LifeWatch-WoRMS RAS Traits Workshop Report

Venue

Flanders Marine Institute (VLIZ) – Wandelaarkaai 7, 8400 Oostende
25-28 November 2019

Summary

Attendees: Anton Van de Putte, Yi Ming Gan, Quentin Jossart, Christian D. Jersabek, Pete Convey, Stefano Schiaparelli, Faradina Merican, Julian Gutt, Katrin Linse, Lidia Lins Pereira, Gemma Elyse Collins, Susanne Lockhart, Leen Vandepitte, Bart Vanhoorne, Thomas Lanssens, Wim Decock, Stefanie Dekeyzer
Remote attendees: Yan Ropert-Coudert, Maddie Brasier
Apologies: Justine Shaw

From 25-28th November thematic editors of the Register of Antarctic Species and the Register of Antarctic Marine Species met in Ostend to discuss the application of trait data in the Aphia System in the context of the Southern Ocean and the Antarctic region. A mixture of terrestrial and marine expertise was represented from various countries around the world. Further experts provided input through remote participation.

Participants received training in the use of the Lifewatch taxonomic backbone/WoRMS online editing tools and how to add and validate information. There were discussions on the prioritisation of traits, both in terms of those that should be added to the system as well as those that (thematic) editors should focus on adding. Eight priority data types were determined based on the need for information, the availability of data and, finally, how well these concepts were advanced within the taxonomic backbone. This includes information on habitat, mobility, holotype image and geographical information about type locality, feeding method/type and diet information, size, larval and juvenile development, data on invasive species and Vulnerable Marine Ecosystem (VME) indicator taxa.

While many similar priority variables were identified between marine and terrestrial ecology, there are considerable differences, especially in the terminology and vocabulary used.

Given the complexity of the task, it was also recommended to engage with the community to extend the current pool of thematic editors for all realms and taxa.

Key Workshop outcomes

Participants to the workshop received an introduction to the SCAR Antarctic Biodiversity Portal (Anton Van de Putte) and the Lifewatch Species Information Backbone (Stefanie Dekeyzer), both of which constitute Belgian In Kind contribution to the Lifewatch ERIC. The Register of Antarctic Species (RAS) was created in 2016 and builds upon the Register of Antarctic Marine Species (RAMS).
This was followed by a training session on how to use the Lifewatch Species Information Backbone online editing tool as thematic editors (Thomas Lanssens) in order to familiarise participants with the existing tools, functionalities and available fields. Throughout the week the editors contributed new data to the register, alternated with discussions of gaps and identification of priorities to start addressing these gaps.

Additional needs for Antarctic terrestrial; inland saline; and freshwater organisms

Environment	Add Freshwater	
Distribution	Add Antarctic Conservation Biogeographic Regions	online paper
	Add tool to check terrestrial occurrence records	
Biology Life stage	Add more plant-specific life stages	

Priority traits

In defining priority traits, various aspects were relevant. How relevant is the trait in terms of its ecological significance, how measurable is the trait, how feasible would it be to add the data.

a- Habitat
   Especially Vertical Biological Zonation, Environmental Position# and Substratum#.
   For filling out the habitat, feedback is required from the WoRMS Scientific Committee as there are currently various terms that overlap vertical zonation, environmental position, substrate and functional grouping.
b- Mobility#
c- Larval and juvenile development
d- Holotype including geographic location and pictures
   For holotypes it would be very valuable to have precise information on the geographic location where the specimen was collected, i.e. the type locality, as well as access to high quality images (drawings and or pictures) of the holotype itself that can be used for identification/comparison.
e- Functional group/Feeding method/type and diet information
f- Size
g- Data on invasive species
   Information on the status of invasive species is highly relevant for the Antarctic and sub Antarctic regions.
h- Vulnerable Marine Ecosystem indicator taxa including VME tag

 # Relevant for terrestrial

Create Regional Species Checklist that can be used for summarising existing information on species distribution, including invasive species status.
Physiological tolerances such as temperature, oxygen, salinity and pH range, and also desiccation and radiation tolerance (for terrestrial and freshwater species especially in shallow and/or temporary bodies) were considered to be very important but would need more coordination in order to advance.

Community engagement

Increase number of thematic editors in RA(m)S, set up small task group to work on specific traits and coordinate input of those.

