SCOR Working Group Proposal

Title:Elucidating THreats tO Sandy beaches: a global synthesis

Acronym:ETHOS

Summary/Abstract (max. 250 words)
The WG intends to gather expertise from different contexts and experiences to elucidate a full picture of the current threats to sandy beaches, extracting viable methods for their monitoring and providing guidelines towards interoperable datasets, finally allowing the scientific community to target threats to sandy beaches on a background of cooperative research. The present situation is in fact characterized by a scatter of data, which do not allow for the synthesis of global patterns in terms of spatial and temporal trends. These trends would indeed be key to face threats to sandy beach functionality posed by human-driven impacts, which often act synergistically. On the other hand, the local dimension is essential for understanding patterns and drivers of this ecosystem. The identification of shared methodologies is therefore key to the study of such multi-dimensionality, allowing also for the progressive integration of a) emerging threats and b) research from different disciplines. To reach its goals, the WG will proceed by aggregating the best available datasets and learning lessons from related methodologies; expanding the research queries with inputs from a representative range of areas and disciplines; accompanying the threats identified with methods for the study of their single and synergistic effects. Actions will hold a strong component of capacity-building by pairing WG meetings with international conferences. Outputs will be open access and accompanied by a communication plan to sustain their broad use and ensure a long-lasting effect of WG contributions.

Scientific Background and Rationale (max 1250 words)

Sandy beaches are globally distributed ecosystems that underpin a diversity of locally and regionally important ecosystem services. These systems are at the land-sea interface and support biodiversity by providing sites for nesting (e.g. turtles), spawning (e.g. fish), foraging and resting (e.g. migratory birds). Additionally, beach sediments filter seawater and cycle nutrients, while sediment, beach-cast wrack and dune systems provide natural shoreline protection. Yet, despite their ecological significance, the ecological functions of sandy beaches are underappreciated, with many considered solely as tourist destinations and recreational assets. Most sandy beaches are managed primarily with respect to their recreational value, and without a strong evidence base on which to assess the efficacy of interventions. (Dugan et al, 2010).

As a consequence, beaches are among the most threatened marine ecosystems due to the combined effects of coastal development and climate change, causing a “squeeze” (Elliott et al., 2019) between increasing urbanization on the landward side and erosion and sea-level rise on the seaward side. This threat is often exacerbated by maladaptive management approaches such as the construction of coastal defense structures (e.g. seawalls, breakwaters) that prevent shoreline retreat in response to sea level rise. At local scales, beaches are also subject to a suite of stressors, including beach cleaning, trampling and off-road vehicle use, plastic and light pollution, nutrient enrichment and unsustainable fisheries

management practices. The research on sandy beach ecosystems is, at present, hampered by a lack of a mechanistic understanding of how sandy beaches respond to individual and multiple stressors at scales of meters to 100s of kilometer. The lack of a clear framework depicting to which extent these stressors could threat sandy beach functionality is a severe gap.

Although a number of paradigms regarding the physical and biological processes that structure sandy beach ecosystems have been have been put forward, the support for these comes primarily from microtidal Southern hemisphere beaches with fine-to-medium sand (McLachlan and Defeo, 2018). Hence, their widespread applicability remains unknown. Other literature points to sandy beach ecosystems displaying considerable small-scale variation in their response to environmental change (Defeo and McLachlan, 2013; Barboza and Defeo, 2015). Research is urgently needed that addresses the response of sandy beach ecosystems to multiple stressors, acting singly or synergistically, with acute or chronic characteristics, over different time scales at local (single-beach unit) to landscape scales.

In order to address multiple-stressor impacts there is firstly need to comprehensively catalogue the full range of stressors to which sandy beaches are exposed, and the scales at which they act. Although a number of reviews on threats to sandy beaches have been conducted over the years (Defeo et al. 2009, Elliott et al. 2014; Fanini et al., 2020), these have primarily focused on climate-change as a driver of beach habitat loss (see Vousdoukas et al., 2020). Stressors associated with climate change need to be integrated with emerging issues such as plastic pollution (Borja and Elliott, 2019) and urbanization-related impacts (e.g. Artificial Light At Night, ALAN), providing a complete and up-to-date framework for research on threats physically eroding the functionality of beaches.

