WORKING GROUP ON INTEGRATED MORPHOLOGICAL AND MOLECULAR TAXONOMY (WGIMT)

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Contents

i Executive summary

The ICES Working Group on Integrated Morphological and Molecular Taxonomy (WGIMT) met in Las Palmas de Gran Canaria, Spain, on 15 March 2019. The meeting was chaired by Naiara Rodriguez-Ezpeleta (Spain) and Elaine Fileman (UK) and attended by 17 scientists representing 7 countries. During the meeting, WGIMT members reviewed progress on multi-annual ToRs, reports, and recommendations; evaluated progress on existing ToRs and sought opportunities for partnerships in the ICES science community.

WGIMT membership currently totals 50 members from 18 countries; new members were added again this year, continuing the steady increase in membership numbers each year since 2013. This trend is consistent with WGIMT goals to recruit and welcome new members (ToR A), in order to enhance our capacity for developing and using molecular and morphological approaches to taxonomic analysis of zooplankton.

Initial development of the WGIMT web platform has been completed (ToR B), it will continue to be updated and expanded as WGIMT continues into the future.

WGIMT continued work to initiate and support provision of standards, preparation of training materials, and organization of formal workshops (ToR C).

WGIMT members have been involved as expert instructors and/or organizers for two workshops this year. WGIMT promoted and encouraged the continuing integration of molecular and morphological taxonomy by organizing special sessions at national and international conferences, including 2018 ICES Annual Science Conference and 2019 Ocean Science meeting and the upcoming 2019 ICES Annual Science Conference (ToR D).

WGIMT is seeking avenues via the Ecosystem Processes and Dynamics Steering Group and other science expert groups to advise on implications and applications of integrative taxonomy for marine science and management (ToR E).

During 2018–2019, WGIMT members published at least 10 relevant peer-reviewed articles directly related to the core mission and goals of the EG (ToR F).

WGIMT collaborated with the Working Group on Zooplankton Ecology (WGZE) and the Working Group on Phytoplankton and Microbial Ecology (WGPME) on a joint ToR to determine the status of microzooplankton time-series data collection within the ICES area, which assessed progress made in this area over the last ten years (ToR G).

Discussions were undertaken with WGZE and WGPME on gap analysis and taxonomic consistency of molecular databases to identify where taxonomists and geneticists should work together (ToR H).

ii Expert group information

Expert group name	Working Group on Integrated Morphological and Molecular Taxonomy (WGIMT)
Expert group cycle	Multiannual fixed term
Year cycle started	2017
Reporting year in cycle	3/3
Chair(s)	Naiara Rodriguez-Ezpeleta (Spain)
	Elaine Fileman (UK)
Meeting venue(s) and dates	31 March 2017 Boulogne-Sur-Mer, France (17 participants)
	24 March 2018 Helsinki, Finland (18)
	15 March 2019 Las Palmas de Gran Canaria, Spain (17)

1 Introduction

The main focus of the ICES Working Group on Integrated Morphological and Molecular Taxonomy (WGIMT) is to promote and provide new tools for species-level taxonomic analysis of the pelagic ecosystem. WGIMT works towards these objectives with a particular focus on species recognition, discrimination, and identification of marine metazoan zooplankton. Closely allied with this are more specific goals, including the detection of cryptic species and determination of the evolutionary/systematic relationships between pelagic metazoan species. WGIMT seeks to contribute to efforts to analyse, recognise, and understand changes in community structure, species diversity, and species phenology and productivity. Furthermore, the group contributes to ICES efforts to understand and predict how these characteristics will affect foodwebs and trophic relationships, as well as the transfers and cycles of nutrients, chemical elements, energy, and biological production. In addition to the ICES-hosted WGIMT brief overview page (http://www.ices.dk/community/groups/Pages/WGIMT.aspx), WGIMT has designed and maintains a web portal (http://wgimt.net) to facilitate access to useful websites, materials, and online publications related to morphological, molecular, and optical approaches to species identification of marine zooplankton.

