

2022 Annual SCOR Working Group Report

Summary

A special issue the ICES (International Council for the Exploration of the Sea) Journal of Marine Science entitled, Patterns of biodiversity of marine zooplankton based on molecular analysis, was organized by WG157 members. (see https://academic.oup.com/icesjms/pages/themed_sets).

WG157 members chaired a session at the 2022 Ocean Sciences Meeting, Zooplankton diversity through space and time, (March 2-3, 2022; virtual) that was well-attended, with enthusiastic discussions. Of 28 presentations, 18 were led by early career scientists (ECS) and 9 included WG157 members as co-authors.

MetaZooGene SCOR WG157 was endorsed as a new UN Ocean Decade Action (No.102.2) linked to Marine Life 2030 (<https://marinelife2030.org/>). An announcement is posted on the MetaZooGene website (<https://metazoogene.org/ocean-decade-action>).

SCOR WG157 members have organized and will convene a special MetaZooGene Symposium, New insights into biodiversity, biogeography, ecology, and evolution of marine zooplankton based on molecular approaches, in association with the ICES Annual Science Conference (Hybrid; Dublin, Ireland; September 23, 2022). The program currently includes 26 presentations, of which 14 are by Early Career Scientists (ECS), and 16 include WG157 members as co-authors (see: <https://metazoogene.org/planned/symposium2022>).

Work toward WG157 deliverables has continued despite ongoing challenges, with primary focus on online and virtual activities. To date, MetaZooGene members have published 11 papers in the peer-reviewed scientific literature acknowledging SCOR support. MetaZooGene has also been successful in engaging significant numbers of Early Career Scientists (ECS) in all WG157 activities, including publication, meetings, and special sessions at conferences and symposia.

1. Name of group

SCOR WG157 MetaZooGene: Toward a new global view of marine zooplankton biodiversity based on DNA metabarcoding and reference DNA sequence databases

2. Activities since previous report to SCOR (e.g., virtual or in-person meetings, email discussions, special sessions). Limit 1000 words

Virtual Meetings for Creation of MetaZooGene Barcode Atlas & Database:

Planning and cooperation among WG157 members was carried out through email, virtual meetings, and an online work area (<https://metazoogene.org/work-area-login>) with project-related folders for sharing files and preparing documents and manuscripts.

Special journal issue of the ICES Journal of Marine Science:

A Themed Set of the ICES (International Council for the Exploration of the Sea) **Journal of Marine Science** entitled, *Patterns of biodiversity of marine zooplankton based on molecular analysis*, was organized by WG157 members Ann Bucklin, Katja Peijnenburg, Ksenia Kosobokova and Ryuji Machida, who also wrote an overview and introduction for the special issue. In all, 15 manuscripts were included in the special issue, of which 7 were co-authored by WG157 members, and 3 acknowledged SCOR and NSF funding (see https://academic.oup.com/icesjms/pages/themed_sets).

Special Session at Ocean Sciences Meeting:

OSM 2022 Session ME20, *Zooplankton diversity through space and time*, was chaired by Katja Peijnenburg*, Erica Goetze*, Galice Hoarau, and Matthew Miller. The conference was entirely virtual and Session ME20 was scheduled on March 2-3, 2022. The session was well-organized and very well-attended, with enthusiastic discussions and excellent presentations. Of 28 presentations, 18 were led by early career scientists (ECS) and 9 included WG157 members as co-authors (listed below; WG157 members indicated by asterisk *).

- *Impact of copepod diversity on carbon export using imaging and environmental data*. Margaux Perhirin (ECS, Sorbonne Université), Jessica Godfrey, Hannah Gossner, Amy Maas, Rodney Johnson, Sakina-Dorothee Ayata, Leocadio Blanco-Bercial*

- *Cryptic speciation in the open ocean: planktonic calcifier *Limacina bulimoides* (Pteropoda) shows genetically divergent lineages within and between ocean basins*. Le Qin Choo (ECS, Naturalis Biodiversity Center), Giada Spaggiardi, Marvin Choquet, Erica Goetze*, Galice Hoarau, Katja Peijnenburg*

- *Merging integrative taxonomy and the biogeochemical contributions of the euphausiids in the Sargasso Sea*. Yuuki Niimi (ECS, Arizona State University), Leocadio Blanco-Bercial*, Amy Maas, Nancy Mercado Salas, Stephanie Köhnik, Susanne Neuer