Secondly, there is need to ascertain the scales at which impacts occur for single and multiple co-occurring stressors. Defining the generality of stressor impacts and the scales at which they are apparent is hampered by variation among studies in the way in which units (e.g. beaches) are defined, making cross-study comparisons difficult. Additionally, most of the available literature examines impacts across relatively short time scales, with only few studies encompassing larger spatial and temporal scales (see e.g. Dugan et al., 2013). Despite several papers now putting forward hypotheses about how impacts may propagate across scales (Heery et al., 2014; Scapini et al., 2019) and calls to examine impacts of stressors at the landscape scale (Schlacher et al. 2015), large-scale studies remain rare. Experimental (rather than observational) and mesocosm studies, together with increasing use of molecular and telemetry approaches, provide opportunities for scaling up impact assessments, yet these approaches are rarely applied to sandy beach studies.

A further challenge is that global knowledge of how stressors impact sandy beaches remains limited to a relatively small sub-set of stressors. While the impacts of direct human use of beaches (e.g. trampling, beach cleaning, off-road vehicles, shell-fishery) and of actions to counteract erosion (e.g. nourishment, construction of hard coastal defenses) are relatively well understood, impacts of emerging stressors are not. Studies on plastics remain dominated by those quantifying debris on beaches, rather than the biological impacts of this debris. Predictions, based on research from other ecosystems, as to how artificial light pollution might affect the behavior and food webs of sandy beaches, are yet to be tested. Although these (and other) stressors have been overlooked, it does not mean that they are any less

important. For example, oil spills usually generate short-term investment in clean-up efforts and impact assessments, but their impacts are rarely assessed over longer time scales. Other impacts are severe but localized (e.g. sewage discharge) and the lack of research groups active on the topic at the specific location leaves them invisible to the scientific community.

Indeed, synthesizing research and methods related to the more commonly studied stressors (e.g. beach nourishment) may offer insights about standardized, cost-effective methods and indicators of impact assessment on beaches (see e.g. Peterson and Bishop 2005) that could be applied to the study of other stressors. These reviews of beach responses to individual, well-studied, stressors may also allow the formulation of hypotheses about the scale of impacts of unstudied stressors and how multiple stressors act synergistically.

This WG will (1) develop a comprehensive catalogue of threats to the ecosystem function of sandy beaches and the scales at which they act, (2) compile existing knowledge of stressor impacts to sandy beaches and the methods used to assess them, and (3) integrate this information to develop a framework for progressing our global understanding of how sandy beaches respond to multiple stressors, at a range of spatial and temporal scales, and across a diversity of environmental and socio-economic settings. The outcomes will include a set of protocols which can be used globally, across beach types, to assess the scales at which stressors impact sandy beach ecosystems. These protocols will consider current paradigms and hypotheses, and integrate cutting edge technologies (telemetry, molecular biology, remote sensing) derived from a diversity of disciplines.

This coordinated research effort is expected to provide interoperable data and thoroughly address questions related to changes in beach functionality, finally reconnecting theoretical hypotheses with field and experimental research (Benedetti-Cecchi et al., 2018), thereby generating results of global relevance.

To structure the work around this goal, two main strategies are fundamental:

1) A multi-scale approach, with both threats and best practice management considered at local (single beach), landscape, and regional scales
2) The matching of drivers to specific spatial scales (a distal driver at local scale can be a proximate driver at landscape scale; cross-habitat phenomena such as plastic pollution need to be considered in this light too). This will be achieved using existing data sets and the expertise of WG members.

