of sediment conditions on seagrass metabolism, and increased both with algal biomass (29% in high) and temperature (from 0.5 mM at 26 °C to 2.6 mM at 30 °C), but changes in LNP and LDR were not correlated with sulphide concentrations. Seagrass survival rates showed decreasing trend with algal biomass at all the temperatures (from 74% to 21% survival). *G. vermiculophylla* showed harmful effects on *Z. marina* metabolism and survival with synergistic effects of temperature suggesting greater impact of invasive species under future higher water temperatures.

Katsanevakis, S., Issaris, Y., Poursanidis, D., and Thessalou-Legaki, M. **Vulnerability of marine habitats to the invasive green alga *Caulerpa racemosa* var. *cylindracea* within a marine protected area.** *Marine Environmental Research* 70(2): 210-218, 2010.

Notes: The relative vulnerability of various habitat types to *Caulerpa racemosa* var. *cylindracea* invasion was investigated in the National Marine Park of Zakynthos (Ionian Sea, Greece). The density of *C. racemosa* fronds was modelled with

generalized additive models for location, scale and shape (GAMLSS), based on an information theory approach. The species was present in as much as 33% of 748 randomly placed quadrats, which documents its aggressive establishment in the area. The probability of presence of the alga within randomly placed 20 x 20 cm quadrats was 83% on 'matte morte' (zones of fibrous remnants of a former *Posidonia oceanica* bed), 69% on rocky bottoms, 86% along the margins of *P. oceanica* meadows, 10% on sandy/muddy substrates, and 6% within *P. oceanica* meadows. The high frond density on 'matte morte' and rocky bottoms indicates their high vulnerability. The lowest frond density was observed within *P. oceanica* meadows. However, on the margins of *P. oceanica* meadows and within gaps in fragmented meadows relative high *C. racemosa* densities were observed. Such gaps within meadows represent spots of high vulnerability to *C. racemosa* invasion.

Padilla, D.K. **Context-dependent impacts of a non-native ecosystem engineer, the Pacific oyster *Crassostrea gigas*.** *Integrative and Comparative Biology* 50(2): 213-225, 2010.

Notes: The introduction of non-native species represents unprecedented large-scale experiments that allow us to examine ecological systems in ways that would otherwise not be possible. Invasion by novel ecological types into a community can press a system beyond the bounds normally seen and can reveal community interactions, local drivers and limits within systems that are otherwise hidden by coevolution and a long evolutionary history among local players, as well as local adaptation of species. The success of many invaders is attributed to their ability to thrive in a wide range of habitat types and physical conditions, setting the stage for direct examination of ecological impacts of a species across a range of habitat and community contexts. Bivalves are well-known ecosystem engineers, especially oysters, which are the target of wild-caught fisheries and aquaculture. The Pacific oyster, *Crassostrea gigas*, is grown worldwide for aquaculture, and is presently invading shores on virtually every continent. As a consequence, this non-native species is having large impacts on many systems, but the types of impacts are system specific, and greatly depend on substrate type, how physiologically stressful the environment is for intertidal zone species, and the presence of native engineering species. A novel type of engineering effect is identified for this non-native species, whereby it alters not only the physical environment, but also the thermal environment of the community it invades. The impacts of engineering by this non-native species will depend not only on whether it facilitates or inhibits species but also on the trophic level and ecological role of the species affected, and whether similar ecological types are found within the system.

Heiman, K.W. and Micheli, F. **Non-native ecosystem engineer alters estuarine communities.** *Integrative and Comparative Biology* 50(2): 226-236, 2010.