2 ToR A: Ensure balanced morphological – molecular expertise among membership of WGIMT

Group membership includes expert morphological taxonomists for selected groups represented amongst the pelagic assemblage, as well as experts who use molecular approaches and techniques to examine a broad range of basic and applied research topics in zooplankton systematics, ecology, and evolution (Table 1). WGIMT membership has grown consistently each year since its creation. WGIMT membership now totals 50 members from 18 countries (as of March 2019) and a number of these are members of other ICES SCICOM WGs, including WGZE, WGPME, WGBOSV, WGITMO, WGAGFA, WGCEPH, WGINOR, WGIAB, WGDIG.

Table 1. Balance between members with morphological and molecular expertise at 2018 meeting.

Area of Expertise	Number	%
Morphological	8	44
Molecular	3	17
Both	5	28
None	2	11
Zooplankton	14	88
Phytoplankton	1	6
Fish	0	0
Eukaryotes	1	6

New members are welcome, especially those who develop and use molecular and/or morphological approaches to taxonomic analysis of zooplankton. Membership in WGIMT extends to scientists working in any ocean region, in addition to the ICES area.

3 ToR B: Fully populate the WGIMT web platform with information, protocols and resources to support progress in research and development

Locating and accessing morphological and molecular taxonomic information can be difficult: some classical taxonomic references are out-of-print or in a non-digital format; many molecular data are not released prior to publication and a broad variety of methodologies and approaches exist, possibly overwhelming potential new comers to the field. The WGIMT Resource Portal was developed between 2013 and 2016 and has continued to be expanded and updated over the past 3-year term. The portal provides information overviews and links to relevant literature and web pages, with a special focus on the use of molecular technologies (and morphological verification) for the integrative taxonomy of zooplankton. Open access to this information will expand use of state-of-the-art molecular technologies (e.g., High-Throughput Sequencing) for integrative taxonomy of zooplankton.

The portal comprises two sections

The *Morphological Methods* topic area includes:

- Overview: This section is a brief introduction to the topics and issues of morphological species identification.
- Identification Keys: This section provides a collection of web links (if online media) and literature references (if published media) for zooplankton taxonomic keys and identification resources. This section spotlights the ICES *Identification Leaflets for Zooplankton*, which are being updated and refreshed by WGIMT/ WGZE in an effort expected to continue over the next few years (see description for ToR c, below).
- Photo Gallery: This section features over 1072 photographs of plankton migrated from the Census of Marine Zooplankton (CMarZ) project and/or contributed by WGIMT, WGZE and WGPME members (Figure 1). The photos are stored in "COPEPEDIA, http://copepedia.org/", a relational taxonomic database collaboratively developed by COPEPOD / WGIMT / WGZE / WGPME. The photos are each stored under their associated taxonomic name, along with observational distribution maps and (where available) molecular primer, biometric, and size/biomass information for that taxa (COPEPEDIA represents the effort and output from multiple ToRS in the WGIMT, WGZE, and WGPME working groups).

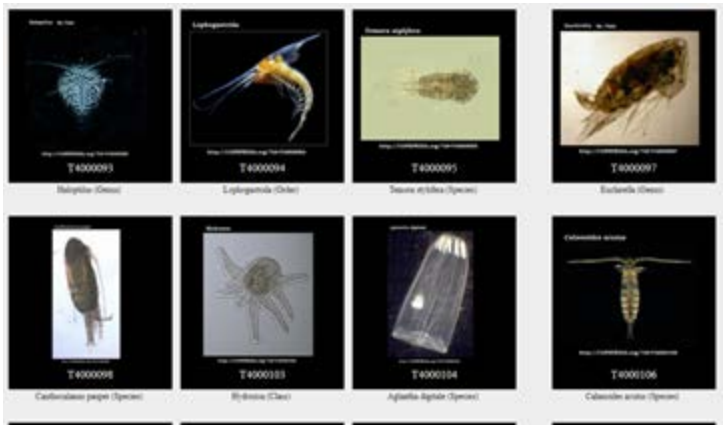

Figure 1. Selected images from the WGIMT.net photo gallery

- Optical Methods: This section gives an overview of optical methods for plankton identification. It provides examples of eleven different optical sampling instruments, including photographs of each instrument as well as literature and web links for more information.

