ECSA 61 POLICY BRIEF

SCIENCE FOR SUSTAINABLE ESTUARINE AND COASTAL ENVIRONMENTS

Recommendations from the ECSA 61 Conference, Scientific Committee and EU Project Leads

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This policy brief highlights how recent scientific evidence, innovative methodologies and good practices from research can be applied to strengthen management, conservation and restoration of estuarine and coastal waters. It underlines the pivotal role of researchers and practitioners in translating knowledge into actionable, place-based solutions. The priority now is to accelerate uptake into policy and practice. To this end, this brief from the Scientific Committee of the 61st Conference of the Estuarine and Coastal Sciences Association (ECSA) sets out sic key messages with concrete actions to strengthen science-based decision-making for estuarine and coastal waters.

Key Messages

1. Elevate Estuarine and Coastal Zones Across Policy Frameworks and Implementation
2. Advance Cumulative Impact Assessments at Land-Sea-Interfaces
3. Scale Next-Generation Monitoring Tools for Coastal Ecosystems
4. Invest strategically in Nature-Based and Nature-Positive Solutions for Coastal and Estuarine Waters
5. Institutionalize Science-Policy-Community Co-Design in Coastal Governance
6. Support Early Career Researchers and Ocean Professionals in their Careers and in Engagement

Why this matters

The European Union is advancing ambitious policy frameworks, including the EU Mission Restore our Ocean and Waters, the Biodiversity Strategy for 2030, the Marine Strategy Framework Directive (MSFD), Water Framework Directive (WFD), Nature Restoration Regulation (NRR), the Ocean Pact, the EU Green Deal and the long-standing Birds and Habitats Directives to halt biodiversity loss, restore ecosystems, and strengthen climate resilience. Emerging policy initiatives are now being discussed, such as the European Ocean Act, dealing with similar objectives.

Coastal and estuarine zones are critical interfaces between land, sea, and society, supporting biodiversity, ecosystem services and human well-being. They play a central role in carbon cycling, flood protection, food provision from fisheries and aquaculture and water quality maintenance. Yet, despite their importance, many gaps persist within these systems in the implementation and operationalisation of EU marine monitoring and assessment frameworks.

These environments are strongly affected by land-sea interactions and face complex and cumulative pressures, including pollution, eutrophication, sedimentation, urbanisation, intensification of agriculture and aquaculture, biological invasions and climate change. Impacts from riverine inputs, nutrient loads, changing salinity gradients and industrial activities interact across river catchments and coastal zones, across ecosystems and administrative boundaries. The wide range of management and governance instruments and approaches remain fragmented across policy domains (water, land, marine). Monitoring systems lack fine-scale, specific indicators.

The investment in conservation and restoration, particularly nature-based and nature-positive solutions such as wetland and saltmarsh creation, and effective marine protected areas, remains insufficient.

Our research, and its advice to policymakers, has generated a rich and practical knowledge base to address these challenges, including tools for spatial planning, cumulative impact assessment, ecosystem monitoring and restoration. The key challenge now is coordinated uptake of these research outputs and their implementation into policy and practice.

Key Messages

The whole science community, including natural, social and political scientists, are essential actors in advancing science-based marine policy, especially at the land-sea interface. Many research initiatives provide powerful approaches and tools - now is the time to identify and apply them. These recommendations stem from many years of expertise and are underpinned by research findings from EU projects. They reinforce existing calls for action and provide concrete new impetus.

1. ELEVATE ESTUARINE AND COASTAL ZONES ACROSS POLICY FRAMEWORKS AND IMPLEMENTATION

Estuarine and coastal zones are dynamic interfaces that are hotspots for biodiversity, ecosystem services and nature's contributions to people, yet they are not sufficiently addressed in marine governance processes such as MSP (Maritime Spatial Planning), MPA (Marine Protected Area) design and restoration targets.

