

Assessing **M**icroplastic **I**mpacts & **T**ransport in **U**pwelling **S**ystems **(AMITUS)**

Working group proposal submitted to SCOR 2023

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1.0 Summary

Upwelling Systems (UpS) are a key bridge between land, the open ocean, and the troposphere, with transport potential for microplastics. Here we focus on major UpS with significant exposure to plastics pollution; the eastern boundary UpS of the California, Humboldt, Canary, and Benguela Currents, and the seasonal upwelling system in the Gulf of Guinea (Fig. 1). Rivers and coastlines in UpS-bordering countries contribute tens of thousands of metric tons of plastic pollution per country each year to the ocean, but how much of this plastic arrives in the open ocean, in what form and by what pathways, remain open questions. In addition, because of their high biological productivity, which attracts commercial fishing activity, oceanic sources of plastic pollution in UpS could be significant. Satellite data indicate the UpS are hotspots of microplastics contamination. But baseline measurements of microplastics contamination of the water column are lacking in all UpS.

Preliminary observational work suggests that high biological activity in the UpS could exacerbate and amplify microplastic biogeochemical impacts in these regions of commercial importance. Global ocean modeling tentatively confirms this, with global biogeochemical consequences that might rival the impacts of climate change. Given their potentially large role as a microplastic source to the Earth system, their vulnerability and economic importance, from a global perspective, it is important to understand how plastic pollution is impacting these systems and what mechanisms control its flow through them. This is the aim of AMITUS, which will bring together experts for a global synthesis.

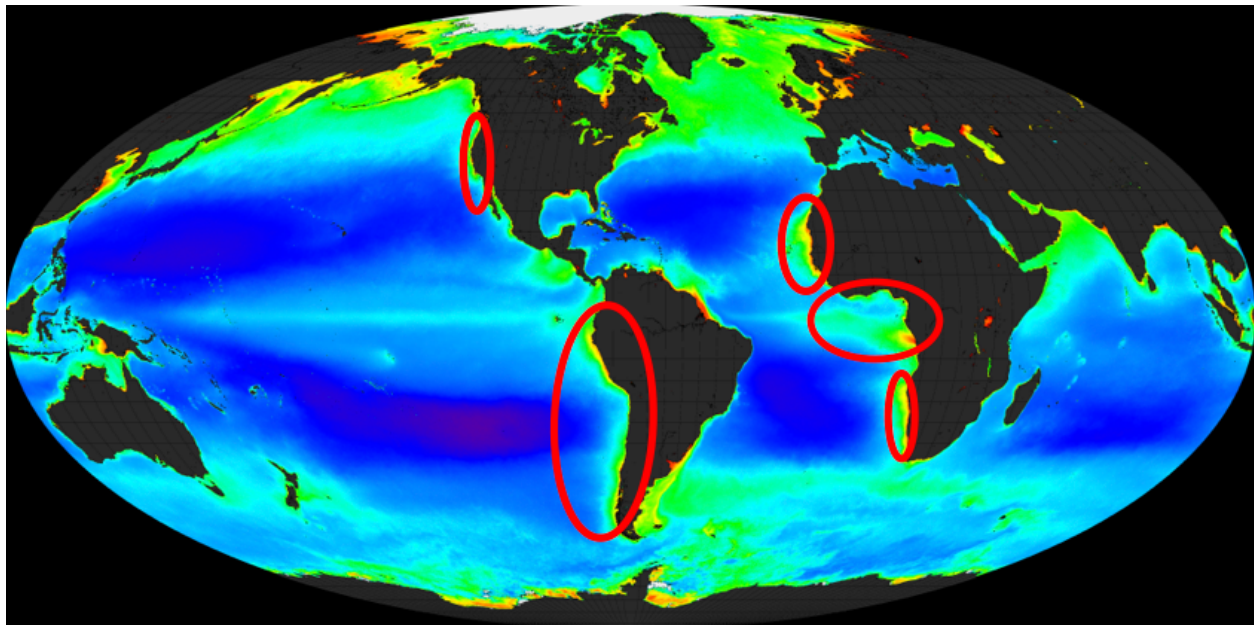


Figure 1. Circled regions show the upwelling systems to be covered in AMITUS.

2.0 Scientific Background and Rationale

Plastic contamination surveys have typically focused on ocean gyres and less is known about Upwelling System (UpS) contamination. This is partly due to the obvious accumulation of floating litter at the center of ocean gyres, such as the North Pacific Garbage Patch, which has been observed for decades and is associated with the fishing industry¹. However, growing awareness of the smaller plastic size fractions ("micro-" having a length between 1 μm and 5 mm) has stimulated recent investigation deeper in the water column and beyond gyres. Survey results challenge the hypothesis that surface waters within gyres host the largest concentrations of microplastics, with relatively larger concentrations reported outside the inner accumulation zone of, and deep below, the South Atlantic Gyre². A novel satellite microplastic dataset suggests seasonally large concentrations of microplastics in UpS surface waters³ (Fig. 2).

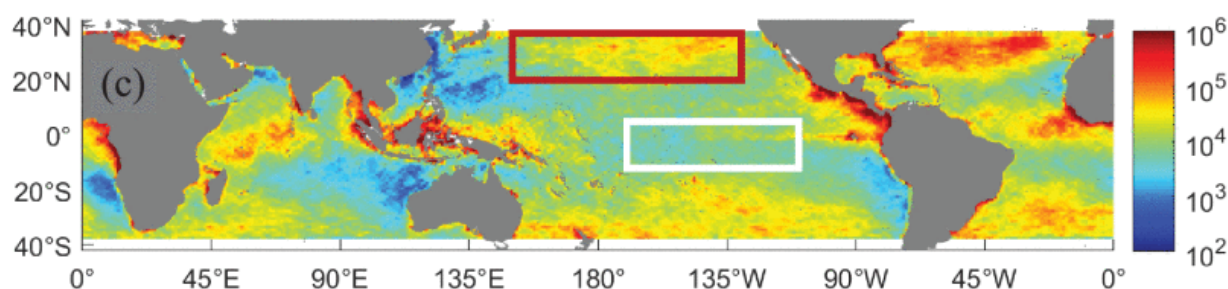


Figure 2. Global distribution of annual average retrieved microplastic concentration ($\#/\text{km}^2$, \log_{10} scale) from satellite observations. Regions of high and low microplastic concentration are indicated by red and white boxes, respectively. Modified from³.