The *Molecular Methods* topic area includes:

- Overview: This section is a brief introduction to the topics and issues of genetic and metagenetic analysis of zooplankton.
- Primers & Protocols: This section gives access to a database of over 100 PCR and sequencing primers . The data elements can be accessed all-together in a single spread sheet, or they can be accessed via their associated taxa entries in COPEPEDIA (as mentioned in the Photo Gallery section above).
- Literature: This section contains a listing of over 67 publications providing protocols, methods, and sequencing primer references.

4 ToR C: Initiate and support provision of standards, training materials, and taxonomy workshops

Workshops, including ICES Taxonomy Workshops, are very effective in engaging target audiences and ensuring trained technicians and researchers for applications in fisheries and ecosystem management. Co-sponsored workshops and meetings with other SCICOM EGs will increase impact and likelihood of application for advisory applications. WGIMT members have been involved with a number of initiatives workshops and training courses over the past three years.

Taxonomy has been revitalized in recent years by the use of molecular tools to improve our understanding of marine biodiversity, ecosystem functioning and services. Stazione Zoologica Anton Dohrn (SZN, Naples, Italy) has a long tradition in taxonomic studies since its foundation in 1872 and still has numerous taxonomic experts on marine organisms, especially for plankton and benthos as well as a Molecular Biology and Bioinformatic Unit. SZN is the centre for the national MOTax network which coordinates and promotes a range of taxonomy initiatives and provides specialized services based on integrated morphological and molecular taxonomy as part of EMBRC-IT. Italian taxonomists have been tasked with identifying a national reference community for systematics and taxonomy of marine organisms (from bacteria to fish) and to provide a common portfolio of taxonomic services and skills as a distributed service. A quarterly newsletter is published on the SZN website to report and update about events, references, congresses and meetings. The MOTax Service is going to provide: 1) integrated morphological and molecular identification; 2) isolation and cultivation of target marine organisms; 3) access to, and supply of, certified marine organisms; 4) revision and update of checklists; 5) advanced training and courses.

The workshop Plankbios "Present and future plankton biogeography and the link between community structure, marine ecosystem functioning and ecosystem service provision" was held at ATZI (Spain) on 13–15 June 2017. Relevant topics presented and discussed at the workshop were biogeography, biodiversity, ecological niches and connectivity, and the numerical tools to address the databases to answer questions related to these topics.

A workshop "Towards an European observatory of the invasive calanoid copepod *Pseudodiaptomus marinus*" was held at SZN, Naples, Italy, on 29–30 January 2018. The topic of this workshop was directly related to research and advisory goals of several science expert groups, including WGIMT.

The 1st Advanced Zooplankton Course (AZC1), organised by M. Grazia Mazzocchi, was held between 22 October and 2 November 2018 at SZN. This course was endorsed by WGIMT as it was directly related to goals of the Working Group. The MOTax at SZN intends to start a series of courses on zooplankton taxonomy by integrating morphological and molecular approaches. For this first year, the course sponsored by Leica with endorsement by ICES and the World Copepod Association (WAC) focused on marine copepods. The main aim of the course was to increase and update the expertise in the taxonomy and species identification of selected copepod families commonly and abundantly distributed in epipelagic and/or mesopelagic waters, by integrating morphological and molecular approaches. It also provided an opportunity for participants to interact and discuss with specialized experts on new challenges of marine copepod taxonomy in the molecular era.

In conjunction with WGZE, WGIMT has been involved in the update and revision of the ICES Plankton Leaflets. The series is being launched using a new format that includes ecological and molecular information as well as the morphological identification keys. There are currently 7

Leaflets in preparation, and the first leaflet on the Cyclopoid copepod Oithona, edited by Maria Grazia Mazzocchi has been published on the ICES website.

https://www.ices.dk/sites/pub/PublicationReports/Planktonleaflets/IDPlankton_188.pdf.

5 ToR D: Demonstrate leadership in promoting and encouraging use of integrative taxonomic approaches for assessment of pelagic biodiversity

Integrative taxonomy is an emergent field; uses and applications for fisheries and ecosystem management should be explained in high-visibility settings in ICES and other organisations through special sessions.

WGIMT members have taken the lead in organizing special sessions at national and international conferences each year, including: ASLO/AGU/TOS Ocean Sciences Meetings, ICES Annual Science Conference. The sessions have examined a broad range of methodologies, provided overviews of recent results using diverse types of data, and encouraged discussion on opportunities and challenges of integrative taxonomy of marine planktonic assemblages.

