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In this Edition: Local needs, global impacts

The period from January to June 2019 saw the IAEA Environment Laboratories in Monaco and Austria working with partners across the world, connecting work in the environmental sciences and technical cooperation related directly to Member States' needs.

During this period, a pan-African ocean acidification network was strengthened, a laboratory in Latin America made great strides in detecting a biotoxin affecting seafood safety, and IAEA expertise critically informed upcoming discussions on the Minamata Convention on Mercury. Furthermore, 45 experts from 35 Member States improved their skills in measuring short-lived radionuclides. While for the eighth year in a row, the Environment Laboratories also took part in Monaco's annual eco-awareness event, known as Monacology, demonstrating the importance of marine science to schoolchildren and staying rooted in the Laboratories' local community.

From Cuba to Liberia to Colombia, the Environment Laboratories' research activities and technical cooperation has reached people as part of their efforts to assist Member States in diverse places and in diverse ways.

For more information on the activities of the IAEA Environment Laboratories, please visit www.iaea.org/nael

David Osborn

Director, IAEA Environment Laboratories



Scientists from the IAEA Environment Laboratories have been working in the Latin American region on issues related to harmful algal blooms (HABs) for a decade, the fruits of their labour now evident in a Cuban laboratory's capacity to detect a biotoxin HABs can produce. (Photo: IAEA)

Laboratory in Cuba first in region with capacity to detect key biotoxin



Scientists in Cuba use nuclear techniques to detect ciguatoxins, biotoxins associated with harmful algal blooms which threaten seafood safety. (Photo: Y. Dechraoui-Bottein / IAEA)

The first laboratory in Latin America and the Caribbean to be able to detect ciguatoxins, the toxins responsible for the most significant non-bacterial seafood poisoning, recently became fully operational in Cuba, the result of close cooperation between the IAEA and local partners. Naturally occurring, ciguatoxins are responsible for ciguatera poisoning, which causes tens of thousands of seafood poisoning cases every year. The new lab will provide analytical services to other countries in the region as well.

To address the ciguatoxin problem, the IAEA has been building capacity for ciguatera monitoring in the region through the use of nuclear and isotopic techniques.

“Ciguatera toxins have been a major problem in Latin America and the Caribbean for years, and now we have become the first laboratory in the region capable of monitoring ciguatera toxins on-site through the use of nuclear techniques,” said Carlos Alonso-Hernandez, Vice Director at the Centre of Environmental Studies of Cienfuegos (CEAC). “From our training in nuclear techniques, we can contribute to robust seafood safety programmes that are crucial for the health and well-being of our region, not to mention the economy.”

Ciguatoxins are one of the many naturally occurring biotoxins associated with [harmful algal blooms](#) (HABs). Microscopic algae, which are at the base of the marine food chain, provide a vital source of nutrients for marine organisms and produce more than

half the earth’s oxygen supply. However, factors such as coastal upwelling or agricultural run-off can increase nutrient levels in water and can cause algal blooms, which in some cases produce biotoxins like ciguatoxin. Every year, HABs are responsible for tens of thousands of poisoning incidents all over the globe due to the consumption of contaminated seafood. Symptoms can include vomiting, diarrhoea, dizziness or, in extreme cases, even death as well as respiratory issues in people who breathe in toxic aerosols.

Nuclear techniques can quickly identify biotoxins in seafood and in the environment and pinpoint these outbreaks more accurately than other methods. To this end, IAEA researchers have been training scientists in close to 40 countries, including Cuba, on the use of a key nuclear tool—the radioligand receptor binding assay (RBA)—and much more. From assistance in procurement, to training in sampling techniques for controlling the presence of toxic algal species, to preparing the samples, the journey that scientists in Cuba have taken will create an impact even beyond their country, Alonso-Hernandez said. The laboratory in Cuba is now fully operational to detect ciguatoxins in samples received from other laboratories in Latin America.

The path to success mirrors the applications of RBA for other biotoxins in El Salvador, Morocco, Oman, the Philippines and Tunisia. The technique is based on the specific interaction between the toxins and the receptor they bind (pharmacological target), in which a radiolabelled toxin competes for a limited number of receptor binding sites with the toxin in the sample being analysed, allowing quantification of the toxicity of the sample. The IAEA has also developed other analytical methods to measure biotoxins and study how they are taken up by marine organisms and transferred up the food chain.

