Xth International Conference on Marine Bioinvasions

16-18 October 2018

ABSTRACT eBOOK

Xth INTERNATIONAL CONFERENCE ON MARINE BIOINVASIONS

Puerto Madryn, Chubut, Patagonia, Argentina, October 16th-18th, 2018

Local Organizing Committee (LOC)

Dr. Evangelina Schwindt (Co-Chair) / Grupo de Ecología en Amb. Costeros (IBIOMAR-CONICET), Argentina
Dr. Alejandro Bortolus (Co-Chair) / Grupo de Ecología en Ambientes Costeros (IPEEC-CONICET), Argentina
Dr. Laura López Greco/ Inst. de Biodiv. y Biol. Exp. y Aplicada (IBBEA, CONICET-UBA), Argentina
Lic. Nicolás Battini / Grupo de Ecología en Ambientes Costeros (IBIOMAR-CONICET), Argentina
Lic. Clara Giachetti / Grupo de Ecología en Ambientes Costeros (IBIOMAR-CONICET), Argentina
Lic. Karen Castro/ Grupo de Ecología en Ambientes Costeros (IBIOMAR-CONICET), Argentina
Lic. Sofía Haller / Grupo de Ecología en Ambientes Costeros (IPCSH-CONICET), Argentina

Scientific Steering Committee

Professor Jeb Byers / Odum School of Ecology, The University of Georgia, USA
Dr. João Canning Clode / MARE - Marine and Environmental Sciences Centre, Portugal
Dr. Jeff Crooks / Tijuana River National Estuarine Research Reserve, USA
Dr. John Darling / EPA National Exposure Laboratory, USA
Dr. Lisa Drake (President SSMB) / SGS Global Marine Services, USA
Dr. Amy Fowler / George Mason University, USA
Dr. Graeme Inglis / National Institute of Water & Atmospheric Sciences Ltd (NIWA), New Zealand
Professor Emma Johnston / School of Biol., Earth and Env. Sci., Univ. of New South Wales, Australia
Dr. Whitman Miller / Smithsonian Environmental Research Centre, USA
Dr. Gil Rilov / National Institute of Oceanographic and Limnological Research, Israel
Dr. Marc Rius / Ocean and Earth Science, University of Southampton, UK
Dr. Thomas Therriault / Fisheries & Oceans, Canada
Dr. Chela Zabin / Smithsonian Env. Res. Centre and University of California, Davis, USA

Advisors

Professor James T. Carlton / Williams College, USA
Dr. Judith Pederson / MIT Sea Grant College Program, USA

Volunteers

Sr. Tadeo Avila (Bilingual Information Desk) / Miss. Luciana Bonardi (Bilingual YaguiArt Desk)
Sr. Ivan Bortolus (Bilingual Information Desk) / Biol. Emilia Calcagno / Dr. Carlos Rumbold

Sponsor Finders

Ale Bortolus / Lisa Drake / Evan Schwindt

Abstract Review Committee

Ale Bortolus / João Canning Clode / Jeff Crooks / Lisa Drake / Amy Fowler / Mark Rius / Gil Rilov
Evan Schwindt / Tom Therriault / Chela Zabin

ECS Award Applications Review Committee

Ale Bortolus / Jeb Byers / Jeff Crooks / Lisa Drake / Evan Schwindt / Chela Zabin

ICMB-X Website Management

Nico Battini (Web Master and general design) / Ale Bortolus (Coordinator) / Clara Giachetti (email exchange) / Graeme Inglis (IX-X Editions transition Coordinator) / Evan Schwindt (Coordinator)

SSMB-ICMB-X Social Media Management 2016-2018

Ale Bortolus (Twitter, FaceBook, Instagram) / Sofía Haller (Instagram) / Evan Schwindt (E-mailing lists)

Conference Program and Abstract Book Editors

Ale Bortolus / Evan Schwindt / Yagui

Art, Science and Society Initiative

Ale Bortolus (Coordinator) / Darío Podestá (Performer) / Yagui (Performer & Exhibit Coordinator)

Hosts and Sponsors

HOSTED BY

SPONSORS

Early Career Travel Awards

ONR Global Awards for Latin-American Young Scientist (5)

Judith A. Pederson and James T. Carlton Early Career Scientist Travel Awards (5)

Society for the Study of Marine Bioinvasions Awards (5)

Best Oral and Poster Presentation Prizes

Biodiversity Heritage Library (5)

PUERTO MADRYN - PATAGONIA - ARGENTINA

Welcome!!

Dear Attendee,

We are excited and honored to host the *Xth International Conference on Marine Bioinvasions* (ICMB-X) in Argentina, the first Edition celebrated in Latin America.

The ICMB is a major international forum for expert scientists and policymakers to discuss the latest science and emerging issues for the understanding and management of Marine Bioinvasions.

The organization of the conference is undertaken solely by voluntary members. We especially celebrate the immense effort made by the LOC members throughout the organizing process while most of them were conducting their doctoral research. We also thank the Oficina de Vinculación Tecnológica (CCT CONICET – CENPAT), for kindly assisting the LOC in whatever was necessary.

We celebrate the good number of Sponsors willing to support the study of the marine bioinvasions in Latin America and the World. They made possible for us to call for 15 Early Career Awards for young researchers from 6 countries (although two of them failed to attend the ICMB at the last minute due to personal reasons).

Scientists, managers, students and communicators from over 41 countries collaborated and sent their results to this ICMB-X Edition, where the leading-expositor authors exchanged their cutting-edge ideas in oral and poster presentations, framed by a formidable team of 7 prestigious Specially Invited Keynote Speakers from 5 continents.

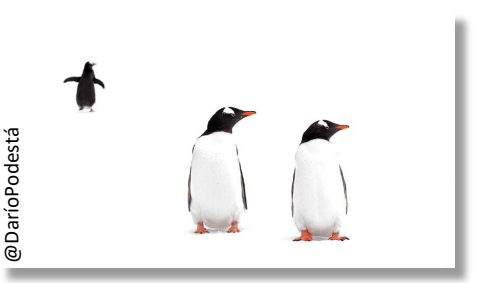
We hope you enjoyed this unique and memorable event!

Co-chairs, Dr. Evangelina Schwindt and Dr. Alejandro Bortolus

Art, Science & Society

People tend to think of marine bioinvasions as a problem exclusively restricted to the oceans, seas, and seashores. However, marine vectors have transgressed coastal-marine borders for centuries, reaching deep inland sites where they also cause serious impacts. In fact, exotic species contained in the goods onboard cargo vessels are periodically transported inland where they often became introduced and invasive. In South America, examples can be traced back to the late 19th Century when early pioneer botanist Carlos Berg detailed an impressive number of exotic species that, having arrived from Europe through the port of Buenos Aires, were later transported -mixed with the cargo/goods- along some 2000 km by land before they become introduced and widely spread across the southernmost end of Patagonia. Within this context, Yagui's art represents the perfect metaphor for us to socialize the problem of biological invasions: marine cargo ships grounded in the middle of arid continental landscapes.

Our local artists Yagui and Darío Podestá have voluntarily collaborated with the Local Organizing Committee of the ICMB-X from the very beginning. Yagui, for instance, didn´t think it twice when we asked him for one of his paintings (owned by a friend) to be used as the header of ICMB-X's social media accounts and website. Darío Podestá graciously shared with us his award-winning photographs to promote the event on the social networks.



We joined efforts with Yagui and Darío to organize the first Art, Science, and Society event ever celebrated in an ICMB edition. Sponsored by Aluar and the Administración Portuaria de Puerto Madryn, the artists merge their skills having in mind the problems debated at the ICMB-X while both ICMB-X Co-Chairs, along with other volunteer local bioinvasion scientists, deliver open-access outreach talks directed to educate people of all ages and to create awareness about Marine Bioinvasions. This SciArt initiative was also present in the Conference Program provided to all attendees at the registration desk, and including precious original art souvenirs specially made for the ocasion.

Visit the art exhibit and be amazed!

Index

Invited Speakers (Program Order)

Presenting authors (Alphabetical Order)

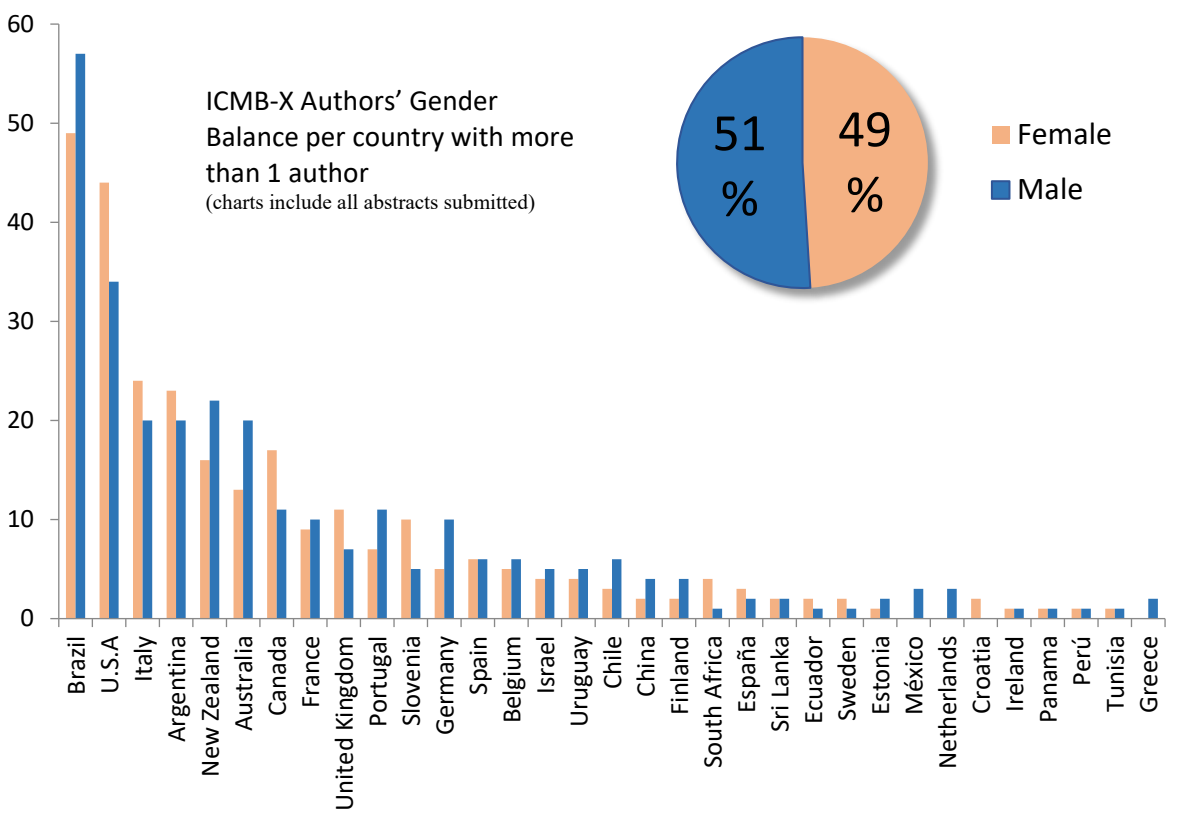
ICMB-Community General Announcements

To reduce the amount of printed paper, we made abstract books and certificates only digital, excepting the ECS Travel Awards we presented during the Conference.

Your Attendance Certificate will be sent to you over the email right after the Conference.

Abstracts

This Patagonia Edition of ICMB increased the number of countries involved since previous editions. Researchers from over 41 countries sent their abstracts with ideas and results to ICMB-X, where colleagues from 25 countries presented their collaboration in oral and poster sessions. We understand that bringing together people from different regions and cultures enrich discussions and make results more interesting. We hope future ICMB Editions will keep pushing forward the Marine Bioinvasion discipline over time with the same international spirit. The Patagonian LOC, with the support of the SSC, has worked tirelessly to put together an outstanding, gender balanced, team of Keynote Speakers, and to promote critical thinking and leadership regardless of both, gender and geographic origin worldwide. Surprisingly, we found an almost perfect gender balance among attendees.



Ubi sumus? Quo vadimus?: perspectives on the past, present, and future of understanding the scale and impact of marine bioinvasions

James Carlton
Special Invited Conference Speaker
Williams College, USA.

Robust if not rapid advances in our understanding of both the global scale and the ecological and evolutionary impacts of non-native species in the ocean are predicated on, (1) the existence of a rigorous fine-grained framework for invasion science that enhances our predictive capacity, accompanied by (2) non-subjective terminology as well as language that clarifies, for public interpretation, the statistical outcomes of experimental work, (3) a deeper appreciation of the potential lag time between the introduction of species and their recognition as non-native, and what that gap may mean for our interpretation of, and assumptions about, the modern-day structure and function of marine communities, and (4) modernizing the invasion agenda to capture the fact that climate change changes the definition of introduced species. Also key to an advanced 21st century agenda is to recognize the depth and breadth of invasions in all ocean environments, including estuaries, bays, lagoons, salt marshes, seagrass beds, dunes, coral reefs, mangroves, kelp beds, exposed rocky shores, the supralittoral fringe, intertidal and subtidal soft-bottoms, sandy beach surf zones, continental shelves, the deep sea, and pelagic habitats–all of which have sustained human-mediated invasions, despite the general impression that invasions primarily rely on artificial structures as habitat in ports and harbors.

James Carlton. E-mail: james.t.carlton@williams.edu

Invasions across latitudes: macroscale patterns, mechanisms, and predictions

Gregory Ruiz
Keynote Speaker
Smithsonian Environmental Research Center, USA.

The decline of species richness with latitude is one of the most robust patterns in ecology. Observed widely in both terrestrial and marine habitats, this latitudinal diversity gradient (LDG) remains largely unexplored for marine bays and estuaries, which have distinct species assemblages from wave-exposed outer coasts and are often hotspots of invasions by marine non-indigenous species (MNIS). On global and regional scales, most MNIS have been reported in bays from mid-latitudes (30-60°), with fewer MNIS known from low (0-30°) or high (60-90°) latitudes, suggesting a peak in non-indigenous species richness at mid-latitudes that departs from the LDG. This pattern is driven by historical differences in some combination of (a) propagule supply characteristics, (b) susceptibility to invasions, due to climatic or biotic resistance, (c) search effort to detect resident biota, and (d) knowledge of taxonomy and biogeography for resident biota. However, quantitative estimates to evaluate MNIS richness across a wide range of latitudes are still rare, limiting our knowledge of the actual macroscale patterns and the underlying mechanisms. This knowledge gap also limits predictions about geographic and temporal shifts in invasion dynamics, in response to rapid changes now underway for propagule supply, disturbance regime, and climate on a global scale. The Americas offer an exceptional model system to evaluate patterns and mechanisms of marine invasions across latitudes, including contiguous coastlines in two ocean basins that span polar to tropical waters. Efforts have begun to establish a collaborative Pan American network, which aims to characterize invasion patterns and processes across sites in North, Central, and South America. Such a collaborative network approach, with coordinated and standardized measures across a wide range of locations, is needed to achieve a truly robust understanding of macroscale invasion patterns across latitude.

Gregory Ruiz. E-mail: ruizg@si.edu

Ascidians in the anthropocene - invasions waiting to happen

Rosana Rocha
Keynote Speaker
Universidade Federal do Paraná, Departamento de Zoologia, Curitiba, PR, Brazil.

Only recently did we realize that the heretofore enigmatic disjunct distributions of many ascidian species were likely to be consequences of human activities, which may also explain why ports and marinas often have very similar assemblages even when separated by great distances. Also, only in this millenium did we note the huge impact of ascidian fouling in the bivalve aquaculture industry. Part of the reasons for the surprising influence of ascidians is because they do not have a typical “good invader” profile. They lack efficient osmoregulatory control that prevents them from surviving wide variation in salinity, typical of ports and marinas. Often they have delicate tunics that do not resist the force of drag on ship hulls. Finally, they face starvation due to the oligotrophic waters of the open ocean. On the other hand, they regenerate rapidly so small pieces can often recover from damage and become complete individuals or colonies. Also, fast growth rates and reproductive traits, such as hermaphroditism, allow rapid establishment once propagules arrive. Consequently, ascidians are becoming interesting and useful models for a broad spectrum of research that focuses on marine bioinvasion. The impressive data that has been gathered during the last 30 years demonstrate that 1) ascidians are less stenohaline than we thought, 2) tunics are often very resistant to detaching and tearing, 3) niches exist on ship hulls that promote transport without drag, and 4) construction in coastal areas offers new habitat and substrate that is now extensively occupied by ascidians. The aggregation of vast numbers of solitary ascidians and the smothering capacity of colonies result in a very high risk of impact by invasive ascidians in natural communities. While the scale of ascidian impact is not yet large, we know that it is simply a question of time. Are we prepared for the consequences of changing biodiversity?

Rosana Rocha. E-mail: rmrocha@ufpr.br

The aquaculture and aliens paradox: could the reliance of the aquaculture industry on non-native species lead to its' downfall?

Elizabeth Cottier-Cook
Keynote Speaker
Scottish Association for Marine Science, United Kingdom.

Global aquaculture production continues to increase, whilst capture fisheries stagnate. The cultivation of marine and freshwater fish, crustaceans and aquatic plants has undergone a dramatic global expansion since the 1960s (~6% yr-1), exceeding the annual growth rates of many other important commercial agricultural products, such as livestock and cereals (~2% yr-1). Yet, this exponential increase in aquaculture has been enhanced in many countries by the cultivation of non-native species. Examples include, the Pacific oyster *Magallana gigas* in Europe, the Atlantic Salmon *Salmo salar* in Chile, the (Eastern) Pacific white leg shrimp *Penaeus vannamei* in southeast Asia and the Asian red alga *Kappaphycus alvarezii* in Tanzania. Despite the apparent success of this industry to date, outbreaks of introduced pests and disease are becoming increasingly common and are having significant negative consequences both directly on production and more widely on the surrounding environment. In the case of seaweed aquaculture, which will be used as a specific example in this paper, numerous countries are facing the acute problem of disease outbreaks and pest infestations, many linked to the introduction of the red algae *Kappaphycus* and *Euchema*. Significant global losses in production of these species (>15%), equating to almost US$0.3 billion yr-1 in lost revenue, have been attributed to disease and pests and have had major socio-economic impacts on communities reliant on this industry. Key challenges include the minimal or even lack of legislation and farm management practices related to biosecurity and risk management, in the many seaweed-producing countries. A recently funded 4-year Programme 'GCRF Global Seaweed STAR' (www.globalseaweed.org), however, aims to address these key challenges and to build capacity in seaweed-producing countries to help safeguard the sustainable development of this industry and the wider aquaculture industry as a whole.

Elizabeth Cottier-Cook. E-mail: ejc@sams.ac.uk

Ballast water and hull fouling in Argentina and South America: vector assessment and regulations

Francisco Sylvester
Keynote Speaker
IEBI-FCN, Universidad Nacional de Salta and CONICET.

The assessment and management of shipping vectors has been a major concern of marine ecologists and government managers since the last decade of the past century. Ballast water, and more recently hull fouling, have been the focus of intensive research and regulatory efforts. Despite the improvements and increasing international adoption of ballast water management strategies, the numbers of marine introductions continue to build up. Pervasive difficulties are related to the efficacy of management actions, such as ballast water middle ocean exchange and on-board treatments, the existence of still largely unregulated pathways (in particular hull fouling), costs to the industry, and the huge heterogeneity of management capabilities, control efforts, and compliance with international regulations between countries. Delays in the implementation of effective management measures, especially in developing countries, cast doubts on our ability to significantly curtail aquatic invasions worldwide in the foreseeable future. In this presentation, I will review the current regulatory frame and state of scientific research on hull fouling and ballast water in Argentina and in South America.Scopus-based searches of the scientific literature allow the assessment of general trends in the evolution of ballast water and hull fouling research in our continent, comparisons between South American countries, and with the rest of the world. A more detailed inspection of the articles provide insights into the specific topics that have interested scientists recently, and help pinpoint aspects that should be covered in the future. I will also review some first-hand experiences of assessment of hull-fouling risks in Argentina.

Francisco Sylvester. E-mail: franciscosylvester@gmail.com

Marine Biosecurity Down under: a 30 year retrospective on the development of world-class systems to deliver outcomes in a fluid environment

Chad Hewitt
Keynote Speaker
University of Waikato, New Zealand.

Our affinity with marine ecosystems, particularly coastal and estuarine systems, significantly influences the public and political will to protect those environments from human-mediated impacts. Both Australia and New Zealand place iconic value on their ocean environment and the unique natural heritage it holds. As a consequence of these held values, and the geographic isolation of the two countries, both have developed world class biosecurity systems since the earliest days of self-governance. Originally this was focused on quarantine systems for protection of human health and land-based primary production. Over the last 50 years both systems have increasingly been extended to include marine ecosystems in recognition of the marine introductions that have occurred from multiple pathways, including intentional and government-sanctioned introductions. Here I provide a 30 year retrospective illustrating how both countries have pursued an evidence base to support their risk management approaches and how sharing of information and policy development have created better outcomes between the two systems, noting that many of the approaches employed by Australia and New Zealand have been exported to the global stage. In summation, I will also provide a high level perspective on the successes of both systems with observations on future challenges.

Chad Hewitt. E-mail: chad.hewitt@waikato.ac.nz

Intraregional spread of marine alien species: Integrating research and management

Tammy Robinson
Keynote Speaker
Centre for Invasion Biology, Department of Botany and Zoology, Stellenbosch University, South Africa.

The importance of the intraregional spread of marine alien biota is increasingly being recognized. Vectors such as yachts, regional fishing vessels and mariculture operations can connect primary sites of introduction to more remote locations, including important conservation areas. As such, they can play an important role in the post-boarder spread of invasive species. Because of the differences between these and primary vectors (e.g. international shipping and mariculture imports), regional vectors draw together a unique set of stakeholders and pose novel management challenges. Nonetheless, such vectors have received little research focus and management often takes the form of ad hoc adjustments to approaches developed to address primary vectors. Using yachts as an example, this presentation will explore the role of research in supporting stakeholder engagement and evidence-based management of regional vectors. It is argued that a clear understanding of the nature and dynamics of a vector, as gained through primary research and parallel stakeholder engagement, can provide the basis for effective management. Ultimately, an integrated approach will to develop a sound knowledge-base while fostering relations between researchers, stakeholders and managers, two fundamental requirements of efficient and effective management.

Tammy Robinson. E-mail: trobins@sun.ac.za

Marine traffic and exotic species in ports of Argentina: needs for early detection and rapid response plans

Mariana Abelando[1], Jessica Chiarandini[1], Magali Bobinac[1], Karen Castro[2], Evangelina Schwindt[2]

1: Prefectura Naval Argentina, Argentina.
2: Grupo de Ecología en Ambientes Costeros (GEAC), IBIOMAR-CONICET, Argentina.

In a connected world there is an urgent need to better known the shipping connectivity in order to improve the management of marine exotic species. Argentina is giving the first steps integrating stakeholders' efforts (maritime authority, port administrations, scientists and government) directed to implement the National Strategy of Exotic Invasive Species. In particular, the maritime authority, Prefectura Naval Argentina (PNA) pioneers the field applying regulations to prevent the introduction of marine exotic species. In this work, we analyze the marine traffic of three major marine ports of Argentina and their relationship with the marine exotic species reported in the literature. Marine traffic data were obtained from the PNA 2012-2016 database with the number of vessels, type of vessel, last port of call in Bahía Blanca (BBLA, 38° S), Quequén (QUEQ, 38° S) and Puerto Madryn (MADR, 42° S). We also collected data of the marine exotic species present (species, native area and likely vector). Our results showed that BBLA and QUEQ ports are receiving vessels mostly (general cargo and chemical tanker) from south Atlantic harbors as the last-port-of-call (39 % and 40 %, respectively) and the La Plata river drainage basin (45 % and 39 %, respectively). In MADR port, nearly half of the vessels (containerships) come from the South Atlantic. The highest numbers of exotic species were reported in BBLA (45), 41 in QUEQ and 27 in MADR. Most of the species (between 31-55%) were likely transported as ship fouling and from the NE Atlantic. Given that the shipping connectivity in the South Atlantic and the importance of Santos harbor (Brazil) as the main hub for the SW Atlantic, there is an urgent need for more studies and for the fast implementation of the management protocols proposed in the National Strategy of Invasive Exotic Species of Argentina.

Presenting author (ONR Global Early Career Award Winner): Mariana Abelando.
E-mail: mariana.ines.abelando@gmail.com

Evaluating the utility of qPCR applied to eDNA as a potential proxy for green crab abundance by direct comparison with traditional methods

Kristen Westfall, Thomas Therriault, Louise Roux, Cathryn Abbott

Fisheries and Oceans Canada, Canada.

Environmental DNA based biosurveillance methods hold great promise for substantial efficiency improvements to marine invasive species detection and monitoring. These include significant time- and cost-efficiency gains that could improve our ability to monitor large spatial scales effectively, which is of particular importance in the marine environment. Several freshwater studies have shown that environmental DNA concentration as determined by qPCR correlates positively with fish abundance/biomass, thus establishing the potential utility of this approach to supplement or even replace traditional monitoring. However, there is a lack of studies examining the relationship between eDNA and traditional methods for monitoring in the marine environment and for target taxa other than finfish. Here we use a targeted qPCR assay for the invasive European green crab (*Carcinus maenas*) to conduct a side-by-side comparison of monitoring results obtained by eDNA versus traditional methods. Our main aim was to determine if catch-per-unit-effort data obtained by green crab trapping significantly correlates with qPCR results obtained from both trace environmental DNA (water) and bulk DNA (zooplankton) samples. We surveyed five study sites in Barkley Sound, British Columbia, Canada: three 'high' and two 'low' sites using historical data on relative green crab abundance. Three trap lines were set at each site and retrieved approximately 18 hours later. Six 1L water samples for traceeDNA extraction followed by qPCR were collected at trap setting and collecting and two vertical zooplankton tows were conducted at each site for bulk eDNA extraction followed by qPCR. To the best of our knowledge, this is the first study that directly compares results of eDNA based methods and traditional methods for monitoring an invasive marine invertebrate species.

Presenting author: Cathryn Abbott. E-mail: cathryn.abbott@dfo-mpo.gc.ca

Influence of the temperature on settlement and mortality of larvae of the invasive coral *Tubastraea coccinea* Lesson, 1829

Luciana Altvater[1], Luciana V.R. Messano[1], Ellen S. Oliveira[1], Fernanda N. Sivero[1], Moacir Apolinário[2], Ricardo Coutinho[1]

1: Instituto de Estudos do Mar Almirante Paulo Moreira, Brazil.
2: CENPES/ Petrobrás, Brazil.

The scleractinian coral *Tubastraea coccinea*, native from the Pacific Ocean, was the first hard coral to invade the Western Atlantic. In Brazil, this species was registered on artificial substrates in late 80's, expanding to the natural environment thereafter. Despite the noticeable spread of *T. coccinea* worldwide, relatively little information is available about its physiological responses to environmental stressors. This study aims to evaluate the effects of temperature variation on settlement and mortality of *T. coccinea* larvae. Colonies of *Tubastraea coccinea* were collected by scuba diving in Arraial do Cabo, Rio de Janeiro, Brazil, placed individually in plastic bags with seawater and transported to the laboratory. In the laboratory, colonies were maintained in 250 l tanks (26° C; 35 psu) to obtain the larvae. Larvae released in a period of 24 hours were collected with a Pasteur pipette and kept in beakers with filtered seawater (5 µm) and constant aeration. Temperature bioassays were conducted in 6 well microplates. Each well received four larvae and 10 ml of filtered seawater. Microplates were held in incubators at the tested temperatures (10°, 16°, 23° and 28° C) for 15 days. Number of dead and settled larvae was counted daily under stereoscopic microscope. Mortality was significantly higher at 10° C than at the other temperatures since the first day, reaching 100% at the tenth day. At the end of the experiment, settlement was about 60% at 16°C, 13% at 23° C and 17% at 28° C. There was no settlement at 10° C. Settlement was significantly higher at 16° C than at 10° C, 23° C and 28° C. Our results showed that temperature greatly affected mortality and settlement of the larvae. Therefore, the introduction and expansion of *T. coccinea* is probably limited by this abiotic parameter.

Presenting author: Luciana Altvater. E-mail: lual81bio@gmail.com

Biota associated with the non-indigenous octocoral *Chromonephthea braziliensis* van Ofwegen, 2005 and its influence on the benthic community in Southeast Brazil

Luciana Altvater[1], Laís P. D. Naval-Xavier[2], Alexandre D. Kassuga[1], Ricardo Coutinho[1]

1: Instituto de Estudos do Mar Almirante Paulo Moreira, Brazil.
2: Programa de Pós-Graduação em Biotecnologia Marinha, Brazil.

The octocoral *Chromonephthea braziliensis*, native from the Indo-Pacific, was introduced in Arraial do Cabo (Southeast Brazil) over 20 years ago. More recently, it was found in two other nearby areas. The establishment of exotic species into a new ecossystem usually affects the local biodiversity. *Chromonephthea braziliensis* is a soft coral with arborescent branching colonies, which makes it a great host to a variety of organisms. Furthermore, the colonies might influence the benthic community around them. This work aims to assess the organisms associated to *C. braziliensis* and to evaluate its effect on the sessile benthic community. The study was conducted in Arraial do Cabo, Rio de Janeiro, Brazil. Twenty-three colonies were analyzed for associated species and fifteen for the effects on benthic community. To collect data on the associated biota, each colony was inspected for five minutes. To assess the effects on the benthic community, quadrats were photographed on three distances (0, 30, 60 cm) around the colonies. The CPCe 4.1 software was used to obtain the percentage coverage of the species from the benthic community. Thirty species were registered living in association with *C. braziliensis*, including algae, sponges, cnidarians, crustaceans, molluscs, echinoderms, bryozoans, ascidians and fishes. The yellowline arrow crab *Stenorhynchus seticornis* and the ophiuroid *Ophiothela mirabilis* were the most frequent species (78% of the colonies), followed by Palaemonidae shrimps (65%) and Paguroidea hermit crabs (52%). Our preliminary results on the benthic community showed that diversity is significantly lower close to the colonies (0 cm) than at 30 and 60 cm (ANOVA F2, 33=3.9371; p=0.02928). *Chromonephthea braziliensis* hosts a very high diversity of species when compared to other studies on octocoral associations. However, the benthic fauna around to the colonies seems to be negatively affected, since diversity was lower close to the colonies.

Presenting author: Luciana Altvater. E-mail: lual81bio@gmail.com

Can anthropogenic forcing shape ascidian invasive potential in a warming ocean?

Elizabeth A. Clutton[1], Gastón Alurralde[2], Tiago Repolho[3]

1: Institute of Marine Sciences, University of Portsmouth, United Kingdom.
2: Universidad Nacional de Córdoba, Facultad de Ciencias Exactas, Físicas y Naturales, Departamento de Diversidad Biológica y Ecología, Ecología Marina, Córdoba, Argentina. / Instituto de Diversidad y Ecología Animal (IDEA) CONICET, Córdoba, Argentina.
3: MARE - Marine and Environmental Sciences Centre, Laboratório Marítimo da Guia, Faculdade de Ciências da Universidade de Lisboa, Portugal.

High alleged levels of pollutants in anthropogenically-modified marine environments may exert high pressure on maximum physiological responses of sessile organisms acting as powerful agents of selection. Thus, local adaptation or acclimation capacity play an important evolutionary role by enabling or conditioning species tolerance to stressful environmental conditions. Temperature modulates marine ectotherms physiology, influencing survival, abundance and distribution of sessile organisms. While native species could be susceptible to ocean warming, thermal tolerance might favour the spread of non-native species. We studied the effect of a simulated heat wave on the developmental performance of *Ciona intestinalis* early life stages (ELS), derived from populations of anthropogenically modified and undisturbed environments. The fertilization rate, embryo and larvae development, settlement and metamorphosis success, and juvenile heart beat rate were assessed as experimental endpoints. Excepting fertilization and heart beat rates, temperature affected all analysed endpoints. *Ciona intestinalis* ELS derived from undisturbed sites were the most negatively affected by increased temperature conditions. Opposingly, populations from anthropogenically modified sites showed an overall positive response to thermal stress. Interaction between temperature and population origin (i.e. anthropogenically modified or undisturbed), was statistically significant for embryo and larvae development, and metamorphosis. For anthropogenically modified sites, a higher proportion of larvae development and settlement and metamorphosis success were observed under increased temperature conditions. No differences were observed for heart beat rates between sampled populations and experimental temperature conditions. We propose that selection resulting from anthropogenic forcing could shape stress resilience of species in their native range and subsequently confer them advantageous traits for invasion.

Presenting author (SSMB Early Career Award Winner): Gastón Alurralde.
E-mail: mitocondriarevelde@gmail.com

Economic impact from blue mussel *Mytilus galloprovincialis* biofouling on green-lipped mussel (*Perna canaliculus*) aquaculture

Barrie Forrest, Javier Atalah

Cawthron Institute, New Zealand.

The native green-lipped mussel (*Perna canaliculus*) forms the cornerstone of the New Zealand aquaculture industry. One of the greatest ongoing biofouling threats is over-settlement by blue mussels (*Mytilus galloprovincialis*) onto green-lipped mussel spat and crop lines. Here we present an overview of three related pieces of research, which analyse long-term and regional-scale industry data, to determine: 1) spatio-temporal patterns in blue mussel recruitment in relation to environmental drivers; 2) economic impacts of blues on green-lipped mussel production; and 3) the effectiveness of industry mitigation practices. Results of the initial study indicated an upward trend in the recruitment of blue mussels over the last 2 decades, with marked seasonal patterns, strong negative depth and relatively weaker environmental effects. These results were incorporated into a web application that enables aquaculture companies to interactively investigate blue mussel historic trends and forecast abundances in the month ahead. The economic impacts study predicted a decrease in annualised green-lipped mussel yield of ca. 5 to 10% at mean blue mussel cover, depending on spat type used. This decline represented an average loss of regional economic value of USD$11.4 million per year. When impacts on seed-stock supply and costs incurred for mitigation were also accounted for, the economic loss from blue mussel biofouling was estimated at USD$16.4 million per year, which represents 10% of the regional value of the mussel aquaculture industry. Lastly, we discuss the benefits of the main industry strategy to avoid blue mussels on crop lines, whereby lines are submerged to 4 m in an attempt to avoid the worst over-settlement. Collectively, this research provides unique quantitative insights into the impacts, benefits and costs of managing an important biofouling pest.

Presenting author: Javier Atalah. E-mail: javier.atalah@cawthron.org.nz

Impacts of the Mediterranean fanworm *Sabella spallanzanii* on subtidal soft-sediment macrofaunal and bacterial communities

Javier Atalah[1], Oliver Floerl[1], Susie Wood[1], Xavier Pochon[1], Isaac Eckert[1], Fiona Gower[1], Michael Townsend[2], Andrew Lohrer[2], Leigh Tait[2], Graeme Inglis[2]

1: Cawthron Institute, New Zealand.
2: National Institute of Water and Atmospheric Research, New Zealand.

The invasive Mediterranean fanworm, *Sabella spallanzanii* (hereafter *Sabella*), was first detected in New Zealand in 2008 and has since become established in both the North and South Islands. *Sabella* is designated as an unwanted organism under the Biosecurity Act, and has been subject to targeted surveillance in major commercial ports and harbours around New Zealand for over a decade. However, the impacts of *Sabella* invasions on New Zealand's benthic biodiversity and functioning are still poorly understood. *Sabella* has the potential to affect the surrounding soft-sediments through changes in benthic habitat due to the physical presence of the worm's tube and associated biological activities, particularly suspension feeding and biodeposition. In this study, a field-based experiment was conducted to investigate the impacts of *Sabella* on existing macrofaunal and microbial communities within soft-sediment habitats in the Waitemata Harbour, Auckland. Live and mimic *Sabella* worms were transplanted at different densities (10 - 50 individuals per m2) into experimental plots with existing assemblages, to test for potential biological and/or physical effects on benthic communities. After 6 months sediment samples were taken, with macrofaunal communities characterised using traditional taxonomic analysis and both eukaryote and bacterial communities characterised using next generation sequencing. Benthic community structure was related to changes in sediment physico-chemical characteristics and to the functions provided by dominant taxa in the studied soft-sediment habitats. Quantitative measurements of impacts of invasive species, as presented here, are crucial to assess the risk of detrimental effects of marine pests on biodiversity and ecosystem functioning to enable prioritisation of management efforts.

Presenting author: Javier Atalah. E-mail: javier.atalah@cawthron.org.nz

A Crab Trilogy: influence of parasites on interactions and interrelations between two introduced and one native crab

Rebecca Barnard, April Blakeslee

East Carolina University, USA.

Parasites have been demonstrated to play a largely overlooked role in invasion success and in mediating interactions between native and introduced species. Two introduced crabs, the Asian shore crab *Hemigrapsus sanguineus* (a late 20th century invasion) and the European green crab *Carcinus maenas* (an early 19th century invasion) co-occur with the native rock crab *Cancer irroratus* in New England. *Carcinus* and *Cancer* host one or more species of a digenean trematode parasite *Microphallus*. Using molecular genetic techniques, we examine trematode presence and identity from southern New England to Canada and consider their probable biogeographic origins. We further consider the influence of parasite infection on interspecific behavioral responses, including righting response, competition for trophic resources, and microhabitat use. Genetic data indicates distinct trematode lineages that have host switched to use *Cancer* and *Carcinus* as intermediate hosts while behavioral data suggests that these trematode parasites alter a host's behavioral responses. These experiments can help us understand the influence of parasites in community interactions, specifically between native and introduced species.

Presenting author: Rebecca Barnard. E-mail: barnardr16@students.ecu.edu

Invasion pattern and diversity of *Tubastraea* in the Western Atlantic: an integrative approach

Nathalia Bastos[1,2], Sávio H. Calazans[2], Vinicius Padula[3], Luciana Altvater[2], Elizabeth G. Neves[3], Alexa L. Trujillo[4], William Sharp[4], Eric A. Hoffman[4], Ricardo Coutinho[2,5]

1: Universidade Federal Fluminense - DOT/UFF, Brazil.
2: Instituto de Estudos do Mar Almirante Paulo Moreira (IEAPM), Departamento de Biotecnologia, Rua Kioto, 253, Praia dos Anjos, Arraial do Cabo, RJ, Brazil.
3: Universidade Federal da Bahia, Instituto de Biologia. Avenida Adhemar de Barros s/nº, Campus Ondina. CEP 40170-290. Salvador, BA, Brazil.
4: University of Central Florida, 4000 Central Florida Blvd, Orlando, FL, 32816, USA.
5: Universidade Federal Fluminense - Programa de pós-graduação em Dinâmica dos Oceanos e da Terra. Av. Gen. Milton Tavares de Souza, s/nº. Gragoatá CEP 24210-346 – Niterói, RJ, Brazil.

Most scleractinian corals of the genus *Tubastraea* have, originally, an Indo-Pacific distribution. However, some species have become globally distributed, living as exotic species on natural and artificial substrates. Interspecific overlapping of some morphological characters resulted in a complex taxonomic scenario, as evidenced by the occurrence of many synonyms. In the present study, we investigate two main questions 1) How *Tubastraea* species can be identified with the combination of morphological and genetic data? 2) Is there any correlation between southeastern US and southeastern Brazilian populations that can provide information on the invasion pattern along the Western Atlantic? According to the genetic data (ITS gene) our study indicates that three main lineages invaded the Brazilian coast and at least six lineages are present in southeastern US. This result is supported by statistical analysis. By integrating genetic and morphological data we identified three species in southeastern Brazil: *T. aurea*, *T. coccinea* and *Tubastraea* n.i. Morphologically, *T. aurea* differs from *T. coccinea* by the presence of larger corallites and a fifth cycle of septa (S5) with equal or larger size than S4. *Tubastraea* n.i., from Brazil, corresponds to the morphotype identified as *Tubastraea tagusensis* in the literature. The colonies of *Tubastraea* n.i. has morphological characteristics that are not present in *T. tagusensis*. Our results point a possible route of invasion from the North Atlantic towards the South Atlantic Ocean, suggesting that the populations from Brazil are descendant of those from North America. This study represents the first step for an integrative and more accurate delimitation of species in *Tubastraea*. This taxonomic refinement is essential for management and conservation actions related to bioinvasion events by the sun corals.

Presenting author: Nathalia Bastos. E-mail: nathaliajf@gmail.com

Recent invaders in the South Western Atlantic: what causes underlie their invasive success?

Nicolás Battini[1,2,3], Clara Giachetti[1,2,3], Karen Castro[1,2,4], Alejandro Bortolus[1,4], Evangelina Schwindt[1,2]

1: Grupo de Ecología en Ambientes Costeros (GEAC).
2: Instituto de Biología de Organismos Marinos (CONICET), Argentina.
3: Facultad de Ciencias Exactas y Naturales (UBA), Argentina.
4: Centro Regional Universitario Bariloche (UNCOMA), Argentina.
5: Instituto Patagónico para el Estudio de los Ecosistemas Continentales (CONICET), Argentina.

Alien species are among the most important threats to biodiversity, regional economies and public health worldwide. However, only a few produce conspicuous impacts and not all succeed in the same way. For long, invasion biology has inquired on the species traits and ecological processes that lead to invasion success and several hypothesis have been derived. The Enemy Release Hypothesis (ERH) argues that a species succeeds when is freed of predators and parasites in the novel environment, while the Novel Weapons Hypothesis (NWH) states that some invaders may pose novel biochemical "weapons", for which native predators have no adaptive defense. This work aims to unravel the reasons behind the invasion success of a recently introduced species in the SWA, and to test ERH and NWH as possible mechanisms to explain it. The opisthobranch *Pleurobranchaea maculata* has undoubtedly succeeded in the SWA: it has spread at a rate of 330 km per year since its first detection in 2009. This species is capable of accumulating tetrodotoxin, a potent neurotoxin previously undetected in the SWA. We focused on the predator-prey interactions to 1) identify the potential predators and their effects on *P. maculata* in the Nuevo Gulf and 2) examine the possible mechanisms underlying these interactions. Based on field observations and aquarium experiments, we found that none of the crabs and fishes that we identified a priori as potential predators preyed upon *P. maculata*, suggesting ERH, but not NWH, as a possible explanation for its success. We experimentally tested if the cryptic appearance of *P. maculata* or an active predator avoidance could explain the lack of predation, but we did not find evidences supporting either mechanism. We discuss alternative hypothesis that might explain the invasive success in the SWA.

Presenting author: Nicolás Battini. E-mail: nicolasbattini@gmail.com

Alien invaders induce homogenization in the recipient ecosystems: a simulation-like approach

Carlo Nike Bianchi[1], Monica Montefalcone[1], Giulia Gatti[2], Paolo Vassallo[1], Chiara Paoli[1], Carla Morri[1]

1: University of Genoa, Italy.
2: Station Marine d'Endoume, France.

