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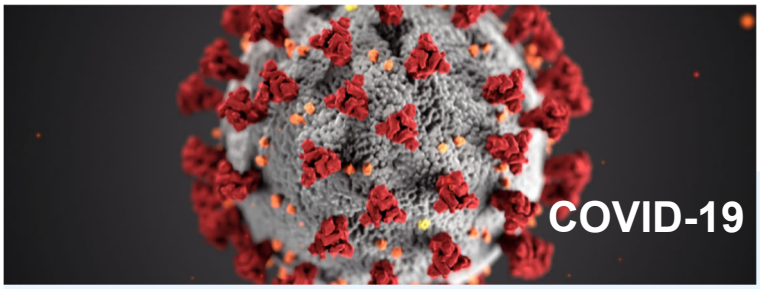
In this Edition: Working toward Sustainable Development Goals

The IAEA Environment Laboratories work with Member States to address their most pressing environmental challenges. Some of the examples highlighted in this newsletter include research on the impacts of plastics and contaminants such as mercury and lead in the marine environment. Researchers are generating information to determine sources of marine plastic debris and trace metals in the marine environment. By examining these environmental pollutants researchers can gain information on related seafood safety and human health concerns. The work that the Laboratories do with Member States can contribute to preserving marine ecosystems, and advance SDG 14 on Life Below Water, which aims to conserve and sustainably use the oceans, seas and marine resources. Moreover, the Laboratories' activities in environmental radioactivity monitoring can contribute to SDG 15, Life On Land.

This edition of the Environment Laboratories newsletter will provide an overview of our recent projects and activities for the period from January to July 2020 that contribute towards the Sustainable Development Goals, as well as highlights other projects currently underway.

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

Peter Swarzenski
Acting Director, IAEA Environment Laboratories



"Interview

IAEA Environment Laboratories in Monaco: maintaining performance during the coronavirus pandemic

Peter Swarzenski
Acting Director, IAEA Environment Laboratories in Monaco and Head of Radioecology Laboratory

How did the Monaco-based IAEA Environment Laboratories respond to the coronavirus crisis?

Like just about everyone else, the IAEA Environment Laboratories based in Monaco were forced to close their doors for the first time in their 60+ year history because of the 2020 COVID-19 pandemic. As a result, all our staff were requested to work from home. As you can imagine, this imposed some unique and interesting challenges. For example, the IT team was tasked from one day to the next to provide hardware and software solutions so every staff member could eventually log onto the IAEA networks from home.

In many cases, internet use at home was pushed to near capacity. New communications both within and between the Sections and the Directors office and Vienna had to be established and maintained. Tracking individual workflow, let alone simply trying to develop a coherent workplan that could suit everyone was not an easy task. Onboarding of new employees during the pandemic was just about impossible. As a testament to the reliance and fortitude of our staff, within a few weeks, just about everyone became well versed at participating in online meetings. These were used to stay connected, to share COVID-19 stories, and to update on the IAEA news and work. With time, these online communiques were even used to socialize and bring some sense of normality into our otherwise uprooted lives. What became obvious during this unusual time is that the IAEA Environment Laboratories staff were at least as – or probably more – productive in their work. For example, scientific papers and other reports and manuals were written with new-found vigour and focus. I would venture to guess that we will not so quickly see such a tremendous volume of scientific papers produced while under COVID-19 stay at home orders.

Laboratories in Monaco maintain living marine organisms that require daily care. How did the work from home policy affect taking care of the marine animals at the IAEA's marine laboratories?

Staff at the IAEA Monaco-based laboratories were able to continue to care for our live marine organisms by developing a well-thought out agenda of regular laboratory visits that still fit within the constraints of COVID-19 imposed restrictions and posed no additional risks to our employees. Under their care, the marine organisms remained healthy and continued in their daily activities, as if COVID-19 did not exist outside! What we did have to halt during this time was all experimental work at the IAEA in Monaco, including work in the Radioecology Laboratory. But all these lab-based activities are now fully operational again.

Can you describe any positive outcome the three-months lockdown has had on NAEL teams?

Perhaps the most positive outcome in all this is that our staff have really risen to this exceptional challenge: if anything, enhanced communication has brought staff and Sections closer together. The weekly or even daily web calls provided a reassurance that we all face the same ordeals that we can overcome together. We learnt to take care of our staff and family in ways that we normally did not have to even think about. It's also fair to say that online communication was not always easy and required getting used to.

That said, teams came together to collaborate and learned to adapt to new technologies. It is my belief that the staff at the IAEA Environment Laboratories have responded in excellent fashion to the pandemic by stepping up and showing their resilience and good attitude. Here in Monaco, we truly acted as 'one-house, one family.'

What was the lesson learned from this crisis?

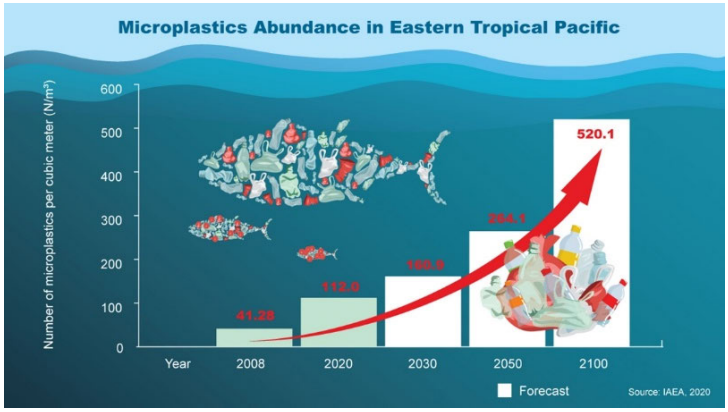
"Try not to take all the good things in life for granted, and trust in yourself that you can manage to overcome a lot, even a global pandemic!"

Challenges posed by COVID-19 have brought out the importance of good communication and trust. In many ways the lockdown has been a large-scale experiment: how we adapt to entirely new situations at work and at home, how we buy groceries, how we exercise, and how we visit family and loved ones, considering ever-changing travel restrictions and other uncertainties. What was particularly endearing to me is how quickly nature rebounded in some places around the globe. From a brief reprieve in what is usually a growing cocktail of environmental stressors brought on by us, animals all over the world seemed to rejoice and re-appeared in areas where they once refused to go, and thus showed us an intrinsic resilience that gives us all hope.

