New Zealand Seafloor Community Classification- Questions and answers

Acronyms

BOMEC – Benthic-optimised Marine Environment Classification

CMECS- Coastal and Marine Ecological Classification Standards

DOC- the Department of Conservation

FNZ/MPI- Fisheries New Zealand/ Ministry for Primary Industries

MEC- Marine Environment Classification

MfE- Ministry for the Environment

MSAG- Marine Science Advisory Group. Includes marine science and policy representatives from three government departments (DOC, MfE, and FNZ/MPI)

NZSCC- New Zealand Seafloor Community Classification

MPA- Marine Protected Area

Questions related to the usage of the classification

How does DOC see the NZSCC being used in marine spatial planning processes?

Within the context of a national-scale MPA network, DOC is working to ensure protection of a representative range of species' habitats as well as areas of particular importance for biodiversity. Because the 75-group NZSCC reflects changes in species composition across broad spatial scales, one of its potential uses is to help in evaluations of how well the MPA network protects a representative range of species and habitats. We can also dial down the number of groups and potentially use the classification as a bioregionalization, or alternatively, dial up the number of groups and use the NZSCC to help inform regional-scale MPA planning.

The NZSCC could also potentially be used when reviewing coastal plans or future regional spatial plans, under the future Strategic Planning Act.

Given that the NZSCC is hierarchical, can the 75 groups within the NZSCC be subdivided when you are working at finer spatial scales?

Yes, it is one of the benefits of these hierarchical classifications. We can statistically derive the nested relationships amongst groups and derive those further.

There are some caveats to consider-

- Areas with high heterogeneity in environmental conditions (e.g., coastal areas) - we need to ensure that using a higher number of classification groups makes sense given what we currently know about those areas. We do that by replicating the same process used to obtain the 75 groups classification and exploring how the distribution of classification groups describe patterns of similarity within a particular location
- Considerations around transferability - If a higher number of classification groups is going to be used to better account of environmental heterogeneity in coastal areas, we need to make sure the classification continues to provide meaningful descriptions of variability in other places.

However, in doing this we need to evaluate the appropriateness of using a higher number of groups and if those groups appear to be consistent with our understanding of changes in species composition at finer spatial scales.

How appropriate would it be to use the results of your model at a regional scale (e.g., Hauraki Gulf) versus using it at a national scale considering the current resolution is pretty good (250x250m)?

While the spatial resolution of the model outputs might be at the 250 by 250 metre scale, the information feeding into the models might not be as high resolution as that. The models include a lot of smoothing, which means that if we want to model outputs to look at the scale of the Hauraki Gulf, we need to zoom in and determine how well current groups represent the biodiversity patterns that we do know exist at that spatial scale. In addition, if we do want to use it at scales of the Hauraki Gulf, we need to think about how many groups might be appropriate to do that. If we want to use the NZSCC at these smaller spatial scales, we may need to increase the number of groups to be able to get some definition at those scales.

How you use the NZSCC will be dependant of your objectives. It may be appropriate in its current state of 75 groups for some objective but not for others. The built-in uncertainty is going to give us some indication of whether you can zoom in and how well the groups are going to be defined at the scale of interest. You really need to investigate if the classification makes sense at the spatial scales of interest.

In summary, there are few things that we need to consider before applying the current 75 group NZSCC at regional scales.

Can you please provide more details on how you see this classification will be used by DOC, and other government agencies in the future?

DOC perspective - within the context of national scale MPA network planning, we're trying to ensure protection of a representative range of species and habitats; as well as protection of those areas which have particular significance for biodiversity.

Example 1-Because the 75 group NZSCC reflects changes in species composition across broad spatial scales, one potential use is to evaluate of how well the MPA network protects a representative range of groups within the NZSCC. One of the pieces of work we currently have available on the DOC website is a gap analysis which looks at representativity. We are currently rerunning that analysis

using the NZSCC to determine how well the current MPA network protects a representative range of the NZSCC groups that occur within the territorial sea.