Accumulation zones of terrestrial-sourced microplastics remain poorly understood. They are speculated to be trapped in coastal zones, to accumulate in the deep ocean, or even to get cycled in biological activity in the subsurface. The diverse composition of microplastics in the open ocean^{2,4} suggests leakage of terrestrial plastics out of coastal zones at odds with the simulation of efficient sequestration of plastics in the coastal ocean⁵. What is becoming clear is that the movement of plastics through the ocean is more complex than originally thought and processes within UpS might play a key role in the global distribution of terrestrially-sourced microplastic. The potential for terrestrially-sourced microplastic pollution to follow different oceanic and atmospheric trajectories from ocean-sourced plastic pollution carries significant implications for the mitigation of future pollution and the remediation of existing pollution, two topics highly relevant to the current United Nations Environment Program negotiation of an international legal instrument to end plastic pollution.

Observations, as well as modeling suggest that upwelling dynamics, plastic particle characteristics, as well as biological interaction with the base of the ocean food web, exert strong controls on microplastic particle distributions in the water column. Importantly, the dynamics of microplastic particle transport are expected to influence the exposure of oceanic ecosystems to this pollution, with implications for negative impacts (i.e., reduced growth, increased mortality) on planktonic organisms. For example, organic particle transfer efficiency is greater in oxygen-deficient water⁶ (a common feature of UpS) and this might logically extend to organic aggregates with microplastics embedded⁴. Because of equatorial currents, local UpS contamination impacts

might carry downstream ecological and biogeochemical consequences (Fig. 3). While individual effects have been identified as having relevance to UpS, a comprehensive assessment is lacking.

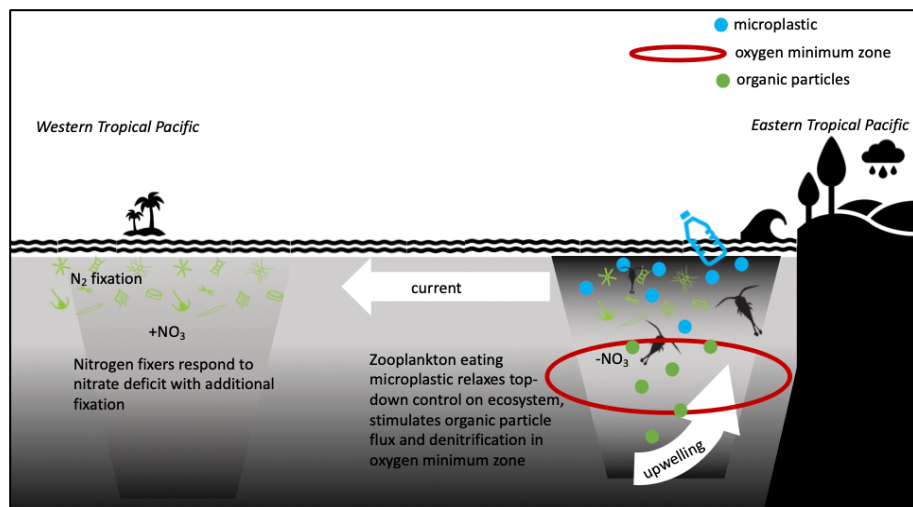


Figure 3. Simulated downstream nitrogen cycle impacts from UpS microplastics contamination in an Earth system model⁷.

2.1 Benguela Current System

South Africa is one of the largest contributors to ocean plastic pollution. Microplastic surveys from the 1970s and 2010s suggest abundances are increasing in South African coastal waters⁸. Greater contamination close to urban centers indicates a terrestrial source for most South African beach contamination (Fig. 4)^{8,9}, but the flux of terrestrial plastics that leave the African coastal zone or settle to the seafloor remains undetermined¹⁰. Further offshore, a survey of upwelling regions in the eastern tropical and subtropical Atlantic revealed microplastic abundances in seawater comparable to non-upwelled regions¹¹. Measurements of microplastics in the eastern coastal zones show considerable variation¹².

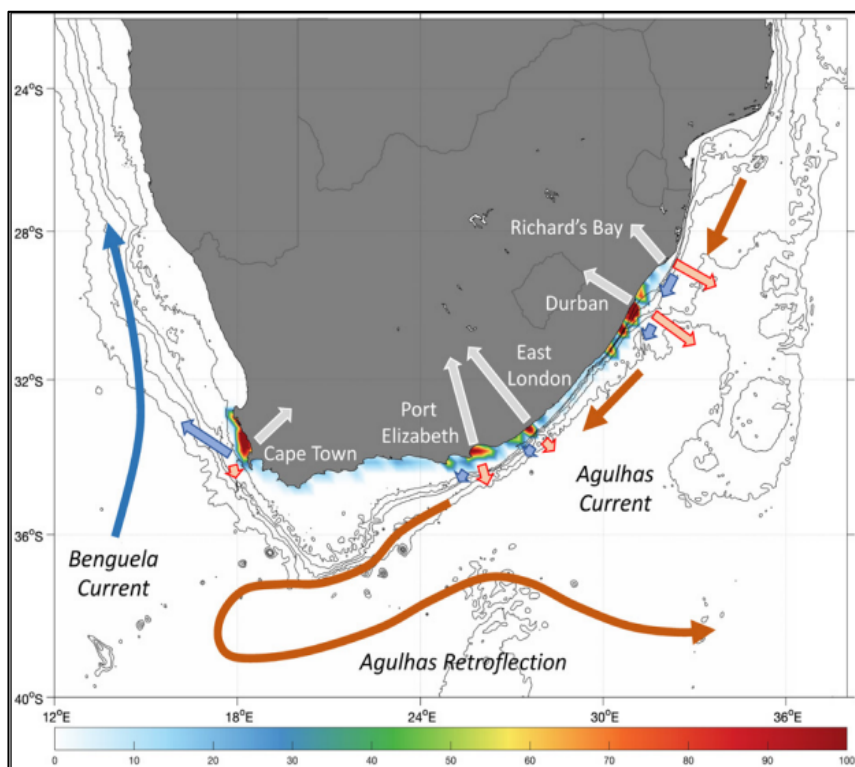


Figure 4. The proportion of plastic items predicted to be exported to the Atlantic (blue) and Indian Ocean basins or stranded (white) from major South African urban areas. Arrow length indicates the relative importance of each path. Coastal heat maps show where beach stranding is predicted to occur. From ¹⁰.