Overview traits

http://www.marinespecies.org/traits/wiki/

TAXONOMIC	Taxonomic*		
		AMBI ecological group	
BIOLOGICAL	Body-size*	Body size	
		Body size (qualitative)	
BIOLOGICAL	Life History & reproduction*	Brooding	
BIOLOGICAL	Physiology	Feeding type	
DISTRIBUTION	Environment*	Fossil range	
DISTRIBUTION	Geography/ Physiography*	Functional group	
DISTRIBUTION	Depth*	Larval and juvenile Development	
DISTRIBUTION	Substratum*		
ECOLOGY	Mobility*	Mobility	
		Plant Habit	
BIOLOGICAL	Life Stage	Species importance to society	
ECOLOGY	Skeleton*	Supporting Structure & enclosure	

Review of Traits

Note when adding trait data to the system: If trait information is assigned to higher taxonomic level it will be inherited by all the child taxa unless specified otherwise.

Adding this type of information is a lot of work.

Need for more thematic editors that can complement the taxonomic editors in adding ecological traits.

Set up working groups for specific categories

Allow volunteers, interns, students and retired experts to add data

Clarification will be needed on what is information at the species (taxonomic) level and what at the population level.
It would be useful to align the terms used for species traits at the species level with those used in the OBIS-EMOF approach. Harmonisation of these terms would allow integration of knowledge at the species level with population level measurements.

Taxonomic

The experts supported linkage to BOLD and Genbank as it may also serve to indicate within-species genetic diversity. The experts thus proposed to add "Cryptic speciation" as a new note category in Aphia. For a specific species, an indication of known genetic variability can be entered as a general note, where the editor can then enter some brief descriptive text (e.g. "According to mitochondrial-CO1 data, three to five species could exist"). This note will then appear on the main landing page of the species, under the category "Descriptive notes". In the case of more limited genetic divergence, this can also be added under the same note. For example, it would be valuable to add a tag for species which have subpopulations based on genetic studies but continue to be treated as the same morphospecies in taxonomy.

Biology

Biology: Life cycle

Currently, life cycle only includes haploid and diploid, addition of polyploid for plants is required.

Biology: Life Stage

Life stages: Description of the larval and juvenile stages in the life cycle of an organism

Not a priority variable as such but highly relevant to the system. Where needed, all traits can be defined for specific life stages of a species or taxonomic unit. For a number of traits, it will be very important to be able to add them for the specific life stage.
Often terminology can be very different between plants and animals e.g. seed.

Biology: Body size

Body Size: A measurement of the size of the organism. … size can vary with gender and life stage

- Qualitative body size: Body size measured in terms of mega, macro, meio/meso and micro.

- Quantitative body size: Body size measured in numerical values

The participants agreed that body size is very import for instance for comparison with species from other regions. Currently size is split into

Body size (quantitative)
Body size (qualitative)

The experts agreed with the approach of keeping the qualitative size broad while the quantitative can be more specific. It might be useful to add some terms related to colonial organisms where it might be useful to distinguish between the size of the colony as a whole and the individual cells/organisms.

Biology: Life history

Life history: Traits that describe the life history characteristics of an organism

Biology: Life history: Brooding behaviour

The workshop participants proposed the addition of Brooding behaviour to the Life History trait.
But has not been assigned a "collection" within the Aphia system yet.
For Antarctic species the distinction between Brooding and Non-Brooding species is very important.

- Brooding (non pelagic development of eggs or larvae but they are rather retained by the adult)
- Non-Brooding (often a planktonic or pelagic lecithotrophic development of embryos and larvae)

It is closely linked to other Life History information and may be further detailed in those.

Biology >Life history>Life Span

The Workshop participants agreed that an approach similar to that of body size would be useful. Was interpreted as maximum attained age but could also indicate average maximum age in a species.

Proposed:

- Qualitative Longevity/maximum life span: Life span measured in terms of 1 day, 1 week, 1 month, 1 year, 10 years, 50 years, 100 years, 500 years, 1000 years
- Quantitative body size: Life span measured in numerical values

Biology >Life history>Age at Maturity

Age and size at maturity are highly relevant traits to include but for Antarctic and Southern Ocean species this is largely unknown. There are strong indications that many species have a late age of maturity that can hinder recovery after disturbance.