Example 2- we can dial the number of groups down to use it as bioregionalization within an MPA planning processes.

MPI/FNZ- are currently using the NZSCC around their benthic work for bottom impact fishing gear.

Questions related to the maintenance framework and validation

Is there an ongoing maintenance framework for the NZSCC and a plan to update it?

The development of a maintenance framework is the next step in this project and is important for maintaining, modifying, and improving the NZSCC, as well as promoting and facilitating its application via open-access online data portals and tools. Part of this will include the development of a schedule for updating and validating the NZSCC as new data becomes available. However, to develop a fit-for-purpose maintenance framework we will need to understand how others might want to use the NZSCC so we can ensure it includes all the necessary components and is maintenance occurs at appropriate frequencies.

One of the issues with classifications and big data sets is the ongoing maintenance and development and housing and making them available to support wider use. Often a lot work is put into developing without a long-term plan. What is the commitment of each of the agencies in the MSAG to ongoing development and utilization, and ongoing data sharing?

This has been an issue for the BOMEC classification which was developed but never formally adopted due to the lack of a maintenance framework for its upkeep. We are conscious of that and one of the next steps we are looking at is the development of a maintenance framework that will prescribe how often the NZSCC needs to be updated and the form of validation that it requires. In terms of the commitment from different agencies to the NZSCC, the MSAG has identified the development of the NZSCC as a priority, hence indicating strong buy-in from the government agencies into its long-term use.

Can the associated model uncertainty be used to help plan the next steps and validation?

Yes, the model uncertainty is important for informing validation of the NZSCC. There are parts of the NZSCC that have high statistical certainty, and others with low statistical certainty. Ideally, we would want to ensure that any work to validate the model incorporates a range of the statistical certainty underpinning the NZSCC so that we do not end up only validating those areas with high statistical certainty.

I understand there are areas of poor data or of higher mapping uncertainty. Can this inform a programme that will focus on future data acquisition, whether biological or environmental?

Understanding where we are data poor is important to validate the NZSCC. When we do a validation of NZSCC, we do not want to use independent datasets that only contain information from those areas which have very good environmental coverage within the NZSCC. We want to pick up independent data which spans a range of environmental coverage and statistical uncertainty of the NZSCC.

In that regards it is important to determine future data acquisition or guide the processing of the data currently available. There is already data out there that are available and not fully processed, such as DTIS (Deep Towed Imaging System – NIWA). Looking at the environmental coverage and uncertainty layers will help us prioritise which pieces of data to process or where we need to collect new data in the future.

Environmental coverage is a very useful output that has been developed in the process of the NZSCC. It can be partitioned to particular taxa, so we can identify the taxa and locations that require additional sampling.

Some of the environmental data layers look to be modelled outputs from global models. What are the plans for validating these models in our region? Are there other environmental variables that could/should be included (Ph, residual currents, particle flux seasonality)?

A lot of the environmental data that we have available, particularly some of the datasets that describe deeper environmental patterns, are derived from models but they underline measurements firstly derived from remote sensing for the NZ region. It is good to think about ways of making sure that those environmental datasets that underline the species turnover are accurate. Currently there is no plan to validate those models, but it is a useful question to think about for the next steps.

In terms of other environmental variables that could or should be included, we did incorporate the full range of variables that were available for the EEZ at the time and within an appropriate spatial resolution. However, there is certainly room for improvement in terms of their temporal resolution. It could be worth exploring particulate flux seasonality but noting we might run into similar previously identified issues in terms of matching the availability of temporal data to the biological data.

When we are looking at the outputs they should be interpreted as spatially and temporally smooth predictions, so it is kind of an average. By keeping it broadscale and having 75 groups we are hoping to buffer some of those differences with changes that might be occurring over time. It would be great to include seasonal changes, it could be possible moving forward, but this would need to be included in a new project.

Questions related to the CMECS

How does this numerical classification work alongside the development of the thematic classification standards in New Zealand (CMECS- Coastal and Marine Ecological Classification Standards)?

