

What you don't see can hurt you

Non-indigenous species threaten seafood security

What are non-indigenous species?

Non-indigenous species (NIS) are species that have been introduced to new locations outside their native range primarily due to human-mediated activities such as shipping and mariculture. Once established in these new locations, introduced species can have a profound and disastrous impact on ecosystem structure and functions that can ultimately threaten productivity and seafood security. For example, introduced species can have an effect on important commercial species through several mechanisms including competition for food and habitat and by predation.

The project

In 2007, PICES Working Group on *Non-indigenous Aquatic Species* (WG 21) embarked on a 5-year project entitled "Development of prevention systems for harmful organisms' expansion in the Pacific Rim" with funding provided by the Japanese Ministry of Agriculture, Forestry and Fisheries (MAFF). WG 21's tasks were to address two key elements required for early detection and rapid response. The first initiative was the development of a comprehensive, searchable database and atlas of non-indigenous marine and estuarine species in the North Pacific. The second initiative was to conduct a series of rapid assessment surveys (RAS) to develop and disseminate techniques for the quick detection and identification of non-indigenous species that presently exist in a variety of habitats of PICES member countries (Canada, China, Japan, Korea, Russia and the United States).

Prevention and detection

Prevention is the first line of defence against NIS. Knowledge about the distribution of potential NIS, dispersal vectors, and their ecological characteristics allows one to characterize their invasion risk. With this information in hand, managers can determine the likely extent and type of risk associated with a new invader and the best course of action for mitigating the impacts of new invaders that can affect local species.

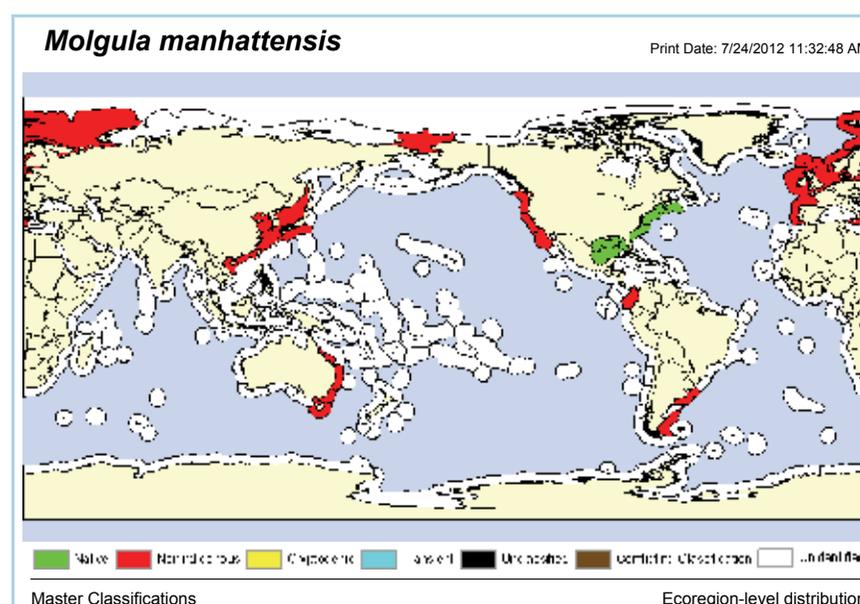
The PICES database allows large-scale collection of this data which can then be used by managers to develop monitoring programs for early detection or rapid response and make mitigation plans for higher-risk NIS to limit the impacts on native biodiversity and commercially important species.

When a potential NIS is first detected, local authorities often are unable to identify the organism and valuable time is lost while species identity is being confirmed along with its preferred ecological requirements (e.g., salinity, temperature, habitat substrate) and its history of invasion success. If a NIS is unsuited for its new location, it will have a low probability of survival and establishment, and there may be no need to implement control or mitigation measures. On the other hand, if conditions are ideal and the species has successfully invaded other areas, with negative impacts, then very quick action may be required.

Database and Atlas of Non-indigenous Marine and Estuarine Species in the North Pacific

The database and Atlas contain profiles of 747 non-indigenous species reported from PICES member countries. The profiles include maps of their global distribution, invasion vectors, life history and habitat information that were collated along with an analysis of their invasion patterns in the North Pacific region. As an example, the distribution of the tunicate *Molgula manhattensis* is shown. This widespread invader, which is native to the Northeast Atlantic, has spread to both the eastern and western North Pacific.

The database and Atlas also contain numerous references to scientific papers that scientists and managers can consult when assessing risks posed by potential NIS, including choosing the most appropriate course of action which can range from immediate and comprehensive eradication to ongoing monitoring.



A sample of *Undaria pinnatifida*. This Japanese kelp has invaded other parts of the world's coastlines.

(Photo credit: Christopher N. Janousek, U.S. Environmental Protection Agency)

Rapid Assessment Surveys (RAS)

Given the continued exchange of species globally by various vectors, especially species redistributions around the North Pacific, it is important to establish collaborations between taxonomists and invasion biologists on both sides of the Pacific Ocean in order to truly understand species distribution patterns and hence invasion patterns. To foster collaborations among NIS researchers, a series of four PICES RAS was conducted with the help of local hosts in Dalian, China, 2008; Jeju, Korea, 2009; Newport, United States, 2010; and Vladivostk, Russia, 2011. Through these collaborations, we now have a much better understanding of the invasion patterns of several taxonomic groups, including algae, amphipods, polychaetes (worms), and ascidians (tunicates or sea squirts).



2011 PICES RAS near Vostok Bay, Russia



2009 PICES RAS team, Jeju, Korea



2010, Awaji Island, Japan



2012, Nagasaki, Japan



2011, Phuket, Thailand

Capacity Building – Training and Outreach

Given a number of vectors redistributing species around the Pacific Ocean, building capacity, especially in developing countries, is critical to better understand invasion dynamics and maintain safe and productive marine ecosystems. One way to share information on global invaders is to hold demonstration workshops to provide participants with the tools needed to conduct their own surveys.

Three demonstration workshops on “Rapid Assessment Survey Methodologies for Non-Indigenous Species” were hosted – Awaji Island, Japan, in 2010; Phuket, Thailand, in 2011; and Nagasaki, Japan, in 2012. The primary goal of these workshops was to increase awareness about marine and estuarine NIS and to provide “hands-on” experience for participants, especially those from developing countries. Over 50 participants from China, Indonesia, Japan, Korea, Malaysia, the Philippines, Singapore, Thailand, and Vietnam have received training.

The ability to provide training to early career scientists will increase our global capacity to respond to ever increasing issues related to NIS. In addition to having early career scientists participate in the RAS and demonstration workshops, over 20 early career scientists were able to present their research on NIS at international conferences world-wide.

Summary

This PICES/MAFF project has made it possible for countries to share information quickly and efficiently, especially details where the species originated and when it arrived. These data are critical for successfully mitigating the impacts of NIS on local environments and economies.

A lasting benefit from the project has been increased awareness and collaboration on NIS issues, especially taxonomic exchanges between PICES member countries and with international organizations like NOWPAP and WESTPAC. The Atlas serves as a valuable resource for agencies and scientists tasked with managing and researching non-indigenous species in the North Pacific, while RAS techniques can be applied around the Pacific or beyond.

Acknowledgements

PICES gratefully acknowledges the generous contribution of the Japanese Government and all those who have participated and contributed to the completion of the database and Atlas of Non-indigenous Marine and Estuarine Species in the North Pacific, and to the rapid assessment surveys.

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