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BULLETIN OF ESTUARINE AND COASTAL SCIENCES

ECSA is an international organisation dedicated to the promotion and advancement of multidisciplinary research into all aspects of estuaries and coasts, and the application of science and technology for their sustainable environmental management.

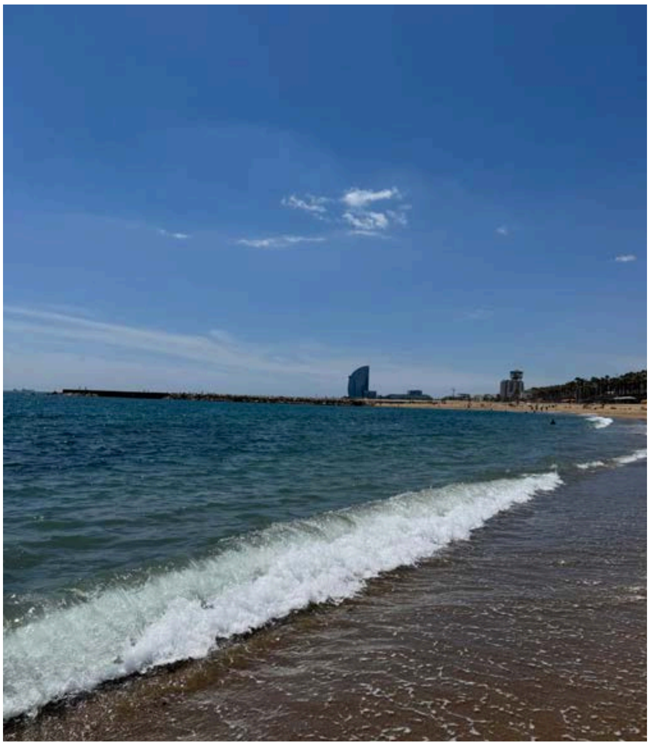
ESTUARINE AND COASTAL SCIENCES ASSOCIATION

March - 2026 - Issue 127

BULLETIN OF ESTUARINE AND COASTAL SCIENCES

IN THIS ISSUE...

Welcome to the 127th issue of the Bulletin of Estuarine and Coastal Sciences.



"The ocean's bottom is at least as important to us as the moon's behind."

\- Gordon G. Lill, Oceanographer

This bulletin was edited by Gemma Smith, International Estuarine and Coastal Specialists Ltd.
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With great thanks to all contributors

EDITORIAL

Gemma Smith
International Estuarine and Coastal Specialists Ltd.
Centre for Systems Studies, University of Hull

In this 127th issue of the Bulletin of Estuarine and Coastal Sciences, we continue to explore the multidisciplinary aspects of our field, ranging from historical methodological advances to modern day restoration efforts.

ECSA remains focused on the upcoming 61st international conference, "Bridging the Gap Between Science and Policy in Estuarine and Coastal Marine Biodiversity: The Way Forward," which is scheduled to take place in **Brussels in August 2026**. This event will feature an inaugural 'Science-meets-Policy' day, designed to ensure research outcomes directly support European marine policies.

This issue **highlights several ongoing projects** that demonstrate the practical application of marine science. For instance, the **REDRESS project** examines the feasibility and value of deep-sea ecosystem restoration, providing tools to support the Nature Restoration Regulation. We also feature insights into the growing importance of Marine Citizen Science, which empowers the public to become stewards of the marine environment while providing cost-effective monitoring for professional researchers, in the **MARBEFES Project.** Alongside a student article as part of the **GES4SEAS Project.**

Furthermore, we delve into the **challenges posed by marine invasive non-native species**. Elinor H. Spencer presents a systematic map of spread pathways, while the **BRIDGE program** introduces a standardized framework for bioinvasion research integration across global ecosystems. These articles underscore the necessity of coordinated, global actions to mitigate biological threats.

We also take a retrospective look through the **ECSA Archives**. Martin Wilkinson reflects on the early use of small hovercraft for estuarine sampling in the 1970s, illustrating the innovative ways of how we previously addressed the logistical difficulties of benthic research. Additionally, we note the digitalisation of Volume 4 of the **Coastal Zone Topics series**, ensuring that historical site-specific expertise on the Humber Estuary remains accessible to our membership.

We hope you find this collection of articles both informative and inspiring as we work together toward the sustainable management of our coasts and estuaries.

Should you wish to contribute a future article, please get in touch at: Gemma.Smith@iecs.ltd

ECSA CONFERENCE

Bridging the Gap: ECSA 61 and the Future of Science-Policy Integration

Location: The Square, Brussels
Date: 24-27 August 2026.

Following the successful Focus Meeting in Antwerp last year, the association returns to Belgium with a significantly expanded scope.

The Estuarine and Coastal Sciences Association has announced its 61st international conference, "Bridging the Gap Between Science and Policy in Estuarine and Coastal Marine Biodiversity: The Way Forward." is set to take place from **24–27 August 2026** at **The Square, Brussels**, this event arrives at an important time for global marine biosecurity and environmental governance.

A primary objective of the conference is to demonstrate how scientific advances can support international policies, such as the EU Biodiversity Strategy for 2030.

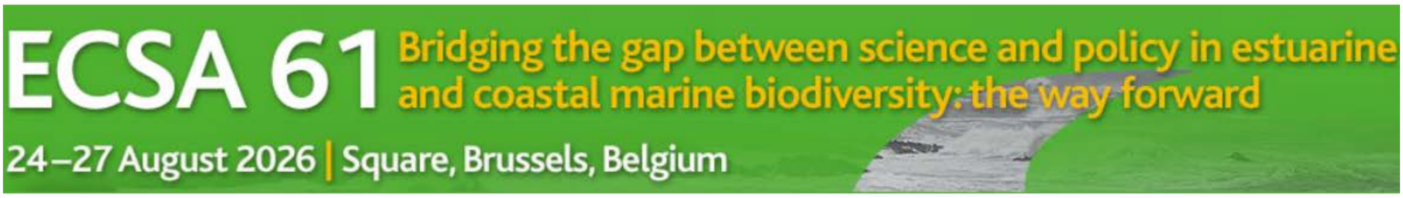
Led by conference chairs Ángel Borja, Michael Elliott, and Tim Jennerjahn, these sessions will explore topics including coastal hydrodynamics, nature-based restoration solutions, and marine spatial planning. The technical programme is built upon the progress of several Horizon Europe projects, such as GES4SEAS, MarineSABRES and MARBEFES, and features many sessions spanning the faces of estuarine and coastal science.

There are four overarching pillars to the conference that cover Physics, Ecology, Biogeochemistry, and the Human Dimension. Within these pillars, sessions will cover a comprehensive range of topics, such as coastal hydrodynamics, sediment transport, and the impacts of extreme events. Ecological discussions will focus on biodiversity, nature-based restoration solutions, and habitat connectivity across systems such as, saltmarshes and seagrass beds, while biogeochemical sessions will address carbon cycling, eutrophication, and "blue carbon" storage. Furthermore, the Human Dimension sessions will explore coastal governance, social-ecological adaptation, and science communication, ensuring a holistic approach to bridging the gap between research and policy.

Regarding expected workshops, the conference encourages innovative formats and flexible timeslots to accommodate practitioner forums, panels, and interactive discussions. For instance, participants may engage with the GES4SEAS innovative software toolbox, including tools such as Tikta and Pressure2Eco, to support assessment needs under the Marine Strategy Framework Directive (MSFD). These workshops aim to transform research outcomes into actionable strategies for sustainable ocean management.

Moreover opportunities for Early Career Researchers to engage with the conference topics, such as the workshop of “The future of coastal and estuarine biodiversity science-policy: intergenerational perspectives”.

ECSA CONFERENCE



The Inaugural 'Science-Meets-Policy' Day

For the first time, the programme includes a dedicated "Science-meets-Policy" day on the **27 August 2026**, offering a unique opportunity to discuss how research outcomes can support the implementation of marine policies across Europe.

The day features keynote presentations on integrating science for global biodiversity and monitoring marine status under global policies, alongside flash presentations of policy briefs from supporting EU projects.

The event will conclude with a roundtable discussion titled "From Research to Action," aimed at making research outcomes useful for policymakers, with an expected audience including European Commission officers, members of the EU Parliament, and national authorities.

Call for Abstracts:

Abstracts are open for oral or poster presentations that align with the conference's overarching themes of physics, ecology, biogeochemistry, or the human dimension of coastal systems.

The submission process is facilitated through an online system, which allows researchers to propose their findings for inclusion in either general sessions or specific special sessions. The specific requirements and deadlines for the submission process are as follows:

- Submission Format: Abstracts must be submitted for consideration as either an oral or a poster presentation.
- Thematic Alignment: Contributions must address topics within the pillars of Physics, Ecology, Biogeochemistry, or the Human Dimension.
- Abstract Submission **Deadline: 31st March 2026.**
- Author **Notification Deadline: 1st May 2026.**
- Early Bird and Author Registration Deadline: **29th May 2026.**

To find out more visit the conference website here.

