

PICES 2010 Rapid Assessment Survey

by Graham Gillespie, John Chapman and Thomas Therriault

Status and trends of non-indigenous species (NIS) are of enormous interest in the North Pacific, but establishing extensive international cooperation required to investigate the problem has been difficult. In 2006, PICES Working Group 21 on *Non-indigenous Aquatic Species* was formed to increase understanding of marine non-indigenous species in the North Pacific. In 2007, two initiatives were started in a 5-year PICES project on “*Development of the prevention systems for harmful organisms’ expansion in the Pacific Rim*” supported by a voluntary contribution from the Ministry of Agriculture, Forestry and Fisheries (MAFF) of Japan. The first initiative, led by Dr. Henry Lee II (U.S. Environmental Protection Agency) was to develop a comprehensive database for non-indigenous species. The second was a taxonomy initiative that included rapid assessment and collector surveys in PICES member countries. Dr. Thomas Therriault (Fisheries and Oceans Canada) has served as the principal investigator of this initiative and organized rapid assessment surveys in 2008 in Dalian,

China (see PICES Press 17(1): 30–32) and in 2009 in Jeju, Korea (see PICES Press 18(1): 38–40). The third rapid assessment survey was conducted in Oregon, U.S.A., just prior to the 2010 PICES Annual Meeting in Portland.

PICES Rapid Assessment Surveys (RAS) serve to collect initial baseline data and inter-calibrate species collection and identification methods that allow distinction of native, non-indigenous, and cryptogenic species. Standardized RAS data permit comparisons of invasions within and among countries and can reveal mechanisms and consequences of invasions. PICES RAS also support international cooperation that is critical for resolving NIS, their origins, mechanisms of dispersal, effects and impacts.

International ports are particularly important recipients of organisms associated with ballast water, ballast sediment or hull fouling, and often have high levels of secondary traffic (recreational or small craft, aquaculture transfers) to adjacent



Participants in the 2010 Oregon Rapid Assessment Survey of non-indigenous, cryptogenic and native species: Front row (left to right): Gayle Hansen, Gyo Itani, Thomas Therriault, Takeaki Hanyuda; middle row: Darlene Smith, Toshio Furota, in front of Katie Marko next to Leslie Harris, John Markham, Gretchen Lambert, Sylvia Yamada; back row: Vasily Radashevsky, Ralph Breitenstein, John Chapman, Graham Gillespie, Charles Lambert, Loren Curran. (Not shown: Donnelle Breitenstein, Jack Chapman, Ian Chun, Faith Cole, Caroline Emch-Wei, John Estabrook, Jeff Fischer, Brian Fodness, Bruce Hansen and Vallorie Hodges).

ports. International ports also tend to be more disturbed than other less urbanized estuaries and bays, possibly enhancing invasion success. New invasions, transoceanic transport mechanisms and vector pathways of dispersal are more readily identified and managed when they can be tracked among major ports. Before PICES-2010, intertidal and shallow subtidal habitats of two Oregon estuaries (Coos Bay and Yaquina Bay) were sampled using fouling plates (collectors), traps for macrofauna (primarily fish and crabs), scrapings of floats and pilings, and by diver collections. Additionally, a seawater reservoir tank at the Hatfield Marine Science Center in Yaquina Bay was drained and sampled for fouling organisms. These qualitative surveys measured species diversity within each location. Classification of species as native, non-native or cryptogenic occurred following species identification based on literature accounts and analyses by RAS team members.

The 2010 investigative team consisted of the authors of this article, Toshio Furota (Toho University, Japan), Gayle Hansen (Environmental Protection Agency, U.S.A.), Takeaki Hanyuda (Kobe University Research Center for Inland Seas, Japan), Leslie Harris (Natural History Museum of Los Angeles County, U.S.A.), Gyo Itani (Kochi University, Japan), Charles and Gretchen Lambert (University of Washington, Friday Harbor, U.S.A.), John Markham (Arch Cape Marine Laboratory, U.S.A.), Vasily Radashevsky (A.V. Zhirmunsky Institute of Marine Biology, Russia) and Sylvia Yamada (Oregon State University, Corvallis, U.S.A.). Volunteer divers and laboratory assistants included Donnelle and Ralph Breitenstein, Jack Chapman, Ian Chun, Faith Cole, Lorne Curran, Carolyn Emch-Wei, John Estabrook, Jeff Fischer, Brian Fodness, Bruce Hansen, Vallorie Hodges, Katie Marko, and Darlene Smith. Laboratory space, equipment, and reference material were graciously provided by the Hatfield Marine Science Center, Oregon State University, Newport, U.S.A. Additional funding and/or support was provided by Fisheries and Oceans Canada, Oregon Sea Grant, University of Guelph, U.S. Environmental Protection Agency, Ralph and Donnelle Breitenstein and Liu Xin (Oregon Oyster, Inc.).

On October 18, the team worked through samples provided to the Hatfield Science Center laboratory and was treated to a welcome reception at the Rogue Brewery in Newport. The reception featured microbrews and food provided by Oregon Oyster, Inc. Investigators and volunteers participated in a day-long field trip on October 19 that included collections from public and commercial boat docks in Charleston Harbor and the City of Coos Bay. Surface collections were supplemented with dive collections from low intertidal and subtidal zones and collection plates from Yaquina Bay. The team completed sample processing on October 20 and was then invited to a wrap-up social at the home of Henry Lee and Debbie Reusser.

