SCOR Working Group Proposal Template

(max. 6000 words, excluding Appendix)

Title: Global Library of Underwater Biological Sounds

Acronym: GLUBS

Summary/Abstract (max. 250 words)

Aquatic environments encompass the world's most extensive habitats, rich with sounds produced by a diversity of animals. Passive acoustic monitoring is an increasingly accessible remote sensing technology that represents an unprecedented, non-invasive method to monitor these environments. Detection of sound-producing species assists in mapping their spatiotemporal distribution and biologically important areas. With worldwide biodiversity in significant decline and underwater soundscapes being altered as a result of anthropogenic activities, there is a need to document, quantify, and understand biotic sound sources–potentially before they disappear. A vital step towards these goals is the development of an accessible platform that: 1) integrates and expands existing repositories to provide a global reference library of known and unknown biological sound sources; 2) houses a data repository portal for annotated and unannotated audio recordings; 3) develops artificial intelligence tools to extract and characterize sounds; 4) includes benchmark training datasets for signal detection and classification; and 5) promotes public awareness of aquatic sound. Although individually, these resources are often met on regional and taxa-specific scales, many are not sustained, and collectively, an enduring global database on an integrated platform has not been realized. A Global Library of Underwater Biological Sounds will address this by developing applications to complete items 1 to 4 and, in doing so, engage the general public through associated reference material. To complete this, our working group, currently placed under SCOR's working group 'International Quiet Ocean Experiment', includes expertise of bioacousticians, bioinformaticians, propagation experts, web engineers, and signal processing specialists (e.g., artificial intelligence).

Scientific Background and Rationale (max 1250 words)

Aquatic environments incorporate the world's most extensive habitats, often rich with diverse sounds from a variety of marine fauna. Advances in data acquisition, storage and processing, have led to reduced costs, easier logistics of sensor deployment, and the ability to collect more comprehensive (higher sampling frequency, longer duration) recordings, making passive acoustic monitoring (PAM) a more accessible and feasible monitoring tool than ever before (Chapuis et al., 2021; Wall et al., 2021). Together with increased understanding of the importance of acoustic cues to aquatic fauna, this has meant underwater bioacoustics has become increasingly important to growing numbers of scientists, managers, artists and the general public, and an almost exponential growth in the volume and number of datasets, collected in more and more locations, on an increasing number of taxa (Mooney et al., 2020). Datasets can easily exceed terabytes in size, years in duration, and contain millions of sounds from hundreds of different types. Thus, manual signal classification—the traditional method of signal validation— is increasingly difficult, and knowledge of all sound types by individual researchers, nearly impossible (Parsons et al., 2022). With global biodiversity in significant decline, there is a need to document and understand as many sound sources as possible, potentially before they disappear.

Applications of PAM include: monitoring and characterizing underwater soundscapes/acoustic communities (e.g., Mooney et al., 2020); characterizing spatiotemporal patterns of migrating whales (e.g., Risch et al., 2014), responses to environmental drivers like temperature, salinity, and lunar patterns (e.g., Rountree et al., 2006; Linke et al., 2020), climate change (e.g., Gordon et al., 2018), anthropogenic noise sources (e.g., Erbe et al., 2019), algal blooms (e.g., Rycyk et al. 2020) or extreme weather events (e.g., Boyd et al., 2021); among an expanding range of uses. This vast volume of data is underpinned by the detection and characterization of sound sources, either for individual assessment or to understand their contribution to the overall soundscape (Mooney et al., 2020), and can aid more effective conservation management, such as spatiotemporal zoning measures found in marine park areas or fishery closures (Nikolich et al., 2021). However, tools are needed to assist this process and to provide access to reference sounds.

Globally, there are 149 fully-aquatic marine mammal species (including subspecies), ~35,000 fishes, and nearly 250,000 species of marine invertebrates (Froese and Pauly, 2021; WoRMS, 2021). The number of species known to produce sound underwater is consistently increasing, recently including birds (Thiebault et al., 2019). Although almost all marine mammals are confirmed as ‘soniferous’ underwater, this has been validated for fewer than 100 aquatic invertebrate (Coquereau et al., 2015) and ~1,000 fish species (Looby et al., 2022; Rice et al. 2022). Further, fishes and invertebrates are typically more difficult to validate in the field than mammals (Riera et al., 2017). Thus, despite fish sounds contribute the majority of all aquatic sounds and the species confirmed as soniferous represent over two-thirds of all fish families, their sound sources remain largely unconfirmed.