Register Now

Submit Abstract

ECSA ARCHIVES

HALF A CENTURY AGO: A NEW WAY OF BENTHIC SAMPLING

Martin Wilkinson

ECSA Treasurer

ECSA was founded 55 years ago because no society in the United Kingdom covered the brackish water habitats, particularly estuaries, which at that time were seeing a big increase in research effort linked to public concern about estuarine pollution.

Looking through the Association's Bulletin in successive decades shows the way our subject areas developed in the UK in response to this concern. One early article caught my imagination in the July 1976 issue of the EBSA Bulletin about dealing with the increased workload of benthic sampling in estuaries that became necessary to find out the ecological cost of pollution.

This was "Small Hovercraft for Estuarine Sampling" by Nick Craig from the Brixham Laboratory of Imperial Chemical Industries (ICI). This was one of Britain's largest companies and had been responsible for severe chemical pollution in some of our major UK estuaries on which they had large chemical plants including the Tees, Forth, Mersey and even the small Garnock estuary in Ayrshire, Scotland, which received strongly polluting effluents from the Nobels Explosives Company, one of ICI's subsidiaries. ICI had its own marine research laboratory at Brixham in Devon, staffed by good scientists, to investigate and improve these polluted estuaries. ICI Brixham was one of the first sponsors of our association contributing to ECSA's activities for several decades.

We would like to hear from other members who tried this method of sampling about their experience with it. The Brixham laboratory closed some years ago but its last representative on ECSA Council, Ross Brown, continues with ECSA as our webmaster. We would also like to hear from any company or organization interested in becoming a sponsor. Presently we have three sponsors but our constitution allows up to five sponsors to appoint representatives to ECSA Council.

Garnock Estuary 1976, taken October 1976

SMALL HOVERCRAFT FOR ESTUARINE SAMPLING

N.C.D. CRAIG, I.C.I. LTD, BRIXHAM, ENGLAND

In recent years the increasing economic and social pressures on the estuaries of Great Britain have resulted in an upsurge in research work in these areas. The physical nature of most British estuaries makes them extremely difficult areas in which to undertake sampling programmes.

The four principal problems in estuarine sampling are:-

(a) Shallow water.
(b) Strong tidal currents.
(c) Relatively large areas.
(d) The presence of extensive areas of mud and sand flats.

Until now the normal methods of sampling have been from boats or on foot. Limited use of helicopters has been possible in certain areas such as the Thames, Humber and Severn but it is a very costly technique.

There are several problems in sampling estuaries from boats. Craft of the MFV size require considerable water depth and marked channels to work in, but they can be used to operate bulky equipment. The shallow draft of inflatables is advantageous, but they have limited capacity for operation of equipment, and they may be difficult to handle in strong tides.

Sampling of foot is laborious and time-consuming. Furthermore it is frequently rendered hazardous by the presence of soft muds and quicksand, and the danger of being trapped by an incoming tide.

These difficulties lead to many estuary investigations being confined to the banks, for practical reasons, and as a result large areas in the centre of estuaries remain unsampled.

A recent solution to this problem is the use of hovercraft; these will cross mud flats, sand, shingle and water with ease and at speed. Hence they permit rapid sampling over extensive areas of an estuary. The ability to travel across different surfaces gives a considerable margin of safety for the operators. The hovercraft effectively speeds up the process of sampling on foot.

Since 1973 the ICI Laboratory at Brixham (Devon) has been using a Pindair 'Skima 4' hovercraft for the collection of biological and sediment samples in estuaries. The craft is of modest dimensions and is relatively inexpensive.

The hull of the 'Skima 4' is inflatable, 4 metres long by 2 metres across. Three identical two-stroke engines are used, one for lift, to provide the air cushion, and two for driving the craft. Steering is by tiller, controlling rudder vanes mounted behind the driving engines. The craft will carry four people at approximately 30 knots on sandy surfaces. The entire hovercraft can be dismantled and transported in a 10 cwt van, although we have a trailer upon which the craft is transported in a fully-operative condition, as this saves considerable time and permits the craft to be cleaned and serviced quickly.

Experience in Use

When using a hovercraft it is essential to remember that, as for an aeroplane, the major limiting factor is maximum payload. For the 'Skima 4' the payload is 320 kilogrammes, which must include the crew, safety equipment, tools, fuel etc as well as the sampling equipment and samples. Hence it is important to design a sampling programme carefully before commencing work.

In sampling in the Mersey, Severn, Forth and Wyre we have worked with a crew of two, and utilised the remaining weight capacity for carrying samples and equipment. A base site is selected and the craft returns to base when it has a full load of samples. The actual sampling is normally undertaken on the sand or mud flats when they are exposed. The craft does not appreciably disturb sediment by its passage and therefore undisturbed surface sediment samples can be taken directly from the craft when it is stationary.

The speed of the hovercraft, combined with its low profile, requires that the pilot concentrate entirely on the control of the craft while it is in motion. Areas like the Mersey estuary have many gullies and run off channels amongst the sand-banks, and the pilot has to make very rapid decisions as to the advisability or otherwise of driving over a gully. The air held beneath the craft by the flexible skirt is lost when the craft passes over a gully. A large gap may cause total loss of 'lift' and in consequence cause a very violent stop. With some 40-50 hours experience a pilot is usually competent to handle the craft efficiently.

The second crew man acts as 'navigator', and he will inform the pilot when and where to stop for sampling purposes, as well as the overall direction required.

Because the 'Skima 4' is an open craft it is inevitable that the crew and the contents of the hovercraft are exposed to spray of mud, water and sand. Full protective clothing is necessary, together with ear protection[1] and life jackets. Regular preventive maintenance of the engines and controls is advisable.

If the craft should suffer an irreparable breakdown in an estuary it will float, and it can be driven slowly across the water. On one occasion in the Mersey estuary a broken lift fan immobilised the craft on a sand bar in the middle of the estuary. However, once the tide returned the craft was driven to the shore as a 'boat'.

We feel that the small hovercraft is a useful and safe tool for sampling in estuaries. It permits considerable distances to be covered rapidly, and allows biological sampling in areas where such work has been virtually impossible by other methods.

ECSA ARCHIVES

Digitalising the Coastal Zone Topics: The 1996 Humber Estuary Local Meeting Outputs

Gemma Smith

International Estuarine and Coastal Specialists Ltd.

The Coastal Zone Topics: Process, Ecology & Management series, published by the ECSA, was established to facilitate the flow of information regarding coastal resources and management. By publishing peer-reviewed volumes based on ECSA local meetings, the series provided a platform for multidisciplinary research covering both the marine and terrestrial components of the UK coastline.

The recently digitalised, **Volume 4, of the Humber Estuary and Adjoining Yorkshire and Lincolnshire Coasts**, represents a baseline for an industrially and ecologically significant region in the UK. The research presented in this volume highlights a key era in estuarine science, where studies transitioned from descriptive accounts toward a process-based understanding of the environment. This collection offers a broad spectrum of insights, examples of articles are found below,

The Historical and Socio-Economic Context:

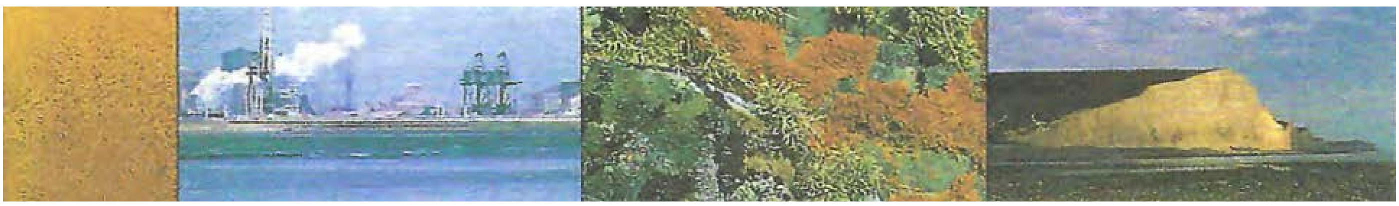
Contributions explore the the Humber wetlands and development of regional commercial fisheries, providing a human dimension to estuarine science. Such as the papers: "The archaeology of the Humber Estuary and its implications for environmental management and planning." by S. Ellis & R. Van de Noort, 'Stable isotopes in scallop shells as indicators of Holocene palaeoenvironments in the North Sea.' by J.A. Hickson, A.L.A. Johnson, T.H.E. Heaton & P.S. Balson, and "The commercial fisheries of the Humber Estuary and their historical development." by C. Radcliffe which provide a human dimension to the scientific understanding of the region.

Physical Processes and Modelling:

The volume details the application of numerical and mathematical models to understand flow, sediment transport, and the complex hydrography of the Ouse and Trent estuaries. These assessments are provided in papers such as: "The role and aspects of mathematical modelling of the Humber Estuary." by R.A. Falconer, B. Lin & E. Harris and "The Ouse Estuary - a precursor to variability in the Humber." by .J. Uncles, J.A. Stephens & R. Parker.