Biotic homogenization (here intended as the process that diminishes floral and faunal differences among previously distinct communities) is a major component of global change. Invasive alien species typically show great adaptability to a wide range of environmental conditions and may penetrate different habitats, thus reducing the dissimilarity among the residing communities. We tested this assumption by analysing community zonation along a sharp ecological gradient in presence or in absence of an alien invader. We used a comprehensive dataset (78 species × 229 stations) collected between 2012 and 2017 in the Marine Protected Area of Portofino (NW Italy), where *Caulerpa cylindracea*, one of the worst invaders in the Mediterranean Sea, exhibits high substratum cover (up to 25%) between 1 and 45 m depth. We simulated a second dataset by eliminating *C. cylindracea* and prorating its cover values among the remaining species. Both datasets were submitted to multivariate analysis, which allowed identifying eight communities. Excluding *C. cylindracea* from the analysis, the eight communities resulted more sharply distinguished, the multivariate dispersion increased, and the overall similarity among stations decreased, thus indicating higher β diversity. Yet, apparently *C. cylindracea* did not replace any native species, some of these having already disappeared or rarefied due to climatic and local human pressures before the invasion by *C. cylindracea*, which therefore acted more as a passenger than as a driver of global change. Although *C. cyilindracea* has contributed to increase regional species richness (α diversity), its own widespread abundance has induced homogenization in the rocky reef communities of Portofino MPA. Continued monitoring activity is needed to understand and assess pattern and extent of *C. cylindracea*'s insertion in the recipient ecosystems.

Presenting author: Carlo N. Bianchi. E-mail: carlo.nike.bianchi@unige.it

Effects of changes in temperature in the invasive sun coral *Tubastraea coccinea*, the native zoanthid *Palythoa caribaeorum* and their interaction

Antonella Carolina Almeida Saá[1,2], Marcelo Crivellaro[3], Bruna Bittencourt Winter[4], Grazyelle Pereira[5], Manuel Vivanco Bercovich[1,2], Cintia Lulher[6], Eduardo de Oliveira Bastos[2], Paulo Antunes Horta[2], Nadine Schubert[1,2]

1: Programa de Pós-graduação em Oceanografia, Centro de Ciências Físicas e Matemáticas, Universidade Federal de Santa Catarina, Campus Trindade, Florianopolis, Brazil.
2: Laboratório de Ficologia, Departamento de Botânica, Centro de Ciências Biológicas, Universidade Federal de Santa Catarina, Florianopolis, Brazil.
3: Programa de Pós-Graduação em Ecologia, Universidade Federal de Santa Catarina, Florianopolis, Brazil.
4: Curso de Graduação em Ciências Biológicas, Universidade Federal de Santa Catarina, Campus Trindade, Florianopolis, Brazil.
5: Programa de Pós-graduação em Ciências Ambientais- CAV, Universidade do Estado de Santa Catarina – UDESC, Lages, Brazil.
6: Departamento de Química, Universidade Federal de Santa Catarina, Florianopolis, Brazil.

Sun corals (*Tubastraea* spp.) belong to the most abundant and widely distributed corals throughout the Indo-Pacific, the eastern Pacific and the wester and eastern Atlantic. Their non-native range extends to the Caribbean, Mexico and the Southwestern Atlantic. Currently, Tubastraea species are found discontinuously in tropical and subtropical biogenic and rock reefs along the Brazilian coast, with its southernmost limit in Santa Catarina. Previous studies indicate that they might cause long-term changes in benthic communities through negative competitive interactions with native species. In addition, temperature increase related to global change may affect both, spread of these species towards higher latitudes and competitive interactions with native species. Therefore, the objective of this study was to (a) evaluate the physiological responses of the native zoanthid *Palythoa caribaeorum* and the invasive coral Sun *Tubastraea coccinea*, (b) and in competitive interactions. For this, we conducted a one-month experiment, where both species were exposed to different temperatures (16, 19, 22, 25, 28, 31°C), individually and in contact with each other (interaction). During the experiment, the daily performance of *T. coccinea* was monitored through feeding/polyp activity, while *P. caribaeorum* was monitoring by chlorophyll a fluorescence. The species interaction under different temperatures was monitored visually through the appearance of *T. coccinea* mesenterial filaments and necrosis in *P. caribaeorum* tissue. At the end of the experiment, species metabolic rates (photosynthesis, respiration, and/or calcification) were measured in individual and interaction treatments. Both species showed metabolic optimums at intermedium temperatures, while at the temperature extremes their interaction resulted in higher respiratory rates or even mortality. The results are discussed in view of the current and future impact of sun coral species in Brazilian subtropical coastal ecosystems.

Presenting author: Bruna Bittencourt Winter. E-mail: brubaloo@gmail.com

Altered susceptibility to trematode parasite infection in native versus introduced populations of the European green crab, *Carcinus maenas*

April Blakeslee[1], Matt Ruocchio[1], Christopher Moore[1], Carolyn Keogh[2]

1: East Carolina University, USA.
2: Emory University, USA.

Non-indigenous species (NIS) often experience a reprieve from infection by their co-evolved indigenous parasite load when they invade novel regions. Yet absolute escape from parasites may be precluded (notably with time) by introduction(s) of parasites from the native range or novel parasite acquisition(s) in the non-indigenous range. As a result, NIS infection susceptibility may differ or change in indigenous versus novel regions due to divergent coevolutionary histories and parasite selective pressures—thus influencing host resistance and/or compatibility. To investigate this question, we reciprocally exposed native (Europe) and non-native (eastern North America) individuals of the globally-invasive green crab, *Carcinus maenas*, to trematode parasites from both regions. We found infection susceptibility to differ by parasite origin for European crabs only: European crabs exposed to European parasites had lower infection prevalence and intensity, and the lowest proportion of irregular trematode cysts or encapsulated cysts (via host immunity), compared with all other combinations. Moreover, all USA crabs became infected and cyst intensities did not differ by parasite origin. Our study provides preliminary evidence for how susceptibility may be relatively rapidly influenced by altered parasite selection pressures.

Presenting author: April Blakeslee. E-mail: blakesleeap14@ecu.edu

Fishing vessels and secondary dispersion of marine exotic species in Argentina

Magali Bobinac[1], Jessica Chiarandini[1], Mariana Abelando[1], Karen Castro[2], Evangelina Schwindt[2]

1: Prefectura Naval Argentina, Argentina.
2: Grupo de Ecología en Ambientes Costeros (GEAC), IBIOMAR-CONICET, Argentina.

Currently, nearly the 90% of the worldwide trade occurs through vessels that accidentally or deliberately transport species from one region to the other. Because of that, an appropriate management is needed to prevent or reduce to a minimum the introduction and secondary regional dispersion of species. Argentina, member of the International Maritime Organization is working in an early detection and rapid response plan as part of the National Strategy of Invasive Exotic Species (ENEEI). Also, the country ratified the BWM convention in 2017 and is now preparing to work in biofouling management strategies. Despite this, little is known about national port connectivity mainly driven by fishing vessels. This work aims to analyze the regional maritime movement among four major ports in Argentina as part of the National Strategy project: Bahía Blanca (BBLA, 38° S), Quequén (QUEQ, 38° S), Puerto Madryn (MADR, 42° S) and San Antonio Este/Oeste (SANT, 40 SL) between 2013 and 2017. All fishing vessels were categorized and the origin and geographic destination for each vessel was noted. Bahia Blanca was the port with the highest activity, showing a major connectivity with the port of Rawson (between 28-35%, 43° S) and then with QUEQ (13-16%). The rest of the ports did not show strong connectivity with other ports (nearly 4%), being most of the fishing activity conducted within the same port (91% MADR, 99.5% SANT and 96% QUEQ). These results suggest a higher risk of regional species dispersion in BBLA in both ways, as a donor and as a receptor of exotic species. The results also unveil where the management efforts should be first directed.

Presenting author: Magali Bobinac. E-mail: m.bobinac@live.com.ar

Predation pressure and propagule supply: How biotic resistance can affect probability of successful ship-borne introductions in marine nearshore ecosystems

Mariana Bonfim, Amy L. Freestone

Temple University, USA.

Biotic resistance has been suggested to vary across biogeographic gradients, with more resistant systems in the tropics in comparison to the temperate zone, for marine nearshore systems. Differential strengths of predation across latitude may contribute to this variation in biotic resistance, given the stronger effect of predators on community assembly and prey survival and growth in the tropics. Strong predation in the tropics may also reduce the likelihood of successful invasion despite high introduction effort (i.e. propagule pressure). Risk assessment models have been developed to understand the relationship between propagule pressure and probability of invasion success from ship-borne introductions. How biotic interactions further mediate invasion success, however, remains unexplored in such models. Using standardized predator exclusion experiments on fouling communities to estimate biotic resistance and commercial shipping data to estimate propagule supply, we used probability models to test how biotic resistance and propagule pressure interact to predict invasion risk for four ports across a latitudinal gradient. We expected that stronger predation pressure in tropical environments would increase biotic resistance and reduce probability of a successful ship-borne introduction. Model simulations for a given propagule size showed a reduced likelihood of invasion in the tropics due to predation effects that were three times stronger there than at higher latitudes. Models further showed, however, that existing propagule pressure into our tropical region is capable of overcoming this biotic resistance and resulting in high risk of invasion despite high predation pressure. Biotic resistance is a key element in determining introduction success of ship-borne biological invasions, and improving modeling approaches that quantify ecological filters may have important implications for the management and prevention of non-native species introductions.

Presenting author (SSMB Early Career Award Winner): Mariana Bonfim.
E-mail: mariana.bonfim@temple.edu

Low salinity stress increases mortality in fouling communities and reduces colonization of non-natives in nearshore subtidal systems

Mariana Bonfim[1], Michele F. Repetto[1], Diana P. Lopez[1], Elena Huynh[2], Laura J. Jurgens[1,2], Gregory M. Ruiz[2], Mark E. Torchin[3], Amy L. Freestone[1]

1: Temple University, USA.
2: Smithsonian Environmental Research Center, USA.
3: Smithsonian Tropical Research Institute, Panama.

Variation in environmental conditions can drive differences in community assembly. Recent evidence has demonstrated that low-salinity stress reduces growth and survivorship of nearshore marine invertebrates and subsequent recruitment of dominant species. In estuarine regions, seasonal variation in precipitation can cause abrupt reductions in salinity, and the frequency and severity of high precipitation events is expected to increase as a consequence of global climate change. Here, we investigate the factors contributing to unusually low abundance of non-native species on 135 experimental adult communities of sessile marine invertebrates in San Francisco Bay, California (USA). Between December 2015 and May 2016, a striking reduction in recruitment occurred in concert with extreme decreases in salinity (including at > 1m depth), equally affecting both native and non-native species. Long-term low salinity likely contributed to increased mortality on fouling communities, particularly affecting adult community composition and non-native species cover. In addition, the recruitment of non-natives was suppressed long-term, indicating slow post-disturbance recovery. The effect of extreme and prolonged weather anomalies on colonization dynamics has implications for the establishment and spread of non-native species in nearshore communities worldwide. Investigating the response of both native and non-native biota to varying environmental conditions can contribute to the understanding of resilience and resistance to biological invasions in the context of extreme weather events.

Presenting author (Early Career Award Winner): Mariana Bonfim.
E-mail: mariana.bonfim@temple.edu

Marine NIS Azores monitoring program

Andrea Botelho[1], Manuela Parente[2], Joana Micael[3], Ana Costa[2]

1: CIBIO-InBIO Associate Laboratory, Universidade dos Açores, Ponta Delgada, Portugal.
2: CIBIO- Research Center in Biodiversity and Genetic Resources, InBIO Associate Laboratory - Research Network in Biodiversity and Evolutionary Biology, Universidade dos Açores, 9501-801 Ponta Delgada.
3: Bird Ecology Lab, Instituto de Ciencias Marinas y Limnológicas, Universidad Austral de Chile, Valdivia, Chile.

The central position in NE Atlantic make the Portuguese archipelago of the Azores an important stopover in transatlantic routes. The main vector for mNIS in the archipelago was previously established as hull-foulling and recreational marinas were considered as high-risk areas for invasive species entrance in the region. Here we present the results of the preliminary monitoring program carried out in 2017 as a contract for the Regional Government to meet the demands of the European MSFD regarding D2 in the Azores. Fieldwork was carried out in four of the nine islands of the archipelago, in five marinas and neighbouring areas that were screened for newcomers. As a result ten new records of non-indigenous species were detected or confirmed for the region, a number that is expected to rise if other islands get covered in the program. The oceanic character of the islands makes them particularly vulnerable to biological invasions and new records of previous unobserved species have been accruing in an alarming pace. Therefore we are proposing an action plan for marine NIS prevention and monitoring in the region, considering high-risk species and priority areas in the basis of risk of invasion calculated by crossing data on presence of marine NIS with marine traffic in local marinas.

Presenting author: Andrea Botelho. E-mail: andrea.zc.botelho@uac.pt

Population structure of *Rapana venosa* in the Río de la Plata estuary during spring 2017

Diego Antuña[1], Ernesto Brugnoli[1], Patricia Correa[1], Ernesto Chiesa[2], Noemí Góngora[1], Verónica Lago[1], Maite Sánchez[1], Pablo Muniz[1]

1: Oceanografía y Ecología Marina, Facultad de Ciencias, Udelar, Uruguay.
2: Dirección Nacional de Recursos Acuáticos (DINARA-MGAP), Uruguay.

Rapana venosa, is a native gastropod from Japan, Yellow and China Sea, an active predator of subtidal mollusc, a threat to native biodiversity, having negative effects on malacofauna including economically important bivalves. *Rapana* was recorded for the first time in the Rio de la Plata (RdlP) in the Argentinean coast in 1999. Nowadays presents a wide distribution range in all muddy bottoms of the subtidal mixohaline zone of RdlP. In this study we analyzed basic population parameters (size, weight and sex proportions), feeding, percentage and richness of epibionts in RdlP estuarine zone and Uruguayan coast of the Argentine-Uruguayan Common Fishing Zone (34° and 39°30' S), in a bathymetric range between 6 and 70 m. Samples were obtained during a spring-2017 cruise coastal fishery evaluation from the fishing research vessel "Aldebarán" using a bottom trawl type "Engel" with a minimum mesh size of 35 mm between knots. Our results (119 individuals analysed) showed a wide distribution in the most mixohaline RdlP zone with organisms around 20 % visited sites. We found 10% of organisms with mollusc inside, reflected active feeding on native species. Generally, males were more abundant (54%), this trend was variable among studied sites. Mean length was 98.2±16.4mm while wide was 71.2+10.7mm. There were no significant differences in total wet weight between males and females (around 160g/indiv.). The total wet weight, aprox. 50g corresponded to soft body, the remainder was shell and epibionts, when present. The epibionts identified were: Coelenterata (*Anemone* sp.), Annelida (*Polydora* sp.), Mollusca (*Ostrea* sp.), Arthropoda (barnacles) and Bryozoa (*Membranipora* sp.), last two ones were the most abundant. A significant number of snails present ovigerous mass over the shell. The majority of the specimens presented high epibionts cover (> 40%).This study will provides useful knowledge for future research to assess this invasive species impact.

Presenting author: Ernesto Brugnoli. E-mail: ebo@fcien.edu.uy

Temporal analysis (2001-2017) of *Rapana venosa* spatial distribution in the Río de la Plata estuary

Ernesto Chiesa[1], Patricia Correa[2], Pablo Muniz[2], Ernesto Brugnoli[2]

1: Dirección Nacional de Recursos Acuáticos (DINARA-MGAP), Uruguay.
2: Oceanografía y Ecología Marina, Facultad de Ciencias, Udelar, Uruguay.

Ballast water transported several marine species from Indo-Pacific and Asia biogeographic provinces to coastal environments of South America. Among the introduced species the gasteropod *Rapana venosa* highlighted by its faster adaptation and wide distribution once arrived. *Rapana venosa* is native from Japan, Yellow and China Sea, and an active mollusc predator, being a threat to native mollusc diversity and malacological resources. The first record in Río de la Plata (RdlP) estuary dated from 1999 for the Argentinean coast (Samborombon Bay). A decade after its first record, the species expanded its distribution out of Samborombon Bay to all muddy bottoms of the subtidal mixohaline zone of RdlP. This study corresponds to the first analysis of spatio-temporal distribution of *R. venosa* in RdlP estuary. The study area correspond to the estuarine zone of the RdlP and the Uruguayan coast of the Argentine-Uruguayan Common Fishing Zone (34°-39°30'S), with a bathymetric varying between 6-70 m. Samples were obtained during cruises of coastal fishery evaluation onboard the fishing research vessel "Aldebaran" using a bottom trawl type "Engel" with a minimum mesh size of 35 mm between knots. The cruises were made seasonally between November 2001 and December 2017. Of a total of 1064 trawls, *Rapana* was present in the 16%, recording its minimum during the winter and summer (12 and 13 respectively) and its maximum in the spring cruise (83). The presence of *Rapana* was delimited by a line between Espinillo (Uruguay) and Punta Piedras (Argentine) and the outer limit of the RdlP between 5 and 20 meters deep. Minimum density was recorded in winter (0.1 kg nm^{-2}) and maximum during spring (11,000 kg nm^{-2}). Spatially, higher densities were found near Samborombon Bay, Montevideo and Canelones coastal areas. These patterns could be related with behaviour (reproductive or feeding) and also with the habitat use.

Presenting author: Ernesto Brugnoli. E-mail: ebo@fcien.edu.uy

Unlocking the history of a trans-Atlantic invader: evolutionary history of *Perna perna*

Sávio H. Calazans C.[1], Carla Lourenço[2], Kate Nicastro[2], Claudia Tagliaro[3], Carlos Eduardo Leite Ferreira[4], Flavio da Costa Fernandes[1], Edson Pereira da Silva[4], Eric A. Hoffman[5]

1: IEAPM, Instituto de Estudos do Mar Almirante Paulo Moreira, Brazil.
2: CCMAR, Universidade do Algarve, Portugal.
3: UFPA, Universidade Federal do Pará, Brazil.
4: UFF, Universidade Federal Fluminense, Brazil.
5: UCF, University of Central Florida, USA.

Perna perna is inconclusive about its origins in the New World. Shell middens investigations dating 2000yr ago failed to provide convincing evidence for the pre-historic presence of *P. perna* in Rio de Janeiro. It raised the hypothesis that *P. perna* were brought to the New World on ships associated to slave trade. Thus we investigate whether Brazilian *P.perna* were recently descended from North Africa approximately 500yr ago evaluating its evolutionary history also investigating its overall dispersal on the Atlantic Ocean estimating when Brazilian populations diverged from African populations and finally, to clarify the question of whether *P. perna* is native or not to the western Atlantic (Brazilian) coast. We genotyped 17 populations of *P. perna* at 10 microsatellite loci from three regions: North Africa (MR), South Africa (SA), and Brazil (BR). We looked at reduced levels of genetic diversity, divergence and cluster formation indicative of a recent invasion, as well testing models of migrations for indicative of historical dispersal and connectivity between populations. Our results showed four genetic clusters (k=4 and 50.31%): East South Africa (ESA), West South Africa (WSA), Brazil (BR), and North Africa (NA). WSA came to be the likely oldest population with models of migration supporting WSA and ESA with an influent connectivity between then and the overall dispersal movement being from WSA to NA and after to BR. Genetic diversity showed no general pattern of reduced or elevated levels within any region across site or loci (Site $p<0.001$, Locus $p<0.001$, and interaction effect for HE and AR, $p<0.001$). All regions are approximately equally genetically differentiated from each other ($p<0.001$) and exhibit a significant pattern of isolation by distance ($r=0.8066$, $p<0.001$). Our interpretation of these results is that they are entirely consistent with Brazilian populations of *P. perna* being a long-established native region.

Presenting author (SSMB Early Career Award Winner): Sávio H. Calazans C.
E-mail: saviocalazans@gmail.com

First record of invasive Asian green mussel *Perna viridis* (Linnaeus, 1758) in the Western South Atlantic

José Eduardo A. Gonçalves, Héctor Fabian Messano, Luciana V. R. De Messano, Sávio H. Calazans C., Ricardo Coutinho

Instituto de Estudos do Mar Almirante Paulo Moreira - IEAPM, Arraial do Cabo, RJ, Brazil.

The invasive Asian green mussel *Perna viridis* is originally found in the Pacific Ocean and Asia. Cases of introduction of this species have been reported for Indian Ocean (East Coast of India); Coral Sea (Cairns, Australia); North Atlantic (Gulf of Mexico; Florida) and Caribbean (Trinidad & Tobago; northeastern Venezuela). This is the first record of the presence of the bivalve *Perna viridis* in the South Western Atlantic. The first specimen was found on experimental panels installed at Guanabara Bay (23°S and 43°W) Rio de Janeiro, Brazil in May 2018. Thereafter, a survey was carried out in the surroundings and four alive juveniles were found attached to boulders together with native bivalves (height: 29.7±14.5; width: 9.8±4.8; length: 17.0±6.0). Some open shells were found with traces of gastropods predation indicating ecological interactions. Until now, it was not possible to identify beds formation. Guanabara Bay is a heavily urbanized and polluted estuary. It comprises a large port area, where vessels are permanently coming and going and where commercial ships anchor, waiting for entrance authorization in the port area. Fouling on vessels was the most likely vector of introduction of *P. viridis.* The occurrence of this species near Guanabara Bay port area represents a risk to other areas of Brazilian coast and neighboring countries. Early detection is one of the premises of bioinvasion management and prevention. Our findings contributed to implement a monitoring program of *P. viridis* dispersion.

Presenting author (SSMB Early Career Award Winner): Sávio H. Calazans C.
E-mail: saviocalazans@gmail.com

Unexpected guests at the table: how a non-native ascidian uses food resources and its consequences on ecosystem functioning

Emilia Calcagno[1], Clara Giachetti[2], Gastón Alurralde[1], Nicolás Battini[2], Evangelina Schwindt[2], Marcos Tatián[1]

1: Univ. Nac. de Córdoba, FCEFyN, Dpto. de Div. Biol. y Ecol, Ecología Marina/Instituto de Diversidad y Ecología Animal, CONICET, Córdoba, Argentina.
2: Grupo de Ecología en Ambientes Costeros (GEAC), IBIOMAR-CONICET, Argentina.

Harbors are prone areas for biological invasions since they provide diverse artificial structures that favor colonization by sessile marine organisms, like ascidians. These filter-feeding animals have a key role in pelagic-benthic coupling when reaching high densities: via the uptake of organic matter and the deposition of feces, ascidians fuel one of the major trophic pathways in marine ecosystems. In order to assess ascidian contribution in this pathway, we performed aquaria experiments using a non-native species (*Ascidiella aspersa*) and a cryptogenic one (*Asterocarpa humilis*) that flourish in a port area in Puerto Madryn city, Argentina. We evaluated the mass-specific biodeposition rate and the feces quality (C:N ratio) for both species, under two different diets (natural seston and natural seston enriched with phytoplankton). These parameters were related to ascidian densities, which were estimated after a year of deployment of artificial succession plates. Ascidians were the most abundant organisms of encrusting communities. *Ascidiella aspersa* predominated, reaching an annual average density of 233 individuals m-2, that is up to five-folds the density reached by *A. humilis*. The trophic processes varied according to the species and the type of diet: biodeposition rates were similar under natural seston but higher in *A. aspersa* under natural seston plus phytoplankton. Feces quality of *A. aspersa* was higher than *A. humilis* after feeding with natural seston. Besides, the amount of carbon and nitrogen in feces is greater in *A. aspersa* than in *A. humilis* for both diets. Considering the densities observed and the estimated trophic processes, *A. aspersa* would have a major incidence in the flow of particles being able to alter the normal stoichiometry and the trophic pathways in the assessed ecosystem.

Presenting author: Emilia Calcagno. E-mail: calcagnoemilia@gmail.com

Creating an effective biosecurity risk model that assesses all values: a New Zealand example

Marnie L. Campbell[1], Chad L. Hewitt[2]

1: Harry Butler Institute, Murdoch University, Australia.
2: University of Waikato, New Zealand.

Successful management of introduced species requires researchers and managers to be nimble and ready to react to new incursions at a moment's notice. To be truly nimble or agile, biosecurity needs to pro-actively establish action plans and create tools that provide aid in making effective decisions in a timely manner. These decisions also need to be agreeable to politicians and the public. With this in mind, we set out to create a series of risk models that can be used by biosecurity personnel to make decisions across a range of biosecurity scenarios, from pre-border to post-border. The risk models offer the ability to examine all values (i.e., things of importance): ecological, economic, social and cultural, and are designed to be interchangeable with different regions and countries. Underpinning the risk models is a data set that spatially represents all of New Zealand and provides a 21st century snap-shot of the publics (including stakeholders, academics, researchers, and managers) opinions and concerns for marine and coastal areas. This talk summarises the risk model, using New Zealand as our frame. We explore some of the interesting outcomes when using quantitative data to map values and to create effective risk models. We also discuss some of the interesting human geographies of New Zealand that we detected and how many of the attitudes have not been documented in the literature. As such, the new risk models are based upon a foundation of important and statistically robust data. Finally, we discuss how such models can be applied to other countries, thus providing an opportunity for a unified and global risk model for marine biosecurity.

Presenting author: Marnie L. Campbell. E-mail: marnie.campbell@murdoch.edu.au

New Zealand societal perceptions of critical values and thresholds of acceptable change within a marine biosecurity context

Marnie L. Campbell[1], Kaeden Leonard[2], Paola Rodriguez-Salinas[2], Chad L. Hewitt[2]

1: Harry Butler Institute, Murdoch University, Australia.
2: University of Waikato, New Zealand.

Coastal areas, especially beaches, are iconic places for New Zealander's that annually attract more than 800,000 international tourists, which is equivalent to 20% of the population. New Zealand is one of the few countries in the world that has policy and regulations that require cumulative effects and biosecurity to be assessed and managed within the environment. Societal and cultural values are included within this management context. However, societal values are often economic in focus, and tend to be collected in a manner that does not represent the New Zealand population or over-extrapolates data across the country. Thus, management choices are often ill-informed. To address this, we set out to identify and assess perceived societal values at a scale and provenance that would provide accurate, quantitative and unbiased information about what New Zealander's thought and cared about in their coastal and marine ecosystems. We also explored concepts of limits of acceptable change. We used a CATI survey to collect a robust spatial spread of respondents, with our tele-matched sample stratified by three broad regions. The survey was cognitively pre-tested using a "double-back" approach to tailor the survey from a "science jargon" questionnaire to one that was understood by the public. The survey went out to more than 8,000 households with just over 1,000 respondents completing the survey. This number of responses provided a statistically robust sample size that represented New Zealand's population based upon age and gender. We present some of the findings from this large data set, noting specific patterns that were previously unknown. We also examine some of the rare perceptions that have serious implications for managing coastal and marine environments. Armed with this new knowledge, engagement with communities can be tailored and decision-makers can make better judgements by understanding their stakeholders expectations.

Presenting author: Marnie L. Campbell. E-mail: marnie.campbell@murdoch.edu.au

Rafting of pests from aquaculture to nearby coastlines

Marnie L. Campbell[1], Staci King[2], Lara D. Heppenstall[2], Ella van Gool[2], Ross Martin[2], Chad L. Hewitt[2]

1: Harry Butler Institute, Murdoch University, Australia.
2: University of Waikato, New Zealand.

The invasion of non-indigenous marine species (NIMS) and the generation and accumulation of anthropogenic marine debris (AMD) are pervasive problems in coastal and marine urban ecosystems. The biosecurity risks associated with AMD rafting NIMS have been described, especially with novel pathways such as tsunami debris. Yet, the role of aquaculture derived AMD has not yet been investigated as a biosecurity vector and pathway. This preliminary study targeted 27 beaches along the Coromandel Peninsula, New Zealand, collecting debris from belt transects. Plastic (specifically plastic rope) was the dominant AMD present on beaches. The most common biofouling taxa were hydroids, bryozoans, algae and polychaetes, with one NIMS pest species, Sabella spallanzanii, detected fouling plastic rope. Sabella spallanzanii is introduced to both Australia and more recently to New Zealand. In New Zealand, it is listed as an Unwanted Organism, which has management implications. Our findings demonstrate that aquaculture is an AMD (plastic rope) generating activity that creates biosecurity risk by enhancing the spread of NIMS. The rafting of *S. spallanzanii* on AMD generated at aquaculture facilities is currently an unmanaged pathway within New Zealand that needs attention.

Presenting author: Marnie L. Campbell. E-mail: marnie.campbell@murdoch.edu.au

Hitch-hikers on marine debris: understanding new arrivals in an offshore island

João Canning-Clode[1], Ignacio Gestoso[1], Patrício Ramalhosa[1], João Monteiro[1], Maria João Lima[2], Rui Caldeira[2]

1: MARE - Marine and Environmental Sciences Centre, Portugal.
2: Oceanic Observatory of Madeira, Portugal.

The accumulation of debris in the ocean is severely affecting ocean and coastal ecosystems, as its' ingestion and entanglement directly impacts marine life. Furthermore, recent research indicates that marine debris is a growing vector for both the introduction of non-indigenous species (NIS), with transoceanic rafting already likely intensifying species invasions worldwide, and also a potential cause of marine diseases, whereby plastic waste in the oceans promotes microbial colonization and transmission of pathogens. In this context and in the framework of CleanAtlantic, an Interreg Atlantic Area funded project, we recently initiated a research program to evaluate marine debris as a possible vector for introduction of NIS to Madeira Island (NE Atlantic) by engaging and establishing a cooperation protocol with stakeholders (e.g. fishermen, dive operators and whale and bird watching companies). While at sea, stakeholders photograph and record the GPS position of detected objects, and collect them for later analysis. Once ashore these items are transferred to the laboratory for classification, measuring and for biological sampling. The origin of detected items is then estimated based upon: i) Biological signature referring to the biogeographic origin of the fouling species on the object; ii) Any identification marks referring to insignia, manufacturer's marks or serial numbers, and; iii) Physical oceanography signature through Lagrangian transport modeling (using the Connectivity Modeling System - CMS v2.0) to determine the most probable origin(s) of these objects. Preliminary analyses indicate over 135 fouling taxa were recorded from more than 80 items and approximately 10% of taxa colonizing floating debris were considered NIS, reinforcing the role of marine debris as a viable vector for the introduction species in the region. In addition, an evaluation and ranking of taxa based on their nuisance/invasiveness potential, provides basis to assess the risk of marine debris promoting outbreaks of NIS.

Presenting author: João Canning-Clode. E-mail: jcanning-clode@mare-centre.pt

Maritime connectivity and management of hull fouling: understanding factors that influence the intraregional spread of marine exotic species in Argentina

Karen Castro[1], Mariana Abelando[2], Magali Bobinac[2], Jessica Chiarandini[2], Evangelina Schwindt[1]

1: Grupo de Ecología en Ambientes Costeros (GEAC), IBIOMAR-CONICET, Argentina.
2: Dirección de Protección Ambiental. Prefectura Naval Argentina. Buenos Aires, Argentina.

To implement management strategies of exotic species in marine ecosystems is difficult and expensive. Because of that, the costs and benefits of each stage (risk assessment, monitoring, early detection, rapid response and prevention of intraregional spread) should be carefully evaluated. Argentina is working to implement these stages with the National Strategy of Exotic Invasive Species and is advancing in the understanding about vector management. In this work we present the results of the first hull fouling management case for Argentina and we analyze the potential of small vectors as intraregional dispersal of exotic species. Because the prohibition of in-water hull cleaning procedures in the marine protected area of Nuevo gulf, a touristic catamaran was intentionally beaching and its hull was completely and manually cleaned. All the biofouling was collected, quantified and disposed out of water. Different biofouling samples were taken at different hotspots hull areas and all species were quantified, identified and categorized as native/exotic/cryptogenic. To analyze the intraregional connectivity the maritime traffic among the eight most important marine ports of Argentina were studied (from Mar del Plata, 38° S to Ushuaia, 54° S) with the Prefectura Naval Argentina database (number and category of ships, origin and destination of all commercial, fishing and recreational vessels per port) between 2012 and 2016. The results showed that only one domestic vessel can accumulate more 6.5 m3 of biofouling after three years without being cleaned. Moreover, the 38% of species found were exotic and half of them are new records for Nuevo gulf. The most interconnected ports were Mar del Plata (38° S) and Puerto Madryn (42° S) by fishing vessels. These results support the importance of intraregional spread of marine exotic species. Our understanding of traffic patterns and associated biofouling contribute to develop effective biofouling management for the National Strategy.

Presenting author: Karen Castro. E-mail: karen.l.castro88@gmail.com

Unraveling the origin and potential invasibility of *Lophocladia* sp. in the Mediterranean Sea

Raul Golo, Alba Vergés, Emma Cebrian

IEA (Institute of Aquatic Ecology), Spain.

Since the opening of the Suez Canal, a large number of invasive species have transformed the complex and diverse native communities from the Mediterranean Sea into simpler invaded ones. Among those species, *Lophocladia lallemandii* was reported for first time in Greece (Pireaus, 1908) and was assumed as a Lessepsian migrant. The invasiveness of these species on the Mediterranean populations will strongly depend whether it comes from warmer areas as the Red Sea (*Lophocladia lallemandii*), as has been thought so far, or from the colder Atlantic Ocean (*Lophocladia trichoclados*). In this study, to assess whether the occupied niches from populations dwelling in the Mediterranean Sea are explained by the original occupied niches, either in the Red Sea or in the Atlantic Ocean; or if in contrast they show an expanding behavior, Ecological Niche Modeling (ENM) was used. Concretely, we used Ecospat (R package) on presence *Lophocladia* spp. data (165 references) from the Red Sea and the Atlantic Ocean; and we compared them with the niches obtained for Mediterranean Sea populations. Although populations studied could not be distinguished based on the morphological traits, they significantly differed on the ecological niche occupied. The ENM showed that whereas Atlantic and Mediterranean populations had an approximate 50% niche overlap; Mediterranean and Red Sea populations only overlapped a 10%, suggesting a closer affinity between *L. trichloclados* and the Mediterranean populations. However, if we consider the Mediterranean populations as the invasive *L. lallemandii*, we observe a high expansion pattern from the original niche. Finally, when we modeled the global distribution of the two *Lophocladia* species considering the particular niche from each one, both showed almost the same worldwide native niche.

Presenting author: Emma Cebrian. E-mail: emma.cebrian@udg.edu

Even two is too much. Additive effects of global warming and bioinvasions may drive drastic effects on calcareous systems.

Emma Cebrian[1], Cristina Linares[2], Joaquim Garrabou[3]

1: Universitat de Girona, Spain.
2: Universitat de Barcelona, Spain.
3: Institute of Marine Sciences-CSIC, Spain.

Knowledge on the interaction of different stressors and the resulting cumulative impacts, is essential to understand and predict the response to enhance the potential resilience of affected habitats. In marine environments, crustose coralline algae (CCA) are a major calcifying component of marine habitats from tropical to polar oceans within the photic zone. The main effects of climate change related stressors reported on CCA include a negative effect of global warming on recruitment, growth and calcification. However, the effects of invasive species on CCA have been fairly studied till now.Using the Mediterranean as a model system of ongoing environmental changes, we aimed to assess for first time the synergic effects of invasive algae and global warming on CCA. We have experimentally test the effect of invasive algae overgrowth on CCA subjected to anomalous high temperatures exploring the mechanisms by which invasive algae may impair CCA (physical effects of overgrowth or allelopathic interactions).Our results highlight an enhanced sensitivity to invasive algae when CCA are concurrently exposed to elevated seawater temperature, and that the interaction of two of the most widespread global change stressors (warming and invasive species) trigger drastic additive effects on a temperate CCA. Besides, the higher percentage of affected specimens subjected to invasive algae overgrowth, compared with the artificial and control treatment, points to an allelopatic effect of the algae. The reduction and eventual disappearance of these “ecosystem engineers” may undermine the ecological functioning leading to the disappearance of populations and communities associated. Understanding how global change-related disturbances interact is critical in the current context of rapid changes and the enlargement of the geographical overlap of stressors and may help to predict changes in community structure resulting from global warming and other stressors (for example bioinvasions).

Presenting author: Emma Cebrian. E-mail: emma.cebrian@udg.edu

Invasive benthic microalgae: the curious case of *Chrysophaeum taylorii* in the NW Mediterranean

Sarah Caronni[1,2], Giulia Ceccherelli[3]

1: Department of Earth and Environmental Sciences, University of Milan Bicocca. Piazza della Scienza 1, I-20126 MILANO, Italy.
2: Department of Earth and Environmental Sciences, University of Pavia. Via S. Epifanio 14, I-27100 Pavia, Italy.
3: Department of Chemistry and Pharmacy, Via Piandanna 4, I-07100 Sassari, Italy.

The benthic microalga *Chrysophaeum taylorii* Lewis and Bryan (Pelagophyceae) was recorded in the Mediterranean Sea about a decade ago, where its occurrence was detected because of the mucilage it produces. Since then, investigations have been addressed to estimate the conditions that promote *C. taylorii* high density, with the aim of forecasting mucilage production. Therefore a 4-year experiment was done by estimating the magnitude of variation in *C. taylorii* cell abundance attributable to each of several spatial (area, site, zone and replicate) and temporal scales (fortnights and years). The results indicate fortnight and year as the most relevant scales of variability in the cell abundance of *C. taylorii* and highlight the unimportance of small spatial scales (zone and replicate) to the species variability. Furthermore, two other field experiments highlighted that cell abundance of *C. taylorii* was significantly lower on macroalgae, mollusc shells and sand than on rock, and decreased with depth >2 m. Lastly, by means of a correlative field experiment it was found that, on the sea bottom, mucilage cover does not depend on epilithic cell density. It also tested the hypothesis that cells embedded in floating mucilage fall on the underlying substratum depending on the water flow. To this aim, in the field the presence of floating mucilaginous aggregates in cages with different levels of exposure to winds was manipulated. The abundance of *C. taylorii* cells on the substratum under cages with mucilage was compared with that of two controls: cages without mucilage (field) and mucilage in still water (lab). The results suggested that mucilage can represent an excellent strategy for the species to disperse, as *C. taylorii* cells fall from the floating mucilage and, if the water flow is unimportant, settle on hard substrata just underneath the cage. The results of these investigations are described and the management of possible mitigating efforts are discussed.

Presenting author: Giulia Ceccherelli. E-mail: cecche@uniss.it

Early detection of the invasive diatom *Didymosphenia geminata* (Lyngbye) in the Beagle Channel

Jessica P. Chiarandini Fiore, Magali A. Bobinac, Mariana I. Abelando

Prefectura Naval Argentina, Argentina

Phytoplankton is a biologically important group, because it is originally responsible for the presence of oxygen in the atmosphere and constitutes the initial link of the food chain of the aquatic environment. But in some cases phytoplankton can be responsible for ecological problems as it grows too much, forming what is known as algal blooms. Even though some native organisms can be very abundant and cause problems, most of the species that cause impacts are introduced types. The invasion of exotic species causes serious economic, ecological, sanitary and landscape problems. The case of *Didymosphenia geminata* (Lyngbye) is one of the most recognized in Argentina for its invasion to lakes and rivers of the Patagonian mountain range, to which this species has come through the basins shared between Argentina and Chile. In the present work, the early detection of *D. geminata* is reported in the area of the Beagle Channel (54°55.01´ S, 67°11.25´ W) at two depths: 5 and 20 meters in 2017, so far being the most austral detection. The presence of this species in the samples is recorded as isolated cells and without substrate binding feet. When analyzing the characteristics of the environment, we detected that it is characterized by being oligotrophic with the following average values: nitrogen 1.1 mg/L, phosphorus 0.2 mg/L, chlorophyll 1.17 µg/L, water temperature 5.6° C, salinity 31.92 ppm, DO 8.35 mg/L and pH 7.17. The Beagle Channel is characterized by having a low concentration of nutrients, which determines clear, well-lit and oxygenated waters, with slightly alkaline pH and quite variable salinities and ecosystems suitable for the development of *D. geminata*. As it is the first austral record found in Argentina and due to the problems caused by species in lakes of Patagonia, it is extremely important to intensify the sampling campaigns in the areas and monitor the channel in a seasonal manner.

Presenting author: Jessica P. Chiarandini Fiore. E-mail: jchiarandini@hotmail.com

The Biodiversity Heritage Library (BHL): epowering research on marine bioinvasions and beyond

Grace Costantino

Biodiversity Heritage Library, USA.

As the world's largest open access digital library for biodiversity literature, the Biodiversity Heritage Library (BHL) has revolutionized scientific research by providing free access to the data needed to study biodiversity, assess ecological changes from an historical context, and inform current conservation programs and policies. In order to document Earth's species and understand the complexities of swiftly-changing ecosystems in the midst of a major extinction crisis, extensive bioinvasions, and widespread climate change, scientists need something that no single library can provide - access to the world's collective knowledge about biodiversity. To address this challenge, the Biodiversity Heritage Library has created an international network of natural history and botanical libraries to connect hundreds of collections from around the world into a single repository, providing free access to over 50 million pages of literature from the 15th-21st centuries. With a range of free services including content downloads, full text search, taxonomic name finding, and APIs, BHL is your literature access solution, whether you're looking for original species descriptions to inform taxonomic revisions or occurrence records to trace the introduction of invasive marine species. The BHL booth at ICMB-X will highlight the library's marine biodiversity collections and free services available to support research on marine species, bioinvasions, and conservation. Materials will also showcase BHL's citizen science projects, which are being used to enrich the library's data and further support research initiatives with our content. Staff will also share real-world examples from scientists who have used BHL collections to inform research on marine bioinvasions and conservation efforts.

Corresponding author: Grace Costantino. E-mail: CostantinoG@si.edu

Fouling the islands: the invasive tubeworm *Ficopomatus enigmaticus* in the Macaronesian Atlantic

Ana Costa[1], Manuela Parente[2], António Frias Martins[3]

1: CIBIO-InBIO Associate Laboratory, Universidade dos Açores, Ponta Delgada, Portugal.
2: CIBIO- Research Center in Biodiversity and Genetic Resources, InBIO Associate Laboratory - Research Network in Biodiversity and Evolutionary Biology, Universidade dos Açores, 9501-801 Ponta Delgada, Portugal.
3: Sociedade Afonso Chaves, Ponta Delgada, Portugal.

Ficopomatus enigmaticus, also known as the Australian tubeworm was recorded from Paúl da Praia da Vitória, Terceira island (Azores), a Ramsar classified marsh. At present, *F. enigmaticus* is exclusively in the lagoon of Paúl da Praia da Vitória where was found in July 2016. *F. enignmaticus* is now well established and exhibits invasive behaviour by massive growth of reef outcrops. To explain the presence of *F. enigmaticus* in this wetland, not directly connected to the sea, we hypothesized migratory bird phoresy as a possible vector, as this mash is a well-known stopover for many migratory birds, especially Nearctic migratory waders, as this worm was not detected during an extensive search in the nearby marina. The record of this non-indigenous polychaete species on the Atlantic islands of the Macaronesia biogeographical region poses several concerns regarding the potential spread to other fragile systems in the islands. Management measures for this invasion are discussed.

Presenting author: Ana Costa. E-mail: ana.cm.costa@uac.pt

Use of vinegar/acetic acid for the control and eradication of aquatic pests: a review of uses and experimental evaluation on invasive corals (*Tubastraea* spp.)