The 75-group NZSCC describes changes in the composition of species and habitats over broad spatial scales. Thematic classifications differ from this in that they provide a hierarchical typology that can

be used to name and map the distribution of individual species and habitats at smaller spatial scales, including those species and habitats that are of particular importance for biodiversity. So, while the NZSCC is useful in assessing representation of species and habitats at a broad scale, a thematic classification will be useful in assessing the protection of areas of particular importance for biodiversity and representation at a smaller scale. In this regard, it is essential that the two classifications can talk to each other, also noting that new data collection made using the thematic classification can also be used to help with ongoing validation of the NZSCC. To achieve this, we need to ensure that the data layers feeding into the numeric classification are based on the typology used in the thematic classification.

Work around the CMECS - the CMECS is a system used in the USA. We are looking at adapting it to New Zealand to replace the current thematic classification that was set up to support the New Zealand MPA policy (2005). It will work alongside the NZSCC depending on the objectives you are trying to achieve. In some instances, the classifications will be used separately, in others jointly.

For example:

- The NZSCC groups can provide the higher-level hierarchy in CMECS,
- And conversely, we can look at using information we get through the CMECS as some sort of modifier to the NZSCC. The CMECS will have better spatial definition where rocky reefs are located, which in turn can be used as a modifier in the NZSCC.

What is the expected timing for future work linking NZSCC with thematic descriptions? The link seems very important for using the NZSCC for identifying significant or sensitive areas.

We are in the early stages of developing the CMECS for application in New Zealand and are probably looking at 2023/2024 for some significant development around how we can incorporate the two together, which is going to be important for identifying significant or sensitive sites.

We have a priority piece of work on Key Ecological Areas (KEA) underway. That work is compiling data layers that speak to nine different Key Ecological Criteria. We want to start looking at how to cross walk those data layers into the CMECS system.

Questions related to the development of the classification

Can you briefly describe how you allocated information from demersal trawl tows (usually several kilometers in length) to your 1 km grid?

For the trawl dataset we used the endpoint, which is the point that is associated with all biological data in that database. It is true that the trawls often go for longer, but we required just a single point for modelling purposes. We do not try to integrate over multiple cells so there is some spatial smoothing associated with that decision.

Within each domain (shallow water, shelf, deep water) could the changes in community be influenced by other environmental parameters? For example, slope/or aspect of the slope would become an important parameter to investigate in shallow water?

The underpinning Gradient Forest model incorporates all environmental parameters in a single model, so they all get an opportunity to contribute to driving species turnover that, in turn, is used to classify the classification groups.

Why did you not include "impacts" in the classification?

Within the context of MPA planning, impacts can be used to identify areas where biodiversity values have been diminished. Those areas can then either be deprioritized for protection because of the diminished biodiversity values or prioritized for protection as areas for targeted restoration. Given the potential value in understanding the distribution of impacts relative to biodiversity values, there is greater value in being able to consider them separately as opposed to integrating impacts within the NZSCC.

Have patterns and types of anthropogenic disturbance to the seafloor been overlain on the 75 groups, and can this shed light on resilience and/or induced homogenization of the seafloor?

The data covers a large temporal spread and "impacts" has not been included. It's not an easy thing to do to work back and answer these questions as it does depend on how far the data being used goes back and how much the environmental variables themselves have changed. Some of them would have changed in conjunction with potential species changes like turbidity.

In summary, no we haven't done that, and it would be quite a complex investigation to develop basically because of the large temporal spread of the data. This would be easier to do for some specific groups where data doesn't go that far back.

It will also depend on specific impacts. Ongoing work lead by FNZ is looking at quantifying the impact of bottom contact gears with the seafloor. Those kinds of spatial footprints could potentially be used in the NZSCC, but there is still quite a bit of thinking and work that would need to go into that. However, this approach might be potentially more straight forward than another impact like climate change, which has lots of complicated interacting components.