- *Pteropod shell proteomes reveal distinct biomineralization toolkits in the formation of crossed lamellar and helical microstructures*. Paula Ramos-Silva (ECS, Naturalis Biodiversity Center), George Janssen, Frédéric Marin, Erica Goetze*, Peter van Veelen, Katja Peijnenburg*

- *The MetaZooGene Barcode Atlas and Database (MZGdb): an interactive resource for molecular zooplankton biodiversity research*. Todd O'Brien* (NOAA Fisheries)

- *Vertical patterns of zooplankton diversity over the Atacama Trench in the Southeast Pacific assessed by metabarcoding analysis*. Carolina González (ECS, Instituto Milenio de Oceanografía), Leocadio Blanco-Bercial*, Ruben Escribano*, Osvaldo Ulloa

- *Global ocean mesozooplankton DNA metabarcoding reveals patterns of diversity and distribution across horizontal and vertical gradients*. Oriol Canals (AZTI, Marine Research), Jon Corell, Eva Aylagas, Iñak Mendibil, Craig Mitchell, Ernesto Villarino, Juan Ignacio González-Gordillo, Guillem Chust, Xabier Irigoien, Naiara Rodríguez-Ezpeleta*

- *Latitudinal and vertical gradients in zooplankton size class and diversity*. Hannah Gossner (ECS, Bermuda Institute of Ocean Sciences), Amy Maas, Rocio Rodriguez-Perez, Kevin Yongblah, Leocadio Blanco-Bercial* (Poster)

- *DNA metabarcoding of zooplankton species diversity for ecosystem monitoring on NW Atlantic continental shelf*. Ann Bucklin* (University of Connecticut), Paola Batta-Lona, Jennifer Questel, David Richardson, Nancy Copley, Todd O'Brien*, Peter Wiebe (Poster)

3. Documents published since previous report to SCOR (e.g., peer-reviewed journal articles, reports, Web pages) and should be limited to publications that resulted directly from WG activities and which acknowledge SCOR support

Bucklin, A., J.M. Questel, L. Blanco-Bercial, S.B. Smolenack, A. Frenzel, and P.H. Wiebe (2021) Population connectivity of the euphausiid, *Stylocheiron elongatum*, in the Gulf Stream (NW Atlantic Ocean) in relation to COI barcode diversity of *Stylocheiron* species. ICES Journal of Marine Science 78(9): 3464–3476. <https://doi.org/10.1093/icesjms/fsab158> (Acknowledges SCOR WG157 & NSF)

Bucklin, A., K.T.C.A. Peijnenburg, K.N. Kosobokova, and R. Machida (2021) New insights into biodiversity, biogeography, ecology, and evolution of marine zooplankton based on molecular approaches. ICES Journal of Marine Science 78(9): 3281–3287. <https://doi.org/10.1093/icesjms/fsab198> (Acknowledges SCOR WG157 & NSF)

Bucklin, A., P.G. Batta-Lona, J.M. Questel, P.H. Wiebe, D.E. Richardson, N.J. Copley and T.D. O'Brien (2022) COI metabarcoding of zooplankton species diversity for time-series monitoring of the NW Atlantic continental shelf. Front. Mar. Sci. 9:867893. <https://doi.org/10.3389/fmars.2022.867893> (Acknowledges SCOR WG157 & NSF)

DiCapua, I., R. D'Angiolo, R. Piredda, C. Minucci, F. Boero, M. Uttieri, and Y. Carotenuto (2022) From phenotypes to genotypes and back: Toward an integrated evaluation of biodiversity in calanoid copepods. Front. Mar. Sci. 9:833089. <https://doi.org/10.3389/fmars.2022.833089> (Acknowledges SCOR WG157)

4. Progress toward achieving group's terms of reference. List each term of reference separately and describe progress on each one. Limit 1000 words

ToR 1) Create an open-access web portal for DNA barcodes for marine zooplankton

The MetaZooGene Atlas and Database (MZGdb; <https://metazoogene.org/atlas>) now includes a total of 218,299 barcode sequences for cytochrome oxidase I (COI) for 11,356 (25%) of the total 45,345 recognized species of marine zooplankton. The MZGdb creator, WG157 member Todd O'Brien (NOAA Fisheries) has expanded the database to include multiple gene regions used as barcodes and has

added fish to the zooplankton focus. Collection records from the OBIS and COPEPOD databases, barcoding coverage, and summary statistics have been generated for >80 taxonomic groups for multiple ocean basins and regions. The MZGdb is a unique and valuable resource for biodiversity researchers and fisheries managers, allowing targeted searches by ocean regions and taxonomic groups, and providing coverage statistics that guide priorities for efforts toward a complete reference database for marine zooplankton.

