

Marine Habitat Assessment Decision Support (MarHADS) Tool

Background and Operating Instructions

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Marine Habitat Assessment Decision Support (MarHADS) Tool

1.0 Introduction

1.1 Background

Regional councils have specific management responsibilities over coastal waters and habitats out to 12 nm offshore, which lie within New Zealand's territorial seas. In the face of increasing use of coastal resources Regional Councils must recognise and provide for the matters of national importance listed in Section 6 of the Resource Management Act (RMA), particularly the preservation of natural character (which includes an ecological element) (Section 6a) and protection of indigenous vegetation and fauna (Section 6c). Regional councils also must give effect to the policies on natural character in the New Zealand Coastal Policy Statement (NZCPS) (2010). Additionally regional councils need to take into consideration the New Zealand Biodiversity Strategy (NZBS) (2000) to halt the decline in New Zealand's indigenous biodiversity, maintain and restore a full range of remaining natural habitats and ecosystems to a healthy functioning state, enhance critically scarce habitats, and sustain the more modified ecosystems in production and urban environments; and do what else is necessary to protect a full range of natural marine habitats and ecosystems to effectively conserve marine biodiversity. These are statutory obligations, not just a commitment.

However, in undertaking the preservation of natural character and protection of indigenous vegetation and fauna, regional councils are severely hampered by a lack of information on the values and sensitivity of coastal ecosystems. In particular, Regional Councils throughout the country are struggling to determine which, if any, of the coastal habitats important to indigenous vegetation and fauna are covered under Section 6, and therefore warrant a higher level of protection. This information is urgently required, because many marine habitats and ecosystems throughout New Zealand are progressively being impacted by activities within the coastal marine area and in adjacent catchments. A recent report¹ identified as many as 52 non-trivial threats affecting New Zealand's coastal marine habitats and found that habitat vulnerability increased from offshore to inshore. Where they have not been spatially identified, there is a serious risk that the matters of national importance identified in Section 6 of the RMA will be, or have already been, degraded or lost through the impacts of these threats.

While the focus of regional councils in the past has largely been on harbours, estuaries and shallow coastal waters, there are emerging issues for more offshore areas within the territorial seas which increases the need to know more about the natural character of these regions as well. These issues include the effects of offshore mineral extraction (e.g. iron-sand mining), wave energy electricity generation, extensive marine farming, long outfalls and potentially nutrient laden river plumes extending, and influencing water quality, to some distance from shore. In most cases regional councils have little or no detailed knowledge about these areas, yet are responsible for their sustainable management.

There are currently no nationally accepted and scientifically robust guidelines on how to determine which areas are significant and therefore should be protected, and existing guidelines for fresh water or terrestrial ecosystems do not readily apply to marine ecosystems. Environmental degradation within the coastal marine area is occurring continuously, and much of this degradation is difficult or impossible to reverse. The best way to protect areas, therefore, is to identify areas of particular ecological significance, and prevent adverse impacts. Thus, there is a clear and pressing need for some nationally consistent and scientifically defensible assessment criteria that regional councils can use to identify which areas to preserve and protect. This will then allow regional councils to take steps to protect them through, for example, regional and

¹ MacDiarmid et al. (2011). Assessment of anthropogenic threats to New Zealand marine habitats. Final Research Report to the NZ Ministry of Fisheries, Project BEN200705.

coastal plans or through working with the Department of Conservation to establish marine reserves and the Ministry of Fisheries to establish Mataitai or Taiapure or other restrictions on fishing activities.

1.2 Meeting regional council needs

To help establish the necessary criteria that could be applied consistently across regions and nationally, regional council coastal marine scientists and NIWA obtained funding from the Envirolink fund to develop a tool that would assist regional council resource managers and decision makers to critically assess the relative state and value of coastal habitats and environments.

Regional council jurisdiction over the marine environment is exercised in a patchy and ad hoc manner around the country as different councils attempt to address common questions and problems using a variety of approaches requiring different information inputs. Consequently, there are considerable benefits from having a nationally consistent methodology and approach for the identification of important ecosystems that is underpinned by robust science. These include:

- Prevention of overlooking significant ecological areas;
- Nationally consistent ecological assessment that will carry more weight and thus provide enhanced credibility and greater uniformity and certainty to stakeholders. The criteria are thus less likely to be rejected by individual councils or interest groups.
- Avoiding duplication, (with consequent cost saving) by removing the need for each individual council to independently develop a set of assessment criteria.
- Enhancing sustainability by reliably and consistently identifying for protection habitats that contribute significantly to ecosystem functionality, and the production of goods and services.
- Better quality regional policy decisions designed to preserve and protect the related aspects of the matters of national importance identified in Section 6 of the RMA.
- Enhanced quality of consent decisions by identifying "special" coastal values which need to be considered by consent officers and hearing commissioners.
- Providing enhanced case presentations in council hearings and the environment court.
- Providing enhanced decisions through less variation in the quality of assessments of matters of national importance.
- Enhanced identification of marine and coastal information gaps (including spatial coverage gaps) that councils can then use to plan research and monitoring requirements.
- Providing the ability to consistently reassess habitats or regions as and when new information becomes available.