Ecological Health and Recovery:

Assessments include the response of intertidal invertebrates to heavy metals and the distribution of fish assemblages, capturing a period of notable ecological change. Such as the papers: "Anglian Water



comprehensive studies in the Humber and on the Lincolnshire coast." by C.J. Hutchings & P.R. Linwood, "Humber invertebrates and their responses to heavy metals." by N.V. Jones, S. Nedwell, A.K. Sahu & S.E. Vowles, and "The biology of fishes in the Humber Estuary." by M. Elliott & S. Marshall.

Conservation and Management:

Several papers focus on the necessity of bridging the gap between scientific understanding and management models to ensure sustainable coastal development. Such as the papers: "The Yorkshire coast in the context of North Sea science and management." by J-P. Ducrotoy & M. Elliott and "The Humber Estuary Management Strategy." by L.Evans.

These studies, and several more included in the series, provide historical accounts to distinguish natural variability from anthropogenic impacts; a requirement that remains central to Ecosystem-Based Management today!

Preservation and the Digitalisaiton:

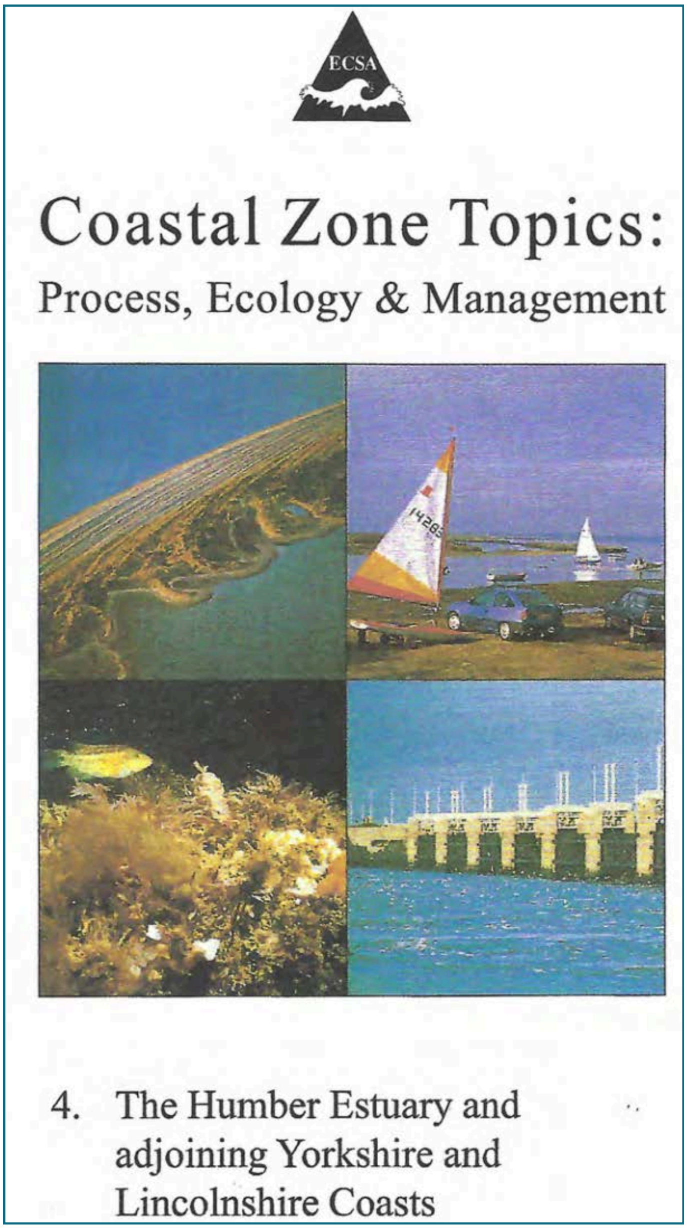
In previous decades, the dissemination of such research was heavily reliant on physical mail and printed bulletins. Today, ECSA is committed to ensuring that this site-specific expertise is preserved and accessible to their membership through ensuring that these articles are located and digitalised.

It is with great thanks to Professor Michael Elliott and Janet Elliott, that the **1996 Humber papers** have recently been digitised and uploaded to the ECSA website. While the Humber volume is now available online, ECSA continues to locate and digitalise the accompanying volumes as regionally important outputs.

These include Volume 2, regarding the Solway Firth, Volume 3, concerning Central Scotland, and Volume 5, "The Estuaries and Coasts of North-East Scotland," resulting from the 2001 Aberdeen meeting.

Members are encouraged to explore these resources on the ECSA website to explore all the articles in **Volume 1: The Changing Coastline** and **Volume 4: The Humber Estuary and adjoining Yorkshire and Lincolnshire Coasts** to bridge the gap between historical data and future coastal science and policy.

Click here to learn more about the Coastal Zone Topics.



ONGOING PROJECT

Feasibility, sustainability, and value of deep-sea ecosystem restoration - providing tools empowering society and governance to support sustainable and effective marine restoration activities.

Nadia Papadopoulou,

Hellenic Centre for Marine Research.

With many anthropogenic activities operating outside acceptable sustainability levels and many associated pressures persisting and potentially increasing, it is no surprise that biodiversity loss and pollution along with climate change form a triple planetary crisis. It is not all gloom and doom however. Against this background of stressed, damaged and/or destroyed marine ecosystems, there is also strong support for reversing this situation and restoring the marine environment.

This can be seen in the requirements of the Marine Strategy Framework Directive (MSFD) to achieve and maintain Good Environmental Status (GES) for the European Seas and the Nature Restoration Regulation (NRR) for restoring, and where needed, re-establishing, habitats and species. The NRR requires member states to restore 20% of degraded marine habitats by 2030, 60% by 2040 and 90-100% by 2050.

REDRESS
RESTORING AND REBUILDING THE DEEP SEA

Numerous restoration measures along a restorative continuum (Gann et al, 2019) are available to countries and EU Member States (MS) to achieve these targets and the targets set by the UN Decade on Ecosystem Restoration. Measures include reducing pressures, restricting the intensity and temporal and spatial footprint of activities to keep within levels compatible with a good status, leaving space for nature to recover and by combining these with active interventions to accelerate recovery. Many countries around the world have already been engaged in marine restoration research and implementation at various scales for different habitats and habitat forming species. Despite its significance the topic has just starting to make headlines in the European press reporting on success stories, e.g. for seagrass or oyster reef restoration.

International teams of experts, including in the EU projects REDRESS, CLIMAREST and MERCES, have demonstrated the effectiveness of marine ecosystem restoration interventions conducting a meta-analysis on 764 active restoration interventions across a wide range of marine habitats worldwide (Danovaro et al., 2025).

Results show that marine ecosystem restorations have an average success of ~64% and that they are: viable for a large variety of marine habitats, including deep-sea ecosystems; highly successful for saltmarshes, tropical coral reefs and habitat-forming species such as animal forests; successful at all spatial scales, so that restoration over large spatial scales can be undertaken using multiple interventions at small-spatial scales that better represent the natural variability, and scalable through dedicated policies, regulations, and financing instruments. Restoration interventions have been effective even in areas where human impacts persisted, demonstrating that successful restoration actions can be initiated before all stressors have been removed. These results demonstrate the immediate feasibility of a global 'blue restoration' plan even for deep-sea ecosystems, enabled by increasing availability of new and cost-effective technologies.

This is the challenge for the European REDRESS project (coordinated by Prof. Roberto Danovaro, UNIVPM), aiming at restoring and rebuilding the deep sea https://redress-project.eu/