This SCOR WG will for the first time bring together sandy beach ecologists from across the world. While a number of WG and networks are already in place, they are regional (e.g. European or Latin America level) and so lack a global perspective. A communication and implementation plan will be drafted at a nearly stage of working group activities, allowing the outcomes of the project to be broadly distributed and incorporated with existing and prospective research,now and into the future.

Terms of Reference (max. 250 words)

ToR 1: To identify key threats to the ecological function of sandy beaches, and classify these according to a) their spatial and temporal scale and b) their provision of acute or chronic perturbations. This will include: identifying multiple stressors that may act synergistically, identifying appropriate scales of analysis for beaches, exploring methods for mapping the distribution of key threats across a range of spatial scales.

ToR 2: To effectively disseminate knowledge gained through WG actions to a diversity of stakeholders, globally. A multi-level dissemination plan will be prepared in the early stages of the project.

ToR 3: To carry out a broad survey, through online consultation open to the entire community of researchers working on sandy shores, to identify and assess the efficacy of methodologies that have been applied to study ecological impacts of stressors to sandy beaches and eventually rescue grey literature. This will also facilitate the establishment of a network of users for protocols generated by the WG.

ToR 4: To develop a standardized protocol for assessing threats to sandy beaches, that can be applied globally as well as at regional scales. The protocol will identify key ecological and physical variables to be measured, the scales at which they should be assessed, and will be developed following a review of existing datasets and methodologies.

ToR 5: To identify and harmonize research directions of global-to-local relevance based on an analysis of the efficacy of methodologies used to generate existing datasets, while incorporating the survey results, highlighting integrative approaches.

Working plan (logical sequence of steps to fulfil terms of reference, with timeline. Max. 1000 words)
The proposed time-line for meetings and completion of ToRs (i.e. with the finalization of the related deliverables) is reported below, in months from the beginning of the WG activities.

	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12
Y1	Meeting1				Virtual thematic meeting1						ToR1	ToR2
Y2		Meeting2					Virtual thematic meeting 2			ToR3		
Y3	Meeting3		ToR4			Virtual thematic meeting 3						ToR5

WG activities will span 36 months.

Annual WG meetings, held at the beginning of each project year, will be utilized to plan the work towards each ToR, and delegate responsibilities and tasks to WG members. These will be complemented by virtual thematic meetings (of relevance of particular regions or disciplines) which progress specific ToRs. The composition of thematic meetings will be decided at the WG meeting 1. The dissemination plan (ToR2) will be drafted at the end of year1, setting the background for the survey (ToR3) and for the up-take of WG deliverables. The proposed timing is defined by the fact that the WG will be showcased

by the deliverable related to ToR1, supporting the vision and the actions of the WG.

The WG meetings will, where possible, be held back-to-back with international events (e.g. major conferences) that WG members are expected to attend. This will minimize travel costs and maximize the opportunity for capacity building and dissemination of WG activities through these international events. Details on these events, with which WG might be coupled, are provided below. Please note, however, the events are indicative, as many are on hold (e.g. the IX International Sandy Beaches Symposium) or being rescheduled due to the Covid-19 pandemic. Also, we are aware that funding to research groups and networks is uncertain at this time. Irrespective of travel restrictions or funding shortfalls we believe that the deliverables can be completed in the time-frame indicated.

Given the present Covid-19 situation, its short and mid-term effects on the international travel it is anticipated that WG meetings may need (at least partially) to occur via online platforms. The Spanish participant will provide the commercial Zoom license necessary to host online meetings, and the Greek participant can apply for the use of the remote conference room (an infrastructure planned for meetings between HCMR institutes and field stations across islands). Should the meetings listed below be cancelled or postponed, back-up options will be developed and communicated in a timely manner. The community consultation underpinning ToR3 will be performed online using questionnaires developed by the chairs with feedback from WG members. As a starting point, the relevant community of global sandy beach researchers to be contacted will be identified using the mailing from the XIII International Sandy Beaches Symposium, to which full and associate WG members will add personal contacts.