In the first use of this tool, we recommend that regional councils deliberately assess examples of each habitat type within their region that lie at, or near, the extremes of environmental degradation and pristineness. Habitats occurring within well established marine reserves may provide one extreme; your local knowledge may suggest the locations of the other extreme. These initial assessments would then provide immediate knowledge of the likely range of environmental characteristics for each habitat that would indicate its regional significance. As further assessments are undertaken the proportions of a habitat within a region that lie along this gradient will become increasingly apparent. Regular sharing of habitat assessments among councils will help to indicate the likely range of environmental characteristics for each habitat that would indicate its national significance.

We envisage regular upgrades to the tool to take advantage of increases in the quality and quantity of ecological information available within New Zealand. In this way, the tool could increase in benefit in the future as well as providing immediate application.

2.0 Overview of the Marine Habitat Assessment Decision Support (MarHADS) Tool

2.1 Council requirements

At a workshop in December 2008 regional council staff from around New Zealand clearly identified that the tool must:

- Provide an indication of the relative proportion of a habitat on a regional and national basis
- Incorporate assessment of threats to marine habitats
- Incorporate assessment of the goods and services provided by marine habitats
- Take into account any threatened and endangered species occurring within a habitat
- Include some measure of the degradation of habitats •
- Incorporate measure of uncertainty •
- Be applicable to a wide range of coastal environments nationally
- Be able to take into account the limited resources and paucity of data available to many regional councils
- Uses information regional councils have, but allows for new information target future sampling
- Prevent data intensive areas from ranking highest
- Be robust and defendable in court •

2.2. Components of the tool

To accommodate the needs of regional councils the tool incorporates five explicit components about marine habitats (Figure 1). These are:

- 1. The quantity of habitat the actual and relative size of the habitat in question on local, regional, bioregional and national scales.
- 2. Habitat vulnerability this includes likely threats, their scale and functional impact, as well as the resilience of the habitat to those particular threats, the recovery timescale once the threat is removed and the level of uncertainty in assessments of these factors given the state of knowledge about them.
- The threatene
 Habitat quality The threatened and at risk species that may occur within particular habitats
- 5. The goods and services provided by marine habitats

In the sections below each component is described in more detail and the relevant sheet in the tool is described and uses explained. Additional sheets such as the Master sheet and two summary sheets are also described and their use explained.

2.3 Application of the tool

In your assessment using this tool you will be considering a habitat from one of three points of view:

- From a region wide perspective (e.g salt-marsh habitat in the Hawke Bay Region generally so as to contribute to regional planning);
- From a harbour or bay point of view (e.g. saltmarsh in Waitemata Harbour generally so as to contribute to an assessment of all habitat types within the habour);
- From the perspective of a particular area of habitat (e.g. the salt-marsh at the head of a particular estuary so as to contribute to an assessment of the impact of a proposed use)

You need to carefully consider which of these three points of view is relevant to your current assessment and then maintain that perspective for the entire assessment. Confusion as to the assessment purpose will cause problems in interpreting the results.



Figure 1: Conceptual view of the MarHADS tool indicating the five components used in assessing habitat significance.

3.0 Master Sheet

3.1 Background

This sheet sets the context for the remainder of the assessment and always needs to be the first sheet you complete. It is important that you insert your name into the space provided, and provide the date of the assessment and as much information as possible about the location of the place you are assessing, including the latitude and longitude. Provision of this information will allow reassessment of the same site at some later date.

It is critical for proper functioning of the tool that you select your region and bioregion as these actions populate other parts of the tool with appropriate information. The bioregions used are defined by Shears et al. $(2008)^2$.

In this sheet you must select the type of habitat you are assessing from a list of 69 habitats as this populates other parts of the tool with appropriate information. These habitats are grouped under the broad categories of Harbours and Estuaries, Fiords, Sheltered Coasts, Exposed Coasts, Slope Habitats, Deep Habitats, and Pelagic Habitats (Table 1). Similar types of habitats may occur in several general categories and it is important to take some time to choose the correct general category as other parts of the assessment are dependent on your choice. Intertidal sands, for example may occur in harbours and along sheltered and exposed coasts (though in the latter two cases we generally call them sandy beaches). The distinction between sheltered and exposed coasts may be difficult when there is a slow graduation from one to the other along a more-or-less uniform coastline that is protected in part by a headland, peninsular or an offshore island. If you can't decide, you could repeat the assessment under both categories and see if there is any substantial difference in the outcome.