Notes: Many ecosystems are created by the presence of ecosystem engineers that play an important role in determining species' abundance and species composition. Additionally, a mosaic environment of engineered and non-engineered habitats has been shown to increase biodiversity. Non-native ecosystem engineers can be introduced into environments that do not contain or have lost species that form biogenic habitat, resulting in dramatic impacts upon native communities. Yet, little is known about how non-native ecosystem engineers interact with natives and other non-natives already present in the environment, specifically whether non-native ecosystem engineers facilitate other non-natives, and whether they increase habitat heterogeneity and alter the diversity, abundance, and distribution of benthic species. Through sampling and experimental removal of reefs, we examine the effects of a non-native reef-building tubeworm, *Ficopomatus enigmaticus*, on community composition in the central Californian estuary, Elkhorn Slough. Tubeworm reefs host significantly greater abundances of many non-native polychaetes and amphipods, particularly the amphipods *Monocorophium insidiosum* and *Melita nitida*, compared to nearby mudflats. Infaunal assemblages under *F. enigmaticus* reefs and around reef's edges show very low abundance and taxonomic diversity. Once reefs are removed, the newly exposed mudflat is colonized by opportunistic non-native species, such as *M. insidiosum* and the polychaete *Streblospio benedicti*, making removal of reefs a questionable strategy for control. These results show that provision of habitat by a non-native ecosystem engineer may be a mechanism for invasional meltdown in Elkhorn Slough, and that reefs increase spatial heterogeneity in the abundance and composition of benthic communities.

Barbour, A.B., Montgomery, M.L., Adamson, A.A., Diaz-Ferguson, E., and Silliman, B.R. **Mangrove use by the invasive lionfish *Pterois volitans***. *Marine Ecology Progress Series* 401: 291-294, 2010.

Notes: Lionfish *Pterois volitans* are successful invasive predators in the sub-tropical and tropical Western Atlantic. Their invasion of coral reef ecosystems is a major conservation concern, as previous studies in the Western Atlantic have found that this top predator (1) occurs at higher densities and forages more successfully than in its native range, (2) lacks significant predators as an adult, and (3) reduces reef fish recruitment. The effects of lionfish on coral reef communities have been examined, but it is not known if these predators use critical non-reef habitat such as mangroves, which serve as nurseries for many reef fish species. To investigate lionfish usage of non-reef critical habitat, we compared population size-structure and stomach contents of *P. volitans* in mangroves and coral reefs on the island of San Salvador, Bahamas. In each habitat, >80% of lionfish stomachs contained prey items with similar gut content wet weight (0.98 ± 0.35 g in reef habitat and 0.99 ± 0.43 g in mangrove habitat) despite differences in total lionfish length (231.1 ± 10.30 mm in reef habitat and 176.3 ± 16.83 mm in mangrove habitat). Prey items detected by genetic analysis included individuals of the families Palaemonidae, Penaeidae, Gobidae, Scaridae, Mullidae and Grammatidae. These results demonstrate that lionfish colonize and feed in mangrove habitat in the Bahamas. Further study of lionfish outside reef habitat is required to understand the effects of this marine invasion.

Côté, I.M. and Maljković, A. **Predation rates of Indo-Pacific lionfish on Bahamian coral reefs**. *Marine Ecology Progress Series* 404: 219-225, 2010.

Notes: Indo-Pacific lionfish, mainly *Pterois volitans*, are currently invading coral reefs throughout the Caribbean region, where they have the potential to outcompete and prey upon a wide range of native reef animals. Here, we derive the first estimates of rates of predation by lionfish from field observations on natural reefs around New Providence, Bahamas. Although lionfish are reported to be crepuscular in their native range, they were very active during daylight hours. Lionfish were observed hunting at least 19 reef fish species, in at least 9 families. They hunted significantly more on overcast days and at greater depths, and frequently hunted near aggregations of fish at cleaning stations. Lionfish consumed native fish at an average rate of 1.44 kills h⁻¹ (0.29 kills h⁻¹ on clear days and 2.29 kills h⁻¹ on overcast days). This estimate may be conservative if lionfish hunt also between dusk and dawn. This rate is considerably higher than the only known prey consumption rate for *P. volitans*, which is extrapolated from ad libitum feeding of fish from the native range. Our results imply that using published predation rates from the native range to predict the impacts of lionfish on native Caribbean fish could lead to severe underestimation of these impacts.