2.2 Canary Current System

High levels of beach contamination by weathered and industrial microplastics in the Canary Islands indicates that the Canary Current transports plastic pollution long distances¹³. Fiber fragments of likely fishing gear origin also suggest oceanic sources of local microplastic pollution¹⁴. Beach contamination is highly seasonal¹³. Water column microplastic variability is also considerable and related to mesoscale mixing dynamics, with plastic fibers and fragments found to at least 1150 m in depth around the Canary Islands¹⁴. However, regions which experience less mixing have more uniform microplastic contamination profiles with less spatial and temporal variability¹⁴. A recent sampling of a commercially important fish, the Atlantic chub mackerel, found microplastic contamination in 78% of the fish examined around the Canary Islands¹⁵.

2.3 California Current System

Microplastics have been found at concentrations in the California Current that exceed levels in the North Pacific Subtropical Gyre¹⁶. They have been detected in anchovies as well as seabirds living in this UpS of the same composition as the surrounding seawater¹⁷. Microplastic particle surface abundances are seasonally variable and represent a mix of terrestrial and oceanic sources, and primary and secondary microplastics¹⁸. Storm events increase coastal microplastic concentrations in this system, and zooplankton mass is regularly exceeded by microplastic mass even before storms¹⁹. But the largest concentrations of microplastics in this UpS have been found between 200 and 600 m depth in an underwater canyon, with upwelling suspected to have a role in transport dynamics²⁰. Krill feeding blue whales are the most exposed to microplastics (Fig. 5)²¹.

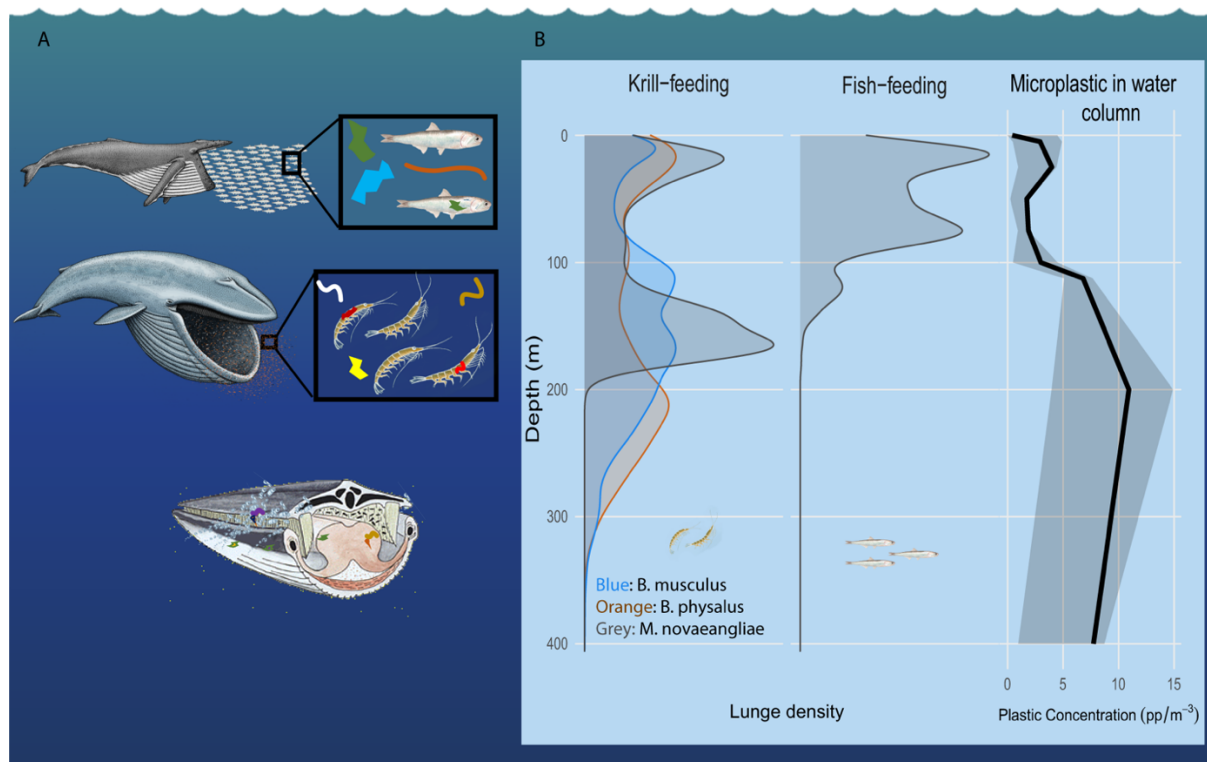


Figure 5. (A) Plastic ingested by whales day⁻¹, modeled as the sum of plastic filtered from water per day and plastic consumed in prey per day. 3 scenarios capture the range of possible exposure risk of plastic ingestion (low, medium, and high) since some of the variables lack comprehensive data; (B) lunge depths from deployments in Monterey Bay aligned with the depth profile of plastic concentrations in Monterey Bay. From ²¹.

2.4 Humboldt Current System

Coastal plastics contamination in Chile has mostly local, terrestrial sources. This is also true for the central coast of Peru, where beached microplastics concentrations are found to be higher^{22,23} (see sampling sites in Fig. 6). It is thought that offshore transport quickly removes terrestrial-sourced microplastics downstream in upwelling regions, thereby keeping microplastic contamination in sea life relatively low²⁴. But, a comprehensive baseline of seawater microplastic particle distributions in this UpS has yet to be established²⁵ and high concentrations of microplastics have been found in the stomachs of carnivorous species in the tropical Eastern Pacific, far offshore²⁶. Study of anchovy egg dynamics suggests particle (including microplastics) accumulation and ecological exposure could be highly dependent on seasonal hydrodynamics in the northern Humboldt UpS⁴⁸. Likewise, food and microplastics may be simultaneously aggregated by coastal fronts in the UpS, thus raising the risk of negative impacts on organisms²⁷.