General habitat	Description	Examples
category		
Harbours and Estuaries	All habitats located within the	Waitemata Hbr, Otago Hbr,
	confines of a harbour or estuary	Tamaki Estuary, much of
		Firth of Thames
Sheltered Coasts	Habitats outside harbours but	Much of the inner Hauraki
	sheltered to a large extent from	Gulf, Marlborough Sounds,
	the prevailing winds and ocean	Inner parts of Doubtless
	swells	Bay, etc
Fiords	Habitats inside fiords of	Fiord rock walls, fiord
	Fiordland	sediments, fiord pelagic
		zone
Exposed Coasts	Habitats exposed to the	Entire coast apart from that
	prevailing winds and ocean	part that falls into the
	swells	above three categories
Slope Habitats	All habitats on the continental	
	slope – generally 200-2000m	
Deep Habitats	All benthic habitats beyond the	Seamounts, abyssal plain,
	slope. Some seamounts may	trenches, hot vents and
	rise close to the surface	cold seeps
Pelagic Habitats	All water column habitats.	Coastal – whole water
	Beyond the shelf this has been	column inside the 50m
	divided into photic zone and	contour
	below photic zone habitats.	

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² Shears et al. (2008). Evaluation of Biogeographic Classification Schemes for Conservation Planning: Application to New Zealand's Coastal Marine Environment. Conservation Biology, Volume 22, No. 2, 467–481

If none of the habitats listed on the Master Sheet match your habitat then you have the option of entering a user defined habitat and initializing the programme. Note that in this case no habitat data will be available on the quantity sheet.

3.2 Operation in the MarHADS tool

- Save the file to a new project file name to ensure you always have a fresh unaltered template version available ready for your next assessment.
- Click on the *Master* sheet tab (Figure 2)
- Enter your name and the date of the assessment in the boxes provided
- In the box to the right, select the region for which the assessment is carried out. Note that the mainland Canterbury and Chatham Islands region are listed separately. This step is critical as it populates the habitat quantity sheet with data appropriate for your region.
- Select the bioregion for which your assessment is carried out. Toggle the Map sheet tab to see which bioregion your assessment sits within. This step is critical as it populates the habitat quantity sheet with data appropriate for your bioregion.
- Name the spatial location of your assessment in the box provided.
- Enter the latitude and longitude of the centre of the habitat you are assessing
- Provide a unique numerical identifier for this assessment. You may wish to use this same number in your file name and else where keep a record of numerical identifiers and assessments.
- Provide descriptive notes of the area you are assessing sufficient to ensure someone else could identify the area assessed.
- Determine the general category of habitat (i.e. harbour, fiord, pelagic, etc) and then select one habitat only from the choices provided in the boxes.
- Check that you have not accidently clicked another habitat box.
- If none of the habitats provided suits your needs then briefly identify you habitat in cell K29 and initialize the programme by ticking the box below.

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19 Mangrove T	Cobble beaches	Seamount >1999 m T	Descriptive notes:	Assessment includes all seagrass habitat ir	Whangateau Harbour
21 Tintertidal sand	Sand 0-9m T	Hot vent			
23 D Intertidal mud	Gravel/pebble/shell 0-9m T	Cold seep	🔽 Go to Dashboard		
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25 V Seagrass T	Mud 10-29m T	Soft abyssal 2000 m+			
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Figure 2: Screenshot of the *Master* sheet showing it filled out for an assessment of seagrass habitat in the Whangateau Harbour.

4.0 Quantity of Habitat

4.1 Background

It is important to clearly define the scale of the habitat that is the focus of your interest as this will used throughout the assessment. The smallest unit of assessment is the area of habitat that you are considering in your assessment. This may be a patch of seagrass in a particular harbour, all seagrass habitat in that harbour, or all seagrass habitat in your region. Clearly, this scale will then affect the vulnerability of the habitat to various threats, the variance in the quality of habitat, the number and magnitude of the goods and services it provides and the number of threatened or at risk species that occur within it.

It is also important to consider the area of your smallest unit of assessment in relation to broader spatial contexts. Where regional, bioregional and national data are available the tool provides these areas for the type of habitat you are assessing (in the *Master* sheet these habitats are indicated by a T) and automatically calculates the proportion contained within your smallest unit of assessment. The tool also allows you to define a unit of interest intermediate between your smallest scale and the regional scale. For instance, you may be interested in the area of your smallest scale of assessment relative to say the whole of the Porirua Harbour, north of Wellington. In this case the area of this harbour (ha) should be entered into the appropriate box on the *Quantity* sheet. Check that you have named this appropriately in cell O13 on the *Maste* sheet.

National, regional and bioregional areas are available only for the habitat types listed in Table 2 below. These were further divided by general category (harbour, sheltered coast, exposed coast, etc) and by depth. While the 30m and deeper depth contours are available for the entire coast the 10m depth contour has one large and several small gaps. The 10m contour is undefined for most of the Canterbury Bight. Here we used the spatial relationships between the 10m and 30m contour in Pegasus Bay to infer the position of the 10m contour. Similarly the 10 m contour is undefined around part of the Karikari Peninsular in Northland. Here we used the spatial relationship between the 10m and 30m contour around Cape Brett to infer the position of the 10m contour.

