

PICES-2011 Workshop on “Trends in Marine Contaminants and their Effects in a Changing Ocean”

by Peter S. Ross and Olga Lukyanova

The sheer number of contaminants entering the North Pacific Ocean from a combination of point and non-point sources provides a daunting backdrop to those concerned with the protection of aquatic biota. However, this did not deter the 16 participants at the workshop on “*Trends in marine contaminants and their effects in a changing ocean: Refining indicator approaches in support of coastal management*”, who spent a productive day discussing topics related to the workshop theme, and a day sampling for microplastics on the Amur River. This workshop, co-sponsored by GESAMP (Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection) and ICES (International Council for the Exploration of the Sea), was held on October 14, 2011, in conjunction with the 2011 PICES Annual Meeting in Khabarovsk, Russia.

The workshop agenda included four invited presentations. Representatives from GESAMP and ICES delivered concise insight into their concerns, priorities, and activities. Dr. Peter Kershaw (Centre for Environment, Fisheries and Aquaculture Science, UK) described the mandate and activities of the UN-sponsored GESAMP, which is also supported by IMO, FAO, IOC-UNESCO, WMO, IAEA, UNEP and UNIDO. GESAMP provides expert advice on priority topics, as well as assessments of regional and global environmental concerns. One major activity of relevance to PICES is reflected in GESAMP efforts to identify and apply pollution indicators for the UN Transboundary Waters Assessment Programme (TWAP) in five categories: groundwater, rivers, lakes, Large Marine Ecosystems (LMEs) and open oceans. GESAMP currently has a number of Working Groups that are active in such areas as “mercury, cadmium and lead” (WG 37), “the historical inputs of contaminants into coastal ecosystems” (WG 39), and “source, fate and effects of microplastics in the marine environment” (WG 40). In addition, a new Correspondence Group is being established to evaluate the “biomagnification of pollutants in top predators”. This concern for the scale of pollution impacts on the marine environment is shared by the general public (Fig. 1).

Dr. Kris Cooreman (Institute for Agricultural and Fisheries Research, Belgium) described the aim within the ICES realm for integrated science in support of management. He stressed that fisheries regulations were ineffectual when the root causes of reduced fish stocks are unrelated to fishing, and presented one case study on the decades-long decline in the abundance of shrimp (*Crangon crangon*) which had been attributed to overfishing. However, recent research suggests that the extensive contamination of coastal sediments in Europe by the antifoulant chemical tributyltin



Fig. 1 Over 10,000 people respond: “When you are thinking about the coastline or the sea, what are the three most important matters that come to mind?” (<http://www.CLAMER.eu>).

(TBT) historically used on vessel hulls caused reduced growth and survival of shrimp. In addition to this example of a population-level impact related to a single chemical, other European examples include the effects of PCBs (polychlorinated biphenyls) and DDT (dichlorodiphenyltrichloroethane) on reproduction and health of seabirds and marine mammals. A long history of interest in the area of marine pollution positions ICES extremely well to partner with PICES on subjects of mutual interest into the future.

Dr. Joel Baker (Center for Urban Waters, University of Washington, U.S.A.) presented an overview on the emerging microplastics concern, which provided a basis for the field trip on the Amur River the next day (see photos). This one pollutant category encompasses a very wide variety of types, sizes, shapes, colours and origins for this “structural pollutant”, highlighting the need for standardized assessment methods. “Microplastics” may be defined as any solid material < 5 mm that is primarily composed of synthetic polymers, but may also be considered from a practical perspective to be larger than 330 µm so as to be compatible with ichthyoplanktonic surveys. Microplastics include both primary (produced intentionally for consumer products) and secondary (generated by disintegration of larger materials) materials. Major challenges, and hence opportunities for collaboration in the North Pacific, are: methods to detect and quantify, distribution over space, and effects on biota (including invertebrates, fish, turtles, seabirds and marine mammals). Evidence of impact today is largely limited to the visually obvious macroplastics which have caused mortality in some stranded turtles, seabirds, and marine mammals.