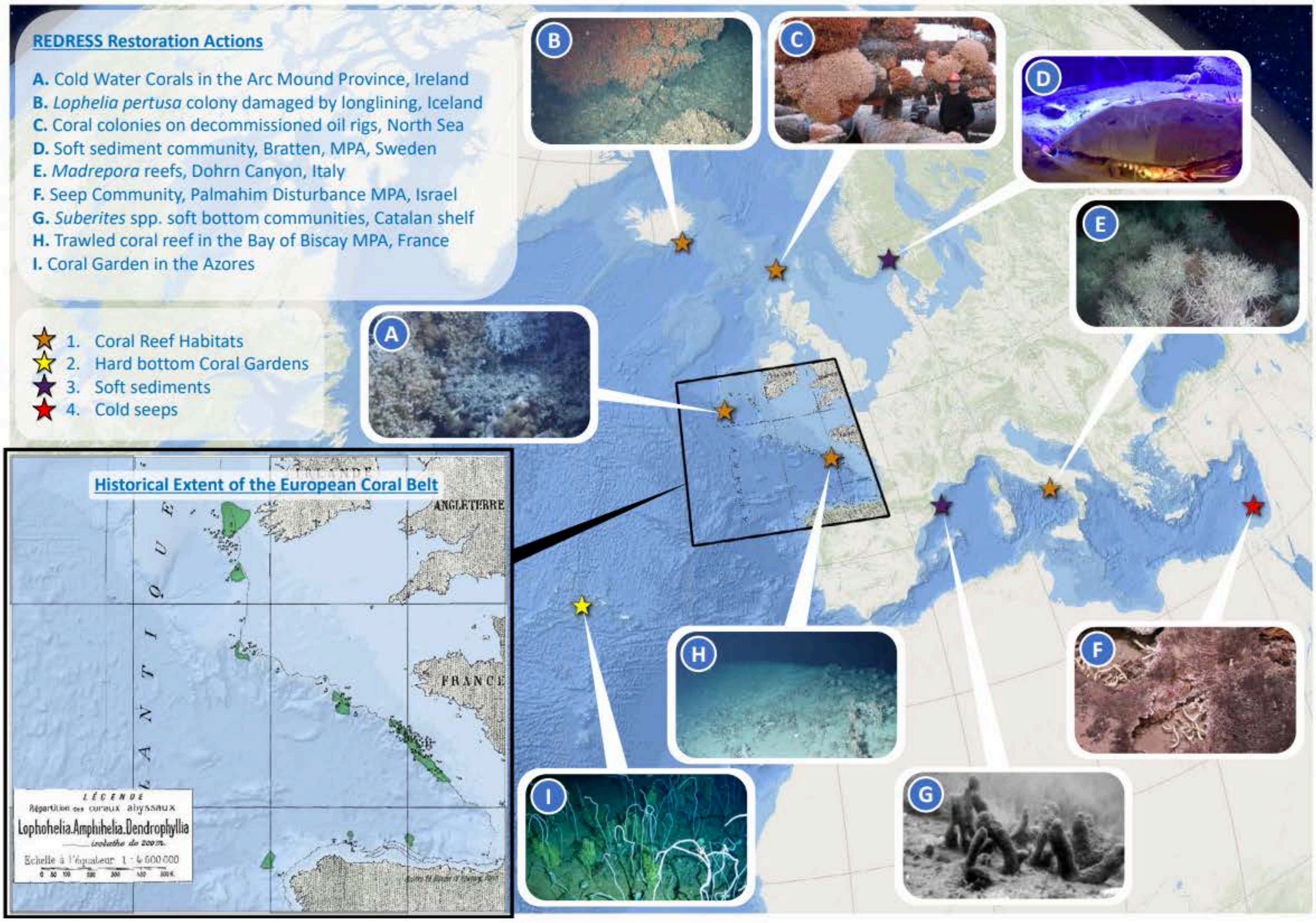
REDRESS aims to demonstrate the feasibility, sustainability, and value of deep-sea ecosystem restoration and provide public authorities with solutions to plan and upscale restoration operations. The REDRESS project will provide a new vision of ecosystem restoration in European deep seas and contribute to a roadmap for the European Green Deal. Major work strands include: prioritization of active deep-sea restoration interventions in a climate change scenario, development of innovative approaches for deep-sea restoration of vulnerable habitats in a range of cases and interventions (https://redress-project.eu/restoration-interventions-and-technologies/), reviewing and combining innovative and cost-efficient technologies to monitor deep-sea passive and active restoration efforts, enabling deep-sea ecosystem restoration by investigating socio-economic costs, benefits, and financing of deep sea restoration, recording perceptions and stakeholder views, assessing deep-sea restoration governance arrangements and enabling and constraining mechanisms and conditions to support restoration interventions, working on increasing technological and societal readiness levels, mapping deep-sea restoration industries in a socio-economic and governance perspective as well as providing tools empowering society and governance to support sustainable and effective marine restoration activities in the mid- and long-term.

Schematic of REDRESS Work Packages to illustrate how the various aspects synergise to provide a new vision of ecosystem restoration in European deep seas and contribute to a roadmap for the European Green Deal.

REDRESS
RESTORING AND REBUILDING THE DEEP SEA

HORIZON-CL6-2023-BIODIV-01-6
REDRESS project: N. 101135492
01.02.2024 - 31.01.2028

ONGOING PROJECT



ONGOING PROJECT

REDRESS works with 12 pilot sites across Europe in the Atlantic and Mediterranean targeting cold water corals, coral and sponge gardens, soft sediments and seep communities. In some sites this includes collaborative work with the fishing and offshore industries. The interventions include utilising 'wedding cake' type 3-D printed eco-reefs (and comparisons with other designs) to restore the deep-sea coral belt (Figure 1 & 2), species transplantations (e.g. on the eco-reefs) and advanced badminton bio-release methods for hard-bottom coral garden habitats (octocorals, sponges) and soft-bottom habitats (sea-pens, sponges).

Figure 1: REDRESS scientists testing the "Wedding cake" Eco-reefs, the 3D structures.

The REDRESS Spatial Data Infrastructure (https://redress-project.eu/redress-resources/), which follows the Open Science and FAIR Principles, includes a Geoportal as the key sharing point where partners and the public can visualize and navigate the collected spatial data during the project, and a synthesis of the past and current knowledge on deep-sea habitat degradation and a dedicated Metadata catalogue of REDRESS products providing information such as authors, sources, keywords, extent, data policy, link for download, and digital identifiers.


Figure 2: Small wedding cake ecoreef designed by D-shape, funded by Project REDRESS, successfully deployed on a coral mini-mound at a Canyon's Marine Coastal Zone.

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SHORT ARTICLE

It takes a village to understand nature: Why should environmental scientists support Marine Citizen Science?

Dorota Kołbuk

Postdoctoral Research Fellow,
University College Dublin

Marine Citizen Science (MCS) is a term encompassing activities where members of the general public, in collaboration with professional researchers, collect and/or analyse data relating to marine environment. Examples include casual recording of marine and coastal biodiversity during beachcombing, diving, angling, fishing, etc.; "one-off" events like a BioBlitz; or more structured approaches, like regular monitoring and recording changes within a selected area, e.g. particular beach, dune complex, or saltmarsh.

Photo from the field by Dorota Kolbuk

There are multiple benefits of MCS, starting with contributions to scientific knowledge. From registering presence and distribution of invasive species to tracking populations and human impacts, MCS offers a cost-effective method of environmental monitoring, and a potential support in evidence-based decision making. Importantly, MCS is a two-way process: by participating in citizen science projects and working together towards shared goals, individuals are empowered to become stewards of the marine environment, which contributes to positive behavioural change and strengthens the sense of community.

Photo from the field by Dorota Kolbuk

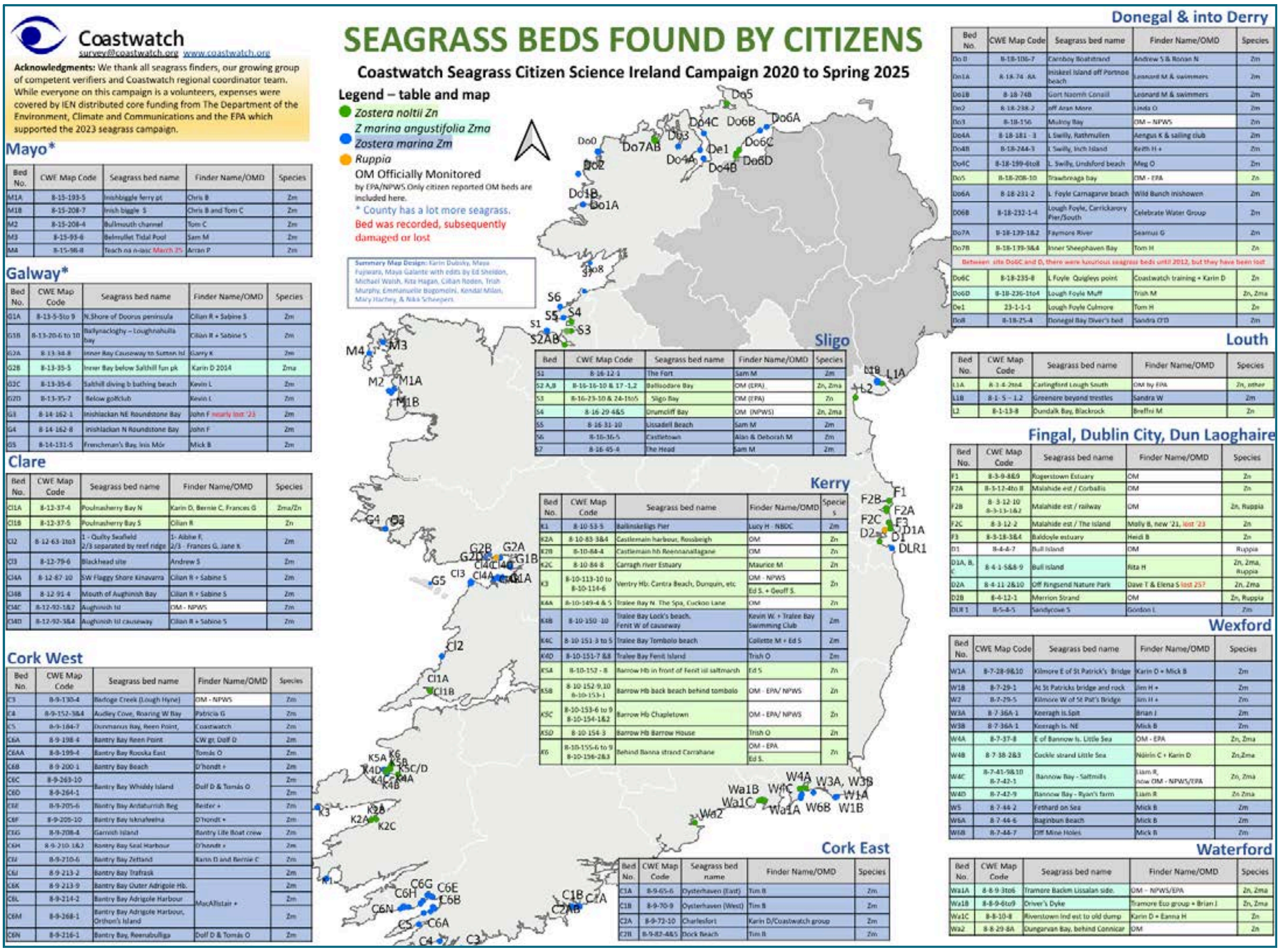
In Ireland, where I am based, there are several MCS-oriented programmes that increase environmental awareness while gathering useful data. For example, Coastwatch Ireland has been mapping and monitoring Irish seagrass beds, many of which were found by citizen scientists. Those contributions are included in wider distribution and environmental condition studies, a first step in conservation of this ecologically important habitat.