Habitat	Source data
Mangrove forest	GIS data layer constructed by NIWA from original 48
	shapefiles of mangrove forests in North Island harbours put
	together by Eagle Technology Ltd.
Seagrass beds	Dataset constructed by Mark Morrison and Jenny Beaumont of
	NIWA. Shapefiles of intertidal bed locations available for some
	locations. In other cases paper maps of bed locations were
	digitized. Estimated areas of beds by local experts only
	available for other harbours. In some areas records have not
	been updated since the 1960's and the distribution of
	seagrass is highly likely to have changed since then.
Intertidal reefs	LINZ dataset constructed by Eagle Technology Ltd from aerial
	photography of the NZ coastline.
Subtidal reefs	DoC dataset of shallow subtidal rocky reefs, to a maximum
	depth of 50m, mapped from historical hydrographic farings
	sheets - contact Clinton Duffy of DoC.
Subtidal mud	Simplified digital version of NIWA sediments charts that
Subtidal sand	includes only three classes of sediment. Some areas remain
Subtidal gravel, pebbles, shell	unclassified, especially areas shallower than 5m.
Seamounts	Dataset constructed by NIWA

 Table 2:
 Sources of data for habitat area information.
 Principal NIWA contact is Anne-Laure

 Verdier (a.verdier@niwa.co.nz)
 Verdier@niwa.co.nz)

Unfortunately for only about half the habitats listed on the Master sheet is there reliable national information available on their spatial location and areal extent. For the other habitats, we have made available within the tool an estimate of their national commonness or rarity and provide you with the opportunity to assess their regional commonness or rarity. It is envisaged that as more data on habitat distributions becomes available nationally then later upgrades of this tool will have an increasing number of habitats with reliable information on this important aspect of assessment.

4.2 Operation in the MarHADS tool

- Click on the *Quantity* sheet (Figure 3)
- Place your name and email address in the boxes provided
- If you have reliable measurements of your intermediate area of interest enter this in ha in cell F18
- If you have reliable measurements of your smallest unit of interest enter this in ha in cell H18.
- If you only have a rough estimate of your smallest unit of interest choose an appropriate value from the dropdown box in cell J18.
- If you only have a rough estimate of your intermediate unit of interest choose an appropriate value from the dropdown box in cell J18.
- Select the regional commonness of your habitat from the choices provided from the dropdown box in cell L18
- Indicate your level of certainty in your assessment of habitat commonness from the choices provided.
- Enter any notes or references about this part of the assessment in the box provided.
- Check the label in cell F17. If this says empty then go back to the *Master* sheet and insert an appropriate name after reading the background notes above.
- Ticking the 'Display NZ habitat areas' button reveals a hidden sheet that summarises the known areas of marine habitats around New Zealand.

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19			0.72915	0.54166	0.66583	0.11735	0.10000			
20	Area of each unit as a proprtion of NZ total		0.72915	0.39495	0.26297	0.03086	0.00309			
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Figure 3: Screenshot of the *Quantity* sheet showing it filled out for an assessment of seagrass habitat in the Whangateau Harbour

5.0 Habitat Vulnerability

5.1 Background

The effect of human activities in the marine environment is influenced by factors relating to both the threat and the habitat. The threats magnitude, distribution and frequency of occurrence and the habitats associated species assemblage that affects its susceptibility to a particular threat, the functional impact of the threat on the habitat, and the time that habitat takes to recover from the threat can all be critical^{3,4}. If a threshold is reached in terms of the size or frequency of an impact then an ecosystem may never recover and could persist in an alternative stable state.

MacDiarmid et al. (2011) carried out an expert based assessment of threats to New Zealand's marine habitats and their national level results have been made available in this tool. Rather than ask each expert to provide a single score for the vulnerability of a habitat to a particular threat, MacDiarmid et al. (2011)¹ followed Halpern et al. (2007)⁴ and asked the experts to assess five distinct vulnerability criteria which they later combined into a single mean score. These criteria included the spatial scale, frequency and functional impact of the threat in the given habitat as well as the susceptibility of the habitat to the threat and the recovery time of the habitat following disturbance (Table 3). They also included a measure of certainty that allowed the respondents to qualify their response with the level of confidence they had in the supporting information for each threat/habitat interaction. This measure of certainty was used to weight the response of each participant to a particular threat/habitat interaction. For each vulnerability criteria MacDiarmid et al. (2011) provided an assessment scale (Table 3) that was explicitly or approximately logarithmic, as well as, where appropriate, descriptive notes and examples.

Experts were first asked to assess the proportion of a habitat affected by each threat (Table 3).

Next experts were asked to describe how often discrete threat events occurred within a particular habitat. This event frequency ranged in scale from rare or very infrequent events such as a major oil spill, to persistent, being more or less constant year round (Table 3). For example, the shading effects of a piled wharf are more less the same every day and may be expected to last for the lifetime of the structure which may be many years, perhaps decades. It is important to note that frequency does not necessarily imply anything about severity. Major oil spills are rare but their impacts on a particular habitat may be extreme as well as long lasting.

To capture the magnitude of an impact participating experts were asked to assess the functional impact of the threat on the habitat by indicating over a four step scale whether a single species or the entire ecosystem was affected (Table 3).