“Outbreaks of HABs that produce ciguatoxins used to be limited to tropical and subtropical regions, but new endemic regions are emerging while expansion of the international seafood trade is also spreading the risks of seafood contamination,” said Marie-Yasmine Dechraoui Bottein, a research scientist at the IAEA Environment Laboratories in Monaco. Indeed, the issue of HABs is one of increasing global importance, [especially since its increase has been linked to climate change](#). The IAEA is working on an interagency strategy to address ciguatoxins through a multi-disciplinary approach, along with the World Health Organization (WHO), the Food and Agricultural Organization (FAO) and the Intergovernmental

Oceanographic Commission of the United Nations Educational, Scientific and Cultural Organization (IOC-UNESCO).

The IAEA Environment Laboratories' work in Cuba is part of a larger technical cooperation project in the Caribbean on strengthening regional monitoring and response for sustainable marine and coastal environments.

Scientists chart out future of ocean acidification research in Africa at high-level conference in Liberia



The OA-Africa side event at the Blue Oceans Conference featured talks on ocean acidification research in Africa, capacity building efforts, and the SDG 14.3 process (Photo: Alicia Cheripka, NOAA)

Scientists from all over the African continent convened in Monrovia, Liberia, during a side event at the [Blue Oceans Conference](#) at the end of March to discuss how to tackle ocean acidification. The group of scientists are part of [Ocean Acidification Africa](#) (OA-Africa), a network supported by the IAEA through its [Ocean Acidification International Coordination Centre](#) (OA-ICC).

During the side event, several OA-Africa members presented the needs and challenges faced by different African regions with regards to ocean acidification research. Recognised as a major threat to vital marine ecosystems, ocean acidification can vary in its impacts. Research that addresses region-specific impacts of ocean acidification is crucial to inform decisions

mitigating its harmful effects. Recent research shows that ocean acidification has the potential to adversely affect fisheries, aquaculture and coral reefs. This is especially important for the many African countries where coastal and marine ecosystems provide livelihoods and sources of food. OA-Africa's research agenda aims to understand what this means for countries in Africa where the status of ocean acidification and its impacts on local species are not yet well understood. The white papers which OA-Africa scientists presented at the side event provide a vision for where research on the Continent should head, enabling better reporting towards the [UN Sustainable Development Goal \(SDG\) 14.3](#), which specifically targets ocean acidification.

“Nuclear and isotopic techniques are particularly important tools to assess the effects of ocean acidification on marine organisms and to better understand a host of other pressing environmental issues” said Peter Swarzenski of the IAEA Environment Laboratories in Monaco, who spoke at the OA-Africa side event and at the Blue Oceans Conference. The conference discussions also addressed topics such as marine plastic pollution, sustainable

Ocean Acidification

Intensive fossil-fuel burning and deforestation over the last two centuries has increased atmospheric carbon dioxide by 50 % above pre-industrial values. The global ocean currently absorbs roughly one third of this human-caused carbon dioxide, and its carbonate chemistry is being fundamentally altered in the process. As a result, the oceans have undergone a decrease in pH, known as ocean acidification. The change in ocean chemistry affects the behaviour and growth of many marine species.

fisheries, and the blue economy.

Since its inception in 2015, OA-Africa has grown to comprise more than 100 scientists across the continent. Their Steering Committee met directly after the closure of the Blue Oceans Conference to discuss the future of ocean acidification studies in Africa. “African countries are among the most vulnerable to climate change and ocean acidification. OA-Africa is committed to keep raising awareness and fill research gaps in its members' countries,” said Sheck Sherif, co-chair of OA-Africa.

OA-Africa is part of a larger IAEA-supported network called the Global Ocean Acidification Observing

Network (GOA-ON) which aims to increase monitoring in areas where ocean acidification data is currently scarce.

IAEA and UN Environment assist Member States on mercury monitoring in seafood

Given its devastating health effects as a potent neurotoxin, mercury is one of the top ten chemicals of public concern, according to the World Health Organisation (WHO). The IAEA Environment Laboratories, together with UN Environment, hosted experts from around the world last month to discuss how best Member States can tackle monitoring of this global pollutant. This meeting took place in the context of a GEF-funded project to support a Global Monitoring Plan of Mercury for the landmark Minamata Convention on Mercury, adopted in 2013 by 128 countries.

Following the convention's Conference of Parties (COP) in 2018, biota (such as plants, fish, seabirds and shellfish) and soil were proposed to be reviewed as additional matrices of interest for mercury monitoring. With global seafood consumption nearly doubling in the past three decades and over 1 billion people around the globe relying predominantly on seafood sources for their protein intake, monitoring of mercury ocean concentrations is critical.