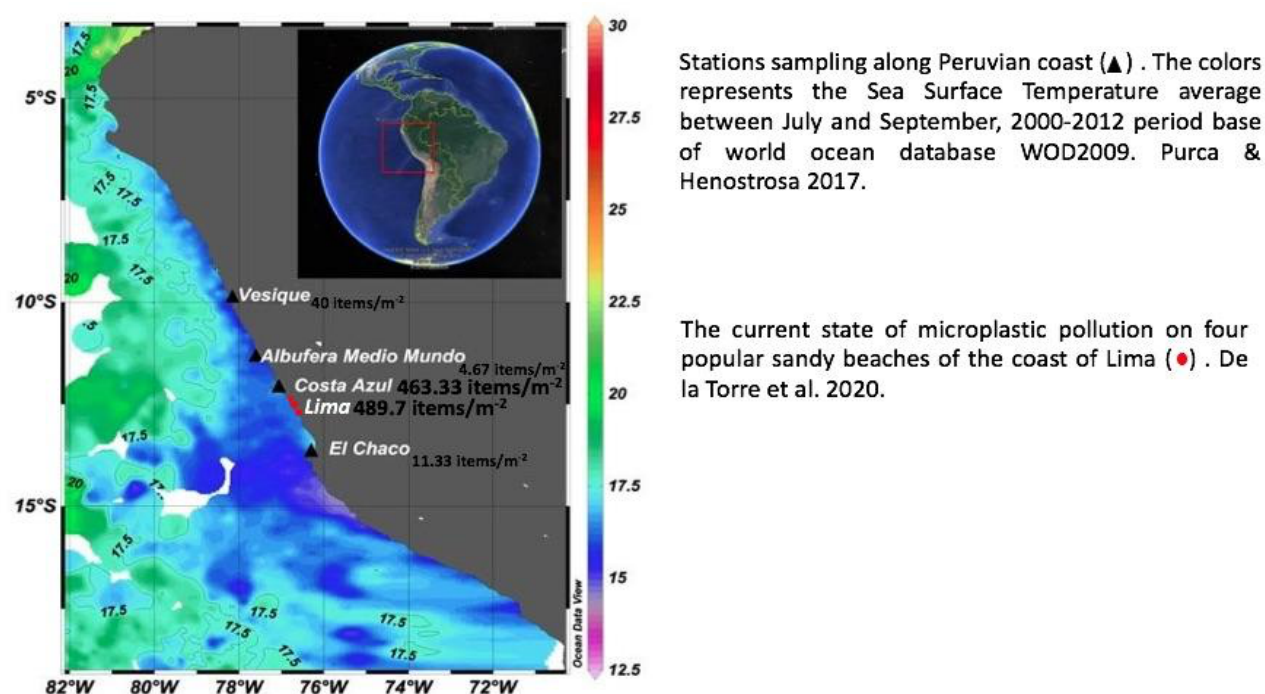


Figure 6. Humboldt Current UpS: The oceanographic and pollution context of current microplastics sampling sites in Peru.

2.5 Gulf of Guinea (GoG) UpS

Seasonal upwelling occurring along the northern coast of the GoG, and river nutrient inputs are major drivers of chlorophyll-A concentrations²⁸. Primary production attracts fishing activities which are implicated in contributing microplastics into the marine ecosystem²⁹. A lack of formal recycling facilities or sanitary landfills in Ghana and Nigeria means significant leakage of plastic into the environment³⁰ including rivers²⁹. The Niger River is a major nutrient and pollution source to the GoG (Fig. 7)²⁸. The COVID-2019 pandemic exacerbated plastics leakage, with an estimated 75 million face masks disposed of daily in Nigeria alone³¹. While biomonitoring of toxins is relatively widespread in Nigeria³², comprehensive assessment of environmental microplastics contamination is lacking³³. In Nigeria, a statistically significant correlation was found between the

occurrence of generic debris and microplastics contamination²⁹ that suggests estimates of microplastic concentrations in the coastal ocean might be extrapolated from debris surveys as a means to estimating microplastics contamination cost-effectively.

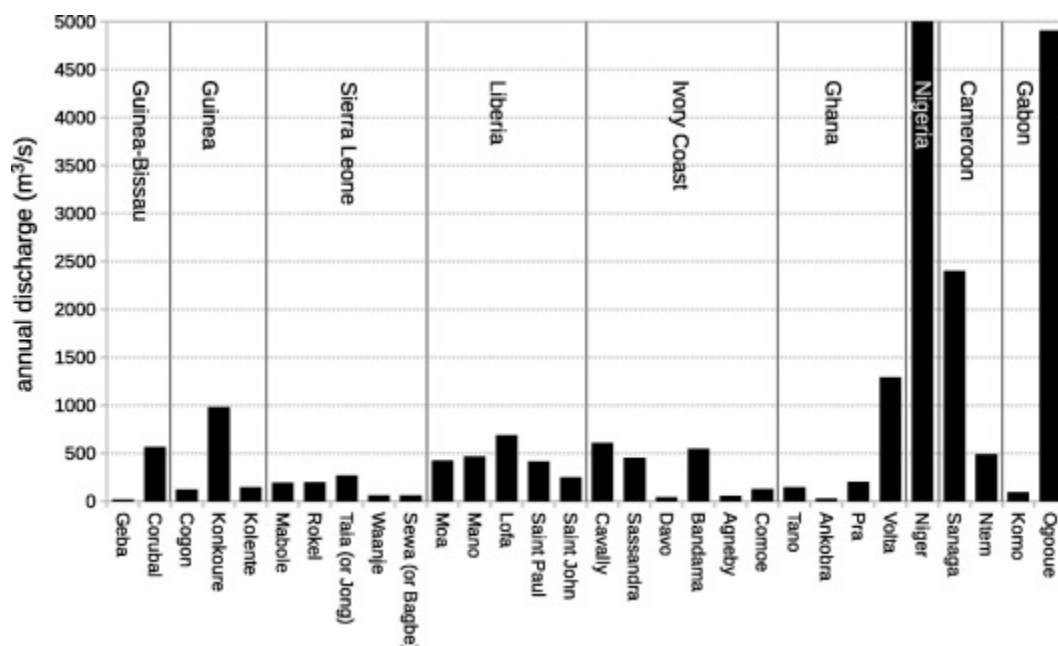


Figure 7. Annual river discharge from rivers feeding the GoG²⁸.

