

Alien Species in European Coastal Waters

The emergence of the ecosystem services concept and the rapidity of its assimilation into the rationale underlying biodiversity science policy has been little short of a scientific revolution. In parallel, the language for communicating and classifying the range of ecosystem services has matured and gained wide acceptance in the science community. The success of its penetration into biodiversity thinking is apparent from the Millennium Ecosystem Assessment (www.maweb.org) – central to which is the awareness that ecosystem services provide the essential basis for continued human well being. One of the few weaknesses of the Millennium Ecosystem Assessment is its restricted treatment of marine ecosystems. Marine ecosystems provide a huge range of supporting, regulating, provisioning and cultural services. In terms of fundamental supporting and regulating services, such as primary production by photosynthetic organisms and regulation of the gaseous composition of the atmosphere, marine systems are probably more important than terrestrial ecosystems on a global scale. Unfortunately, our understanding of marine ecosystem functioning lags significantly behind that of terrestrial systems. The complex relationship between biodiversity and ecosystem functioning (as measured by the continued provision of ecosystem services) has been poorly understood, especially for marine systems. Achieving critical mass across Europe of researchers addressing this issue is the central objective of MarBEF – a Network of Excellence in Marine Biodiversity

and Ecosystem Functioning, funded under the Framework VI programme of the European Union (www.marbef.org).

MarBEF has stimulated and co-ordinated collaborative research on a European Union wide scale, bringing together international teams addressing numerous aspects of biodiversity and ecosystem functioning in the marine realm. It is apparent that an important stressor of ecosystems in European marine waters is alien species – introduced either deliberately or inadvertently, often by shipping. Marine systems have proven to be vulnerable to invasion by alien species. One of the most dramatic and serious invasions thus far has been the invasion of the Black Sea by the ctenophore *Mnemiopsis leidyi*, a species that originated in East coast waters of the Americas. In the late 1980s the explosion of *M. leidyi* in the Black Sea coincided with the collapse of all the pelagic fisheries. The Black Sea has a surface area greater than that of Germany or of California, and the economic and cultural impact of this collapse on nations bordering the Black Sea was profound. Prior to the *Mnemiopsis* invasion the Black Sea was polluted and over-fished, and the combined effect of these stressors probably rendered the system more susceptible to invasion. Today the Black Sea fish stocks are showing signs of recovery and a few fisheries have been re-established. Interestingly, the *Mnemiopsis* problem has been reduced by the impact of a second invasive ctenophore, *Beroe*, which is a voracious predator of *Mnemiopsis*. This one

example has proved highly instructive as it demonstrated how stressors may combine in complex systems and the vulnerability of enclosed marine systems.

Europe has other economically important, largely enclosed marine systems – the Baltic and the Mediterranean Seas. This issue of *Aquatic Invasions* contains major accounts, documenting the state of knowledge of the alien species problem in the eastern Mediterranean and providing risk assessments for the Baltic. These important reviews testify to systems undergoing rapid biotic change. These systems are also stressed by over-fishing and pollution (eutrophication, for example), plus they are subject to global stressors such as climatic change and ocean acidification. The possibility of a dramatic Black Sea-like flip in state in either the Baltic or the eastern Mediterranean, however remote, renders continued monitoring essential. The scale of the alien species input into the eastern Mediterranean is unprecedented, largely but not exclusively, a consequence of migration or transportation of Red Sea and Indo-Pacific organisms through the Suez Canal – the so-called Erythrean (or Lessepsian) biota. This has been a major factor in the tropicalisation of the

Mediterranean. A third large contribution in this volume reviews the alien species recorded in Ireland and provides an interesting comparison because of Ireland's open aspect towards the Atlantic, in comparison with either the Baltic or Mediterranean. The remaining papers provide new population data, new records of aliens, and new range extensions of particular taxa. They can contribute valuable data improving our understanding of both the time line and the rate of particular invasions.

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On behalf of the guest editors:

Geoff Boxshall
Department of Zoology,
The Natural History Museum,
London SW7 5BD,
UK