Byers, J.E., Wright, J.T., and Gribben, P.E. **Variable direct and indirect effects of a habitat-modifying invasive species on mortality of native fauna**. *Ecology* 91(6): 1787-1798, 2010.

Notes: Habitat-modifying invasive species can influence rates of predation on native prey either directly by providing protective structure or indirectly by modifying traits of prey species responding to the habitat. The alga *Caulerpa taxifolia* is one of the most successful invasive species of shallow-water marine systems globally, often provisioning habitat in areas previously lacking in vegetated structure. We experimentally evaluated the direct effect of *Caulerpa* to provide refuge for the native clam *Anadara trapezia* and how this balances with its influence on two trait-mediated indirect interactions that may increase *Anadara*'s susceptibility to predators. Specifically, *Caulerpa*'s alteration of physical and chemical properties of the surrounding water and sediment deteriorate *Anadara*'s condition and predator resistance properties and also cause *Anadara*, though normally buried, to project from beneath the sediment, exposing it to predators. Our results show that *Anadara* are somewhat (but not consistently) protected from predators by living among *Caulerpa*. Shallow burial depth did not counteract this protective effect. However at times of year when predator activity diminishes and conducive environmental conditions develop, negative effects of *Caulerpa* habitat such as hypoxia and lowered flow may dominate. Under such situations, poor clam condition accentuates *Anadara*'s susceptibility to mortality. Ultimately, a slight and inconsistent positive effect of *Caulerpa* to protect *Anadara* from predators is exceeded by the strong negative effect of *Caulerpa* on clam mortality, which is heightened by clams' weakened condition produced

by chronic exposure to **Caulerpa**. Our results show that invasive habitat-modifying species can affect mortality of native species not simply through obvious positive direct effects of their protective structure, but indirectly through contrasting negative modification of the traits of prey species responding to the habitat.

Sorte, C.J.B., Williams, S.L., and Zerebecki, R.A. **Ocean warming increases threat of invasive species in a marine fouling community.** *Ecology* 91(8): 2198-2204, 2010. **O/A**

Notes: We addressed the potential for climate change to facilitate invasions and precipitate shifts in community composition by testing effects of ocean warming on species in a marine fouling community in Bodega Harbor, Bodega Bay, California, USA. First, we determined that introduced species tolerated significantly higher temperatures than natives, suggesting that climate change will have a disproportionately negative impact on native species. Second, we assessed the temperature dependence of survival and growth by exposing juveniles to an ambient control temperature and increased temperatures predicted by ocean warming scenarios (+3 °C and +4.5 °C) in laboratory mesocosms. We found that responses differed between species, species origins, and demographic processes. Based on the temperature tolerance, survival, and growth results, we predict that, as ocean temperatures increase, native species will decrease in abundance, whereas introduced species are likely to increase in this system. Facilitation of invasions by climate change may already be underway; locally, invasive dominance has increased concurrent with ocean warming over the past ~40 years. We suggest that the effects of climate change on communities can occur via both direct impacts on the diversity and abundance of native species and indirect effects due to increased dominance of introduced species.

Bulleri, F., Balata, D., Bertocci, I., Tamburello, L., and Benedetti-Cecchi, L. **The seaweed *Caulerpa racemosa* on Mediterranean rocky reefs: from passenger to driver of ecological change.** *Ecology* 91(8): 2205-2212, 2010. **O/A**

