Developing conceptual diagrams and models
– a guide for facilitating workshops

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Disclaimer

Acknowledgements

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Summary

This document provides guidance on how to facilitate a workshop to develop a conceptual diagram and model of an ecosystem at any scale. The process aims to capture knowledge and input of workshop participants and to get their agreement and common understanding on how the ecosystem works.

Conceptual diagrams and models are a useful component for developing report cards on natural resources. They can quickly communicate to a reader how an ecosystem functions, or how we would like it to function, as well as the threats that may change how the ecosystem functions. Diagrams and models can show how ecosystem components relate to one another in a spatial context, without the need for lengthy descriptive text. They can also guide natural resource managers to choose indicators that track the condition of the system and the impacts of key threats. These indicators can form the basis for on-going monitoring and reporting. Conceptual diagrams and indicator data can be communicated to stakeholders in an engaging way through report cards.

1 Conceptual modelling workshops

1.1 Why hold a workshop?

- You need buy-in from diverse stakeholders

- You need information from stakeholders or experts. The literature and published information may not be sufficient to guide the selection of indicators or natural resources that should be monitored.

- You need to justify to the community, scientific community, stakeholders how you came up with a monitoring program

- Many brains together are better than one.

1.2 What is a conceptual model?

- A diagram (box & line or picture, or combination) (Figures 1, 2 and 3)

- A model shows the key components of an ecosystem, how they link together & the processes affecting/changing the ecosystem

- A way to visualise the natural resources or components of an ecosystem in a spatial setting

1.3 Why do we need a conceptual model of the ecosystem?

- A model sends a clear, simple and broadly accessible message.

- To manage an ecosystem we need to better understand it

    o We need to measure the condition of the ecosystem over time to determine whether our actions are working.

    o We cannot measure everything in the ecosystem because we don't have the resources

    o We need to prioritise the things to measure and the things to manage

    o A conceptual model provides a visual way to communicate how the ecosystem works and what we need to measure

- To educate the community and other stakeholders about how the ecosystem works.

1.4 Before you start

1) Be clear on what you want to achieve in the workshop

- Is it to get an comprehensive understanding of the way the ecosystem works?

- Is it to select indicators to measure the condition of the ecosystem and/or the

- drivers impacting the ecosystem?

- Is it to select components of the ecosystem to focus future efforts (e.g. research, monitoring etc)?

2) Set a goal(s) for the workshop.

- If the goal is broad, you will get broad outcomes, if the goal is very specific, the outcomes will be very specific.

- If the goal is related to a ecosystem you wish to manage, consider how much you can manage with the available funds, capacity etc. Set a goal that gives outcomes that are realistic for monitoring or management.

- Ensure you can meet the workshop goal within one or two days (or less).

3) Select your audience

- This should relate to the goal.

- Get experts on the "whole ecosystem" in the room.

- If the goal is about developing a technical/ecological understanding (in a conceptual model) of the way an ecosystem works, then invite ecologists, naturalists and people who work in the ecosystem (e.g. rangers).

- If the goal is to develop a conceptual model of a region's natural resources that are valued by everyone, then invite a cross section of the community, NRM board, representatives of relevant sectors, industry, managers etc.

- Consider how the audience will interact. Will discrepancies/disagreements between audience opinions be obstructive to the outcomes of the workshop? If so, hold two workshops for different sectors/groups.

- Ensure that sectors are equally represented in the workshop. This will ensure that one opinion doesn't swamp another due to sheer numbers of participants holding the same viewpoint.

4) Select a facilitator

- A facilitator who is known to be impartial to different opinions in the room is preferable. This way, participants will feel their view will be considered without bias. This builds commitment to making the workshop a success.

5) Things you need

- A whiteboard or flip-charts/butcher's paper for brainstorming

- Name tags if people don't know each other. It is sometimes best to omit position titles on the name tags to remove traditional hierarchies in the room.

- For full-day workshops, natural light and healthy food keep people focused.

- White board markers & camera

- Someone to take notes

6) A pre-workshop briefing emailed to participants in advance (see Section 1.9)

- Outline the problem (why do we need this workshop?)

- Outline the background information about the ecosystem to give context (up to one page)

- State the proposed goal(s) of workshop

- Outline the process of the workshop so participants know what to expect. Sometimes participants are concerned that the workshop will be an unfocused general discussion that does not result in a tangible outcome. By briefing them on the process you will alleviate their concerns.