The full repertoire of calls has been captured for very few species and cosmopolitan taxa, whether wide-roaming individuals, (e.g., whales), or broadly-distributed species, (e.g., fishes) often exhibit dialects, or completely different signal structures among regions, and evolve over time (e.g., Garland et al., 2011). Thus, while collating global records of known sounds is feasible (e.g., for fishes; Looby et al., 2022), these variations mean maintaining representative samples requires continuous effort. Further, there remains no global system to characterize or identify new unidentified or previously reported sounds (Anderson et al., 2008; Rountree et al., 2020). Only recently have studies begun to address the groupings of such sounds, through ‘acoustic community ecology’ (Di Iorio et al., 2021; Bolgan et al., 2020) and a standardized categorization method would reduce confusion and errors in naming and identifying sounds, a goal of this WG.

An optimal library provides first-hand sound clips for comparison, preferably with clearly annotated spectrograms and sufficient metadata to facilitate comparison between user and library samples. However, current libraries often focus on a host institute researchers’ species of interest, often recorded from a particular phylum or more restricted taxon, with a smaller selection of opportunistically recorded species. In general, existing libraries are “silos”—lacking the cohesiveness that a taxa-independent global library or network could provide and keeping such libraries up to date has not been a focus meaning some libraries have lagged in their updates or shutdown suddenly.

Bringing known sounds together in a unified depository, linked to existing databases, facilitates easy comparison among species, locations, repertoires, and recording methodologies. In parallel to a library of known sounds, this program will generate a repository of unknown sounds, i.e. stereotyped sounds with no verified sound source. As the field progresses, new unidentified sounds will be collected, and more unidentified sounds can be matched to species. These sounds and their metadata can form a basis for future identification and ease mapping of the species’ distribution once the source has been confirmed. A library to archive unknown sounds and their recording times and locations will be crucial for guiding future studies of marine bioacoustics and biodiversity. This is especially important in areas that are rarely investigated or where source identification is particularly problematic, (e.g., twilight and midnight zones), where a description of unknown sounds can give us insights on biodiversity in the deep ocean (Rountree et al., 2012; Lin et al., 2019). Parallels for this work can be found in the libraries created for the description of bird, frog and insect species (e.g., Macauley Library, 2021, Kahl et al., 2021), though even these libraries often contain under-represented regions of the world.

Although a library of reference sounds requires few examples for each individual sound type, a dataset for training artificial intelligence (AI) algorithms requires a larger number of signals, ideally several thousand (e.g., Madhusudhana et al., 2020). With recent advances, studies now extract multiple features to detect the different types of signals, such as for avians (Bravo-Sanchez et al., 2021), odontocetes (Roch et al., 2021), frogs (Xie et al., 2020), and fishes (Malfante et al., 2018). As sample numbers reach critical mass, and recordings are collected under different conditions (e.g., signal-to-noise ratio, acoustic environment), a sound ‘type’ can be flagged for algorithm development. For species with more complex vocal repertoires, greater amounts of training data further improve classification, but a library that can include an entire species’ repertoire provides the ability to expand detection to a global, rather than local scale. Thus, the prerequisite to apply these techniques is robust and representative benchmark training datasets, an objective of this working group.

Similar to taxonomically focused AI applications like BirdNet and FrogID, a library of underwater biological sounds and any automated detection algorithms would be important for users with a general interest. Sound libraries are becoming invaluable to citizen scientists and the general public, with signal-processing automated detection algorithms supporting the decision networks behind apps like FrogID and Bird ID for someone to record a sound and identify the source. By fostering a deeper appreciation of underwater soundscapes we will promote greater stewardship of aquatic ecosystems.

The proposed Global Library of Underwater Biological Sounds (GLUBS) will therefore develop and merge new technologies with existing bioacoustics resources to make the exploration of biological sounds more accessible to researchers, managers, educators, and enthusiasts and assist the examples of PAM applications list above. The final objectives would include: (1) a full inventory of known underwater sound sources with multiple reference examples for each sound; (2) a baseline of unidentified biological sounds; (3) the foundation for a training platform for detection and classification algorithms; and (4) an open-access (including for citizen science/public users) database to make aquatic biological sounds more accessible to the general public. Finally, the global sharing of such an expansive database—from potentially numerous contributors—holds the potential for multiple broadscale collaborations on regional and international trends of PAM detections.