Notes: Disentangling the ecological effects of biological invasions from those of other human disturbances is crucial to understanding the mechanisms underlying ongoing biotic homogenization. We evaluated whether the exotic seaweed, ***Caulerpa racemosa***, is the primary cause of degradation (i.e., responsible for the loss of canopy-formers and dominance by algal turfs) on Mediterranean rocky reefs, by experimentally removing the invader alone or the entire invaded assemblage. In addition, we assessed the effects of enhanced sedimentation on the survival and recovery of canopy-forming macroalgae at a relatively pristine location and how their loss affects the ability of ***C. racemosa*** to conquer space. ***C. racemosa*** did not invade dense canopy stands or influence their recovery in cleared plots. Competition with ***C. racemosa*** could not explain the rarity of canopy-forming species at degraded sites. Removing the assemblages invaded by ***C. racemosa*** and preventing reinvasion did not trigger the transition from algal turfs to canopies, but it enhanced the cover of morphologically complex erect macroalgae under some circumstances. Once established, ***C. racemosa***, enhancing sediment accumulation, favors algal turfs over erect algal forms and enables them to monopolize space. Our results show that introduced species that rely on disturbance to establish can subsequently become the main drivers of ecological change.

Sammarco, P.W., Porter, S.A., and Cairns, S.D. **A new coral species introduced into the Atlantic Ocean – *Tubastraea micranthus* (Ehrenberg 1834) (Cnidaria, Anthozoa, Scleractinia): An invasive threat?** *Aquatic Invasions* 5(2): 131-140, 2010. **O/A**

Notes: Over the past 60-70 years, the invasive Indo-Pacific coral ***Tubastraea coccinea*** (Lesson 1830; Cnidaria, Scleractinia) has colonized the western tropical Atlantic Ocean – the Americas, the Antilles, northern Gulf of Mexico (GOM), and many of its 3,600 oil/gas platforms. It is now the single, most abundant coral on artificial substrata in the GOM, with hundreds of thousands of colonies on a single platform. Here, we report for the first time the observation of a closely related congener in the western Atlantic – the Indo-Pacific azooxanthellate ***Tubastraea micranthus*** (Ehrenberg 1834) – and suggest that it may pose a threat similar to ***T. coccinea***. A total of 83 platforms, including deep-water, toppled, Rigs-to-Reefs structures, were surveyed in the northern Gulf of Mexico between 2000 and 2009, from Matagorda Island, Texas to Mobile, Alabama, USA, between the depths of 7 and 37 m, by SCUBA divers. Five platforms were surveyed by

Remotely Operated Vehicle (ROV) to depths of up to 117 m. **T. micranthus** was found on only one platform – Grand Isle 93 (GI-93), off Port Fourchon, Louisiana, near the Mississippi River mouth, at the cross-roads of two major safety fairways/shipping lanes transited by large international commercial ships. The introduction appears to be recent, probably derived from the ballast water or hull of a vessel from the Indo-Pacific. If the growth and reproductive rates of **T. micranthus**, both sexual and asexual, are similar to those of **T. coccinea**, this species could dominate this region like its congener. It is not known whether this species is an opportunist/pioneer species, like **T. coccinea**, a trait protecting benthic communities from its dominance. The question of rapid-response eradication is raised.

El Nagar, A., Huys, R., and Bishop, J.D.D. **Widespread occurrence of the Southern Hemisphere ascidian *Corella eumyota* Traustedt, 1882 on the Atlantic coast of Iberia.** *Aquatic Invasions* 5(2): 169-173, 2010. O/A

Notes: The Southern Hemisphere unitary ascidian **Corella eumyota** was discovered in 2002 in France and is now widespread on the southern coast of England and in Ireland. It has also been reported from seabed surveys in Ría de Vigo, north-west Spain. Surveys of marinas in February 2008 and June-July 2009 identified additional localities in Ría de Vigo and revealed widespread occurrence of **C. eumyota** on the Atlantic coast of the Iberian Peninsula. The species was very abundant on some structures built less than two years before the surveys, indicating a capacity for very rapid colonization and population increase. This suggests that the species is a potential threat to biodiversity and aquaculture interests. Records of the non-native ascidians **Styela dava**, **S. plicata**, **Perophora japonica**, **Botrylloides violaceus**, and **Didemnum vexillum** are also reported.