Joel Creed, Bruno Masi, Marcelo Mantelatto

Universidade do Estado do Rio de Janeiro, Brazil.

We provide a critical review and analyse the state of knowledge regarding the use of vinegar/acetic acid (V/AA) to control unwanted marine and freshwater species. We also investigated the toxicity of vinegar for the invasive corals *Tubastraea coccinea* and *T. tagusensis* (Dendrophylliidae), using injections (1, 2 or 4 of 10, 20 or 40 ml of vinegar) and immersions (full and half concentration). A significant knowledge of the use and effects of V/AA (acetic acid n=12; vinegar n=12 studies) is available. Most studies (65%) considered marine taxa (n= 25 named species considered) compared to freshwater ones (n= 5). Three quarters of entries investigated the positive effects of V/AA as a biocide, the rest negative collateral effects. For *Tubastraea* spp., immersion treatment always resulted in the death of the corals. In contrast, the lethality of injected vinegar depended on the number and volume of injections per coral colony; partially damaged colonies may be able to recover after vinegar injection. V/AA it is an effective agent for killing most aquatic organisms, it can be applied using different methods, it can be used in different environments and for different purposes, such as controlling invasive or outbreak species and biofouling by native or invasive species on aquaculture systems and vectors. As a naturally occurring, available and ubiquitous substance most countries' legislations do not consider V/AA as harmful to the environment so they may be used applied pre-border to shipping vectors potentially transporting non-indigenous marine biofouling species such as *Tubastraea* spp.

Presenting author: Joel Creed. E-mail: jcreed@uerj.br

Invasions as consequences of change: examples from the Californias

Jeffrey Crooks[1], Julio Lorda[2], Kellie Uyeda[1], Justin McCullough[1], Monica Almeida[1], Melissa Belen-Gonzalez[3,1]

1: Tijuana River National Estuarine Research Reserve, USA.
2: Universidad Autónoma de Baja California, Mexico.
3: San Diego State University, USA.

Biological invasions can be viewed as both causes and consequences of environmental change. While there has been considerable focus on the means by which invaders change ecosystems, invasions as indicators of change has received somewhat less attention. Most generally, anthropogenic invasions result from fundamental changes in the manners by which species move around the globe. Also, "natural" range expansions might be viewed as a consequence of change, especially when driven by climate factors such as warming. Climate change, as well as smaller-scale changes in environmental conditions due to factors such as habitat degradation and pollution, also are likely to influence invader success with ecosystems. The coastal waters of California, USA, and Baja California, Mexico, provide examples of both natural and anthropogenic invasions that highlight various ways in which invaders can be viewed through the lens of changing ecosystems. These include responses to large-scale climate factors and extreme events, such as El Niño, as well as local effects due to urbanization and disturbance. Examination of these invasions provides insight into drivers of change and offers opportunities to preview potential consequences of further human alteration to ecosystems.

Presenting author: Jeffrey Crooks. E-mail: jcrooks@trnerr.org

Mitigating the threat of marine invasive species to Fiordland, New Zealand: a pathway management approach

Shaun Cunningham[1], Richard Bowman[1], Laurel Teirney[2], Rebecca McLeod[3], Jen Brunton[4], Richard Kinsey[5]

1: Environment Southland, New Zealand.
2: Independent consultant, New Zealand.
3: Fiordland Marine Guardians, New Zealand.
4: Ministry for Primary Industries, New Zealand.
5: Department of Conservation, New Zealand.

In 2012, New Zealand's Biosecurity Act was amended to allow for domestic and regional pathway management plans. This amendment was significant for managing domestic biosecurity as it allowed for rules to be placed on the vectors that invasive species utilize to reach new environments. Pathway management is vital to manage marine biosecurity risk and high value areas such as the Fiordland Marine Area (FMA) require this protection. Following the amendment, the Fiordland Marine Guardians (FMG) pushed for the governing agencies to develop a pathway management plan to manage marine biosecurity for Fiordland. A steering group was formed consisting of representatives from Environment Southland, FMG, Ministry for Primary Industries, Department of Conservation, Ngāi Tahu and Fiordland stakeholders. In April 2017 the Fiordland Marine Regional Pathway Management Plan (FMPP) was adopted by Environment Southland (the Southland Regional Council) in which it then became operative. This is the first plan of its kind. Three rules form the basis of the FMPP. The first is that all vessels operating within the FMA must hold a current 'Clean Vessel Pass' which is effectively a declaration that this vessel will meet clean hull, gear and water requirements. The pass also allows the Council to gather important information to assist communications and compliance operations. The second component is the requirement for vessels to meet a clean hull standard (no more than a slime layer and goose barnacles), a clean gear standard and residual seawater standard on entry to Fiordland. And the third rule is for vessel operators to carry evidence of the steps they have taken to meet the clean vessel standards. The Plan has now been operative for over one year, and our focus is on communications, regulatory compliance, surveillance and administering our clean vessel pass. Our successes and learning's will be discussed.

Presenting author: Shaun Cunningham. E-mail: shaun.cunningham@es.govt.nz

Advancing global monitoring of ship borne invasive species through streamlined metabarcoding

Paul Czechowski[1], Erin Grey-Avis[2], David Lodge[1]

1: Cornell University, USA.
2: Governors State University, USA.

The unintentional transport of invasive species through the global shipping network causes substantial losses to social and economic welfare. Addressing this complex challenge requires identification of potentially harmful species, and confirmation of their movement along highly frequented shipping routes. As we have previously shown, properly calibrated network models are able to describe passive movement of ship-borne invasive species around the world. Such network models can be substantially improved using in-situ biological data. This biological data can be yielded efficiently through sequencing of environmental DNA (eDNA) from port waters. Here, we report on the relationship between biologic communities, described for a growing number of ports, and key variables of shipping traffic. Environmental DNA sequence data was generated using a scalable approach. Shipping traffic information was compiled with consideration of environmental factors such as ecoregion, temperature, and salinity. We demonstrate how metabarcoding of eDNA can be used to estimate exchange of ship-borne species between economically important regions of the planet, including North America, Europe, East Asia and South East Asia. Our work is well suited to inform policy managers and decision makers on the mitigation of damage caused by invasive aquatic species.

Presenting author: Paul Czechowski. E-mail: pc683@cornell.edu

DNA metabarcoding for ballast water monitoring: an evaluation for three major United States ports

John Darling[1], John Martinson[1], Sara Okum[1], Erik Pilgrim[1], Katrina Pagenkopp Lohan[2], Katharine Carney[2], Gregory Ruiz[2]

1: US Environmental Protection Agency, USA.
2: Smithsonian Environmental Research Center, USA.

Ballast water represents a significant vector of non-native aquatic species introduction, despite increased global efforts to reduce risk of ballast water mediated invasions. Unfortunately, assessment of biodiversity transported in ships' ballast remains challenging and costly, and estimates of the propagule pools entering ports have been limited to a small number of studies. Here we employ metabarcoding based on high-throughput sequencing (HTS) to assess the diversity of propagule pools entering three major US ports over a period of several years. Ballast water samples were collected from over 150 ships entering Chesapeake Bay, Galveston, Texas, and Valdez, Alaska between 2012 and 2014. Representative DNA sequences were obtained from individual samples using the Illumina MiSeq platform. Using standard bioinformatics approaches based on sequence data derived primarily from the nuclear 18S ribosomal RNA locus, we describe delivery of biodiversity into these ports and investigate the degree to which HTS data can be used to draw inferences regarding sources of ballast water-borne diversity or effectiveness of management, specifically mid-ocean ballast exchange. Our results suggest that DNA metabarcodes reflect biodiversity signals enabling identification of ballast water source regions, and that these signals are obscured by mid-ocean exchange. While exchange does not reduce overall diversity carried with vessels, it does result in significant assemblage shifts; a subset of coastal taxa including mollusks, decapods, bryozoans, and cnidarians are strong, significant predictors of unexchanged ballast, whereas exchanged ballast shows significantly higher frequencies of planktonic taxa. Analyses based on assigned identities of operational taxonomic units also suggest the possibility that metabarcoding may provide early indications of potentially novel species introductions, particularly in unmanaged ballast.

Presenting author: John Darling. E-mail: darling.john@epa.gov

Detection of *Mnemiopsis leidyi* in UK coastal waters using an environmental DNA approach

Véronique Créach[1], Sabrine Derveaux[2], Katy Owen[3], Sophie Pitois[1], Phil Davison[1], Elvire Antajan[4]

1: Centre for Environment, Fisheries and Aquaculture Science, United Kingdom.
2: Institute for Agricultural and Fisheries Research (ILVO), Belgium.
3: Norfolk Non-native Species Initiative, United Kingdom.
4: Ifremer, France.

Since 2005, the ctenophore *Mnemiopsis leidyi* has been reported as present in the North Sea. Although the impacts of this voracious predator on North Sea fisheries remain uncertain, it is in direct competition with fish larvae for food availability and is considered a threat to the structure and function of the marine ecosystem. *M. leidyi* has never been officially recorded in UK waters. However recent model predictions showed potential for *M. leidyi* populations to establish along the UK continental coasts of the English Channel and North Sea. In this study, we used an environmental DNA (eDNA) approach to detect the presence of *M. leidyi* on the east coast of UK, indicated as a high-risk area for invasion by this ctenophore. This technique is based on the detection of DNA from cells secreted by an organism into its environment. A set of specific primers were used to target a region in the mitochondrial COI locus. Conventional PCR and SYBR® Green quantitative PCR assays were optimized and compared for sensitivity during laboratory experiments describing the kinetic of DNA released by *M. leidyi*. Natural samples collected in an open bay on the north Norfolk coast between 2010 and 2015 were tested and a positive detection was observed in 2014. This is the first time the presence of *M. leidyi* has been confirmed in UK coastal waters. This study showed how powerful the eDNA approach can be in the early stages of an invasion in a challenging environment, representing an alternative or supplementary tool to traditional monitoring techniques.

Presenting author: Phil Davison. E-mail: phil.davison@cefas.co.uk

What drives the invasion of the brittle star *Ophiothela mirabilis* Verrill, 1867 along a subtropical coast?

Patrick Derviche, Angeline Saucsen, Paulo da Cunha Lana

Laboratório de Bentos, Centro de Estudos do Mar, Universidade Federal do Paraná, Brazil.

The Eastern Pacific brittle star *Ophiothela mirabilis* Verril, 1867 has invaded the Western Atlantic and is altering the appearance and ecology of coastal rocky habitats due to its behavior of densely colonizing host species. Our aim was to assess the occurrence, distribution patterns, main hosts and suitable habitats of *O. mirabilis* along the Paraná coast, in Southern Brazil. The sampling design was defined by randomly stratified transects, sampled by scuba diving at depths between 3 and 9 meters during January-April 2018. We surveyed the brittle star and potential hosts with photo-quadrats of 10 x 10 cm at each meter along three 20-m long transects, replicated at three estuarine and three inner continental shelf sites. Host species were collected for identification in the laboratory. Species diversity of hosts increased with salinity. Leptogorgia punicea was the host most densely covered by brittle stars and *Carijoa riisei* was the most frequently colonized. The frequency of occurrence and cover rates of the brittle star were higher in estuarine habitats than in the inner shelf, although their overall distribution was limited in the inner estuarine sectors due to the absence of hosts and low salinity. We suggest that the brittle stars were initially introduced in the estuarine system and then dispersed to the inner shelf, which would explain their higher concentrations in the estuary. Since the first record in the region, about nine years ago, the species has already densely and widely spread, posing potential threats to native species and benthic associations.

Presenting author: Patrick Derviche. E-mail: patrickderviche@gmail.com

Feeding ecology of the invasive ctenophore *Mnemiopsis leidyi* as key to success: a trophic biomarker approach

Lies Vansteenbrugge[1], Kris Hostens[1], Marleen De Troch[2]

1: Institute for Agricultural and Fisheries Research (ILVO), Animal Sciences Unit, Ankerstraat 1, 8400 Oostende, Belgium.
2: Ghent University (UGent), Biology Department, Marine Biology, Sterre Campus, Krijgslaan 281 – S8, 9000 Gent, Belgium.

The invasive success of the ctenophore *Mnemiopsis leidyi* is partly related to its broad diet, which mainly consists of micro-, meso- and ichthyoplankton. Next to gut content analyses, which only provide a snapshot of the diet, grazing experiments and trophic biomarkers contribute to our understanding of *M. leidyi*'s feeding ecology. Grazing experiments were executed to determine the feeding rate of *M. leidyi* on *Artemia salina* and *Acartia tonsa* as small crustaceans, and on eggs and larvae of *Dicentrarchus labrax*. No significant differences in *M. leidyi* clearance rates (av. 0.2 ± 0.1 L.mL*M.leidyi*-1.h-1) were observed between prey types or sizes. Secondly, 13C tracer experiments were performed to determine carbon assimilation in *M. leidyi*, by offering enriched diatoms and the above mentioned animal prey as food sources. Highest carbon assimilation was observed for *Acartia* and sea bass larvae, and lowest for *Phaeodactylum*. To further elucidate prey-dependent variation in carbon uptake, the fatty acid composition was investigated, as a proxy for food quality. The consumption of sea bass larvae, characterized by higher levels of DHA (an essential fatty acid), resulted in significantly higher FA concentrations in *M. leidyi*. As *M. leidyi* does not convert excess food into storage lipids, it is likely that growth and reproduction will be enhanced when feeding on high quality food sources. A potential temporal overlap between the occurrence of *M. leidyi* and the high energetic fish larvae (e.g. due to global warming) may substantially impact the ichthyoplankton community in areas where *M. leidyi* has been introduced.

Presenting author: Marleen De Troch. E-mail: marleen.detroch@ugent.be

Disease translocation in a connected world: the anatomy of a mollusc disease outbreak

Marty Deveney[1], Kathryn Wiltshire[1], Daniele Giblot-Ducray[1], Shane Roberts[2], Nick Moody[3], Mark Crane[3], Kevin Ellard[4]

1: South Australian Research and Development Institute, Australia.
2: Department of Primary Industries and Regions, South Australia, Australia.
3: CSIRO Australian Animal Health Laboratory, Australia.
4: Department of Primary Industries, Water and Environment, Tasmania, Australia.

The Pacific oyster is an important commercial edible oyster and an established invasive species. Each year hundreds of vessels arrive in Australian ports from sources in the known range of Pacific oysters and OsHV-1 microvariant, the causative agent of Pacific Oyster Mortality Syndrome. In South Australia (SA), measures are in place to prevent entry of OsHV-1. In July 2016 a barge was towed 1050nm from Sydney, NSW, to Port Adelaide, SA with Pacific Oysters on its hull. The barge was cleaned on arrival, but 1/54 oysters tested positive for OsHV-1 microvariant. Processed oysters for human consumption were also imported to SA from infected areas. A surveillance program for *C. gigas* and OsHV-1, using eDNA commenced in 2016. In November 2017 OsHV-1 was detected from a plankton sample in Port Adelaide, SA. On 28 February 2018 South Australia confirmed its first case of POMS in Port Adelaide. Plankton samples and Pacific oysters from Port Adelaide were analysed and showed high viral load. The outbreak caused very high mortalities (>99%) in Pacific oysters in the Western side of Port Adelaide, and was detected throughout the system. An emergency response was mounted to decrease viral load and limit the risk of the virus spreading to oyster farming regions. Hydrodynamic modelling of viral particle dispersal showed that spread via currents was unlikely to carry the virus to farm sites and active and passive surveillance has demonstrated that SA farmed oysters are free of OsHV-1. Vessel biofouling can translocate OsHV-1, and probably other pathogens, across continental-scale distances. The sudden range extension of OsHV-1 demonstrates the complexity of understanding and controlling vectors.

Presenting author: Marty Deveney. E-mail: marty.deveney@sa.gov.au

Validating molecular surveys for marine pests in Australia

Marty Deveney[1], Kathryn Wiltshire[1], Daniele Giblot-Ducray[1], James Forwood[2]

1: South Australian Research and Development Institute, Australia.
2: Department of Agriculture and Water Resources, Australia.

Surveillance provides knowledge about marine pest distributions to inform vector management and pest risk mitigation, and can detect new incursions or range extensions for understanding and effectively responding to threats. We surveyed seven Australian ports for key marine pest species using molecular assays that have been laboratory validated and applied to surveys in Port Adelaide, and parallel traditional surveys. Across the surveys all the target pests were detected at each location where they are established, with some showing distinct seasonal patterns of detection. Some range extensions were also described. Field validation is an important component of implementing robust systems for molecular surveillance. In parallel, these assays are being validated. This work is contributing to developing a core facility for molecular detection of marine pests in Australia.

Presenting author: Marty Deveney. E-mail: marty.deveney@sa.gov.au

Biotic resistance to invasion is stronger in the tropics and mediated by functional traits of prey

Gustavo M. Dias[1], Edson A. Vieira[1], Lueji B. Pestana[2,3], Katherine M. Griffith[4], Antonio C. Marques[2], Stuart R. Jenkins[4]

1: Centro de Ciências Naturais e Humanas, Universidade Federal do ABC, São Bernardo do Campo, Brazil.
2: Departamento de Zoologia, Instituto de Biociências, Universidade de São Paulo, São Paulo, Brazil.
3: Departamento de Biologia, Faculdade de Ciências, Universidade Agostinho Neto, Angola.
4: School of Ocean Sciences, University of Wales Bangor, Anglesey, United Kingdom.

Predation is one of the main interactions shaping diversity, providing communities resistance to biological invasion. It has been hypothesized that the effects of predation follow a latitudinal gradient, being more intense towards the tropics. However, recent studies have shown that the outcome of predation is variable, null or opposite of what it is expected for tropical and temperate zones. Since there are disputing hypotheses concerning the latitudinal pattern of predation effects, we conducted a large scale (40 degrees of latitude) exclusion experiment in order to assess how predation shapes sessile communities and the occurrence of exotic species. The experiment was conducted during summer time over a period of 3 months at tropical (Angola), subtropical (Brazil) and temperate sites (United Kingdom). It consisted of PVC panels for sessile community settlement, which were assigned to caged, fenced and open treatments. While predators had no effect on panels from temperate sites, they consistently reduced species richness and exotic species in the tropics. Predation also affected community structure leading to a dominance of soft bodied animals (ascidians and polychaetes) on caged panels and calcified organisms (laminar bryozoans) on panels open to predators. In the subtropics, predation had no effect on the total number of species and number of exotic species, however community structure was modified by predation in a similar way to the tropics; the abundance of soft-bodied organisms decreased, and the area covered by calcified animals increased on panels exposed to predation. Our results reinforce that predation is more effective in shaping sessile community and controlling invasion in the tropics, and that functional traits of prey mediate resistance to predation, suggesting that physically defended organisms are more likely to become harmful invaders where predation is strong. FAPESP 2016/17647-5

Presenting author: Gustavo M. Dias. E-mail: gmdias@ufabc.edu.br

Invasion of *Boccardia proboscidea* (Annelida: Spionidae) in South America

Vasily I. Radashevsky[1], María Emilia Diez[2]

1: Institute of Marine Biology, National Scientific Center of Marine Biology, Far Eastern Branch of the Russian Academy of Sciences, Russian Federation.
2: Laboratorio de Parasitología (LAPA), Instituto de Biología de Organismos Marinos (IBIOMAR) (CCT CONICET-CENPAT); Laboratorio de Investigación en informática (LINVI), Facultad de Ingeniería, Universidad Nacional de la Patagonia San Juan Bosco (UNPSJB), Argentina.

Spionid polychaete, mudworm *Boccardia proboscidea* Hartman, 1940 was originally described from California and later widely reported from the Pacific side of North America from British Columbia south to California, and also in Japan, Korea, China, Australia, Tasmania, New Zealand, Hawaii, South Africa, northern Spain and British Islands. In South America, an explosive development of *B. proboscidea* was found near the sewage outfall of Mar del Plata city, Buenos Aires Province, Argentina, in 2008. The dense sand tubes of these worms (up to 650.000 ind·m^{-2}) rapidly formed large biogenic reefs in sewage-impacted intertidal area. In January 2010, dense population of *B. proboscidea* was discovered in the area of Puerto Madryn, Chubut Province, five degrees of latitude south of Mar del Plata. Mudworms were found in a variety of substrates: in mud and sand flats, smothering barnacles and mussels on rocky substrates, and burrowing into intertidal abrasion platforms composed of friable sedimentary rocks. Since then, well established intertidal settlements of reproducing individuals were found all along the coasts of northern Patagonia, greatly affecting the associated native communities. Progressive invasion of *B. proboscidea* in Argentina is accompanied by extinction of its close relative, *Boccardia claparedei* (Kinberg, 1866), which occupies the same ecological niche and is considered to be native in South America. *Boccardia proboscidea* has not been reported from the Atlantic coast of North America, and the Pacific coast of South America. It is likely to have been transported to Argentina as larvae in ballast water. Reproductive biology of *B. proboscidea* is discussed in relation to its invading population.

Presenting author: María Emilia Diez. E-mail: emiliadiez@cenpat-conicet.gob.ar

The Practicability of Combining Ballast Water Exchange with Ballast Water Treatment: results of Shipowner Survey

Lisa Drake[1], Jon Stewart[2], Gary Croot[3], Matthew First[1]

1: SGS Global Marine Services, USA, USA.
2: International Maritime Technology Consultants, Inc., USA.
3: International Maritime Environmental and Safety Associates, USA.

Two agencies are currently responsible for regulating ballast water discharges in the United States—the U.S. Coast Guard (USCG) and Environmental Protection Agency (EPA)—and they have promulgated an identical, numeric standard that limits the density of living organisms in discharged water. The regulations do, however, differ in some aspects. One notable difference is the additional protection stipulated in the EPA's Vessel General Permit (VGP) for some ships arriving to the North American Great Lakes. For ships meeting the criteria in the VGP, once it is required to meet the numeric discharge standard—likely by treating the ballast water using a ballast water management system (BWMS)—it must also conduct "ballast water exchange" (BWE) or "saltwater flushing". Thus, ships will need to undergo BWE in addition to ballast water treatment (BWT). A survey of shipowners was conducted to gather data related to this practice. These data are intended to inform the next issuance of the VGP, specifically, the inclusion (or not) of the BWE plus BWT provision. Here, 22 questions were developed to gain insight into existing BWMS installations, focusing on the challenges of operating such systems and any difficulties in conducting BWE plus BWT. Responses were received from 24 shipowners representing all major sectors of the shipping industry and a total of 409 unique BWMS installations. Most (72%) of the respondents determined that BWE plus BWT would incur additional costs, for example, in labor, consumables, and equipment service life. One respondent stated that his or her company's "newbuilds" (newly constructed ships) were designed and built to conduct BWT, not BWE. These vessels were built without the capability or strength to conduct exchange since they were installing a BWMS and assumed that BWE would not be necessary.

Presenting author: Lisa Drake. E-mail: lisa.drake@sgs.com

Disturbance and fouling communities: the role of non-indigenous species on artificial habitats and natural shores

Jasmine Ferrario[1], Ignacio Gestoso[2], Patricio Ramalhosa[2], Eva Cacabelos[2], João Canning-Clode[2]

1: University of Pavia, Italy.
2: MARE - Marine and Environmental Sciences Centre, Portugal.

The tolerance capability on fouling communities from different habitats to anthropogenic stressors has often given opposite results due to the interaction of several variables. Investigating the resistance of different fouling communities to port habitat conditions is therefore an important issue for the development of future "green ports", that from a "biopollution" point of view will be aimed to favour fouling communities able to limit the settlement and then the introduction of non-indigenous species (NIS). In this context, a manipulative experiment conducted in a mesocosm system was carried out by testing the disturbance of two stressors (chemical and physical) on fouling communities collected inside a marina located in Madeira Island (NE Atlantic) and from a natural rocky habitat nearby. Three-months old fouling communities were collected from a total of 24 PVC panels and randomly exposed to a chemical (heavy metals exposure through an antifouling paint) and/or physical condition of disturbance (physical pressure of the panels). The main goal of this experiment was to compare the responses of the two communities after a disturbance event, by analysing the whole fouling species composition and the non-indigenous component only. The two fouling communities were observed to be different: inside the marina the plates were mostly colonized by NIS, while outside natives were dominant in total cover, even if NIS richness was similar in both communities. Fouling communities were both strongly affected by the chemical stressor and not by the physical one, but the communities from the natural habitat were observed to be more resistant. Our findings highlight how communities dominant in native species composition and more diverse (in this case from natural rocky habitat) can prove a certain degree of tolerance to stressful conditions, conversely to the expected better resistance of NIS-based fouling communities.

Presenting author: Jasmine Ferrario. E-mail: jasmine.ferrario@unipv.it

Bowed down in a sea of troubles: the role of recreational boats in the spread of alien species in the Mediterranean Sea

Aylin Ulman[1], Jasmine Ferrario[1], Aitor Forcada[2], Hanno Seebens[3], Christos Arvanitidis[4], Anna Occhipinti-Ambrogi[1], Agnese Marchini[1]

1: University of Pavia, Italy.
2: University of Alicante, Spain.
3: Senckenberg Biodiversität und Klima – Forschungszentrum, Germany.
4: Hellenic Centre of Marine Research, Greece.

A large-scale study on the biofouling communities on recreational vessels and marinas was undertaken in the Mediterranean Sea. Approximately 600 boat owners in total from 25 marinas (in France, Italy, Malta, Greece, Turkey and Cyprus) were surveyed on their boat specifics, antifouling practices and travel history. Additionally, samples were collected from these same boat-hulls to first identify which NIS they were carrying, and then statistical analyses were tested to determine which factors drive the higher species richness on boat-hulls. About 500 of the vessels contained fouling, the remainder having been recently cleaned. Of all sampled vessels, 70% hosted at least one NIS, up to a maximum of 11. NIS richness in marinas is found here to strongly correlate to NIS richness on their boats. Of ten factors tested to determine influence of higher NIS richness on boat-hulls, the most significant were: time since last cleaning (which includes the last antifouling coating) and the visible hull fouling estimate of niche areas (observed from the boat hulls). Boat hull material, average cruising speed, and increased marina visits did not contribute here to higher NIS richness on boat-hulls. We warn here that boats moored in the Eastern Mediterranean region especially pose a much higher risk of spreading NIS due to a higher divergence in species occurrences between marinas and the boats within them.

Presenting author: Jasmine Ferrario. E-mail: jasmine.ferrario@unipv.it

Who's next? Marinas of the Red Sea, potential sources of marine species introductions in the Mediterranean Sea

Mohamed El-Metwally[1], Jasmine Ferrario[2], Matteo Bertoni[2], Cesare Bogi[3], Joachim Langeneck[4], Agnese Marchini[2], Anna Occhipinti-Ambrogi[2]

1: National Institute of Oceanography and Fisheries (NIOF), Hurghada, Egypt.
2: Department of Earth and Environmental Sciences, University of Pavia, Italy.
3: Gruppo Malacologico Livornese, Leghorn, Italy.
4: Department of Biology, University of Pisa, Italy.

The arrival of Indo-Pacific species in the Mediterranean Sea is a process not yet fully understood. Species may have been introduced by two distinct vectors: spontaneous migration through the Suez Canal, or hitch-hiking on ships that navigate through the Canal. When a new Indo-Pacific species appears in the Mediterranean, its vector of introduction is often only a guess. In this work we analyse fouling communities in marinas and moorings along the Egyptian coast of the Red Sea, in order to unveil the possible source and vector of alien species already entered in the Mediterranean Sea and identify potential new invaders. Within a CICOPS fellowship (University of Pavia), a collaboration project between the Department of Earth and Environmental Sciences (University of Pavia, Italy) and the National Institute of Oceanography and Fisheries (Egypt) was carried out. Two different survey methods were carried out in different localities along the northern Red Sea coast (from Qusier to Hurghada), in summer 2017. Samples were collected both from PVC panels and concrete docks, or other artificial substrates. We found over 20 species, including bryozoans, crustaceans, molluscs and polychaetes, that are considered alien species in the Mediterranean; thus supporting the hypothesis that they might have been introduced by boats travelling from there. The fouling communities observed were also composed by some Indo-Pacific species that had never been reported before from the Red Sea. These results raises a new question: is the Red Sea part of their natural geographic range, or have they been brought there artificially by boats? Finally, few taxonomically unresolved specimens were found, probably undescribed species. For a better knowledge of fouling communities of the Red Sea and the on-going alteration of the biogeography of marine biota caused by human activities, scientific cooperation among countries should be promoted.

Presenting author: Jasmine Ferrario. E-mail: jasmine.ferrario@unipv.it

New Zealand's biosecurity response to *Bonamia ostreae*

Nicky Fitzgibbon, Anjali Pande

Ministry for Primary Industries, New Zealand.

Bonamia ostreae, a single-celled parasite that can cause death of flat oyster species, was first detected in Marlborough, New Zealand in 2015. The spread of *B. ostreae* presents a significant issue to New Zealand's biodiversity, ecosystem structure and economy. A biosecurity response was therefore initiated by the Ministry for Primary Industries (MPI). The initial response included an ongoing, long term surveillance plan to monitor the spread. It was under this surveillance plan that *B. ostreae* was detected almost 800kms away in Big Glory Bay in Stewart Island in 2017. This detection changed the overall picture of *B. ostreae* presence in New Zealand. Though eradication was not considered feasible, MPI made the decision to urgently depopulate oyster stocks from all high-density farming areas to reduce the parasite burden and slow the disease's spread. Almost 2500 tonnes of material was removed from 25 farms. The complex nature of the response involved removing infected material across the main fishery, sometimes in very inhospitable conditions. The presentation will detail the biosecurity response actions taken in 2017, the economic and social impacts as well as exploring the potential future long term management options.

Presenting author: Nicky Fitzgibbon. E-mail: nicky.fitzgibbon@mpi.govt.nz

Ballast waters as an important vector for the transfer of Harmful Aquatic Organisms and Pathogens (HAOP) and Non-Indigenous Species (NIS) – BALMAS project case study

Vesna Flander-Putrle[1], Patricija Mozetič[1], Janja Francé[1], Valentina Turk[1], Tinkara Tinta[1], Mateja Grego[1], Martina Orlando-Bonaca[1], Borut Mavrič[1], Jernej Uhan[2], Lovrenc Lipej[1]

1: Marine Biology Station, National Institute of Biology, Fornace 41, SI-6330 Piran, Slovenia.
2: Slovenian Museum of Natural History, Prešernova cesta 20, p. o. box 290, SI-1001 Ljubljana, Slovenia.

Ballast waters are an important vector for the transfer of Harmful Aquatic Organisms and Pathogens (HAOP) and Non-Indigenous Species (NIS). Many organisms loaded on board survive ballasting operations and longer voyages. For the efficient ballast water control and management system, which would track NIS introductions and identify threats for ballast water receiving ports, Port Baseline Surveys (PBS) are to be conducted in ports in order to compile a list of native species and NIS. These PBSs comprise the sampling of benthic organisms on hard and soft bottoms, plankton and fish community. In the frame of the IPA Project BALMAS (Ballast water management system for Adriatic Sea protection) a PBS in the Port of Koper (Slovenia, Adriatic Sea) was performed. In phytoplankton samples 15 species were recognized as potentially harmful and a few species were detected for the first time in Slovenian waters. Cysts of five potentially harmful dinoflagellates were present in the port sediments. Among zooplankton, certain species related to the tropicalisation process were identified. Moreover, the first finding of one copepod (indigenous to the Northwestern Pacific Ocean) in Slovenian waters was related to the bioinvasion, and was possibly introduced by ships. In macrofouling and benthic infauna samples ten NIS were identified. To serve as a basis for the establishment of ballast water monitoring in the ports, the ballast water sampling was performed, as well. Besides, the BALMAS project aimed to provide a regional framework and an integrated operational plan for an effective water management strategy for the Adriatic ports, and to increase awareness. All the activities followed the rules and regulations of the International Convention for the Control and Management of Ships' Ballast Water and Sediments – BWM Convention (London, 2004).

Presenting author: Vesna Flander-Putrle. E-mail: flander@nib.si

Understanding the potential for marine pest spread via bilge water: an evaluation of vessel systems and operator behaviours

Lauren M. Fletcher, Javier Atalah, Grant A. Hopkins

Cawthron Institute, Private Bag 2, Nelson 7042, New Zealand.

Vessel movements are considered the primary anthropogenic pathway for secondary spread of marine non-indigenous species. Recent studies have highlighted the potential for organisms to be transported within bilge water of small vessels, including the potential for some organisms to be viable at the time of discharge. It is conceivable that some vessel types, uses and operator behaviours represent a greater species transfer risk. In this study, a questionnaire-based survey of vessel operators was carried out to: (1) describe the bilge water operational profiles of a range of domestic vessels operating in New Zealand; (2) prioritise factors driving the level of risk and calculate a vessel risk score; and (3) elucidate the relative influence of risk factors and vessel descriptors. Significant differences in risk scores between vessel types were shown; risk was highest for yachts, followed by launches, trailer boats and commercial vessels. Thirty-five percent of vessels surveyed were shown to pose no risk of transporting viable marine species (i.e. risk score = 0). These vessels reported no uptake of water, solely engine cooling or freshwater sources, or no use of the bilge system. Boosted tree regression analysis of 'risky' vessels (i.e. risk score > 0) indicated vessel risk was primarily driven by differences in distance travelled, the likelihood of bilge water on board at departure, and the maximum volume of water that can accumulate. Our findings show that bilge water discharges from some vessels are likely to pose a non-negligible biosecurity threat, and that this mechanism has the potential to compromise the overall effectiveness of vector management initiatives. Validation of vessel risk profiles through targeted sampling for specific marine pests in case-study regions is recommended, along with further research to identify potential practical and cost-effective mitigation measures.

Presenting author: Lauren M. Fletcher. E-mail: lauren.fletcher@cawthron.org.nz

Marine pest distribution, reservoirs and dispersal firebreaks in relation to green-lipped mussel farms in New Zealand

Javier Atalah, Lauren Fletcher, Xavier Pochon, Barrie Forrest

Cawthron Institute, New Zealand.

Commercial shellfish culture is particularly prone to issues from biofouling, due to the creation of complex novel habitats provided by bivalve shells and farm structures. Biofouling assemblages often include a high proportion of non-indigenous species, which are considered a significant threat to coastal ecosystems. The work presented here is part of on-going research to characterise the regional distribution of several pest species in relation to green-lipped mussel (*Perna canaliculus*) farms in the Pelorus Sound region of New Zealand. Specifically, the study aims to determine whether: (i) pest occurrence and abundance is determined by the distance to artificial structures associated with mussel farms; (ii) pest distribution in relation to artificial structures is determined by larval dispersal capacity; and (iii) mussel farms act as reservoir and/or 'stepping stones' for the dispersal of marine pests. Field surveys are being conducted to describe spatial and temporal patterns of pest distribution on mussel farm structures and in adjacent and distant rocky habitats. Preliminary results indicate pest-specific regional-scale patterns in abundance, with some species found exclusively on farm structures, while others were dominant in both artificial and natural habitats. Of particular interest were 'blooms' of several opportunistic macroalgal species during a recent summer survey, with some species colonising extensive areas of natural habitat. Some of these algal species were subsequently described for the first time in New Zealand using molecular techniques. Pest distribution and dispersal patterns will be further investigated to elucidate potential 'firebreaks' in farm connectivity that can be used to develop pest management strategies focused on pest avoidance through farm fallowing.

Presenting author: Lauren M. Fletcher. E-mail: lauren.fletcher@cawthron.org.nz

Change structure and abundance of shallow tropical rocky shore benthos over twelve years invasion by the corals *Tubastraea* spp.

Beatriz Fleury[1], Bruno Lages[2], Amanda Silva[1], Joel Creed[1]

1: Universidade do Estado do Rio de Janeiro / UERJ and Insituto Brasileiro de Biodiversidade (BrBio), Brazil.
2: Universidade do Estado do Rio de Janeiro / UERJ, Brazil.

Despite increasing numbers of experimental studies investigating invasive species around the globe, our understanding of mechanisms that bring about population consolidations, range expansion and community change in the native biota of the receptor community is still incipient. The sun corals *Tubastraea coccinea* and *T. tagusensis*, native to the Pacific and Indian Oceans, were introduced on the Brazilian coast in the late 1980's. Both species are recognized as being highly invasive and causing significant environmental, economic, and social impacts in this region. The aim of present study was to quantify change in (1) abundance and cover of *Tubastraea* spp. and (2) community structure and function, along twelve years of study. Eight pre-established sites on tropical rocky shores with different densities of *Tubastraea* were chosen and studied in 2005, 2006, 2008, 2011, 2012 and 2016 employing 15 fixed and 15 randomly positioned quadrats. In general, the density and percent cover of Tubastraea showed change for each species over time for 4 sites, while at 3 sites there was significant increase in 2016, with dominance of *T. tagusensis* over *T. coccinea*. The density of *T. tagusensis* found in our study between 2005-2016 was more than twice that of its congener; a similar pattern in percent cover was also found (1.4 times). Fourty space occupying benthic species, dominated by turf algae, crustose calcareous algae, *Desmapsamma anchorata* and *Palythoa caribaeorum* were found at all sites and years studied. Lower diversity of species was linked to high abundance and percent cover of *Tubastraea* spp. at 3 sites where *Tubastraea* increased. These invasive corals affect the native benthic communities structure, with adverse consequences for local biodiversity in the long term for the Southwest Atlantic.

Presenting author: Beatriz Fleury. E-mail: bgfleury@gmail.com

Six years of monitoring of the invasive corals *Tubastraea* spp. in the benthic communities of ESEC-Tamoios Marine Protected Area, RJ, Brazil.

Yollanda Vançato, Joel Creed, Beatriz Fleury

Universidade do Estado do Rio de Janeiro / UERJ and Insituto Brasileiro de Biodiversidade (BrBio), Brazil.

We characterized the benthic communities of eight islands of the Tamoios Ecological Station: Araçatiba de Dentro, Araçatiba de Fora, Sabacu, Búzios and Cobras Islands, Imboassica, Queimada Grande and Queimada Pequena WE compared the native communities and those invaded by the *Tubastraea* spp. three times over six years: 2011, 2012 and 2017. We quantified the communities through the percentage of cover of the main species occupying space, as well as the cover and colony densities of the corals *T. tagusensis* and *T. coccinea*. We observed *Tubastraea* spp. in five of the eight studied sites: Búzios Islands, Cobras, Imboassica, Queimada Grande and Queimada Pequena. In general, the density of *Tubastraea* spp. declined while the percentage of coverage increased significantly over the years and differed between sites. We listed a total of 38 taxa in the communities, the most abundant being the algae turf and the mat forming zoantharian *Palythoa caribaeorum*. Richness, diversity and equitability were lower at sites with *Tubastraea* spp. Multidimensional analyzes indicated two significantly different community groups: those with and without *Tubastraea* spp. Thus, the present study confirms that the invasion of *Tubastraea* spp. alters the structure of the native benthic communities, compromising the biodiversity of the Marine Protected Area.

Presenting author: Beatriz Fleury. E-mail: bgfleury@gmail.com

A synthesis of the marine live bait trade as a vector for species invasions

Amy Fowler[1], April Blakeslee[2], João Canning-Clode[3], Michele Repetto[4], Robert Wieland[5], Edwin Grosholz[6], Fredrika Moser[7], Gregory Ruiz[8], A. Whitman Miller[8]

1: Department of Environmental Science and Policy, George Mason University, USA.
2: Biology Department, East Carolina University, USA.
3: MARE - Marine and Environmental Sciences Centre, Portugal.
4: Biology Department, Temple University, USA.
5: Main Street Economics, Trappe, MD, USA.
6: Department of Environmental Science and Policy, University of California, Davis, USA.
7: Maryland Sea Grant, University System of Maryland, College Park, USA.
8: Marine Invasions Laboratory, Smithsonian Environmental Research Center, USA.

The year-round Maine (USA) live marine bait trade ships bloodworms overnight, along with packing algae and associated macroinvertebrate hitchhikers, globally for fishing. We used this highly tractable vector as a model to characterize seasonal changes in abundance and diversity (taxonomic and functional) of hitchhiker taxa, experimentally test removal of hitchhiking taxa, and survey local fishermen about bloodworm use and disposal. We sampled algae in source (Maine field) and recipient regions (Mid-Atlantic distributors) in spring, summer, and fall, identifying 42,735 live macro-organisms from 56 taxa. The macroinvertebrate community changed seasonally in abundance, richness, and diversity (taxonomic and functional), with highest propagule pressure during spring and summer. Vector stage and season significantly influenced taxonomic and functional group richness, while abundance and percent organisms alive was driven by vector stage alone. Seasonal changes were not apparent taxonomically but were apparent in functional groups. Therefore, in similar temperate vectors, season can be a strong predictor of the timing of cumulative richness, diversity, and functional traits that influence the chances of successful invasions. Osmotic shock was an effective method for removing hitchhikers on algae, with 85% of macroinvertebrates removed after 12 hours in freshwater; this treatment was statistically as effective as more complicated treatments (hypersalinity) in reducing associated biota. A survey of Maine distributors revealed that, without laws or incentives, they were not receptive to soaking algae. However, we discovered that they ship bloodworms naked in trays to certain global vendors, costing the same as shipping bloodworms in algae. Currently, it remains unknown if Mid-Atlantic fishermen would buy live bloodworms naked in trays, but surveys suggest there is scope for leveraging environmental concerns of fishermen with regard to bloodworm packing materials.

Presenting author: Amy Fowler. E-mail: afowler6@gmu.edu

INVASIVESNET: international association for open knowledge on invasive alien species

Amy Fowler[1], João Canning-Clode[2], Frances Lucy[3], Vadim Panov[4]

1: Department of Environmental Science and Policy, George Mason University, USA.
2: MARE - Marine and Environmental Sciences Centre, Portugal.
3: Centre for Environmental Innovation and Sustainability (CERIS), Institute of Technology, Sligo, Ireland.
4: Regional Euro-Asian Biological Invasions Centre (REABIC), Helsinki, Finland.

In a world where invasive alien species (IAS) are recognised as one of the major threats to biodiversity, leading invasion biology scientists from five continents have created INVASIVESNET, which is an international association for open knowledge and open data on invasive species (https://www.invasivesnet.org). INVASIVESNET links networks of all interested stakeholders including scientists, citizens, international and national expert working groups and initiatives, database managers, thematic open access journals, environmental agencies, practitioners, managers, industry, non-government organisations and educational bodies. The association promotes networking opportunities, knowledge sharing and learning and provides resources via high quality communication, information, publication and education services. We have developed a sustainable knowledge sharing association to network the outputs of invasion biology research and inform management about societal challenges arising from introductions. To that end, the open access, peer-reviewed international journals Aquatic Invasions (est. 2006; 2016 Impact Factor: 2.069), BioInvasions Records (est. 2011; 2016 IF: 0.835), and Management of Biological Invasions (est. 2010; 2016 IF: 1.439) are serving as a core linking element of INVASIVESNET as a global platform for networks on invasive species. In 2017, the INVASIVESNET journal Management of Biological Invasions served as a publication platform for 9th International Conference on Marine Bioinvasions (ICMB-IX) proceedings for the first time. For ICMB-X, we will publish two special issues to highlight research presented at the conference, one in Aquatic Invasions (focusing on academic research of bioinvasions) and another in Management of Biological Invasions (focusing on applied research of invasive species). Manuscript submission information is available at the ICMB-X website. We encourage all ICMB-X participants to submit their research manuscripts for publication.