The IAEA Radioecology Laboratory facility in Monaco (Photo: IAEA)

World Oceans Day 2020: New IAEA Research Records Dramatic Increase in Microplastic Pollution in Eastern Tropical Pacific Ocean

On 8 June, we celebrate World Oceans Day at a time when about 8 million tons of plastic waste are ending up in the oceans each year, damaging ecosystems and wildlife, according to the UN Environment Programme. The major challenge scientists and policy makers face today is a lack of knowledge on the biological impacts of microplastics in marine organisms. To help anticipate and hence better address marine pollution scenarios in the eastern tropical Pacific Ocean, scientists from the IAEA and Ecuador have recently completed the first-ever, decade-long study on plastic particle abundance in the coastal waters of Ecuador. The study results form a baseline for future research, including on seafood safety. The eastern tropical Pacific Ocean is home to some of the world's unique marine reserves, including the Galapagos Islands in Ecuador, the Cocos Island in Costa Rica and the Coiba National Park in Panama – all included on UNESCO's list of World Heritage Sites. "The research has revealed that the microplastic pollution in the eastern tropical Pacific Ocean is set to continue to increase in the coming decades," said Peter Swarzenski, Acting Director of the IAEA Environment Laboratories.



Future projections of microplastics abundance in Eastern Tropical Pacific, (Graphic: IAEA)

Plastic particles below 5 mm in length are called *microplastics*, which are accidentally consumed by marine organisms making their way to the food chain, as a recent IAEA study has revealed. The amount of microplastics in the region is expected by 2030 to increase some 3.9 times compared to 2008 levels. By 2050, this quantity could almost double again, rising by 6.4 times compared to 2008 levels, and by 2100, the amount of plastics in the ocean is projected to be more than 10 times higher than in 2008 unless action is taken to change this trajectory.

Once of the crucial findings of this study is that the change in the microplastics abundance over time increases systematically and identically at all the sampling sites. This implies that the source of microplastics pollution is likely not local, but regional and maybe even global in scale**.** As many of the world's mega-cities are located near coastlines, adjacent coastal waters are often elevated in marine plastics abundance, which in turn may impact local fisheries and seafood safety.

"It is sad but not surprising to see such a steep increase of microplastic abundance in the region," said Rafael Bermudez Monsalve, Investigator Scientist from Ecuador supporting the research at the IAEA Environment Laboratories. "This data is crucial for the understanding of future oceanic scenarios and such studies can help policy makers on the implementation of adequate plastic life-cycle management."

Monitoring marine plastic pollution

Plastics are by design tough and resistant to degradation and have thus over time been found even in the deepest marine trenches. In our oceans, plastic fragments are broken down continuously by ultra-violet light, by the corrosive nature of seawater and by the constant physical erosion due to waves and shear. This continuous degradation supplies a stream of tiny micro- and nano-sized plastic particles that can be inadvertently consumed by marine organism and thus introduced into the food chain.

So far, a limited number of research studies have attempted to assess the historic abundance of plastic pollution. There had not been any comprehensive study to have examined a long-time series of marine plastic waste in the eastern tropical Pacific Ocean region. The IAEA research, supported by the Ecuadoran Galapagos Science Center and the National Fishery Institute of Ecuador, was based on measuring data obtained from past expeditions and observations of plastics collected from the five stations along the coast of mainland Ecuador including Esmeraldas, Puerto Lopez, Salinas and Santa Clara. The microplastics under evaluation were classified into three types: *fragments* (bottles, cups, food containers), *fibers* (plastic lines and fishing detritus), and *film* (plastic bags, zip bags). Fibers were found to be the most common plastic particle in the open water. These tiny particles have been found to travel as far as 10 000 kilometres in the Pacific Ocean and have reached even the most remote areas such as Galapagos Islands, polluting its pristine waters and rich wildlife.

"As we continue to develop our research on marine plastics, nuclear and isotopic techniques are playing a particularly important role in advancing both the science and knowledge on the subtle, sustained impacts of microplastic pollution in the marine realm," said Peter Swarzenski.

How do nuclear and atomic techniques help trace plastic pollution in our oceans

IAEA researchers are developing methods using nuclear and atomic techniques to precisely quantify the movement, fate and impact of plastic particles and associated organic and inorganic contaminants on a range of aquatic biota - including fish and oysters - under controlled laboratory conditions. By using radiotracers such as carbon-14, IAEA researchers can study how pollutants such as PCBs 'attach' themselves to microplastics in the environment and if they can dissociate or 'detach' from these plastics when ingested by marine animals.

A plastic bag submerged under water. Currents can push plastic and microplastic debris towards the coast where a large number of unique marine species may be impacted, such as marine turtles, sea birds, sea-lions.
(Photo: F. Oberhaensli /IAEA)

IAEA researchers also use radiotracers to study the movement and fate of microplastics within the animals to understand how exactly these are taken up - whether through the digestive system or through their gills, depending on the organism. They also aim to find out if the microplastics can be eliminated, or if they clog organs. If plastics accumulate in the gut, for example, organisms could get a false sense of being full, which can negatively influence their nutrient intake.

IAEA Provides Standards to Help Laboratories Measure Changes in the Environment

This year's World Environment Day calls for a 'Time for Nature'. Indeed, it is time to understand the messages that nature is sending through the millions of tiny changes that are beginning to cause major shifts in global ecosystems. The IAEA and its partners have the nuclear tools that have been measuring these changes at the most precise levels for over 50 years. These datasets and reference materials, which have been accumulated by thousands of scientists in hundreds of laboratories, are now fully available online to the public and policy makers with the aim to develop effective conservation policies.

Laboratories around the world can be assured of their performance and degree of accuracy by comparing their results directly with known standard reference materials that have been carefully measured and quantified. This is why easy access to reference standards is essential for quantitatively and fairly assessing a laboratory's proficiency. Since the early 1960s, the IAEA has developed and made available a large suite of reference materials for laboratories worldwide to assist them in quality assurance of the results they obtain using nuclear analytical techniques. These reference products pertain to reliable and accurate results in studies of environmental radionuclides, stable isotopes, trace elements and organic contaminants. They are available at the newly upgraded IAEA Reference Products for Environment and Trade website, which offers enhanced repository data, improved search capacity and an online system for purchasing certified reference materials.