The meeting brought together a variety of stakeholders on mercury monitoring - scientists, the Minamata Convention Secretariat, UN Environment and representatives from Parties to the Convention - to discuss the merits in adding biota and soil to the matrices to be monitored within the Minamata Convention implementation. Currently only atmospheric and human bio-monitoring are being conducted.

As the only marine laboratory in the UN system, the IAEA Environment Laboratories have been at the forefront of providing fit-for-purpose analytical

methods for [monitoring](#) of mercury and methyl mercury in marine samples, such as fish or shellfish, marine sediments and seawater. At the meeting, Ms. Emiliya Vasileva, research scientist at the IAEA, shared the Laboratories' expertise on mercury and methyl mercury methods development, supporting improvement of worldwide performance of monitoring



Participants of the UN Environment Expert Consultation Meeting on Mercury Monitoring in Soil and Biota held at the premises of the Environment Laboratories of the IAEA in Monaco. (Photo: T. Misra/IAEA)

laboratories and the availability of reliable and comparable analytical data for global mercury monitoring.

“The new avenue to become a partner with UN Environment in the implementation of the Minamata convention is exciting, and we are looking forward to receive a clear mandate from the signatories during the next COP in November. Together, we can assist our Member States with much needed mercury monitoring to promote seafood safety and the health of the most vulnerable members of society,” said Sylvia Sander, Section Head of the Marine Environment Studies Laboratory, one of the three Monaco-based laboratories that comprise the IAEA Environment Laboratories, the fourth being the Terrestrial Environment Laboratory in Seibersdorf, Austria.

The IAEA Environment Laboratories have long worked with Member States on the development of criteria for generating high-quality data and improvement of mercury monitoring in the ocean as well as on studies related with the transfer of this toxic pollutant up the food chain. This includes the distribution of recommended analytical procedures for the determination of mercury and mercury species, production of matrix certified reference materials, organisation of global inter-laboratory comparisons and training of laboratory practitioners dealing with

mercury monitoring. IAEA Certified Reference Materials are valuable tools for the validation of analytical methods and for the establishment of traceability of measurement results used for mercury monitoring to the units from the internationally accepted system of reference, SI.

IAEA spotlights marine pollution at youth eco-awareness week



H.S.H. Prince Albert II speaks with IAEA Environment Laboratories Director David Osborn
(Photo: T. Misra / IAEA)

As part of its longstanding commitment to outreach, the IAEA Environment Laboratories in Monaco participated in Monacology, a week-long annual event in June to raise environmental awareness among schoolchildren, for the 8th year in a row. As the theme for Monacology this year was *Ma Ville Durable*, or, My Sustainable City, the Environment Laboratories highlighted the crucial topic of marine pollution as well as the importance of clean energy.

Monacology is one of several important outreach activities the Environment Laboratories undertake to promote awareness about their work in the region. The event was attended not only by schoolchildren of all ages from all over Monaco but also H.S.H. Prince Albert II who thanked the IAEA for their continued attendance at Monacology over the years.

To demonstrate the importance of tackling marine pollution, the Environment Laboratories used a sandbox filled with various objects to represent a

polluted beach for one of its interactive projects. Once the schoolchildren removed the large objects from the sandbox, IAEA scientists explained how the small polystyrene balls represent microplastics—plastics smaller than five millimeters which pollute the marine environment but are hardly visible to the human eye.

IAEA hosts workshop on measuring short-lived radionuclides in environment



Participants in the training workshop on analysis of short-lived radionuclides by gamma-ray spectrometry outside the IAEA Headquarters in Vienna (Photo: IAEA)

Having the capability to accurately measure and quantify radionuclides with a short lifetime is important for conducting environmental assessments following any nuclear or radiological accidents. However, the analysis in such cases is often technically complex and may be affected by measurement errors if not done correctly. The results of short-lived radionuclide water samples included in recent proficiency test exercises held for worldwide environmental laboratories also demonstrated this challenge, as many laboratories experienced analytical difficulties.

With this in mind, the IAEA recently held a training workshop on the analysis of short-lived radionuclides by gamma-ray spectrometry, organized by the Terrestrial Environment Laboratory, one of the four laboratories comprising the IAEA Environment Laboratories, in Vienna from 11 to 13 June 2019. The workshop allowed 45 participants from 35 Member States to learn about best practice approaches for

dealing with complex analysis situations encountered in both normal and emergency cases of environmental assessment. The workshop consisted of lectures as well as exercises to allow the participants to apply the theoretical concepts in a practical and realistic context. Under the guidance of IAEA experts, the participants benefited from strengthened capability to perform accurate analysis of complex gamma-ray spectrum data; the workshop also promoted harmonization and cooperation between Member State Laboratories.