Biology >Life history>Growth rate

In addition to life span, growth rate is an important trait but is often missing for Antarctic and Southern Ocean species. For terrestrial and freshwater organisms distinction needs to be made whether growth rate refers to cell, organism, colony or community. Slow growth rate is a life history trait that contributes difficulty in recovery of a species after disturbance.
Qualitative categories for growth rate could be very useful in the process of designating marine taxa as indicators of VMEs.
Division into slow, medium, high is probably too crude a qualitative definition of growth rate.

The participants suggested an approach similar to body size with quantitative and qualitative definitions.

Biology >Life history>

Biology >Life history>Larval and juvenile development

The participants suggested adding larval and juvenile development

- Direct development
    - Oviparous (producing eggs that are laid and hatch externally (Lincoln *et al.*, 1998)
    - Viviparous (producing live offspring from within the body of the parent (Lincoln *et al.*, 1998))
    - Ovoviviparous (Fully formed eggs are retained and hatched inside the maternal body and are released as live offspring (Lincoln *et al.*, 1998)
- Planktotrophic: Feeding at least in part on materials captured from the plankton (Barnes *et al.*, 1993)
- Lecithotrophic (Development at the expense of internal resources (i.e. yolk) provided by the female (Barnes *et al.*, 1993)

Biology >Life history>Duration of Larval stage

Would benefit from a similar approach as Body Size

- Larval duration
    - Pelagic
    - Benthic
    - Other organism (Marseniopsis mollis, a gastropod, lays egg masses into an ascidian and from these egg masses, pelagic larvae hatch)
- 1 week, 1 month, 3 months, 6 months, 12 months

For terrestrial freshwater and inland saline requires something similar for seeds, resting eggs. E.g. number of instar stages in development, before reaching adulthood, but needs further development

Biology: Physiology

Ecophysiology: Traits that describe the physiological and environmental tolerance of an organism

http://marinespecies.org/traits/wiki/Traits:Ecophysiology

There was an extended discussion on physiology and ecophysiology. The importance of terminology was recognised, for instance for the parameterisation of species distribution models and to assess possible effects of climate change. Given that terms still need to be defined, further discussion is required to advance this topic with a wider circle of physiological experts.

The experts found it might be useful to combine the terms physiology and ecophysiology. Overall, care should be taken to ensure that values for physiological characteristics should originate from experimental data rather than be based on inferences from available distribution, such as the environmental variable range (e.g. NOAA environmental layer) offered by OBIS. Each entry needs to be accompanied with a reference or expert (if it is an expert opinion, the person is the reference) and each trait can have multiple entries (for multiple papers). Preference would be for quantitative information rather than qualitative terms that may be difficult to define in a way that is consistent across groups. However, in some cases just having an indication for the existence of tolerance or avoidance of a parameter might be a good starting place e.g. freeze-tolerant and freeze-avoiding)

Key Physiological traits for the Southern Ocean would include:

Temperature range
Oxygen range
pH range
Salinity range

for terrestrial and freshwater species

desiccation tolerance /avoidance
Radiation tolerance /avoidance
Freeze tolerance /avoidance

All tolerance values should be expressed as a range (min, max, optimum). Qualitative range such as steno-/eury- is hard to define for these variables. The values for these variables should originate from experimental data rather than inference from values based on available distribution such as the environmental variable range (e.g. NOAA environmental layer) offered by OBIS. Each entry needs to be accompanied with a reference or expert (if it is an expert opinion, the person is the reference) and each trait can have multiple entries (for multiple papers).

Physiological rates such as growth rate, oxygen consumption rate and energy consumption rate were recognised as being valuable but also complex. Priorities should be given to above-mentioned tolerance related variables.

Distribution

Distribution: Environment

Environment: Broad descriptors of the major environmental regions

The trait Environment has been used to identify what is not Marine (WoRMS legacy) and one species can be linked to multiple environments. With the expanding non-Marine scope of the taxonomic backbone it would be of clear benefit to add Freshwater and possibly ice (see below).

Proposed terms

- - Brackish, Freshwater, Marine, Terrestrial

Distribution: (Physio)Geography

For terrestrial species numerous terms should be added. For information on association with geology type and terrain topography, but some of these are already available in other fields. Hence this will require good guidelines for editors.

examples

- - Habitat > Physiography > missing terrestrial terminology
- - "Geothermal habitat", "oxygen free habitat" ... link to biological descriptors?