Terms of Reference (max. 250 words)

The Terms of Reference (ToR) are broad objectives for the GLUBS WG. Reaching these objectives will require activities achievable within the budget provided for SCOR working groups, as well as more comprehensive projects, for which the WG is seeking additional funding (detailed separately in the working plan and deliverables). These ToRs are:

1. Soniferous species list: Produce and continually update and open-access inventory of species that are known and anticipated to produce sound underwater.
2. Library of mammal sounds: Develop an open-access searchable tool that provides reference sounds for all aquatic mammals together with temporal and spatial variations.
3. Categorizing sound types: Develop a standard categorization process to report sounds and collate previously reported sounds into meaningful groups.
4. Library of unknown sounds: Develop an open-access searchable tool that provides reference sounds for all categorized unknown sound types together with temporal and spatial variations.
5. Artificial intelligence tools: Develop an analytical methodology for detecting, separating, and classifying underwater biological sounds via AI techniques.
6. Promote awareness of underwater sound: Develop and implement ways to engage managers, artists, citizen scientists and the general public to promote knowledge of the importance of underwater sound to marine fauna.
7. GLUBS cyberinfrastructure: Develop the flow process to integrate these systems into a practical platform that would implement GLUBS as a global application.

Working plan (logical sequence of steps to fulfil terms of reference, with timeline. Max. 1000 words)

The GLUBS working group was initiated as a sub-group of a SCOR International Quiet Ocean Experiment working group on 'Acoustic assessments of biodiversity hotspots'. GLUBS has achieved significant success while supported by SCOR-IQOE and expanded from 11 people initially to a collaboration of 43 partners at the last GLUBS meeting. The work plan identified below is an extension of the actions and goals achieved to date, under the auspices of SOCR and the IQOE.

Together with a broader group of collaborators, the SCOR working group of full and associated members will work together to maximize the ToRs. The group has been selected to ensure geographic representation (14 different countries are represented and only two full or associate members reside in any one country) and inclusivity (parity of male and female members), with both local and global experts. The group includes early and mid-career researchers who are developing to become leaders in their fields and will benefit immensely from the knowledge transfer and networking gained by taking part in this group. The group is motivated by a common goal of understanding bioacoustics, developing the use of passive acoustic monitoring as a research and management tool, and promoting the importance of underwater sound to the broader scientific and public community. The group also aims to fill the knowledge gap that has developed from the focus of research effort spent on charismatic species that is moving towards other less-studied groups that hold commercial value or are important for ecosystem function. These goals will be achieved through producing the deliverables for each of the ToRs.

Each ToR possesses its own sub-working group that will meet every three months to assess progress and the overall WG will meet online every six months and hold a hybrid meeting with as many people in person as possible, every 12 months. The last GLUBS meeting was held at WHOI on April 28th-29th, 2023 to which 31 people attended in person and 14 online (with 4 apologies), with joint funding from the Woods Hole Oceanographic Institution Morss Colloquia and Richard Lounsbery Foundation (RLF). A carbon offset fund was created to ensure the meeting was carbon neutral, which was completed by the attendees. The intention is to ensure that GLUBS activities remain as close to carbon neutral as possible.

Co-chair Sierra Jarriel is an early career researcher employed full-time by WHOI and Perpignan University to assist GLUBS in achieving its goals, under the supervision of members Aran Mooney and Lucia Di Iorio, respectively. This funding has been received through the RLF.

*Activities requiring additional funding that the WG is already exploring.

†Several of these activities include additional members of the WG member's research centres with inherent training of students and early career researchers.

ToR	Actions	Timelines
1) Inventory of soniferous species	a) Undertake literature searches and community engagement to continually update an inventory of species known and anticipated to produce sound underwater around the world, that the GLUBS WG and collaborators have already made openly accessible through the World Register of Marine Species (WoRMS). b) Publish update of the inventory highlighting changes in knowledge since Looby et al. (in prep)	Year 1 On-going Year 3
2) Mammal sounds library	a) Collate reports of soniferous behavior by aquatic mammals including individual, geographic and temporal variation. b) *Categorise these sounds using the practice developed in ToR 3. c) *Design and implement an online open-access library for these sounds, including species search functions (crossover with ToR 6)	Year 1-2 and on-going Year 2 Year 3