1.5   What spatial scale should be used for a conceptual model?

- Any scale can be used (e.g. one small wetland, a back yard or an entire NRM region)

- The scale must be consistent with your goal.

  o   If the goal is to develop indicators to measure the condition of vegetation in a National Park, then the scale should be the whole Park.

  o   If the goal is to develop indicators to measure condition of parks in an entire NRM region, then the scale should be the whole region.

1.6   Why focus on natural resources instead of issues?

- A natural resource is something that is spatially explicit and that is valued in some way. The natural resources that are most valued are the ones that typically need to be monitored and managed. Values can be derived from a range of sources (social, economic and environmental).

- Issues are processes. Examples of issues are herbivory by overabundant species, predation by foxes and impacts of fire. These are often the focus of on-ground activities, such as pest control, fire management etc. Issues are something the community is often focused on. There is a perception that by killing foxes etc is good for the environment, so why not do it? What is the natural resource that is being protected by these activities?

- If you identify the natural resource you want to protect first, then you can identify what is likely to be threatening it. Then you can decide what action should be done to mitigate the threat. You should measure the impact of the threat and the condition of the natural resource to know if your management is improving or maintaining the natural resource that you value. If you do fox control without knowing what you are trying to protect, what will you measure to know if fox control is working?

1.7 How to develop a conceptual model

- Discuss proposed goal(s) and reword if necessary. It is important to get buy-in from everyone on the goal of the workshop. If discussion starts to meander off topic during the workshop you can then reiterate the goal that everyone agreed to at the start and redirect discussion back on track.

- Define the spatial or ecological boundaries of your ecosystem. Is it the entire region or subregion etc.

- Add the structure and components of the ecosystem. Decide if you want to depict the ecosystem as it exists now, or as it was 200 years ago. If it is a picture of the future incorporate all likely land use impacts.

- What are your assumptions about the ecosystem?

- What don't we know about they ecosystem?

- If the ecosystem is very large and complex (e.g. a whole region), it may be necessary to prioritise the most important components of the ecosystem.

- Capture the key drivers of change (changes in the state of the ecosystem) – physical/chemical and anthropogenic, social/cultural drivers and economic drivers. Do not be too concerned about small impacts, because the large impacts will be the priority ones to monitor and manage.

- Confirm agreement from everybody on how the model looks. Reduce it in complexity if possible.

- A conceptual model can be depicted in a diagram. In a conceptual diagram, the landscape, components and drivers are included as representative icons and interactions between icons are indicated with arrows or symbols. These diagrams can be created in Adobe Illustrator® (Figs 1 and 3) or an equivalent program. Alternatively the model may be portrayed as a series of words (often in boxes) that are linked with arrows to show where the interactions are between them (Fig. 2). This kind of model shows interactions clearly but the interactions cannot be readily viewed in a spatial context (in a landscape for example). While some people relate well to a box and line model, most people are more engaged by a diagram, because they can relate to pictures better than words.

- Distribute the model for stakeholder review.

1.8 Using your conceptual model to develop monitoring programs

- Use the key drivers and responders (indicated in your model) to identify potential indicators and metrics.

- For example, if herbivory by sheep is a key driver and native grasses are the responder (the natural resource that is affected by herbivory), you could select a measure of sheep density as the driver indicator and cover & diversity of native grasses as the responder indicator. If the native vegetation community is the priority natural resource you are managing, then it is important to measure this using a vegetation condition indicator as well.

- Ensure metrics are of appropriate scale (relative to the ecosystem scale), i.e. is a 1x1 m quadrat suitable for measuring a 1 km stretch of a river?

- Where there are key gaps in knowledge about the ecosystem, baseline information and research can be focused on these areas.