MacDiarmid et al. (2011) modified Halpern et al's (2007) vulnerability criteria 'habitat resistance' to 'habitat susceptibility' as it was thought this term was more widely understood, would help differentiate the measure from resilience and more logically increased in step with the threat level (Table 3). In fact this measure is close to Halpern et al's (2010) measure of "percentage change" used in the assessment of threats to US west coast marine ecosystems. Susceptibility was estimated in four steps from low where there was no significant change in biomass, structure or diversity until extreme threat levels, to extreme where the slightest occurrence of the threat causes a major change.

Experts were asked to assess recovery time, the average time required for the affected species, trophic level(s), or entire community to return to its former state following disturbance by a particular threat. This was estimated in years with the scale ranging in four steps from <1 year to >100 years.

³ Hughes, TP., Bellwood, D.R., Folke, C., Steneck, R.S. and Wilson, J. (2005) New paradigms for supporting the resilience of marine ecosystems. Trends in Ecology & Evolution 20: 380-386.

⁴ Halpern et al (2007). Evaluating and ranking the vulnerability of global marine ecosystems to anthropogenic threats. Conservation Biology Volume 21, No. 5, 1301–1315

Lastly, a measure of certainty was included to allow participating experts to indicate the quality of the knowledge available to them to make judgments in relation to each of the above criteria for a particular threat to a specific habitat. The certainty scale ranged from no certainty at all in the absence of any documented or personal evidence to absolutely certain when extensive empirical work exists or the expert has extensive personal research knowledge (Table 3). For each vulnerability criteria a 'don't know' option was provided.

Table 3.	Ranking	system	for e	each	vulnerability	measure	used	to	assess	how	threats	affect	NZ	marine
habitats (based on	Table 2	in Ha	alperr	n et al 2007).									

Vulnerability	Category	Rank	Descriptive Notes	Example
Measure				
Percentage of				
habitat affected				
by threat				
	No threat	0		
	1-10%	1		Damage from a single anchor
	11-25%	2		
	26-50%	3		
	>50%	4		Sea surface temperature change; ocean acidification
Frequency				
	Never occurs	0		
	Rare	1	Very infrequent	Major oil spill
	Occasional	2	Frequent but irregular in nature	Toxic algal bloom
	Annual or regular	3	Frequent & often seasonal or periodic	Runoff events due to seasonal rains
	Persistent	4	More or less constant year round, lasting through multiple years or decades	Reclamation or shading effects of pile wharf
Functional				
Impact ⁵				
	No impact	0		
	Species (single or multiple)	1	One or more species in a single or different trophic level	Ship strikes on whales
	Single trophic	2	Multiple species affected; entire trophic level	Over harvest of multiple species within
	level		changes	the same trophic guild
	>1 trophic	3	Multiple species affected; multiple trophic	Over harvest of key species from
	level		levels change	multiple trophic guilds
	Entire	4	Cascading effect that affects entire	Increase in ocean temperature or
Susceptibility	ceosystem		cosystem	
Susceptionity			· · · · · · · · · · · · · · · · · · ·	
	Not susceptible	0		
	Low	1	No significant change in biomass, structure	Trawling on shallow sediment
			or diversity until extreme threat levels	communities on an exposed coast
	Medium	2	Moderate intensities or frequencies causes	Effects of industrial pollution
			change	discharges on coastal habitats
	High	3	Threat causes significant but not catastrophic	Effects of acidification on growth of
			effects; some capacity for adaptation	calcareous biogenic reef organisms
	Extreme	4	Slightest occurrence causes a major change	Bottom trawling on deep-sea corals
Recovery time (yrs)				
	No impact	0		
	<1	1		Kelp forest recovery after disturbance
	1-10	2		Short lived species recover from
	10.100	2		episodic toxic pollution
	10-100	5		Long-lived species recover after over-

⁵ Note that functional impact would be expected to be low if recovery time was short

				harvesting eg. right whales
	>100 or	4		Deep-sea coral recovery after trawl
	permanent			damage; reclamation
Certainty				
	None	0	Vague hunch or gut-feeling only	
	Low	1	No empirical work exists of this interaction specifically, perhaps some general knowledge	
	Medium	2	Some empirical work exists or expert has some personal knowledge	
	High	3	Body of empirical work exists or the expert has direct personal research experience	
	Absolutely certain	4	Extensive empirical work exists or the expert has extensive personal research knowledge	

5.2 Assessing habitat vulnerability

The national level expert assessment of habitat vulnerabilities has been made available in the tool. Note that the vulnerability scores are expressed in two ways; as the mean across all threats (including zero scoring threats), and as the mean across just those threats active in a habitat. In most cases use the mean score across all threats as this allows comparisons of habitat vulnerability across the widest range of threats. Use of the mean vulnerability score across just those active threats should be restricted only to comparisons of habitats facing the same set of threats.