3)	Standardised method to categorise sounds	a) †Develop a structured practice for the standard categorization of sounds when reporting new sounds and collating previously reported sounds into meaningful groups.	Year 1-2
4)	Unknown sounds library	a) Curate a compilation of peer-reviewed papers on unidentified sounds, complete with editorial article in an open-access journal. b) Produce general interest editorial articles on the topic of unidentified sounds to promote awareness in the scientific and broader communities. c) †Collate a database of unknown sounds collected by the research centers of the GLUBS WG members and collaborators, as a basis for the development of a library of unidentified underwater sounds. d) †*Design and implement an online open-access library for these sounds, including species search functions (crossover with ToR 6)	Year 1 Years 1-3 Years 2-3 Year 3
5)	Develop AI tools to detect biological sounds	a) Explore artificial intelligence (AI) techniques for the analysis of underwater biological sounds b) †Curate benchmark datasets for the training, validation, and testing of AI models. c) †Conduct case studies to evaluate the application of AI models in real-world scenarios. d) *Develop an analytical methodology to detect, separate, and classify underwater biological sounds, and the associated contexts in which they occur.	Year 1 Year 1-2 Year 2 Years 1-3
6)	Promote awareness of underwater sound	a) †Reporting of WG activities through social media and bioacoustics forums to broaden the reach of the GLUBS WG for ToR 1-4 and promote awareness of aquatic sound. b) †Develop media (e.g., training videos, presentations, reference material) to assist in building best practice methods with students, early career researchers and scientists new to underwater bioacoustics c) †Develop or assist in producing novel infrastructure and media to engage the general public in awareness of underwater sound (e.g., interactive displays, education challenges, artistic displays)	On-going On-going On-going
7)	GLUBS cyberinfrastructure	a) Build and present a list of existing applications and reference material relevant to underwater bioacoustics and describing their data offerings, standards, and website functionality. b) Identify requirements and flow process for the cyberinfrastructure required to complete ToRs 2, and 4. c) Identify requirements and flow process to integrate the fullest extent of ToRs 5 and 6 with the libraries mentioned in ToRs 2 and 4. d) *Implement cyberinfrastructure for ToR 7b and 7c	Year 1 Year 2 Year 2-3 Year 3

Deliverables (state clearly what products the WG will generate. Should relate to the terms of reference. Max 250 words). A workshop is not a deliverable. Please note that SCOR prefers that publications be in open-access journals.

The working group will deliver the following outputs with respect to each of the terms of reference (all publications will be open-access, '*' marks deliverables that require additional funding):

ToR	Deliverable	Timing
1)	Up-to-date species list available on WoRMS	On-going
	Publication on new species identified as soniferous between 2023 and 2026	2026
2 a and b)	*Publication of categorized underwater sounds of aquatic mammals by species, geographic location and time	2025
2c)	*Open-access library of underwater sounds of aquatic mammals	2026
3)	Peer-reviewed article on a standard method to characterize sounds. Implementation of ToR 3 in deliverables for ToRs 2 and 4.	2025 2026
4a)	Research Topic compilation of papers on unidentified sounds in Frontiers in Remote Sensing, including an editorial synopsis	2024
4b)	Editorial article on unidentified sounds in general science magazines	2025
4d)	*Open-access library of underwater unidentified sounds	2026
5b)	Open access dataset and accompanying publication on the use of AI detection algorithms to assess a fish community	2025
5c)	A collection of annotated open access datasets for the machine learning community to test their algorithms	2025
5d)	Papers outlining a variety of AI detection algorithms	2026
6)	A synopsis of media materials produced to promote awareness of aquatic sound	Annual
	A suite of produced reference materials	2026
7a)	Publication and webpage outlining existing applications relevant to underwater bioacoustics and GLUBS	2025
7b and c)	Report on the required infrastructure to implement GLUBS libraries	2025
7)	*Implemented open access, web-based platform, GLUBS (encompasses deliverables 2c) and 4d)	2026

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

The GLUBS mission statement is to 'Develop and merge new technologies with existing bioacoustics resources to make the exploration of biological sounds more accessible to researchers, managers, educators, and enthusiasts. By fostering a deeper appreciation of underwater soundscapes we will promote greater stewardship of aquatic ecosystems.' GLUBS is at its very essence, an exercise in building capacity for bioacoustics research into the future. The overarching goal of a platform to assist multiple stakeholder sectors to better understand the importance of sound to marine fauna and how to collect, process, assess and report bioacoustic data is a paradigm shift in building wholesale capacity for the field.