ToR 2) Design an optimal DNA barcoding pipeline for marine zooplankton

A published summary of recommended protocols for DNA barcoding of marine zooplankton based on cytochrome oxidase I (COI) remains an important deliverable for WG157. Several WG157 members (led by WG157 chair Ann Bucklin) have accepted an invitation from an editor of a planned book focused on molecular protocols. The MetaZooGene chapter will be designed to provide guidelines for DNA barcoding of marine zooplankton, including preservation and sequencing of identified specimens, and analysis and interpretation of DNA barcode data. The target audience for the book chapter will include curators of museum collections and researchers focused on diverse topics requiring accurate identification of species.

ToR 3) Develop best practices for DNA metabarcoding of marine zooplankton biodiversity

WG157 members are planning a metabarcoding inter-calibration experiment, which will entail distribution of a set of reference samples among the laboratories of participating WG157 members. The eventual publication will compare results for the reference samples and evaluate the impact and significance of different molecular, bioinformatics, and statistics protocols and parameters used by the research groups. Continued progress on this deliverable is planned for 2022-2023.

5. WG activities planned for the coming year. Limit 500 words

MetaZooGene Symposium @ ICES 2022 Annual Science Conference

SCOR WG157 will sponsor a symposium, *New insights into biodiversity, biogeography, ecology, and evolution of marine zooplankton based on molecular approaches*, in association with the ICES Annual Science Conference (Hybrid; Dublin, Ireland; September 23, 2022). Convenors are Ann Bucklin* (USA), Katja Peijnenburg* (NL), Leocadio Blanco-Bercial* (BM), and Silke Laakmann* (DE). The program currently includes 26 presentations, of which 14 are by Early Career Scientists (ECS), and 16 include WG157 members as co-authors (see: <https://metazoogene.org/planned/symposium2022>).

Planning for Capacity Building Workshops

Hands-on 'DNA-to-data' training workshop, organized by Ryuji Machida, Academia Sinica (Taipei, Taiwan). A workshop is in (tentative) planning stages. Funding will be requested from SCOR, PICES, and other sources.

Support for Early Career Scientists

Early Career participants will continue to be invited and actively encouraged to participate in all WG157 activities, including meetings, special sessions at conferences, and publications. These efforts have been very successful in ensuring significant numbers of ECS colleagues at conferences, special sessions, and symposia. Special attention to active participation of ECS will be expanded whenever and however possible.

Continued Progress on Deliverables

Progress on Terms of Reference and Deliverables will continue online and via web resources, including project-specific virtual “work areas” for WG157 members.

6. Is the group having difficulties expected in achieving terms of reference or meeting original time schedule? If so, why, and what is being done to address the difficulties Limit 200 words

Work toward WG157 deliverables has continued despite ongoing challenges, with primary focus on online and virtual activities. Activities requiring international travel and in-person collaboration have been postponed or cancelled since Spring 2020. In most cases, the planned activity has been carried out virtually, including international conferences and symposia. A special online work area with folders for MetaZooGene goals and activities was created to allow WG157 members to access and share documents and files (see <https://metazoogene.org/work-area-login>), which is not possible for all WG157 using other web platforms.

7. Any special comments or requests to SCOR. Limit 100 words.

We are requesting that WG157 be granted approval for a no cost extension of one year to December 31, 2023. The additional time will be used to carry out planned activities in association with ToRs, including: continued expansion of the MetaZooGene Atlas & Database (ToR 1); ongoing intercalibration experiment for metabarcoding zooplankton diversity with reference samples from 10 WG157 research groups (ToR 3); and approved MetaZooGene UN Ocean Decade Action (No. 102.2). We also request that WG157 be allowed to use any remaining funds to work on these activities during the additional year.

Additional information can be submitted and will be included in the background book for the SCOR meeting at the discretion of the SCOR Executive Committee Reporter for the WG and the SCOR Secretariat.