The vulnerability score represents the vulnerability of a habitat to a particular threat over a range of 0 - 4. These scores are equivalent to responses to threats over several orders of magnitude. For instance, a score of 0 indicates that the particular human activity does not threaten a specific habitat. A score of 1.0 would indicate that typically a threat affects 1-10% of a habitat, is very infrequent over the course of a year and affects only one or a few species, and that the habitat in question has low susceptibility to the threat and recovers in less than a year. A score of 2.0 would indicate that typically a threat affects 10-25% of a habitat, is frequent but irregular in nature, multiple species or an entire trophic level is affected, that moderate intensities or frequencies of the threat causes change and that the habitat takes 1-10 years to recover. A score of 3.0 would indicate that typically a threat affects up to 50% of a habitat, is frequent and often seasonal or periodic, affects multiple species in multiple trophic levels, causes significant but not catastrophic effects and that the habitat takes between 10 and 100 years to recover. A score of 4.0 would indicate that typically a threat affects most if not all of a habitat, is persistent, affects the entire ecosystem, the slightest occurrence of the threat causes a major change to the habitat, and that the habitat recovery time is more than 100 years. To reach an average vulnerability score of 4.0 all threats would need to score at the maximum values for all five vulnerability criteria. In practice this is unlikely so the maximum vulnerability estimates may lie between 3 and 4.

Available in the tool is a 'Vulnerability' assessment sheet that is set up to allow the habitat under scrutiny to be assessed using the same criteria as used in the national assessment. The difference between the two assessments is the focus. In the national level assessment experts were asked to consider the average threats impacting a particular habitat type from a NZ wide, average point of view. In your assessment using this tool you will be considering a habitat from one of three points of view:

- 1. From a region wide perspective (e.g threats to salt-marsh habitat in the Hawke Bay Region generally);
- 2. From a harbour or bay point of view (e.g. threats to saltmarsh in Waitemata Harbour generally); From the perspective of a particular area of habitat (e.g. the specific threats impacting salt-marsh at the head of a particular estuary)

5.3 Operation in the MarHADS tool

- Click on the Vulnerability sheet (Figure 4).
- Potential threats to your habitat are listed down the left-most column.
- Please consider the manner in which actual threats affects the particular area of habitat you're assessing.
- Five aspects of the operation of each threat in a habitat are listed across the sheet. For each threat score assess the proportion of the habitat affected by the threat, the frequency of the threat, and the functional impact of the threat on your habitat using the levels available from the drop down boxes.
- Also assess the susceptibility of your habitat to each threat, and indicate the time it would take for your habitat to recover if the threat was removed.
- If the threat has no impact on the habitat leave the score button as is but for each threat please indicate how certain you are of your answer.
- At the right end of each row is a box where you can add notes if you wish to further qualify your responses or insert a reference to published work.
- Ticking the 'Display NZ vulnerability scores" produces a sheet displaying the national vulnerability values.
- When completed, tick the 'Summarise your vulnerability scores' button, which summarises the data you have entered and places these on the Summary Dashboard

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	A1 - (- <i>f</i> * Sc	oring the vulnerabilit	y of your habitat or area							~
- 1	A	ВС	DI	F G	HI	J K L	M N	O P		A
1	Scoring the vulr	erability of	your habitat o	or area						_
2		using site	specific infor	nation						=
3	Please read the instruction	ons worksheet	t before completi	ng this form						
4		7								
6	Summarise your vulnerability scores									
7			Your	ame: Alison MacDiarmid						
9	Display NZ vulnerability scores	Da	ate you did the assess	ment: 23 May 20011						
10										
	🗖 Go to Dashboard									
12 B	elow score each threat to the habitat(s) you se	elected on the Masters	sheet If the threat has no in	nnact on the habitat leave the score	e button as is but for each t	reat please indicate how cert	ain you are of your answe	r. Please consider the	1	
n	anner in which actual threats affects the partic	ular area of habitat you	re assessing. At the right of	end of each row is a box where you	can add notes if you wish t	o futher qualify your response	s or insert a reference to	oublished work. When		
12 VI	ompleted, hit Summarise your vulnerability sco. Ilnerability values.	res button, which sumi	marises the data you have	entered and places the summary of	n the Summary Dashboard.	The Display NZ Vulnerability	scores produces a sheet	displaying the national		
13	Habitat nama]	
14	Habitat hame									
15	Seagrass bed	Descentere		Habitat Vulnerabilitie	S					
		of habitat	Threat	Functional	Habitat	Recovery Time (vrs) if				
		currently affected by	frequency	Impact of Threat	Susceptibility to Threat	Threat	Certainty	Notes		
16	hreats	threat				Eliminated				
17	Fishing:									-
26 S	eaweed gathering	0 🔻	Never occurs 🗸	No impact 🔹	Not susceptible	Unaffected 🔻	None 🗸			^
27										
28 S	pear fishing	1-10%	Occasional	Species (single or multiple	Very minor to low	1-10	High 💌			
29										
30	et netting	11-25%	Annual or regular	Species (single or multiple	Medium	1-10	None			
P	elagic low bycatch (e.g. squid jigging)	0	Never occurs	No impact	Not susceptible		None			
32	olagio ion byeaton (o.g. oquid higging)	11-25% 26-50%								
24 P	elagic high bycatch (e.g. mid-water trawling)	>50%	Never occurs 🗸	No impact	Not susceptible 🔻	Unaffected 💌	None 💌			
35										
36 L	ong-lining	0 💌	Never occurs	No impact 🔹	Not susceptible 💌	Unaffected 💌	None 💌			
37										•
14 4	Master Maps Vulnerability Qua	antity EcosystemGS	Quality ThreatenedSp	SummaryDashboard Displ	ayNZVulnerabilityScores	ComparativeHabitatScoring	2			
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Figure 4: Screenshot of the *Vulnerability* sheet at the start of an assessment of threats to seagrass habitats in the Whangateau Harbour