- ICES 2017 Annual Science Conference (Sept. 2017, Fort Lauderdale, FL); Theme Session C: Microbes to mammals: metabarcoding of the marine pelagic assemblage; co-convenors: Ann Bucklin (USA), Rowena Stern (UK), Katja Metfies (Germany).
- ASLO/AGU 2018 Ocean Sciences Meeting (Feb. 2018, Portland, OR); Rediscovering marine biodiversity: progress, promise, and challenges of metabarcoding of microbes to mammals; co-chairs: Ann Bucklin (USA); Leocadio Blanco-Bercial (Bermuda); Ryuji Machida (Taiwan).
- ICES 2018 Annual Science Conference (September 2018, Hamburg, Germany); Session M: Molecules and morphology: Integrative taxonomic analysis of marine planktonic assemblages; co-convenors: Pennie Lindeque (UK); Lidia Yebra (Spain); Ann Bucklin (USA).
- ICES 2019 Annual Science conference (September 2019, Gothenburg, Sweden); Session K New approaches to the understanding of energy transfer through the food webs. Co-convenors: Hildur Pétursdóttir (Iceland), Janna Peters (Germany), Marie Johansen (Sweden).

6 ToR E: Advise on the implications of developments for marine science and management

Integrative taxonomy (e.g., 'library' of DNA sequences for accurately-identified species) can provide a foundation for genetic methods for assessing species, diversity and abundance in integrated ecosystem assessments. Standardized metagenetic data can fulfil requirements of biodiversity assessments (WGZE, WGPME) and indicators defined in the Marine Strategy Framework Directive (WGAGFM).

Metagenetic analysis (also called metabarcoding) has the potential to rapidly detect and describe marine biodiversity, and can consequently contribute to improve our understanding of the impacts of climate change and anthropogenic effects on marine ecosystems. Yet, before this is possible, standardization and validation of metabarcoding analytical approaches is necessary for development of practical indicators and useful applications for assessment and management of pelagic ecosystems, including calculation of biotic indices, targeted detection of indicator species, food-web analysis, and detection of introduced, non-indigenous species

This ToR aims at: i) promoting and facilitating the use of integrative morphological – molecular taxonomy as a foundation for assessing species diversity and abundance of marine organisms, especially zooplankton, in integrated ecosystem assessments; ii) leading to standardization of metagenetic and metabarcoding approaches to fulfil requirements of biodiversity assessments and indicators defined in the Marine Strategy Framework Directive (MSFD). For that aim, members of the WGIMT have shared the work they are performing in this field as well as that carried out in collaboration with other Working Groups such as the WGPME, WGAGFM, WGZE.

During the development of this ToR, members of the group discussed applications of metabarcoding that are related to marine management while highlighting the challenges for a routine use of this technique.

The following WGIMT activities provide support to ICES scientific and advisory goals and priorities:

- **Detection of non-indigenous species (NIS) in ballast water and performing port baseline surveys** this work is being performed within the project Aquainvad-ED (https://www.aquainvad-ed.com/).
- **Determining environmental status through the measurement of indicators included in the MSFD**. This work has been performed through the DEVOTES project (http://www.devotes-project.eu/), with continuation through collaboration with local agencies. The analyses have mostly focused on benthic macroinvertebrate metabarcoding, but endeavours including zoo and phytoplankton have also commenced.
- **Analysis of trophic relationships and food web dynamics**: Metagenetic (metabarcoding) approaches are being widely used for analysis of the diets and prey preferences of commercial fish species, including herring, anchovy, and sardine. The molecular results are being compared to traditional microscopic examination, in order to evaluate and interpret the different types of information molecular approaches can provide. Related research is using PCR approaches for identification and evaluation of relative importance of prey types (Yebra *et al.* 2019).
- **Metagenetic analysis of biodiversity**: WGIMT members are actively working to evaluate the impact of using different gene markers for metabarcoding analysis of pelagic biodiversity. These are also being compared with results from the morphological taxo-

nomic analysis of samples, especially for mock communities and test samples with identified species and quantification of species abundance (counts) and/or biomass. An example of progress toward development of standardized biotic indices for use in management and assessment was described and referenced (Aylagas *et al.* 2014, 2016).