2.6 Scientific and Societal Relevance

UpS ecosystems are economically crucial and provide 21% of the fish caught globally³⁴, therefore an assessment of their susceptibility to ecological damage from microplastics contamination is urgently required. Because of their role in linking land-sea-atmosphere, focused study of microplastics in UpS can help to cost-effectively accelerate our understanding of microplastics cycling and impacts in the Earth system. Assessment and synthesis of already available information into a common framework and the development of recommendations for monitoring and risk assessment, and mitigation and remediation measures can advance the high-level goals of the United Nations Ocean Decade, supporting the Challenge 'Understand and Beat Marine Pollution'. It also supports the United Nations Sustainable Development Goal 14 with the aim to 'Conserve and sustainably use the ocean, sea and marine resources for sustainable development'. SCOR can support our contribution, which requires international cooperation not easily funded through other means. Project outcomes will enable the future expansion of our scope of investigation to other upwelling systems and atmospheric interaction.

3.0 Terms of Reference

UpS' status as a land-ocean-atmosphere crossroads renders their ecosystems vulnerable to the multiple stressors of overfishing, climate warming, ocean acidification and pollution. So far, research into microplastic transport through, and impacts in, UpS has been published with a local focus and often in national or regional journals with paywalls or no English translation. No

synthesis currently exists which attempts to find commonality across UpS regions, nor to contextualize their global role in microplastics cycling, nor to estimate their vulnerability to multiple anthropogenic stressors including microplastics. Our working group proposes to:

1. **Review and synthesize** available information on microplastic sources, sinks, and standing stocks within UpS and estimate the exposure of the base of the marine food web to this microplastic contamination, as well as identify key knowledge gaps.
2. **Develop a conceptual model** of microplastic cycling, ecological and biogeochemical impacts in UpS that contextualizes regional mechanisms and processes in a global Earth system reference frame, including those expected to change (e.g. warming, deoxygenation, ocean acidification).
3. **Provide evidence-informed policy and program recommendations** for governments, national and international scientific organizations and stakeholders to support the development of long term strategy for environmental microplastic monitoring and impact/risk assessment.
4. **Provide evidence-informed recommendations** to governments, NGOs, and industry to support regional microplastic impacts mitigation and remediation measures.

A key benefit of the project will be that the forward-looking synthesis of regional impacts and processes will result in an enhanced international appreciation of the unique role UpS may play in global microplastics cycling.

4.0 Working Plan

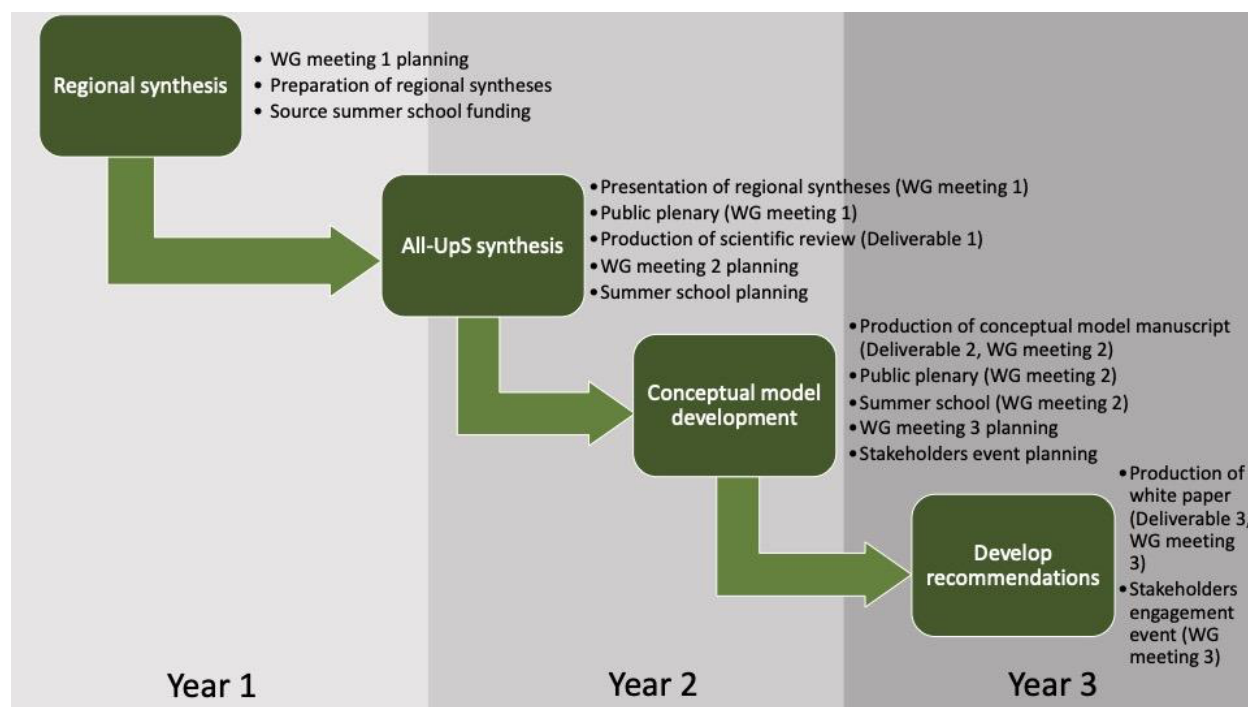


Figure 8. Timeline of actions to achieve the Terms of Reference and Deliverables.

Figure 8 provides a timeline to progress each of the Terms of Reference (ToR) and actions that will accomplish them, as well as the described Deliverables. Full Members (FM) will be

responsible for meeting planning and the submission of publications, while Associated Members (AM) and other interested persons will be able to attend meetings and to contribute their authorship. A Slack channel will be established to facilitate regular communication in-between meetings. Key features of each Working Group (WG) meeting will be a public plenary or stakeholder event delivered in the host country.

Year 1: Meeting preparation, summer school funding, regional syntheses

Preparations for the first WG meeting will begin immediately, with FM and a local organizing committee planning the first meeting to occur within the first year. Remote participation in the meeting will be an option for those who cannot travel. Simultaneously, all FM and AM will organize by region to produce syntheses of their knowledge of microplastics as they relate to the regional environmental conditions. Members whose expertise is not affiliated to a particular region will help to fill expertise gaps in the regional syntheses, and will take responsibility for summarizing research for UpS not well represented by the membership. A Summer School sub-committee will also form immediately to source funds for hosting a Summer School in conjunction with the second Working Group meeting in the second year.