6.0 Ecosystem Goods and Services

6.1 Background

Ecosystem goods and services are defined as "the direct and indirect benefits that humans receive or value from natural or semi-natural habitats"^{6,7,8}. Townsend and Thrush (2010)⁹ define ecosystem 'goods' as the tangible resources that can be extracted and utilised by humans, such as food and raw materials, and ecosystem services as the abilities of ecological systems to provide favourable conditions for humans by processing material or providing intrinsic benefits (e.g., water filtration, dampening environmental pressures, recreational opportunities).

Regional councils need to take into account the goods and services provided by marine habitats and ecosystems within their region. This tool provides a national level assessment of goods and services provided by each of 63 marine habitats. This assessment was completed by a panel of NIWA scientists and regional council scientists through a process of two 1-day workshops and email correspondence over a six month period. This process established the goods and services likely produced by each habitat and then assessed the magnitude of the service over a five point scale. We identified three general categories of service; regulatory, provisioning and non-consumptive (Table 4). In Table 4 for each service, we describe the scale of services and provide examples. The scale of services outlined in Table 4 was assisted by reference to Townsend and Thrush (2010) who developed a general principals approach to linking ecosystems service provision to the underlying ecosystem processes.

We included twelve widely recognized regulatory services including climate regulation, physically mediated sediment capture and stabilization, biologically mediated sediment capture and stabilization, carbon capture and sequestration, pollutant capture and sequestration, pollutant detoxification, storm surge amelioration, erosion dampening, storage of nurtrients, cycling of nutrients, net annual oxygen production, and provision of biogenic habitat material. Note that regulatory services continue to operate even if they are not recognized.

Six provisioning services are provided including present tourism value, presently harvestable food species, sources of present aquaculture species, present used biological compounds, bacterially enhanced gas and mineral deposits, and biodiversity. Note that we have defined the first four of these as present services as there is a strong human cultural component to what we currently recognize as suitable for exploitation as a provision. For example, one hundred years ago we generally considered whales as providers of oil while now we view them in terms of their tourism value. Biodiversity should be considered here in terms of a future proofing service as from this enormous diversity new provisioning of food, molecules and genes may someday arise.

⁶ Daily, G.C. (1997). The potential impacts of global warming on managed and natural ecosystem:

Implications for human well-being. Abstracts of Papers of The American Chemical Society 213.

⁷ Constanza, R. et al. (1997). The value of the world's ecosystem services and natural capital. Nature 387: 253–260.

⁸ Boyd, J.; Banzhaf, S. (2007). What are ecosystem services? The need for standardized environmental accounting units. Ecological Economics 63(2-3): 616–626.

⁹ Townsend, M.; Thrush, S. (2010). Ecosystem functioning, goods and services in the coastal environment. Prepared by the National Institute of Water and Atmospheric Research for Auckland Regional Council. Auckland Regional Council Technical Report 2010/033.