Presenting author: Amy Fowler. E-mail: afowler6@gmu.edu

The Asian shore crab, *Hemigrapsus sanguineus*, invasion may be facilitated by high pesticide tolerance

Aaren Freeman, Alexandra Henaghan, Himlir Louima, Vanesa Martinez, Erin Taub

Adelphi University, USA.

Malathion is an organophosphorus pesticide commonly used in the United States in agricultural, public health, and residential settings to target and arthropods. The pesticide also affects non-target organisms, such as estuarine crabs and may influence ecological interactions. In this experiment, we evaluated the lethal and sublethal impacts of malathion on invasive (*Hemigrapsus sanguineus*) and native (*Eurypanopeus depressus*) crabs. After 96 hours of exposure to malathion we found that *H. sanguineus* had a higher LC50 than native *E. depressus*, 1935 ppb and 707 ppb malathion, respectively. Furthermore, at low concentrations of malathion *H. sanguineus* did not suffer sublethal, behavioral impacts while *E. depressus* did; *H. sanguineus* exposed to control (0ppb), middle (32-64ppb), and high (100-256ppb) concentrations of malathion did not alter righting behaviors, but *E. depressus* had significantly prolonged righting times at middle and high concentrations. Our results suggest that malathion may negatively impact native crab and that the invasive *H. sanguineus* is better adapted to habitats where this pesticide exerts influences on the crab communities. Excessive use of the pesticide may promote the invasion of *H. sanguineus* and even select for resistance in the crab.

Presenting author: Aaren Freeman. E-mail: afreeman@adelphi.edu

Do strong species interactions in the tropics render tropical communities more resistant to invasion?

Amy Freestone[1], Mark Torchin[2], Laura Jurgens[1], Mariana Bonfim[1], Diana Lopez[1], Michele Repetto[1], Carmen Schloeder[2], Brent Sewall[1], Gregory Ruiz[3]

1: Temple University, USA.
2: Smithsonian Tropical Research Institute, Panama.
3: Smithsonian Environmental Research Institute, USA.

Over a half century ago, biotic interactions were predicted to be stronger at lower latitudes, underlying the origin and maintenance of global biodiversity. Strong interactions can also render communities more resistant to invasion, suggesting that biotic resistance may also be stronger at lower latitudes. Lively debate on these hypotheses continues, while large-scale experimental studies remain rare. We tested the hypotheses that predation and competition are stronger at lower latitudes and can shape patterns of invasion. We conducted predator exclusion and exposure experiments and biomass removal treatments to manipulate predation and competition, respectively, in sessile marine invertebrate communities in four coastal regions spanning 47-degrees latitude of the eastern Pacific Ocean. For the full community, results showed a stronger effect of predators in the tropics than at higher latitudes. Predation strongly reduced prey community biomass during exclusion and exposure experiments in the tropics, but not at higher latitudes. Competition, as manipulated through biomass removals, had no effect on community biomass after a recovery period. Through direct observation of the predator guild, we further documented higher predation rates in the tropics. These results suggest the potential for biotic resistance via predation in the tropics is strong. Our results for non-native species richness are preliminary, but intriguing. At the scale of local communities, richness of non-native species was lower in the tropics than in the mid-temperate zone. Predation decreased non-native richness relative to native richness in the tropics, but not at higher latitudes, while biomass removals had no effect. These results suggest that species interactions, particularly predation, may indeed be stronger at lower latitudes, rendering tropical communities more resistant to invasion and helping shape global patterns of non-native species richness.

Presenting author: Amy Freestone. E-mail: amy.freestone@temple.edu

Metagenetics of Plankton: detection of non-indigenous marine species and community composition in California bays (2013-2015)

Jonathan Geller[1], Tracy Campbell[1], Andrew Chang[2], Ruth DiMaria[2], Jinchin Guo[1], Katrina PagenKopp Lohan[2], Melinda Wheelock[1], Gregory Ruiz[2]

1: Moss Landing Marine Laboratories, USA.
2: Smithsonian Environmental Research Center, USA.

Monitoring benthic marine non-indigenous species (NIS) across broad geographic scales is laborious and expensive. Plankton is easier to collect, and larvae of NIS are evidence of local reproductive adults. We collected 593 plankton samples by pump and net tow from 10 bays spanning the coast of California from 2013-2015. DNA was extracted from subsamples, and a fragment of mitochondrial Cytochrome c oxidase subunit I was amplified and sequenced using Illumina MiSeq chemistry. After merging pairs and filtering low quality sequences, 28,605,589 reads were obtained. We used USEARCH 9.0 & 10.0 to denoise sequences and generate 14,635 zero-radius operational taxonomic units (OTUs). These were clustered at a similarity threshold of 95% to suggest 3,719 OTU at a species level. For community analyses, we rarefied at 1,000 and 10,000 reads per sample, retaining 94% and 63% of samples, respectively, and compared sites by PERMANOVA and SIMPER analyses. Regardless of rarefaction level, strong differences in plankton and NIS communities were observed across sites, but not strictly corresponding to geographic separation. Surface temperature and salinity were important drivers of community composition. Sequences were identified by BLAST using private and public databases. NIS were detected in every bay, and we found 69 of 252 marine NIS recognized in California. We also found sequences matching up to 26 additional NIS not presently verified in California. On average, we found 32.3 ±6.6 (SD) NIS per bay in plankton, 32.4 ±7.7 from morphological analysis of settlement panels, and 14.4 ±4.3 NIS found in both sample types. Among plankton samples were infaunal and planktonic NIS not found on plates. High throughput sequencing was effective at detecting NIS and finding community variation in Californian estuarine waters, however the episodic nature of larval production may suggests a need for higher frequency of plankton sampling or supplementation with benthic surveys.

Presenting author: Jonathan Geller. E-mail: geller@mlml.calstate.edu

The role of ecosystem engineer species in shaping the resistance of resident communities to marine invasion events

Ignacio Gestoso[1], Ian Davidson[2], João Canning-Clode[3], Christina Simkanin[4], Greg Ruiz[4]

1: MARE – Marine and Environmental Sciences Centre; Smithsonian Environmental Research Center; OOM—Oceanic Observatory of Madeira, Portugal.
2: Smithsonian Environmental Research Center, Ireland.
3: MARE – Marine and Environmental Sciences Centre; Smithsonian Environmental Research Center; Centre of IMAR of the University of the Azores, Portugal.
4: Smithsonian Environmental Research Center, USA.

Whether on land or in the sea, predicting community invasibility, or identifying the factors that make places more or less invasible, is a critical question in the study of biological invasions. One theory, used to describe differences in invasion rates, suggests that diverse native communities limit the establishment of non-indigenous species (NIS) – termed biotic resistance. One mechanism for this resistance is that communities with high levels of diversity have fewer available resources, leaving limited free ecological niches in the host community for the invader to establish. However, conflicting results between experimental studies at different spatial scales have contributed to the ongoing debate on the role of diversity in preventing invasions (i.e. invasion paradox). In this study, we manipulated resident benthic communities to test how different parameters of native/resident community respond to invasion. Specifically, we tested whether ecosystem engineer species (EE) (i.e. organisms that may affect strongly both structure and functioning of benthic assemblages) could confer particular biotic resistance to settlement and/or recruitment of invertebrate NIS. We allowed colonization of marine benthic assemblages on PVC settling plates with and without oysters, as EE model species, and manipulated biotic features and propagule pressure of NIS. This approach provides key insights into biotic mechanisms – such as competition for space or consumption of non-native propagules (larvae) – that underscore resident community resistance to NIS incursions. Future work will involve conducting this experiment in other global locations to determine the generality of responses found.

Presenting author: Ignacio Gestoso. E-mail: igestoso@mare-centre.pt

Hanging paradise: the role of benthic predators in colonization success of exotic ascidians

Clara Giachetti[1,2,3], Nicolás Battini[1,2,3], Karen Castro[1,2,4], Marcos Tatián[5], Evangelina Schwindt[1,2]

1: Grupo de Ecología en Ambientes Costeros, Argentina.
2: Instituto de Biología de Organismos Marinos (CONICET), Argentina.
3: Facultad de Ciencias Exactas y Naturales (UBA), Argentina.
4: Centro Regional Universitario Bariloche (UNCOMA), Argentina.
5: Instituto de Diversidad y Ecología Animal (IDEA) CONICET-UNC, Argentina.

Colonization success of marine exotic species in artificial structures depends on physical characteristics of these structures, and on environmental factors and/or ecological interactions among species. Predation plays a key role in tropical and subtropical areas with an apparent decrease at higher latitudes, establishing the hypothesis that tropical communities present a stronger biotic resistance to new exotic species. Among marine exotic species, ascidians appear to be the most successful sessile filter feeder in colonize new habitats as fouling communities on artificial structures. In this work, we (1) evaluate the effect of predation over colonization success of solitary ascidian community on different artificial structures, and (2) test the vulnerability of juveniles and adults of solitary exotic ascidian species in presence of different potential predators. We performed a field experiment in a cold-temperate port to evaluate the ascidian recruitment in fixed and hanging structures, in presence and absence of benthic and nektonic predators, and aquarium experiments under controlled conditions. We observed that benthic predators play a key role in the recruitment of exotic ascidians, which presented the highest cover in absence of these predators in both structures. Aquarium experiments showed that predation is higher over juveniles, while the effect on adults depends on the ascidian species. Sea urchins are the most successful predators, consuming both adults and juveniles. The results suggest that predation have a strong effect during the juvenile period with benthic species as the main predators. In this way, hanging structures might act as refuges from benthic predators for exotic ascidians in cold temperate regions.

Presenting author: Clara Giachetti. E-mail: claragia88@gmail.com

Identifying actions for the mitigation of biological invasions in the Mediterranean Sea

Sylvaine Giakoumi[1], Stelios Katsanevakis[2], Paolo G. Albano[3], Vesna Macic[4]

1: University of Nice, France.
2: University of the Aegean, Greece.
3: University of Vienna, Austria.
4: University of Montenegro, Montenegro.

Biological invasions are amongst the major components of current global change and drivers of native biodiversity in marine ecosystems. Ecological impacts including the loss of native genotypes, degradation of habitats, changes in trophic interactions, and displacement of native species have been documented across different marine ecoregions. Invasives can also impact the provision of ecosystem services, for instance causing the decline of commercial fish stocks or decreasing the potential for recreational activities, with negative socio-economic consequences for coastal communities. Moreover, some marine invasives are venomous or toxic and can have negative impacts on human health. Therefore, the uptake of management actions able to control invasive populations and/or mitigate their impacts is urgent. This is particularly the case for the Mediterranean Sea, the most invaded sea in the world. Approximately 1,000 alien species have been reported in the Mediterranean Sea, and this number is expected to grow with the ongoing enlargement of the Suez Canal. To identify the effectiveness of an array of potential management actions for the mitigation of biological invasions, an expert knowledge elicitation process was followed. Eleven experts on biological invasions were asked to evaluate ten potential management actions based on their: 1) effectiveness 2) technical feasibility, 3) social acceptance, 4) negative impacts on native communities, and 5) cost. The assessment included three steps: 1) individual evaluation, 2) group discussions, and 3) individual re-evaluation. Instead of using a species by species approach for the evaluation of the actions, we generated model species based on their traits and dispersion abilities. Preliminary results of this exercise will be presented during this conference.

Presenting author: Sylvaine Giakoumi. E-mail: sylvaine.giakoumi1@gmail.com

Salinity shock as a biosecurity control: short-term exposure to freshwater as a treatment for fouling marine invasive species

Rebecca Giesler[1], Elizabeth Cottier-Cook[1], Meriwether Wilson[2]

1: Scottish Association of Marine Science, United Kingdom.
2: University of Edinburgh, United Kingdom.

Marine invasive alien species (IAS) can have profound economic and environmental impacts in introduced regions. The need to develop novel management methods for control of marine IAS has seen research into a number of treatment options that exploit the natural physiological tolerance limits common to marine species. However, as IAS have been shown to be better able to recover following environmental stress than similar natives, consideration of community tolerance and dynamics post-treatment is important. Salinity shock with freshwater has been shown to be an effective treatment option for a number of IAS, but there have been few studies which consider response of the biofouling community as a whole. An experiment was designed to test response and recovery of IAS and their associated communities following short-term exposure to lower salinity conditions. The experiments used biofouling communities grown on settlement panels suspended from floating pontoons in four Scottish marinas with environmental salinity conditions varying from high freshwater inflow to fully saline. Eight-week-old communities were subjected to low salinity conditions for one to four hours, then photographed and returned to the pontoons, and recovery monitored over an eight week period. Results showed significant variation in the biofouling communities between sites with different natural salinity conditions. The largest changes in biofouling community assemblages were seen in the marina with the most stable natural fully saline conditions, while little effect of treatment was observed in the marina with high freshwater inflow. Response varied between different IAS, with some species controlled by freshwater treatment and others increasing in abundance, possibly as a result of reduced competition. These findings highlight the importance of considering post-treatment processes and local community dynamics when planning control of fouling marine species using freshwater.

Presenting author (Best Oral BHL): Rebecca Giesler. E-mail: rebecca.giesler@ed.ac.uk

Testing ballast water management systems – Challenge water conditions during more than 100 test voyages

Stephan Gollasch[1], Matej David[2]

1: GoConsult, Germany.
2: Matej David Consult d.o.o., Slovenia.

Ballast water management systems (BWMS) are rigorously tested in land-based and shipboard settings according to requirements outlined in the Guidelines G8 of the International Maritime Organization (IMO). Noting doubts that the water conditions to challenge BWMS as stated in G8 may not be challenging enough to represent all port water conditions world-wide, this guideline was revised at IMO in 2016 to make G8 better fit for purpose. We have conducted more than 100 performance test voyages of BWMS during the last 13 years and this contribution summarizes the intake water conditions we observed during these tests. The data presented include the abiotic water conditions (i.e., temperature, salinity, TSS and POC) and the counts of living organisms in the two size classes addressed by the Ballast Water Performance Standard (Regulation D-2) of the IMO Ballast Water Management Convention. We further compare our findings with the test requirements set by the U.S. Coast Guard and outlined in the ETV Protocol 2010. Our data will show how close the shipboard challenge water requirements are to what we observed in nature. Further, based on our findings, recommendations for possible further G8 improvements will be given. These recommendations will refer to the challenge water conditions in land-based performance tests of BWMS, which was kept unchanged during the recent G8 revision. One of our recommendations is to increase the TSS content in the test water to provide for a stronger challenge that BWMS meet the D-2 standard.

Presenting author: Stephan Gollasch. E-mail: sgollasch@gmx.net

Effects of disturbance and propagule pressure on invasion success are mediated by propagule quality

Paul Gribben[1], Marc Uya[2], Fabio Bulleri[2]

1: University of New South Wales, Australia.
2: University of Pisa, Italy.

Prominent among the factors mediating the establishment and spread of invasive species are disturbance and propagule pressure. Although these factors have received empirical support, results from experiments are often equivocal. This may be because manipulative experimental studies have generally focused on only one of these factors, despite compelling evidence that invasion success is dependent on interactions between them. Moreover, in marine ecosystems, the role of propagule morphology (a proxy for propagule quality) has largely been overlooked. Propagule quality may be more important than propagule number in determining the establishment and spread of clonal non-native algae as the presence or absence of different morphological components (rhizoids or fronds) has important implications for the acquisition of different resources. We utilized two different systems (one on hard and one on soft substrata), but both consisting of an invasive *Caulerpa* sp. and a native seagrass to investigate the interactive effects of disturbance (removal of native seagrass), *Caulerpa* fragment no. and morphology on fragment success. Whilst disturbance was of primary importance for establishment success, fragment morphology had a much stronger influence on fragment success compared to fragment number. In fact, increasing fragment number resulted in lower growth of individual fragments suggestive of negative feedbacks from intra-specific competition among fragments. Additional laboratory and field experiments further demonstrated that fragment morphology mediates the growth of fragments in response to sediment nutrient inputs. Our results demonstrate that propagule traits enabling the acquisition of resources made available by disturbance can be more important than propagule number in determining the establishment and spread of clonal non-native plants. More generally, our study suggests that propagule quality is a key, yet underexplored, determinant of invasion success.

Presenting author: Paul Gribben. E-mail: p.gribben@unsw.edu.au

The Moran effect and regional synchrony of introduced European green crab populations in Western North America

Edwin Grosholz[1], Andrew Chang[2], Rikke Jeppesen[3], Linda McCann[2], Catherine de Rivera[4], Gregory Ruiz[2], Thomas Therriault[5], Kerstin Wasson[3], Sylvia Yamada[6]

1: University of California, Davis, USA.
2: Smithsonian Environmental Research Center, USA.
3: Elkhorn Slough National Estuarine Research Reserve, USA.
4: Portland State University, USA.
5: Fisheries and Oceans Canada, Canada.
6: Oregon State University, USA.

Populations of marine and estuarine species can be influenced climatic and oceanographic process that influence broad geographic areas. Synchrony at scales larger than the scale of dispersal would likely represent a Moran effect potentially driven by oceanographic or atmospheric drivers. These effects have been observed for outer coast and subtidal species, but have only recently been examined for estuarine species that are also subject to similar regional forcing. We analyzed data for the non-native invasive European green crab along the western coast of North America collected over a twenty year period from a dozen sites from between British Columbia and Mexico. Unlike results from native outer coast species, there was no evidence of spatial synchrony among introduced green crab populations as a function of distance between estuaries. However, there were patterns of synchrony among estuaries that differed strongly among regions. Similar to earlier studies, there was strong synchrony among estuaries in Washington and Oregon. However, we found no evidence of synchrony among California estuaries over the same period. Tests of the effects of oceanographic processes on the degree of synchrony showed highly significant effects of El Niño-Southern Oscillation on synchrony that varied strongly with latitude. We also found a moderate effect of the Pacific Decadal Oscillation, however, there was no significant effect of local upwelling strength on the degree of synchrony among estuaries. We discuss the consequences of these results for the future management of the European green crabs in western North America.

Presenting author: Edwin Grosholz. E-mail: tedgrosholz@ucdavis.edu

Invasion of the coral *Tubastraea* through a Marine Protected Area and effectiveness of control measures for conservation in Brazil

Amanda Guilherme da Silva[1], Joel Creed[2], Beatriz Fleury[2]

1: Instituto Brasileiro de Biodiversidade - BrBio, Brazil.
2: Universidade do Estado do Rio de Janeiro, Brazil.

The invasion of exotic species is considered the primary cause of change in biodiversity in protected areas. The scleractinian corals *Tubastraea coccinea* Lesson, 1829 and *Tubastraea tagusensis* Wells, 1882 are the first alien corals to be introduced into the South Atlantic. In Brazil, these invaders are widely distributed, with records of expansion into new areas including several Marine Protected Areas (MPA). A semi-quantitative method was used to investigate the geographical distribution of the two congeners on subtidal rocky reefs throughout the Tamoios Ecological Station MPA, located in southeast of Brazil. Monitoring was carried out at 32 sites, in 2011 and 2017, by applying a semi-quantitative relative abundance index (RAI - dominant, abundant, frequent, occasional, rare or absent) to quantify change. Significant differences were observed in coral abundance among the sites, over time and between species. In 2011 *T. coccinea* was present at 25% and *T. tagusensis* at 41% of sites. In 2017 50% of sites were invaded. The number of sites scored as 'abundant' increased for *T. coccinea*, but remained constant for *T. tagusensis* over time. However, it is important to note that management (manual removal) was carried out on two islands in the region, in 2013 and 2015, resulting in control, carried out by the Marine Protected Area and by the Sun Coral Project: on Queimada Grande island the relative abundance of the corals decreased from 'frequent' to 'occasional' and on Catimbaú island from 'occasional' to 'rare'. The RAI proved sensitive enough as a monitoring tool to detect change over time, both natural increases in abundance and reduction due to management. The results attest to the effectiveness of the control to reduce abundance and slowing-the-spread of these noxious corals.

Presenting author: Amanda Guilherme da Silva. E-mail: amandabio.uerj@gmail.com

Invasive corals *Tubastraea* spp. competing with sponges (Porifera, Demospongiae), Ilha Grande Bay, Southeastern Brazil

Amanda Guilherme da Silva[1], Victor Rodrigues[1], Lélis Carlos-Júnior[1], Vinícius Neres-Lima[1], Bruno Lages[1], Lenize Maia[2], Luís Fernando Cappa[2], Flavia Oliveira[2], Beatriz Fleury[1]

1: Universidade do Estado do Rio de Janeiro, Brazil.
2: Universidade Federal de Juiz de Fora, Brazil.

Tubastraea coccinea Lesson, 1829 and *T. tagusensis* Wells, 1982 were the first scleractinian corals to invade the South Atlantic. These species have been successful on the Brazilian coast, but are not free from competitors like the sponges *Desmapsamma anchorata* and *Iotrochota arenosa*. This study aimed to understand the dynamics of competition for space between *Tubastraea* spp. and the sponges. We used field experiments to investigate the effects of physical (both sponge species) and chemical (only to *D. anchorata*) defenses responsible for interactions between competitors. The competition trial used physical barriers to separate chemical and physical effects. Raman spectroscopy technique was applied in order to identify chemicals present during in situ experiment. The physical responses were assessed by the sponges' growth and if they had grown even in the presence of a physical barrier, stimulated by *Tubastraea* chemistry. The growth of sponges was monitored by photography and measuring the highest height. About 80% of sponge specimens overlapped *Tubastraea* spp. The results indicated that the overlap was the main mechanism used in defense against the invasive coral by *D. anchorata*. Also the Raman analysis could suggest that the sponge uses chemical agents during the process of coral overgrowth during direct competition with *T. coccinea*. The observed differences in the growth of *I. arenosa* only directional when in direct contact with the competitor *T. tagusensis*. In this case, the sponge grew by skirting the sun coral, as a competitive strategy. *D. anchorata* overrides the invasives *Tubastraea* might cause choking or preventing coral raise funds in some specific places where the competition was found. These results corroborate previous observations that sponges are not able to inhibit expansion of these invaders in the natural environments, only their punctual growth.

Presenting author: Amanda Guilherme da Silva. E-mail: amandabio.uerj@gmail.com

Thick or thin? Comparing induced defenses in snail congeners in response to an invasive crushing predator

Renee Halloran, L. David Smith

Smith College, USA.

Introduced predators can cause prey species in invaded communities to produce induced defenses. In marine gastropods, phenotypic plasticity in shell shape and thickness reduces vulnerability to durophagous invaders. The extent to which different snail species express inducible defenses may be influenced by their life history characteristics. The northward expansion of the Asian shore crab *Hemigrapsus sanguineus* in the Gulf of Maine, USA offers an opportunity to examine the dynamics between snail prey and an introduced predator; to address whether related snail species exhibit similar adaptive responses, and to test whether induced morphological plasticity is reversible when the threat of predation is removed. Over a 6-month period, naïve *Littorina littorea* and *Littorina obtusata* snails were exposed to waterborne cues from *H. sanguineus*. Differences in morphological response to predation threat between snails suggest that species-specific traits influence the extent and form of inducible defenses and costs associated with morphological plasticity. The larger species, *L. littorea* responded with accelerated linear shell growth, perhaps to attain a size refuge. In contrast, the smaller species, *L. obtusata*, slowed linear shell growth and thickened its shell lip. Both species altered internal columella width and shell layer microstructure. When the predator cue was removed, reversibility of phenotypic plasticity was observed in both snail species, suggesting that trade-offs associated with shell plasticity exist and are temporary. Comparisons of armament strategies among related species in response to a common introduced predator can inform predictions about community dynamics with the increasing frequency of marine bioinvasions.

Presenting author (JAP&JTC Early Career Award Winner): Renee Halloran.
E-mail: rhalloran@smith.edu

How marine plastic could be facilitating invasive species introduction into and throughout the Galápagos Islands

Jessica Howard[1], Tomas Hannam-Penfold[1], Inti Keith[1], James Carlton[2]

1: Charles Darwin Research Station, Charles Darwin Foundation, Marine Science Department, Santa Cruz Island, Galapagos, Ecuador.
2: Williams College and The Williams College - Mystic Seaport Maritime Studies Program, Mystic, Connecticut, USA.

Plastic marine debris (PMD) has provided a novel and devastatingly abundant habitat for encrusting marine organisms, creating diverse communities associated with floating plastic that can be transported over large distances by oceanic currents. Galápagos is positioned with currents converging from the East of the islands, and consequently plastic is washed up on shores throughout the archipelago. Our research suggests that PMD provides an adequate habitat for the attachment and transport of marine species into the archipelago, indicating the potential to introduce invasive species. The influx of PMD into the Galápagos Marine Reserve is unknown and completely unregulated, therefore it is of paramount importance to assess all effects of PMD in Galápagos, building on previous research into entanglement and ingestion. Use of disposable plastics in the island communities confounds the problem, as it provides a direct source of litter to marine ecosystems. The influx of local plastic into the ocean signifies that inter-island spread of marine invasive species could occur; transporting established invasive species from port towns to more remote sites, extending the scope of these invasive species independent of the shipping, fishing and tourism industries. Stranded plastic was collected from various islands within the Galápagos archipelago, using opportunistic methods, and weekly sampling of Tortuga Bay was conducted in an attempt to establish accumulation rates. Samples were analysed under light microscopes, and encrusting organisms were identified. 15.2% of all plastic found at Tortuga Bay was colonised by at least one fouling organism, which represents a high abundance of marine hitchhikers entering or being transported around the islands. We also present here the first record of *Dosima fasicularis* in the Galápagos Islands. Processing and analysis of samples and data is still on going, we will have further results to present in August 2018.

Presenting author: Jessica Howard. E-mail: jessica.howard@fcdarwin.org.ec

Incorporating new genetic tools in community-based monitoring for nonindigenous species in the Canadian Arctic

Kimberly Howland[1], Anais Lacoursiere-Roussel[1], Maelle Savellic[2], Andrew Arreak[3], Shelly Elverum[3,4], Chris Idluat[3], Sylvia Pewatoalook[3], Rachel Smale[3], Eric Solomon[4,5], Louis Bernatchez[2]

1: Fisheries and Oceans Canada, Canada.
2: Laval University, Canada.
3: Community of Pond Inlet, Canada.
4: Ikaarvik, Canada.
5: Vancouver Aquarium, Canada.

Climate change and introductions of new species are predicted to significantly impact Arctic ecosystems, substantially changing biodiversity, particularly in coastal regions where development/warming will be greatest. Establishing reliable baseline data and tracking future changes are essential to develop effective management and conservation plans and adapt to ecosystem modifications. However, many Canadian Arctic marine coastal areas are poorly surveyed. We have been focussing on establishing baseline species inventories in coastal areas of the Canadian Arctic to facilitate future tracking of biodiversity shifts/species introductions, with an emphasis on areas of increased development. This is being coupled with the development of user-friendly environmental sampling tools and training/engagement of indigenous community members and northern research staff in the use of these tools, to build local capacity and provide a foundation for ongoing, cost-effective, community-based data collection. In particular, we have been adapting eDNA methods for Arctic marine ecosystems to enhance detection of more difficult to sample organisms, improve early detection of new species and provide robust baseline genetic information as a reference point for current native biodiversity. Our experience demonstrates the effectiveness of eDNA as a novel data collection tool that, with proper instruction, can be used effectively in citizen science and community-based research program. In this presentation we discuss advances with this tool and provide examples of how it has been utilized for opportunistic collection of coastal biodiversity information by citizens and non-experts as part of collaborative research with communities in the eastern Canadian Arctic.

Presenting author: Kimberly Howland. E-mail: kimberly.howland@dfo-mpo.gc.ca

Predicting hotspots of new habitats of high-risk aquatic invasive species in the Arctic

Jesica Goldsmit[1,2], Chris McKindsey[1], Philippe Archambault[2], Kimberly Howland[1]

1: Fisheries and Oceans, Canada.
2: Laval University, Canada.

The risk of aquatic invasive species (AIS) introductions in the Arctic is expected to increase with ongoing trends of greater shipping activity, resource exploitation, and climate warming in the region. We identified a suite of AIS (benthic invertebrates, zooplankton, macroalgae and phytoplankton) with the greatest likelihood of introduction and impact in the Canadian Arctic, using mainly the Canadian Marine Invasive Screening Tool. The top twenty three riskiest species (mainly benthic) were then modelled to predict the potential spatial distributions (habitat modelling using Maximum Entropy) at an Arctic and global scales. Modelling was conducted under present environmental conditions and under two future global warming scenarios (2050 and 2100). Results show that hotspots or regions where suitable habitat is more densely accumulated for modelled AIS are in the Hudson Complex, Chukchi / Eastern Bering Sea, and Barents / White Sea. Most taxonomic groups showed a trend for a positive pole-ward shift in the future, increasing from the present time to the end of the century. This approach will aid in the identification of present and future high-risk areas for AIS in response to global warming.

Presenting author: Kimberly Howland. E-mail: kimberly.howland@dfo-mpo.gc.ca

Crowd-sourcing innovative solutions for the eradication and control of invasive marine species

Graeme Inglis[1], Justin McDonald[2], Peter Wilkinson[3], Oliver Floerl[4], Marnie Campbell[5], Chad Hewitt[6], Gregory Ruiz[7], Thomas Therriault[8]

1: National Institute of Water & Atmospheric Research Ltd. (NIWA), New Zealand.
2: Department of Primary Industries and Regional Development, Western Australia, (DPIRD), Australia.
3: Australian Government Department of Agriculture & Water Resources, (DAWR), Australia
4: Cawthron Institute, New Zealand.
5: Harry Butler Institute, Murdoch University, Australia.
6: University of Waikato, New Zealand.
7: Smithsonian Environmental Research Centre, (SERC), USA.
8: Department of Fisheries & Oceans, (DFO), Canada.

Eradication and control of invasive species are controversial and expensive undertakings in any environment, but are especially demanding in marine environments. The need to work underwater, large natural biodiversity and the microscopic life-stages of many marine species present significant challenges for the detection, containment and extirpation of pests. Attempts to manage populations have been limited mostly to small areas of infestation (10's to 100's of meters), are labor intensive, expensive and often unsuccessful. There is a critical need for new approaches that are species-specific, cost-efficient, able to be applied over large areas and which are publicly acceptable. We took a novel approach to this problem by holding an international, crowd-sourced competition for new ideas on technologies for marine pest eradication and control. 'Crowd-sourced' problem solving draws on a distributed network of individuals to offer solutions to a defined problem. The premise is that by exposing a large, diverse community of minds to difficult R&D problems, potential solutions are not constrained by the knowledge and experience of a single discipline, but can capture innovation from a diverse range of interests and expertise. The competition was run on the InnoCentive platform, which has a global community of >380,000 R&D problem Solvers. It was open for 45 days as a time-limited challenge with a total prize pool of US$10,000 for the best solution(s). The competition engaged 185 potential Solvers from 37 countries. Thirty-four prospective solutions were ultimately received from 15 different countries, 27 of which were considered worthy of further examination. They variously included innovative uses of chemical, audio, sonar, robotic, biological, molecular, and thermal mechanisms of control, including some "off-the-wall" approaches! A coalition of scientists from New Zealand, Australia, the USA and Canada selected the best solutions for further R&D.

Presenting author: Graeme Inglis. E-mail: graeme.inglis@niwa.co.nz

Reprioritizing national surveillance effort for marine pests based on predicted pathway risks

Graeme Inglis[1], Andrew Robinson[2], Abraham Growcott[3], Tracey Hollings[2], Daniel Kluza[3], Kimberley Seaward[1], Catherine Lubarsky[3]

1: National Institute of Water & Atmospheric Research Ltd. (NIWA), New Zealand.
2: Centre of Excellence for Biosecurity Risk Analysis, Australia.
3: Biosecurity New Zealand, New Zealand.

Resources for biosecurity surveillance are limited, so it is important that they are allocated efficiently, where they will achieve the greatest net benefit for the investment. New Zealand's national programme of surveillance for non-indigenous marine species (NIMS) - the "Marine High Risk Site Surveillance" (MHRSS) - was established in 2002 with the aim of detecting incursions by potentially harmful species early in the invasion process. Sites included in the programme were chosen following assessment of their relative exposure to shipping vectors and environmental factors that could facilitate establishment of a suite of identified pests. Although the objectives for the MHRSS and the survey methods used within it have been refined since its inception, there has been no re-evaluation of the sites included in the programme to account for any changes in relative risks from shipping vectors and their behaviour since 2002. Additionally, allocation of survey effort among the sites is not related to the relative likelihood of entry by NIMS. We developed a systematic, statistical likelihood-based methodology to determine the relative likelihood of NIMS entry at ports throughout New Zealand and to guide allocation of surveillance effort among them. Historical data on the (a) patterns of ballast management and discharge and (b) biomass of fouling organisms on vessels entering New Zealand ports were used to parameterise separate statistical models that predicted the volume of ballast discharge and biofouling biomass on individual vessels based on modelled risk factors. The models were then applied to data on vessels that arrived in New Zealand ports over two periods (2000-2005 and 2015-2017) to determine changes in the relative exposure to NIMS from each pathway. An updated allocation of current survey effort among the ports was determined based on the relative likelihood of NIMS entry to the ports.

Presenting author: Graeme Inglis. E-mail: graeme.inglis@niwa.co.nz

Non-native marine species around a natural and artificial habitat at central coast of Peru

Anali Jimenez Campean[1], Remy Canales[2], Ximena Velez-Zuazo[3]

1: Asociación Conservación, Lima, Perú.
2: Laboratorio de Biología y Sistemática de Invertebrados Marinos, Facultad de Ciencias Biológicas, Universidad Nacional Mayor de San Marcos, Apdo. 11-0058, Lima, 11, Perú.
3: Center for Conservation and Sustainability, Smithsonian Conservation Biology Institute, National Zoological Park, Washington, DC, USA.

There is limited knowledge about non-native species and marine biological invasions in Peru. Along the coast of Peru, there is marine infrastructure, including a Liquefied Natural Gas (LNG) terminal, built in 2010. At this, the Biodiversity Monitoring and Assessment Program, a strategic alliance between Smithsonian Conservation Biology Institute and company PERU LNG, is studying the origin, distribution, abundance, and dynamics of non-native species since 2011. The terminal is located in the central coast of Peru, 167km south of Lima. Macrobenthos samples from natural soft and artificial hard-substrate have been collected at the end of the austral summer and spring. The benthos community is dominated by three taxa: Polychaeta, Mollusca and Crustacea. Within these, non-native species dominate in benthic and fouling communities. To date, 12 species are considered as non-native, belonging to Arthropoda, Annelida and Bryozoa phyllum. More than 50% of species are amphipods belonging to five families: Ischyroceridae, Corophiidae, Stenothoidae, Maeridae and Caprellidae. Polychaeta species were found to dominate the soft substrate (*Spiophanes bombyx*) and the artificial hard substrate (*Polydora websteri*). *Caprella penantis* was associated with *Bugula neritica* and other non-native species found in hard artificial substrate. The abundance of non-native species has fluctuated during the last seven years likely due to natural seasonal and interannual processes (ENSO), but the influence of port activity remains to be investigated; this LNG terminal is relatively recent compared to other marine infrastructure in the area and its role in the arrival of non-native species remains to be clarified. Some of the non-native species present have been already reported in benthic studies in a nearby area where older marine infrastructure exists. A nation-wide initiative to catalogue non-native marine species is a necessary for Peru as well as the implementation of a monitoring program.

Presenting author: Anali Jimenez Campean. E-mail: analijim@gmail.com

How long does it take to detect bioinvasion impacts? Monitoring of the invasive *Saccostrea cucullata* and the native *Crassostrea rhizophorae* (Ostreidae) on a rocky shore in the southeast Brazil

Andrea Junqueira[1], Camila Puga[2], Aline Augusto[1], Cristiano Lazoski[1], Paulo Paiva[1]

1: Universidade Federal do Rio de Janeiro, Brazil.
2: Programa de Pós Graduação em Ecologia (UFRJ), Brazil.

In 2010, a long-term monitoring program was established in several compartments in Guanabara Bay, one of the most prominent and polluted bays on the Brazilian coast. The introduction of the Indo-Pacific oyster *Saccostrea cucullata* was detected on the mid-intertidal of rocky shores previously dominated by barnacles, biofilm and the native oyster *Crassostrea rhizophorae*. In this study we compare the temporal variation between population density and percent cover of these oysters. These parameters were assessed seasonally through photographic sampling during 7 years of monitoring on the mid-intertidal of the rocky shore of Boa Viagem beach, Rio de Janeiro. A fragment of the 16S mtDNA marker was sequenced to confirm the morphological identification of both species. During the first 5 years, *S. cucullata* occurred at lower densities than *C. rhizophorae*. However, from the fall of year 5, the density of the introduced species increased sharply while the density of the native species decreased. Hierarchical analysis of variance indicated that both species did not show any seasonal pattern in percent cover ($p>0.05$), but both presented an inter-annual variation ($p<0.05$). In the summer of the last year it was possible to verify almost the same percent cover for them. According to the dbRDA analysis, which includes climatic variables in different time lags, both species thrive in cooler waters and in warmer air temperatures and are sensitive to high levels of pollution and long periods of air exposure. Null models approach showed that the niche overlap observed between these oysters was significantly greater ($p<0.001$) than expected by chance. In this study we identified a significant increase of a non-indigenous species only from the fifth year of monitoring. The effects of bioinvasion took a long time to be detected. It reinforces the great importance of long and continuous monitoring studies.

Presenting author: Andrea Junqueira. E-mail: aerdnajunqueira@gmail.com

A new method to assess the risk of sun coral invasion in marine protected areas

Thiago Couto[1], Elianne Omena[1], Simone Oigman-Pszczol[1], Andrea Junqueira[2]

1: Projeto Coral-Sol, Instituto Brasileiro de Biodiversidade – BrBio, Brazil.
2: Universidade Federal do Rio de Janeiro, Brazil.

The safest and most efficient method of avoiding costs and impacts associated with biological invasions is to prevent the introduction and establishment of non-native species. In Brazil, two invasive coral species have been causing ecological, economic and social impacts. Sun coral is the popular name given to the species of the genus *Tubastraea*. Two species of sun coral are found on the Brazilian coast. This work presents a protocol to analyze the risk of sun coral (*Tubastraea coccinea* and *Tubastraea tagusensis*) invasion in Marine Protected Areas (MPAs) in the State of Rio de Janeiro considering its main vector on the Brazilian coast. The evaluation of the relative risk of invasion was carried out for five MPAs. The protocol was based on the Ballast Water Risk Assessment made for the Port of Sepetiba (Brazil), by the Global Ballast Water Management Programme (GloBallast) implemented by the International Maritime Organization. It takes into account five risk factors: I) environmental similarity between the donor area and the possible receiving area using 21 abiotic variables; II) quantity of available substrate to sun coral colonization; III) proximity to the donor region; IV) proximity and quantity of oil platforms and drill ships that passed by the analyzed MPAs; V) proximity and quantity of oil platforms and drill ships that anchored near the MPAs. The analyzed MPAs were ranked from the highest to the lowest risk score in order to prioritize the management of sun coral invasion. This protocol can be applied to analyze the relative risk of invasion along the Brazilian coast to minimize secondary introductions and identify areas for early detection.

Presenting author: Andrea Junqueira. E-mail: aerdnajunqueira@gmail.com

Multiple uses of a port survey protocol as a tool for alien species management

Saa Henry Kabuta[1], Alexander A.J. Smolders[2], Arjan Gittenberger[3]

1: Rijkswaterstaat, Department of Water Quality and Nature Management, Ministry of Infrastructure and Water Management, The Netherlands.
2: Team Invasive Alien Species – Office of Risk Assessment and Research, The Netherlands Food and Product Safety Authority, Ministry of Agriculture, Nature and food Quality, The Netherlands.
3: Institute of Biology Leiden, Leiden University, The Netherlands.

The HELCOM/OSPAR Port Survey Protocol developed in Europe includes all habitats within a port area where alien species can and may have settled. Data collected through the use of a port survey protocol is already used for several projects and programs including: [1] potential exemptions to the ballast water convention, [2] evaluation of European and national marine alien species management. It can also be used for [1] assessing possibilities for Same Risk Areas (SRA), [2] developing management measures for hull fouling as a pathway for alien species and [3] a more general evaluation of alien species impact on the native biodiversity. This presentation will provide an overview of how the port survey protocol was developed, and how the data collection is carried out using two surveys (Rotterdam and Vlissingen) that have already been completed in the Netherlands. The data collected are in use and plans, on how the data may be enriched for use in other programs in the future will also be presented. Finally, the importance of collecting additional data, like eDNA data, to optimize marine alien species management will be highlighted at the end of the presentation.

Presenting author: Saa Henry Kabuta. E-mail: Saahenry.kabuta@rws.nl

A reassessment of the alien nereidids from South Africa: why thorough taxonomic investigations are necessary before declaring species as alien

Jyothi Kara[1], Carol Simon[1], Angus Macdonald[2]

1: Stellenbosch University, South Africa.
2: University of KwaZulu-Natal, South Africa.

Correct identification of, and differentiation between, alien and indigenous species is critical for management and conservation of species. However, alien and undescribed indigenous species often go unnoticed when they are mistaken for widely distributed cosmopolitan species. Consequently, both alien and indigenous diversity of a country may be underestimated when the taxonomy of these species is not resolved. In South Africa, the lists of alien polychaetes were based mainly on whether cosmopolitan species had been categorised as alien elsewhere, and or if they have several synonymised names with disjunct global distributions. Only one nereidid, *Alitta succinea* Leuckhart, 1847 was considered an alien even though *Platynereis dumerilii* (Audouin & Milne Edwards, 1833), *Platynereis australis* (Schmarda, 1861) and *Pseudonereis variegata* (Grube, 1857) also fulfil these criteria. *A. succinea*, *P. dumerilii* and *P. australis*, previously considered alien in some parts of its distribution, proved to be misidentified local species that are part of pseudo(-cryptic) species complexes, thus casting doubt on their identifications in an extended distribution range. The taxonomy for these species has not been confirmed in South Africa. Twelve sites along the South African coast were sampled. *A. succinea* was not found, even at sites where it had been recorded before, thus casting doubt that it occurs here and should therefore be removed from the alien list. Morphological and molecular analyses revealed that the remaining species represent historically misidentified species that are indigenous to South Africa and members of (pseudo-)cryptic species complexes. *Pseudonereis variegata* was an incorrectly synonymised local species, *P. podocirra*, *P. australis* was mistaken for *P. massiliensis* and should be considered alien in the Mediterranean and *P. dumerilii* represents a new indigenous species. Results from this study highlight the importance of using genetic data with thorough morphological examination to confirm species identifications for alien inventories and biodiversity assessments.