- **Identification of knowledge gaps and research needs**: WGIMT can and should provide useful leadership in identifying topics and areas of high priority for new research and application of integrative morphological - molecular taxonomic approaches. WGIMT should focus in particular on the need for integration and identify opportunities for morphological taxonomists and geneticists to work together. These include: 1) impacts of gene marker of choice for identification of taxa; and 2) gap analysis to evaluate taxonomic constituents in reference databases.

Technical challenges for the routine implementation of metabarcoding to the above mentioned applications have been raised. The most urgent to be addressed being:

- **To produce a reference DNA sequence databases for target species, groups, and regions**: WGIMT should consider development of proposals to support creation of comprehensive reference databases to support identification of taxa (Operational Taxonomic Units, or OTUs) resulting from metabarcoding analysis. Consideration should be given to coordination and collaboration with the Barcode of Life Database (BOLD, see URL http://www.boldsystems.org/); Ocean Genome Legacy (see https://www.northeastern.edu/ogl/); and others.
- **To work towards standardization of sampling, laboratory and data analysis protocols**: WGIMT can and should provide useful leadership in identifying topics and areas of high priority for new research and application of integrative morphological - molecular taxonomic approaches.
- **To work towards collaborative work among morphological taxonomists and geneticists**. This will help to identify 1) impacts of gene marker of choice for identification of taxa; and 2) gap analysis to evaluate taxonomic constituents in reference databases.

7 ToR F: Publish high-profile peer-reviewed articles that provide documented evidence of advances in metagenetic analysis of zooplankton diversity, distribution and abundance

A stronger foundation and visibility in primary research literature is necessary to establish the validity of metagenetic approaches for analysis of zooplankton diversity. Publication in peer-reviewed scientific journals will demonstrate validity of data, protocols, and results, and allow dissemination and new applications in ecosystem management.

Over the three-year period, members of the Working Group have produced 34 publications on topics directly related to the specific aims of WGIMT.

Peer-reviewed publications by WGIMT members have focused on the advancement of metagenetic / metabarcoding methods and/or compared methods suitable for monitoring and integrated ecosystem assessment (Abad *et al.* 2016; Aylagas *et al.* 2016, 2018; Danovaro *et al.* 2016). The findings include the comparison of morphological and molecular based species inventories and the assessment of the newly developed molecular tools for monitoring ecological status or detecting invasive species, among others.

Further publications represent integrative studies addressing phylogeography and connectivity using morphological and barcoding techniques e.g. Licandro *et al.* 2015 – Jelly fish; Cornils *et al.* 2017 – *Oithonasimilis*; Questel *et al.* 2016 & Aarbakke *et al.* 2017 – *Pseudocalanus*; Weydman *et al.* 2018 – *Calanus glacialis*; Wiebe *et al.* 2016- euphausiids. These publications provide a strong foundation in the literature to validate metagenetic approaches for analysis of zooplankton diversity.

Finally, the book, *Marine Plankton: A Practical Guide to Ecology, Methodology, and Taxonomy*, co-edited by WGIMT member Claudia Castellani was published in 2017, revised in 2018 (Figure 2). The book provides a practical guide to taxonomy including information on molecular approaches. Several WGIMT members contributed to various chapters.

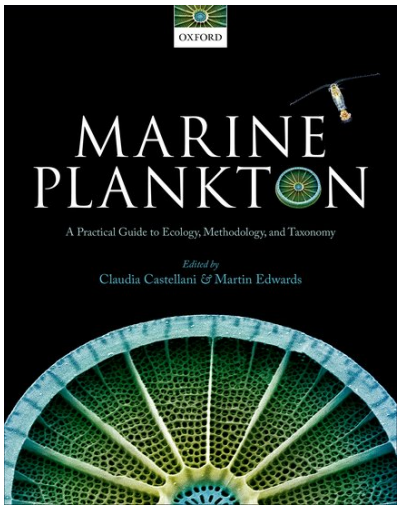

Figure 2. *Marine Plankton* (2017) co-edited by Claudia Castellani (UK).

A full list of relevant publications by WGIMT members.