Participants in the survey also contributed to presentations given at the WG 21 meeting and the Topic Session on

“Anthropogenic forcing in North Pacific coastal ecosystems: Understanding changes in ecosystem structure and function” convened at PICES-2010. These talks and posters helped to facilitate cooperation and exchange between experts from PICES member countries. Topics included the WG 21 atlas of non-indigenous species in the North Pacific (Henry Lee II and Debbie Reusser); invasions, island biogeography and human welfare (John Chapman); propagule pressure in *Didemnum vexillum* (John Chapman *et al.*); *Didemnum* in New Zealand and other tunicate news (Gretchen and Charles Lambert); *Hediste* genetics (Toshio Furota and Hiroaki Toshiuji); *Orthione griffensis* in Japan (Gyo Itani, Yukari Miyoshi and Hiroshi Kume); molecular elucidation of introduced seaweeds (Takeaki Hanyuda and Hiroshi Kawai); family Spionidae (Vasily Radashevsky); what makes better taxonomy (Leslie Harris); and green crab assessment in Yaquina Bay (Sylvia Yamada, Graham Gillespie and Katie Marko).



PICES RAS participants (left to right) Katie Marko, Graham Gillespie and Sylvia Yamada display non-indigenous European green crabs captured in Yaquina Bay.

Preliminary results of the Oregon RAS included 191 taxa from 400 sample lots. Nearly all taxa were identified to the species level, although many are provisional identifications and work is ongoing to resolve these. Twenty-five species of polychaete represent first records of these species in one or more of the sampled Oregon estuaries, and eight species of polychaete represent new records in Oregon. It is possible that other non-indigenous species were encountered but identifications and classifications are pending. In collaboration with the Barcode of Life Project, many incomplete identifications will be explored further using molecular methods.

A significant advantage of these surveys is the opportunity for taxonomists to examine material from different areas and exchange ideas directly with other taxonomists of the same taxa and with other invasion ecologists. The participation of ascidian taxonomists in our survey allowed the identification of the second Pacific record of the introduced North Atlantic sea grape *Molgula citrina*, which was also the first Pacific record south of Alaska. Another

advantage is the comparison of collecting techniques and the development of standards. During this survey, Canadian and U.S. methods to trap European green crab *Carcinus maenas* were contrasted, allowing a unique opportunity to inter-calibrate methods used among PICES member countries. Other special projects examined the distribution of the invasive tunicate *Didemnum vexillum* in Coos and Yaquina Bays and the Umpqua triangle, genetic samples of the algae *Ulva* and the nereid worm *Hediste* to determine possible Asian or North American origins, and infection rates of bopyrid isopod parasites in the Eastern and Western North Pacific.

The 2008 rapid assessment survey in Dalian (China) identified a total of 119 taxa, three of which (all bivalve

molluscs) were classified as non-indigenous. The 2009 survey in Jeju (Korea) identified 213 taxa with four (one bivalve mollusc, one cirriped, one amphipod and one polychaete) designated as non-indigenous. The Oregon survey yielded at least 14 species that were classified as non-indigenous: four algae, six ascidians, three polychaetes and one crustacean. Many identifications remain provisional; therefore, the total number of species and number of non-indigenous species may increase for all surveys.

Introductions reduce the wealth of every nation, and no country can deal with introductions alone. The PICES surveys provide critical information and a mechanism to foster the international cooperation needed for each nation to detect and manage its introduced species.



Graham Gillespie (Graham.Gillespie@dfo-mpo.gc.ca) is Head of the Shellfish Section at the Pacific Biological Station, Fisheries and Oceans Canada (DFO) in Nanaimo, British Columbia. Graham conducts stock assessments for commercially important species, provides scientific advice for the SARA-listed Olympia oyster and participates in ecosystem-level research involving these groups. He also coordinates an Aquatic Invasive Species program that examines distribution, dispersal and impacts of intertidal non-indigenous species on the Pacific Coast of Canada. Graham is a member of PICES WG 21 on Non-indigenous Aquatic Species and WG 24 on Environmental Interactions of Marine Aquaculture.

John Chapman (John.Chapman@oregonstate.edu) is a marine biological invasions ecologist at the Hatfield Marine Science Center, in Newport, Oregon, U.S.A. In addition to the PICES surveys in 2009 and 2010, John's recent research has included the 1000 AD Viking species introductions across the North Atlantic, the systematics of shallow water gammaridean amphipod crustaceans of the northeast Pacific and the ecology of introduced and native bopyrid isopods on their burrowing shrimp hosts of the North Pacific. John also teaches lower and upper division Aquatic Biological Invasions through the departments of Biology and Fisheries and Wildlife at Oregon State University.

Dr. Thomas Therriault (Thomas.Therriault@dfo-mpo.gc.ca) is a Research Scientist with Fisheries and Oceans Canada (DFO) at the Pacific Biological Station in Nanaimo, British Columbia. Tom is working on a number of aquatic invasive species research questions both within DFO and through the Canadian Aquatic Invasive Species Network (CAISN). He is the Principal Investigator for the Taxonomy Initiative of PICES WG 21 on Non-indigenous Aquatic Species ((under the project on "Development of the prevention systems for harmful organisms' expansion in the Pacific Rim" supported by the Ministry of Agriculture, Forestry and Fisheries (MAFF) of Japan) that includes rapid assessment surveys (RAS) for non-indigenous species. Within PICES, Tom serves as Vice-Chairman of Science Board and leads the FUTURE Advisory Panel on Anthropogenic Influences on Coastal Ecosystems (AICE). He is a member of the Marine Environmental Quality Committee (MEQ) and the PICES Study Group on Developing a Framework for Scientific Cooperation in the Northern Hemisphere.