To achieve this goal, GLUBS has brought together multiple centers focused on acoustics and artificial intelligence, as a unified group, to share expertise. In addition, full WG member Sierra Jarriel is an early career researcher that has been employed through a RLF grant to assist in achieving GLUBS objectives and build capacity and relationships between research groups in France and the US. She will spend time in each country to develop research priorities and will gain additional experience and co-chair of this working group.

The GLUBS WG listed here contains members from multiple developing countries and a broader GLUBS collaboration includes an additional 24 partners from various institutes around the world (14 countries total). This collaboration provides good geographic representations with members from five continents and will continue to encourage involvement from researchers in areas that are under-represented. This is important as some of the most poorly understood regions and species are associated with economically poor areas that often have unsustainable or unregulated fishing and use of aquatic resources.

In terms of earl career researchers, this broader collaboration includes one Masters student, one staff member about to commence a PhD and three PhD students, as well as multiple early- and mid-career researchers. These members will be involved in on-going discussions through the working group as a whole and as part of the ToRs. Many of the tasks required in this working group require not only the experience gained through decades of acoustics research, but also innovative methods of analysis and presentation, social engagement and novel cyberinfrastructure development that benefit from inventive minds and different perspectives. In this way, GLUBS will not only build capacity in early and mid-career researchers, but also develop the skills of the more experienced in the team.

Many of GLUBS's partners hail from research centers that include students and early career researchers, several of which will be involved in the development of several of the ToRs listed above, notably the development of a library of unknown sounds. In doing so, they will be heavily involved in the research conducted by GLUBS, contribute to the development of training materials, receive interactions with several senior researchers and will be included as authors on papers, where appropriate. This alone will provide a collective development of capacity for the bioacoustics research field into the future.

Each of the ToRs listed in this proposal are the responsibility of a sub-working group within the GLUBS collaboration. While several of the tasks described above are within the scope of the SCOR WG funding, these sub-working groups have been tasked with securing funding to complete the overarching objective of their respective ToR, as an extension for the activities supported by the SCOR.

Finally, ToR 6 is specifically designed to build capacity of researchers and students already studying the bioacoustics field, through for example, training videos and workshops, but also to engage the general public through interactive materials and community projects. These may be goals of individual partners, that GLUBS can support, or through collective discussion to identify and implement novel engagement activities.

Working Group composition (as table). Divide by Full Members (10 people) and Associate Members, taking note of scientific discipline spread, geographical spread, gender balance, and participation by early-career scientists (max. 500 words)

Full Members (no more than 10, please identify chair(s))

Name	Gender	Place of work	Expertise relevant to proposal (years post PhD)
1 Miles Parsons (co-chair)	Male	Australia	Acoustician focused on fishes and soundscapes around Australia (14)
2 Sierra Jarriel (co-chair)	Female	US	Behavioural ecologist with recent experience in bioacoustics, focusing on coral reef soundscapes. Employed by GLUBS to assist in achieving ToRs (0)
3 Lucia Di Iorio	Female	France	Acoustician focused on acoustic communities and soundscapes around Europe (17)
4 Tzu-Hao Lin	Male	Taiwan	Signal processing artificial intelligence with experience collecting sounds of marine fauna around Asia (10)
5 Aaron Rice	Male	US	Acoustician focused on fish sounds with experience in developing sound libraries (14)
6 Tess Gridley	Female	South Africa	Marine mammal specialist with a focus on cetaceans and biological sounds around Africa (10)
7 Shyam Madhusudhana	Male	Mauritius	Artificial intelligence and machine learning techniques to detect biological sounds (8)
8 Renata Sousa-Lima	Female	Brazil	Acoustician focused on marine mammal sounds around South America (16)
9 Louisa van Zeeland	Female	UK	Artificial intelligence with expertise in detecting marine mammal sounds (13)
10 Fannie Shabangu	Male	South Africa	Acoustician focused on marine mammal sounds around Africa (5)

Associate Member (no more than 10)

Name	Gender	Place of work	Expertise relevant to proposal
1 Jenni Stanley	Female	New Zealand	Acoustician focused on fish, invertebrates and soundscapes, particularly around the US and New Zealand