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8 ToR G: Determine the status of microzooplankton time-series data collection within the ICES area

Determine the status of microzooplankton time-series data collection within the ICES area, assess progress made in this area over the last ten years, and identify collaboration, gaps or overlap with other WGs (WGZE, WGPME).

Members of WGIMT, WGZE and WGPME have been surveyed to provide information on which of their time-series include a sampling regime for categories of microzooplankton. Information has been compiled showing the different sampling techniques adopted together with a list of time-series stations and laboratories that measure microzooplankton. Out of 54 time-series stations which responded to the survey, only 3 do not include any microzooplankton categories in their analyses. Methods of collection were found to be variable and only two stations reported collection of samples for molecular identification (CPR survey and Plymouth L4). Timing of this ToR coincided with publication of a review by the ICES working group for Phytoplankton and Microbial ecology (WGPME) led by WGPME/WGIMT member Stern *et al.* (2018) on the use of molecular methods for the identification of protists. The study comprised a combined review and questionnaire on how molecular methodology is carried out. The results from the study revealed an increased use of high-throughput sequencing methods and recognition that sequence data enhance overall datasets on protist species composition. However, the authors noted a lack of integration between microscopic and molecular methods and recommended improvements to make molecular methods more accessible to time-series investigators.

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9 ToR H: Review and evaluate methodologies used for metagenetic analysis of plankton

The specific goal of this ToR was to facilitate development of standardized protocols for applications in fisheries management and ecosystem assessment.

The different challenges associated with the use of metabarcoding for management related applications were identified and discussed (Figure 3) in order to generate action points for future work. It was agreed that two of the main challenges of using metabarcoding for monitoring was standardization and database completeness. Regarding the latter, it was discussed that a gap analysis on zooplankton species could be relevant so that target species for barcoding could be easily identified. Yet, this task is challenging as it requires strong collaboration between molecular and morphological taxonomists and significant economic resources. Concerning databases, there was also a discussion on the fact that different databases have different taxonomic levels and that comparison among different markers is different. Some database curation work would be desirable for zooplankton species but again, resources are a limiting factor.

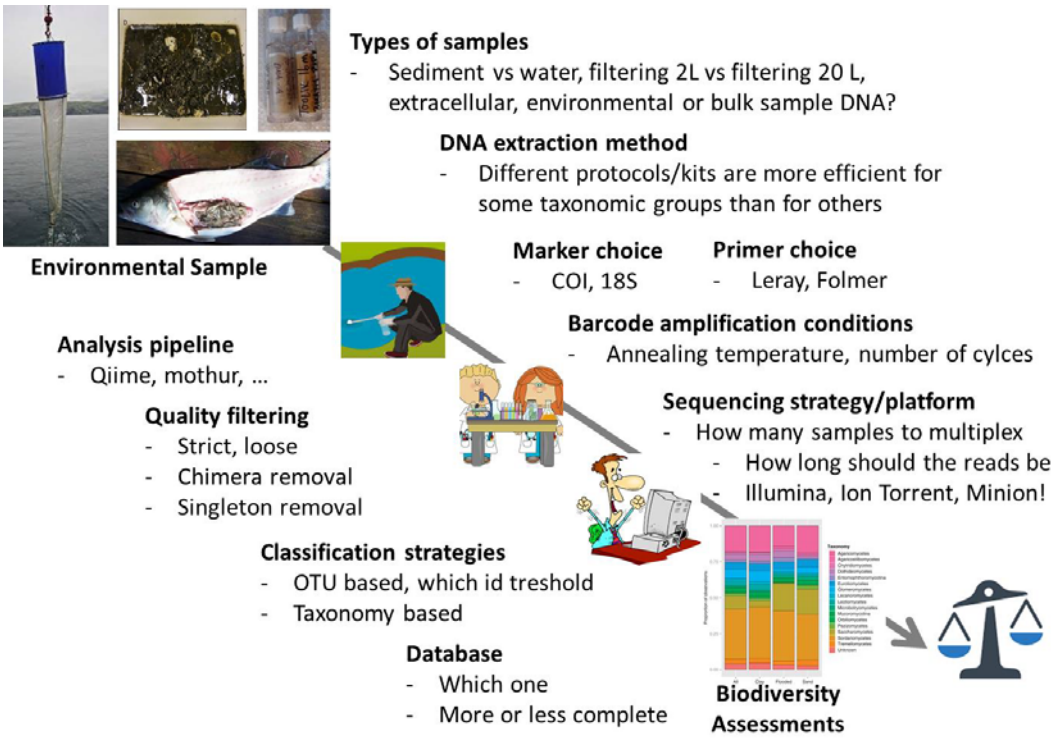

Figure 3. Main steps of a metabarcoding analysis including the different choices that need to be made at each of them.