Presenting author: Jyothi Kara. E-mail: jyothi.kara@gmail.com

Status and trends of marine bioinvasions and invasion vectors in the Galapagos Archipelago and the Cocos Islands

Inti Keith[1], James Carlton[2], Greg Ruiz[3]

1: Charles Darwin Foundation, Ecuador.
2: Williams College-Mystic, USA.
3: Smithsonian Environmental Reaserch Center, USA.

The marine ecosystems of the Galapagos Islands harbor unique biological communities with a high incidence of endemic species. Galapagos is a UNESCO world heritage site, renowned for its high biodiversity and extraordinary oceanographic features. Marine biological invasions have increased due to global trade and tourism. The Galapagos Islands are under continuing threat from marine non-native arrivals, given the connectivity and increase in marine traffic that exists across the Eastern Tropical Pacific (ETP), as well as the effect of extreme climatic events such as the El Niño. The management strategies to tackle marine invasive species in Marine Protected Areas (MPAs) in the Pacific region have to be addressed in order to protect marine biodiversity. The number and impact of marine invasions are accelerating worldwide and yet most regions, especially in the tropics, lack the rigorous data required to understand status and trends of invasions and the effectiveness of management strategies to prevent new invasions and their associated impacts. The risk posed by non-native marine species already established in the GMR and the region, and those non-native species now poised on the mainland, should not be under-underestimated, nor should the amount of crucial research needed to mitigate this risk. We have started to quantify the risks present in the ETP region by documenting the introduced marine species that have been found in the Galapagos Islands (Ecuador) and Cocos Island (Costa Rica), as well as in mainland Ecuador.

Presenting author: Inti Keith. E-mail: inti.keith@fcdarwin.org.ec

Does this look risky to you? Profiling vessel biofouling in a biosecurity context

Daniel Kluza

New Zealand Ministry for Primary Industries, New Zealand.

The Ministry for Primary Industries (MPI) has issued the Craft Risk Management Standard (CRMS) for Biofouling on Vessels Arriving to New Zealand, which came into force in May 2018. The ability to recognise vessels that have potentially risky levels of biofouling is critical for the successful implementation of the CRMS, therefore MPI has developed a set of risk indicators which are being used at the border for clearance of international vessels. These risk indicators have been informative for identifying high-risk vessels, but quantitative evaluation is needed to assess indicator utility and robustness for determining compliance with biosecurity thresholds. To assess the performance of these indicators, MPI commissioned underwater hull surveys of international commercial vessels arriving to New Zealand. Over a 16-month period, 40 vessels were inspected and assessed for compliance with the CRMS short-stay biofouling thresholds. Biofouling was present on 39 of 40 vessels, occurring primarily in hull niche areas, and 16 vessels (40%) had substantial macrofouling (≥ 20% cover in individual niche areas). With respect to predicting compliance with the CRMS, the initial risk indicator thresholds performed poorly—this was expected given the values were set to target heavily-fouled vessels, and not intended to flag the levels of fouling associated with CRMS non-compliance. Signal Detection Theory analyses were used to refine the high-risk indicator thresholds, which resulted in a statistically significant improvement in performance (93% correct prediction). These new thresholds and risk indicators are being further tested and trialled by MPI. (Work commissioned for this study was undertaken by Cawthron Institute).

Presenting author: Daniel Kluza. E-mail: daniel.kluza@mpi.govt.nz

Potential distribution of the invasive brown seaweed *Sargassum muticum*: an evaluation of physiological traits and habitat suitability modeling

Gabrielle Koerich[1], Giulia Burle Costa[1], Lidiane Pires Gouveâ[1], Eduardo Bastos de Oliveira[1], Larissa Villar[2], Giancarlo Valduga[2], Jean-Claude Yvin[2], Paulo Antunes Horta[1]

1: Universidade Federal de Santa Catarina, Brazil.
2: Centre mondial de l'innovation - Le Groupe Roullier, France.

Globalization and increasing maritime transport allow the free movement of species through biogeographical barriers, enabling the geographical expansion of species then called bioinvasors. Oceanographic processes can also expand the dispersal of marine organisms with high drifting capabilities. Furthermore, considering that both anthropic and oceanographic process of bioinvasion can be facilitated by climatic changes, it is essential to apply tools that allow the prediction of new invasions by species regarded as a threat to the ecological balance of native communities. *Sargassum muticum* is considered one of the most widespread invasive macroalga in the world, recorded throughout the Northern Hemisphere. Where it is found, *S. muticum* impacts native algae reducing light and nutrient concentration. *S. muticum* has not yet been recorded in the Southern Hemisphere, reinforcing the need to monitor and prevent its spread. Therefore, the objective of this study is to identify the potential expansion of *S. muticum* distribution, using a Habitat Suitability Model and physiological performance from an experiment with different temperatures. Model results suggest that *S. muticum* has a high invasive potential in many coastal regions, concentrated in temperate climates. However, experiment results suggest the survival of *S. muticum* in tropical areas, in which the model showed low suitability. It is important to recognize the model's limitation caused by the known distribution of the species, and complementary strategies, such as ecophysiological evaluations are needed to reinforce the management of bioinvasions in a global perspective. To consider the biology of *S. muticum* in predicting its possible distribution is also essential, since it can tolerate high temperatures (as demonstrated by the experiment) and its propagules present a high dispersal capability. This work was financed by CNPq, PROSPECMAR, INCT-MC, SISBIOTA, FAPESC, Fundação Boticário, CAPES, and Roullier Group.

Presenting author (ONR Global Early Career Award Winner): Gabrielle Koerich.
E-mail: gabriellekoerich@gmail.com

Ecophysiology and Ecological Niche Modeling of the invasive red algae *Grateloupia turuturu* (Halymeniales, Rhodophyta)

Gabrielle Koerich[1], Marina Narsi Sissini[1], Eduardo Bastos de Oliveira[1], Giulia Burle Costa[1], Manuela Bernardes Batista[1], Leonardo Rubi Rörig[1], Larissa Villar[2], Giancarlo Valduga[2], Frank Jamois[2], Paulo Antunes Horta[1]

1: Universidade Federal de Santa Catarina, Brazil.
2: Centre mondial de l'innovation - Le Groupe Roullier, France.

In 2015 *Grateloupia turuturu* was recorded for the first time in the South Atlantic, in Santa Catarina's coast. *G. turuturu* is considered the fifth most harmful alga in a global perspective, capable of damaging ecosystems functions and services, and causing biodiversity loss. Therefore, the coastal management, especially regarding marine protected areas and environments with high socio-economic importance, demands more information about *G. turuturu*'s biology. The bioinvasion process is characterized by the expansion of the species geographic distribution, considering ecophysiological thresholds imposed by environmental factor characteristics of dispersion routes and settlements areas. Combining Habitat Suitability Model (HSM) and ecophysiological essays, *G. turuturu* process of invasion was discussed and target areas and vectors, that should be monitored and managed, were identified. The HSM considered the actual global distribution of this species, and two populations with different acclimation regions (temperate and warm temperate areas) were utilized in the ecophysiological experiments. Our results show higher physiological performance of *G. turuturu* in colder waters and presents higher habitat suitability in temperate and warm-temperate regions, with high suitability in the South America's south region. Our results reinforce the potential of expansion of *G. turuturu*. MPAs should consider eradication programs regarding areas invaded and adjacent areas. Potential vectors should receive special attention in areas where the species is abundant. This invasion event reinforces the importance of transnational coordinated actions regarding conservation and management of coastal habitat and activities. This work was financed by CNPq, PROSPECMAR, INCT-MC, SISBIOTA, FAPESC, Fundação Boticário, CAPES, and Roullier Group.

Presenting author (ONR Global Early Career Award Winner): Gabrielle Koerich.
E-mail: gabriellekoerich@gmail.com

Do parasites act as a natural control in regulating the non-native *Mnemiopsis leidyi* population from the northern Adriatic Sea?

Tjaša Kogovšek[1], Davor Lučić[2], Diego Borme[3], Valentina Tirelli[3], Alenka Malej[1]

1: Marine Biology Station, National Institute of Biology, Slovenia.
2: Institute for Marine and Coastal Research, University of Dubrovnik, Croatia.
3: OGS, Istituto Nazionale di Oceanografia e di Geofisica Sperimentale, Dipartimento di Oceanografia Biologica, Italy.

The rate of bioinvasions is increasing worldwide, impacting biodiversity and ecosystem functioning. A paucity of natural enemies, such as predators and parasites, may increase performance of introduced species relative to conspecifics in their native environment. Indeed, it is suggested that native populations of marine invasive species have more than twice as high prevalence and three times higher species richness of parasites compared to introduced populations. In this regard, we investigated the rate and species richness of associated animals with a non-native and highly invasive ctenophore, *Mnemiopsis leidyi* in its newly invaded environment. A total of 24 ctenophores were collected in October and November 2017 in the coastal sea of the northern Adriatic. Individuals were scooped with a small bucket, immediately transferred into 500 mL transparent containers filled with pre-filtered (0.2 µm) sea water and incubated at 20°C and 12/12 dark/light conditions for 24 hours. At the end of the incubation, total eggs released were counted, while ctenophore size was measured, and individuals were inspected for associated animals under the stereoscope. Only 2 years after its successful establishment in the area, in total, all examined individuals were infected. Six taxa were identified, with trematode metacercariae and hiperiid amphipods having the highest prevalence (P) and intensity of infection (I) (P=96 %, I= 0-18, and P=71 %, I=0-9, respectively). Although our study shows a high P and I of this newly invader, there was no clear impact detected on ctenophore reproductive output. Such high rate of metacercariae infestation suggests, that *M. leidyi* could have an important role in the transmission of parasitic trematode to the zooplanktivorous fish from the northern Adriatic Sea, the area where anchovy and sardines are the most important commercial species for the local fisheries.

Presenting author: Tjaša Kogovšek. E-mail: tjasa.kogovsek@nib.si

The potential of the invasive ctenophore *Mnemiopsis leidyi* as a source of protein in fish feed

Tjaša Kogovšek, Gašper Polajnar, Katja Klun

Marine Biology Station, National Institute of Biology, Slovenia.

The rate of bioinvasions is increasing worldwide, impacting biodiversity and ecosystem functioning. Ctenophores, in particular *Mnemiopsis leidyi*, has proven to be a highly successful invader and listed among the 100 worst invasive alien species worldwide. The most notorious example is its introduction into the Black Sea in the 1980s that had catastrophic consequences for the pelagic fish populations, leading to large economic losses to the fishing industry. Despite its severe ecosystem implications in the northern and southern Europe, where it was introduced, there is no consensus of an effective management to mitigate the outburst of *M. leidyi* populations in its non-native environments. However, accidental (as by-catch) or intentional removal of large biomass, as a local action plan to alleviate the pressure of the invader on the local ecosystem and economy, may take place locally. The accumulated volumes of the gelatinous biomass may be problematic to dispose, on the other hand, such protein-rich operational by-product may present a valuable source of biomaterial, as various possibilities of its utilization have been emerging in the recent years. In this regard, we investigated the potential of gelatinous biomass of *M. leidyi* as a source for protein in feed for fish in aquaculture. Based on the elemental (C, N and P) analysis, total protein and lipid content, and fatty acid profiles, we evaluated the potential of utilizing gelatinous biomass as food in sustainable culturing of the European bass (*Dicentrarchus labrax*).

Presenting author: Tjaša Kogovšek. E-mail: tjasa.kogovsek@nib.si

Hawaii's ballast water and biofouling program: managing the top two vectors of aquatic alien species transfer

Julie (Jules) Kuo

Hawaii Department of Land and Natural Resources, USA.

Ballast water (BW) and vessel biofouling (BF) has been linked to a range of environmental, socioeconomic, and human health implications worldwide and compels the need for proactive management. The number of aquatic alien and cryptogenic species established in the State of Hawaii now exceeds the number of non-indigenous (NIS) in all of the Continental U.S. combined—473 vs. 450, respectively. Hawaii residents rely on more than 80% of all consumer products to be delivered overseas by the commercial shipping industry, requiring around 1000 commercial ship visits annually, including container vessels, oil tanker, bulk carriers, etc. from around the world—each arriving with varying degrees of biosecurity risk as it relates to ballast water and vessel biofouling. Consequently, BW and BF are the top two vectors of aquatic NIS transfer and have been attributed to 78% of the aquatic alien marine algae and invertebrate species currently established in the State. This presentation will provide an overview of the State's proactive management strategies for BW and BF vectors of aquatic alien species transfer as well as ongoing aquatic NIS detection and mitigation projects.

Presenting author: Julie (Jules) Kuo.E-mail: julie.c.kuo@hawaii.gov

Potential suitable habitat of the invasive red alga *Capreolia implexa* along South American and native coasts under present day and future climate conditions – based on correlative and mechanistic modelling

Philipp Laeseke[1], Brezo Martínez[2], Andrés Mansilla[3], Kai Bischof[1]

1: Department of Marine Botany, University of Bremen, Germany.
2: Universidad Rey Juan Carlos, Área de Biodiversidad y Conservación, Madrid, Spain.
3: Laboratory of Antarctic & sub-Antarctic Marine Ecosystems (LEMAS), University of Magallanes, Institute of Ecology & Biodiversity (IEB); Fondecyt: 1140940, Chile.

Species migrations under climate change are a global phenomenon and can pose threats to invaded ecosystems. *Capreolia implexa* (Rhodophyta) is a species native to Southern Australia and New Zealand and has recently been introduced to Chile. At the infested coastlines it has established in dense mats in the upper intertidal at several rocky shores some hundred kilometers apart. Here, we present the results of a comprehensive modelling approach to identify potentially suitable habitat in the native and novel range. We conducted a correlative species distribution model trained on native distributional and environmental data. Additionally, we conducted a temperature tolerance experiment (2 – 22°C) to investigate physiological temperature limits for a mechanistic suitability model. Both models were used for present day and future (year 2100, rcp26 & rcp85 predictions) habitat suitability projections. Based on the correlative model *C. implexa* has a wide potential suitable range along the Chilean, Peruvian, Argentinian, Uruguayan and Brazilian coasts. However, based on the mechanistic model, the potential range reaches to colder and far more southern regions not detected by the correlative model. Both models predict a southward shift of the projected suitable range under future climate conditions. This implies a loss in total suitable habitat in both the native as well as the novel regions. Besides identifying possibly suitable areas for *C. implexa*, the study shows limits of purely correlative model approaches.

Presenting author (SSMB Early Career Award Winner): Philipp Laeseke.
E-mail: philipp.laeseke@uni-bremen.de

Influence of anthropogenic activities and substrate type on the distribution of NIS in the Biobio region, Chile

Jean-Charles Leclerc[1], Frédérique Viard[2], Elizabeth González Sepúlveda[3], Christian Díaz[4], José Neira Hinojosa[5], Karla Pérez Araneda[6], Francisco Silva[6], Antonio Brante[6]

1: UCSC, Departamento de Ecología, Facultad de Ciencias, Centro de Investigación en Biodiversidad y Ambientes Sustentables (CIBAS), Concepción, Chile.
2: Sorbonne Université, CNRS, UMR 7144 AD2M, Station Biologique de Roscoff, Place Georges Teissier, 29680 Roscoff, France.
3: Departamento de Química Ambiental, Facultad de Ciencias, Universidad Católica de la Santísima Concepción, Concepción, Chile.
4: Departamento de Medio Ambiente y Energía, Facultad de Ingeniería, Centro de Investigación en Biodiversidad y Ambientes Sustentables (CIBAS), Universidad Católica de la Santísima Concepción, Concepción, Chile.
5: Departamento de Análisis Instrumental, Facultad de Farmacia, Universidad de Concepción, Casilla 160 C, Concepción, Chile.
6: Universidad Católica de la Santísima Concepción, Departamento de Ecología, Facultad de Ciencias, Centro de Investigación en Biodiversidad y Ambientes Sustentables (CIBAS), Casilla 297, Concepción, Chile.

The growing coastal urbanization together with the intensification of maritime traffic are major processes explaining the increasing rate of biological introductions in marine environments. To investigate the link between anthropogenic activities (aquaculture, local shipping and international maritime traffic) and the establishment of non-indigenous species (NIS) in coastal areas, we compared fouling communities among 3 international ports (on fixed pilings and suspended ropes), 3 local piers (immobile pilings), 2 aquaculture facilities (floating longlines) and 2 floating pontoons, along 100 km of coastline in South-central Chile, using a combination of settlement panels (collected after 3 and 12 months) and rapid assessment surveys. A larger number of NIS was generally observed in international ports and aquaculture facilities, as expected in these 'invasion hubs'. Nonetheless, the abundance of most NIS was generally greater upon floating substratum, irrespective of the site category and surrounding environmental conditions (light, temperature and metal concentrations). Exclusion experiments performed in 4 study sites suggest that benthic micro- and macro-predators can have locally a significant influence in limiting the early development of these taxa (especially bryozoan and ascidians) upon immobile pilings. In mature communities, free space could also be a limiting factor for NIS establishment. Overall, our results suggest that the diversity of artificial structures and putative vectors (international and local) should be considered for NIS surveillance programmes.

Presenting author: Jean-Charles Leclerc. E-mail: leclercjc@gmail.com

Biotic resistance under realistic assembly rules within fouling communities

Jean-Charles Leclerc[1], Frédérique Viard[2], Christian Díaz[3], Antonio Brante[4]

1: UCSC, Departamento de Ecología, Facultad de Ciencias, Centro de Investigación en Biodiversidad y Ambientes Sustentables (CIBAS), Concepción, Chile.
2: Sorbonne Université, CNRS, UMR 7144 AD2M, Station Biologique de Roscoff, Place Georges Teissier, 29680 Roscoff, France.
3: Departamento de Medio Ambiente y Energía, Facultad de Ingeniería, Centro de Investigación en Biodiversidad y Ambientes Sustentables (CIBAS), Universidad Católica de la Santísima Concepción, Concepción, Chile.
4: Universidad Católica de la Santísima Concepción, Departamento de Ecología, Facultad de Ciencias, Centro de Investigación en Biodiversidad y Ambientes Sustentables (CIBAS), Casilla 297, Concepción, Chile.

NIS establishment is context dependent and varies with a complex mixture of invader attributes, resource levels, abiotic conditions, and community structure of the invaded habitat. The biotic resistance hypothesis predicts that NIS establishment and spread fail in diverse communities because strong biotic interactions with native species and had led to numerous strategies worldwide (e.g. increasing habitat complexity of artificial coastal structures) in order to promote the native component at the expense of the NIS. Nonetheless, the influence of native biodiversity under realistic assembly rules has, to our knowledge, never been thoroughly tested in marine environments. The relationships between diversity and invasiveness can indeed vary according to the distribution of competitive traits in the species pool and may be skewed in many possible scenarios, as the distribution of facilitative traits is also considered. We herein tested these models in marine fouling community using a controlled translocation approach from a “pristine” to an “invaded” site (experiencing higher propagule pressure) at two occasions (spring and fall). Translocated substrates were previously left being colonized for either 0, 1, 3, 7 or 13 mo. After a first sampling at the time of translocation (procedural control), panels were retrieved after 1 mo to assess recruitment patterns and after 4 mo to account for preliminary species interactions. NIS recruitment and colonization was generally greater on early stages-panels (0, 1, 3 mo) and bare space availability generally correlated with NIS recruit number. However, several NIS were either indifferent to the successional stage of the recipient assemblage or positively influenced by native habitat-forming species (barnacles and ascidians). The influence of facilitation of native and non-native species thus seems acting upon diversity and community development and should deserve further attention in models of biotic resistance.

Presenting author: Jean-Charles Leclerc. E-mail: leclercjc@gmail.com

Opportunistic epibiosis enables non indigenous invertebrates to insinuate themselves into space limited environments

Kaeden Leonard[1], Marnie Campbell[2], Carmen Primo[3], Chad Hewitt[1]

1: University of Waikato, New Zealand.
2: Murdoch University, Australia.
3: University of Tasmania, Australia.

Marine biofouling communities are often space-limited and characterised by intense overgrowth competition, often resulting in the mortality of the weakest competitor. Competitive hierarchies demonstrably influence larval settlement choice, with inferior competitors selecting settlement sites further away from superior competitors or not finding an adequate settlement sites at all. The ability of a non-indigenous species (NIS) to find adequate substrate to settle and grow has been shown to be an important function of success. Yet our understanding of the mechanisms that marine species use to insinuate themselves into extant, well connected communities remains elusive. Monthly observations of recruitment on PVC settlement plates over a year illustrated that NIS generally recruit in higher numbers and for longer periods than native species. However, the observed recruitment did not equate to species composition and dominance on plates that remained in-situ for three or six months, mostly due to the presence of the dominant native solitary ascidian *Molgula ficus*. Therefore, we examined changes in settlement preferences for settling on artificial or biogenic substrates by contrasting recruitment phenology with epibiotic settlement. We observed that in order to live and maintain a hold within space limited environments, NIS increasingly relied on epibiosis. More specifically, with the availability of space NIS tend to show no real preference with regards to settling on uncolonised space or as epibionts. However preference changes to settling as epibionts, when bare space became limited. In contrast native species that were recorded as epibionts generally showed a preference to settle on basibionts regardless of space availability.

Presenting author (Best Poster BHL): Kaeden Leonard. E-mail: kaeden.leonard@waikato.ac.nz

The effect of tourism on benthic introduced species in the Galapagos marine reserve

Jonas Letschert[1], Inti Keith[2], Matthias Wolff[1]

1: Leibniz Centre for Tropical Marine Research, Germany.
2: Charles Darwin Research Station, Ecuador.

In line with increasing globalization marine bioinvasions accumulate, posing a threat to global biodiversity. Marine reserves are no exclusion and findings about invaded marine protected areas have gathered in the last decades. Intense marine tourism in reserves might enhance the risk of local dispersal, as it disturbs native communities and increases the number of potential vectors. This study investigated the interaction between marine tourism and the abundance of sessile introduced species in the Galapagos Marine Reserve (GMR), Ecuador. Settlement plates and dive surveys were used to assess fouling assemblages in different management zones of the GMR, and data were analyzed using multivariate statistics. Anthropogenic influence at study sites was quantified by inspecting a 4 year-long data set about ship positions, provided by the Galapagos National Park. Settlement plate communities in tourism and conservation zones differed up to 62% and the factor zone was significant, explaining 14% of variance. More than 70 species were preliminary identified, at least one new record for Galapagos was found, and cryptogenic and introduced species were more abundant at marine visitor than at protected sites. Species cannot be named in this abstract due to pending confirmations by experts, but will be complemented in the next months. Ship traffic was only marginally significant due to strong confounding factors such as the abundance of benthic pickers, upwelling, mean temperature, and bathymetry. This was the first project of its kind in Galapagos, and findings comply with studies from reserves in other regions in the world. This study concludes that more awareness should be raised about invasive species eroding conservation efforts in marine reserves, and management rules are necessary preventing introduced species dispersal by tourism. Finally, the outlook is given of how ship position data sets could be used to assess the scope of regional dispersal.

Presenting author: Jonas Letschert. E-mail: Jonas_letschert@web.de

What can geographic origin of species tell us about biological invasions?

Yaping Lin[1], Aibin Zhan[2], Elizabeta Briski[1]

1: GEOMAR, Helmholtz-Zentrum für Ozeanforschung Kiel, Germany.
2: Research Center for Eco-Environmental Sciences, Chinese Academy of Sciences, China.

In the past decades, Ponto-Caspian species established in freshwater and brackish habitats of Northern Europe and the Great Lakes-St. Lawrence River in much higher numbers than expected based on introduction effort (i.e., shipping frequency) and environmental conditions between these regions. Hence, it has been suggested that Ponto-Caspian taxa are inherently better colonizers than species from other regions and that majority of Ponto-Caspian endemics may be of freshwater ancestry rather than of marine one. So, in this study we explore rapid adaptive mechanisms for promoting such inherent advantages, and in particular selection on standing genetic variation and epigenetic variation. To determine whether Ponto-Caspian taxa easier adapt to different salinities than taxa from other regions, we conducted laboratory experiments on five populations of three gammarid species native to the Ponto-Caspian (*Pontogammarus maeoticus*), Northern European (*Gammarus salinus*) and Great Lakes–St. Lawrence River regions (*G. tigrinus*). The experiments consisted of control, low and high salinity treatments. Using MethylRAD (DNA methylation profiling method using Mrr-like enzymes) method, we are exploring differences in standing genetic variation and epigenetic variation of survived individuals among populations of the same species originating from different salinities, and among species from different regions. The results of this study are expected to improve our understanding of the mechanisms underlying the patterns of salinity tolerance which will be integral for predicting which species/populations might easier establish in new environments.

Presenting author: Yaping Lin. E-mail: ylin@geomar.de

Invasive species compromising aquaculture in Brazil

Daniel Lins, Rosana Rocha

Universidade Federal do Paraná, Brazil.

The southern Brazilian state of Santa Catarina is the leading producer of bivalve mollusks. The municipalities (sites) Penha, Governador Celso Ramos (GCR), Florianópolis and Palhoça are responsible for over 90% of the national brown mussel (*Perna perna*) production which is also of extreme importance to the local economy. Despite this economic importance, challenges for the mussel production include harmful algae outbreaks and the impact of invasive fouling species. Fouling species increase management costs and can reduce mussel growth compromising aquaculture profits. We evaluated the distribution of invasive species in eight mussel farms, two per site, between October and December 2017, through active search and visual sense of 30 buoys, 30 2m-stretches of main long-line ropes and 30 socks of mussels per site. Eight introduced species were identified and occur in all sites, with the exception of *Mytilus* sp. (possibly *M. platensis*) which did not occur at the north-most site, Penha. The ascidia *Styela plicata* is the most widespread species and occurs in more than 70% of all substrates evaluated at each site. From north to south, other very frequent species (> 50%) are the barnacle *Megabalanus coccopoma* and the ascidians *Aplidium accarense* and *Didemnum perlucidum* in Penha, the bryozoan *Schizoporella errata* in GCR, the polychaete *Branchiomma luctuosum* in Palhoça, and *M. coccopoma* in Florianópolis. With intermediate frequencies (>30%) are *S. errata* in Penha, *M. coccopoma* in GCR, the ascidian *Botrylloides giganteum* and *M. platensis* in Palhoça. The long-line rope is the substrate less occupied (< 30%) by the species, only *S. plicata* reaching 77%. Occupancy of buoys by *M. coccopoma* is near 80% and over 40% to *S. errata*. Frequently fouling mussel socks are *B. luctuosum*, *M. coccopoma*, *S. errata* (>50%) and *D. perlucidum* (40%). We will discuss landscape and environmental factors that may influence species frequency. Funding agency: CAPES

Presenting author: Daniel Lins. E-mail: daniel.lins@ufpr.br

Recently colonized non-indigenous species in native fish species diet: case studies from Archipelago Sea, SW Finland

Olli Loisa[1], Riikka Puntila[2], Eemeli Huhta[1], Jussi Laaksonlaita[1]

1: Turku University of Applied Sciences, Finland.
2: Finnish Environment Institute, Finland.

Upon successful introduction, non-indigenous species (NIS) can alter food web structure and function in a variety of ways. These changes are potentially more pronounced with functionally novel invaders, such as the Harris mud crab *Rhithropanopeus harrisii* in the northern Baltic Sea. Additionally, while the predatory role of novel NIS in aquatic environments is commonly studied, their role as a prey item for native predators is frequently overlooked. As the northern Baltic Sea lacks any native crab species, this system provides an opportunity to observe how a functionally novel species changes food web structure. Based on a pilot study in fall 2013 in the Archipelago Sea, SW Finland, mud crabs were present in stomachs of perch *Perca fluviatilis*, four-horned sculpins *Myoxocephalus quadricornis*, roach *Rutilus rutilus*, and three other species (*Leuciscus ide*, *Gymnocephalus cernuus*, and *Blicca bjoerkna*). Four-horned sculpins were the most frequent crab predator, with 83% having mud crabs in their stomach at the densest mud crab sites. In comparison, at these same sites, 7% of the perch and roach had consumed mud crabs. Between August 2017 and May 2018, >2500 stomach samples were collected from 22 fish species from the same area with an attempt to investigate the seasonal changes in fish predation on the mud crab. The samples are currently being analyzed with broader focus on recently colonized and abundant NIS species (e.g. *Rhithropanopeus harrisii* and *Neogobius melanostomus*) and their spatiotemporal occurrence in fish diet. The preliminary results show occurrence of both NIS as prey items and confirm that the mud crab is particularly well established in the diet of the native fish species in the study area. These results highlight the need to understand the process of how native predators learn to prey on novel NIS and whether there is potential of native predators controlling NIS populations.

Presenting author: Olli Loisa. E-mail: olli.loisa@turkuamk.fi

Functional differentiation between native and non-native species from temperate and tropical communities

Diana Lopez, Amy Freestone

Temple University, USA.

Trait similarity between native and non-native species can elucidate underlying mechanisms that drive invasion success. According to the matching hypothesis, introduced species are more likely to survive if they have similar traits to the native community that allow them to cope with local conditions. Conversely, trait differences may contribute to the success of non-native species by enabling them to fill an empty niche and overcome biotic pressure such as competition (i.e., niche differentiation hypothesis). While support for both hypotheses is prevalent in the invasion literature, particularly for plants, studies that consider both hypotheses as possible mechanisms for invasion success along environmental gradients are lacking. We compared the amount of functional space (i.e., functional richness) occupied by native and non-native sessile marine invertebrate communities to examine whether trait matching or niche differentiation are the primary mechanisms for invasion success in temperate and tropical regions. In temperate regions, we hypothesized that environmental constraints will require adaptations to withstand physical conditions and may cause native and non-native species to have functionally similar traits, leading to no difference in functional richness. However, at lower latitudes, we hypothesized that biotic interactions will be stronger and that successful non-native species will have novel trait combinations to minimize competition with natives, leading to niche differentiation. Our preliminary results indicate there are differences in functional richness between native and non-native communities in both temperate and tropical regions. If these results hold in further analyses, then they suggest that even in the face of distinctly different abiotic and biotic conditions, niche differentiation may be an important predictor of invasion success across latitude.

Presenting author: Diana Lopez. E-mail: dlopez@temple.edu

Invasion of aquarium origin soft corals on a tropical rocky reef in the southwest Atlantic, Brazil

Marcelo Mantelatto[1], Amanda Silva[1], Tayana Louzada[1], Catherine McFadden[2], Joel Creed[1]

1: Universidade do Estado do Rio de Janeiro, Brazil.
2: Harvey Mudd College, USA.

In September 2017 previously unknown and apparently two non-indigenous species (NIS) of soft corals were detected on a subtidal tropical rocky reef at Ilha Grande Bay, Brazil. The present study aimed to identify the species and probable pathway of introduction, quantify their distribution abundance and changes in the native benthic community. Specimens were identified using standard morphological and molecular methods. The extension of the invaded site (IS) was established by diving to observe local distributional limits as well searching ten nearby sites for the NIS. Benthic community coverage surveys were conducted at the IS and at two non-invaded control sites (CS). Twenty 50×50cm photo quadrats were placed along three 20m transects at shallow, intermediate and near the sandy bottom in each site. The most abundant NIS belonged to the recently described genus *Sansibia* (Xeniidae) and the less common species was identified as *Clavularia* cf. *viridis* (Clavulariidae). Both are of Indo-Pacific origin and typical of those ornamentals found in the aquarium trade, so probably they were introduced by deliberate release from an aquarium. They were found along 170m of shoreline at all depths where hard substrate was available, but not at the other nearby locations. Communities invaded by the soft corals were distinct from native communities and Sansibia sp. was the principal taxon/functional group which contributed to dissimilarity between CS and IS. *Sansibia* sp. coverage increased from shallow (mean coverage = ~ 13%) to bottom depths (mean coverage = ~ 37%) and was negatively related to the abundance of Palythoa caribaeorum, which probably provided greater biotic resistance to invasion. Xeniid soft corals usually exhibit high fecundity, prolonged planulation period and rapid recruitment and growth that results in continuous space occupation with high densities. The soft corals still have a restricted and relatively limited distribution, which is favorable for management.

Presenting author (ONR Global Early Career Award Winner): Marcelo Mantelatto.
E-mail: marcelomantelatto@gmail.com

Spatial distribution, host species and observed rafting of the non-indigenous brittle star *Ophiothela mirabilis* (Echinodermata: Ophiuroidea) at Ilha Grande Bay, Brazil

Marcelo Mantelatto[1], Lélis Carlos-Júnior[2], Joel Creed[1]

1: Universidade do Estado do Rio de Janeiro, Brazil.
2: Instituto Brasileiro de Biodiversidade, Brazil.

The brittle star *Ophiothela mirabilis*, native to the Pacific Ocean, recently invaded Brazil and expanded along the coastline. The ophiuroid may have been introduced by shipping, in ballast water, associated with fouling communities encrusting on the ships hulls or through natural transport by oceanic currents from the Caribbean Sea. The present study aimed to describe the distribution of *O. mirabilis* and host preference in Ilha Grande Bay (IGB), Brazil. 112 sites were visited and at each site a snorkeler swam parallel to the rocky reefs looking for *O. mirabilis*. A 20m transect parallel to the shore was placed at 25 sites and species hosting *O. mirabilis* quantified. Ophiothela mirabilis was found at 61.61% (n=69) of sites and on 25 taxon/functional group hosts (14 sponges, 7 cnidarians, 2 algae and 2 echinoderms). Among these, four were new host records for *O. mirabilis*: *Millepora alcicornis*, *Madracis decactis*, *Mussismilia hispida* and crustose coralline algae. The ophiuroid was more frequently found on the north and east side of the bay, where it encountered most of its hosts, with fewer occurrences on the west side and south of the IGB. The sponges *Desmapsamma anchorata* and *Lotrochota arenosa* were by far the most frequent hosts (56% and 40% of occurrences, respectively). The brittle star is capable of asexual reproduction, which facilitates its proliferation and allows it to achieve higher densities on its hosts. After colonization it is possible that the ophiuroids crawl out and disperse short distances to other nearby hosts and can also disperse by rafting; this was observed on *Sargassum* spp. These traits permit it to rapidly expand its range. Its now widespread distribution, high density, use of multiple hosts and dispersion abilities makes its management difficult in Brazil.

Presenting author (ONR Global Early Career Award Winner): Marcelo Mantelatto.
E-mail: marcelomantelatto@gmail.com

Roadmap to the management of marine invasive alien species in Europe: a prioritization exercise in a Mediterranean country

Agnese Marchini[1], Alice Cardeccia[1], Franco Andaloro[2], Ernesto Azzurro[2], Lucilla Carnevali[2], Alberto Castelli[3], Ester Cecere[4], Luigia Donnarumma[5], Jasmine Ferrario[1], Piero Genovesi[2], Adriana Giangrande[6], Cinzia Gravili[6], Flavia Grieco[7], Joachim Langeneck[3], Giorgio Mancinelli[6], Francesco Mastrototaro[7], Cristina Mazziotti[8], Michele Mistri[9], Federica Montesanto[7], Cristina Munari[9], Lidia Orsi-Relini[10], Antonella Petrocelli[4], Luigi Piazzi[11], Giulio Relini[10], Giovanni Fulvio Russo[5], Adriano Sfriso[12], Anna Occhipinti-Ambrogi[1]

1: University of Pavia, Italy. / 2: ISPRA - Istituto Superiore per la Protezione e la Ricerca Ambientale, Italy. / 3: University of Pisa, Italy./ 4: IAMC (Institute for the Marine Coastal Environment) - CNR, Italy. / 5: Parthenope University of Naples, Italy./ 6: University of Salento, Italy. / 7: University of Bari, Italy. / 8: ARPAE (Agenzia Regionale per la Prevenzione, l'Ambiente e l'Energia dell'Emilia-Romagna), Italy. / 9: University of Ferrara, Italy. / 10: University of Genoa, Italy. / 11: University of Sassari, Italy. / 12: Ca' Foscari University of Venice, Italy.

In 2014 the Regulation 1143/14 on invasive alien species (IAS) was issued by the European Community. It provides for important restrictions (as importing and selling) and a set of measures (early detection, rapid eradication or control) that EU member states are required to take for the species included on a list of IAS of Union Concern. The inclusion of a species in this list is based on the results of a risk-assessment procedure. The list, adopted in 2016 and updated in August 2017 contains at present 49 IAS, none of which marine (except from the brackish water crab *Eriocheir sinensis*). Member states can also adopt a list of "species of national concern" and apply the same measures provided for the species of Union concern. In Italy the scientific community is working on a prioritization exercise to develop a list of IAS of national concern, that may eventually include marine IAS. This list will be composed by both IAS already present and potential new IAS, from a horizon scanning exercise. Their principal pathways have been discussed in relation to the effectiveness of prevention measures. Italy is a major "first hub" for marine introductions in the Mediterranean Sea, with over 200 multicellular marine alien species reported so far. With its central position in the Mediterranean Sea, it shares several species with the Western European countries, carried by ships or with shellfish stocks, as well as a number of Indo-Pacific species with the Eastern Mediterranean countries, entered through the Suez Canal. Therefore, the roadmap that Italy is currently tracing towards the possible inclusion of marine species in the list of IAS to be managed and controlled, is also relevant for other European and Mediterranean countries. This presentation will show how the process has been organized and conducted, and the preliminary outcomes.

Presenting author: Agnese Marchini. E-mail: agnese.marchini@unipv.it

Introducing the World Register of introduced Marine Species (WRiMS)

Agnese Marchini[1], Shane Ahyong[2], Mark J. Costello[3], Wim Decock[4], Stephanie Dekeyzer[4], Bella S. Galil[5], Thomas Lanssens[4], Christophe Lejeusne[6], Anna Occhipinti-Ambrogi[1], Shyama Pagad[3], Vadim E. Panov[7], Marc Rius[8], Tamara B. Robinson[9], Xavier Turon[10], Thomas Verleye[4], Leen Vandepitte[4], Bart Vanhoorne[4], Kevin Verfaille[4]

1: University of Pavia, Italy.
2: Australian Museum, Australia.
3: University of Auckland, New Zealand.
4: VLIZ-Vlaams Instituut Voor De Zee, Oostende, Belgium.
5: The Steinhardt Museum of Natural History, Tel Aviv University, Israel.
6: Sorbonne Université, Station Biologique de Roscoff, France.
7: Regional Euro-Asian Biological Invasions Centre (REABIC).
8: University of Southampton, Ocean & Earth Science, United Kingdom.
9: Stellenbosch University, South Africa.
10: Centre for Advanced Studies of Blanes (CSIC-CEAB), Spain.

In the past decade two world databases have been established with a focus on marine biodiversity: the World Register of Marine Species (WoRMS), a checklist of nearly 250,000 marine species constantly edited by a global team of taxonomic experts, and the Ocean Biogeographic Information System (OBIS), reporting records in space and time of over 100,000 marine species. However, until now, a standardised, global list of introduced marine species was not available, thus preventing assessment of large-scale patterns of marine introductions (e.g. temporal trends of accumulation, the first records of species across regions, or emerging introduced species). Here we describe the establishment of the World Register of Introduced Marine Species (WRiMS, http://marinespecies.org/introduced/): a comprehensive, continuously updated, expert-validated, information system on marine introduced species. We indicate how WRiMS may contribute to an exploration of global patterns of marine bioinvasions and serve as a valuable management tool.

Presenting author: Agnese Marchini. E-mail: agnese.marchini@unipv.it

Recreational boating as a vector of spread in the Mediterranean Sea: linking boaters habits and peracarids assemblages

Gemma Martínez-Laiz[1], Aylin Ulman[2], Macarena Ros[3], Agnese Marchini[2]

1: Laboratorio de Biología Marina, Departamento de Zoología, Facultad de Biología, University of Seville. 41012, Seville, Spain.
2: Dipartimento di Scienze della Terra e dell'Ambiente, University of Pavia. 27100, Pavia, Italy.
3: Departamento de Biología, CASEM. Facultad de Ciencias del Mar y Ambientales, Campus Universitario de Puerto Real, University of Cadiz. 11510, Cadiz, Spain.

Shipping is understood to be a major pathway for the introduction of marine non-indigenous species (NIS), while its two main methods of transfer are via ballast water and biofouling. While ballast-water exchanges have now entered global regulation, biofouling is not yet managed, and until now has been particularly overlooked. The Mediterranean Sea is the second most popular recreational boating destination worldwide; but the influence of recreational boating as a vector for the spreading of NIS has not yet been assessed here. We present the first large-scale study to examine this sector by using a combined biological (analyzing hull and marina fouling) and social approach (boater surveys on maintenance habits, travel patterns and awareness), with a focus on peracarid crustaceans. We explored the presence of native vs. non-indigenous peracarid species in recreational marina habitats across the Mediterranean Sea; and investigated which aspects of boat owners behaviors influence higher probability of NIS occurrence in biofouling communities colonizing their vessel hulls. A surprisingly high number of NIS were found on vessels cruising Mediterranean waters; and species compositions suggest an exchange between marina and vessel assemblages. This means recreational boating presents a risk for NIS spread which should warrant regulation. Results also imply that each marina the boat visits does pose an 'infection' risk; and that management at both the regional and basin-wide scale are both needed in the Mediterranean Sea. In addition, a lack of awareness of NIS was demonstrated amongst boat owners, which could be improved upon with targeted environmental education.

Presenting author (JAP&JTC Early Career Award Winner): Gemma Martínez-Laiz.
E-mail: martinezlaiz@us.es

An experimental study of growth interactions between the tropical zoantharian *Palythoa caribaeorum* (Cnidaria: Anthozoa) and invasive corals *Tubastraea* spp.

Isabella Guilhem, Bruno Masi, Joel Creed

Universidade do Estado do Rio de Janeiro, Brazil.

Competition for space directly affects the structure of the sessile benthic communities of hard substrata. *Palythoa caribaeorum* is a shallow water mat-forming zoantharian which is abundant on the Brazilian coast, has a high growth rate and dominates space. The objective of the present study was to investigate changes in the growth of *P. caribaeorum* when interacting (in contact) with the invasive coral species *Tubastraea tagusensis* and *Tubastraea coccinea* on a rocky shore at Ilha Grande, Brazil (southwest Atlantic). Eight blocks of areas of 10 × 10 cm of *P. caribaeorum* colonies were removed along the rocky shore to open up spaces on the substrate. The invasive corals were transplanted into the spaces using epoxy putty, with four different levels: empty (control), (dead) skeleton, live *T. coccinea* and live *T. tagusensis*. Growth measures of the zoantharian were performed using photographs and CPCe software. During the 184 days of the experiment *P. caribaeorum* had the highest total growth rate in the empty treatment (mean 0.00708 ± 0.00063 cm.day-1) and the treatment with the lowest total growth rate was live *T. coccinea* (mean 0.00368 ± 0.00039 cm.day-1). We can conclude that the presence of *T. coccinea* reduces the growth rate of *P. caribaeorum*, unlike *T. tagusensis*, as growth rates did not significantly differ from the control. As a control measure it is believed that the removal *Tubastraea* spp. will favor the growth of *P. caribaeorum* which is the most abundant shallow water subtidal space occupying organism in the region. This strategy will contribute to the ecosystem recovery of invaded areas and the re-occupation of the substrate by native species.