The first WG meeting will occur at the Universidad Andrés Bello CIMARQ in Quintay, Chile. At the first WG meeting, regional syntheses of microplastics cycling and impacts in the Benguela, California, Canary, GoG and Humboldt UpS will be presented and discussed. FM will collate these syntheses into a review manuscript after the meeting's conclusion and take responsibility for managing its submission to an open-access journal. All participants will be credited as authors. A public plenary will conclude the meeting.

After the first WG meeting, FM will prepare and submit the scientific review article to a journal. Upon publication, this review will fulfill the first Deliverable and first ToR. This review will be a novel and significant step towards a global understanding of the role of UpS in microplastics cycling and will identify key knowledge gaps. This work will be facilitated by a Slack channel to maintain regular communication.

Year 2: Meeting preparation, summer school planning, conceptual model development

The FM will plan the second WG meeting with the help of a local organizing committee, to be held in Year 2. This second WG meeting will be held either at the University of Calabar, Nigeria or the University of Lagos, Nigeria. Remote participation in the meeting will be an option for those who cannot travel. A public plenary will conclude the meeting.

From the scientific review of microplastics in UpS conducted over the first ~18 months, a conceptual model will start to coalesce. This conceptual model will be refined through discussion in the second meeting of the WG as well as on the Slack channel. At the meeting, FM & AM, as well as other interested persons, will be invited to participate in the discussion and to present their latest UpS-relevant work. After the second meeting, the conceptual model of microplastic cycling and impacts in UpS will be prepared for publication by the FM and submitted to an open-access, high-impact journal. All meeting participants will receive co-authorship. Publication of this conceptual model will fulfill the second Deliverable and second ToR. This conceptual model will

be an important contribution to the fundamental science of microplastics cycling and impacts in UpS and their global significance in a changing climate.

Depending on the outcome of the search for funds, a Summer School will either be run in-person alongside the second WG meeting, or online as a series of webinars over the second year. A preliminary program is provided under “Capacity Building”, but feedback on course contents will also be sought as part of the review process during and after the first WG meeting. Identified knowledge gaps can help to inform the content of the Summer School. The content will be aimed at Early Career Researchers.

Year 3: Meeting preparation, research strategy and policy advice preparation, stakeholder engagement

FM and a local organizing committee will plan the last WG meeting and stakeholder engagement event, to be held in Year 3. This meeting will be held at the Instituto del Mar del Peru (IMARPE) in Callao, Perú. Remote participation will be an option. At the meeting, FM & AM will develop Deliverable 3, a White Paper in fulfillment of the TOR 3 and 4. This White Paper will give policy context to the scientific knowledge gained through the WG discussions, to provide recommendations to government and regional as well as international scientific organizations for regional monitoring and impacts assessment as well as impacts mitigation and remediation. It is anticipated that an expanded list of participants (i.e. social scientists, policymakers, industry/practitioners) may be appropriate to invite to this meeting. This White Paper will be finalized after the third meeting by the FM and published open-access. All meeting participants will be recognized as authors for their contributions. Upon publication, all TOR and Deliverables will be fulfilled. In conjunction with the meeting, a Stakeholder engagement event will be held to disseminate the latest findings of the WG to NGOs, regional governments, journalists and other interested parties.

Upon conclusion of the Work Plan, a new understanding of microplastic cycling in UpS will have been achieved by the joint research effort within the WG. A new cohort of microplastics researchers will have been trained with a focus on filling the identified knowledge gaps. Members of the WG will have established a global network of colleagues working on similar research across different UpS and will be well positioned to apply for joint future funding opportunities targeting identified testable hypotheses and rapid advances in understanding of key areas to advance the frontiers of science/knowledge of microplastics in UpS.

5.0 Deliverables

To fulfill the ToR and enhance fundamental scientific understanding of UpS microplastics cycling and impacts, we will deliver:

1. **A peer-reviewed scientific review** of available information on microplastic sources, sinks, and standing stocks within UpS that estimates exposure of marine life to plastics and potential regional and downstream ecological, biogeochemical, biophysical and physical impacts. Such an effort was recently published for the polar ocean³⁵ and an UpS description is currently absent from the literature. (ToR 1)

2. **A high impact, peer-reviewed publication** that proposes a conceptual model of the role of UpS mechanisms in distributing microplastic pollution as well as impacts. This model will be applied to current estimated and future projected trends in both pollution and climate change to anticipate the multi-stressor impacts facing UpS in the future, as well as to estimate the effectiveness of impact mitigation efforts. (ToR 2)
3. **A White Paper** for policymakers, NGOs, industrial actors, and regional and international scientific organizations that includes recommendations for plastics pollution mitigation, impacts monitoring and risk assessments. (ToR 3 & 4)

These deliverables will fulfill the ToR of the WG to share our newly developed understanding of the role of UpS in microplastics cycling with the broader scientific community and stakeholders. These deliverables will also provide a road map to fill identified knowledge gaps and to expand future investigation into atmospheric transport, other coastal systems, and linkages to social science. Development of long-term monitoring and risk assessment recommendations will be of a high value to the scientific community.

6.0 Capacity Building

Our proposal is exceptional for SCOR in that it is dominated by Early-Mid Career Researchers in the Global South on an emerging topic of critical regional health and economic importance with global impact. Our membership does not generally have easy access to co-funding, thus SCOR funding represents capacity building in and of itself.

6.1 Strategy Overview

Capacity building will be a key component of the proposed work plan. All WG meetings will be held in UpS-bordering countries, with a remote option, to maximize participation. Meeting locations are chosen to maximize participation of AMs without travel funds, so that every member should be able to participate in at least 1 WG meeting in-person. AMs without their own funding will be nominated by the WG and encouraged to apply for SCOR travel funding as well as other sources to attend as many meetings as possible in-person. FMs will be encouraged to subsidize their own travel to attend meetings, so that any funds saved (thanks to the funding contributions of FMs) can be requested to support the in-person participation of AMs, especially early career members. A Slack channel will be established to facilitate regular communication between meetings and to enable a larger range of participation in WG activities. WG members will be encouraged to present WG outcomes to global and regional networks such as the PAN African Micro and Nano Plastic Network and the SPLACH Network, as well as with other scientific working groups they have membership in. At WG meetings 1 and 2, a public plenary will be offered to provide local residents with an opportunity to learn about microplastic in the marine environment. At the last meeting, a one day Stakeholder Engagement event will conclude the meeting. This event will invite regional stakeholders to high-level presentations summarizing the outcomes of the WG efforts, in addition to discussion of the recommendations to be made in the White Paper. The aim of these “open house” activities will be to increase the microplastics scientific awareness of the general public and to foster support for further research from stakeholders.