Actions

- Systematically integrate estuarine and coastal waters into the implementation of environmental policies such as the MSFD and, WFD, as well as national MSP and biodiversity restoration frameworks
- Strengthen the inclusion of estuarine habitats in MPA design, restoration targets and spatial planning priorities
- Use case studies and local evidence for design and spatial targets and to guide implementation of legislation
- Adopt a social-ecological perspective that links biodiversity protection with the delivery of societal benefits

Insights and evidence:

- GES4SEAS has created a decision support tool (SEAS4GES) to select the most adequate tools for decision-makers in ecosystem-based management.
- Marine SABRES has proposed a simple social-ecological systems analysis in holistic marine environmental management.
- MARBEFES has developed a framework for plural valuation of marine biodiversity and nature’s contributions to people.
- MarinePlan has highlighted the need to align MSP processes with conservation and restoration actions, co-developed with stakeholders an operational tool to assess ecosystem based MSP in practice and illustrated the identification of priority areas for conservation

Supported by research: Tocco et al. (2024), Alfonso et al. (2026), Smith et al. (2025), Barnard et al. (2026), Galparsoro et al. (2025), Giakoumi et al. (2025), Lukyanova et al. (2025)

2. ADVANCE CUMULATIVE IMPACT ASSESSMENTS AT LAND–SEA INTERFACES

Estuarine and coastal systems support most human activities and therefore endure unique overlapping pressures from agricultural runoff to urban and coastal development and climate stressors. These cumulative impacts require tailored indicators and integrative policy considering the cascaded impacts on these ecosystems cross-cutting economic sectors and knowledge domains. The environmental impacts are currently determined for single activities which are licensed while the cumulative impacts of all activities and all operations are relatively understudied. Current assessment frameworks (WFD and MSFD) remain largely fragmented with limited integration of land-based and marine pressures. As a result, cumulative impacts in estuarine systems are not consistently captured or managed, reducing the effectiveness of measures to achieve good environmental status of areas (e.g. Good Environmental Status, Good Ecological Status, Favourable Conservation Status) and restoration targets.

Actions

- Adopt an ecosystem-based and a systemic framework of analysis to address cumulative impacts
- Develop and implement problem- or solution-driven models and decision-support approaches that explicitly combine pressures from estuaries, coastal zones, and marine systems, aligned with WFD and MSFD requirements
- Integrate social-ecological thresholds in the design of models and policy frameworks to address cumulative pressures, applying the precautionary principle where uncertainties remain significant
- Enable international and cross-sector data sharing to capture the systemic coastal catchment impacts and support integrated assessments across government scales
- Include connectivity, coherence and equivalence in transboundary marine management

Insights and evidence:

- The GES4SEAS project has developed a comprehensive toolbox to support the achievement and management of GES in European seas. It provides science-based instruments for assessing cumulative effects, monitoring ecological components, and exploring management scenarios. It can be used for conducting MSFD assessments, designing MSP measures, or evaluating risks from human activities, in Europe, and elsewhere. See also Policy Brief: Cumulative pressures at sea demand action: Tools to make management possible. https://zenodo.org/records/19085187
- The MARBEFES project has created a toolbox for exploring the multi-pressures facing marine ecosystems and their consequences for ecosystem function and services.
- The Marine SABRES project has created a decision support tool underpinned by a simple social ecological system to assist decision-makers in the management of complex challenges in the marine environment.
- ACTNOW uses what-if scenarios to explore the cumulative impact of multiple drivers on marine biodiversity and ecosystem services.
- DiverSea strongly depends on participatory co-design to identify the drivers and impacts of marine biodiversity loss and introduce stakeholders and local experts to systems thinking.

Supported by research: Borja et al. (2010), de Oliveira et al. (2025), Cardoso et al. (2022), Shubham et al. (2025), Elliott et al. (2023), Kołbuk et al. (2026), Vermeulen-Miltz (2023)

3. SCALE NEXT-GENERATION MONITORING AND MANAGEMENT TOOLS FOR COASTAL ECOSYSTEMS

There is the need for functional tools for ecosystem based management and monitoring that are easily accessible and available in the longer term. Newer approaches such as genomics, autonomisation and high-resolution modelling offer significant potential to monitor more easily and cost-effectively over larger areas.