Presenting author: Bruno Masi. E-mail: masibruno@gmail.com

Simulated in-transit survival of fouling zebra and blue mussels in maritime shipping

Christopher W. McKindsey, Luc Comeau, David Drolet, Jesica Goldsmit, Kimberly Howland, Cynthia McKenzie, Cyrena Riley, Nathalie Simard

Fisheries and Oceans Canada, Canada.

Ships may act as vectors of introduction for aquatic invasive species (AIS) through hull fouling. However, there is limited understanding of the survival of fouling species following short-term in-transit changes in environmental conditions. Normally, last port-of-call (LPoC) information is used to assess the relative risk of introduction of AIS. However, species present in hull fouling communities may be very different from those in the LPoC given that organisms may have accumulated over time through voyages to multiple destinations subjected to a variety of environmental conditions. We evaluated AIS survival and recovery following exposure to short-term changes in salinity and temperature simulating pathways with transitions between marine and freshwater and back to marine environments, and vice-versa, with the model species zebra mussel (*Dresseina polymorpha*, freshwater) and blue mussel (*Mytilus edulis*, marine). Using a multi-factorial experiment (Temperature, Salinity, and Duration), we concurrently modified temperature (six treatment levels: A) constant 5° C; B) constant 10° C; C) first and last port at 5° C, transition port at 10° C; D) first and last port at 10°C, transition port at 5° C; E) first and last port at 10° C, transition port at 20° C; F) first and last port at 20° C, transition port at 10° C), salinity (freshwater-marine-freshwater and marine-freshwater-marine) and duration of exposure (1 and 8 days). We present results on mussel survival and discuss the implications of these with respect to risk analyses.

Presenting author: Christopher W. McKindsey. E-mail: chris.mckindsey@dfo-mpo.gc.ca

Eco-engineering in a harbour area at Rio de Janeiro, Brazil and its implications to biofouling and non-indigenous species management

Lais P.D. Naval-Xavier[1], Luciana V.R. de Messano[2], Elisabeth M.A. Strain[3], Ricardo Coutinho[2]

1: Programa de Pós Graduação em Biotecnologia Marinha - IEAPM/UFF, Brazil.
2: Instituto de Estudos do Mar Almirante Paulo Moreira - IEAPM, Brazil.
3: National Centre for Coasts and Climate and School of BioSciences, the University of Melbourne, Australia.

Man-made structures in coastal zones cause negative impacts to marine ecosystems. The application of eco-engineering techniques might be an important tool to minimize these impacts. The present study was part of the Green Engineering working group of the World Harbour Project (WHP), initiated by the Sydney Institute of Marine Science (Australia), to enhance programs of research and management of urban harbours of the world. In Brazil, the project was carried out at Arraial do Cabo, Rio de Janeiro and aimed to (1) evaluate the effect of microhabitats (crevices/ridges) on the fouling community diversity; and (2) assess the effects of microhabitats (crevices/ridges) on the establishment of non-indigenous species (NIS). Experimental concrete tiles were produced from 3D-printing molds by Reef Design Lab (Melbourne, Australia). The tiles were distributed along the breakwater of Forno Harbour (Arraial do Cabo) and photographed from September/16 to September/17. Four treatments with five replicates each were tested: (T1) Complex tile - 2.5 cm ridges; (T2) Complex tile - 5 cm ridges; (C1) control - flat tile; and (C2) control (tile made of the same material of the breakwater). At the end of the experiment, we recorded a total of 7 functional groups (filamentous and encrusting algae, serpulid tubeworms, barnacles, bivalves, encrusting bryozoans and colonial ascidians). The Shannon-Wiener diversity index was significantly higher comparing the experimental treatments (T1 and T2) to controls (C1 and C2) (ANOVA $F= 20.194$; $p<0.05$) from the sixth month until the end. Considering the NIS, fewer species were recorded compared to native species, but NIS only colonized on complex tiles. Our results suggested that microhabitats increased local fouling diversity, but it did not inhibit NIS colonization. Hence, further studies are needed at Arraial do Cabo harbour to better understand the NIS fouling dynamics in relation to complex habitats.

Presenting author (ONR Global Early Career Award Winner): Lais P.D. Naval-Xavier.
E-mail: laisnaval@hotmail.com

Population structure of the invasive bivalve *Isognomon bicolor* in port terminals at Northeast Brazil

Luysa Nunes, Diego Bezerra, Wilson Júnior, Cristina Barreira

Universidade Federal do Ceará; Instituto de Ciências Marinhas Tropicais, Brazil.

Port terminals add submerged inshore and offshore artificial surfaces generating marine invasion hotspots. Originally from Caribe, *Isognomon bicolor* is an example of successful invader on the Brazilian coast. It is a sessile suspensivore bivalve, with a shell size ranging from 1.3mm to 36mm.This study aims to verify the density and population structure of *I. bicolor* in port terminals at Ceará state, Brazil. Bathymetric sampling was undertaken in 2009, using SCUBA, comparing *I. bicolor* populations from the offshore Pecém port, which was operating for only around 10 years versus the inshore Mucuripe port that was operating for over 50 years. Samples were collected between 0-5m depths from the pier pillars, using a quadrat of 0.15x0.15 m, totaling 40 samples in each study area. *I. bicolor* density was 182.2 ind/m² in Pecém port, whereas it was 281.1 ind/m² at Pecém port. In both ports, the occurrence of the species was greater between 0-2m, possibly due to the preferential settlement pattern of *I. bicolor* population into intertidal ranges. On the newer port, shell size ranged from 1.75 to 13.67 mm, with an average size of 7.3mm, whilst on the older one, it ranged from 1.86 to 18.55 mm having 6.85 mm. Despite this difference, it was not statistically significant between ports. Shell size variation related with depth was only found at Pecém port, where the smaller individuals occupied the first meter, while the larger individuals, although fewer, were found in the third and fifth meters. These organisms had successful recruitments and remain stocked in the population. Thus, *I. bicolor* seems to be well established on Pecém and Mucuripe port terminals.

Presenting author: Luysa Nunes. E-mail: luysa.nunes@gmail.com

Sun Coral Project: linking scientific knowledge and education to manage the biological invasion of *Tubastraea* spp. in Brazil

Elianne Omena[1], Simone Oigman-Pszczol[1], Beatriz Fleury[2], Andrea Junqueira[2], Thiago Couto[1], Carla Zilberberg[2], Athila Bertoncini[3], Bruno Masi[2], Edson Juinior[1], Joel Creed[2]

1: BrBio, Brazil.
2: UERJ, Brazil.
3: UNIRIO, Brazil.

Sun-corals (*Tubastraea* spp.) are now distributed at points along about half (3,500 km) of Brazil's coastline. The invasion of these introduced species impacts marine biodiversity, as they have been proven to be harmful to native corals and change benthic communities. Since its beginning in 2006, the Sun-Coral Project (PCS) has been restoring marine ecosystems, mitigating the environmental damage and redressing the social and economic impacts caused to coastal communities by the sun corals. Currently PCS´s main goals are to improve management techniques, monitor the distribution and the influence of sun–coral on fish and benthic fauna, estimate risk and promote communication and environmental education. A multidisciplinary team of 60 managers, researchers and postgraduate students as well as consultants from three universities are involved. Management studies have been carried out through field experiments using 48 fixed quadrats at three sites along Rio de Janeiro State coast. Range expansion of the sun-corals and their influence on the native rocky shore species have been assessed by monitoring 250 sites. PCS is developing a protocol to evaluate the risk of sun-coral invasion into marine protected areas, an important tool to curtail new invasion episodes. Trained volunteers have developed educational activities in partnership with a marine aquarium and museums. We also work to enhance dive operators and SCUBA divers awareness as a strategy developed for early detection and management. This is achieved by getting the scientific diving team directly involved with the SCUBA divers and underwater photographer hobbyists. More than 19,500 people have been reached by the different education actions. As a science-based project, PCS is proving to be an effective conservation initiative that connects scientific knowledge and education with monitoring and management of the sun coral invasion

Presenting author: Simone Oigman-Pszczol. E-mail: simone@brbio.org.br

Parasite infestation of the invasive round goby in the Baltic Sea

Henn Ojaveer[1], Aleksei Turovski[2], Kristiina Nurkse[1]

1: Estonian Marine Institute, University of Tartu, Estonia.
2: Tallinn Zoological Gardens, Estonia.

Parasite infestation of the non-indigenous round goby was investigated based on spatially and seasonally replicated sampling in the NE Baltic Sea (Muuga Bay in the Gulf of Finland and Pärnu Bay in the Gulf of Riga) from May to December 2016. These sites represent two different invasion history situations: an established population in Muuga Bay and the beginning of colonisation in Pärnu Bay. Infection rate of the fish was very high in both localities (86% in Pärnu Bay and 95% in Muuga Bay) with in total of 21 parasite taxa identified. 71% of parasite taxa were found to occur in both bays. The eye fluke *Diplostomum spathaceum* showed by far the highest infection and prevalence rates (65% and 6.1, respectively), followed by a group of four species (*Cryptocotyle concavum*, *Cucullanus heterocrous*, *Cucullanellus minutus* and *Pomphorhynchus laevis*) with much lower and broadly similar infestations and prevalence (15-21% and 3.5-4.6, respectively). Infection rate of all other parasites remained below 10%. Our study suggests relatively high local infestation rates, which are independent from invasion history. In addition, the study confirms low prevalence rate, the latter being likely one of the reasons behind the spatial expansion and establishing of vital populations in the newly colonised environments.

Presenting author: Henn Ojaveer. E-mail: henn.ojaveer@ut.ee

Historical baselines in marine bioinvasions: implications for policy and management

Henn Ojaveer[1], Bella Galil[2], Heidi Alleway[3], James Carlton[4], Philippe Goulletquer[5], Maiju Lehtiniemi[6], Agnese Marchini[7], Whitman Miller[8], Anna Occhipinti-Ambrogi[7], Melita Peharda[9], Gregory Ruiz[10], Susan Williams†[11], Anastasija Zaiko[12]

1: Estonian Marine Institute, University of Tartu, Estonia.
2: The Steinhardt Museum of Natural History, Israel.
3: School of Biological Sciences, University of Adelaide, Australia.
4: Maritime Studies Program of Williams College and Mystic Seaport, USA.
5: IFREMER, France.
6: Finnish Environment Institute, Finland.
7: Department of Earth and Environmental Sciences, University of Pavia, Italy.
8: Marine Invasion Research Laboratory, Smithsonian Environmental Research Center, USA.
9: Institute of Oceanography and Fisheries, Croatia.
10: Marine Invasion Research Laboratory, Smithsonian Environmental Research Center, USA.
11: Bodega Marine Laboratory and Department of Evolution and Ecology, University of California at Davis, USA.
12: Cawthron Institute, New Zealand; Marine Research Institute, Klaipeda University, Lithuania.

The human-mediated introduction of marine non-indigenous species is a centuries- if not millennia-old phenomenon, but was only recently acknowledged as a potent driver of change in the sea. We provide a synopsis of key historical milestones for marine bioinvasions, including timelines of (a) discovery and understanding of the invasion process, focusing on transfer mechanisms and outcomes, (b) methodologies used for detection and monitoring, (c) approaches to ecological impacts research, and (d) management and policy responses. Early (until the mid-1900s) marine bioinvasions were given little attention, and in a number of cases actively and routinely facilitated. Beginning in the second half of the 20th century, several conspicuous non-indigenous species outbreaks with strong environmental, economic, and public health impacts raised widespread concerns and initiated shifts in public and scientific perceptions. These high-profile invasions led to policy documents and strategies to reduce the introduction and spread of non-indigenous species, although with significant time lags and limited success and focused on only a subset of transfer mechanisms. Integrated, multi-vector management within an ecosystem-based marine management context is urgently needed to address the complex interactions of natural and human pressures that drive invasions in marine ecosystems.

Presenting author: Henn Ojaveer. E-mail: henn.ojaveer@ut.ee

Diversity of native and exotic species in six urbanized habitats located between the two most populated regions from the southwestern Atlantic Ocean

Felipe Oricchio, Gustavo Muniz Dias

Universidade Federal do ABC, Brazil.

Bioinvasion is one of the major factors responsible for the loss of diversity across the globe. In coastal marine environments, man-made constructions may favor bioinvasion, due to homogenization of the environmental conditions and the intense flow of vessels. In Brazil, the coastal region between the cities of São Paulo and Rio de Janeiro contains a large portion of the Brazilian population, as well as the two largest ports in the country. To describe the diversity of fouling organisms in this region associated with marinas, we deployed ten 30x30 cm PVC panels in six different marinas, located between the two largest urban centers in Brazil. We allowed the fouling community to develop for six months, sampling the diversity every two months. We identified each species, its status regarding biogeographical origin and quantified its relative abundance. We registered a total of 68 species, but only six of them were native from Brazil, 13 were exotic and 49 were cryptogenic. The most speciose groups were ascidians, bryozoans and sponges. In the marinas of Angra dos Reis, Ubatuba and Ilhabela the cryptogenic encrusting bryozoan *Schizoporella errata* dominated most of the substrata. At the marina located in Niterói, within Guanabara Bay, one of the most polluted regions in the Brazilian Coast, the communities were initially dominated by the exotic polychaete *Hydroides elegans* and then replaced by the also exotic solitary ascidian *Styela plicata*. In Paraty, communities are dominated by an unidentified oyster and also the exotic *S. plicata*, while in São Sebastião, one of the smallest marinas, the community was very diverse, presenting no clear dominance pattern, but also with high abundance of the exotic ascidian *Didemnum perlucidum* and *S. errata*. Our results suggest that non-native species play an important role in the organization of fouling communities from artificial habitats. FAPESP 2016/17647-5

Presenting author: Felipe Oricchio. E-mail: felipeoricchio@gmail.com

A review of non-indigenous macrophytes in Adriatic transitional waters and ports (Mediterranean Sea)

Martina Orlando-Bonaca[1], Giuseppe Bonanno[2], Lovrenc Lipej[1]

1: Marine Biology Station, National Institute of Biology, Slovenia.
2: Department of Biological, Geological and Environmental Sciences, University of Catania, Italy.

The Adriatic Sea is a semi enclosed sea that represents the northernmost part of the Mediterranean Sea. It is considered a hotspot of marine biodiversity but, due to human activities (e.g. maritime transport, biocontrol, the opening of the Suez Canal and aquaculture), the Adriatic Sea became also a recipient area of non-indigenous species (NIS). Therefore, in the last three decades, several marine biologists have focused their research on the spread and impacts of NIS, among which there are many macrophytes, as well. Transitional waters (TW) proved to be very important coastal areas for the arrival and settlement of NIS. The present work takes into account the published records in scientific literature addressing NIS of macrophytes in TW of the Adriatic Sea, in the period 1987-2018. In addition, published data of NIS in marinas and ports were considered. The data analysis revealed that 48 non-native macrophytes were confirmed in Adriatic TW. Among them, 30 are red algae (Rhodophyta), 10 brown algae (Ochrophyta), 7 green algae (Chlorophyta), and one vascular plant (Tracheophyta). Overall, 14 of these macrophytes are considered as invasive or potentially invasive species. The highest number of macroalgal NIS was recorded in Italian part of the Adriatic Sea with 43 species, of which 38 were found in the Venice Lagoon. Ten algal NIS were confirmed in Croatian TW, 5 in Albanian TW, and only one in Slovenian and Montenegrin TW. Moreover, the only vascular NIS was found in Albanian TW. It is worth to emphasize that non-native brown algae were reported only for Italian TW. Due to the recent enlargement of the Suez Canal and the growing human pressures on the marine environment, we can assume that the number of NIS among macrophytes in the Adriatic Sea will continue to increase.

Presenting author: Martina Orlando-Bonaca. E-mail: martina.orlando@nib.si

Green chemistry as a sustainable source of potential additives for marine antifouling paints

Angélica Escobar[1], Míriam Pérez[2,3], Ángel Sathicq[4], Mónica García[3], Analia Paola[2,3], Gustavo Romanelli[4,5], Guillermo Blustein[3,6]

1: CINDECA, Departamento de Química, Facultad de Ciencias Exactas, UNLP-CCT-CONICET, Calle 47 N 257, 1900 La Plata, Argentina.
2: Facultad de Ciencias Naturales y Museo, Universidad Nacional de La Plata, Calle 60 y 122, 1900 La Plata, Argentina.
3: Centro de Investigación y Desarrollo en Tecnología de Pinturas (CIDEPINT), CICPBA-CONICET, Calle 52 e/ 121 y 122, 1900 La Plata, Argentina.
4: Centro de Investigación y Desarrollo en Ciencias Aplicadas (CINDECA), Departamento de Química, Facultad de Ciencias Exactas, UNLP-CCT-CONICET, Calle 47 N 257, 1900 La Plata, Argentina.
5: Centro de Investigación en Sanidad Vegetal (CISaV), Facultad de Ciencias Agrarias y Forestales, Universidad Nacional de La Plata, Calle 60 y 119, 1900 La Plata, Argentina.
6: Facultad de Ciencias Agrarias y Forestales, Universidad Nacional de La Plata, Calle 60 y 119, 1900 La Plata, Argentina.

Biofouling can be defined as the undesirable accumulation of micro- and macroorganisms on artificial surfaces immersed in seawater. Biological fouling is a severe problem for the shipping industry and leads to an increase in weight, subsequent speed reduction and loss of maneuverability and as a consequence, higher fuel consumption is needed. Another consequence is the transport of species that could generate a significant negative impact on biodiversity. In this sense, some studies suggest that most of marine introduced species are found in Buenos Aires coast. Particularly, Mar del Plata harbor has strong recreational, commercial and international fishing activities. Besides, its growing urbanization generates new available substrates for organism settlement. All these conditions plus competition among fouling species promote exotic species dispersion. Therefore, Mar del Plata harbor is an adequate place to study and develop antifouling systems. In the search for new environmentally friendly alternatives to replace or reduce the use of metallic antifouling pigments in marine paints, three n-alkyl 2-furoates (butyl 2-furoate, hexyl 2-furoate and octyl 2-furoate) were prepared by green sustainable procedures. These compounds were characterized by current organic analysis and their antifouling properties were firstly evaluated on *Artemia salina* nauplii in the laboratory. Then, antifouling paints formulated with these compounds were exposed for 45 days in Mar del Plata harbor. Results indicated that furoate paints completely inhibited the settlement of conspicuous species of Mar del Plata harbor such as the calcareous tubeworm *Hydroides elegans*, colonial ascidians such as *Botryllus* sp., and the sandtube builder *Polydora* sp. Both laboratory and field tests indicate that n-alkyl 2-furoates have strong antifouling activity and are promising candidates for antifouling technology.

Presenting author: Analia Paola. E-mail: a.paola@cidepint.gov.ar

Antifouling activity of azulenoid sesquiterpenes from the antarctic gorgonian *Acanthogorgia laxa*

Laura Patiño Cano[1], Analía Paola[2,3], Miriam Pérez[2,3], Mónica García[2], Laura Schejter[4], Rodrigo Quintana Manfredi[1], Ralf Cordeiro[5], Carlos Pérez[5], Jorge Palermo[1], Guillermo Blustein[2,6]

1: Unidad de Microanálisis y Métodos Físicos en Química Orgánica (UMYMFOR), CONICET-Universidad de Buenos Aires, Buenos Aires, Argentina.
2: Centro de Investigación y Desarrollo en Tecnología de Pinturas (CIDEPINT), CICPBA-CONICET-UNLP, La Plata.
3: Facultad de Ciencias Naturales y Museo, Universidad Nacional de La Plata, La Plata, Argentina.
4: Laboratorio de Bentos, Instituto Nacional de Investigación y Desarrollo Pesquero (INIDEP), Mar del Plata, Argentina.
5: GPA-Grupo de Pesquisa em Antozoarios, Centro Académico de Vitoria, Universidade Federal de Pernambuco, Brazil.
6: Facultad de Ciencias Agrarias y Forestales, Universidad Nacional de La Plata, La Plata, Argentina.

Biofouling has been recognized as a widespread problem in the design and operation of waterborne structures, with high associated economic costs, for example in ship's hulls, oil platforms, pipes of cooling systems for power plants, and cages used for aquaculture. In the shipping industry, the economic effects of biofouling are the most dramatic, since fouled hulls produce additional frictional resistance which leads to an increase of up to 40% in fuel consumption. Additionally, shipping activities have been identified as the main source of species introductions in coastal habitats. A vast amount of literature has shown that marine invasive species commonly arrive, not only in the ballast water but also in ballast water sediments and biofouling communities. These are main vectors has led to high percentages of cryptogenic and exotic species in Mar del Plata harbour. Antifouling paints are the most effective method used to prevent fouling settlement. However, they are formulated with toxics which contaminate water and sediments. For these reason, there is a growing need for environmentally safe antifouling systems. In the search for new antifouling compounds, samples of the grey-blue gorgonian *Acanthogorgia laxa* were collected by bottom otter trawls (-343 m) on board the research vessel 'Puerto Deseado' (CONICET) in Antarctic waters (64°41.50S, 63°1.60W). Two azulenoid sesquiterpenes, Linderazulene (1) and Ketolactone (2) isolated from the *A. laxa* were assayed as potential antifoulants by incorporation in experimental soluble-matrix marine paints. Field tests were conducted at Mar del Plata harbour for 45 days. The results showed that compounds 1 and 2 displayed good antifouling potencies against a wide array of organisms. As always, the marine environment provides knowledge and inspiration for the development of additives for the control of biofouling. In the present work, it was demonstrated that azulenoids can be environmentally friendly natural additives for marine paints.

Presenting author: Analia Paola. E-mail: a.paola@cidepint.gov.ar

The non-indigenous macroalgae's hide-and-seek play

Manuela Parente[1], Andrea Botelho[1], Joana Micael[2], Raquel Torres[1], David Milla[3], Gabriel Daniela[1], João Monteiro[4], Enrique Ballesteros[5], Pedro Afonso[3], Ana Costa[1]

1: CIBIO- InBIO Associate Laboratory - Research Network in Biodiversity and Evolutionary Biology, Universidade dos Açores, 9501-801 Ponta Delgada, Portugal.
2: BirdEcologyLab, Instituto de Ciencias Marinas y Limnológicas, Universidad Austral de Chile, Valdivia, Chile.
3: Okeanus/MARE, Marine and Environmental Science Centre/IMAR, Institute of Marine Research, University of the Azores, 9901-862 Horta
4: MARE – Marine and Environmental Sciences Centre, Quinta do Lorde Marina, 9200 - 044 Caniçal, Madeira
5: Centre d'EstudisAvançats de Blanes-CSIC, Acc. CalaSantFrancesc 14, 17300 Blanes, Girona, Spain.

The colonization rate of Atlantic oceanic archipelagos by non-indigenous species of marine macroalgae has been shown to be higher than in continental locations. The NIS macroalgae list in the Azores that started to be compiled since the late eighties has been updated by data collected during the regional monitoring program of marine NIS. Under this program monitoring sites have been mainly located in marinas and their neighboring areas. The present study analyses the observed NIS communities' composition in the monitored areas, and the natural ranges of the observed non-indigenous macroalgae. Unexpectedly, non-indigenous macroalgae records are much lower in marinas than in natural areas, a pattern opposite to that exhibited by non-indigenous sessile invertebrates. Biotic resistance posed by stronger invertebrate competitors in marinas is raised as one of the explanations for the observed pattern. The tropical to subtropical native distribution of many of the recent arrivals supports the on-going tropicalization trend of the Azores biota and raises concerns on further indirect effects of climate change on local marine biodiversity.

Presenting author: Manuela Parente. E-mail: nelaparente@hotmail.com

Hitch-hiking with diving-boats: the risk of NIS dispersal in islands

Paola Parretti[1], Jasmine Ferrario[2], Agnese Marchini[2], João Canning-Clode[3], Ana Cristina Costa[4]

1: CIBIO-InBIO, Faculdade de Ciências e Tecnologia da Universidade dos Açores, 9501-801 Ponta Delgada, Portugal.
2: Department of Earth and Environmental Sciences, University of Pavia, Via S. Epifanio 14, 27100 Pavia, Italy.
3: MARE - Marine and Environmental Sciences Centre, Quinta do Lorde Marina, 9200-044 Caniçal, Madeira, Portugal.
4: CIBIO, Centro de Investigacão em Biodiversidade e Recursos Genéticos, InBIO Laboratório Associado, Pólo dos Açores – Faculdade de Ciências e Tecnologia da Universidade dos Açores, 9501-801 Ponta Delgada, Portugal.

The Portuguese archipelagos Azores and Madeira are located in a strategic position in the NE Atlantic being a stopover on marine routes between the European, African and American continents. Since 2014 there has been an increase in marine traffic to these islands and estimates indicate that this trend will continue to increase. Considering that the major vector of introduction of marine non-indigenous species (mNIS) in these archipelagos is marine traffic, and given the absence of legislation on hull biofouling management, the number of mNIS introduced in the marinas of these archipelagos is also expected to grow. Moreover, tourism intensification has brought more attention on seascapes increasing the number of recreational diving in these islands. The potential impact of recreational boating as a vector of NIS secondary spread has been already addressed but no studies have been conducted yet on the role of diving-boats in transport and local dispersion of mNIS, eg. from marinas to diving sites. In this context, we developed a model as a fuzzy inference system composed by three levels. In level one we evaluate the risk of each marina to act as mNIS source using as input variables: number of detected mNIS, marina cleaning frequency, presence of dry dock facilities and water disposal system, and proximity to commercial harbors; in level two, we assess each diving center' risk to transport mNIS to diving spots using two variables: risk of home marina and diving-boat cleaning frequency; and in level three we calculate the risk of a diving spot to receive mNIS based on its visits' frequency and on diving center' risk. This model represents a valuable method to identify "high-risk" marinas; spreading risk by diving-boats and diving spot risk in the study area, thus enabling to prioritize actions for the diving centers to control mNis local spreading and promote the preservation of the protected marine habitats.

Presenting author (JAP&JTC Early Career Award Winner): Paola Parretti.
E-mail: paola.parretti@gmail.com

Engagement in marine NIS management: what really moves local stakeholders?

Paola Parretti[1,2], João Canning-Clode[2], Armando B Mendes[3], Ana Cristina Costa[1]

1: CIBIO, Centro de Investigacão em Biodiversidade e Recursos Genéticos, InBIO Laboratório Associado, Pólo dos Açores – Faculdade de Ciências e Tecnologia da Universidade dos Açores, 9501-801 Ponta Delgada, Portugal.
2: MARE - Marine and Environmental Sciences Centre, Quinta do Lorde Marina, 9200-044 Caniçal, Madeira, Portugal.
3: NIDeS and Centre ALGORITMI - University of Minho, Portugal.

A key aspect for global management of marine non-indigenous species (NIS) is the cooperation with local stakeholders. When public engagement is not possible, stakeholders' awareness may constitute an effective approach to increase public support for NIS management. In this study we assessed baseline knowledge for developing regulatory stance and legislation to prevent and manage NIS establishment and spread in the Azores and Madeira archipelagos. In the last decades several NIS have been detected in these islands and, the intensification of shipping activity and absence of legislation on hull biofouling management prospect an increase in NIS. Survey questionnaires were addressed to stakeholders groups classified based on their relation with NIS (1-manager of recreational marinas; 2-marine tourism operator; 3-people with direct interaction with marine environment and; 4-people with no direct interaction) aiming to assess: i) current knowledge and public perception of NIS and associated problems; ii) influence of NIS awareness dissemination programs, and; iii) stakeholders' willingness to be involved in NIS management actions. We found strong baseline awareness on NIS and associated consequences but a weak accuracy to identify NIS examples. Differences between stakeholders groups' awareness were found, somehow related with successful dissemination programs. The most powerful predictor of participation in NIS management actions is to belong to stakeholder group 3 and within this group practicing marine sports (i.e. SCUBA diving) are factors that combined mostly influence this willingness. Despite a positive interest shown by stakeholders in engaging NIS monitoring and management, our results highlight a consensus to attribute governmental responsibility to such activities. More effort should be made in NIS awareness programs targeting less participative stakeholders and in promoting NIS good practices for the most engaged to contribute for a better marine environment.

Presenting author (JAP&JTC Early Career Award Winner): Paola Parretti.
E-mail: paola.parretti@gmail.com

Seasonal Use of Open Spaces by Non-Native and Native Species

Judith Pederson, Carolina Bastidas

MIT Sea Grant College Program, USA.

Climate change is altering physical and biological conditions in marine ecosystems in ways that have impacts on both native and non-native species. Along the Northeast coast of the U.S., non-native species especially ascidians are dominant in the fouling communities. This study examined the settlement of fouling organisms on PVC plates throughout a year to assess the role of monthly available open space and early competition on established and newly placed plates. We compared patterns between two sites at different bioregions and slightly different physical conditions, in the Virginian (Buzzards Bay) and Acadian (Boston Harbor) Provinces. These locations were chosen because pre-existing data from five rapid assessment surveys between 2000 and 2013, and allowed comparisons between deployed plates with results from summer surveys of in situ communities in terms of species present. Settlement of native (~90-110) and non-native species (14) were recorded over 12 months using plates removed throughout the years at one, two, and three months after submersion. We assessed settlement of organisms and interaction among species and compared these data based on location and previous surveys. Non-native ascidians were present at both sites, often dominating plates, especially during the warmer months, with differences in which species became dominant. During the coldest months, plates were basically bare or covered with turf algae, except for two ascidians, *Didemnum vexillum* and *Botrylloides violaceus* that were present as diminished colonies in Buzzards Bay. Differences between the two sites were most marked by the presence of two non-native ascidians, *D. vexillum* more prevalent at Buzzards Bay and the *Ascidiella aspersa* more prevalent at Boston Harbor. Data on the timing of arrival and settlement of non-native species will be shared with marina operators and managers responsible for prevention and control.

Presenting author: Judith Pederson. E-mail: jpederso@mit.edu

When Introduced equals invasive: Normative use of "invasive" with ascidians

Patricio Javier Pereyra, Matías Ocampo Reinaldo

CIMAS - CONICET - UNCOMA, Argentina.

Since early 2000, there was ample debate on what is and how to define an invasive species. With several definitions coexisting and being used indistinctly, there was highlighted the possible use of the "invasive" in a normative way, meaning that instead of describing an ecological behavior related with invasiveness (i.e. spread, effects), the species are labeled as invasive for other reasons (e.g. habit, citation practices). To test this hypothesis, we have used as working example introduced ascidians worldwide. We also describe the type of research performed with introduced ascidians, with a focus in all ascidians vs those described in the literature as model species, to synthesize the research made with ascidians so far, and identified possible research gaps. A specific search in Web of Science was performed, and articles suitable for analysis were selected. Each article was classified according to the type of environment, species under study, type of effects and spread that ascidians are linked to. Most of the 184 articles analyzed did not consider any type of dispersal or effects as study subject (82 and 71%, respectively). Most research was conducted in laboratory conditions (41%) or man-made environments (32%) or indicating few escapes to natural environments. Almost half of the articles (47%) were made with the six model ascidians. These results indicate that the normative use is widely used regarding introduced ascidians. Spread and Effects, necessary conditions to consider a species as invasive, are notoriously understudied. Most research was not conducted in natural environments and over few species, weakening the perception of introduced ascidians as a conservation problem. This distinction allows us to discuss two separate aspects of the same phenomena: are some species intrinsically problematic for conservation (i.e. invasive) or is the movement of non-native species (i.e. biological invasion) the conservation problem?

Presenting author: Patricio Javier Pereyra. E-mail: pereyranis@gmail.com

Facilitation between two introduced species in Patagonia: a mechanistical approach

Patricio Javier Pereyra, Juan Saad, Marianela Gastaldi, Paula de la Barra, Raúl Cándido González, Maite Narvarte

CONICET, Argentina.

Positive interactions are increasingly studied in marine environments. We were recently able to document a novel interaction between two introduced species, the clubbed tunicate *Styela clava* and the macroalga "wakame" *Undaria pinnatifida*, in which the presence and abundance of *U. pinnatifida* was favored by the occurrence of *S. clava*. We inquired if this was due to a biological effect (i.e. presence of *S. clava* vs. an inanimate, erect substrate), or if it was due to a greater added complexity, either in total area available for settlement or in height (i.e. increasing access to light). To test this, we made mimics of synthetic rubber that copied adult (10 ± 3 cm) and juvenile (3 ± 1 cm) individuals of *S. clava*, and arranged them in four different groups of structural complexity, from higher to lower complexity: (a) 5 adult mimics, (b) 5 juvenile mimics, (c) 1 adult mimic and (d) 1 juvenile mimic. We deployed them (n = 20 for each treatment) in an inner channel of San Antonio Bay below mature *U. pinnatifida* in November 2017 to promote spores settlement. In March 2018, we collected *S. clava* individuals with similar size to the adult mimics and attached them to tiles (n = 20) to test for biological effects. In May 2018 we retrieved all the experimental units. We found that more *U. pinnatifida* settled on alive *S. clava* than on mimics, showing that *S. clava* may offer additional benefits than only more area for settlement. We also found a larger number of *U. pinnatifida* per area in adult than in juvenile mimics, but the density of mimics did not affect the response, showing that *U. pinnatifida* takes more advantage at settling on adult than on juveniles mimics, possibly related with greater access to light.

Presenting author: Patricio Javier Pereyra. E-mail: pereyranis@gmail.com

Quadrilateral Scientific Collaboration: accelerating the development of high-throughput sequencing methods for marine surveillance

Xavier Pochon[1], Anastasija Zaiko[1], Cathryn Abbott[2], Michael Bunce[3], Jonathan Geller[4], Paul Greenfield[5], Mehrdad Hajibabaei[6], Graeme Inglis[7], Susie Wood[1], HTS Working Group (27 Members)[8]

1: Cawthron Institute, New Zealand.
2: Fisheries and Oceans, Canada.
3: Curtin University, Australia.
4: Moss Landing Marine Lab, USA.
5: CSIRO, Australia.
6: University of Guelph, Canada.
7: NIWA, New Zealand.
8: International, New Zealand.

Recent technological advances in high-throughput sequencing (HTS) could revolutionize surveillance in marine environments by enabling rapid, accurate and simultaneous detection of an array of species within complex biological samples. Multiple research institutions have initiated research on invasive marine species employing HTS methods, but there are significant challenges to be overcome before these methods can be applied with confidence to routine surveillance. As part of a Quadrilateral Scientific Collaboration between New Zealand, Australia, Canada and the USA, an international team of scientists was assembled with the aim to tackle existing barriers to effective HTS-based marine surveillance via alignment of methodologies, exchanges of sequence data and reference collections, and through fostering long-term collaborations. A workshop was held in New Zealand (2017), during which a possibility to elaborate standardized HTS protocols for biosecurity applications was addressed. An international experiment was initiated to assess the effectiveness of a uniform DNA extraction protocol and amplification of two genes (nuclear 18S rRNA and mitochondrial COI) following two distinct HTS library preparation (double primer indexing versus fusion primers) for MiSeq IlluminaTM sequencing. Homogenized biofouling samples collected from four bioinvasion hotspots (i.e. busy port or coastal marina) were distributed to 12 distinct laboratories. Participants were asked to strictly follow one of the two HTS library workflows, which were then sequenced at two distinct facilities (Curtin University, Australia; University of Guelph, Canada). The results of this collaborative experiment will be presented and discussed in the current context of the opportunities and challenges facing the field of eDNA.

Presenting author: Xavier Pochon. E-mail: xavier.pochon@cawthron.org.nz

The green crab (*Carcinus maenas*) as a novel food source for the opportunistic kelp gull (*Larus dominicanus*) in Patagonia, Argentina

Miriam Pollicelli[1], Tatiana Kasinsky[2], Nicolás Suárez[2], Pablo Yorio[2,3]

1: Universidad Nacional de la Patagonia San Juan Bosco, Argentina.
2: Centro para el Estudio de Sistemas Marinos-CONICET, Argentina.
3: Wildlife Conservation Society Argentina.

The introduction of alien species is one of the main threats to biological diversity, as it can result in changes in trophic webs and functioning of coastal and marine systems. The Green Crab (*Carcinus maenas*) is and invasive species, which was first recorded in the coasts of Patagonia, Argentina, between 1999 and 2000, and has expanded since throughout a large coastal sector. The Green Crab is a threat to coastal biodiversity due to its predatory habits on mollusks, crustaceans and other invertebrates, which could lead to negative effects on predators that depend on them, such as birds. In addition, the Green Crab is preyed upon by several bird species, so the invasion of this exotic crab may result in direct positive effects on upper trophic level predators. Our goals were to (1) determine if the Kelp Gull (*Larus dominicanus*), a widely distributed species with generalist feeding habits, takes advantage of this novel food source, and (2) if so, quantify the relative contribution of the Green Crab to the diet composition of breeding Kelp Gull. Diet assessment was based on regurgitated pellets (n = 157) and stomach content samples of adults and chicks (n = 36) obtained during different stages of the breeding cycle in 2016 at the Isla Vernaci Este colony in the Patagonia Austral Marine Park, Golfo San Jorge. Results based on regurgitated pellet analysis showed a wide trophic spectrum, based mainly on fish. Frequency of occurrence of the Green Crab varied between 6.5 and 43.9% depending on the breeding stage, with the highest representation during the Kelp Gull incubation stage. Green Crabs were not recorded in adult or chick stomach content samples. Results show that Green Crabs are regularly consumed by breeding Kelp Gulls, particularly during the incubation stage, and will contribute to the understanding of the role of this invasive species in the ecology of upper trophic level predators of coastal Patagonia.

Presenting author (Best Poster BHL): Miriam Pollicelli. E-mail: yorio@cenpat-conicet.gob.ar

Population aspects of *Eualetes tulipa* (Rousseau in Chenu, 1843) in port areas at Northeast Brazil

André Porfírio, Diego Bezerra, Wilson Franklin-Junior

Universidade Federal do Ceará \ Labomar, Brazil.

The occurrence of non-indigenous species is one of the main causes of biodiversity loss on the planet. With increasing maritime trade, ports are vulnerable to non-indigenous species introductions via ballast water and ship hulls. This paper aimed to test the hypothesis that there was difference in frequency of occurrence and specific density of the invasive gastropod *Eualetes tulipa* (Rousseau in Chenu, 1843) between two ports in Northeast Brazil. Pecém Port has an offshore infrastructure and was operating for only around 10 years. The hypothesis was that a greater specific density at Mucuripe Port would be found, due its over 50 years time of operation, therefore presenting a more established population. In 2009, using SCUBA and a quadrat of 0.15 x 0.15m samples were taken from the pier pillars at depths of 0-5 meters, at 1 meter intervals. The invasive *E. tulipa* was more frequent at Pecém Port (19.26%), where we found a greater density of individuals. The mean density of the individuals in the pillars decreased with increasing depth. The hypothesis that in the older port would be a greater abundance of individuals was refuted. Possibly, the well-established benthic community at Mucuripe pillars has increased the competition for space and resources, determining a diminished *E. tulipa* density. In addition, a greater availability of artificial substrata to be colonized at Pecém Port may facilitate the success of the invasive *E. tulipa* at early stages of colonization when competing with local species. Moreover, the first record of this species for Brazil occurred in 2005, under the name *Petaloconchus aff. varians* and the confirmation of the invasion record on the Brazilian coast occurred only recently in 2017. Thus, effective early detection and control can only be implemented when non-indigenous species are correctly and promptly identified. Ultimately, further investigations identifying the drivers of non-indigenous species colonization success is pivotal.

Presenting author: André Porfírio. E-mail: afporfirio@gmail.com

The Sepetiba bay is a great gateway to fouling organisms! A study on serpulid polychaetes (Annelida - Serpulidae)

Andrielle Raposo Rodrigues[1], Vinícius da Rocha Miranda[2], Ana Claudia dos Santos Brasil[1]

1: UFRRJ, Brazil.
2: UFF, Brazil.

Serpulidae are encrusting tubiculous polychaetes, which are able to disperse attached to ship hull, platforms, etc. Serpulids are an important group in harbor area, because of many economic issues related to increase of maintenance of berths, aquaculture facilities and by affecting vessels performance. Because of these and also bioinvasion potential, it is important to record its occurrence along the coast. Herein we present a survey of Serpulidae species occurring near the Harbors of Itaguaí and Guaíba (Sepetiba Bay, Brazil) and its influence as gateway for exotic species. A total of seven species were identified, six were previously reported for the Brazilian coast and one is a new occurrence. *Hydroides dirampha* is considered an alien species for Brazil and occur on the coast of Paraíba, Pernambuco, São Paulo, Rio de Janeiro and Santa Catarina; on Sepetiba bay is the most frequent. *Hydroides elegans* was previously reported for Rio de Janeiro only, in our samples is the first most abundant species. *Hydroides brachyacantha* was already recorded for Rio de Janeiro and São Paulo, in our samples is a scarce species. Three species have their range of occurrence extended to Rio de Janeiro: *Hydroides dianthus* (previously reported for São Paulo and Paraná), *Protula balboensis* (previously reported for São Paulo and an uncertain register for Bahia) and *Salmacina* cf. *ceciliae* (with occurrence only for São Paulo). Specimens belonging to the *Spirobranchus tetraceros* complex are first recorded for Brazil and is the most interesting serpulid in our study. This species presents a great diversity of operculum morphology in a same sample, with at least four opercular shapes. Except for *S.* cf. *ceciliae*, all other species identified in our survey can be considered as invasive on Sepetiba bay and even two of them (*H. elegans* and *H. dirampha*) are considered alien species for other countries.

Presenting author: Andrielle Raposo Rodrigues. E-mail: andriraposo@gmail.com

Influence of introduced species, predation, and functional traits on competitive networks across a biogeographic gradient

Michele F. Repetto, Amy L. Freestone

Temple University, USA.

The biotic interactions hypothesis has strong evolutionary roots and suggests that species interactions, such as competition and predation, serve to maintain tropical biodiversity. Despite the potentially strong effects of both predation and competition in shaping natural communities, few empirical data exist to demonstrate latitudinal interaction patterns. Further, although admixture communities of native and introduced species are ubiquitous in coastal areas worldwide, empirical work testing the generality of the hypothesis that successful invaders act as superior competitors remains scarce. Ecological impacts of invading species on native communities largely depend on whether the invader coexists with or displaces native species. Intransitive competition, defined as competitive networks lacking hierarchy, may be common in nature and enhance coexistence even when species compete strongly. However, the role of intransitivity in structuring communities and the importance of other factors, such as predation, influencing these competition networks remains unclear. Additionally, functional traits may be important to consider when comparing competitive ranks between native and introduced species. Using standardized settlement panels in three biogeographic regions spanning 47 degrees of latitude, we quantified competitive intransitivity among sessile marine invertebrate communities and tested effects of predation, functional trait variation, and NIS status on intransitivity. We found that in the tropics, despite striking differences in community composition, predation had no discernable effect on intransitivity or overall NIS cover. Additionally, based on current taxonomic resolution, communities dominated by introduced species in Panama and California (USA) contributed to lower levels of intransitivity, trending toward competitive hierarchies. These results suggest that introduced species can be competitively dominant and consequently alter competitive networks.