Another interesting example comes from the Explore Your Shore! Programme, launched in 2019 by National Biodiversity Data Centre (NBDC) and funded by Environmental Protection Agency (EPA), which has largely contributed to an increase in submissions of marine species records to the NBDC database (from less than 2,000 contributions per year between 2014-2019 to almost 8,500 in 2024 alone; source: D. Wall, NBDC).

The programme allows for different ways of engagement, from casual submissions to monitoring favourite rockpools. Focused on collecting baseline data of intertidal species and assessing their capacity as indicators of climate change and water quality, the programme is already providing data for scientific studies.

Having highlighted the potential of MCS, I would like to share now some ideas of how professional scientists can actively support these initiatives. A practical example comes from the Horizon Europe-funded MARBEFES project, in which I am currently involved. Since 2023, MARBEFES has been organising Bioblitzes – large, coordinated events which aim to capture a "snapshot" of local biodiversity within a strict timeframe, usually up to 24 hours.

Coastwatch Seagrass Citizen Science Ireland Campaign 2020 to Spring 2025



SHORT ARTICLE

"The enthusiasm and curiosity of our participants showed us just how much needed these engagement activities are."

In August 2025, my colleagues from University College Dublin (UCD) and I had the pleasure of organising such an event in Dún Laoghaire (Co. Dublin), with the invaluable support of several partners and local authorities. A team of ecologists, student volunteers, and over 60 enthusiastic citizen scientists came together to document as many species as possible along a stretch of coast between Seapoint and Forty Foot, where habitats range from intertidal mudflats to rocky shores with rockpools.

Despite the increasingly rainy weather, we have led four guided walks to the shoreline, giving everyone the opportunity to search for coastal and marine species and to seek assistance with identification. Each observation was then submitted to the NBDC database, contributing valuable data to national records. For our younger participants there was an additional fun activity: a seashore bingo with prizes. The enthusiasm and curiosity of our participants showed us just how much needed these engagement activities are.

While events like BioBlitzes are rewarding and enjoyable, it is important to acknowledge that they require significant time and effort from organisers/researchers – resources that are often stretched. Opportunities for involvement on a smaller, manageable scale include for instance registering one's interest with local authorities, biodiversity officers, or NGOs to deliver guided walks or taxonomic identification workshops.

Photos from the field by Dorota Kolbuk

It is also vital to keep social inclusion at the centre of your initiatives. By embracing engagement and inclusivity, scientists can help foster a culture of shared stewardship of our marine environments.

Photo from the field Courtesy of Nika Scheepers (Coastwatch Ireland).

SHORT ARTICLE

Photo from the field Courtesy of Nika Scheepers (Coastwatch Ireland).

While volunteering with Coastwatch Ireland, I organised a few guided walks to educate citizen scientists on how to survey the shore: record observed species, monitor water quality with simple nitrate kits, and track litter on the beach.

Another way of supporting citizen science is helping with validation of citizen science records, thus ensuring the collected data is robust and useful, or contributing as an expert in a biodiversity hackathon.

Before developing your own citizen science initiative, it is worth getting familiar with best practices – a perfect place to start are the Ten principles of citizen science, developed by the European Citizen Science Association (or ECSA – the author finds the acronym similarity quite amusing).

ecsa | European Citizen Science Association

Ten principles of citizen science

Citizen science is a flexible concept which can be adapted and applied within diverse situations and disciplines. The statements below were developed by the *'Sharing best practice and building capacity'* working group of the **European Citizen Science Association**, led by the Natural History Museum London with input from many members of the Association, to set out some of the key principles which as a community we believe underlie good practice in citizen science.

Ten principles of citizen science link.

All of the above is written from an academic perspective, but none of the above would be possible without the non-academic community.

The author would like to thank citizen/community scientists working and caring for the Irish coasts. Special thanks for supporting MARBEFES BioBlitz go to Dave Wall (NBDC), Martina O'Brien (DLR CoCo), Muriel Rumball (INSS), Karin Dubsky (Coastwatch), and IOPAN.

MARBEFES
MARine Biodiversity and Ecosystem Functioning leadig to Ecosystem Services MARBEFES

About the Author:

Dorota Kołbuk is a Postdoctoral Research Fellow at University College Dublin. Her main areas of research are marine ecology and paleobiology. Currently she works in the Horizon Europe project MARBEFES, where she studies how marine biodiversity translates into ecosystem services. She also collaborates with Coastwatch Ireland to promote citizen science activities.

Photo from the field by Dorota Kolbuk

SHORT ARTICLE

Assessing the environmental status of the western Mediterranean Sea

Ben Möller, Miquel Ortega, and Marta Coll

Institut de Ciències del Mar (ICM-CSIC), Passeig Marítim de la Barceloneta 37-49, E-08003 Barcelona, Spain

Abstract

This work investigated the effect of anthropogenic pressures on the environmental status of the western Mediterranean Sea. It presents an integrated assessment of environmental status within the framework of the Marine Strategy Framework Directive (MSFD). The Nested Environmental Assessment Tool (NEAT) was used to combine an extensive amount of measured and modelled data.

The results showed that the western Mediterranean does not achieve Good Environmental Status (GES) on a basin-wide scale, with moderate ecological status across all sub-regions. Basin wide trends were observed with MSFD descriptors Biodiversity and Seafloor integrity scoring the lowest. The study represents a step forward towards a standardized methodology for evaluating marine environmental status. Integration with pressure assessments, will be essential for achieving the MSFD's objectives in the western Mediterranean Sea.

Introduction

My thesis was conducted at the Institut de Ciències del Mar (ICM-CSIC) under the supervision of Dr. Marta Coll and Dr. Miquel Ortega and contributed to the activities of the GES4SEAS project. One of the project's key objectives is to support the European Union's goal of achieving Good Environmental Status (GES) across all European seas. Achieving GES in European seas is challenging given the high degree of exploitation these systems experience.

The Marine Strategy Framework Directive (MSFD) provides the main policy framework for achieving GES through Ecosystem-Based Management (EBM), which aims to ensure that cumulative human pressures do not degrade marine ecosystems while contribution benefits to people (Pascual et al., 2017). A key requirement for the success of EBM is the reliable assessment of environmental status (Borja et al., 2024).

The assessment of environmental status comes with its own set of difficulties and is further complicated through the diversity of Europe's marine systems (Hummel et al., 2015). The MSFD is structured around 11 qualitative descriptors covering both anthropogenic pressure and ecological status which are subdivided into specific criteria, all requiring individual assessment of GES (European Commission, 2023).

Extensive work has been conducted to create measurable indicators each giving insights on the status of a different aspects of the ecosystem. But a further challenge is how to aggregate and integrate these indicators given their multidimensional origin (Borja et al., 2024).

SHORT ARTICLE

Methods

NEAT employs a structured, hierarchical approach for its environmental status assessment (Berg et al., 2019). The study area was divided into 14 Spatial Assessment Units (SAUs) corresponding to General Fisheries Commission for the Mediterranean geographical sub-areas, which were evaluated using indicators, each representing a specific ecological aspect (e.g., species mortality through fishing). To align the method with the MSFD, each indicator was linked to an ecosystem component and MSFD criteria forming a unique combination. Each SAU was classified based on the combined status of all MSFD criteria, which was determined by aggregating the status of the associated indicators. To enable standardized comparisons, NEAT normalized lineally all indicators on a unified scale of 0–1 (where 1 represents optimal conditions and 0 represents the poorest). The segmentation aligned with the MSFD's ecological status classification (Bad: 0–0.2; Poor: 0.2-0.4; Moderate: 0.4–0.6; Good: 0.6–0.8; High: 0.8–1). GES was achieved when the values exceeded a threshold of 0.6. The successful application of NEAT required the selection of relevant indicators for each criteria, the establishment of thresholds for GES and the availability of regional data (Borja et al., 2021). Indicator and threshold selection was based on previous assessment and regional research and was adapted to the available data. Both measured and modelled data were used.

Results

Results indicate that the western Mediterranean Sea does not reach GES and is classified as in moderate ecological status. The worst performing indicators were associated with seafloor integrity and biodiversity.