WG meetings are planned to be held back-to-back with:

- International Sandy Beaches Symposium, Oldenburg, Germany, 2021 dates TBC (WG meeting 1)
- ASLO Ocean Sciences Meeting, Honolulu, Hawaii, USA, February 27-March 4, 2022 (WG meeting 2)
- Estuarine and Coastal Sciences Association (ECSA) meeting 2023, dates TBC (WG meeting 3). As the WG will be entering its third year, the possibility of contributing a symposium or special session to the meeting will be explored.

The work will be coordinated by the chairs, using online meeting platforms as the main channel for collaborating on and coordinating actions. Chairs will be in charge of communication with the SCOR secretariat about yearly reporting, as well as meeting planning. Chairs will also be in charge of balancing the general and thematic perspectives, and promoting the adoption of research protocols and practices to participants. The dissemination plan will be shared among all participants and all those who, during the consultation, expressed interest and capability in adopting the protocols and practices proposed. The plan will be periodically (at WG and node meetings) revised and updated.

Deliverables (state clearly what products the WG will generate. Should relate to the terms of reference. Max 250 words).

The actions of the WG are expected to result in the following deliverables:

D1. One open access publication in the target journal, Journal of Marine Policy (related to ToR1).

D2. One protocol detailing methodologies that can be applied to the assessment of stressor impacts at the global and regional scale (derived from ToR3 and ToR4), developed using information derived under ToR1. To be uploaded on Ocean Best Practices platform, obtaining a doi. To be topic of a webinar or integrative course for graduate students.

D3. One best practices manual (derived from ToR3 and ToR4), to be considered a reference for training (targeting secondary and tertiary students, as well as citizen science groups), that is framed around scientific research questions (related to ToR 3 and ToR4). To be uploaded on Ocean Best Practices platform, obtaining a doi.

D4. One open access publication in the target journal, Science of the Total Environment, or Global Ecology and Biogeography (related to ToR5), with links to protocol and best practice manual (D2 and D3).

Note: ToR2 in itself is not producing a deliverable such a paper in a journal or a manual. However we consider it essential to have a strategy for disseminating the outcomes of this WG and building a network of users of these.

Capacity Building (How will this WG build long-lasting capacity for practicing and understanding this area of marine science globally. Max 1500 words)

This WG will build international capacity in sandy beach ecology and management by:

1) including early career researchers

> This will be achieved through: strong representation of ECRS in the WG; a webinar or course for tertiary students (training next generation) about Threats to Sandy Beaches, likely within the graduate program of Coastal and Ocean System (http://www.cem.ufpr.br/portal/cem_english/), with Dr. Di Domenico as coordinator.

2) establishing a peer-to-peer learning environment among WG members of diverse backgrounds and experiences, and between the WG and the community of sandy beach researchers and managers more broadly

> This will be achieved through: diversity in the composition of the WG; surveying the broader research community on their research perspective to build collective wisdom; pairing meetings with conferences and major international meetings, proposing the topic as a thematic session at conferences [ECSA, WG meeting 3]; sharing the outcomes of the WG with the broader community of sandy beach researchers and managers; building a network of researchers that are ready to capitalize on future funding opportunities

3) developing best practice guides and protocols, that are freely available.

> This includes: identifying cost-effective and robust methodologies that are broadly applicable; identifying opportunities for citizen scientist and school participation in field programs; making

publications and manuals open-access.

Working Group composition (as table).
Full Members– chairs in bold. Asterisks indicate early career researchers.