Reinhardt, J.F., Stefaniak, L.M., Hudson, D.M., Mangiafico, J., Gladych, R., and Whitlatch, R.B. **First record of the non-native light bulb tunicate *Clavelina lepadiformis* (Müller, 1776) in the northwest Atlantic.** *Aquatic Invasions* 5(2): 185-190, 2010. O/A

Notes: We report the first record of the colonial tunicate **Clavelina lepadiformis** (Müller, 1776) in the northwest Atlantic. Populations were found along the eastern Connecticut shoreline in October 2009. At one site **C. lepadiformis** had a mean percent cover of 19.95% (\pm 4.16 S.E.). A regional survey suggests that the invasion is relatively localized. Genetic analysis confirms our morphological identification and places the introduced population in the previously described 'Atlantic clade'. While it appears **Clavelina lepadiformis** is currently in the incipient stage of introduction in eastern Connecticut waters, its spread to other areas in the region could lead to competition with resident members of shallow water epifaunal assemblages and shellfish species.

López Gappa, J., Carranza, A., Gianuca, N.M., and Scarabino, F. **Membraniporopsis tubigera, an invasive bryozoan in sandy beaches of southern Brazil and Uruguay.** *Biological Invasions* 12(5): 977-982, 2010.

Notes: The massive irruption of the invasive bryozoan **Membraniporopsis tubigera** (Osburn) in sandy beaches of southern Brazil and Uruguay is reported. The species, originally described from Puerto Rico, Texas and Florida, has also been recorded for Brazilian beaches from 21 °S to 26 °S as well as for harbours of Australia, New Zealand and the Sea of Japan. The southward spreading rate of this bryozoan along the Brazilian and Uruguayan coasts can be estimated in approximately 183-195 km year⁻¹. The chances that this invasion could proceed southwards in the Southwest Atlantic and the possible impacts that it may be causing are discussed. The case of **M. tubigera** seems to be qualitatively and quantitatively different from those of other alien bryozoans previously recorded for this region, since it appeared massively in exposed sandy beaches, a habitat regarded to date as apparently free from the pervasive ecological impact of invasion by exotic species in the Southwest Atlantic.

Carranza, A., de Mello, C., Ligrone, A., González, S., Píriz, P., and Scarabino, F. **Observations on the invading gastropod *Rapana venosa* in Punta del Este, Maldonado Bay, Uruguay.** *Biological Invasions* 12(5): 995-998, 2010.

Notes: We report on the first sightings of the invasive Rapa Whelk *Rapana venosa* in Maldonado Bay (Punta del Este Harbor and Gorriti Island) using in vivo, underwater observations and video surveys. The species was first detected in the Rio de la Plata (Uruguay and Argentina) in 1999, and by 2004 it had extended its local distribution to Punta del Este at the eastern boundary of the estuary. Observations performed by SCUBA diving showed that *R. venosa* is preying on native mussels *Mytilus edulis* and *Brachidontes* spp., and that formerly abundant mussel beds are being seriously depleted due to a combination of human extraction, habitat deterioration and predation by the Rapa Whelk.

Klein, G., MacIntosh, K., Kaczmarska, I., and Ehrman, J.M. **Diatom survivorship in ballast water during trans-Pacific crossings.** *Biological Invasions* 12(5): 1031-1044, 2010.

Notes: Ship ballast water is believed to be responsible for global dispersal of alien biota; mid-ocean ballast water exchange is most commonly used to mitigate this process. Diatoms are among the most abundant biotic-component in ballast water, yet their invasive biology is poorly understood. To test effectiveness of MOE we examined diatom species composition and cell density in two sets of samples. First, we examined samples collected daily during one 24 days long trans-Pacific crossing in tanks with and without ballast exchanged. Second, we used samples from 23 trans oceanic vessels arriving at Vancouver harbour where diatoms were collected on arrival. Up to 86,429 live diatom cells/l were found in the tanks, ~50% of the samples share up to eight species consistently present. Cell densities and species richness declined over time and with replacement of coastal ballast water by mid-oceanic water. In both data sets diatoms survive in the tanks for as long as 33 days despite ballast exchange.