"The modernized website is easy to navigate through a comprehensive range of reference products available for our external customers, helping to improve and maintain their analytical excellence," said Manfred Groening, Head of the IAEA's Terrestrial Environment Laboratory. A wide range of organic substances obtained from products such as rice, fish and oyster powder, grass and spruce needles, moss, cellulose, ancient and modern wood, soil and marine sediment, seawater, distilled water, powdered rock materials such as obsidian, carbonates, and pure chemicals and gases are processed at the IAEA Environment Laboratories under strictly controlled conditions. They serve as reference materials for scientific needs to help laboratories investigate and protect the environment.

"Regular participation in IAEA proficiency tests and access to reference materials for measurements of radionuclides in the environment is very important to us," said Hamid Marah, Scientific Director of CNESTEN, the Moroccan National Center for Nuclear energy, Sciences and Techniques. "This access helps our research centre to demonstrate its analytical excellency and supports all our activities to ensure the well-being of the public."

High precision weighing at the radiochemistry laboratory of the Terrestrial Environment Laboratory in Seibersdorf The photo credit: S. Tarjan, TEL.

Over 90 different reference materials characterized for radionuclides, stable isotopes, trace elements and organic contaminants have been made available to the scientific community. Altogether more than 2000 individual units of these materials are distributed to over 600 laboratories per year. In addition, 700 laboratories benefit annually from quality assurance services by receiving several thousand similar dedicated samples through IAEA proficiency tests free of charge, largely handled through this website.

"The IAEA is the world's largest supplier of matrix reference materials for radionuclides. Some of these reference products, for example those characterized for stable isotope ratios, are at the highest metrological level as international measurements standards," said Groening.

The upgraded website will provide enhanced access to this library of reference materials so that laboratories worldwide can purchase specialized reference materials from the IAEA through a more user-friendly system and can also register for accompanying proficiency tests. Annually, more than 1000 laboratories in over 70 countries are making use of the registered services that are available through this dedicated website.

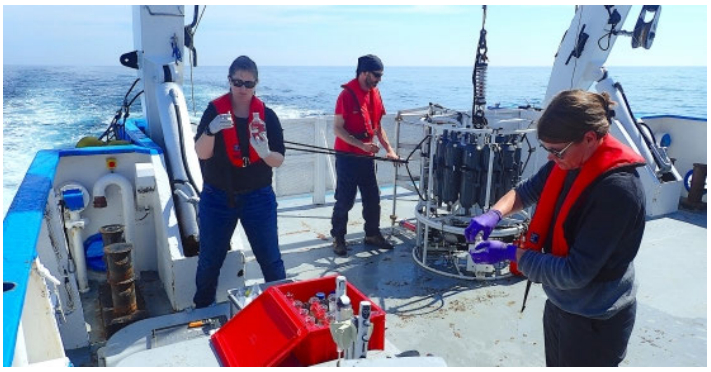
Expanding Access to Global Data on Marine Radioactivity

Radioactivity has occurred naturally in the environment since the beginning of time on earth. Over the last 75 years humans have added an anthropogenic component to this natural background through atmospheric nuclear weapons testing in the mid-20th century, releases from nuclear accidents and routine discharges from nuclear facilities. The IAEA has been keeping track of radioactivity levels in the marine environment for almost 60 years, and has made a wealth of global data available through a newly-updated, on-line data portal known as the Marine Radioactivity Information System (MARIS). Through MARIS, environmental scientists, policy makers and members of the public now have improved open access to recent and historical marine radioactivity data from laboratories around the world.

"MARIS is a powerful tool for researchers as it provides easy access to radioactivity data for most areas of the marine environment, with records dating back to 1957," said Paul McGinnity, Research Scientist at the IAEA Radiometrics Laboratory. “The new MARIS site offers improved mapping functionality, more intuitive access to data and generally a better user experience.”

Radionuclides, also known as radioisotopes, are atoms with unstable nuclei that emit energy in the form of radiation during decay. Some radionuclides occur naturally, such as potassium-40 and lead-210, and others are produced by humans in industrial facilities, such as caesium-137 and strontium-90.

Originating as an internal database in 1992 and first made available online in 2005, the MARIS has been developed through the continuous contributions of scientists around the globe undertaking sampling campaigns and performing measurements that are now fully traceable on the website.



Seawater sampling and sample treatment for biological and chemical parameters, on-board a research vessel in the Ligurian Sea, north-western Mediterranean. (Photo: B. Gasser/IAEA)

MARIS today provides online open access to some 600,000 verified radioactivity measurement results representing more than 100 different radionuclides or radionuclide ratios in seawater, biota, sediments, and suspended matter from both the open ocean and coastal locations.

“Radionuclides transfer between different compartments of the marine environment, such as the sediment, fish and shellfish and the water itself,” said McGinnity. “To trace these pathways and provide data for adequate assessments of such movements in the world’s oceans, scientists and policy makers need a comprehensive database such as MARIS.”

The extensive information accessible through MARIS can be used to estimate radiation doses to people and the marine biota from potential exposure in the marine environment, and to validate computational models used for simulation of the transport and transfer of radionuclides in the marine environment. MARIS contains data compiled from a range of sources including scientific papers, technical reports, databases developed within institutes or scientific programmes in IAEA Member States. For making data contributions to MARIS, please contact maris@iaea.org.

Meet the MARIS Team

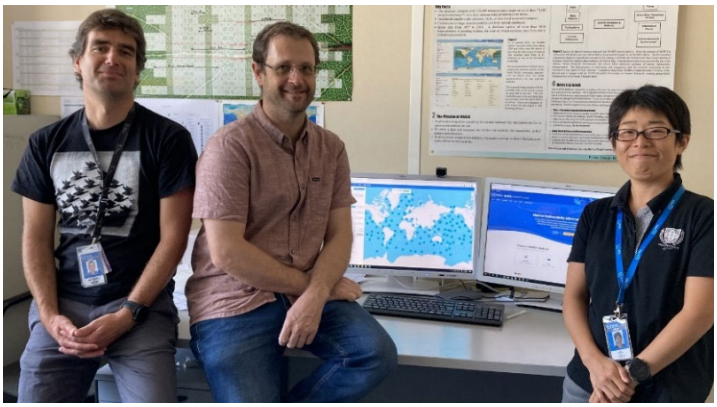
At the IAEA Environment Laboratories in Monaco, a team of passionate research scientists have worked to redevelop MARIS and to increase the volume of data available online. The Marine Radioactivity Information System (MARIS) provides critical input on the evaluation of the environmental radionuclide levels in regional seas and the world's oceans. Access to measurements performed in the aftermath of all historical nuclear testing and accidents such as the Chernobyl Nuclear Power Plant accident or the Fukushima Daiichi Nuclear Power Plant accident, is essential for understanding natural marine processes and the impact of human activities on the seas and oceans.