Name	Gender	Place of work	Expertise relevant to proposal
1 **Lucia Fanini**	F	Crete, Greece	Behavioral Ecology, non-oceanic beaches
2 **Omar Defeo**	M	Montevideo, Uruguay	Ecology of sandy shores, fishery
3 Vanessa-Sarah Salvo	F	Barcelona, Spain	Plastics monitoring and regulation, science-to-policy communication, survey methodology
4 Leonardo Costa*	M	Rio de Janeiro, Brazil	Bioindicators, ghost crabs, REBENTOS network
5 Melanie Bishop	F	Sydney, NSW, Australia	Ocean sprawl, urbanization, World Harbour network
6 Linda Harris*	F	Port Elizabeth, South Africa	Marine conservation and management, spatial coastal ecology, Marine Spatial Planning
7 Kyle Emery*	M	Santa Barbara, California, USA	Nutrient cycling, Long Term Ecological Research Stations
8 Shinji Sassa	M	Yokosuka, Japan	Beach geophysical environment and coastal disasters
9 Maikon Di Domenico	M	Curitiba, ParanàBrazil	Anellidae, MBON-P2P protocol
10 Michael Elliott	M	Hull, UK	Coastal and estuarine ecology, human impacts

Full members of the WG have been selected from the pool of global experts on sandy beach ecology in accordance with the following principles:

- The members come from geographically dispersed countries, from across the globe, which collectively cover the full spectrum of beach geomorphology (i.e. micro- to macrotidal beaches) and biogeography, as well anthropogenic modification (e.g. Rio de Janeiro and Sydney harbor to Southern Crete Marine Protected Areas), and whose jurisdictions offer a spectrum of

approaches to beach management.

- The expertise of the group spans sandy to shingle beaches, island, coastal and estuarine beaches, and highly disturbed to protected beaches.
- The researchers lead or represent (in the case of early career researchers) research groups with a strong track-record of studying human impacts to marine ecosystems, and especially to sandy beaches (e.g. impacts of coastal development, beach cleaning, coastal protection).
- The members are part of global research networks, which will benefit from this project (e.g. MBON-P2P, Dr. Di Domenico; World Harbour Project, Dr. Bishop; Marine Litter Watch, Dr. Salvo).
- The membership includes expertise in beach management (e.g. the experience of Dr. Linda Harris along the South African coast, or the LTERs in California).
- The group is inclusive of early- and mid-career researchers, as well as senior researchers, and has a gender-balanced composition.

Associate Members have been selected based on their expertise in fields (e.g. Dr. Mendez, invasive species); the use of stable isotopes to track trophic connectivity of organisms and organic matter between the beach and the coastal subtidal areas (Dr. Rossi) or methodological approaches of relevance to, but often overlooked, in the study of sandy beaches. For example, the field of Artificial Light At Night (Dr. Maggi) is of relevance to urban beaches, but is seldom considered in their study. Ecological approaches in the field (Dr. Li) provide potential for examining impacts of stressors on connectivity but are rarely applied to sandy beaches. The interoperability of data among disciplines and studies will be addressed at the whole WG level through the inclusion of a modeling expert (Dr. Bozzeda). Dr. Riechers will provide expertise in considering stressors and impacts as proximate and distal drivers in social-ecological systems. The group as a whole will hold expertise to confirm causal relationships between drivers and responses observed at different scales.

Associate Member

Name	Gender	Place of work	Expertise relevant to proposal
1 Francesca Rossi	F	Nice, France	Trophic ecology, experimental ecology
2 Elena Maggi	F	Pisa, Italy	ALAN pollution in coastal environments , GLOW network
3 Yoshitake Takada	M	Chuo, Niigata, Japan	Benthic ecology, islands
4 Maraja Riechers*	F	Lueneburg, Germany	Social-ecological systems, leverage points
5 Xinzheng Li	M	Qingdao, China	Taxonomy, benthic ecology
6 Fabio Bozzeda*	M	Valdivia, Chile	Mathematical modeling, machine learning
7 María Mendez	F	Puerto Madryn, Argentina	Impacts related to human recreation, Invasive species

Working Group contributions (max. 500 words)

As the local dimension is extremely relevant, each participant's expertise related to local environment and people attitude is considered a unique contribution in itself, key to the local-regional dimension.