Distribution: Depth

Depth Range “Maximum to minimum recorded depth (expressed as metres below chart datum)”

Depth in substratum: The depth within the substratum at which the organism is found (max recorded in metres)

This trait is strongly linked to *Biology: Life Stage,* as individual life stages may have a very different depth distribution.
When the depth range of an organism is provided this should always be done for a specific life stage.
For organisms on land the elevation of the lake/substrate should also be included

Distribution: Elevation

Highly relevant for organisms on land. Would be relevant to include the vertical reference (e.g. vertical reference is height above the WGS84 ellipsoid).

Distribution: Habitat

Distribution: Habitat Preferences

- Lake nutrient status - polytrophic to ultraoligotrophic

Distribution: Province

Distribution: Vertical biological zone or zonation

Well developed for the Marine environment. For the inland water bodies the terminology exists for the classification of lakes (e.g. limnoterrestric, athalassic saline), and the parts of the lake. This requires adding to the backbone.

Ice definition

http://marinespecies.org/traits/wiki/Traits:SeaIce
Recommend to use terms:
|__Terrestrial
|__ glacial
|__ snow
|__ sub-glacial
|__ Marine
|__ Sea ice
|__ Shelf ice
If necessary can specify “under”, “in”, “on top” of ice.

Ecology

Ecology: Body Form

Ecology: Body Form: Supporting structures and Enclosures (Skeleton)

Can be important to provide details in order to indicate possible effect of ocean acidification. For Marine invertebrates this is fairly complete;
For Antarctic terrestrial organisms most animals have an exoskeleton although this is not that relevant. For plants the way they attach to the substratum can be relevant, for instance the presence or absence of roots. This will require an additional vocabulary to describe.
Linked to this discussion was molting behaviour for a number of birds, which is an important trait; where should this be included?

Ecology: Body Form: Fragility

- Fragile: Likely to break, or crack as a result of physical impact; brittle or friable
- Intermediate: Liable to suffer minor damage, chips or cracks as result of physical impacts
- Robust: Unlikely to be damaged as a result of physical impacts, e.g. hard or tough enough to withstand impact, or leathery or wiry enough to resist impact

CCAMLR scores fragility as high, medium, low, It will be need to verify with the CCMALR secretariat if the terms correspond.

Ecology Ecological Interactions

Ecology: Ecological Interactions: habitat modification

Relevant for Antarctic and Southern Ocean species.
Suggestion replace bio-genic with habitat modification

Reef building (http://marinespecies.org/traits/wiki/Traits:ReefBuilding). Would benefit to have a yes/no option for simplicity

- Yes: An organism that creates a large and extensive biogenic physical structure raised above the surrounding seabed creating a consolidated habitat for epibenthic species
- No: Does not do the above

Ecology: Ecophysiology

See discussion under Biology: Physiology

Ecology: feeding

Ecology: Mode of Life

Ecology Movement

All terms under movement are closely linked. Foraging range would be a relevant trait to add as dispersal and foraging range are often quite different.
Terrestrial species would require a revision of the vocabulary used to describe mobility

Ecology: Movement > Mobility

Mobility should be described for individual life stages.
It should include

- Mobile (capable of movement)
- Sessile (Non-motile; permanently attached at the base)
- Sedentary (attached to a substrate but are capable of limited movement)

For fossils terms such as fixosessile and liberosessile are also used

Ecology: Movement > Dispersal Potential ~~Adult~~

Dispersal potential can apply to different life stages so should not be focussed on the adult stage alone. Highly relevant for both terrestrial and marine species. Method of calculation of dispersal varies widely between groups so may not be very comparable. Additional discussion is required.

In general Dispersal potential can be covered by providing information on mobility, brooding, larval development and larval duration.

Distinction between mechanisms of dispersal, should be included, e.g. wind, currents, zoochory (animal), hydrochory (water), anemochory (wind), dispersal on debris, anthropogenic assistance, passive/active, physical scale (dispersal can happen over very different spatial scales).

Ecology: Movement > Migration (migratory)

Not discussed in detail.

Ecology: Diet and trophic level

- - predatory or not
- - energetic content? attribute of an individual animal
- - simple traditional trophic level
- - feeding methods

Species Importance to society

Relevant catagories where information on Antarctic and Southern Ocean species should be added.

Species' Importance to Society: Introduced Species Catalogue

http://marinespecies.org/introduced/wiki
http://www.marinespecies.org/traits/wiki/Traits:Species_Importance_To_Society

For terrestrial species, as well as for marine species, invasive species are more of an issue for the sub-Antarctic islands than they are currently for the continent. Marine organisms with depth ranges that include shallower depths will also be more greatly impacted than will those restricted to deeper water.