Presenting author: Michele F. Repetto. E-mail: michele.repetto@temple.edu

Loss or gain? The complex role of thermophilic aliens in fast-warming seas where heat-sensitive natives collapse

Gil Rilov, Tamar Guy-Haim, Ohad Peleg

Israel Oceanographic and Limnological Research (IOLR), Israel.

Bioinvasions and climate change are two major drivers of marine biodiversity change that can also be closely linked, especially in fast-warming ocean regions. In such regions, populations of natives sensitive to warming may collapse, and with them, some ecological functions may be lost. Simultaneously, thermophilic aliens are boosted, and those with traits similar to the collapsing natives, might compensate for the loss of some functions. One such fast-warming region is the southeastern Mediterranean, that has warmed by 2-3° C in the past three decades, and is also a invasion hotspot of thermophilic species from the IndoPacific through the Suez Canal. On shallow reef in the region, dozens of once-abundant native reef non-harvested invertebrate species collapsed and aliens completely dominate some groups like mollusca. We tested the thermal performance of many native and alien invertebrates and macroalgae and found that in most cases aliens have indeed a much higher optimum temperature than natives that preform badly under current summer conditions. In the field, incubation experiments showed that communities dominated by declining native brown-algae meadows have much higher biodiversity, biomass and metabolic functions than the now expansive turf barrens overgrazed by invasive herbivores rabbitfish, while areas covered by an increasingly dominate alien red algae “shrub”, have taxa richness similar to the native community, and biomass in them is partially regained, but functioning is shifted from overall autotrophic to heterotrophic. Mesocosm experiments showed that under warming and acidification, the brown-algae community itself becomes more heterotrophic, and more dominated by alien species (but richness did not change). These dramatic alterations in functions mean that the reefs are going through a regime shift to a novel ecological state that will intensify in the future, but some functions lost by the collapse of sensitive aliens may be regained by aliens.

Presenting author: Gil Rilov. E-mail: rilovg@ocean.org.il

Marine invasion genomics: revealing ecological and evolutionary mechanisms shaping biological invasions

Marc Rius[1,2], Jamie Hudson[1], Luke Holman[1], Steve Bourne[1]

1: Ocean and Earth Science, National Oceanography Centre, University of Southampton, United Kingdom.
2: Centre for Ecological Genomics and Wildlife Conservation, University of Johannesburg, South Africa.

Genetic studies of biological invasions have recently incorporated high-throughput sequencing (HTS) approaches, providing an unprecedented resolution for understanding key aspects such as population connectivity or rapid adaptation. In addition, researchers using genome-wide approaches are now able to analyse previously understudied taxa. Genomic studies have traditionally been restricted to the study of model organisms, which represent only a small fraction of total global biodiversity. HTS has opened up genome-wide analyses to non-model organisms, which are now routinely studied without prior knowledge of reference genome data. Therefore, the increased use of genomic tools has allowed invasion biologists to address novel research questions across a wider array of taxa. Here, we first analysed how HTS has aided our understanding of mechanisms associated with biological invasions. These include the transport of propagules to pre-invaded areas, an exploration of the consequences of hybridisation during range expansions, and the pre- and post- invasion adaptation of colonising populations. We then explored how genomic tools have been used to probe and monitor the spread of non-indigenous species. More specifically, we focused on the detection of species richness from environmental samples, analyses of rapid adaptation, and the study of invasion routes. Finally, we looked to the future, exploring how genomic approaches can assist forthcoming research and conservation efforts to mitigate the effects of biological invasions.

Presenting author: Marc Rius. E-mail: M.Rius@soton.ac.uk

Identifying, mapping and assessing perceived coastal and marine values in the 21st century

Paola Rodríguez-Salinas[1], Marnie Campbell[2], Emma Jackson[3], Chad Hewitt[1]

1: The School of Science, University of Waikato, Private Bag 3105, Hamilton 3240, New Zealand.
2: Harry Butler Institute, Murdoch University, 90 South Street, Murdoch, Western Australia, 6150, Australia.
3: School of Medical and Applied Science, Central Queensland University, Bryan Jordan Drive, Gladstone, Queensland 4680, Australia.

Understanding nature's benefits to people (or values) from an instrumental and relational point of view has acquired increasing relevance within the conservation and sustainable development fields, particularly given the current deterioration of the environment. Therefore, identifying what is important (e.g. environmental, economic, social and cultural values) from an individual's perspective and the individual perception of the geographical localisation for specific values can help to improve how we manage our coastal marine environments. A wide variety of methodologies has been designed to elicit value presence and relative importance to a sample frame of respondents from both deductive and inductive points of view. While most of these methods have been designed to inform and improve conservation planning, they could readily be used to identify and localise the impact of non-native species on societal values. To build further knowledge and test different mechanisms for eliciting, analysing and representing societal information, this research developed an approach that identifies and maps perceived values of a coastal marine area, drawing on a case study from Gladstone, a port industrial city in central Queensland, Australia, situated within the Great Barrier Reef World Heritage Area (GBRWHA).

Presenting author: Paola Rodríguez-Salinas. E-mail: prodrigu@waikato.ac.nz

Does ecophysiology modulate biotic interactions and determine invasion success? A perspective from caprellid amphipods

Macarena Ros[1], Georgina Rivera-Ingraham[2], Jose M Guerra-García[3], Jehan-Herve Lignot[4]

1: Universidad de Cádiz, Spain.
2: Laboratoire Environnement de Petit Saut, Guyana.
3: Universidad de Sevilla, Spain.
4: CNRS-Ifremer-IRD-Université de Montpellier, France.

Climate change is predicted to favor the increase and impacts of biological invasions in some areas. However, few studies have examined the physiological mechanisms underlying this supposed differential success between native and introduced species. *Caprella scaura* is among the most widespread introduced crustaceans in the Mediterranean Sea, where it seems to be displacing an ecologically similar congener, *Caprella equilibra*. A field-based study along the Iberian Peninsula highlighted the role of salinity and seawater temperature in modulating this interaction. However, the effect of environmental stress on the physiological responses of these coexisting species is unknown. We explore the differential species-specific stress tolerances to different combination of salinities and seawater temperatures to identify if the introduced species is more stress tolerant than its congener. We conducted respirometric experiments and survival rate, measures of hemolymph osmotic pressure, reactive oxygen species (ROS) formation, antioxidant activities (catalases) and apoptotic damage (caspases). Despite the two species being osmoconformers, at 25° C *C. scaura* tolerated a wider range of salinities than *C. equilibra*. At this temperature, both species showed similar oxygen consumption rates, but the oxyregulatory capacity was only maintained by *C. scaura*. At 10° C, both species decreased their respiration rates, but *C. scaura* tolerated exposure with lower energetic expenditure than *C. equilibra*, which increased the ROS formation. Since this misbalance was not accompanied by changes in antioxidant defenses, *C. equilibra* suffered higher degrees of cellular damage and mortality rates under lower temperatures. Therefore, *C. scaura* performs better both at higher and lower temperatures, suggesting a great potential for spreading across ecoregions. This study highlights the potential role of ecophysiology in modulating biotic interactions and determining invasive success.

Presenting author: Macarena Ros. E-mail: mros@us.es

Invasion patterns in artificial vs natural marine habitats: peracarids as models at different spatial scales in the Southwestern Atlantic

Carlos Rumbold[1], Nicolás Battini[2], Clara Giachetti[2], Karen Castro[2], Sandra Obenat[1], Evangelina Schwindt[2]

1: Instituto de Investigaciones Marinas y Costeras (IIMyC), Universidad Nacional de Mar del Plata-CONICET, Argentina.
2: Grupo de Ecología en Ambientes Costeros (GEAC), IBIOMAR-CONICET, Argentina.

Peracarid species have invaded a large number of environments worldwide, making them an excellent model to study invasive patterns in marine environments. In the present study we identified and quantified peracarid species in artificial and natural environments of the SW Atlantic, to determine the current status of exotic and native species, their richness and seasonal variation and distribution, and to understand the general invasion patterns of peracarids at different spatial scales. Five fouling samples were collected seasonally from 2016 to 2017 in two ports and two natural environments from two biogeographic provinces of Argentina, exposed to warm- (38° S) and cold-temperate waters (42° S). Replicate samples were collected by hand and scuba diving (0.20 x 0.20 m quadrants each). Artificial environment from warm-temperate region showed higher richness of exotic and cryptogenic species (n=9) than the natural habitat (n=4), while in the cold-temperate environments no differences were found (n=3-4) for exotic and cryptogenic species. Only two native species were registered in both regions. The present study showed a dominance of cryptogenic and exotic peracarid species during all seasons in natural and artificial marine environments of SW Atlantic. Differences in species assemblages at local and regional scale, suggest that factors such as propagule pressure, temperature, species diversity and the structure of artificial habitats would be closely related to these dissimilarities. The analysis of species assemblages together with their regional distribution allows us to discuss the potential invasive pattern in Southwestern Atlantic.

Presenting author: Carlos Rumbold. E-mail: c_rumbold@hotmail.com

When natives can control aliens. Fish herbivory reduces the proliferation of the invasive alga *Caulerpa cylindracea* in the Western Mediterranean Sea.

Jorge Santamaría[1], Fiona Tomas[2,3,4], Enric Ballesteros[5], Juan Manuel Ruiz[6], Jorge Terrados[2], Emma Cebrian[7]

1: Universitat de Girona, Spain.
2: Departament d´Ecologia i Recursos Marins, Institut Mediterrani d´Estudis Avançats (IMEDEA), Consejo Superior de Investigaciones Científicas, Spain.
3: Universitat de les Illes Balears (CSIC-UIB), Esporles, Balearic Islands, Spain.
4: Department of Fisheries and Wildlife, Oregon State University, Corvallis, OR, USA.
5: Centre d'Estudis Avançats de Blanes, Spain.
6: Centro Oceanográfico de Murcia, Instituto Español de Oceanografía (IEO), Spain.
7: GRMAR, Institut d´Ecologia Aquàtica, Universitat de Girona, Spain.

Herbivory on invasive species has been considered as a generalized biotic resistance mechanism, but so far, it is still not clear whether this mechanism might play a significant role on marine algae invasions. In fact, up to date, it seems that the strength of the consumptive biotic resistance on marine ecosystems is highly dependent on the characteristics of both, the consumer and the producer, and how they interact. For these reasons, it is difficult to generalize and each specific case needs to be assessed individually. In the Mediterranean Sea, the highly invasive C*aulerpa cylindracea* is known to be consumed by different herbivores but it is still not clear whether this consumption acts as a biotic resistance mechanism. In this study, we first determined the electivity that different fish species have towards *C. cylindracea* by analyzing fish stomach contents and then, we experimentally tested if the grazing activity could limit the spread and abundance of this invasive alga by performing a cage-exclusion experiment. Our results show that although several fish species can feed on *C. cylindracea*, the low values in the Ivlev´s Electivity Index suggest that this consumption is accidental except for *Sarpa salpa*. On the other hand, the exclusion experiment demonstrated that fish herbivory can limit *C. cylindracea* abundance, although this effect was restricted to shallow waters, something that is in accordance with the current distribution of *C. cylindracea* in the study area. The control effect observed above 25m deep is linked to the higher abundance and activity of *Caulerpa* consumers in shallow waters, emphasizing the role of fish herbivory as a form of biotic resistance against *C. cylindracea* invasion.

Presenting author (JAP&JTC Early Career Award Winner): Jorge Santamaría.
E-mail: jorgesantamariaperez@gmail.com

Can we rely on climate warming as a limiting factor for *Caulerpa cylindracea* invasion?

Laura Clapés[1], Jorge Santamaría[1], Emma Cebrian[2], Alba Vergés[2]

1: Universitat de Girona, Spain.
2: GRMAR, Institut d´Ecologia Aquàtica, Universitat de Girona, Spain.

Invasive species are one of the main threats to marine biodiversity worldwide and under rapid environmental change they have been predicted to enhance their expansion. In fact, once they arrive to a new place, the suitability of the environmental conditions will determine their establishment and invasive success. Therefore, knowledge on how environmental change may determine invasive spread is of capital interest. Specifically, the Mediterranean Sea has become a hotspot for marine invasions and it is especially prone to climate change. Among alien species, *Caulerpa cylindracea* has been identified as one of the main invasive algae species and is a common representative in the benthic Mediterranean habitats. This species is native from the SW coast of Australia and since its introduction in 1991; it has expanded all along the Mediterranean coastlines and has even reached some Atlantic islands. According to this, it seems that this species can tolerate a broad range of temperature conditions, having the potential to continue with its spread. However no experimental study has determined its thermal thresholds until now, which is essential to predict the future distribution of *C. cylindracea* populations in the invasive range. In the present study, we cultured several individuals of *C. cylindracea* at different seawater temperatures searching for the maximum and minimum survival thresholds. Starting from the optimal conditions (18° C and 21° C), water temperature was increased or decreased 1° C each 4 days. After 28 days, our results suggest that both, cold and hot temperatures affect the survival of this species, but the upper thermal threshold is well beyond what is expected as the maximum sea surface temperature in the Mediterranean Sea for the next 100 years. So future conditions will not be able to hinder the expansion of *C. cylindracea* in the Mediterranean Sea, while they could foster potential future invasions overseas.

Presenting author (JAP&JTC Early Career Award Winner): Jorge Santamaría.
E-mail: jorgesantamariaperez@gmail.com

Environmental matching used to predict range expansion of two invasive corals (*Tubastraea* spp.)

Herick Santos[1], Fabrine Silva[2], Bruno Masi[2], Beatriz Fleury[2], Joel Creed[2]

1: Instituto Brasileiro de Biodiversidade - BrBio, Brazil.
2: Universidade do Estado do Rio de Janeiro - UERJ, Brazil.

The scleractinian corals *Tubastraea coccinea* (Lesson, 1829) and *Tubastraea tagusensis* (Wells, 1982) were first recorded in Brazilian waters in the 1980's on oil platforms in the Campos Basin, Rio de Janeiro. Besides the ability to establish new populations and expand their distributions in coral reef and rocky shore habitats, *Tubastraea* spp. are considered to be highly efficient competitors, causing change in native communities and impacting endemic species. In order to map the distribution and predict range expansion through the Cabo Frio upwelling region, field surveys were carried out in December 2011 and February 2017. A standard, fast, easily repeatable semi-quantitative method for the large-scale mapping was used and abiotic parameters (temperature, salinity and water transparency) were collected at each sites. Abundance data were expressed as a Relative Abundance Index (RAI) and 2011 compared with 2017. To forecast the range expansion throughout the region we used the abiotic parameters in an hierarchical cluster analysis sliced to establish site-similar groups with adequate environmental matching for invasive presence. These were superimposed on a three-dimensional PCA ordination of abiotic data (2011 and 2017) to verify the environmental factors responsible for site separation and predict expansion. The number of invaded sites doubled (from 5 to 11, one per year). Mean abundance at invaded sites increased from 0.2 to 2.6 and 0.22 to 1.8 (*T. coccinea* and *T. tagusensis* respectively). The invasives occurred in only two of five site groups, characterised by high water clarity and temperature and lower salinity. Matching in these groups identified 40 sites with greater potential for invasion, indicating priority areas for future management and control actions.

Presenting author: Herick Santos. E-mail: hericksimas@yahoo.com.br

Population structure of invasive corals *Tubastraea coccinea* and *T. tagusensis* in the Cabo Frio upwelling region RJ - Brazil.

Herick Santos, Bruno Masi, Beatriz Fleury, Joel Creed

Universidade do Estado do Rio de Janeiro - UERJ, Brazil.

Cup corals of the genus *Tubastraea* (Cnidaria, Scleractinia) have been reported as invasive in Brazil since the 1980s, and two species *Tubastraea coccinea* and *T. tagusensis* have invaded the Cabo Frio Region since the late 1990s. Although invasive species expand through growth and reproduction, population size structure is a potential but rarely used descriptor of the history of establishment and expansion. In the present study we used population parameters to investigate range expansion through the region by correlating population characteristics with the distances from probable points of introduction. We analyzed population size structure through four colony parameters: wet weight, size, number of polyps and calicular diameter as well as colony density. We used PCA and Cluster analyses to identify subpopulations with similar attributes. The size-frequency distribution analysis indicated that both species are in the establishment phase in the region. Data for Minimum Reproductive Size (MRS ≥ 3cm) indicated that all the points sampled had reproductive colonies, thus acting as source populations for other points through the region with similar environmental characteristics. The results of the present study confirm that *Tubastraea* spp. are established and expanding their range and demonstrate that population characteristics can be useful for reconstructing range expansion scenarios.

Presenting author: Herick Santos. E-mail: hericksimas@yahoo.com.br

Invaders on the run: the capability of marine invertebrates to tolerate aperiodic extreme events

Susanne Schäfer[1], Gil Rilov[2], Martin Wahl[1], João Canning-Clode[3]

1: GEOMAR - Helmholtz Institute for Ocean Research Kiel, Germany.
2: National Institute of Oceanographic and Limnological Research, Israel.
3: MARE – Marine and Environmental Sciences Centre, Portugal.

The rate of invasive species detections in the marine system has been rising during the last decades mainly due to commercial shipping. However, invasion dynamics are also affected by global scale changes and recent studies suggest a close relationship between climate change and the increase of bioinvasions, local extinctions and shifts in distributional ranges. As a response to ocean warming, a poleward movement of numerous species has been observed in many biogeographic regions, including the European theater where numerous southern species are advancing into temperate Europe. In fact, many successful invasive marine species tolerate broader thermal ranges than functionally similar native species. Although these range expansions have been attributed to progressive global warming of the oceans, little is known about the potential influence of aperiodic extreme events such as heat and cold waves. With the ultimate objective of investigating the effects of extreme events on the invasion success of invertebrate species that are invading the Mediterranean from Macaronesia and North Africa, we started analyzing historical temperature datasets of these regions and determined the thermal tolerance limits of selected marine invertebrates, both native and invasive at different regions. Preliminary analysis on historical temperature data in Madeira indicates a steady increase in average water temperature over time, as well as an increase in the frequency of heat waves. In this context, we are examining the effect of rates of temperature change and acclimation capacity of the shrimp *Palaemon elegans*, the crab *Percnon gibbesi* and the anemone *Aiptasia diaphana* in Madeira Island by testing their thermal tolerance at different warming and recovery rates. We anticipate with slower rates decreasing thermal limits as the exposure time is longer. Finally, temperature tolerance and recovery rates of *P. elegans* will be compared with populations from other thermal environments.

Presenting author: Susanne Schäfer. E-mail: susi-schaefer@web.de

Heading northward to Scandinavia – *Undaria pinnatifida* in the northern Wadden Sea

Jessica Schiller[1], Dagmar Lackschewitz[2], Christian Buschbaum[2], Karsten Reise[2], Tifeng Shan[3], Shaojun Pang[3], Jing Li[3], Li Su[3], Jason Hall-Spencer[4], Kai Bischof[1]

1: University of Bremen, Bremen Marine Ecology (BreMarE), Marine Botany, Germany.
2: Alfred-Wegener-Institute, Helmholtz-Centre for Polar and Marine Research, Wadden Sea Station Sylt, Germany.
3: Institute of Oceanology, Chinese Academy of Sciences, China.
4: University of Plymouth, United Kingdom.

The kelp *Undaria pinnatifida*, native to East Asian shores, was unintentionally introduced with Pacific oysters into the Mediterranean in 1971. Intentional introduction from there to the French Atlantic coast 12 years later led to a gradual spread to the British Isles and the North Sea. Here, we report on the northernmost established population in continental Europe, and suggest a further spread into Scandinavian waters to be almost inevitable. In 2016, several thalli were found washed ashore at the eastern side of the island of Sylt in the northern Wadden Sea (German Bight, Eastern North Sea). Most specimens bore fertile sporophylls and thallus lengths of > 1 m were common. In June 2017, 91 sporophytes were found attached to a mixed bed of Pacific oysters and native blue mussels, located just below low tide level in a moderately sheltered position. Mean thallus length was 0.2 m and the longest 0.7 m. Most had distinctive sporophylls and released spores in the laboratory. Genetic relationships between the recently established population on Sylt and five other populations in France, the Netherlands and England plus three natural populations in China were assessed using ten microsatellite markers. Nearly no genetic differentiation was detected between the floating and attached populations on Sylt, but they were genetically distinct from all the other European populations, which are thus not the origin of the founding populations on Sylt. The very low genetic diversity revealed in the new founders of Sylt implies that they came from a limited number of genetically similar parents from a single source. From sporophylls collected on Sylt in 2016, we successfully reared a new generation, demonstrating the kelp's potential for further spread by natural means or human vectors.

Presenting author: Jessica Schiller. E-mail: j.schiller@uni-bremen.de

The ongoing effect of the container revolution on marine bioinvasion

Noa Shenkar[1], David Rosen[2]

1: School of Zoology, Tel-Aviv University, Israel.
2: Department of Business Administration, Maritime and Ports studies, Haifa University, Haifa, Israel.

The advent of container vessel networks has revolutionized global freight transport. While numerous studies in various disciplines such as economics, law, geography, engineering, and more, have discussed the impact of the "Container Revolution", the direct impact on marine bioinvasion is considered to a much lesser extent. The current study discusses the shift of container network topologies towards hub and spoke networks with high shipping intensities and route interfaces. The importance of "Hub ports" versus "Gate" ports, in relation to potential invasion routes, and to ports invasibility is explained. The increasing use of Ultra-Large Container Vessels (ULCV) worldwide further induces a change in introduction dynamics: fewer large vessels are now required for the arterial routes between the area hubs, but smaller vessels are required for the distribution of the goods between the hubs and regional spokes to the gate ports. This is evident from analysis of vessels movement via the Suez Canal from 2011 to 2017. As ULCV further advance the hub-and-spoke network, it is recommended to investigate adapted maintenance regulations in order to prevent the spread of alien species via the interface of vessels in Hub ports. With the increase of global trade and development of large regional container ports globally and larger vessels, it is anticipated that the bioinvasion potential will be amplified. An integrated study of both the commercial and the biological networks is thus essential in order to fully comprehend their interaction.

Presenting author: Noa Shenkar. E-mail: shenkarn@post.tau.ac.il

Going tropical- genetic analysis of a Red Sea population of *Ciona intestinalis* type A reveals unique introduction scenarios

Yiyong Chen[1], Noa Shenkar[2], Aibin Zhan[1]

1: Research Center for Eco-Environmental Sciences, Chinese Academy of Sciences, China.
2: School of Zoology, Tel-Aviv University, Israel.

The solitary ascidian *Ciona intestinalis* Type-A (*C. robusta*) is among the most damaging of invasive fouling species in the world. It is mostly known from cold-water or temperate environments, where it is able to form dense aggregations. However, in 2015 several individuals were found fouling the bottom of few floating docks in Eilat marina, Israeli Red Sea coast. While numerous cases of introduction are known from marine environments in temperate and sub-tropical latitudes, only a few introduced species have been reported from tropical regions, and none have been previously reported in Eilat. In order to elucidate the potential source of this unique tropical population we conducted a genetic analysis based on cytochrome c oxidase subunit 3-NADH dehydrogenase subunit 1 region (COX3-ND1) of 22 individuals. The Red Sea sequences were compared to over 300 sequences from 19 populations around the world, revealing 3 new haplotypes to the Red Sea. The Red Sea population genetic diversity was lower than the American populations but higher than that in European populations. Thus, based on polymorphism of this mtDNA fragment, we did not see a significant genetic bottleneck, suggesting of several introduction events. Previous studies showed that the optimal temperature for sustainable populations of Mediterranean *Ciona intestinalis* type A is 14–23.4 °C. The occurrence of a reproductive population in a Red Sea marina, with SST fluctuating between 19 and 27 °C and salinity of 40–41 ‰, indicates that this species possesses a wider environmental tolerance than previously assumed. The distinctive population genetic pattern in Red Sea may result from rapid adaptation to local conditions.

Presenting author: Noa Shenkar. E-mail: shenkarn@post.tau.ac.il

Development of a predictive model to avoid settlement of the invasive bryozoan *Membranipora membranacea* on cultured kelps

Nathalie Simard[1], Michèle Pelletier-Rousseau[1], David Drolet[1], Isabelle Gendron-Lemieux[2], Chris W. McKindsey[1], Anna Metaxas[3], Danielle Denley[3], Éric Tamigneaux[4]

1: Fisheries and Oceans Canada, Canada.
2: Merinov, Canada.
3: Dalhousie University, Canada.
4: Cégep de Grande-Rivière, Canada.

The invasive bryozoan *Membranipora membranacea* forms colonies on stipes and blades of kelps and causes serious problems to algae farmers as it reduces harvests and product quality when they are colonized by this species. A simple predictive tool to allow kelp growers to determine the optimal timing of harvest was developed, to minimize impacts by *Membranipora* and maximize harvested biomass. Adding a novel approach for its application, we have built upon the model of previous works which uses temperature as a predictor for *Membranipora* larval settlement timing. We have tested and calibrated this model for three aquaculture sites located in Quebec, using abundance of *Membranipora* settlers on kelps during two years. To improve the predictive model, we have determined an optimal threshold (i.e. minimum temperature at which *Membranipora* becomes active) using our data collected on two years (2017-2018), as well as data in Nova Scotia (2005-2017). Preliminary results of aquaculture sites showed a good correlation between the abundance of settlers on kelps (number of colonies smaller of two zooid rows (log+1) per m-2 of kelp) and the growing degree day, which support the model of previous works. In more details, the colonisation timing was similar for the two aquaculture sites located in Bay des Chaleurs while it was delayed for the site located on the North Shore of the St. Lawrence. Laboratory work with *Membranipora* colonies exposed to different temperature regimes in order to corroborate the temperature threshold identified with field data (~3° C) and to better understand the species dynamic will be discussed.

Presenting author: Nathalie Simard. E-mail: nathalie.simard@dfo-mpo.gc.ca

Lionfish behavior day versus night: implications for control efforts

Isabella Simões[1], Dayne Buddo[2]

1: Federal University of Parana, Brazil.
2: Alligator Head Foundation, Jamaica.

The invasive Indo-Pacific lionfish, *Pterois volitans*, continue to pose a severe threat in addition to various stressors, contributing to changes in the ecological and physical structures of the Western Atlantic coral reefs. It is increasingly important that adequate and efficient strategies are applied at invaded locations to minimize impact. Effective removal techniques require a thorough understanding of the species' behavior in the invaded range and, considering the limited resources, it seems to be relevant to determine an optimal methodology. This study aimed to determine whether lionfish density and detectability differ between daytime versus night-time. Underwater census using SCUBA, was used to assess lionfish during the day and night at 9 survey sites along the northern coast of Jamaica from February to April 2017. Across all sites, 135 lionfish were detected, ranging from 70 mm to 380 mm. Mean densities did not differ significantly between periods (~40 lionfish/ha). At night, 77% of lionfish were exposed while during the day there was a mixed trend. Exposed was the dominant position at 88% of the sites during the night; and only at 44% of the sites during the day. Statistically, lionfish position was associated with the period of the day. Overall, although mean densities are similar for both periods, observations were more likely to occur at night, when most lionfish were exposed (higher detectability), even when resting. Four major factors influence detectability: 1) lionfish density 2) ecological conditions 3) habitat variation 4) diel patterns. Whilst complete eradication is unlikely, a combination of both day and night long-term removal programs would increase removal efficacy, substantially reduce lionfish numbers and ameliorate concerns.

Presenting author (ONR Global Early Career Award Winner): Isabella Simões.
E-mail: isabellasimoes4@gmail.com

Considerations and case studies in the design and implementation of eDNA biosecurity surveillance using metabarcoding

Tiffany Simpson[1], Adam Koziol[1], Tina Berry[1], Michael Stat[2], Justin McDonald[3], Michael Bunce[1]

1: Curtin University, Australia.
2: Macquarie University, Australia.
3: Department of Primary Industries and Regional Development, Australia.

Environmental DNA (eDNA) metabarcoding using high throughput sequencing (HTS) is rapidly becoming a valuable biosecurity tool in marine surveillance. While these technologies are powerful for the accurate and efficient detection of species within complex biological samples, optimising sampling design and robust eDNA workflows are critical in producing meaningful results. Through a variety of studies, we examined factors such as seasonality, substrate selection, DNA movement, replication and sensitivity. We found that these influences should be carefully considered when determining the sampling design, as they are not only important in the successful establishment of invasive species but can also significantly impact the potential for detection. Using the findings of these studies we aim to develop best-practice eDNA strategies across a number of applications including; invasive marine species (IMS) detection, establishment of baselines, in-water vessel cleaning and ballast water treatment. The results of these studies will be presented in the context of the commercial services, focusing on IMS detection and surveillance, which we are now able to provide to industry partners.

Presenting author: Tiffany Simpson. E-mail: tiffany.simpson@curtin.edu.au

Implications of the *Semimytilus algosus* invasion for predator-prey interactions: unexpected insights gained through the combination of field and laboratory studies

Lisa Skein[1], Tammy Robinson[1], Mhairi Alexander[2]

1: Stellenbosch University, South Africa.
2: University of the West of Scotland, United Kingdom.

To date, alien prey invasions have received little research attention leaving many unanswered questions regarding the impacts of alien prey in recipient regions. The Chilean mussel *Semimytilus algosus* is a dominant subtidal invader along the South African coast. Recent laboratory studies found that the native predator, the rock lobster *Jasus lalandii*, seeks out native mussels over alien mussels, even when native species are the least abundant prey. This suggests little predator driven biotic resistance to the *S. algosus* invasion, highlighting the potential for facilitation of prey invasions if not consumed by native predators. However, how reflective these findings are of interactions in the field remains unclear. The present study assessed this question. Native (*Aulacomya atra* and *Choromytilus meridionalis*) and invasive (*S. algosus*) mussels attached to plates were offered to rock lobsters in a large rock pool. The plates were returned to the surface after 12 hours and the proportion of each species consumed determined. Based on visual observations and the state of mussel shells (i.e. shells opened but not broken as were those taken by lobsters), it became clear that predatory whelks (*Burnupena* spp.) affected the ultimate proportions of mussels consumed. Prey selection indices revealed that whelks positively selected for invasive *S. algosus* and native *C. meridionalis*, while rock lobsters selected for native *A. atra*. Subsequent laboratory experiments were conducted to examine the mechanism driving these results. Preliminary results suggest that prey selection by lobsters changes when whelks are present, ultimately increasing the likelihood of consumption of invasive *S. algosus*. This suggests that, despite initial findings, facilitation of the *S. algosus* invasion by lack of predation is unlikely. This emphasizes the complexity of predator-prey interactions in the field and highlights the need for an experimental approach combining both laboratory and field components.

Presenting author (Best Oral BHL): Lisa Skein. E-mail: lskein@sun.ac.za

Distribution of *Ciona robusta* Hoshino & Tokioka, 1967 and *Rhodosoma turcicum* (Savigny, 1816) along Brazilian coast

Danielle Barboza, Luis Skinner

UERJ - DCIEN/ PPGOCn, Brazil.

Marine bioinvasion is a worldwide problem and since the last decades, the number of scientific papers dealing with this theme have increased. Commonly, non-indigenous species (NIS) that became invasive could impact biodiversity by the reduction of populations, local extinction of species, and damage to economic activities. Prevention and persistence of non-indigenous species are dependent of environmental factors like temperature, or by biological factors like predation and competition. In Brazil, two species recognized as invasive in many parts of the world were recorded in recent years: *Ciona robusta* and *Rhodosoma turcicum*. The present study was conducted between January 2013 and May 2018 in four bays of Rio de Janeiro state: Ilha Grande, Sepetiba, Guanabara and Cabo Frio / Arraial do Cabo. Three sampling strategies were used: experimental structures composed of granite plates (21 x 12 cm) inside protected cages to prevent predation by fishes; black polyethylene plates (15×15 cm) mounted like a sandwich; and active collection by scuba diving, searching under boulders and other cryptic and predation protected habitats. These different methods allow us to collect many individuals of *C. robusta* and *R. turcicum* both on artificial and on natural substrates. Confronting our data about *C. intestinalis* and *R. turcicum* with those from literature, we could relate it to regional characteristics of water temperature and ship traffic. *Ciona robusta* and *R. turcicum* were recorded for the first time at Ilha Grande Bay, including natural substrates. They were found at four sites, but only in one site both species were recorded together. Our previous samples and the literature indicate that *C. intestinalis* for Guanabara Bay (RJ), Sepetiba Bay (RJ) and Arraial do Cabo (RJ) and probably from São Sebastião (SP) correspond to *C. robusta*. *Rhodosoma turcicum* was recorded for Salvador (BA), São Gonçalo do Amarante (CE), Arraial do Cabo (RJ) and Ilha Grande Bay (RJ).

Presenting author: Luis Skinner. E-mail: lskinner@uerj.br

Ten years of non-indigenous species survey along southwestern Tropical Atlantic: the rise of vectors and environment

Luis Felipe Skinner[1,2], Danielle Barboza[1,2], Flávia Oliveira Marins[1]

1: UERJ - DCIEN, Brazil.
2: PPGOCn, Brazil.

Surveys of non-indigenous species (NIS) are essential to understand the invasive potential of many marine species. Early detection of NIS and environmental monitoring of habitats are one of the most important issues to establish the invasive potential, the environmental impacts and the spread of NIS. Since 2008, we are surveying the occurrence of NIS, some of them described as invasive on other world oceans. Surveys were performed using predator exclusion cages, sandwich like plates and active search by scuba diving. We surveyed, from south to north, Ilha Grande Bay, Sepetiba bay, Guanabara bay and Arraial do Cabo/ Cabo Frio peninsula. During these 10 years, we detected and expand studies on many recently introduced species like the sponge *Paraleucilla magna,* the polychaeta *Spirobranchus giganteus*, the moluscan *Eualetes tulipa*, and the ascidians *Ciona robusta* and *Rhodosoma turcicum*. We identify, based on the distribution, abundance and range expansion of species the main factors influencing their invasive potential. Among these species, all of them except *P. magna* were not directly related to oil industry. The second factor that emerges from all data are the influence of water temperature limiting the occurrence of *C. robusta* and the role of predation controlling the establishment of species. Palatable species like the ascidians *C. robusta* and *R. turcicum* are still controlled by predators. The only detected species that is expanding its density is *E. tulipa*. *Rhodosoma turcicum* is the species with the higest range expansion since its detection, in 2009. Continuously survey is essential to follow increases on density and range expansion. However, the absence of the politics and funding to this survey limit the early detection and monitoring programs. Since marine activities like harbours, marinas, oil industry, aquaculture and urban development among others are expanding, new habitats is being created favouring species spread and increase in density

Presenting author: Luis Felipe Skinner. E-mail: lskinner@uerj.br

Alien species threats in an UNESCO World Heritage site the Wadden Sea

Alexander A.J. Smolders[1], Saa Henry Kabuta[2], Arjan Gittenberger[3]

1: Team Invasive Alien Species – Office of Risk Assessment and Research, The Netherlands Food and Product Safety Authority, Ministry of Agriculture, Nature and food Quality, The Netherlands.
2: Rijkswaterstaat, Department of Water Quality and Nature Management, Ministry of Infrastructure and Water Management, The Netherlands.
3: Institute of Biology Leiden, Leiden University, The Netherlands.

The Wadden Sea forms one of the largest unbroken wetlands in the world. It includes a multitude of habitats with tidal channels, sandy shoals, sea-grass meadows, mussel beds, sandbars, mudflats, salt marshes and estuaries. Therefore the area is home to numerous plant and animal species, includingmammals like seals and porpoises. Several invasive alien species like the Pacific oyster *Magallana gigas*, the American razor clam *Ensis leei* and the American comb jelly *Mnemiopsis leidyi* (are expected to) have long-lasting effects on the native fouling, infauna, and pelagic species communities. Acknowledging this biodiversity risk, the Netherlands, Germany and Denmark are working together to develop a trilateral "Management and Action Plan Alien Species" for the Wadden Sea. The Netherlands contributed to this plan by commissioning species inventories in the Dutch part of the Wadden Sea. We here present the results of the inventories that were done in 2009, 2011, and 2014, and the latest results of 2018. In addition to the rapid detection of new alien species, these surveys result in a better understanding of the main sites ofintroduction and colonization. These hotspots and new alien species introductionsare highlighted.

Presenting author: Alexander A.J. Smolders. E-mail: a.a.j.smolders@nvwa.nl

Hull fouling, the neglected pathway for marine alien species

Alexander A.J. Smolders[1], Saa Henry Kabuta[2], Arjan Gittenberger[3]

1: Team Invasive Alien Species – Office of Risk Assessment and Research, The Netherlands Food and Product Safety Authority, Ministry of Agriculture, Nature and food Quality, The Netherlands.
2: Rijkswaterstaat, Department of Water Quality and Nature Management, Ministry of Infrastructure and Water Management, The Netherlands.
3: Institute of Biology Leiden, Leiden University, The Netherlands.

Although hull fouling is one of the main transport vectors around the world, invasive alien species legislation tends to focus on ballast water and aquaculture related vectors. The Netherlands assessed the risk of hull fouling as a pathway. This study focussed on recreational crafts. It was based on citizen science, fouling plates, port surveys and students' projects. The results show that morealienspecies were found on floating objects in harbours than in any other habitat surveyed along the coastline of the Netherlands, including soft sediments, shellfish beds and on the dikes. The study furthermore illustrated that 59% of all pleasure crafts in marinas have fouling on their hulls. About a third of the crafts visiting a marina on the North Sea came from other countries and continents including America, Asia and Australia. At present hull fouling is therefore considered to be the main pathway of marine alien distribution within the NE Atlantic whereby harbours and ports function as important stepping stones for biofouling species. Hull fouling is therefore the main primary pathway and harbours are important stepping stones. The poster shows a pattern of biofouling in the various sea ports along the North Sea coast of the Netherlands.

Presenting author: Alexander A.J. Smolders. E-mail: a.a.j.smolders@nvwa.nl

Using expert elicitation to develop a prioritization framework for marine bioinvasions

Leigh Tait[1], Graeme Inglis[1], Tarek Soliman[2]

1: NIWA, New Zealand.
2: Landcare Research, New Zealand.

The stochastic nature of marine bioinvasions makes predicting the next invasive arrival impossible. While several authorities regularly monitor for specific unwanted organisms, numerous species with similar physical, physiological or ecological traits may be equally damaging to values of marine ecosystems. To actively control an incursion, a fast response is essential, but this can be difficult when species with few or no prior invasion records are detected. Here we propose a prioritisation framework for quickly assessing the potential impacts of unknown, or little-known species by identifying traits of invaders known to have significant impacts on marine systems. The framework separately considers the relative effects of different traits on three major value sets, environmental, economic and social values to provide a combined assessment of various types of impacts. Species traits are weighted by a discrete choice experiment where experts in marine biosecurity and ecology were asked to compare a series of hypothetical species. Our research provides insights into the potential for bias associated with functional groups that regions/countries are familiar with and other demographic trends. We hope that with further development that this model will provide a tool for prioritising management of the most damaging species on a global scale.

Presenting author: Leigh Tait. E-mail: leigh.tait@niwa.co.nz

Density related impacts of the invasive Mediterranean fanworm, *Sabella spallanzanii* on ecosystem functioning

Leigh Tait[1], Michael Townsend[1], Andrew Lohrer[1], Javier Atalah[2], Oliver Floerl[2], Graeme Inglis[1]

1: NIWA, New Zealand.
2: Cawthron Institute, New Zealand.

Our knowledge of invasive species impact is frequently limited to assessments of shifting community composition in response to an invader. However, such shifts are often confounded by a range of variables and determining whether invaders are 'passengers' or 'drivers' of change is debated rigorously in invasion ecology. Here we have initiated a density manipulation experiment of the Mediterranean fanworm, *Sabella spallanzanii* to examine the per capita impacts of this species on the functioning of benthic communities. The experiment includes a density gradient of the fanworm "planted" in soft-sediments, as well as a *Sabella* control (fake worms) to disentangle the relative influence of these large filter-feeding organisms and the biofouling communities attached to the tubes. Following experiment initiation, communities were given c. 5-6 months to modify infaunal communities before examining the influence of worm densities on various metrics of functioning. Here we present the findings of benthic flux incubations on filtering rates, nitrogen flux (including denitrification) and community metabolism (CM). Our results show that increasing *Sabella* density increased CM, but at high densities fake worms reduced CM. These results will be discussed in relation to the infauna, epifauna and physical influence of *Sabella* on these habitats.

Presenting author: Leigh Tait. E-mail: leigh.tait@niwa.co.nz

Contrasting systematic, biogeography and historical data to define ascidian invasions in the SW Atlantic (Argentine Sea)

Marcos Tatián[1], Gastón Alurralde[2], Emilia Calcagno[2], Nancy Correa[3], Clara Giachetti[4], Diego Gimenez[1], Cristian Lagger[2], Tamara Maggioni[2], Marco Meloni[5], Fabrizio Scarabino[6], Evangelina Schwindt[4], Francisco Sylvester[7], Anabela Taverna[2]

1: UNC, FCEFyN, Dep. Div. Biol. y Ecol., Ecología Marina, Córdoba, Argentina.
2: Instituto de Diversidad y Ecología Animal (IDEA) CONICET, Córdoba, Argentina.
3: Servicio de Hidrografía Naval y Escuela de Ciencias del Mar, INUN facultad de la defensa, UNDEF, Ministerio de Defensa, Argentina.
4: Grupo de Ecología en Ambientes Costeros (GEAC), IBIOMAR-CONICET, Argentina.
5: IEGEBA (CONICET-UBA), Facultad de Ciencias Exactas y Naturales, Universidad de Buenos Aires, Ciudad de Buenos Aires, Argentina.
6: MNHN y Centro Universitario Regional del Este – CURE, Universidad de la República, Uruguay.
7: Instituto para el Estudio de la Biodiversidad de Invertebrados (IEBI), Facultad de Ciencias Exactas y Naturales, Universidad Nacional de Salta - CONICET, Argentina.

The Southwestern Atlantic (SWA) is one of the poorest known regions in terms of biodiversity, in particular in the case of ascidians. This diverse group of animals has long time been considered in bioinvasion studies because of its association with negative ecological as well as economic impacts. Accurate species identification is crucial to detect and clarify invasion processes. Our aim is to permanently enhance the knowledge on species richness along the shelf and continental slope in order to upgrade the following ascidian statuses for the assessed area: native; exotic; cryptogenic (those whose status is still doubtful). We performed field samplings, including coastal and oceanic areas, and evaluated ship fouling communities. We also studied old museum collections and compiled data from specific taxonomic and global literature. The general survey of species reveals at the moment a hundred ascidian species, being 14 of them, species whose status is considered exotic or cryptogenic. From these, two species: *Ascidiella aspersa* and *Styela clava*, have been stated to reach ecological impact at the SWA but, their distribution is still limited. The distribution of *A. aspersa* is probably restricted by low temperatures, while *S. clava* is a recent introduction. The use of morphological and genetic tools to clarify species identities is the first step in the evaluation of invasion processes. Besides, the study of these processes also helps to better understand the native biodiversity of this wide and not completely know area.

