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Department of Conservation
Te Papa Atawhai

NIWA
Taihoro Nukurangi

Workshop on research needs for protected corals in New Zealand waters

Gaps Identified during workshop, and the initial characterisation of the value of filling them.

Biological Gaps	
Please identify as many research/knowledge gaps as you can	***What use would we have for this information, how would it benefit management?***
Improved understanding of adaptability.	*Identification of species that could potentially adapt to changes in the environment, which might support the identification of important areas for spatial management.*
Improved understanding of small effective population sizes.	*Identifies the constraints on the resilience of populations to impacts.*
Improved understanding of taxonomy.	*To provide basic understanding about the components of coral biodiversity, which is necessary for effective decision-making about conservation and sustainable use.*
Improved understanding of the barriers of gene flow.	*Could allow us to identify species that may better cope with environmental changes, and to recover from disturbances, and those that can't and are more vulnerable to extinction.*
Improved understanding of contemporary vs historical structure.	*To identify trends over longer time series.* *To increase our knowledge on dispersal, connectivity, and genetic hotspots.* *Could benefit the identification of areas of high protection value.*
Improved understanding of productivity.	*To understand the potential resilience of corals to impacts.* *Main limiting factor identified in the ERA in relation to recovery ability.*
Improved understanding of age and growth, there is a lack of New Zealand specific parameters.	*Increased knowledge on the recoverability of species after disturbance.* *Could support prioritisation of areas/species to protect.*
Improved understanding of the reproductive and dispersal capabilities.	*To understand if asexual budding is more or less common than sexual broadcast release, and determine how capable species are of long-distance dispersal. Increased understanding of dispersal will increase our knowledge of connectivity.* *Improved knowledge of coral fecundity could identify vulnerable/less resilient species.* *Could help to prioritise areas/habitats with low reproduction and dispersal for protection.*
Work on larval biology & duration.	*To increase our knowledge of larval duration for broadcast spawners, how capable species are of long-distance dispersal, and at what depth the larvae move in the current. Increased understanding of dispersal will increase our knowledge of connectivity.*

	Could help to prioritise areas/habitats with low reproduction and dispersal for protection.
Improved understanding and definition of what a coral 'population' is.	*Could help us understand the spatial extent of interbreeding units and define sources and sinks.* *Could help define management units.* *Could help us to consider and assess the effects of impacts both spatially and temporally.*
Determine the coral mineralogy of more species and evidence for carbonate dissolution using tools like Scanning Electron Microscope.	*This will allow the identification of species that may be more resilient to changes in the environment such as decreasing pH, which might support the identification of important areas for spatial management.*

Environmental Gaps	
Please identify as many research/knowledge gaps as you can	***What use would we have for this information, how would it benefit management***
Improved understanding of physical oceanography.	*Essential for understanding distribution and abundance patterns, resilience, adaptability, dispersal etc. to better inform the importance of certain environmental drivers of coral distribution and abundance for use in future models.*
Improved understanding of biogeochemical variation in explaining connectivity.	*To optimize management by incorporating landscape sensitivity and hydrological connectivity.*
Improved understanding of the drivers of environment and ocean stressors (temperatures and chemistry).	*Necessary to understand past and current changes to help inform on policy relevant to future projections.*
What habitat values/function does it support.	*To identify functional linkages and incorporate this information into sustainable management of resources supported by corals.*

Spatial Gaps	
Please identify as many research/knowledge gaps as you can	***What use would we have for this information, how would it benefit management***
Improved sampling effort in areas of New Zealand interest in the High Seas (SPRFMO) and Ross Sea (CCAMLR) coral identification and distribution.	*Important to know what species are in these regions. Being able to understand total species distribution and population structure rather than just what is in our EEZ will increase our knowledge on connectivity between habitats/populations.* *Will help to inform management plans.*
Further understanding on distribution and abundance. Still a lot of 'holes' in the map. Limited sampling in some areas (>2000m and some BPAs).	*Difficult to manage the EEZ if there are still large gaps in the map because the information isn't available.* *Filling in these gaps will support spatial management of the New Zealand EEZ.*
Identification of sources and sinks, and biodiversity/functional hotspots.	*To identify high value areas to support decision making in spatial management.*
Are patterns of structure and gene flow "universal".	*Ensuring that research and management assumptions are appropriate and well informed.*

	Ecosystem-based management would benefit from assessment of multiple species.
Comparison of coral VME to other VME data such as that for sponges to identify overall vulnerable ecosystems.	*To be able to learn from and apply successful international regulation to protect vulnerable populations, communities, and habitats.*
Further genetic collections from sources not already explored.	*To provide basic understanding about the components of coral biodiversity, which is necessary for effective decision-making about conservation and sustainable use.*
How effective are current seamount closures and BPAs for protecting deep water corals.	*Better understanding if these spatial management measures have been useful, and provide evidence that they may or may not require modifications (e.g., moving, expanding, additions).*
Identification of the areas of highest protection value for deep water corals, given competing interests of fishing, future seabed mining, and effects of climate change/OA.	*Better understanding if these spatial management measures have been useful, and provide evidence that they may or may not require modifications (e.g., moving, expanding, additions).*
Improved understanding of colonisation and settlement patterns of larvae.	*To better understand nature and potential for recovery of populations in areas*
Further connectivity work, including work on different species than has previously been done.	*This information is needed to be able to predict recovery.*
Improved understanding on the role of life-history variation, physical oceanography, ABNJ and biogeochemical variation in explaining connectivity.	To be able to determine appropriate spatial and temporal scales for management and recovery of impacted areas.
Further information about the link between shallow and deep-water corals. For example, regarding shelf break areas etc.	*To be able to differentiate management measures between areas that require different protection.*