Coast and Marine Systems

Science Resource Centre DENR

Pelagic | Seagrass | Beach | Mangrove/Estuary | Reef
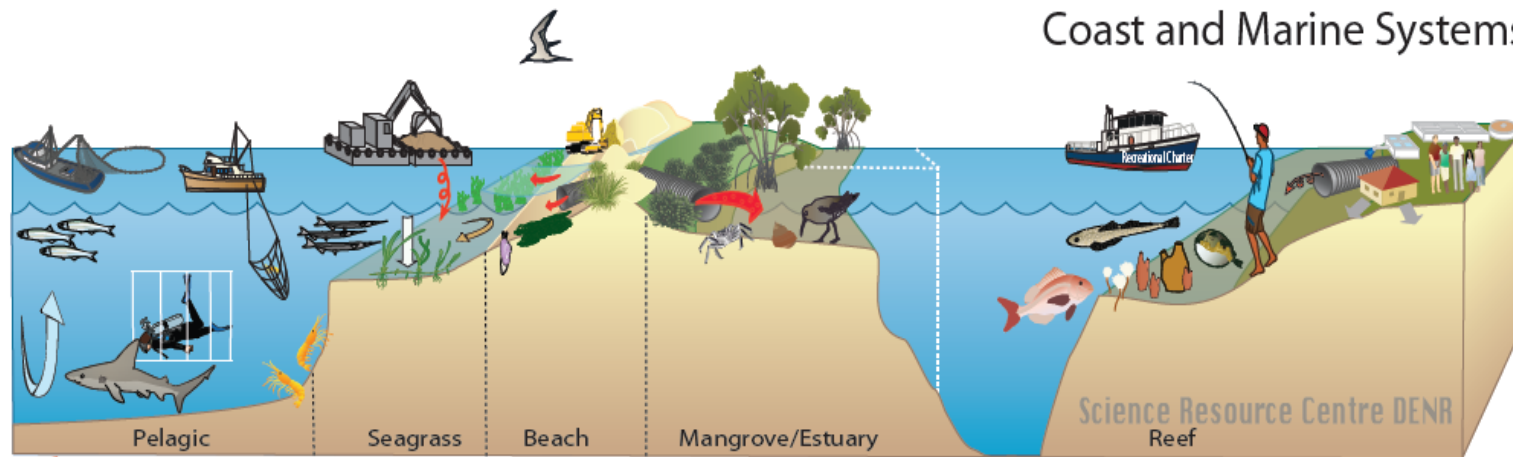
Legend (symbols):
- Nutrient input
- Sediment input
- Sand carting
- Dredging
- Light availability
- Marine park
- Erosion between seagrass beds
- Urban sprawl
- Cage diving
- Waste treatment or desalinisation plant
- Upwelling from the continental shelf
- Beach wrack (seagrass)
- Resilient community

Impacts

Sedimentation & erosion
1) Turbidity affects light availability for seagrass and algaes
2) Sediment can smother sessile reef organisms
3) Sediment can affect fish health by clogging gills
4) Erosion prevents seagrass propaules from establishing

Nutrients
1) High nutrient loads can kill seagrass, estuarine organisms & cause algal blooms which smother benthic communities

Over-fishing
1) Loss of fish/crustacean/molluscan stocks & change in marine foodwebs (top-down or bottom-up pressure)

Pollution & toxicants
1) Loss of susceptible species
2) Human health issues for swimmers & seafood consumers

Modification of coastal habitat
1) Loss of beach structure & habitat (wrack, topography)
2) Loss of coastal vegetation & associated fauna

Exotic species
1) Loss of native species which are out-competed

Entanglement
1) Loss of threatened species (e.g. sea lions)

Shark feeding
1) Habitualisation of sharks to humans

Drivers of change
1) Sedimentation from dredging, run-off, waste out-flow, storms, erosion of dunes or seabed
2) Nutrient input from land run-off, fish-farm feeding, waste treatment plants, storm-water
3) Over-fishing
4) Pollution at-sea (e.g. oil spills)
5) Modification of coastal habitat (e.g. samphire, beaches) for human use
6) Introduction of exotic species
7) Entanglement in marine debris, fishing gear
8) Shark feeding & tourism activities
9) Upwelling of cold, nutrient-rich water
10) Climate change

Indicators

Environmental
1) Water quality
2) Turbidity
3) Vegetation condition & extent (remote sensed marine/terres)
4) Habitat condition & species diversity in marine parks (BRUVs)
5) Change in amount of seagrass wrack
6) Pest species incurrsions & abundance
7) Reef condition (Reef Watch)
8) Marine debris type & abundance
9) Commercial fish stocks/catches
10) Up-welling index
11) Shark sightings
12) Habitat condition & species diversity inside & at distance from marine parks (BRUVs)

Economic
1) Productivity of aquaculture, fishing, tourism, recreational, other industries
2) Taxable income
3) Boat ramp use
4) Sand moved for beach replenishment

Social
1) Number of people employed in coast/marine industries
2) Level of education & population size
3) Use of marine resources & parks