Lucia Fanini has been researching for over a decade the beaches of the Mediterranean, testing ecological paradigms, assessing human impacts and integrating them with an ethology perspective. She was host of the most recent International Sandy Beaches Symposium in Crete (May 2018).

Omar Defeo has been working on sandy beach ecosystems for the last 35 years. His long-term research evaluates the effects of human activities on sandy beaches, including global effects driven by climate change stressors.

Vanessa-Sarah Salvo has been in charge of large NGOs, managing projects of environmental protection and being part as expert of working groups including the Marine Litterwatch group of European Environmental Agency and the Spanish node for the Marine Strategy implementation. As experienced in knowledge communication she will support the survey and dynamization of information of the WG and its deliverables.

Leonardo Costa carried out research along an urbanization gradient of the Rio de Janeiro coastline, with a main focus on bioindicator species. He is testing the application of conservation biology principles to sandy beaches and his work is aligned with the REBENTOS network in Brazil.

Melanie Bishop has over 15 years of experience studying sandy beaches in Australia, and the USA, using a combination of large-scale field sampling and small-scale field and mesocosm experiments. She is leader of the Green Engineering Working group of the World Harbour Project, a global network of collaborating scientists researching and managing urban harbours, and in this capacity has lead global syntheses and experiments addressing stressors to marine systems.

Linda Harris is specializing in spatial coastal ecology, conservation and management, particularly for beaches, with expertise in Ecologically or Biologically Significant Marine Areas (EBSAs), spatial prioritization to support Marine Spatial Planning and Integrated Coastal Zone Management. She leads the Coastal component of South Africa's National Biodiversity Assessment.

Kyle Emery's dissertation research is focused on sandy beach community ecology and ecosystem functions. He is part of the US Long Term Ecological Research program and as part of Prof. Jennifer Dugan's research group has contributed to several ecological synthesis projects.

Shinji Sassa is Head of Soil Dynamics Group and Research Director of Asia-Pacific Center for Coastal Disaster Research at Port and Airport Research Institute. He will bring to the group expertise on the role of the geophysical environment in sandy beach ecology and hydro-geodynamics based coastal disaster prevention and mitigation.

Maikon Di Domenico is coordinating the working group for the development of a Sandy Beach protocol within the MBON-P2P. His research targets the use of marine organisms, especially macrofauna and meiofauna, as adaptive-biological models by applying different methodologies, including morphology,

genetics, and ecology.

Michael Elliott has extensive knowledge of coastal and estuarine systems and human impacts. He will supervise the synthesis of the WG activities towards the outcomes, placing them in the global context of research on coastal environments.

Relationship to other international programs and SCOR Working groups (max. 500 words)

The contacts established with the SCOR executive committee for the preparation and submission of the proposal will be kept tight to enhance the collaboration and mutual support of research programs, current and prospective.

The WG members are involved in a range of initiatives and networks, at global and regional scales, which will sustain and promote the activities of the WG: the Marine Biodiversity Observation Pole to Pole (P2P) involving marine scientists collaborating to understand changes in biodiversity of coastal ecosystems of the American continent https://marinebon.org/p2p/ , the World Harbour Project (a network of researchers and managers representing 27 harbour cities around the world, http://www.worldharbourproject.org/), the MarineLitterWatch action of the European Environmental Agency https://www.eea.europa.eu/themes/water/europes-seas-and-coasts/assessments/marine-litterwatch , the global GLOW network for the study of light pollution at night https://www.euromarinenetwork.eu/activities/emergent-impacts-coastal-areas. Also networks at local scale will result reinforced by the actions of the WG such as the Long Term Ecological Research Stations network in the USA, the coastal benthic habitats monitoring network (REBENTOS, http://www.rebentos.org/ in Portuguese) and programs for citizen science being developed in Rio de Janeiro and on the Mediterranean coast (CNRS Nice Antipolis), at the local scale. All these would support and get mutual benefit from the actions of the WG, progressively including participants from other areas and serve as example to promote the building of networks covering areas where the attention to sandy beaches is still low.