In contrast food webs was the only descriptor that achieved GES basin wide (Figure. 1). The worst performing criteria were those related to habitat condition, by-catch, abundance of baleen whales and fish biomass, while high NEAT values were obtained for abundance of marine turtles and toothed whales, diversity and abundance of trophic guilds and habitat loss. The worst performing subregions were the Sothern and Northern Alboran Sea (GSA1 and GSA3, 0.5 and 0.53), Corsica Island (GSA8, 0.5) and Southern Italy (GSA16, 0.51), while the Tyrrhenian Sea (GSA10, 0.6), Western Sardinia (GSA11.1, 0.64) and Northern Tunisia (GSA16, 0.63) achieved GES. However, even in these regions roughly half of all criteria were classified as below GES. The amount of indicators used for status assessment varied with subregion but for each GSA a robust scope of at least 38 indicators was utilised (Fig. 1).

Discussion

While this thesis provides a holistic and detailed assessment of environmental status across MSFD criteria, it is not yet fully aligned with the latest MSFD guidelines due to the different strategies of aggregation used in the MSFD context (European Commission, 2023). Nevertheless, the results consistently indicate that the western Mediterranean Sea does not achieve GES, in agreement with previous partial assessments of environmental status (Fraschetti et al., 2022; Nikolaou et al., 2025) and analyses of cumulative pressures (Micheli et al., 2013).

Areas exposed to high cumulative pressures (Micheli et al., 2013), such as the Alboran Sea, exhibit the lowest ecological status, supporting evidence that cumulative pressures can hamper the achievement of GES (Korpinen et al., 2021).

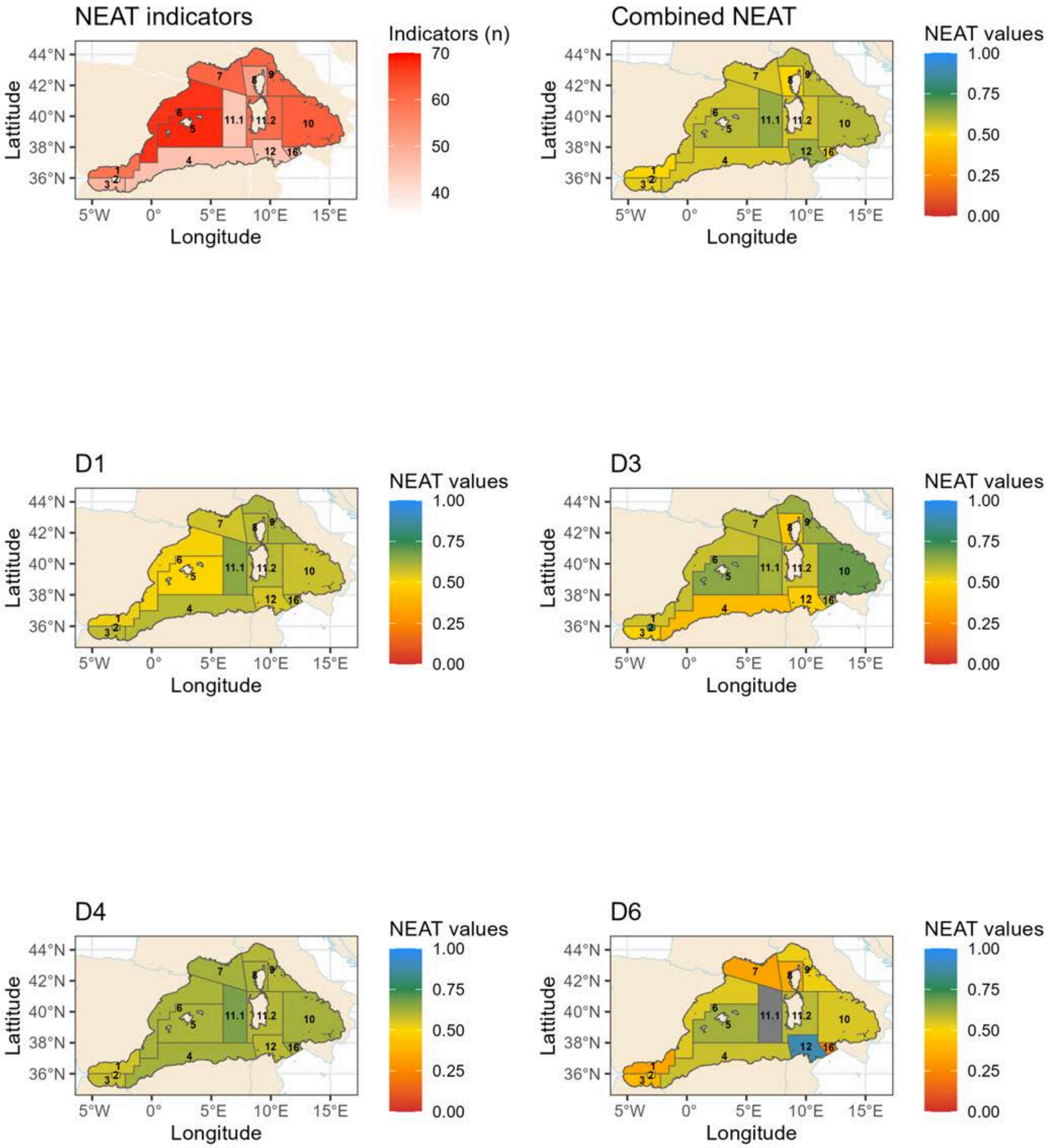


Figure 1: Number of assessed NEAT indicators per GSA (top left), combined result of NEAT assessment (top right), NEAT assessment D1 (middle left), NEAT assessment D3 (middle right), NEAT assessment D4 (bottom left) and NEAT assessment D6 (bottom left). NEAT status classes bad (0-0.2, red), poor (0.2-0.4, orange), moderate (0.4-0.6, yellow), good (0.6-0.8, green), and high (0.8-1, blue) were assigned based on the respective NEAT value. The GSA areas are indicated by the numbers.

A strong link was identified between fishing pressure and its effect on biodiversity (by-catch, fish biomass) and seafloor integrity (habitat disturbance) criteria substantially driving the ecological status of the region. This is in line with observations that fishing remains a widespread and significant pressure in the western Mediterranean (FAO, 2023). Combined these results suggest that the current level of protection is insufficient to reach GES.

The study supports calls for better-enforced Marine Protected Areas (MPAs), including the establishment of fishery-prohibited and no-trawling zones and a better management of fishing pressure (Fraschetti et al., 2022; Castro-Cadenas et al., 2025), together with complementary measures in other areas such as an improvement of marine pollution management.

Given that the Mediterranean Sea is bordered by both European and African nations, stronger regional cooperation and transnational management, as facilitated by the General Fishery Commission of the Mediterranean Sea and the Barcelona convention (UNEP, 2024) are essential to achieve basin-wide GES, particularly in the context of increasing pressures from climate change (Hassoun et al., 2025).

About the Author:

Ben Möller is a recent graduate from the University Algarve, where he finished the master of science program Marine and Coastal Systems. He conducted his master thesis at the Institute of Marine Sciences (ICM-CSIC) under the supervision of Dr. Marta Coll and Dr. Miquel Ortega.

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STUDENT GRANT AWARD

Systematic Map: Methods of identifying and analysing pathways of marine invasive non-native species spread

Elinor H. Spencer*; Rebecca J. Giesler; Lauren H. McWhinnie; Jenni E. Kakkonen; Elizabeth J. Cottier-Cook

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Introduction

Marine non-native species (NNS) have been recognised as one of the most significant threats to marine biodiversity by the Convention on Biological Diversity1.

To mitigate or prevent economic, ecological or human health impacts from NNS, there should be frequent monitoring of NNS presence in areas that are most likely to receive arrivals and the pathways by which NNS spread should be traced. This can inform how NNS are introduced to new areas. Marinas and harbours on the coast are useful sites to monitor as boat traffic is a significant vector of NNS spread.

Recently, the preliminary results of a systematic map and some very early Scotland-wide NNS survey results were presented in poster format at the International Conference on Marine Bioinvasions (ICMB) XII, in Madeira, with the help of funding from ESCA.

The ICMB is a conference which brings scientists from across the globe to present their research and to discuss the pervasive issue of marine bioinvasions. The biennial ICMB presents a platform for early career researchers, like myself, to mix with scientists and policy makers who have long been experienced in marine bioinvasion research. The next conference is due to be held in South Africa, in 2027.

Research Focus

A research objective is to trace pathways of NNS spread from Scotland to vulnerable sites, such as remote islands and the Arctic. A systematic map was carried out to collate all existing research on NNS spread pathways so that the current state of NNS pathway research could be highlighted. A systematic search combining NNS pathway and vector keywords and search terms were conducted across key bibliographic search engines and databases. Following PRISMA guidelines (2020), the search results were uploaded to a database. Duplicate records were removed, and the remaining records were assessed against an inclusion and exclusion criteria over two rounds of review.