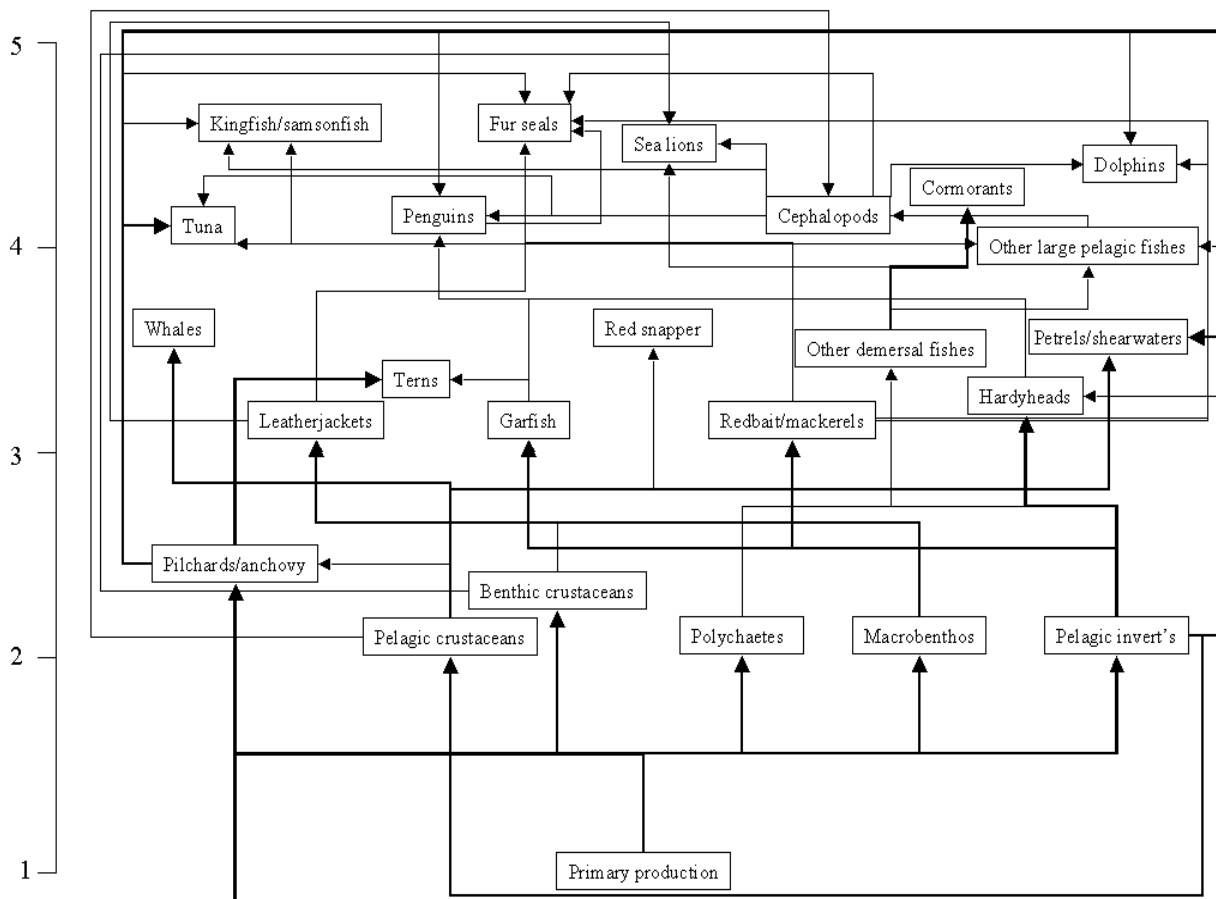**Figure 1. Example of a coastal and marine diagram model**

Figure 2. Examples of a conceptual model (box and line)

A simplified food-web that summarises the main trophic interactions among species groups in the eastern Great Australian Bight. Species' trophic levels are indicated on the left. To improve clarity, dietary contributions >50% are indicated by bold lines, contributions <50% are indicated by fine lines and contributions <10% have been omitted (reproduced from Ward TM, Goldsworthy SD and Page B. 2004. Trophodynamics of the GAB: assessing the need for an ecological allocation in the SA pilchard fishery. FRDC Project No. 2003/072. SARDI Research Report. 155 pp).

1.9   Presentation of information provided to workshop participants

The following is an example (Box 1) of a briefing provided to workshop participants before the workshop. It outlines background information and the need for the workshop, as well as the goals that will guide the workshop outcomes. There is also a short section on what conceptual modelling is and how it can aid in the development of indicators and monitoring objectives. Figure 3 illustrates the conceptual diagram model developed during this workshop, along with the indicators for future monitoring and the knowledge gaps identified in the workshop.

Box 1.

Great White Shark monitoring and research workshop

The Great White Shark (Carchardon carcharias) is listed as a threatened species under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

A Recovery Plan has been developed for this species under the EPBC Act that includes specific actions relating to tourism activity. Achieving a sustainable relationship between the Great White Shark and tourism is paramount for the long term sustainability of this important industry for South Australian.