The WG co-chair Lucia Fanini is part of the program for the development of basic sciences in Uruguay (PEDECIBA, http://www.pedeciba.edu.uy/indice.php in Spanish), established in 1986 to act as a platform sustaining high level scientific investigation. The co-chairing with Omar Defeo will therefore be framed within and supported by the PEDECIBA, being in compliance with the program's objectives of consolidation and innovation of the scientific research through collaborations with foreign researchers.

The early career researchers involved in the group are expected to promote the WG activities to their respective research groups, each of which are fully supportive of their participation in the WG. Finally, we intend to explore the possibility of integrating proposed protocols with the actions of the Cientificos de la Basura through Dr. Martin Thiel, who was also part of the SCOR WG 153 "FLOATSAM". The role of beached litter in modifying transitional beach ecosystems would add to their perspective on litter circulation.

The dissemination plan, included within the WG ToRs, will be planned to specially tackle the relationships of the WG actions and outcomes to other programs, maximizing their effects. Platforms such as the Ocean Best Practices platform https://www.oceanbestpractices.net/ and the EU platform

on citizen science https://eu-citizen.science/ , just made live, will be used for dissemination of WG deliverables, which will receive a doi and remain citable yet open access.

Key References (max. 500 words)

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Dugan, J.E., Hubbard, D.M. and Quigley, B.J., 2013. Beyond beach width: steps toward identifying and integrating ecological envelopes with geomorphic features and datums for sandy beach ecosystems. *Geomorphology*, *199*, pp.95-105.

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Peterson, C.H. and Bishop, M.J., 2005. Assessing the environmental impacts of beach nourishment. *Bioscience*, *55*(10), pp.887-896.

Scapini, F., Degli, E.I. and Defeo, O., 2019. Behavioral adaptations of sandy beach macrofauna in face of climate change impacts: A conceptual framework. *Estuarine, Coastal and Shelf Science*, *225*, 106236.

Schlacher, T.A., Weston, M.A., Schoeman, D.S., Olds, A.D., Huijbers, C.M. and Connolly, R.M., 2015. Golden opportunities: a horizon scan to expand sandy beach ecology. *Estuarine, Coastal and Shelf Science*, *157*, pp.1-6.

Vousdoukas, M.I., Ranasinghe, R., Mentaschi, L., Plomaritis, T.A., Athanasiou, P., Luijendijk, A. and Feyen, L., 2020. Sandy coastlines under threat of erosion. *Nature Climate Change*, *10*(3), pp.260-263.

Appendix

For each Full Member are here reported 5 key publications related to the proposal. Members are listed in alphabetical order by surname:

Melanie Bishop

[1] Cooke BC, Morton JK, Baldry A, **Bishop, M.J.,** 2020. Backshore nourishment of a beach degraded by off-road vehicles: Ecological impacts and benefits. *Science of the Total Environment*, p.138115 **[2] Bishop MJ**, Mayer-Pinto M, Airoldi L, Firth LB, Morris RL, Loke LH, Hawkins SJ, Naylor LA, Coleman RA, Chee SY, Dafforn KA, 2017. Effects of ocean sprawl on ecological connectivity: impacts and solutions. *Journal of Experimental Marine Biology and Ecology*, *492*, pp.7-30. **[3]**Manning LM, Peterson CH, **Bishop MJ,** 2014. Dominant macrobenthic populations experience sustained impacts from annual disposal of fine sediments on sandy beaches. *Marine Ecology Progress Series* 508: 1-15**. [4]** Peterson CH, **Bishop MJ,** D'Anna LM, Johnson GA, 2014. Multi-year persistence of beach habitat degradation from nourishment using coarse shelly sediments. *Science of the Total Environment* 487: 481-492**.[5]**Peterson CH, **Bishop MJ,** 2005. Assessing the environmental impacts of beach nourishment. *Bioscience* 55: 887-896.

Leonardo Costa

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