Research Scientists ***Paul McGinnity***, ***Paul Morris*** and ***Airi Mori*** have worked together in the Radiometrics Laboratory in Monaco since 2018, in collaboration with software developers in IAEA Headquarters in Vienna and scientists in Member States to collect additional data on marine radioactivity covering the period of 1957 up until now.

Paul McGinnity, a Research Scientist with experience in both environmental radioactivity and software development, led the MARIS redevelopment project coordinating the contributions of the team in Monaco, developing requirements and acting as the main point of contact with various stakeholders and partners. Paul Morris, a Research Scientist with a background in marine radiochemistry managed the day-to-day operation of MARIS. Paul ensured the inclusion of key functional improvements in the redeveloped MARIS including data traceability features, educational assist and toolkits and filter controls to allow users to refine the available data and customize.

Airi Mori joined the IAEA as an Associate Research Scientist from Japan, bringing on board her experience on dose assessment and environmental radioactivity research following the Fukushima accident. Airi's role has been crucial to MARIS in applying her experience for collection of data of marine radioactivity around Fukushima and dose assessment from seafood. Her expertise in using a Geographic Information System (GIS) software to store, retrieve and display all types of geographic and spatial data has been a great asset behind MARIS's features.

"Thanks to teamwork and excellent coordination within the team and with software developing colleagues, a substantive upgrade of the database was achieved, bringing MARIS up to today's standards. In an unprecedented focused effort, the volume of data available through MARIS was more than tripled over a period of 2 years. This considerably increased the value of MARIS as an asset for the Agency and Member States. Congratulations to the team and thanks to all data contributors!" said Iolanda Osvath, Head of the Radiometrics Laboratory.



MARIS team: Paul McGinnity (first left), Paul Morris (second left) and Airi Mori (right), Radiometrics Laboratory

IAEA Joins the UNEP Global Partnership to Reduce Mercury Emissions

The IAEA and the United Nations Environment Programme (UNEP) joined forces in April to better protect human health and global ecosystems from sustained releases of mercury and its toxic derivative compounds into the environment. The UNEP Global Mercury Partnership was initiated in 2005 with the goal of minimizing, and where feasible, ultimately eliminating the release of mercury and its compounds into the air, water and land. The Global Mercury Partnership focuses on those sectors that use and

release mercury or process raw materials that contain mercury, as well as areas engaged in mercury management and science.

Mercury is a highly toxic element in the environment that is found both naturally and as an anthropogenic contaminant. It can accumulate in the body and in high concentrations can cause damage to the brain and the central nervous system.

“The participation of the Agency sends a strong signal on the utmost importance of global cooperation to address the threat posed by mercury, and will undoubtedly bring a major contribution to the Partnership's work in developing knowledge and science, raising awareness towards global action on mercury and supporting timely and effective implementation of the Minamata Convention,” said Monika G. MacDevette, Chief of the Chemicals and Health Branch, Economy Division of UNEP.

As the only marine laboratories in the UN system, the IAEA Environment Laboratories have been for decades at the forefront of providing customized analytical methods for detection and monitoring of mercury and methyl mercury in diverse marine samples, such as fish or shellfish, marine sediment and seawater – using nuclear and isotopic techniques. IAEA scientists are developing new detection methods and analytical procedures for monitoring mercury in the marine environment, as well as for studying the transfer of toxic pollutants up the food chain.

“This new partnership will enhance global capacity to successfully carry out these studies around the world,” said Peter Swarzenski, Acting Director of the IAEA Environment Laboratories, based in Monaco. “Precise marine pollution assessments and accurate baseline information of contaminant concentrations are fundamental to better understand the potential impacts of such toxic compounds on the environment.”

According to the World Health Organization, mercury is one of the top ten chemicals of major public concern, due in part to its persistence and tendency to accumulate in living organisms and the environment as a whole. Mercury is a highly volatile contaminant which does not respect borders. Once mercury has entered the ocean or lakes it is further biomagnified through the food chain. Populations that depend on seafood are at especially high risk.

As one of the main mechanisms for the delivery of immediate actions on mercury, the UNEP Global Mercury Partnership also facilitates the timely ratification and implementation of the Minamata Convention on Mercury. The Convention sets a framework to eliminate or limit numerous mercury-emitting processes and products and limit mercury emissions. It calls upon Member States to establish and strengthen environmental mercury monitoring efforts.

"Today, the two major man-made sources of mercury emissions are the burning of fossil fuels and artisanal gold mining," said Swarzenski. “While these sectors cannot simply cease operations, they need to improve their environmental performances. It is crucial to take a holistic and realistic approach to the problem, and the Minamata Convention in concert with the UNEP Global Mercury Partnership provides a platform for the reduction or control of mercury pollution sources.”

In supporting the Global Mercury Partnership goal’s on protecting human health and the environment, the IAEA is making available analytical methods, which include nuclear and isotopic techniques, and tools for the quality assurance and control of environmental monitoring of hazardous pollutants, such as mercury and its most toxic organic form, monomethyl-mercury.

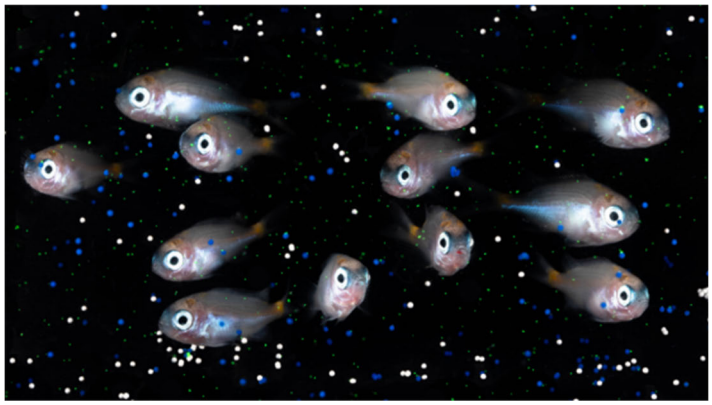
"UNEP is thrilled to be welcoming the IAEA as a member of the Global Mercury Partnership," said Monika G. MacDevette, Chief of the Chemicals and Health Branch, Economy Division of UNEP. "The participation of the Agency sends a strong signal on the utmost importance of global cooperation to address the threat posed by mercury, and will undoubtedly bring a major contribution to the Partnership's work in developing knowledge and science, raising awareness towards global action on mercury and supporting timely and effective implementation of the Minamata Convention."