IAEA training course supports sustainable management of water resources in Colombia



Participants in the IAEA training course take part in a sediment core cutting exercise in the field. (Photo Credit: Andra-Rada Iurian/IAEA)

The wide availability of water resources in Colombia has enabled the country to generate 85% of its national electricity through renewable energy plants, of which 68% were hydroelectric plants. However, due to anthropogenic activities, changes in land use and climate change, a considerable amount of suspended sediment is carried out through the country's water systems, causing a reduction in both generation capacity and the water storage of hydroelectric plants and dams in the last few years.

To help support the sustainable management of water resources and hydroelectric energy efficiency, the IAEA, in cooperation with the government of Colombia, through the Ministry of Mines and Energy,

launched a national training course on sediment sampling for aquatic sediment dating using ^{210}Pb . Hosted by the Antonio Nariño University in Bogotá, Colombia, the course demonstrated to Colombian scientists how nuclear and isotopic techniques can facilitate accurate and precise evaluation of sedimentary processes and help identify hydrological risks in artificial and natural water bodies. The course was organized under an ongoing, national IAEA technical cooperation project on estimating sedimentation rates and reconstructing sedimentary processes in hydroelectric power plants, water dams and reservoirs.

The course was attended by 15 participants from four Colombian institutions, including Antonio Nariño University, Colombian Geological Survey (SGC), Marine and Coastal Research Institute (INVEMAR) and the Nuclear Affairs Group of the Ministry of Mines and Energy. The participants attended lectures on the principles of ^{210}Pb geochronology and its application in different regions, methodologies for collection and sectioning of sediment cores and the basic techniques for determination of sediments physical parameters, useful in the interpretation of sedimentation rates. Participants also took part in a 'hands-on' session on field application of a sediment corer and core cutting at Tomine Reservoir, north of Bogota.

“The course contributed to strengthen the participants' theoretical knowledge and practical skills in designing proper sampling strategy, in applying relevant sediment coring techniques and in using the sampling and coring equipment provided by the IAEA for this purpose. In addition, it contributed to enhancing collaboration among Colombian institutions with interest in the determination of sedimentation rates and sediment geochronology to mitigate the negative effects of anthropogenic activities and climate change on the sustainability of hydroelectric dams”, said Ms. Andra-Rada Iurian, technical officer of the IAEA project.

Selected Publications

Radioactive particle characteristics, environmental behaviour and potential biological impact, SALBU, B., FESENKO, S., ULANOWSKI, A., *Journal of Environmental Radioactivity*, 201, pp. 56-57.

Proficiency testing in analytical chemistry, microbiology and laboratory medicine: discussions on current practice and future directions, BROOKMAN, B., BUTLER, O., CIARALLI, L., HORSKY, M., LAURENT, C., NOBLETT, T., ÖRNEMARK, U., PATRIARCA, M., SIBBESEN, L. P., TIIKKAINEN, U., VAN PUTTEN, K., ROBOUCH, P., *Accreditation and Quality Assurance* (2019), pp. 93–101.

On prognostic estimates of radiation risk in medicine and radiation protection, ULANOWSKI, A., KAISER, J. C., SCHNEIDER, U., WALSH, L., *Radiation and Environmental Biophysics* (2019).

Advances in reference materials and measurement techniques for greenhouse gas atmospheric observations, BREWER, P. J., KIM, J. S., LEE, S., TARASOVA, O. A., VIALLO J., FLORES E., WIELGOSZ, R. I., SHIMOSAKA, T., ASSONOV, S., ALLISON, C. E., VAN DER VEEN, A. M. H., HALL, B., CROTWELL, A. M., RHODERICK G. C., HODGES, J. T., MAHN, J., ZELLWEGER C., MOOSSEN, H., EBERT, V. GRIFFITH, D. W. T., *Metrologia* 56 (3).

Ocean acidification impacts in select Pacific Basin coral reef ecosystems, LEBREC, M., STEFANSKI, S., GATES, R., ACAR, S., GOLBUU, Y., CLAUDEL-RUSIN, A., KURIHARA, H., REHDANZ, K., PAUGAM-BAUDOIN, D., TSUNODA, T., SWARZENSKI, P. W., *Regional Studies in Marine Science*, 28, 100584.

