

Collection and analysis of marine species functional traits

26/09 – 27/09/2017

Background of Workshop: Ecosystem modelling is complex and resource intensive. Creating species functional groups improves efficiency as species will not be modelled individually. Functional groupings are often based on expert knowledge and species diet. However, species interactions in an ecosystem are also influenced by their life history and morphology. Life history variables add information on how a species uses its environment and how it changes over time. Morphology characteristics may be used to infer dietary preferences and how a species interacts with its environment. There are two major hurdles for defining functional groups with this type of data. First, which functional traits to define for different species groups and second which method to use to identify the groups. One potential solution is to use cluster analysis to identify species functional groups and the variables that contribute significantly to that grouping choice.

Aims and outputs of Workshop: The workshop aims to bring together marine ecologists to create a functional traits database of temperate coastal marine species in Australia/New Zealand and cluster analysis specialists to identify the best way to analyse the data currently available. Such a database does not currently exist. Results will include a list of traits important for defining different functional groups, and identification of the best cluster analysis techniques for analysing this type of data.

Day 1: Building a trait matrix

What are the functional traits of different groups of marine species (benthic invertebrates, teleost fish, elasmobranchs and cephalopods) needed to define functional groups and how do we measure them?

Day 2: Statistical analysis

What are the most appropriate statistical methods for defining functional groups, and how do we decide that we have a good fit?

Attendees:

Beth Fulton (or representative) – CSIRO; Shirley Pledger - Victoria University of Wellington; Nokuthaba Sibanda - Victoria University of Wellington; Matt Dunn – NIWA; Judi Hewitt and Carolyn Lundquist – NIWA; Michelle Masi – NIWA; Roy Costilla – University of Queensland, Monique Ladds - Victoria University of Wellington

Program

Time	Activity	Presenter	Questions	Expected outcomes	References
<i>Day 1 Tuesday 26-09-2017</i>					
9:00 – 9:30	Introductions and outline for the workshop	Monique Ladds		Agreement on outcomes to be achieved for the workshop	
9:30 – 10:00	Session 1: Fundamentals of ecosystem models	Michelle Masi	Why do we need functional groups? How do they fit into ecosystems models?	Set up the underlying basis for the problem	
10:00 – 10:45 Half an hour plus discussion.	Session 2: Functional groups	Beth Fulton (or representative)	How sensitive are the models to functional groups? How are we currently dealing with functional groups?	Overview of the Atlantis model and possible extensions.	Fulton et al., 2001, 2003
10:45 – 11:15	Break				
11:15 – 12:00 Half an hour plus discussion.	Session 4a: Functional traits of plants and corals	Mark Westoby	What can we learn about using functional traits to define functional groups for marine species from other well studied groups?	Develop an understanding of how functional traits have been used to develop functional groups.	Madin et al., 2016 TREE
12:00 – 12:45 Half an hour plus discussion.	Session 4b: Functional traits of benthic invertebrates	NIWA benthic invertebrate representative	Which functional traits matter and why? How are they different? How do we know? What matters why and when?	Build an idea of what traits should be included in order to create a functional group.	Hewitt et al., 2008
12:45 – 13:45	Lunch				
13:45 – 14:45 Half an hour plus discussion	Session 5: Meristics and morphology	Anthony Gill	What should and could we measure for each of the different classes? How do we measure them?	Outline the possible traits to measure and discover why those traits are important.	Sibbing et al., 2000
14:45 – 15:15	Break				
15:15 – 16:15	Session 5: Selecting traits to define functional groups	Monique Ladds/ Matt Dunn	What are the important functional traits to measure to create functional groups?	Facilitated discussion around the different traits that should be recorded for different classes of marine species.	

16:15 – 17:00 Half an hour plus discussion.	Session 6: Challenges of validation of the functional groups.	Matt Dunn	What do we need to make functional groups for ecosystems models? How do we validate and can we validate?	Bring together the ecology and the statistics of what is needed to make functional groups that are useful for ecosystem modelling.	
19:00	Dinner				

Time	Activity	Presenter	Questions	Expected outcomes	References
Day 2 Wednesday 27-09-2017					
9:00 – 9:45 Half an hour plus discussion.	Session 7: Statistical analysis – data preparation	Monique Ladds	How do we deal with missing data? Should the data be transformed?	Find an appropriate method of dealing with missing data. Show the different impacts of transforming data.	
9:45 – 10:30 Half an hour plus discussion.	Session 8: Statistical analysis – selecting the most important traits and number of functional groups	Roy Costilla	Of the traits selected to be collected for analysis, which contribute the most to explaining group membership?	Dimensionality reduction methods: Bi- clustering as an alternative to two-step process of dimension reduction + clustering	Bremner et al., 2006
10:30 – 11:00	Break				
11:00 – 11:45 Half an hour plus discussion.	Session 9: Statistical analysis – options for finding groups	Shirley Pledger	How do we find the functional groups of marine species without any prior knowledge?	Outline some possible statistical analyses that can be used for creating functional groups.	Fernandez and Pledger 2015
11:45 – 12:30	Session 10: Simulation and cross validation	Nokuthaba Sibanda	How do we validate our approach?	Show the methods available for simulating data and provide options for cross-validation	
12:30 – 13:15	Lunch				
13:15 – 14:00	Session 11: Bringing it all together – data collection, analysis and publications		What do we need to make functional groups for ecosystems models?	Bring together the ecology and the statistics of what is needed to make functional groups that are useful for ecosystem modelling. Make a timeline of papers to be written and delegate tasks.	