Modelling Gaps	
Please identify as many research/knowledge gaps as you can	***What use would we have for this information, how would it benefit management***
Improved prediction of future refugia for both deep water and shallow water species.	*Identification of priority areas for spatial management.*
Better estimates of model uncertainty.	*Allows us to make more accurate decisions and trade-offs in spatial management.*
Models that estimate abundance in addition to presence absence.	*To allow the estimation of biomass as well as distribution. This could support work in identifying high value areas, or species that have a greater need for protection.*
The use of models to work out what biological variables are the key drivers	*In order to prioritise research projects so that the key environmental data are collected.*

of coral community composition, density, and "health".	
Incorporation of refined and updated predictions of future ocean climate from new Earth System Models.	*Updated model will enable spatial planning software's to utilise predicted future distributions and aid in re-prioritizing areas for protection.*
Identification of the linkages of gene flow to physical flow.	*To improve understanding of connectivity the therefore resilience of populations to disruption.*
Updated risk assessment with updated information, perhaps including parameters from the same coral species from other countries.	*To give us more accurate estimates to assess risk to coral species.*
More accurate models, that also include shallow water corals.	*Improve predictive power and priorities management strategies.*
Models with more accurate inclusion of data on biology of corals, and adaptive capacity.	*Improve prediction power and priorities management strategies.*

Threat & Pressure Gaps	
Please identify as many research/knowledge gaps as you can	***What use would we have for this information, how would it benefit management***
Investigation of ocean acidification impacts for deep and shallow water corals in the region, their dissolution and resilience.	*To identify possible refugia areas and identify species that are more likely to withstand the changes in the environment.*
Further experiments to understand the sensitivity of deep-sea corals to climate change, and if there is potential for acclimation.	*To provide more policy relevant projections, not just end-of-century to help management – e.g. we could protect any areas of potential refugia.*
Further investigation into the impacts of trawling on ecosystem function/services (e.g. carbon cycling, habitat provision for juveniles, fish etc.) provided by deep water coral/reefs.	*Better understand the wider impact on corals and associated communities, and be able to consider these impacts when designing management measures.*
Further investigation into the impacts of seabed mining on ecosystem function/services provided by deep water coral/reefs.	*Better understand the wider impact on corals and associated communities, and be able to consider these impacts when designing management measures.*
Improved understanding on how long recovery from trawling impacts and seabed mining take, and if communities recover to previous state.	*Better understanding on how long spatial closures may need to be in place, and if recovered areas will provide similar ecosystem function/services.*
Improved understanding on what facilitates the recovery of corals/habitat after trawling and seabed mining.	*Better understanding if there are any management measures that can be taken to improve recovery rate.*
What stressors and threats do these habitats and areas face (both	*To identify all threats that these habitats and areas face for further assessment of risk.*

repeated single stressors, and cumulative and multiple stressors).	
What management approaches can we adopt to reduce/mitigate these stressors, and perhaps even enhance productivity.	*To inform a diverse and effective suite of management approaches.*
Further information on affected and 'unaffected' areas from anthropogenic pressures	*To increase our understanding on these risks.*
In which regions/areas are we seeing the most rapid change, or which ecosystems.	*To help us identify possible refugia areas and aid in spatial management of these areas.*
Monitoring for changes in different areas, both in relation to larvae settlement and climate change.	*Improve the understanding of resilience and recoverability to better inform management approaches.*

Data, management & communicating science	
Please identify as many research/knowledge gaps as you can	***What use would we have for this information, how would it benefit management***
Incorporate new variables, records and methods.	*Ensure that the data architecture is adequate to facilitate relevant analysis.*
More robust image database storage system used for the observer collected digital images.	*For efficiencies and consistency of the image identification, which will help inform management decisions.*
Important to refine what is accepted as "robust" science when sample sizes are often small and spatial coverage may be poor.	*To ensure that management is informed by appropriate science.*
Improved understanding of *Areas Beyond National Jurisdiction* (ABNJ).	*Ensures that and research and management decisions take into account whole populations rather than being made at an EEZ or regional level.* *This also ensures a degree of consistency on coral management within and adjacent to the EEZ.*
Selection (e.g. SNPs – seascape genomics).	*To better understand the processes shaping the genetic structure of corals and the appropriate spatial management scales of coral taxa.*
How to best link in with other coral work, including approaches to assessing risk to corals.	*To minimize duplication in research and maximize the outcomes of research projects.*
Identifying and accessing relevant information sources; data consolidation.	*To have an easy and accessible way of reviewing existing information.*
Management discussion on what these gaps, or this information, means to us and to the management of the activities/species etc.	*To help us make more informed management decisions that both benefit the protection of these areas as well as the sustainable use of resources that are linked to them.*
Identification of new ways to communicate this science and knowledge to the public, and/or other platforms – data platform?	*To get the public more involved and interested in the protection of coral species.*

More coordination of existing coral research/projects.	*Minimize duplication and create synergies.*
We need to identify the difference of legislative. balance between inshore and offshore areas.	*To be able to better manage both shallow and deep-sea corals.*
We need to define specific management goals for deep-sea corals in New Zealand. Specific management objectives are ill-defined and poorly outlined, so it remains unclear what we're trying to achieve in terms of management with the data that we have (e.g, 10% spatial coverage? consider the CBD etc.).	*To use data available so far to, for example, derive management actions in line with NZs national and with international agreements to which NZ is a signatory.*