Other members include the United Nations Development Programme (UNDP), the United Nations Industrial Development Organization (UNIDO) and the World Health Organization (WHO) among other stakeholders from governments, industry, non-governmental organizations, and academia who are dedicated to ending global mercury pollution. Reference materials produced by the IAEA laboratories play an important role in increasing the accuracy and certainty of environmental mercury measurements. The IAEA is also providing assistance on testing proficiency of laboratories worldwide in analysing those compounds in environmental samples.

New Research on the Possible Effects of Micro- and Nano-plastics on Marine Animals

Plastic debris is one of the most serious environmental challenges our oceans face. It affects marine organisms, habitats and ecosystems, as well as the health and well-being of people, particularly those dependent on the oceans. Smaller plastic particles are especially dangerous, because they are easily ingested and can enter organs and body fluids of organisms and thus propagate up the food chain. The fact that these particles are also co-contaminated with various chemicals and other pollutants makes accurate assessments of the effects and toxicity of plastic pollution challenging.

A group of scientists led by the IAEA has recently published a comprehensive review on the effects on fish of 'virgin' micro- and nano-plastics – tiny plastic particles such as resin pellets used in plastics manufacturing. The review, published in the journal Environmental Science and Technology in March 2020, revealed that in one third of all studies assessed, such virgin plastic particles were indeed affecting biological functions in fish, such as their behaviour and neurological functions, as well as their metabolism, intestinal permeability and intestinal microbiome diversity.



Graphical representation of spiny chromis (Acanthochromis polyacanthus*) juveniles in microplastics-contaminated water. (Image: M. Besson/IAEA)*

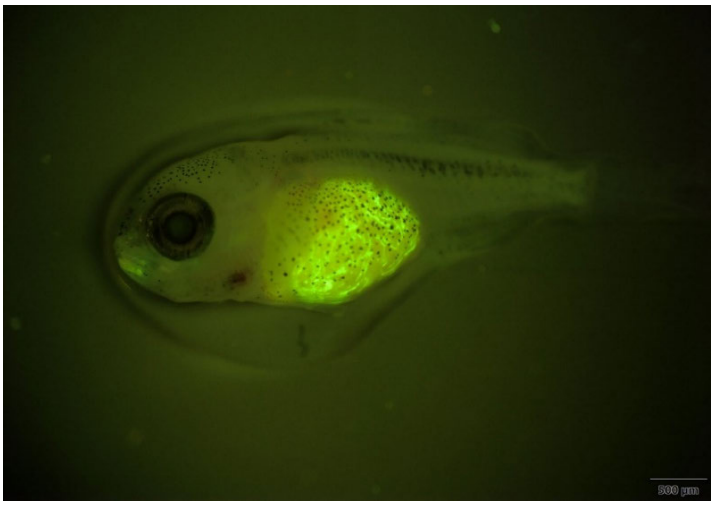
"Accurate monitoring is crucial for understanding the effect these particles have on organisms as well as for designing effective environmental management and mitigation strategies," said Marc Metian, Research Scientist at the IAEA Radioecology Laboratory and one of the co-authors of the research paper.

Some of these strategies, such as accurate assessments of cellular- to ecosystem-level impacts, or the production of new, degradable plastic materials that are more environmentally friendly, could involve nuclear and isotopic techniques that the IAEA can provide support with. Identifying those strategies will be the next step.

Plastics in the ocean

According to the UN Environment Programme, 8 million tonnes of plastic end up the world's oceans every year, often carried there by rivers. If the trend

continues, by 2050 our oceans could contain more plastic than fish. Environmental plastic pollution has become a major ecological and societal concern. Plastic pollutants vary widely in size, from large debris, such as fishing nets and single-use plastic bags, to invisible nano-sized plastic particles. While the visible impact of large plastic debris, so-called macroplastics, in marine environments has been well documented, the potential harm caused by microplastics and even more by nanoplastics is much less clear. Plastic particles below 5 mm in length are called microplastics. The smaller ones, with a size equal to or less than 100 nm (1/10 000 mm) are called nanoplastics. They are so tiny that one cannot see them with naked eye or even with an ordinary optical microscope. Microplastic particles are accidentally consumed by marine organisms, which are then consumed by predator fish. Nanoplastic particles are even more toxic to living organisms as they are more likely to be absorbed through the walls of digestive tracts and thereby transported into the tissues and organs. Consequently, such plastic particles can interfere with various physiological processes, from neurotransmission to oxidative stress and immunity levels of freshwater and marine organisms. Over the last decade, the global scientific community has invested substantial work into advancing the knowledge of the impact of plastic debris on diverse aquatic organisms. However, monitoring methods for small microplastics and nanoplastics are still in the development phase, which means that their exact concentration in the oceans remains unknown.



Fluorescent nano-plastic beads (in green) can be seen here in the stomach of a reef juvenile fish. (Photo: M. Besson, F. Oberhansli/IAEA)

"This is where nuclear technology can play an important role," added Metian. "Nuclear and isotopic techniques are already successfully used to study pollution processes. Their advantage is that they are highly sensitive and precise and can be used similarly to study small microplastic and nanoplastic movement and impact." At the same time, from a toxicology perspective, it is important to distinguish the toxicity of plastic particles per se from the toxicity associated with the contaminants that can become attached to them. To date, research into the effects of virgin micro and nano-sized plastic particles in freshwater and marine fish is still limited, hence the increased focus on investigating the toxicity of virgin plastics at the IAEA.