2 Kranthikumar Chanda	Male	India	Acoustician with experience in machine learning to detect and classify fish calls, with particular focus around Indian ocean region.
3 Laela Sayigh	Female	US	Acoustician focused on the behavioral ecology of marine mammals. Involved in the development of the Watkins sound library.
4 Fabio Frazao	Male	Canada	Artificial intelligence expert with experience in cyberinfrastructure design and platform build
5 Aran Mooney	Male	US	Acoustician focused on behavioral responses of marine fauna to anthropogenic activities and fauna contributing to the soundscapes of coral reefs
6 Sophie Nedelec	Female	UK	Acoustician focused on particle motion component of biological sounds with significant experience in citizen science and community engagement.
7 Songhai Li	Male	China	Acoustician focused on the analysis of soundscapes around the Asia region and involved in the development of the Worldwide Soundscape project web platform.
8 Karolin Thomisch	Female	Germany	Acoustician with expertise in web development for data repository portals
9 Filipa Samara	Female	Iceland	Acoustic ecologist focused on marine mammals around arctic waters.
10 Simon Linke	Male	Australia	Acoustic ecologist with a focus on freshwater sounds of fishes and invertebrates.

Working Group contributions (max. 500 words)

Detail for each Full Member (max. 2 sentences per member) why she/he is being proposed as a Full Member of the Working Group, what is her/his unique contribution?

1) Miles Parsons (co-chair): Convening meetings and ensuring momentum between meetings to achieve WG objectives. Specialty in marine soundscapes, fish vocalizations and behavioral response of animals to stressors, (e.g., anthropogenic activities), with particular focus on Australasian fauna.
2) Sierra Jarriel (co-chair): Convening meetings, completing administration and ensuring momentum between meetings. Early career researcher, employed through WHOI and University of Perpignan to progress GLUBS activities and build capacity and relationships between French and American research groups as part of a Richard Lounsbery Foundation grant awarded to GLUBS partners.
3) Lucia Di Iorio: Acoustician with 20 years of experience with in understanding the impacts and

currently involved in the design and implementation of a European library of aquatic anthropogenic sounds.

4) Tsu-Hao Lin: Co-leading artificial intelligence components of the working group, with particular expertise in unsupervised classification techniques. Over ten years of experience studying vocalizations of marine animals around Asia.
5) Aaron Rice: Acoustician with 20 years of experience in fish and bird vocalizations, behavioral and biomorphological drivers behind the types of sounds produced. Involved in the setup of the Macauley library of sounds.
6) Tess Gridley: Marine mammal scientist specializing in vocal behaviors of cetaceans and distribution of marine mammals around Africa. Founding director of the African Bioacoustics Community.
7) Shyam Madhusudhana: Artificial intelligence expert with nearly twenty years' experience in signal processing and developing signal detectors for biological signals (marine mammals, insects, birds).
8) Renata Sousa-Lima: Expert in vocalizations of terrestrial and marine mammals and reptiles from around South America, with particular emphasis on changes in vocal behavior in response to noise.
9) Louisa van Zeeland: Co-leading artificial intelligence components of the working group with particular expertise in the use of machine learning to detect marine mammal signals.
10) Fannie Shabangu: Early career researcher with expertise in bioacoustics of marine mammals around Africa and recently completed an assessment of seven decades of bioacoustics research in the continent.

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

The GLUBS working group is linked to SCOR's International Quiet Ocean Experiment (IQOE) WG. GLUBS were initiated as part of the IQOE's working group on Acoustic Measurement of Biodiversity Hotspots. GLUBS maintains close ties with both of these working groups.

Close collaborators with the GLUBS working group have developed FishSound.net, an inventory of all known soniferous fish species around the world. The GLUBS WG and Fishsounds recently collaborated to produce a list of all species known and anticipated to produce sound for the WoRMS database (Looby et al., in prep). The two groups will continue to collaborate to promote the use of PAM in aquatic research and management, and to produce impactful studies and publications on aquatic bioacoustics.

The GLUBS WG is building links with the WorldWide Scoundscape project and GLUBS partners have provided the platform with multiple datasets (Darras et al., 2023, in review), a platform that hosts and analyses terrestrial and aquatic soundscapes from around the world.

Key References (max. 500 words)

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Appendix

Miles Parsons

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