Systematic Map Preliminary Results

After reviewing the full text of 300 included articles, 56 records were approved to meet the inclusion criteria for the systematic map research question. From the results, it was found that there is a geographical bias in pathway research.

From the very early stages of systematic map analysis, most pathway research was conducted in the Mediterranean US & Canada, followed closely by the Mediterranean.

There was a geographical gap in the European Arctic, Scotland, remote UK islands and the Tropics. Of the UK and Ireland research, most records were found to be from Ireland.

Regarding the methods applied to identify pathways of NNS spread, most approaches were based on assessing biofouling of marina surfaces, boat hulls and associated equipment. Ballast water was previously a focus when identifying pathways, however recognising that recreational boats are a significant pathway, hull fouling is emerging as a more popular assessment of pathways. Other approaches have been applied, such as genetic testing near to busy boating areas, marine litter fouling assessments, dispersal modelling of larvae and litter, epidemiological models and mapping boat traffic and their routes.

Other approaches have been applied, such as genetic testing near to busy boating areas, marine litter fouling assessments, dispersal modelling of larvae and litter, epidemiological models and mapping boat traffic and their routes.

Most of the methods applied to identifying NNS pathways aimed to identify pathways with an element of assumption, based on boat network analysis and NNS characteristics – whether they are more likely to take a hull fouling or ballast pathway. Few studies traced NNS from port to port as this is time and financially expensive. Pathway research conducted on a global scale followed commercial shipping nodes or ports of call – assuming NNS could be transferred via these routes. Some papers incorporated environmental matching as a method of assessing likely viable pathways. Pathway research on a smaller scale focussed on recreational boating networks locally and to nearby regions. In summary, few papers investigated pathways that could be linked together i.e ballast deposit and stepping stones from there onwards, such as marine litter and ocean current larval dispersal. There are examples where pathways have been traced to remote islands, such as Madeira, Shetland, and islands in New Zealand. Secondary spread has also been emerging as a research focus over the past two decades, however a knowledge gap still remains in tracing secondary spread between islands harbours within a country.

Scotland-Wide marine NNS survey

A month-long Scotland-wide NNS survey was carried out across over 30 marina sites from August to September this year. Together with my PhD supervisors, Rebecca Giesler, Jenni Kakkonen, Elizabeth Cottier-Cook, and two volunteers, Erin and Iona, we conducted rapid assessment surveys (RASs) at each of the sites.

These surveys lasted from between an hour to almost four hours for some of the larger sites. We captured underwater video footage beneath the pontoons to combine with pictures. Any biota that looked suspicious or showed a resemblance to a NNS, was collected and preserved for identification in the lab. Voucher specimens were collected for evidence if new NNS introductions to a site were found. The number of sites visited Scotland's largest baseline NNS survey

Figure 1: Scraping equipment is an effective way to sample from marinas.

conducted so far. This baseline survey aimed to update any previous NNS records and to collect data at any sites that had not been previously surveyed. New sites included several remote island marinas. Less frequently surveyed sites in the far North of Scotland were also included.

The results from this survey are still to be finalised. From the initial comparisons with previous surveys, there were several notable new marine non-native species introductions to Scotland and new sites in Scotland.

There is an overall range-expansion in most of the NNS previously recorded in Scotland. This could likely be attributed to the increasing connectivity between marinas in Scotland, with popularity of recreational boating on the rise.

The pathways which facilitate NNS secondary spread will be the next focus of this PhD.

By examining the pathways of secondary spread, preventative measures can be implemented before NNS arrive to new sites. The NNS distribution across Scotland can act as an early warning system. This data could help to inform any future biosecurity management.

Figure 2: A buoy that was pulled up at an island site. There are several non-native species present; Schizoporella japonica, Watersipora subrata, Tricellaria inopinata and Bugula neritina

Acknowledgements

I would like to thank the Estuarine and Coastal Science Association for granting the Charles Boyden Award towards the presentation of this research. Without this grant, travelling to a key conference such as ICMB would not have been possible, and it has proved to have been hugely beneficial to attend.

To find out more about the Charles Boyden awards, please [visit the link here.](#)

SHORT ARTICLE

BRIDGE: Bioinvasion Research Integration across Dynamic Global Ecosystems

Amy Freestone, Ingrid Watson, & Martin Thiel

Smithsonian Environmental Research Center (SERC), Edgewater, USA

Marine biodiversity and non-native species are substantially under-sampled relative to other biomes, creating gaps in knowledge that limit biosecurity actions to prevent invasions. Scientific networks are working to reduce the spread and impact of marine invasive species and conserve marine biodiversity more broadly, but coordination and collaboration among these networks is needed to address critical knowledge gaps that hinder marine invasion science at the global scale.

To address this need, the Smithsonian Institution recently launched the BRIDGE program (Bioinvasion Research Integration across Dynamic Global Ecosystems).

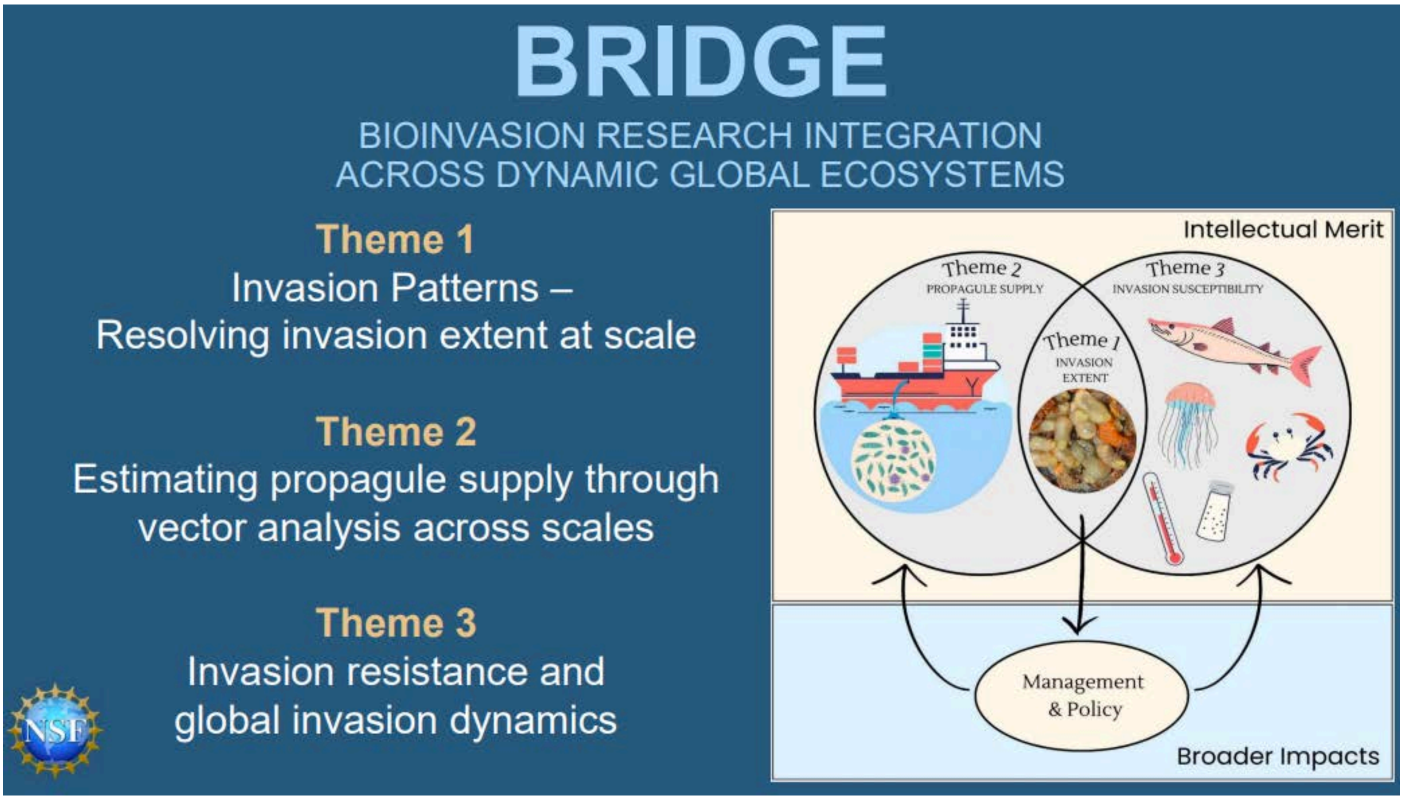
Funded by the U.S. National Science Foundation (NSF) AccelNet program, BRIDGE provides a platform for collaboration and communication across regional and global marine science and bioinvasion networks, promotes a standardized framework and shared protocols, and expands capacity to advance a unified assessment of marine invasions across Earth's oceans. Current BRIDGE collaborating networks include: Eastern Tropical Pacific Marine Corridor (CMAR); International Council for the Exploration of the Sea (ICES), WGBIOINV (Working Group on Marine Bioinvasions) and Working Group on Ballast and Other Ship Vectors (WGBOSV); Coastal Ocean Marine Biosecurity International Network of the Americas (COMBINA); Global Approach in Marine Ecology (GAME); Marine Biodiversity Observation Network (MBON); NOAA's National Estuarine Research Reserve System (NERRS) and National Marine Sanctuaries; MarineGEO; and the Arctic Council.