Annex 1: List of participants

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Annex 2: WGIMT Resolution 2017–2019

The **Working Group on Integrated Morphological and Molecular Taxonomy** (WGIMT), chaired by Naiara Rodriguez-Ezpeleta, Spain, and Elaine Fileman, UK, will work on ToRs and generate deliverables as listed in the Table below.

	Meeting dates	Venue	Reporting details	Comments (change in Chair, etc.)
Year 2017	31 March	Boulogne-sur-Mer, France	Interim report by 1 June	
Year 2018	24 March	Helsinki, Finland	Interim report by 1 June t	**Change of Chair:** Outgoing: Ann Bucklin Incoming: Elaine Fileman and Naiara Rodriguez-Ezpeleta
Year 2019	15 March	Las Palmas de Gran Canaria, Spain	Final report by 1 June	Meeting in association with WGZE and WGPME

ToR descriptors

ToR	Description	Background	Science Plan codes	Duration	Expected Deliverables
A	Ensure balanced morphological – molecular expertise among membership of WGIMT	a) Integrative taxonomy requires experts in both morphological and molecular taxonomic approaches. b,c) Members in common will facilitate coordination between WGIMT and SCICOM EGs and help ensure goals are met.	1.6; 1.8	Year 1,2,3	WGIMT will continue to add new members, who are experts in morphological and molecular taxonomy for major zooplankton groups; 2 members in common with other SCICOM EGs.
B	Fully populate the WGIMT web platform with information, protocols and resources to support progress in research and development	a) Locating and accessing morphological and molecular taxonomic information can be difficult: some classical taxonomic references are out-of-print; molecular data are not released prior to publication. b,c) Open access to data and information will expand use of state-of-the-art molecular technologies (e.g., High-Throughput Sequencing) for integrative taxonomy of zooplankton.	1.4; 1.6; 1.7	Years 1,2,3	Complete and fully populate all areas of WGIMT.net web portal (Year 1). Complete specially-designed elements and deep links to support and promote use of technologies (Years 1, 2).
C	Initiate and support provision of standards, training materials, and taxonomy	a,b) Workshops, including ICES Taxonomy Workshops, are very effective in engaging target audiences and ensuring trained technicians and researchers for	1.6; 1.7	Year 2	Design, organize and offer integrative taxonomy workshops; request support via ICES Taxonomy Workshop funds (Year

	workshops	applications in fisheries and ecosystem management. c) Co-sponsored workshops and meetings with other SCICOM EGs will increase impact and likelihood of application for advisory applications.			2)
D	Demonstrate leadership in promoting and encouraging use of integrative taxonomic approaches for assessment of pelagic biodiversity	a,b,c) Integrative taxonomy is an emergent field; uses and applications for fisheries and ecosystem management should be explained in high-visibility settings in ICES and other organisations through special sessions	1.6; 1.8	Years 1,2,3	Organize special sessions at national and international conferences: ASLO/TOS Ocean Sciences Meetings; ICES ASC (Years 1, 2, 3).
E	Advise on the implications of developments for marine science and management	b,c) Integrative taxonomy (e.g., 'library' of DNA sequences for accurately-identified species) can provide a foundation for genetic methods for assessing species, diversity and abundance in integrated ecosystem assessments. c) Standardized metagenetic data can fulfill requirements of biodiversity assessments (WGPME) and indicators defined in the Marine Strategy Framework Directive (WGAGFM).	1.4;1.7; 1.8	Years 2,3	Report via EPDSG and SCICOM EGs on promise, progress and pitfalls , of metagenetics (metabarcoding) for integrated ecosystem assessments (Years 1, 2, 3).
F	Publish high-profile peer-reviewed articles that provide documented evidence of advances in metagenetic analysis of zooplankton diversity, distribution, and abundance.	a) Stronger foundation and visibility in primary research literature is needed to establish the validity of metagenetic approaches for analysis of zooplankton diversity. b) Publication in peer-reviewed scientific journals will demonstrate validity of data, protocols, and results, and allow dissemination and new applications in ecosystem management.	1.6; 1.7; 1.8	Years 1, 2, 3	Publish two papers focused on integrative taxonomy of zooplankton using state-ofpthe-art molecular approaches, including overview, review, and perspective articles (Years 1, 2, 3).
G	Determine the status of microzooplankton time-series data collection within the ICES area.	a, c) Determine the status of microzooplankton time-series data collection within the ICES area, assess progress made in this area over the last ten years, and identify collaboration, gaps or overlap with other WGs (WGZE, WGPME).	1.4	Years 2, 3	List of scientists and laboratories measuring microzooplankton groups within time-series datasets; data table to compare sampling and analysis methods, indicate which groups are regularly counted or routinely missed;