6.2 Summer School

The Summer School will train regional Early Career Researchers (ECRs) in the state-of-the-science of microplastics research. This will include both lectures as well as practical activities. By including the Summer School as part of the second WG meeting, it is expected that ECRs will benefit from dual participation as well as networking with senior researchers. The following topics are proposed, but are subject to change according to the identified knowledge gaps found during the review process and first WG meeting:

Day 1: Collecting and sampling of microplastics on beaches and extraction from sediments

Day 2: Microplastic counting through image analysis using digital microscopes, and science communication with stakeholders

Day 3: Microplastic-ocean circulation models, biogeochemical impacts and climate change interactions

Day 4: Study of microplastics in the gastrointestinal contents of fish and microplastics impacts on human health

Day 5: Analysis of microplastics by Fourier Transform Infrared (FTIR) spectroscopy and other analytical methods

Should an in-person Summer School not be possible, an alternative format of a webinar series will be produced over the course of the second year offering practical sessions on the above topics. These recorded lectures will be made available on YouTube, or a similar open-access viewing platform, and distributed to the PAN African Micro- and Nanoplastic network, SPLACH, and other microplastics research communities listed in the “Relationships with other programs” section.

6.3 Complementary funding

A sub-committee will convene in the first year of the WG to secure funds to host the Summer School in conjunction with the second WG meeting in Nigeria. Possible sources of funding have already been identified (i.e. the International Ocean Institute, which funds marine science and policy training in Nigeria, potential partnership with the Coastal Ocean Environment Summer Schools in Ghana and Nigeria (COESSING) and/or Solving Sustainability Challenges at the Food-Climate-Biodiversity nexus (Solving FCB), or the Richard Lounsbery Foundation). The sub-committee will have about 18 months to secure funding. Costs for the Summer School will be low as FM will already be attending the WG meeting in-person and can offer their instruction.

6.4 Positioning for future work

Our project unites and expands upon the topics of SCOR Working Groups 153 Floating Litter and its Oceanic Transport Analysis and Modelling (FLOTSAM), and 155 Eastern Boundary Upwelling Systems (EBUS): Diversity, Coupled Dynamics and Sensitivity to Climate Change. It goes beyond FLOTSAM by investigating water column contamination by microplastics, and by addressing biological, ecological, and Earth system impacts of this contamination. It goes beyond EBUS in examining the changing dynamics of upwelling systems as they relate to microplastics contamination and impacts. The timing of our project is excellent because long-term monitoring of microplastics in UpS has not yet been established, which means that our information synthesis will be able to provide critical information for establishing such monitoring. Fulfillment of the ToR will develop the capacity of our Members to lead future international-level, groundbreaking work

on microplastics impacts on the Earth system, and will establish a road map for implementation and research coordination that can be expanded to other components of the Earth system (i.e., the atmosphere) and other ocean realms.

7.0 Working Group Composition

The composition of our WG is exceptional, with both Chairs and 16 out of 20 Members from or in the Global South. Six out of 20 members meet both SCOR criteria for Early Career Researcher, but 14 out of 20 meet at least one of the criteria. Gender is equally balanced. This demographic representation speaks to the passion of our membership for understanding and addressing the problems of microplastics impacts. It also means that SCOR is well-positioned to make a strategic funding decision that will elevate and support emerging global leaders with many years of productivity to come.

*Early career researchers (<10 years post-PhD and <40 years old) have a * by their names. Chairs are in boldface type.*

Full Members

Name	Gender	Place of work	Expertise relevant to proposal
Alonzo Alfaro-Núñez	M	University of Copenhagen, Denmark	Characterization of environmental microplastics, toxicology
Luisa Galgani	F	University of Siena, Italy GEOMAR, Germany	Plastics impacts on marine carbon biogeochemistry. Metagenomics of the plastisphere.
Karin Kvale	F	GNS Science, New Zealand	Global microplastics-ecosystem impacts modeling
Clara Manno	F	British Antarctic Survey, UK	Microplastic fluxes in marine environment and organisms
Trishan Naidoo*	M	Rhodes University, South Africa	Coastal ecology, microplastics in sediment, water and fish.
Sara Purca	F	Instituto del Mar del Peru Callao-Perú	Microplastics characterization in

			fish and invertebrates.
Andrés H. Arias	M	Argentinean Institute of Oceanography, National South University, Argentina	Environmental science, Ecotoxicology
Charlene Lujan-Vega*	F	Microplastic Fauna Peru Project Peru	Microplastic extraction and characterization in biota
Omowunmi Fred-Ahmadu	F	Covenant University Ota Ogun State, Nigeria	Detection and characterization of environmental microplastics, toxicology
Christian Laforsch	M	University of Bayreuth, Germany	Ecotoxicology, detection and characterization of microplastics, transport in the environment.

Associate Members

Name	Gender	Place of work	Expertise relevant to proposal
Paulina Andrea Bahomonde Cárdenas*	F	Universidad de Playa Ancha, Chile	Pollution and endocrine effects of pollutants on fish
José Ortega-Alfaro*	M	Microplastic Fauna Peru Project Peru	Microplastic extraction and characterization in biota
Marina Fernandez	F	Instituto de Biología y Medicina Experimental, Argentina	Endocrine disrupting chemicals
Karla Andrea Pozo Gallardo	F	Universidad San Sebastián, Chile/Croatia	Environmental pollution chemistry
Gideon Idowu*	M	Federal University of Technology Akure, Nigeria	Microplastics and endocrine disruptors, biodiversity.

Martin Löder	M	University of Bayreuth, Germany	Method development for characterization of environmental microplastics, ecotoxicology, microplastic transport
Cristobal Galbán Malagón	M	Universidad Mayor, Florida International University Chile	Biogeochemical impacts of POP cycling, air-sea exchange of pollutants, impacts on ocean ecosystems.
Ibor Oju*	M	University of Calabar, Nigeria	Trophic transfer of microplastics in marine food webs
Temitope O. Sogbanmu*	F	University of Lagos, Nigeria	Environmental microplastic monitoring and evaluation, ecotoxicology, waste management
William Froneman	M	Rhodes University, South Africa	Plankton food webs, shallow water ecology

Additional researchers have expressed their willingness to contribute to the success of this project:

Gustavo André Chiang Rojas (Universidad Andrés Bello CIMARQ, Chile)

Emma Rocke* (University of Cape Town, South Africa)

Collaboration with the relevant SCOR Working Groups 153 FLOTSAM, and 155 EBUS will be established, with their members invited to participate in our activities.