You have covered species spatial variability but not temporal variability. Some of the presented data seems to be quite ancient. How does that affect the output of the model? For example, some of the species observed, let's say 50 years ago, might not be present at the recorded locations anymore. This issue likely affects environmental variables as well – e.g., turbidity being very different at the same location across years/decades.

The data used in some cases will be validated because nothing has occurred that would change the species distribution. If an environmental variable is changing, such as turbidity, it will be integrated into an updated version of the NZSCC.

How and when do you decide to make the temporal cuts is a hard question to answer. If we had decided not to have any data older than 20 years, we would have had a lot less data, hence a weaker model.

Temporal averaging also relates to a previous question on overlaying of impacts. A single impact may not actually be what is affecting changes, but this is most likely linked to cumulative impacts and multiple stresses. In consequence, integrating those factors into the model is not just the matter of

laying a change over the top and looking at how that would affect things. It is very hard to decide what data should and shouldn't be included and deal with those impacts and changing environmental conditions. The current NZSCC is a good start with some very robust results, and those questions will need to be addressed in future iterations.

The classification appears to be based on models of species turnover across environmental gradients, so groups reflect differences in species composition. Within groups this approach does not explicitly incorporate geomorphic drivers that are important for biodiversity, such as seamounts. Is there a way to incorporate seamounts and other geological features within the classification?

Yes, there is, and we have been considering how we can use other types of information as modifiers within the NZSCC. So, taking seamounts as an example, we could take groups within which seamounts occur and disaggregate them to reflect that biodiversity values within the group may differ between areas with and without seamounts. This approach could be applied to a range of features and are considered to influence biodiversity values within a group.

It looks like we have come a long way since the original MEC (~2005) and the BOMEC (~2007). Have you been able to assess statistically the improvement in this new classification, and can you partition the improvement into contributions from having more data and better modelling approaches?

At present, we haven't run statistical comparison of the NZSCC with previous classifications like the BOMEC, but there are good reasons for doing this in the future. A statistical comparison can be used to measure the improvements in our ability to characterise pattern of biodiversity for the EEZ. There is a range of ways we could do that by looking at the ability of groups within the classifications to describe patterns of similarity based on our current data.

In terms of understanding how additional sampling may have increased the performance of the accuracy of those previous classifications, unfortunately they did not have associated measures of uncertainty. In consequence, we do not have a direct comparison with how uncertainty has been improved between the modelling frameworks and the classifications. One option is to be able to break down the environmental coverage layer into the different component taxa to see how improvements and the availability of data, at the time of the development of the BOMEC for example, has improved to the present case where we have significantly more sampling. We can see if there is any relationship between those improvements and environmental coverage, and the ability of the classifications to the tease out differences in group dissimilarity.

When will the validation exercise be completed? And when completed will it change the predictions of certainty in the model?

This is the next step of the project, which can be divided into two parts: development of a maintenance framework and validation of the NZSCC. We are still in the process of determining the timeline for the development of these next steps.

The NZSCC uses a massive amount of data, so one of the challenges is to identify sets of independent data to help validate it. For example, we are looking at some of the DTIS data that NIWA has been

collecting. How we integrate those data will be dependent on how we develop the maintenance framework for the NZSCC.

The maintenance framework will likely identify how often we will validate or update the NZSCC.

To update the spatial layer uncertainty with the acquisition of new data, we need to rerun the classification, which is certainly possible. The frequency of rerunning the model should be integrated in the maintenance framework.

How is this classification robust/weak against temporal trends in environmental data? For instance, how does the observed increasing trend in (sea surface) temperature impact the classification, especially in the context of species range shifts.

The biological data feeding into the development of classification covers a wide temporal spread, and how temporal trends in environmental data may impacts species distributions have not been included so far.

There is ongoing work about how different species might correspond to different temporal changes. A big caveat is we don't know how a lot of species distributions are related to different temperatures. While the classification is pulling out temperature as being an important driver, it doesn't mean that changes in water temperature are going to drive future distributions of particular species in a certain direction. Interacting variables most likely ultimately determine changes in species distributions, of which temperature may only be one.