Actions

- Support implementation of innovative technologies specifically calibrated for estuary conditions
- Provide support for schemes deploying advanced tools (e.g. omics, drones, acoustics, autonomous sensors) in coastal and estuarine waters
- Promote integration of multiple data streams into monitoring and assessment frameworks
- Link the monitoring to suitable archiving and provenance of the data. Ensure that data archiving, interoperability and provenance (FAIR principles) are built into monitoring design
- Support interoperable marine dataspaces, common biodiversity standards, and Digital Twin technologies to enable harmonised monitoring, integrated assessments, and evidence-based decision-making across coastal and marine ecosystems
- Critically evaluate the opportunities and limitations of AI for next generation monitoring

Insights and evidence:
EU-funded initiatives contribute to the development of integrated European observation systems, linking in-situ monitoring, Earth observation, and modelling, and demonstrate that next-generation monitoring is feasible:

- eDNAqua-Plan develops a roadmap for integrating environmental DNA (eDNA) into aquatic monitoring frameworks.
- OBAMA-NEXT develops a toolbox integrating emerging technologies (e.g. remote sensing, eDNA, optical instruments, and citizen science) to generate accurate and relevant information on marine ecosystems and biodiversity.
- DiverSea develops and applies integrated methods and technologies to monitor biodiversity and the drivers of its decline. Using remote sensing, eDNA, autonomous sampling and mapping, indicator-based approaches, monitoring of selected essential ocean variables, and citizen science, DiverSea creates models linking functional biodiversity indicators to ecological status class, environment goods and services. DiverSea visualizes and communicates the data in a cutting-edge science-policy dashboard based on systems thinking.
- MARCO-BOLO has developed an integrated suite of technological solutions for biodiversity observation and mapping, including DNA-based approaches, autonomous multi-sensor monitoring systems, remote sensing, and advanced modelling tools.
- GuardIAS develops an integrated framework for aquatic invasive species surveillance and management, combining AI, early warning systems, eDNA, autonomous robotics, remote sensing, passive acoustics, citizen science, and advanced modelling. By linking next-generation monitoring technologies with risk assessment, decision-support tools, and systematic conservation planning, it enables proactive, adaptive, and cost-effective management of aquatic ecosystems.
- ACTNOW critically appraises marine biodiversity indicators and recommends a suite of measures to capture changes in not only species but also communities and habitats.
- MARBEFES has developed metabarcoding frameworks, technologies for collecting sublethal genetic indicators, explored novel methods for monitoring benthic ecosystem function and created new tools for monitoring ecological, economic and societal value of marine ecosystems.

Supported by research: Bohan et al. (2017), Bourlat et al. (2013), Eguidazu-de la Parte et al. (2025) Katsanevakis et al. (2024), Hillebrand et al. (2025)

4. INVEST STRATEGICALLY IN NATURE-BASED AND NATURE-POSITIVE SOLUTIONS FOR COASTAL AND ESTUARINE WATERS

Coastal and estuarine habitats (e.g. saltmarshes, wetlands) deliver high-value multifunctional ecosystem services and societal benefits, yet remain underfunded and undervalued.

Actions

- Launch earmarked funding for coastal restoration (e.g. saltmarsh creation, wetland rewilding)
- Link restoration outcomes to ecosystem service valuation (e.g. flood protection, carbon sequestration), the delivery of societal benefits (e.g. fish and shellfish resources, water purification and cultural heritage)
- Incorporate restoration from catchment to coast as a holistic system

Insights and evidence:

- ROWER analyzes restoration solutions from catchment to coast
- Marine SABRES has analysed how social-ecological systems can help advance ecosystem-based management and balance biodiversity conservation with economic activities.
- MARBEFES has developed tools to estimate the ecological, economic and cultural value of marine ecosystems, which allows the multifaceted benefits of restoration to be measured in parallel.
- DiverSea provides evidence of the value of seagrass meadows and other coastal habitats/species function as nature-based solutions, delivering biodiversity, coastal resilience, and/or ecosystem services benefits

Supported by research: Buitendijk et al. (2024), Watson et al. (2026), OCEAN & CLIMATE (2021), Moreas et al. (2022), Forsblom et al. (2024)

5. INSTITUTIONALIZE SCIENCE–POLICY–COMMUNITY CO-DESIGN IN COASTAL GOVERNANCE

Strengthen collaborative management and governance by involving local communities, citizen scientists, practitioners and researchers in co-produced science, planning and restoration.

Actions

- Introduce co-design requirements into EU-funded research to ensure early, continuous and meaningful engagements and participation of local stakeholders, communities and scientists.
- Develop multi-actor platforms or field laboratories (e.g. living labs) and participatory models to support adaptive, inclusive and sustainable decision-making.
- Engage local communities in management actions and the implementation of nature-based solutions.
- Encourage related projects to work collaboratively on stakeholder co-design to maximise input from shared stakeholder groups and minimise contributor fatigue.