The aim of this workshop is to develop a monitoring and research framework that can be used to support future management decisions for the Great White Shark tourism industry in South Australia.

Workshop goals

> **GOAL 1:** Develop a conceptual model that describes the relationship between tourism and Great White Shark populations at the Neptune Islands Conservation Park.

> **GOAL 2:** Identify drivers that influence the Neptune Islands ecosystem process and response (ecological, social, economic)

> **GOAL 3:** Indentify indicators and establish measures to guide monitoring of relationships between tourism and Great White Shark populations at the Neptune Islands Conservation Park.

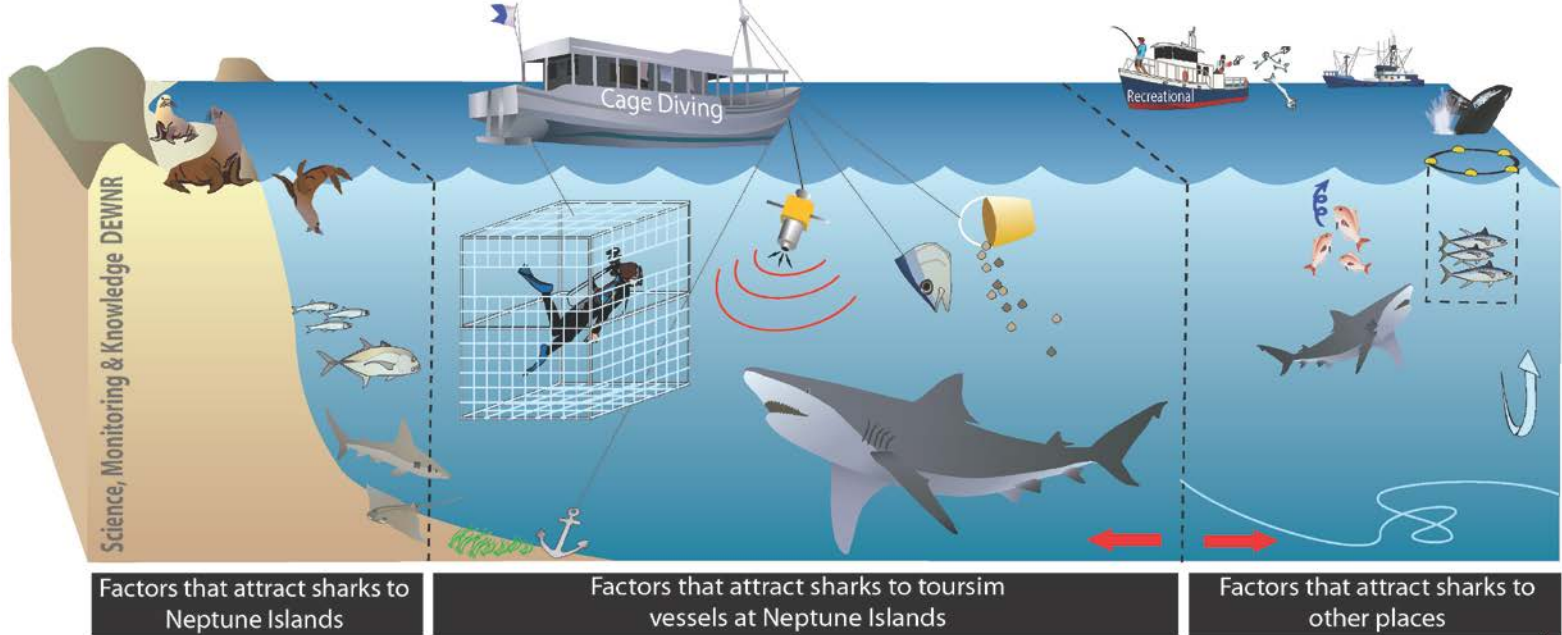These goals will help direct the setting of priorities for monitoring and research efforts.

What is conceptual modelling ?

Conceptual models are visual representations of real world natural eco-systems using symbols, pictures and colours. They can create a common understanding of how the system functions and changes we would like to see.

Developing a conceptual model can highlight knowledge gaps, establish priorities, clarify and synthesise thinking and can inform monitoring programs. They can also be altered over time to capture emerging research outcomes.

The process allows for an open and inclusive means to identify the system components, the natural and human-induced factors that may cause change (drivers) and a set of indicators to be monitored.

Figure 3. Development of a conceptual diagram model of Great White Sharks at the Neptune Islands CP