8.0 Working Group contributions

Alonzo Alfaro-Núñez is an evolutionary biologist with experience in the characterization of nano and microplastics in organisms and their potential implications in the development of diseases. He will contribute his knowledge of impacts in the Humboldt UpS and overall expertise.

Omowunmi Fred-Ahmadu is an environmental chemist with expertise in the mapping, detection, and characterization of microplastics and associated organic and inorganic contaminants. She is a Cohort 1 recipient of the ACU Blue Charter Fellowship and a member of the PAN-African Micro

and Nano plastics Network Group. She will contribute her knowledge of west African microplastics monitoring and impacts and overall expertise.

Andrés H. Arias is a senior marine environmental scientist with a background in ecotoxicology of microplastics and chemicals. Expert from the UNEP-GESAMP working group 40, Ocean plastics. He will contribute his expertise on environmental microplastics and international-level science coordination.

Karin Kvale is an Earth system modeler with a global perspective on microplastics, biogeochemistry, and UpS dynamics and willing organizer of all meetings and side events. She will act as co-chair.

Christian Laforsch is a biologist focusing on the effects of environmental stressors on organisms and was one of the first researchers reporting on microplastics in freshwater. He is spokesperson of the SFB 1357 microplastics and Chair of Animal Ecology in his department. He has a strong background in method development for sampling, extraction, detection and characterization of microplastics in water, sediment, air and biota as well as ecotoxicology of microplastics. He will contribute his expertise to meetings and publications of the WG.

Charlene Lujan-Vega is a veterinarian and an early-career researcher, principal investigator and founder of the Microplastic Fauna Peru Project. She has expertise in wild bird diseases and is currently surveying microplastics in seabird populations and their prey from the Northern Humboldt Current Large Marine Ecosystem. She will contribute her knowledge of the Humboldt and California Current UpS.

Clara Manno is a biological oceanographer with experience on coastal and open-ocean microplastic-zooplankton-carbon cycle interactions. She is co-founder and co-chair of the SCAR_PLASTIC working group. She will contribute her expertise to meetings and publications of the WG.

Sara Purca is a physical and biological oceanographer with extensive research expertise in the Humboldt upwelling system climate variability, environmental impact assessment, and marine ecology. She is co-chair of the Research Network of Marine-coastal Stressors in Latin America and the Caribbean Seas - REMARCO, microplastics component. She will contribute her expertise to the group and has agreed to act as co-chair.

Luisa Galgani is a biological oceanographer and biogeochemist with a global expertise in coastal and open-ocean nutrient and carbon cycling and microplastics-organic particle dynamics using a wide array of empirical methods. She will contribute her expertise on open-ocean ecosystems and the Humboldt UpS.

Trishan Naidoo is an early career scientist. He has been working in the field of microplastics within South Africa since 2013, and has published nine peer reviewed papers on the topic. He will contribute his expertise on the Benguela UpS.

9.0 Relationship to other international programs and SCOR Working Groups

SCOR Working Group 155 Eastern Boundary Upwelling Systems (EBUS): Diversity, Coupled Dynamics and Sensitivity to Climate Change

This WG is progressing the physical oceanographic and biogeochemical basis for the initiation of our proposed WG. We anticipate sharing our findings with this WG and inviting them to participate in our activities.

SCOR Working Group 153 Floating Litter and its Oceanic Transport Analysis and Modelling (FLOTSAM)

This WG is synthesizing ocean surface litter distribution and transport dynamics which can help to inform our investigation of microplastics impacts throughout the water column. Their members will be invited into our activities.

Scientific Committee on Antarctic Research PLASTIC working group (Clara Manno)

The SCAR Plastic working group has established a network of researchers to synthesize information about plastics pollution in the polar oceans. Outcomes of our WG will be shared with SCAR.

GESAMP Working Group 40 Marine plastics (Andrés H. Arias)

This WG is producing recommendations for standardizing definitions and methodologies for microplastics sampling and analysis. It is also examining microplastics' impact on marine organisms and a risk framework to make policy recommendations. Its work will help to inform our WG progress and outcomes.

UN Ocean Decade endorsement will be sought for the Action 'Understand and beat marine pollution'.

SEPIA Science for Plastics Impacts Argentina (Andrés H. Arias) is a scientific network of active Argentinean plastics researchers which promotes collaborative interactions. Progress and outcomes of our WG will be actively distributed within this network.

Scientific Plastic Pollution Alliance of Chile (SPLACH) Network (Karla Andrea Pozo Gallardo)

This scientific network of active Chilean plastics researchers promotes coordinated and collaborative projects across the whole country. Progress and outcomes of our WG will be actively distributed within the network.

PAN African Micro and Nano Plastic Network (Omowunmi Fred-Ahmadu)

This network has organized researchers working on plastics contamination across Africa and hosts regular events and webinars in support of common research goals. Findings of our WG will be shared regularly with them.

Microplastic Fauna Peru Project (Charlene Lujan-Vega, José Ortega-Alfaro)

Peruvian research initiative made up of a multidisciplinary team that participates from different locations nationally and internationally, focused on investigating microplastics, their associated contaminants, and their effects on Peruvian fauna. This is an early-career driven research initiative that will contribute significantly to the outcomes of our project, and that may also benefit from the support of our WG.

SFB 1357 Mikroplastik (SFB spokesperson Christian Laforsch, SFB member Martin Löder)

A Collaborative Research Centre (SFB) funded by the German Research Foundation currently in the second 4-year phase. SFB 1357 Mikroplastik investigates the formation, migration and effects of microplastics in the environment. Two way communication with this project will be established.

Research Network of Marine-coastal Stressors in Latin America and the Caribbean Seas (REMARCO) (Sara Purca)

A cooperation network in that connects 18 Latin America and the Caribbean (LAC) Member States. Microplastics kits for monitoring by National Programs on marine plastics debris are distributed to LAC countries. Supported by RLA70/25/ International Atomic Energy Agency (IAEA).

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Appendix: Five key publications for each Full Member

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