Dr. Annamalai Subramanian (Ehime University, Japan) delivered an overview of persistent organic pollutants (POPs) and metals in the Asia-Pacific region. Dedicated sampling from multiple species over the past three decades has been carried out through the Environmental Specimen Bank for Global Monitoring at his university. Contaminants



A field trip to the Amur River near Khabarovsk on October 15, 2011, provided an opportunity for some of the workshop participants to conduct surface tows for microplastics from a small craft. Shown here clockwise, starting at top is the sampling platform, participants decanting microplastic samples from the plankton net on shore, workshop members examining samples using a dissecting microscope in the laboratory of the Khabarovsk Branch of Pacific Research Fisheries Centre, Russian Federal Agency on Fisheries, and Drs. Joel Baker and Olga Lukyanova with 330 μm mesh plankton net prior to deployment. Photos by A. Subramanian, P.S. Ross and O. Lukyanova.

have been determined for some of the many hundreds of invertebrate, fish, seabird and marine mammal species for which samples have been collected and preserved over time and space. Results reveal widespread environmental responses to the use, disposal and subsequent regulation of many of the POPs. Mussels have been utilized as sessile indicators of coastal pollution by POPs and metals throughout Asia. Albatross have been used to provide an integrated measure of POPs along their migratory corridor. Northern fur seals reveal improvements in the way of reductions in the concentrations of some POPs over time.

Russian scientists, including Olga Lukyanova, Mikhail Simokon and Vasiliy Tsygankov, provided insight into some

of the priority concerns along the coastline of the Russian Far East and adjacent waters. While human population density is relatively low in this region, there exist concerns about offshore oil and gas exploration and development in the Sea of Okhotsk, metals related to local industrial activity, radioactive releases, and POPs and biological pollutants from global sources.

Because of the complexity of marine pollution issues in the North Pacific Ocean, workshop participants were focussed on defining concepts and strategies that would lead to pragmatic indicators. It was agreed that a series of basic concepts should be used to identify contaminant indicators that could be shared among PICES member countries. In

this way, the indicator must:

- involve a species (*e.g.*, mussels) or matrix (*e.g.*, sediment) which is well understood;
- involve a pollutant or class of pollutants for which analytical methods are available;
- provide the best available science to management;
- provide insight into spatial and temporal changes;
- have linkages to a risk of adverse effects;
- be responsive to regulations;
- be able to identify emerging contaminant concerns;
- be cost-effective.

Since there exists no single indicator which can adequately capture all contaminant concerns, workshop participants acknowledged the need for a suite of indicators which could capture different contaminant types including, for example, persistent, bioaccumulative contaminants (*e.g.*, POPs) in seabird eggs or marine mammals, metals and radionuclides in mussels, hydrocarbons in flatfish, and plastics in seawater. Several regional examples from researchers in different PICES member countries were cited as examples to build on, where opportunities to improve analytical techniques, exchange samples, collect new samples, and/or exchange expertise were considered.

During the next year, a new PICES Study Group on *Marine Pollutants* (SG-MP) will operate under the

aegis of the Marine Environmental Quality (MEQ) Committee to identify novel approaches to operational marine pollution assessment with the aim of: establishing a list of priority pollutants; identifying indicators of status, trends and effects; harmonizing methods to evaluate impacts on biota; and describing case studies which demonstrate the effectiveness of indicators to inform the success of remedial actions. This effort will create opportunities for PICES scientists to participate in a renewal of the pollution topic and to identify emerging concerns, technologies and concepts into the FUTURE.



Following the workshop on marine pollution indicators, some workshop participants went on an excursion on the Amur River to collect microplastics under the guidance of Dr. Joel Baker (third from the left). Photo by O. Lukyanova



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Dr. Olga Lukyanova (onlukyanova@tinro.ru) is a Research Biologist at the Pacific Research Fisheries Centre (TINRO-Centre) in Vladivostok, Russia. Olga conducts research on marine pollution and its effects on biota in the Russian zone of Far Eastern seas in the North Pacific. She is wearing multiple hats within PICES being a member of the Section on Harmful Algal Blooms, Section on Human Dimensions of Marine Systems, Working Group on Development of Ecosystem Indicators to Characterize Ecosystem Responses to Multiple Stressors and Study Group on Marine Pollutants.