Question on Group 30 "Marine mammal"- This appears to be the Maui dolphin area. Have marine mammal distributions been overlain over the 75 groups? If so, what was found and has this been published?

No, the marine mammal distributions have not been overlaid over the 75 groups. There is a lot of interesting overlap potentially with other pelagic taxa as well. One of caveats mentioned was around not having sufficient information for pelagic species.

Are coastal bioregions still a useful concept in environmental classification, and are they able to integrate into this new classification?

You could roll up some of these classes into fewer groups and use them as a bioregion classification. Another part of our work focuses on developing a thematic classification for coastal areas and standardising mapping of marine protected areas. The NZSCC could feed into the thematic classification process by providing a bioregional setting as a part of the hierarchical thematic classification.

You've mentioned the data-poor issues on some locations and highlighted that the results haven't been ground-truthed/validated. Keeping all of this in mind, do you have an overall sense (perhaps with that uncertainty layer) of which areas are likely to be better than others? I'd be particularly interested to hear about the solidity of results between coastal/estuarine and more pelagic/deep water areas.

There are some areas that we have less confidence in, and we have used various methods to try and identify those. The models have been assessed in terms of how well we think they are working; this is done through a bootstrapping process where data is withheld at each iteration and then used to validate the predictions, so although it is not completely independent there are estimates of how well we think the models are doing and they seem to be doing a good job. There are areas with more, or less, uncertainty. I would absolutely agree that using the two uncertainty layers can help identify places that would be good to go to ground truth and validate. We mentioned that the environmental coverage layer can be generated for each taxa and that is absolutely correct and is another good way of splitting that up.

In terms of the results between deeper water and coastal and estuarine areas, we have a lot of data for coastal areas, but for the estuarine areas, although we have a lot of data, they were not necessarily applicable in the same way as a lot of the coastal data was; so in that sense estuarine areas may be less robust than some of the other areas within our study. As per deeper water areas, the uncertainty layers point out the need to sample more information from such areas.

Questions related to engagement with stakeholders and Tangata whenua

In addition to the useful overview of the NZSCC, it would be useful to comment upon the whole exercise in relation to Te Ao Māori and Mātauranga.

At this stage of the NZSCC development, we have solely focused on creating a statistical classification and have not yet considered its practical applications, such as how it would fit with Te Ao Māori and mātauranga. From a DOC perspective, the next step is to think about how we use the NZSCC within any MPA planning processes, although acknowledging some of the other government organisations are looking at using it in different processes as well. When we engage in a regional or local scale on MPA planning processes, we think about how Te Ao Māori, interconnectedness in relationships of all living things, and mātauranga would fit into that framework. We haven't done that thinking yet except to say that we are very conscious that when we take this framework and use it at regional scale process, we need to think about how it reflects a wide range of values held by different stakeholders and iwi/ hapū /whanau. We are also conscious that those values often change from place to place as well, so there's a lot of work to do to think about how the NZSCC can be used within those variable contexts.

Regarding use of the NZSCC in future MPA processes at a regional scale, to avoid duplication, can DOC engage early and jointly with both tangata whenua and the respective regional council(s)?

We acknowledge that this is an important step for any marine spatial planning processes, including the design of marine protected areas. There is an expectation that early engagement occurs and that is seen as an important component of successful planning. This is particularly important in terms of working with Tangata whenua and ensuring the principles of the Tiriti o Waitangi are observed. We are aware of the tremendous amount of work that has been done on significant sites across Regional Councils and already engage with them regularly on this topic.

How did you socialise this work with iwi/whanau/ hapū? There is a high desire to include Mātauranga Māori in marine science and I might have missed something but not sure I have heard much involvement of mana whenua?

We have not yet socialised the work with iwi/whanau/hapū. We are keen on any suggestions on how to incorporate Mātauranga Māori, particularly in the future maintenance framework of the NZSCC.

When it comes to using the NZSCC it will be critical to ensure it is considered alongside Mātauranga Māori in any planning process.