Conserving Life Below Water: Nuclear Techniques to Help Latin America and the Caribbean towards Reaching Sustainable Development Goal 14

Experts from eighteen Latin America and the Caribbean countries develop a work plan for regional collaboration on marine activities during the coordination meeting in Monaco. (Photo: IAEA)

Latin America and the Caribbean is sometimes called a 'biodiversity superpower' with some of the most beautiful and important endowments of natural capital in the world. But the region is experiencing many anthropogenic and climate-related impacts such as ecosystem degradation, coastal pollution and ocean change.

To develop strategies involving tailored nuclear and isotopic techniques to address these challenges, representatives from the region gathered at the IAEA Environment Laboratories in Monaco in early March. The coastal population is increasing in the region and many who live there depend on the ocean for their income and nutrition, but changes in water temperature and increased ocean acidification and deoxygenation could have a significant impact on local communities.

Recent research suggests that current increases in seawater acidity in the region is already impacting the ability of certain marine organisms, such as shellfish and corals, to effectively build their shells and skeletons. This could impact regional fisheries and the livelihoods of those living in the affected coastal zones. At this first regional coordination meeting of the IAEA Technical Cooperation Project *Strengthening Capacities in Marine and Coastal Environments Using Nuclear and Isotopic Techniques,* 24 experts from national authorities of 18 countries agreed on the major environmental threats that need to be addressed and set out a strategic framework for action.

Ocean acidification, harmful algal blooms (HABs) and pollution derived mainly from ubiquitous marine plastics were identified as the most pressing environmental concerns that would require coordinated action; sharing key data and enhancing analytical capacities on measuring ocean acidification, eutrophication and marine pollution were also highlighted.

"Existing international policies and treaties calling for responsible use of ocean resources are not enough," said Ana Carolina Ruiz Fernandez, a Researcher at National Autonomous University of Mexico. "We need to increase our capacities to generate qualified information and to establish a solid communication channel to exchange information to ensure our countries effectively contribute to the sustainability of the ocean."

"In the context of climate change, Peru is a very important hot-spot for marine research," said Michelle Ivette Graco, Doctor in Oceanography, Insituto del Mar del Peru (IMARPE). "It serves as a natural laboratory to explore major climate change stressors such as ocean acidification and deoxygenation because of the presence of naturally low acidic Ph levels and oxygen minimum zones in one of the most productive ecosystems in the world." In this regard, the oxygen minimum zones, in which oxygen saturation in seawater is at its lowest, are a useful key to understanding the oceans' role on atmospheric greenhouse control.

Emily Smail, Executive Director at GEO Blue Planet, noted that this kick-off meeting of the regional technical cooperation project provided valuable insights into the challenges faced by countries in monitoring and achieving targets of SDG 14. GEO Blue Planet is a partnership of more than 100 national governments and over 100 Participating Organizations bridging the gap between data and services to deliver usable information that supports informed decision-making toward reaching sustainable development.
"Partnerships developed at the meeting will allow the GEO Blue Planet initiative to improve our efforts to bridge the gap between the scientific community and decision makers in Latin America and in other regions," said Emily Smail.

How nuclear techniques can help tackle marine environmental challenges

Nuclear technologies are essential tools to help mitigate and adapt to the effects of sustained climate and ocean change. Nuclear tracers and isotopic techniques can be used to monitor the impacts of ocean acidification and other ocean stressors and help identify the sources of pollution in the water. Findings can facilitate the scientific community and policy makers to make informed decisions to protect vulnerable ecosystems. One example discussed was harmful algal blooms, a natural marine process that causes harm to human health and negatively affects ecosystems and is a threat to coastal zones. Scientists are concerned that climate warming and other anthropogenic activities may

exacerbate the intensity and impacts of HABs. For many years, the IAEA Environment Laboratories have promoted the use of a nuclear-based technique known as the Receptor Binding Assay (RBA), a highly sensitive and precise method that allows scientists early detection and monitoring of biotoxins caused by HABs. Several successful applications have been reported and documented in Chile, El Salvador, Colombia and Cuba.

"Early detection of biotoxins is vital in preventing the negative impacts of HABs," said Carlos Alonso Hernandez, Research Scientist at IAEA Radioecology Laboratory. "Nuclear techniques can be used to promptly identify biotoxins in seafood or in the environment, thus help to pinpoint outbreaks with more accuracy. This protects the food chain and can help to limit the amount of time that fishing grounds must be closed."

Massive accumulation of algal biomass can result in localized deoxygenation of seawater, which may contribute to widescale mortality among less mobile aquatic organisms. This phenomenon can also affect humans either directly by affecting respiration, or indirectly by the consumption of contaminated seafood. This satellite image reveals a large coastal algal bloom. (Photo: ESA)

HABs are just one aspect of this wide-reaching 18-nation project. "The IAEA is dedicated to working with the countries in Latin America and the Caribbean through this technical cooperation project to find practical solutions for their most important marine environmental challenges", said Peter Swarzenski, Acting Director of the IAEA Environment Laboratories. The project includes experts from Argentina, Belize, Brazil, Chile, Colombia, Costa Rica, Cuba, Ecuador, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama, Peru, the Dominican Republic, Uruguay and Venezuela.

Enhancing Capacity to Assess Environmental Radioactivity in Africa through IAEA Training on Sample Collection and Pre-Treatment

Both the marine and terrestrial environments in many African countries have been impacted by contamination from diverse anthropogenic activities such as mining, industrialization, shipping, and offshore oil and gas exploration. All these activities can potentially introduce radionuclides into the environment. By establishing appropriate environmental radioactivity monitoring programmes, these countries can begin to reliably monitor the pollution that can arise from these activities.

To help address this challenge, the IAEA supported a regional 10-day training course in late February 2020 on the *Marine and Terrestrial Sampling and Pre-treatment of Samples for Radioactivity Measurements* held in Kenya at three coastal locations: Mombasa, Ukunda and Malindi. Through this field training, the IAEA trained scientists and technical staff from selected African countries that recently established, or are in the process of establishing, their national environmental radioactivity monitoring programs: Angola, Burkina Faso, Chad, Congo, Djibouti, Ethiopia, Ghana, Madagascar, Malawi, Mauritius, Namibia, Nigeria, Senegal, Sudan, Tanzania, Zambia and Zimbabwe.

"There is limited capacity in this region to measure and monitor radionuclides in the marine, coastal and terrestrial environment. Through building the capacity in these skills, it will be possible to produce reliable quality data to help protect local populations that heavily depend on agriculture and seafood," said

Martina Rozmaric, Research Scientist and Quality Manager, IAEA Radiometrics Laboratory, Monaco.