In general, it would be good to create regional species checklists at various scales that indicate the status of the species in the area. This could be Antarctic Conservation Biogeographic Regions, Sub Antarctic Island or CCAMLR statistical Areas.

Species' Importance to Society: Endangered status
IUCN list (regular automatic update)

Species' Importance to Society: Vulnerable Marine Ecosystems

The Participants suggested to add a category: "Vulnerable marine ecosystem indicative taxa based on FAO guidelines"

Vulnerable marine ecosystems constitute areas that may be vulnerable to impacts from fishing activities. VMEs are defined under FAO guidelines (FAO, 2009). Some conditions are generally applicable to all VME, but each region has its own interpretation (Rogers et al., 2008; Jones et al., 2016).

For the regions the participants proposed to stick to the major FAO fishing areas, which already exist in Marine Regions. Using Subareas will likely be too complicated. Therefore, globally or for specific regions, a taxon would get an indication whether it is an indicative taxon for delineating a VME based on the FAO guidelines, which in turn could be used in analytical effort to identify VMEs

A marine ecosystem should be classified as vulnerable based on the characteristics that it possesses. The following list of characteristics should be used as criteria in the identification of VMEs:

Uniqueness or rarity; Functional significance of the habitat; Fragility; Life-history traits of component species that make recovery difficult; and Structural complexity

Important traits discussed during the workshop that can contribute to considering a taxon as a VME indicative taxon are:

Habitat forming (reef building), Rare or unique populations, Longevity, Slow growth, Fragility, Larval dispersion potential, Lack of adult motility

Dispersal potential can be derived from mobility + brooder (yes/no) + larval development

How to indicate endemism?

Suggested faceted search:
Species importance to society
|__ IUCN red list
|__ VME indicator taxa based on FAO guidelines
Each entry below should provide source
|__ no region info available
|__ FAO fishing area I
|__ FAO fishing area II

These indicates status for regions inside or outside (no region available) of FAO jurisdiction. E.g. a species that is thought to be a VME indicator that occurs in a regional marine protected area within an EEZ and therefore is governed outside of the FAO regions. The source in this case would be some other government document.
This category can also be used by specialists as recommendations i.e.this taxa fits the UNGA/FAO definition of a VME even if it isn't officially listed by any FAO region. In this case the source would be the editor who can also inlcude source citations as supporting material.

….

Additional reading

Biological and ecological traits of marine species https://peerj.com/articles/1201.pdf

Improving Darwin Core for research and management of alien species
https://biss.pensoft.net/article/38084/

Antarctic biogeography revisited: updating the Antarctic Conservation Biogeographic Regions
https://onlinelibrary.wiley.com/doi/full/10.1111/ddi.12453

Trait-based approaches in rapidly changing ecosystems: A roadmap to the future polar oceans. Degen et al. 2018. http://www.vliz.be/en/imis?module=ref&refid=295272

UNGA (2007) Resolution adopted by the General Assembly on 8 December 2006.
B
Jones et al (2016) Antarctic and Southern Ocean. In: Thompson et al (eds) Vulnerable Marine Ecosystems: Processes and Practices in the High Seas. FAO Fisheries and Aquaculture Technical Paper. Rome, FAO. 595: 159-176.

Rogers et al. (2008) The science behind the guidelines: A scientific guide to the FAO Draft International Guidelines (Dec 2007) for the management of deep-sea fisheries in the High Seas and examples of how the guidelines may be practically implemented. IUCN, Switzerland.

FAO (2009) International Guidelines for the Management of Deep-sea Fisheries in the High Seas . Rome: Food and Agriculture Organisation.

Clark, M. R., Althaus, F., Schlacher, T. A., Williams, A., Bowden, D. A., and Rowden, A. A. (2016). The impacts of deep-sea fisheries on benthic communities: a review. ICES J. Mar. Sci. 73, i51–i69. doi: 10.1371/journal.pone.0022588
Hogg, M. M., Tendal, O. S., Conway, K. W., Pomponi, S. A., van Soest, R. W. M., Gutt, J., et al. (2010). Deep-Sea Sponge Grounds: Reservoirs of Biodiversity. Cambridge: UNEP-WCMC.

Relevant resources

Polytraits http://polytraits.lifewatchgreece.eu

Sea life Base https://sealifebase.se/search.php