					database input; webpage update.
H	Review and evaluate methodologies used for metagenetic analysis of plankton.	a, c) Recommend development of standardized protocols for applications in fisheries management and ecosystem assessment.	1.6; 1.8	Years 2, 3	Present findings at scientific conferences (Year 2); Report to EG members and ICES community (Year 2, 3); prepare manuscript for publication in peer-reviewed journal (Year 3).

Summary of the Work Plan

Year 1	Recruit new members for WGIMT, ensuring balanced membership (ToR a); fully populate all areas of web portal (ToR b). Cooperate with other SCICOM EGs to promote and accelerate use of state-of-the-art molecular approaches for biodiversity assessment and applications for management and assessment goals (ToR e).
Year 2	Carry out collaborative activities with other SCICOM EGs to promote integrative taxonomy (ToR c). Publish peer reviewed scientific articles on topics central to the WGIMT mission (ToR f). Compile and disseminate information on microzooplankton (ToR g).
Year 3	Recommend, encourage, and enable use of integrated morphological and molecular taxonomic analysis of zooplankton in integrated ecosystem assessments in ICES area seas (ToRs d,e,f,h).

Supporting information

Priority:	This Working Group will assist ICES and its Expert Groups with issues related to the development, dissemination and application of taxonomic knowledge and skills in support of Integrated Ecosystem Understanding. Accurate identification of species and characterization of species-level diversity are and will remain foundations of integrated ecosystem assessments of function and state. Integrated taxonomic approaches – including morphological, molecular, optical, and other – may enhance and accelerate progress toward rapid, automatable, and near-real-time identification of species for fisheries and integrated ecosystem assessments; detecting of the impacts of climate change on species diversity, distribution, abundance; and understanding alterations in food web structure and function, and associated biogeochemical cycles. The availability of and need for new technology and techniques in taxonomic analysis make WGIMT's goals and activities important and high priority.
Resource requirements:	No additional resources are requested or required for planned activities.
Participants:	The Expert Group now includes 42 members from 15 countries, with strong representation among experts in morphological and molecular taxonomic approaches. We continue to seek additional members, including especially members from partner ICES Working Groups and other scientists with needed expertise and knowledge. The goal is to maintain balance and coverage of varied taxonomic approaches (including morphological taxonomists for the full range of taxonomic groups) and ICES geographic regions.
Secretariat facilities:	None.
Financial:	No financial implications.
Linkages to ACOM and groups under ACOM:	None.

Linkages to other committees or groups:	WGIMT arose as a Study Group from the WGZE in response to perceived need, meeting in association with WGZE during 2012 and 2013. WGIMT will remain in close partnership with WGZE and is pursuing additional partnerships (e.g., WGPME, WGAGFM), while promoting and supporting integrated morphological and molecular taxonomy science for the benefit of the ICES science and advisory communities as a whole.
Linkages to other organizations:	The work of this group relates to and is connected to a diversity of other projects and organisations, e.g., EU DEVOTES (DEVelopment Of innovative Tools for understanding marine biodiversity and assessing Good Environmental Status), BONUS BIO-C3 project, NOAA COPEPOD and COPEPODITE, GOBI, and others.