This hands-on field and laboratory-based training equipped the participants and technical professionals with knowledge how to correctly collect and pre-treat environmental samples for measurement of radioactivity. Radioanalytical laboratories are still scarce in Africa; about one laboratory per country on average addresses environmental radioactivity concerns today. Therefore, collaboration between laboratories is crucial to improve and sustain capacity for reliable environmental radioactivity monitoring through knowledge sharing and networking.

"Zambia is a landlocked country with many freshwater rivers and lakes. However, the country's economy relies heavily on mining and both old and new mines are a potential steady source of radioactive waste," said Phillimon Shaba from the National Institute for Scientific and Industrial Research in Zambia. "If not managed properly, this contamination can have a drastic effect on our precious environmental resources and public health."

Coastal environments are particularly vulnerable to radiochemical contamination. Harbours, for example, with their slow-moving waters and high rates of sedimentation, can act as sinks for radiological and toxic contamination. Contaminants can also be carried to the coastal environment by rivers, which often deposit their sediment along the coastline. To adequately conduct marine pollution studies using nuclear techniques, local technicians must be able to perform appropriate sampling and preparation techniques for radioactivity measurements.

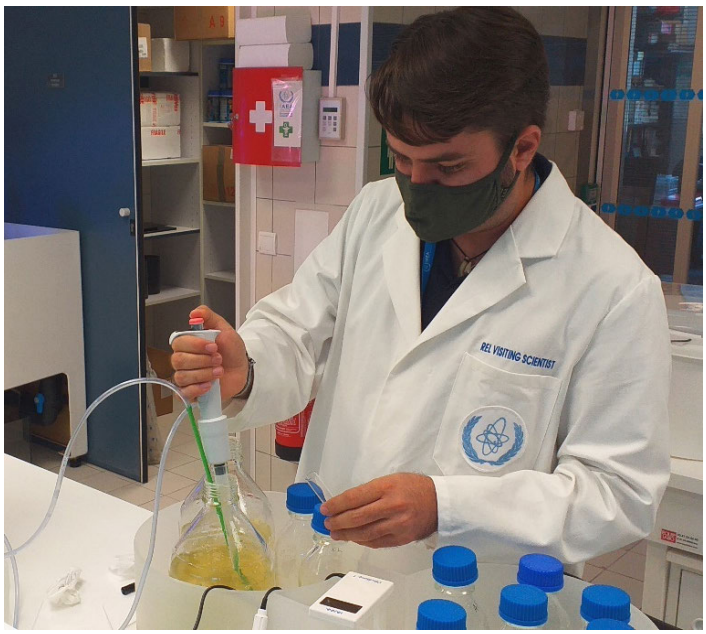
"Every good analytical result begins with getting the sampling process right," said Oscar Adukpo from the Radiation Protection Institute, Ghana Atomic Energy Commission. "I firmly believe now that we can avoid petty mistakes in sampling and samples preparations that may have been made prior to the use of analytical devices for measurement, as these training hands-on exercises demonstrate."

Over a two-week period, 23 technical staff from radioanalytical laboratories in 19 African countries collected a number of seawater, marine sediment, terrestrial soil, biota, and seaweed samples from different locations in Kenya, including the coastal waters near Mombasa, mangroves near Diani Beach in the south, and rivers, flood plains and terrestrial environments near a manganese mine near Malindi. Trainees learned how to correctly sample, handle and pre-treat water, biota and sediment samples in the laboratory prior to any further radioactivity measurements. Correct sampling and sample preparation is the basis for the reliable data, which decision makers need to sustainably manage their environment. Participants were trained how to do appropriate sampling and sample preparation according to International Standardization Organization (ISO) requirements and guidance in a recent IAEA publication: Guidelines on Soil and Vegetation Sampling for Radiological Monitoring.

Participants collecting sediment core samples at a mud flat in seagrass area in Diani south coast of Kenya. (Photo: D.C. Louw/IAEA)

Organized through Technical Cooperation project on *Promoting Technical Cooperation among the Radio-Analytical Laboratories for the Measurement of Environmental Radioactivity (RAF7017)*, efforts will continue to strengthen laboratories' capacities to generate quality and reliable information on radioactivity levels in all types of environmental materials and food products.

New Employee & Intern Profiles



"Investigating how microplastics affect marine organisms and the ocean carbon cycle is my strongest passion."
Rafael Bermúdez Monsalve

Consultant and visiting scientist from Ecuador, Rafael Bermúdez Monsalve has supported the Radioecology Laboratory team since January 2020 studying the impacts of microplastics on marine life and ecosystems. Rafael has combined his expertise in biological oceanography with his work experience as a researcher-lecturer at the Escuela Superior Politécnica del Litoral, in Guayaquil Ecuador as well as his role as a Director of the Galapgos Marine Research and Exploration program GMaRE at the Galapagos Islands. He scientific and analytical expertise is helping the Radioecology Laboratory to advance our knowledge on the role of marine animals in re-distributing marine plastics and its influence on aspects of the marine carbon cycle. A graduate from the GEOMAR Research Center in Kiel, Germany, where he obtained his MS. and PhD degrees, Rafael has also worked on ocean acidification (OA) research in the Galapagos Islands, leading the archipelago's OA monitoring programme.

"I am excited to work on environmental radioactivity at the IAEA because I feel that here, I am best able to contribute to global networking efforts in mitigating anthropogenic pollution and climate change."
Madeleine Walker

In December 2019, a scientist from the United States, Madeleine Walker, joined the Radiometrics Laboratory as an intern, bringing her new ideas and enthusiasm to support the coordination of the Analytical Laboratories for the Measurement of Environmental Radioactivity (ALMERA) network. ALMERA is the largest environmental network of its kind, with 188 laboratories from 89 countries actively participating to provide accurate and timely measurements of environmental radioactivity in routine and emergency situations. Madeleine supports the IAEA's Environment Laboratories by developing materials for new the ALMERA web site. She also is in charge of a new survey of ALMERA capabilities so that the network can be optimized and lead to more efficient information exchange with Member State laboratories. During the past months, she has integrated a new map-based interface with unique search options to the ALMERA website and is working on access authorizations that will be made available soon.

'It is never too late to be what you might have been…!'