The three BRIDGE research themes (see the figure) are: 1) resolving invasion extent at scale; 2) estimating propagule supply through vector analysis across scales; and 3) understanding invasion susceptibility. BRIDGE is co-designing methods for standardized, efficient non-native marine species detection, and increasing capacity and available tools for data management. Focused activities will develop integrated measures of vector dynamics to estimate propagule supply across scales and identify key opportunities for collaborative experiments to diagnose underlying mechanisms that shape invasion outcomes and improve detection efforts. Through workshops, training courses, and scientific exchanges, BRIDGE will catalyze research in marine invasion science and mobilize this science into action.

Register for BRIDGE Virtual All Hands Meeting

BRIDGE will host our first annual Virtual All Hands Meeting on April 29, 2026 (*registration link*). Members of BRIDGE networks and anyone working on marine bioinvasions are welcome, including students, post-docs, and scientists.

SHORT ARTICLE



BRIDGE Training Course and Fellows Exchange Opportunities

Currently BRIDGE is seeking applications for the first Training Course on the detection of non-native marine species, which will be held from 21 to 24 September 2026 at the Smithsonian Environmental Research Center in Edgewater, Maryland, USA (application deadline: 13 March 2026).

This course is tailored for people actively working in marine invasions biology, including graduate students, post-docs, technicians, and scientists. Early career professionals are encouraged to apply. For links to apply: https://s.si.edu/45HBTxW

BRIDGE is also developing an annual Fellows Exchange program, where advanced bioinvasions scholars will visit the labs of BRIDGE collaborators starting in 2027, to learn specific techniques. More information coming soon.

We continue building the BRIDGE program and are open to additional participation. A BRIDGE website is currently under development.

For more information about BRIDGE, contact Program Coordinator Ingrid Watson at BRIDGE@si.edu.

BOOK REVIEW

Philippe Goulletquer: Marine Biological Invasions: Ecology, Impacts and Management

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University of Hull

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The author, Dr Philippe Goulletquer, has published widely on marine invasive and alien species (IAS). As a French author, in this concise book of 120 pages, in 7 chapters which cover current knowledge, methods of introduction, impacts, management and research needed, he gives many examples from France and French overseas territories. Indeed, one gets the impression that this might have been written as a report on IAS for France and the French territories and then made into a worthwhile book thereby having a greater reach.

It is good to see there are 200 references and that the book must have been produced quickly as there are references to information up to September 2025. It is good to see that there are links to electronic resources and that the book is available as an Open Access e-version (see the website Marine Biological Invasions - Goulletquer - Pelagic Publishing - 9781784276553).

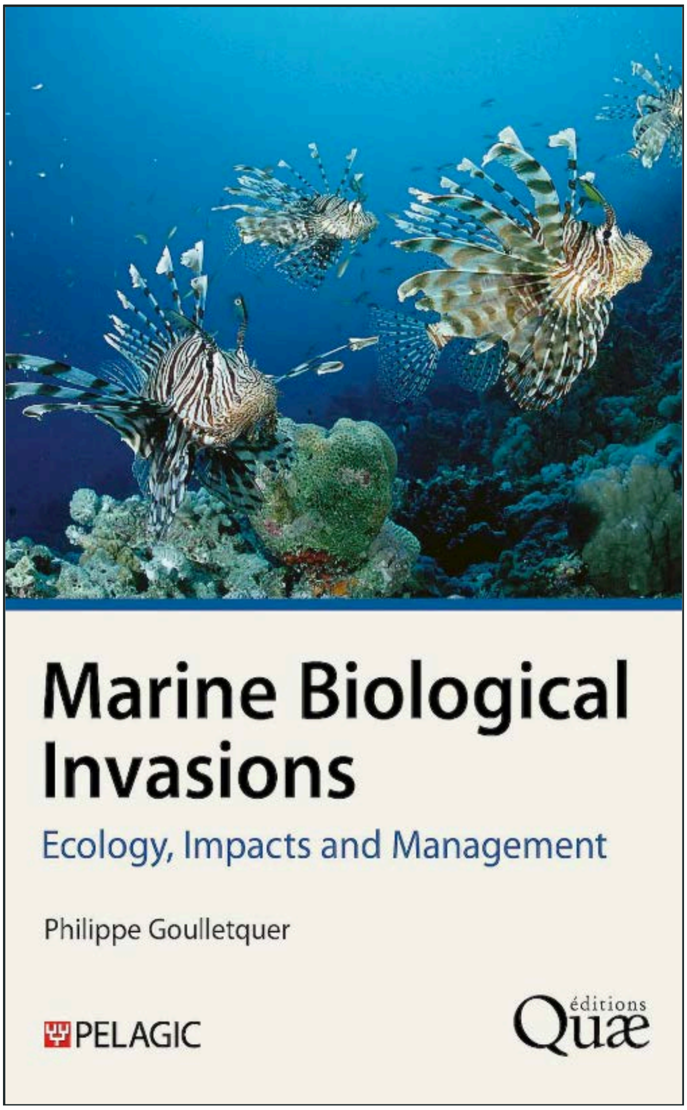
The book gives some mention of the plethora of terms used in the field and uses terms interchangeably – IAS, invasives, exotics, aliens, etc., although it needs more on semantics and terms used including the use of biological pollution (see Olenin et al., 2024). It gives interesting historical references to introductions and control methods and contains many good worldwide examples. However, it shows the central challenge that the marine area is less studied and that while eradication can occur on land and perhaps in freshwaters, this is not the case in the sea – the prevailing wisdom is that once an IAS is detected in the sea then it is probably established. The discussion rightly touches, albeit briefly, on the importance of the Ecosystem Approach in marine integrated management. It emphasises that managing marine IAS is a greater challenge then on land, or even in freshwaters, and therefore prevention is better (and perhaps the only option).

Hence, a constant message in marine IAS is that eradication is rarely possible and there are very few examples - a marine polychaete in the US and the striped black mussel in Australia are given. However, it is not clear whether eradication is only due to management or whether the species finds the new situation unsuitable for successful colonisation. The author considers the mechanisms of control of IAS Control as biological control (none works), direct destruction (ineffectual), or exploitation (if possible). For those interested in solutions, it would have been good to have greater discussion on the governance basis of treating IAS. Therefore, eventually, will we just have to accept the new state and assume the natural system will adjust to the new species?

The book is a very good summary but Dr Goulletquer needs to be more critical and not just repeat the literature. He has reproduced relevant figures but without adding anything or even changing the mistakes (spelling, recent concepts). However, it is disappointing that in a field with such a wealth of recent information, conceptual and empirical models, examples and data, that there are only four figures and no tables!

Rightly there is emphasis on examples of the economic and environmental costs and benefits of IAS and especially on vectors and transmission methods, including the Suez and Panama Canals. Despite this, there is the need to consider force majeure in marine management in that some aspects such as the effects of IAS are outside the control of local marine managers (see Elliott et al., 2015; Saul et al., 2016). Hence, it would have been good to consider joint pressures – that while inter-ocean canals may impact the environment through the delivery of IAS, the net benefit on the planet through GHG reduction from shorter shipping times may outweigh this adverse impact. Hence, the text discusses species spreading as well as deliberate introductions but there needs to be more on climate change, not least the opening up of Arctic shipping passages increasing IAS transmission rates.

In discussing the costs and benefits of IAS, the author talks of cultural ecosystem services (although he means cultural benefits) and also mentions other societal benefits such as reef creation for coastal erosion prevention. The IAS Wakame alga, Pacific oyster and King Crab are given as examples of economic benefits from deliberate introductions but IAS can create problems from unintended consequences



not least in introducing or spreading pathogens.

This book will be of value to all interested in IAS and will have a wide readership. However, while some passages. The author naturally recommends that more and wider monitoring is needed; however, as indicated, dedicated monitoring for IAS is logistically not possible although it could be merged with other surveillance monitoring.

It is good to see the book covers the role of research and it gives some recommendations for research but it would have been better to put these (5 bullet points given + 7 actions from IPBES) as a table or box for emphasis. It should be noted that this field is moving on rapidly as shown by major initiatives such as the EU Horizon Europe project GuardIAS which started in January 2025 and fortunately covers the research suggestions mentioned (see https://guardias.eu and Katsanevakis et al., 2024).

This book will be of value to all interested in IAS and will have a wide readership. However, while some passages have many references, others are unreferenced thereby making them less valuable for students. It is of note that there are other books and collected works dedicated to individual aspects e.g. biofouling, governance, aquaculture, ballast water, shipping etc., but this book gives a very good summary and is well-produced and good value for those who want the physical copy.

Finally, of a particular link to ECSA, the Manila clam is mentioned as a good example of an IAS then becoming commercially important thereby indicating the conflict between conservation and fisheries management. This species is covered in the new special issue in Estuarine Coastal and Shelf Science plus the forthcoming book by John Humphries (the ECSA President).

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SHARING EVENTS, PUBLICATIONS, AND OPPORTUNITIES IN ECSA

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