Presenting author: Marcos Tatián. E-mail: marcostatian@gmail.com

The ascidian *Asterocarpa humilis* (Heller, 1878) in the South Western Atlantic: a native or introduced species?

Anabela Taverna[1], María Carla de Aranzamendi[1], Tamara Maggioni[1], Gastón Alurralde[1], Xavier Turon[2], Marcos Tatián[1]

1: Instituto de Diversidad y Ecología Animal (IDEA) CONICET-UNC, Córdoba, Argentina.
2: Centro de Estudios Avanzados de Blanes (CEAB-CSIC), Blanes, Spain.

Taxonomic problems when dealing with morphologically similar marine taxa can hinder the correct assignment of the status of a species as native or introduced. This is the case of *Asterocarpa humilis* (Heller, 1878) considered native for the Southern Hemisphere. The species was originally described for New Zealand and later cited for Tasmania and South Africa. However, for Chile *A. humilis* was considered introduced, as well as for the Northern Hemisphere in Great Britain and France. For the SW Atlantic, another species with a similar morphology, *Cnemidocarpa robinsoni* Hartmeyer, 1918 has been reported as a cryptogenic species. The aim of this work was to define the entity and status of these species: *Asterocarpa humilis* and *Cnemidocarpa robinsoni* through molecular analyses. We sequenced a partial fragment of COI gene of seven samples of *C. robinsoni* collected at the Argentine Sea. A median joining haplotype network was constructed including the seven new sequences and four sequences of *A. humilis* from Chile, New Zealand and France mined from published databases. Four haplotypes with eight variable sites were obtained. The haplotype network shows a more frequent haplotype present in South America and France, suggesting that the Argentine specimens described as *C. robinsoni* and those from Chile and France as *A. humilis*, correspond to the same taxonomic entity. Phylogenetic trees reconstructed by Bayesian Inference, Maximum Likelihood and Maximum Parsimony, grouped *A. humilis* and *C. robinsoni* into one well-supported monophyletic clade. The scarce genetic difference among individuals from distant populations proves the existence of a unique specific identity. Thus, the name *Asterocarpa humilis* takes precedence over *Cnemidocarpa robinsoni*; the latter must be considered a junior synonym of the former. The presence of this species in natural habitats in addition to its register in old collections (1920) in the SW Atlantic, suggests that the species is native for this area.

Presenting author: Anabela Taverna. E-mail: anabelataverna@gmail.com

Rapid adaptation and differentiation despite low genetic diversity in European green crab populations along the west coast of North America

Carolyn Tepolt[1], Gregory Ruiz[2], Edwin Grosholz[3], Catherine de Rivera[4], Emily Grason[5], P. Sean McDonald[5], Jeff Adams[6]

1: Woods Hole Oceanographic Institution, USA.
2: Smithsonian Environmental Research Center, USA.
3: University of California at Davis, USA.
4: Portland State University, USA.
5: Washington Sea Grant, USA.
6: University of Washington, USA.

Marine invasive species that have gone through founding bottlenecks are typically assumed to have limited adaptive potential due to low genetic diversity and, frequently, high gene flow between populations. Low diversity can also complicate studies of post-establishment spread and expansion in invasive ranges, if bottlenecks are severe enough to result in few mitochondrial haplotypes and/or little microsatellite differentiation. Here, we present a case study of the utility of genome-wide markers in exposing post-invasion dynamics in a highly bottlenecked invasive population of European green crabs (*Carcinus maenas*) along the west coast of North America. Green crabs on the west coast derived from a single, secondary introduction around 1990 from an invasive source, and spread >1,500 km along the coast in under 10 years. Significant, sequential drops in nuclear genetic diversity were observed with both introductions, and mitochondrial COI is invariant along the west coast. Despite this, using a suite of >3,000 transcriptome-derived SNPs, we detected significant structure and adaptive divergence across west coast populations in the <30 years since founding. Multiple genomic regions appear to be under strong selection to temperature or latitude; four of these regions were independently identified as significantly associated with temperature and cold tolerance across native and invasive *C. maenas* populations. While connectivity between west coast populations was generally high, two oceanographically isolated populations have developed distinct genetic signatures in as little as 10 years. Using these signatures, we ruled out these populations as sources for newly discovered *C. maenas* populations in the Salish Sea, and identified periodic immigrants from one such population to other sites along the coast. These results demonstrate that taking a genome-wide approach to examining patterns of diversity can uncover complex landscapes of adaptation and divergence even in genetically depauperate invasive populations.

Presenting author: Carolyn Tepolt. E-mail: ctepolt@whoi.edu

Developing a bilateral management plan for European green crab in the Salish Sea: advances and challenges

Thomas W. Therriault[1], Allen Pleus[2], Jeff Adams[3], P. Sean McDonald[4], Emily W. Grason[3], Renny Talbot[1], Todd Hass[5], Kate Litle[3]

1: Fisheries and Oceans Canada, Canada.
2: Washington Department of Fish and Wildlife, USA.
3: Washington Sea Grant, University of Washington, USA.
4: Program on the Environment, University of Washington, USA.
5: Puget Sound Partnership, USA.

Management of biological invasions in marine environments already is a complex, challenging and costly undertaking so when an invasion spans an international border these complexities and challenges are exacerbated. However, this doesn't have to equate to a "doom and gloom" scenario but rather provides an opportunity to focus limited resources on a common problem with mutually identified priorities that engage managers, researchers, First Nations/Tribes, stakeholders, politicians and the public to develop and implement potential solutions, both shorter- and longer-term. Here we use the recent discovery of European green crab (*Carcinus maenas*) in the Salish Sea as a working example to highlight advances and challenges around developing a truly bilateral management plan for a high risk invader in shared waters. Although researchers have maintained a less formal network to exchange scientific information on green crab invasion dynamics on the west coast of North America since the early days of the invasion (and in fact this network was used to convey the first reports in the Salish Sea) a more formalized network was needed to identify and align management priorities/objectives, including engagement of citizen science through Washington Sea Grant's Crab Team (a model that is being considered for implementation in Canadian waters). Currently, both Canada and the USA don't consider green crab to be widely established in the Salish Sea (they are known to be established in Sooke Basin) so many of the initial management decisions have focused on Early Detection/Rapid Response activities, especially delineating the extent of the incursion, while a European green crab-specific bilateral management plan is developed. Some of the challenges such as identifying the potential source population(s), and the advances that can inform management options including the implementation of novel genetic analyses and modeling larval dispersal, will be discussed.

Presenting author: Thomas W. Therriault. E-mail: thomas.therriault@dfo-mpo.gc.ca

Harbors and marinas as recipient areas of non indigenous mollusk species in Slovenia

Domen Trkov, Borut Mavrič, Lovrenc Lipej

National Institute of Biology, Slovenia.

Harbors and marinas are considered as entrance points for nonindigenous species (NIS). Such environments are characterized as areas which are facing considerable oscillations of temperatures and salinity and occasional oxygen depletion. In addition, lagoons and coastal wetlands, located close to harbors and marinas are susceptible to bioinvasion, as well. In a period from 2006 to 2017 occasional samplings (39 sampling days) of alien fauna were performed in 9 Slovenian marine harbors and marinas and 4 adjacent coastal wetlands. In the period 2013-2016 a monitoring of alien biota was performed twice a year in the harbor of Koper in the framework of the project BALMAS. Six alien sea slug species, *Bursatella leachi*, *Haminoea japonica*, *Polycera hedgpethi*, *Polycerella emmertoni*, *Cuthona perca* and *Okenia zoobotryon* were found during the last decade in different marine harbors, marinas and adjacent coastal lagoons of Slovenia. Among bivalves four species were recorded such as *Magallana gigas*, *Arcuatula senhousia*, *Xenostrobus securis* and *Ruditapes philippinarum*. The majority of gastropods were found dwelling on nonindigenous bryozoans such as *Zoobotryon verticillatus* and *Bugula neritina*, while *H. japonica* was found feeding on sea lettuce *Ulva* sp. The anaspidean *Bursatella leachi* was found in mediolitoral belt crawling on muddy sea bottom. Among alien mollusks only *A. senhousia* and *M. gigas* could be considered as invasive. *Arcuatula senhousia* was recorded in different microhabitat types, especially frequently on the alien colonial polychaete *Ficopomatus enigmaticus*. In winter 2012 an extreme density of 3370 specimens/m2 was recorded in a coastal lagoon. The great majority of all alien mollusks was related to two vectors of introduction, maritime traffic and mariculture. Due to the predicted water warming in the nearby future the spreading, introduction and establishment of alien slugs in the studied recipient areas is further expected.

Presenting author: Domen Trkov. E-mail: domen.trkov@nib.si

Microbial bioinvasions via ships' ballast water

Valentina Turk[1], Grazia Marina Quero[2], Katja Klun[1], Tinkara Tinta[1], Gian Marco Luna[3]

1: Marine Biology Station, National Institute of Biology, Fornace 41, 6330 Piran, Slovenia.
2: Stazione Zoologica Anton Dohrn, 80121 Villa Comunale, Naples, Italy.
3: Institute of Marine Sciences (CNR-ISMAR), National Research Council, Largo Fiera della Pesca 2, 60125 Ancona, Italy.

Global transport of ballast water represents an important pathway for microbial worldwide distribution and the largest dispersal mechanism of pathogens, potentially source of waterborne marine plants or animal diseases. In this study, bacterial abundance, growth rate and bacterial community composition was analysed in ten ballast water tanks in the Port of Koper, from ships arriving from different Adriatic and Mediterranean ports (Haifa, Misurata, Bejaia, Chioggia, Marghera, Ravenna, Rijeka, Split and Piraeus). Sampling of ballast water on board of vessels was performed in the period between November 2015 and February 2016. The concentrations of *Vibrio cholera, Escherichia coli* and intestinal *Enterococci* were determined in the integrated ballast water samples together with salinity, temperature, pH, oxygen and nutrient concentrations (nitrite, nitrate, orthophosphate, ammonium and silicates and dissolved organic carbon-DOC). To determine the diversity in community composition of microbial assemblages' in ballast water from each vessels 16S rRNA gene sequences were analyzed by high-throughput sequencing. The samples that were taken from ships coming from various marine environment showed different pollution level, low bacterial number and bacterial carbon production. However, the presence of a high faecal concentration and bacterial community composition showed a potential risk for the environment.

Presenting author: Valentina Turk. E-mail: valentina.turk@nib.si

Population size structure, asexual reproduction and somatic growth estimates of the non-indigenous brittle star *Ophiothela* cf. *mirabilis* (Echinodermata) in the southeastern coast of Brazil

Marcela Tavares[1], Paulo Costa[2], Carlos Renato Ventura[1]

1: Museu Nacional-UFRJ, Brazil.
2: UNIRIO, Brazil.

The ophiuroid *Ophiothela* cf. *mirabilis* is non-indigenous and it is considered as a potentially invasive species in the Brazilian coast because it occurs through long extensions and it is locally abundant. We aimed at describing population size structure, asexual reproduction and estimates of somatic growth of this species in two localities in the coast of Rio de Janeiro State apart of 300 Km: Angra dos Reis and Armação de Búzios. Specimens associated to their host sponges *Desmapsamma anchorata* and *Aplysina fulva*, respectively, were collected monthly in the two sites during 2012 and 2013. Ophiuroids were classified in three categories: individuals with whole discs, regenerating discs and split discs. Of 5429 ophiuroids collected, 59.6% had whole discs, 23.7% regenerating discs and 16.8% split discs. No evidences of massive recruitments were recorded and fission occurred throughout the year. Therefore, asexual reproduction is not a seasonal process in *Ophiothela* cf. *mirabilis* and it seems to be the main mechanism of maintenance and increasing of populations. Mean diameter of the region delimited by oral shields (OD) from both populations was 0.752±0.0049 mm. The highest frequency of smaller specimens (OD<0.8 mm) associated to highest ophiuroid density (1.78±0.63 ind.ml-1) were recorded in population of Angra dos Reis. In addition, the lowest mean sponge volume (141±30.3 ml) was found in this locality. In contrast, the lowest ophiuroid density recorded in Armação de Búzios (0.39±0.11 ind*ml-1) was associated to the highest mean sponge volume (322±74.4 ml). The asymptotic size (L∞) was broadly similar between the two populations: 1.184 mm in Angra dos Reis and 1.200 mm in Armação de Búzios. The longevity and growth rate recorded from population of Angra dos Reis were 1.8 years and 1.71 mm.year-1 while these features from population of Armação de Búzios was 1.4 years and 2.21 mm.year-1, respectively.

Presenting author: Carlos R. Ventura. E-mail: rventura@mn.ufrj.br

Metabarcoding of e-DNA and bulk-DNA in the context of the Marine Strategy Framework Directive, with a focus on larval stages of marine benthic invertebrates

Frédérique Viard[1], Marjorie Couton[2], Sabrina Le Cam[3], Erwan Corre[1], Claire Daguin-Thiébaut[1], Laurent Lévêque[1], Thierry Comtet[1]

1: CNRS - Roscoff Marine Biological Station, France.
2: Sorbonne University, France.
3: Roscoff Marine Biological Station, France.

DNA-based tools are powerful to study biological invasion processes. High-throughput sequencing (HTS) technologies offer new promises to support surveillance programs targeting marine non-indigenous species (NIS). This is exemplified by the European Marine Strategy Framework Directive (MSFD), which aims at achieving or maintaining good environmental status in the marine environment. Among 11 descriptors, one is dedicated to NIS and relies on 3 criteria. Addressing the MSFD requirements is a challenging task with traditional methods (e.g., decline in taxonomic expertise, limited habitat accessibility, etc.). Metabarcoding might circumvent these limitations, through different strategies that might be relevant in the context of MSFD. For instance, eDNA from water samples collected in entry points (e.g. ports) could improve the early detection of new NIS (criterion 1). Monitoring the spread and evaluating the impacts of established NIS (criteria 2 and 3) could gain from studying bulk DNA obtained from scrapped settlement panels or from zooplankton samples, in natural habitats. We illustrate the last application with an analysis of bulk DNA retrieved from plankton samples (22 months) collected in one bay in Brittany (France). Many marine NIS indeed display larval stages which play a critical role for NIS spread and are particularly difficult (or impossible) to identify using morphological criteria. Using HTS of amplicons obtained with two markers (COI and 18S) and a metabarcoding approach, 10 NIS (5 with both markers) were identified and their temporal larval dynamics was monitored. Importantly, we chose to focus on a closed list of species with molecular references obtained locally. Under these conditions, the method was shown to be sensitive, and the results in agreement with those obtained with traditional methods. While DNA-based approaches are not free from limitations and biases, they seem effective for active surveillance of targeted NIS, notably to support MSFD.

Presenting author: Frédérique Viard. E-mail: viard@sb-roscoff.fr

Population genomics of the introduced and cultivated Pacific kelp *Undaria pinnatifida*: marinas — not farms — drive regional connectivity and establishment in natural rocky reefs

Jaromir Guzinski, Marion Ballenghien, Claire Daguin-Thiébaut, Laurent Lévêque, Frédérique Viard

CNRS - Roscoff Marine Biological Station, France.

Ports and farms are introduction hotspots for marine non-indigenous species (NIS). The extent to which these anthropogenic habitats are sustainable sources of propagules and influence the evolution of NIS in natural habitats was examined in the edible seaweed *Undaria pinnatifida*, a worldwide invader, native to Asia. Following its introduction 40 years ago along the French coast of the English Channel, this kelp is now found in three contrasting habitats: farms, marinas, and natural rocky reefs. Population genomics studies can shed light on the evolutionary processes sustaining successful introduction and guide policies directed towards NIS management. In addition to an analysis using microsatellites, we developed, for the first time in a kelp, a ddRAD-sequencing technique to genotype 738 individuals sampled in 11 rocky reefs, 12 marinas, and 2 farms located along ca. 1000 km of coastline. As expected, the RAD-seq panel showed more power than the microsatellite panel for identifying fine-grained patterns and detecting outliers. However, both panels demonstrated habitat-specific properties of the study populations: i) farms displayed very low genetic diversity and no inbreeding, conversely to populations in marinas and rocky reefs and ii) strong, but chaotic regional genetic structure, was revealed, consistent with human-mediated dispersal (e.g., leisure boating). We also uncovered a tight relationship between populations in rocky reefs and those in nearby marinas, but not with nearby farms, suggesting spill-over from marinas into the wild. This finding highlights the need for management policies that also target marinas. Finally, a temporal survey (over 20 generations) showed that wild populations are now self-sustaining, albeit there was no evidence for local adaptation to any of the three habitats. We anticipate that adaptation could nevertheless occur if the populations remain protected from gene flow counter-balancing local adaptation to their local environment.

Presenting author: Frédérique Viard. E-mail: viard@sb-roscoff.fr

Experimental evidence of water flow affecting sun coral growth: phenotypic plasticity as an important component for invasion success

Edson Vieira[1], Rodrigo Tanasovici[2], Marcelo Kitahara[3], Gustavo Dias[2]

1: Departamento de Oceanografia e Limnologia, Universidade Federal do Rio Grande do Norte - UFRN, Brazil.
2: Centro de Ciências Naturais e Humanas, Universidade Federal do ABC - UFABC, Brazil.
3: Instituto do Mar, Universidade Federal de São Paulo - UNIFESP, Brazil.

Brazilian subtidal is changing owing to the fast spread of the non-native sun coral (*Tubastrea* spp.), with most of its success being accounted to reproductive and spreading strategies. In a recreational marina in São Paulo State, the density of colonies is increasing fast, from absent in 2010 to around 462/m2 in the inner platforms and 73/m2 in the breakwater in 2017. Spatial variability with a more intense water flow and predation in the breakwater allowed us to experimentally investigate how such processes, besides habitat variation, affect sun coral growth. Experimental unities (n=20/experiment/area) consisted of vertically suspended (2m deep) PVC panels (15x15cm) with 4 small colonies (1-3 polyps) attached to it. In one experiment, predators were excluded using cages on half of the panels, and in the other experiment, flow was reduced by a transparent block panel on half of the replicates. After two months, predation did not show any effect, but colonies had more new polyps in the breakwater, and a higher area increment in the inner platforms. Conversely, flow indeed affected coral growth, with a higher number of new polyps in the breakwater and in the high flow treatment in both areas, and a higher area increment in the low flow treatment in both areas. Our results indicate that sun coral invests in polyps under high flow and in area occupation under low flow. This trade-off may be related to food availability, since the low flow in the inner area results in high productivity, not requiring a large number of polyps and allowing area occupation, which is constrained in the breakwater and may decrease survival. Besides helping to explain the differential distribution of sun coral in the study area, our results indicate that plasticity may be a key component for sun coral success in the Brazilian coast and elsewhere.

Presenting author (ONR Global Early Career Award Winner): Edson Vieira.
E-mail: edson.vieira@ufabc.edu.br

Non-indigenous marine biofoulers in an upwelling region from Southwestern Atlantic Ocean

Luciana Vieira Granthom-Costa[1], Luciana Messano[1], Paula Spotorno-Oliveira[1,2], Luciana Altvater[1], Alexandre Kassuga[1], José Eduardo Arruda Gonçalves[1], Ricardo Coutinho[1]

1: IEAPM, Brazil.
2: FURG, Brazil.

Bioinvasion is considered a threat to biodiversity and it has been modified benthic marine communities worldwide. Brazilian coastline is the longest in the Southwest Atlantic comprising three biogeographical provinces, in which the south is one of the most speciose marine ecoregion. According to Brazilian government environmental agencies, 32 non-indigenous (NIS) fouling species (detected, established and invasive) were recorded. Recent surveys added 24 fouling species to the list, totaling 56 NIS on natural and artificial marine substrates in the Brazilian Coast. Arraial do Cabo region (23° S-42° W) comprises a multiple-use Marine Protected Area located in the main upwelling system of Southwestern Atlantic. The local geomorphology consists in an inner embayment, with tropical environmental characteristics and an area exposed directly to the coastal upwelling, with subtropical characteristics. Furthermore, Arraial do Cabo holds a small commercial harbor that occasionally supports domestic and offshore vessels, that may act as a vector of NIS. In this study, we conducted a survey based on the literature in order to assess the NIS recorded to Arraial do Cabo. As a result, we listed 31 NIS recorded only in the inner embayment. Ten species are new recent records to the region – the green algae *Caulerpa brachypus*, the sponge *Darwinella cf. oxeata*, the serpulid *Branchioma luctuosum*, the gastropod *Eualetes tullipa* and six ascidians species *Didemnum sp* RJAC, *Ciona robusta*, *Ascidia curvata*, *Cnemidocarpa irene*, *Styela canopus* and *Rhodosoma turcicum*. We concluded that the harbor area is a receptor of NIS due to high number of species found inside the bay and may act as a donor to surrounding areas. Our data suggest that the inner area is open to introduction events, expansion and establishment of NIS. Although in the outside area the low water temperature may create a barrier to their spread, it is susceptible to the establishment of NIS with subtropical affinities.

Presenting author: Luciana Vieira Granthom-Costa. E-mail: lu.granthom@gmail.com

A brand new non-native species of *Didemnum* genus (Tunicata: Ascidiacea: Aplousobranchia) in Southeastern Brazilian coast

Lucas P. Castelo Branco[1], Luciana Vieira Granthom-Costa[2], Ricardo Coutinho[1,2]

1: Programa de Pós-Graduação em Biotecnologia Marinha - IEAPM/UFF, Brazil.
2: Departamento de Biotecnologia Marinha - Instituto de Estudos do Mar Almirante Paulo Moreira – IEAPM, Brazil.

Non-native species are major threats to the marine environment. During a field work in harbor area in the municipality of Arraial do Cabo, Rio de Janeiro (22º57'58"S-42º01'40"W), was found a colonial ascidian of the genus Didemnum unreported in previous studies. We conducted this study during november and december/2017 in order was to assess the invasive potential this brand new record considering spatial distribution, colonization ability, reproductive effort and predation this species named here as *Didemnum* sp. RJAC. Our results showed *Didemnum* sp. RJAC is confined to the Anjos Inlet occurring in both sides of the beach in natural and artificial substrates covering 69.10 m²/200m² in harbor area (iron cables, pillars) and rocky shores, covering 14m²/200m². We observed that *Didemnum* sp. RJAC colonies were reproductively active during all year study where we found full larvae in all analyzed colonies mainly in (Autumn). During this study, we found lowest densities in January/2017 with 2 larvae/cm² and highest densities with 127 larvae/cm² in May/2017. The colonization ability of *Didemnum* sp. RJAC was assess experimentally in two seasons during 2017 showing a significative difference between then (Student's t-test, T=4.45, df=278, p=0.01) and also both sides -upper and lower of the plates tests -(Student's t-test, T=5.35, df=278, p=0.00). Besides, predation pression results based on experimental test showed that *Didemnum* sp. RJAC colonies were not bite in two differents periods of the day. It was also observed that *Didemnum* sp. RJAC overgrowings other native and non-native benthic species in region and may induce to death by suffocation or tissue necrosis. As conclusion, *Didemnum* sp. RJAC exhibit characteristics of invasive species, such as rapid growth, high fecundity and regeneration of colonies from fragments. We recommend the continuous monitoring of the population dynamics of this species where it already occurs in order to control and prevent to bioinvasion events.

Presenting author: Luciana Vieira Granthom Costa. E-mail: lucas.castelo20@gmail.com

Combining morpho-taxonomy, metabarcoding and digital droplet PCR to enhance non-indigenous marine pest detections

Ulla von Ammon[1], Susanna Wood[1], Olivier Laroche[1], Zaiko Anastasija[1], Leigh Tait[2], Shane Lavery[3], Graeme Inglis[2], Xavier Pochon[1]

1: Cawthron Institute, New Zealand.
2: National Institute for Water and Atmospheric Research, New Zealand.
3: University of Auckland, New Zealand.

Marine infrastructure can enhance the spread of non-indigenous marine biofouling species by providing suitable habitat for them to settle and proliferate. Current detection methods rely primarily on morpho-taxonomical identification. Cryptic organisms or those in early life stages can be difficult to identify morphologically and molecular tools may enhance their detection. In the first study passive samplers were deployed in the Westhaven marina (Auckland) in order to compare the detection sensitivity for non-indigenous species between morpho-taxonomy and metabarcoding (18S ribosomal rRNA and Cytochrome Oxidase I (COI)). Using all methods, 56 potentially non-indigenous species (NIS) were detected. Metabarcoding detected the highest proportion of NIS species: 41% by 18S rRNA and 12.5% by COI, but some taxa such as Bryozoa were not always identified. An additional 17% (mainly Bryozoa) were detected by morpho-taxonomy only. A total of 22% of the species were identified by both morpho-taxonomy and metabarcoding. The data highlight several on-going challenges for the development and application of metabarcoding, including: differential marker resolution, primer biases, incomplete sequence reference databases, and the influence of different sample matrices on detection of rare species. An additional study was undertaken to investigate the influence of community complexity on detection of the NIS, *Sabella spallanzanii*. A species-specific digital droplet PCR (ddPCR) assay and metabarcoding were used to analyse water and biofouling samples and detection rates compared. Despite ddPCR indicating the presence of *S. spallanzanii* in 65% of all tested samples, metabarcoding failed to detect its presence. Collectively the result of this study suggest the application of morpho-taxonomy and molecular techniques will enhance the likelihood of detecting non-indigenous species in complex biofouling samples and may also reduce “omission” and “commission”.

Presenting author: Ulla von Ammon. E-mail: ulla.ammon@cawthron.org.nz

Exploring perceptions of marine biosecurity interventions: insights from the marina sector

Siobhan Vye[1], Sophie Wynne-Jones[2], Stuart Jenkins[1]

1: School of Ocean Sciences, Bangor University, United Kingdom.
2: School of Environment, Natural Resources and Geography, Bangor University, United Kingdom.

Recreational boating is a largely unregulated vector of non-native species and contributes to both initial introduction and secondary spread. As such, marinas and ports often experience high propagule pressure and are commonly hotspots of non-native species. In many countries, there is little or no legal requirement for marinas to implement biosecurity interventions in day to day operations to reduce the risk of non-native species introduction. Instead biosecurity interventions are often encouraged as best practise and implemented voluntarily and therefore, uptake may be limited. To elucidate the drivers and barriers to biosecurity in marinas, focus groups were conducted at a workshop attended by marina operators from Ireland and Wales. Participants described and discussed the barriers and drivers to the overall process of biosecurity planning in marinas. In order to identify practical issues with specific biosecurity tools, such as risk assessments and in-water quarantine berths, a second session asked participants to identify strengths and weaknesses of a range of biosecurity tools. Thematic analysis revealed knowledge and financial resources, in combination with the perceived effectiveness of biosecurity interventions in combating non-native species, to be the greatest barriers to biosecurity. However, good practise and the benefits of a clean environment to marina businesses were drivers. Overall, the results suggest biosecurity interventions should be supported by simple guidance, legislation and financial support, alongside robust, digestible evidence of the cost-effectiveness of any intervention in reducing the risk of non-native species introductions. This study has increased our understanding of marina operators' perceptions of non-native species biosecurity and may inform the development of biosecurity tools that are more readily implemented in the commercial environment of a marina.

Presenting author: Siobhan Vye. E-mail: s.vye@bangor.ac.uk

Keeping the pests at bay: a case study of detailing how vessel biosecurity and marine monitoring reduced the potential of introducing pests into a marine reserve

Fred Wells[1], Simon McKirdy[1], Sandy Norris[2], Greg Booth[2], Kristin Horton[2], Johann van der Mewre[2], Grey Coupland[1]

1: Murdoch University, Australia.
2: Chevron Australia, Australia.

A liquefied natural gas (LNG) plant was recently constructed in a nature reserve at Barrow Island, Western Australia. A key environmental commitment was that no introduced marine pests (IMP) be introduced to the island. A detailed Quarantine Management System (QMS) was developed to prevent the arrival of potential IMP species, monitor for any that penetrated the quarantine barriers and respond to any incursions detected. Emphasis was placed on preventing IMP arrival. The Australian IMP list was checked for species capable of surviving at the island. A 2.5 km exclusion zone was established with progressively greater requirements for vessels approaching nearer to the shoreline and/or remaining longer at Barrow Island. Detailed risk assessment procedures were developed to assess all vessels entering the exclusion zone, with protocols for inspecting vessels for IMP prior to their mobilization. Additional requirements were established for vessels making repeat mobilizations. Over 600 vessels were risk assessed between 2010 and 2016, and many were cleaned. Vessels remaining in port more than seven days after cleaning but prior to mobilization were reinspected after 90 days. IMP were detected on four vessels already operating in WA (two with barnacles [*Amphibalanus improvisus* and *Balanus pulchellus*] and two with Asian green mussels, *Perna viridis*). They were cleaned before mobilizing to Barrow Island. Juvenile *Perna viridis* were detected at Barrow Island on six vessels from southeast Asia. Because of the 90 day rule the mussels were juvenile and the vessels were cleaned. A detailed IMP monitoring program conducted over seven years commenced prior to major marine construction and ended after construction was completed. The ascidian *Didemnum perlucidum* was at Barrow Island before construction began but no IMP were introduced to the island during construction. This program successfully demonstrates that appropriate management procedures can prevent the introduction of IMP to a high value marine environment.

Presenting author: Fred Wells. E-mail: f.wells@murdoch.edu.au

Behaviour of *Tubastraea coccinea* in different temperatures and in ecological interaction with a native sessile species

Bruna B. Winter[1], Antonella Carolina A. Saá[1], Thiago Cesar L. Silveira[1], Nadine Schubert[1], Bárbara Segal[1], Marcelo Crivellaro[1], Grazyelle Pereira[2]

1: Universidade Federal de Santa Catarina, Brazil.
2: Universidade Estadual de Santa Catarina, Brazil.

Tubastraea coccinea is a scleractinian coral from the Indo-Pacific Ocean, and it is registered in Brazilian coast since the late 80s, encrusted in artificial and natural substrates along Rio de Janeiro shoreline. Nowadays *T. coccinea* is also observed in southern Brazil, where it has been a potential threat inside the Biological Marine Reserve of Arvoredo. This marine protected area takes place at a transition of temperature zone, receiving temperatures below 16° C up to 27.5° C. As we do not know the effect of temperature on *T. coccinea* behaviour, this study aims to evaluate the effect of temperature on feeding activity of sun coral when it is alone and when it is interacting with the native zoanthid, *Palythoa caribaeorum*. We carried out an experiment exposing *T. coccinea* to two treatments: temperature (16°, 19°, 22°, 25°, 28°, 31° C), and ecological interaction, in contact with *P. caribaeorum*. The experiment lasted twenty-eight days. Polyp activity was measured every two days, one hour after they were fed with *Artemia salina*. The response variable, polyp activity percentage, was obtained by the valuation of the different status of the polyp activity in each colony and calculating an activity percentage for 3 periods of 8 days each (1-initial, 2-intermediate, 3-final). We used a Mann-Whitney test to evaluate if the ecological interaction affected polyp activity in different temperatures. *T. coccinea* interacting with *P. caribaeorum* showed higher polyp activity. *T. coccinea* colonies exposed to 16° C died after ten days. To evaluate the effect of temperature in polyp activity, we performed a linear regression, but there was no significant response. The higher polyp activity of *T. coccinea* when in interaction with *P. caribaeorum* may be an agonistic behaviour, and not just feeding competition, as we observed this activity even before we fed them.

Presenting author (Best Poster BHL): Bruna B. Winter. E-mail: brubaloo@gmail.com

Contributions for the management of exotic marine species at port of Suape, Brazil

Everthon Xavier, Andrea Silva, Leandro Vieira

UFPE, Brazil.

Environmental management in port activities is often considered complex due to large vessel traffic and a wide variety of operations occurring in a single location. As a result of these activities, several impacts to the environment may be related, including biological invasions, considered a major threat to biodiversity. In this context, a study was conducted in the port of Suape, Pernambuco, northeastern Brazil, to evaluate the application of public policies and their agreement with management models on bioinvasions and ballast water. Thus, we performed a content analysis of public policies and interviews with technicians and managers of two responsible agencies (National Health Surveillance Agency – ANVISA; and Brazilian Navy) for the management of exotic species at port of Suape. Despite the existence of international guidelines (such as those elaborated by International Maritime Organization) and national standards guiding the management of bioinvasion and ballast water, no effective local policies have been observed for the control and eradication of invasive species. It was noticed that, ANVISA and Navy interviewees have knowledge about both national and international regulations and models for bioinvasion prevention and management. On the other hand, there are difficulties in putting these regulations into practice: such as poor or non-existent monitoring, many inefficient human resources or only concern with possible human pathogenic agents. So, we propose a model of Integrated Management System, through of Strategic Environmental Assessment, including preventive and multidisciplinary strategies of detection and control of exotic species, with sufficient number of agents trained to better apply existing regulations, and the creation of local programs that fit to reality of each port, to obtain better results. Mostly, it is necessary to go further, abandon the defensive and reactive stance on issues related to bioinvasion and anticipate potential problems.

Presenting author: Everthon Xavier. E-mail: everthonxavier@gmail.com

Management of the invasive oyster drill *Urosalpinx cinerea* to improve native oyster (*Ostrea lurida*) restoration outcomes: field experiments in San Francisco Bay

Chela Zabin[1], Brian Cheng[2], Jeffrey Blumenthal[1], Andrew Chang[1], Karina Nielsen[3], Sarah Ferner[4], Matthew Ferner[4], Gregory Ruiz[1]

1: Smithsonian Environmental Research Center, USA.
2: University of Massachusetts at Amherst, USA.
3: Estuary & Ocean Science Center, San Francisco State University, USA.
4: San Francisco Bay National Estuarine Research Reserve, USA.

The Atlantic oyster drill *Urosalpinx cinerea* is found in San Francisco Bay (CA, USA) and other estuaries along the west coast of the US, where it presents a hurdle to restoration of the native oyster *Ostrea lurida*, and impacts a suite of other intertidal species. We engaged community scientists in two experiments testing potential methods for managing this invader: functional eradication and using tidal elevation to reduce predation. The goal of functional eradication for a non-native species is to reduce its population density to levels that have negligible-to-low impacts on native species. The Atlantic drill has several traits that indicate this approach may be successful: 1) benthic egg capsules from which crawl-away juveniles emerge; 2) a predictable reproductive period based on water temperatures; 3) low adult dispersal. In 2017 and 2018, ~300 community members helped remove 29,000 snails from two sites. At one site, we recorded a decrease in catch per unit effort (CPUE) over sequential removal efforts each year, and a decline in drill densities in the removal plot compared to a control plot. CPUE did not decline at the second site, but drill densities had decreased in the removal plot by spring 2018. A field experiment in summer 2018 will determine whether oyster survival is improved in the removal plots compared with control plots. In 2017, surveys of 10 sites in San Francisco Bay indicated differences by tidal elevation in oyster recruitment and survival on experimental tiles, and in adult oyster and oyster drill densities and distribution on the shoreline. In an earlier pilot study, we found drill abundance decreased and oyster survival increased on tiles placed at +40 cm MLLW compared with +70 cm. A field experiment in summer 2018 will test oyster survival at three tidal elevations at our functional eradication control sites.

Presenting author: Chela Zabin. E-mail: zabinc@si.edu

Molecular tools for implementing international ballast water regulations – insights from a cross-latitudinal en-route study

Anastasija Zaiko[1], Susie Wood[1], Xavier Pochon[1], Peter Croot[2], Eva Garcia-Vazquez[3]

1: Cawthron Institute, New Zealand.
2: National University of Ireland, Ireland.
3: University of Oviedo, Spain.

The international Ballast Water Management Convention (BWMC) which aims to prevent, minimise and ultimately eliminate the transfer of harmful aquatic organisms and pathogens via ballast water transport associated with shipping, came into force on 8 September 2017. Regulation D-2 specifies a compliance threshold for the abundance of viable organisms in ballast water after on-board treatment. Currently no single method exists that can be applied to ballast water compliance monitoring. Most of the testing approaches are applicable only to specific taxonomic groups, are not quantitative, require high degrees of taxonomic skill, are time consuming and expensive. In this study we performed concurrent measurements of ATP and eDNA/eRNA-metabarcoding during cross-latitudinal vessel transit, collecting triplicate ballast water samples every second day over 3 weeks period. The results obtained by different methods provided complementary information, allowing more comprehensive inferences on biological activity than could be derived by each method separately. They suggest die-off of larger metazoans during the first week of observations, gradual fading of dinoflagellates and ochrophytes and persistent or increased cellular activity of proteobacteria and ciliates. Although these combined approaches show potential for gross-negligence screening, they are still unable to provide reliable numbers for detailed compliance tests as required by the BWMC.

Presenting author: Anastasija Zaiko. E-mail: anastasija.zaiko@cawthron.org.nz

In Memoriam:
Professors Susan Williams and Alfred Crosby

On October 17th, 2018, “Day 2” of the ICMB-X, Jim Carlton delivered very emotional words of condolence, respect and love for these two outstanding Scientists.

Thank you very much Jim. They will be remembered.

Susan L. Williams (1951-2018) was Professor of Evolution and Ecology at the University of California Davis and former Director of the Bodega Marine Laboratory. A coastal ecosystems ecologist, she published numerous papers on marine bioinvasions from 1999 to 2015.

Alfred W. Crosby (1931-2018) was Professor Emeritus of History, Geography, and American Studies at the University of Texas at Austin. He is best known among invasion biologists for two ground-breaking books, The Columbian Exchange (1972) and Ecological Imperialism (1986; second edition 2004).

ICMB-X Attendees' Origin

Thanks again to Biodiversity Heritage Library and Smithsonian Libraries for donating the high-resolution image from Darwin's "Journal of researches into the natural history and geology of the countries visited during the voyage round the world of H.M.S. 'Beagle'" for all attendees to mark their origin (several of them shared the same origin).

"The plains of Patagonia…bear the stamp of having lasted, as they are now, for ages, and there appears no limit to their duration through future time." Charles Darwin in Voyage of the Beagle (1831–1836).

What would Darwin have written now?
Bortolus & Schwindt 2007.
Biodiversity and Conservation 16(2):337-345

ICMB-X Repercussion

In the rush of the Conference *nobody* noticed that Science had published this:

http://science.sciencemag.org/content/361/6405/857.2/tab-e-letters

Science Home News Journals Topics Careers

Search

Log in | My account | Contact Us

Become a member
Renew my subscription
Sign up for newsletters

SHARE

Submit a Response to This Article

Marine Bioinvasion Research From Over 40 Countries Debated in Patagonia

Alejandro Bortolus, Investigador Independiente,
Grupo de Ecología en Ambientes Costeros (GEAC), IPEEC-CONICET, Argentina.

Other Contributors:
Evangelina Schwindt, Investigadora Independiente,
Grupo de Ecología en Ambientes Costeros (GEAC), IBIOMAR-CONICET, Argentina

(11 October 2018)

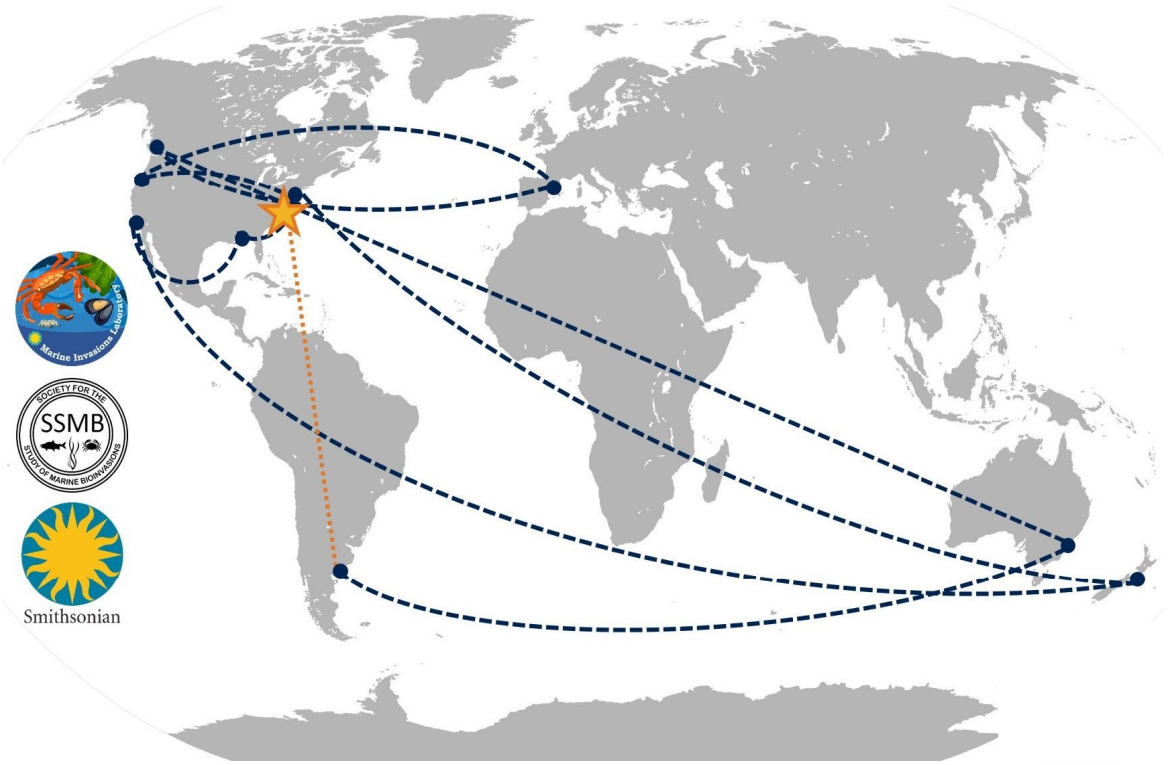
The International Conference on Marine Bioinvasions (ICMB) is a major non-profit forum for expert scientists and policymakers to push forward the discipline. The Xth edition is celebrated (October 16-18, 2018) for the first time in a Latin American country (Puerto Madryn, Chubut, Patagonia, Argentina), a region suffocated by a scientific crisis caused by a lack of budget and political support that have led, for instance, to the collapse of the Argentina Ministry of Science

Science
Vol 361, Issue 6405
31 August 2018
Table of Contents
Print Table of Contents
Advertising (PDF)
Classified (PDF)
Masthead (PDF)

ARTICLE TOOLS
Email
Print
Save to my folders
Alerts
Citation tools
Share

What's Next?

XI International Conference on Marine Bioinvasions Annapolis, Maryland in about 2 years



We hope we meet you again in the USA to enjoy the XIth Edition of the ICMB, hosted by the Smithsonian Environmental Research Center (SERC) where Dr Greg Ruiz and his Invasions Lab will be welcoming us.

Should we mention that during the ICMB-X, the SSC designated Dr. Jeff Crooks and Dr. Chela Zabin as the next Presidents of the SSMB, following former President Dr. Lisa Drake, to whom a certificate of gratitude was extended along a piece of original acrylic painting by the Patagonian artist Yagui (right).

Stay tuned and follow ICMB on Twitter, Instagram, Facebook and website for updates.

Abrazos!!

Chairs, Evan Schwindt and Ale Bortolus

Xth International Conference on Marine Bioinvasions

16-18 October 2018