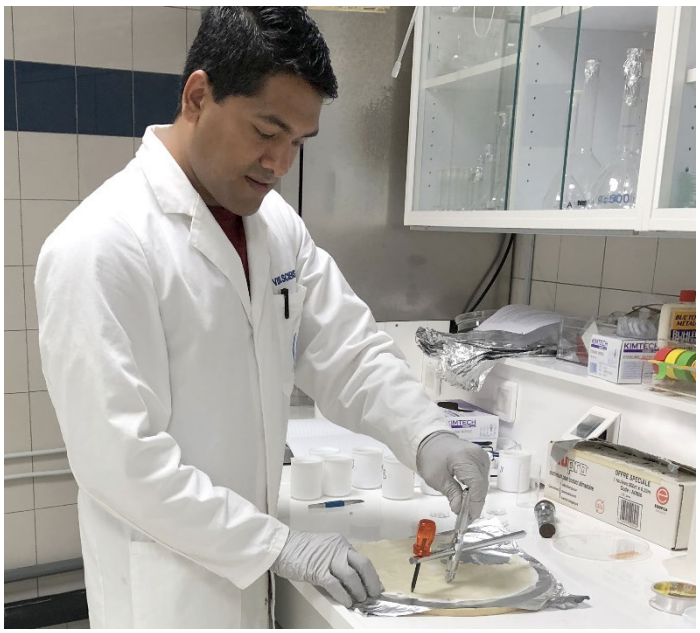
Ava Amideina

In July 2020, Ava Amideina joined the Marine Environment Studies Laboratory as an intern. As part of MESL's inorganic group, Ava will contribute to the development and validation of analytical methods for monitoring mercury species in environmental samples and to further our understanding of the occurrence and fate of mercury in the marine environment. Originally from Bulgaria, Ava earned her bachelor's degree in medical chemistry from the South-West University in Bulgaria. She also holds a master's degree in chemical metrology. Ava is currently pursuing her career as analytical validation chemist in a large pharmaceutical company Sopharma in Bulgaria where she will expand her skillset in quality control/quality assurance.

Outside of her work, Ava enjoys photography, art, travelling and exploring new cultures.

Farewells…

"It has been a wonderful learning experience and I enjoyed every day of my internship at the IAEA." Wokil Bam



In July 2019, **Wokil Bam** joined the Radioecology Laboratory team in Monaco as an intern to participate in a research project on aspects of the marine carbon cycle at the famous DYFAMED site of the Mediterranean Sea. Wokil believes his knowledge and training obtained during his PhD programme were fundamental in enabling him to come to the IAEA in Monaco. Wokil was drawn to this opportunity not only because of his research interests, but also because it gave him an opportunity to be part of the United Nations community, which was his childhood dream. At the IAEA, Wokil spent his days on sample preparation, treatment, and analysis of radionuclides to study marine carbon export and remineralization rates. Besides the main internship project, Wokil has also become involved in several other Radioecology projects and was able to contribute to several scientific manuscripts. Wokil believes that his internship at the IAEA provided him a unique opportunity to not only conduct research but also learn about building connections between science and stakeholder needs. In the coming months, Wokil looks forward to wrapping up his PhD, finalizing some IAEA projects, and pursuing his research career.

Best wishes for success as you enter an exciting new phase of your life, Wokil!

"The experience and knowledge I gained will help me succeed during my graduate school, which I start in the fall of 2020."

Will Mathew

From October 2019 through June 2020, Will Mathew has been an important addition to the organic group of Marine Environmental Studies Laboratory in Monaco. Born and raised in Murray, Utah, United States of America, Will has a degree in chemistry. His experience in extracting and analysing organic pesticides and polychlorinated biphenyls (PCBs) in fish tissue and fish food at the Hageman Laboratory at Utah State University helped him to expand his knowledge by learning liquid chromatography coupled with mass spectrometry. During his internship, Will was involved in several projects including analysing coral samples for perfluoro-octane sulfonic acid (PFOS) and perfluoro-octanoic acid (PFOA). Data obtained from these studies have contributed to MESL's research paper investigating the effect of oxidative stress and contaminant adsorption on coral growth. He also worked on analysing PFAS (perfluoroalkyl and polyfluoroalkyl substances - a large group of manufactured compounds used in a variety of industries) in both biota and water. One of Will's favourite parts of his internship has been learning new analytical instruments, meeting many new people from around the world, and learning more about science and industry.

Going back to school is a big decision, and we wish you make the transition from working full-time to pursuing higher education an exciting journey, Will!

"We are here not for a long-time. What we leave for our children should be a gift, not a trap. Preserving 70% of our planet sets us off to a good start."

Martina Rozmaric

In January 2013, Martina Rozmaric joined the Radiometrics Laboratory in Monaco as a Research Scientist and Quality Manager bringing her extensive experience in radiochemistry. For over 7 years, Martina supported the laboratory in radiochemical method development, training, establishment of Quality Management Systems (QMS), and managing different types of projects related to the environment. Martina's significant contributions through the IAEA's environment laboratory has benefitted Member States in Africa, Middle East and Latin America regions, in the field of environmental radioactivity. One of these major projects has been implemented in Namibia, establishing a baseline for measurement of radioactivity and other contaminants off the Namibian coast - one of the world's most productive large marine ecosystems. During her service to the IAEA, Martina also worked on a coordinated research project on marine pollution studies using nuclear and isotopic techniques involving many Member States. As a Quality Manager for environment laboratories, she was at the forefront in establishing and maintaining IAEA's QMS at divisional level, which led to recognition by Austrian Accreditation Association in the ranks of reference material producers (ISO 17034) and analytical techniques (ISO/IEC 17025). In 2018, Martina received an IAEA Merit Award for her outstanding performance.

Saying goodbye is never easy, especially to someone who has been such a valued team member. We wish you all the best now and into the future, Martina!

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Upcoming events

Dates	Description	Location
30 November - 2 December, 2020	Technical Meeting on the Use of Nuclear and Isotopic Techniques to Strengthen Member State Seafood Safety Programmes	IAEA Environment Laboratories, Monaco
8-11 September, 2020	Virtual annual meeting, 47th session of the Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (GESAMP)	Online
30 November – 1 December, 2020	2020 ALMERA Coordination Meeting	Online
2-4 December, 2020	Human Health and the Ocean, International Symposium	Monte-Carlo, Monaco

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