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First assessment on the trace elements in sediment cores from Namibian coast and pollution sources evaluation, ORANI, A.M., VASSILEVA, E., RENAC, C., SCHMIDT, S., ANGELIDIS, M., ROZMARIC, M., LOUW, D., *Science of the Total Environment*, 669 (2019) pp.668-682

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Investigating the fate of copper in a laboratory-based toxicity test with embryos of *Mytilus galloprovincialis*, ZITOUN, R., HASSLER, C., CLEARWATER, S.J., THOMPSON, K.J., ALBERT, A., SANDER, S. G, *Environmental Toxicology and Chemistry*, Vol. 38 (3), pp. 561-574

Copper toxicity to blue mussel embryos (*Mytilus galloprovincialis*) The effect of natural dissolved organic matter on copper toxicity in estuarine waters, ZITOUN, R., CLEARWATER, S.J., HASSLER, C., THOMPSON, K.J., ALBERT, A., SANDER, S. G., *Science of the Total Environment*, 653, pp. 300-314

Exploring mechanism for Spring Bloom Evolution: Contrasting the 2008 and 2012 blooms in South West Pacific Ocean, CHISWELL, S.M., SAFI, K., SANDER, S.G., STRZEPEK, R., ELLWOOD, M.J., MILNE, A., BOYD, P. W., *Journal of Plankton Research*, pp. 1-20

Selected Upcoming Events

Dates	Description	Location
26 – 30 August	First Research Coordination Meeting on Evaluating the Impacts of Ocean Acidification on Seafood – A Global Approach	Fiskebäckskil, Sweden
26 August – 6 September	Regional Training Course on Gamma-Ray Spectrometry	ANSTO, Sydney, Australia
2 – 5 September	20th WMO/IAEA Meeting on Carbon Dioxide, Other Greenhouse Gases, and Related Measurement Techniques - GGMT-2019 (Cooperation meeting)	Jeju, Republic of Korea
2 – 6 September	Final Research Coordinated Meeting for CRP K41016 on the Study of Temporal Trends of Pollution in Selected Coastal Areas by the Application of Isotopes and Nuclear Tools	Marrakech, Morocco
23 – 27 September	First Regional Training Course on the Use of Isotopic Techniques in Assessing Coastal Geomorphic Change	ANSTO, Sydney, Australia
14 – 18 October	Second Consultancy Meeting on the Preparation of an IAEA Technical Report Series Document on The Environmental Behaviour of Tritium	IAEA, Vienna, Austria
16 – 18 October	16th Coordination Meeting of the IAEA's Network of Analytical Laboratories for the Measurement of Environmental Radioactivity	Schwarzenburg, Switzerland
21 – 25 October	ALMERA Training Workshop on In-situ Measurement Techniques for the Characterization of Contaminated Sites	Spiez, Switzerland
28 October – 1 November	IAEA/RCA Regional Training Course on Dose Assessment And Risk Analysis Modelling	Hangzhou, China
28 October – 3 November	Second Consultancy Meeting on the Preparation of an IAEA Document on the Development of Training Materials on Environmental Sampling for Radiation Monitoring	IAEA, Vienna, Aus
2 – 5 September	20th WMO/IAEA Meeting on Carbon Dioxide, Other Greenhouse Gases, and Related Measurement Techniques - GGMT-2019 (Cooperation meeting)	Jeju, Republic of Korea
2- 13 September	Training Courses on Analytical Techniques for Determination of Trace Elements in Environmental Samples & Analysis of Organochlorine Pesticides and Polychlorinated Biphenyls in Environmental Samples	IAEA Environment Laboratories, Monaco
14 – 18 October	Second Consultancy Meeting on the Preparation of an IAEA Technical Report Series Document on The Environmental Behaviour of Tritium	IAEA, Vienna, Austria
21 – 25 October	ALMERA Training Workshop on In-situ Measurement Techniques for the Characterization of Contaminated Sites	Spiez, Switzerland
25 – 28 November 2019	First Research Coordination Meeting on Applied Radioecological Tracers to Assess Coastal and Marine Ecosystem Health	IAEA Environment Laboratories, Monaco
2 - 6 December	Basic training course on ocean acidification: carbonate chemistry measurements, experimental design and the application of nuclear and isotopic techniques (TC Project INT7019)	IAEA Environment Laboratories, Monaco
10 – 13 December	Technical Meeting on the Best Practices to Monitor Microplastic Pollution in the Marine Environment	IAEA Environment Laboratories, Monaco

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