Insights and evidence:

- MARBEFES integrates stakeholder engagement and co-production approaches to develop its biodiversity and ecosystem functioning/services toolbox.
- Marine SABRES applies transdisciplinary and co-design approaches to enhance marine biodiversity resilience. Marine SABRES and MARBEFES share stakeholder engagement activities and this model is well received by stakeholder groups.
- GuardIAS promotes participatory aquatic invasive species management through citizen science, stakeholder co-design, communities of practice, applied games, and BioArtBlitz events. By engaging communities, practitioners, and managers in monitoring, early warning, and management actions, it advances inclusive and evidence-based governance of aquatic ecosystems.
- DiverSea strongly depends on participatory co-design to identify the drivers and impacts of coastal marine biodiversity and ecosystems loss and introduce stakeholders and local experts to systems thinking. This approach is further strengthened through the integration of citizen science initiatives and targeted capacity development, enhancing community engagement in coastal ecosystem assessment and decision-making.

Supported by research: Norström et al. (2020), Pendleton et al. (2023), Katsanevakis et al. (2024), Verling et al. (2025), Borja et al. (2025)

6. SUPPORT EARLY CAREER RESEARCHERS AND OCEAN PROFESSIONALS IN THEIR CAREERS AND IN ENGAGEMENT

Early Career Researchers (ECRs) and Early Career Ocean Professionals (ECOPs) are essential to the future of marine and coastal science, innovation and governance. However, they face persistent structural challenges, including job insecurity, limited access to long-term funding, high competition for grants and barriers to their inclusion in policy engagement. At the same time, ECRs and ECOPs are well positioned to drive interdisciplinary approaches, innovation and science–policy–society integration, which are critical for addressing complex coastal challenges. Horizon Europe projects provide development opportunities for ECRs and ECOPs. However, their participation is typically based on short-term, project-funded contracts, with limited continuity beyond project lifetimes and such conditions force trade-offs between career and personal lives.

Actions

- Invest in multi-year funding and dedicated fellowship and placement programmes to support sustained participation of Early Career Ocean Professionals in policy engagement. Provide stable career pathways and long-term funding opportunities
- Allocate dedicated funding for ECR-led research and development
- Ensure representation in policy and advisory processes
- Invest in skills, mobility and interdisciplinary training

Insights and evidence:

- The UN Ocean Decade ECOP Programme highlights the importance of supporting early-career professionals to ensure long-term ocean sustainability and innovation capacity.
- Horizon Europe projects (e.g. MARBEFES, Marine SABRES, GES4SEAS, OBAMA-NEXT, GuardIAS) actively involve early-career researchers in modelling, stakeholder engagement, and policy-relevant work, making them central to developing innovative approaches and bridging science, policy, and practice.

LinkedIn Early Career Researchers Community

Supported by research: Satterthwaite (2025)

Strategic Outlook

The science community will support the European Commission and Member States, and international partners facing similar challenges with science-based recommendations and place-based expertise to meet the goals of the EU Ocean Pact, Mission Ocean and Waters, and the Biodiversity Strategy for 2030.

Together, we have the opportunity to strengthen governance by integrating estuarine and coastal systems better into marine policy, planning, monitoring and management. Implementing these six recommendations will improve the coherence and effectiveness of EU policies: It will help to overcome the separation of terrestrial, marine, and coastal approaches through integration. Supporting cumulative impact assessment, innovative monitoring, nature-based solutions, participatory decision-making, and sustained investment in future scientific capacity that will support healthier and more resilient ecosystems, enhance biodiversity and climate resilience, and increase the delivery of ecosystem services and nature's contributions to people.

ECSA 61 Conference Page

Who we are

This brief represents the views of a leading network of scientists, practitioners and managers across Europe and beyond who have contributed extensively to EU-funded research on marine biodiversity, ecosystem services, spatial planning and climate change resilience. These scientists and practitioners facilitate stakeholder engagement in local and national planning, provide real-world baseline and datasets and local expertise, and collaborate in demonstration projects across different ecosystems, regions and contexts.

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Supporting Projects

Imprint

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