Table 4: Scotting Marine E	cosystem Sen		per unit area or nabitat over a	
Regulatory Services	Category	Rank	Descriptive Notes	Example
Climate regulation				
This includes contribution to DMS production, biological	Trace	0	Minimal climate regulatory role	Deep benthic habitats. Pelagic habitats below photic zone
contribution to evapo- transpiration and heat	Low	1	Very limited climate regulatory	Offshore, oligotrophic surface
absorbance or reflectance	Madium	2	Minor though registerst role	Shallow autoidal reafa
but not carbon sequestration	Medium Ulat	2		
which is assessed separately	Figh	3	Critical alimente recordate record	Highlight the second se
Note every habitat is likely to	Extreme	4	Critical climate regulatory role	Highly productive inshore surface
have at least a trace of such				waters. Mangrove forest
activity				
Physically mediated sedimen	t canture, stabili	zation		
Canture of sediment by	Trace	0	Almost no role in sediment	Deep ocean below photic zone
virtue of shape or density of	Trace	U U	capture	Deep been below phote zone
organisms. Note every	Low	1	Very limited role in trapping and	Hard canyons
habitat is likely to have at	2011	•	stabilizing sediments	
least a trace of such activity.	Medium	2	Minor though persistent role	Cobble beaches
·······	High	3	Important role	Mussel beds on sediments
	mgn	5	important foic	Widsser beds on sediments
	Extreme	4	Very active role in trapping and	Mangrove forest, intertidal mud
Dislogically mediated acdime	nt conture and a	tabilizati	stabilizing sediments	Ilais
Cantume and stabilization of	Trace		Almost no role in sediment	Surface shalf palacia waters
sediments by virtue of active	Trace	0	capture	Surface shell peragic waters
biological processes. Note	Low	1	Very limited role in trapping and	Cobble beaches
every habitat is likely to have			stabilizing sediments	
at least a trace of such	Medium	2	Minor though persistent role	Biogenic calcareous reefs
activity.	High	3	Important role	Shallow coastal waters
	Extreme	4	Very active role in trapping and	Dense mangrove forest, saltmarsh
Carbon conture & coquestrat	tion		stabilizing sediments	
The conture and/or	Traca	0	Trace carbon acquestration role	Occan waters helow photic zone
The capture ana/or	Low	1	Limited conture & convectration	Offshore, oligotrophic surface
Note every habitat is likely to	LOW	1	of carbon	waters
have at least a trace of such	Medium	2	Minor though persistent role. May	Productive waters of the Hauraki
activity.		-	capture carbon but limited role in	Gulf
			sequestration.	
	High	3	Important role in capture and	Dense, long-lived mangrove
			sequestration	forest
	Extreme	4	Very active fixation of carbon by	Dense cockle beds, dense vent
			oceanic algae and carbonate	mussel and tube worm beds
			animals and eventual deposition	around hot vents and cold seeps
Dellecter to a stress 8 as success	-4		In shell banks of in deep water	
Pollutant capture & sequestr		0	Trace role in pollution contume	Cabble beaches
Biological and physical	Low	0	Very limited untake and storage	Labitate with impoverished found
is likely to have at least a	LOW	1	of pollutants	& flora
trace of such activity	Medium	2	Minor though persistent role	Subtidal reefs
n dee of such denning.	High	3	Important role	Shelf muds
	Extreme	4	Very active uptake and storage of	Dense populations of filter and
	Extreme	•	pollutants	deposit feeders
Pollutant detoxification				
Biochemical change in	Trace	0	Trace levels of detoxification	Deoxygenated and/or highly toxic
toxicity. Note no habitat is				environments
likely to be at zero level.	Low	1	Limited or intermittent role	Deep shelf habitats
	Medium	2	Medium persistent role	Mid shelf habitats
	High	3	Important role in processing and	Saltmarsh, mangrove forest
		4	degrading of pollutants	D' 1'11' 1 1'
	Extreme	4	very nigh, rapid processing &	Diverse nigh biomass habitats or

Table 4: Scoring Marine Ecosystem Services (all per unit area of habitat over a year)

			detoxification of pollutants	high density of filter feeders
Storm surge amelioration	•	-	1	1
Slows or dampens effects of	None	0	No impact on storm surge	No biological buffer zone present
occasional storm surge.	Low	1	Very limited impact on storm surge	All habitats deeper than 30 m
	Medium	2	Minor though persistent role	Thick beds of giant kelp
	High	3	Important role	Inchore cand habitate
	Eutromo	3	Dressman aliminates or drestically	Wide intest meture menoreus
	Extreme	4	ameliorates the effects of storm	forests
Erosion dampening				
Conorio damponing offect on	Nono	0	No impact on wayas or grasion	No biological buffar zona present
Generic dampening effect on	I and	1	No impact on waves of erosion	Habitata 10,20 m danth
erosion. May occur along	LOW	1	very limited impact on waves or	Habitats 10-30 m depth
snoreline or deeper part of			erosion	
habitat e.g channel side or	Medium	2	Minor though persistent role	Thick beds of giant kelp
bottoms.	High	3	Important role	Shellfish lining channels
	Extreme	4	Presence eliminates or drastically ameliorates the effects of waves	Wide, intact, mature, mangrove forests
Storage of nutrients				
Storage of nutrients for short	Trace	0	No known or only trace amounts	Cobble beaches
to longer time periods.	ITace	0	of storage capacity	Cobole beaches
	Low	1	Habitats with low levels of	Offshore, oligotrophic surface
			biological activity	waters
	Medium	2		Shelf muds
	High	3		Shallow shelf reefs, kelp forest
	Extreme	4	Habitats with very high levels of	Very dense cockle or oyster beds
			biological activity and capacity to	
			store nutrients	
Cycling of nutrionts			store nutrents	1
Uptake and veloage of	Traca	0	Trace emounts of nutrient evaling	Cabble basebas
Uplake and release of	Lan	0	Trace amounts of nutrient cycling	Cobble beaches
nuirienis ojien in moaijiea	LOW	1		Saltmarsn, mangrove forest
form	Medium	2		Seagrass, shellfish beds, kelp forest
	High	3		Shelf mud habitats
	Extreme	4	Rapid and extensive recycling of	Shallow sandy habitats
	Extreme	-	nutrients	Shahow sandy hubitats
Not annual avvgan productio	n nor unit orco		inducents	
Seale new sea from high wat	Nono	0	Anovia habitata Damanant langa	Douthin 'dood games'
Scale ranges from high net oxygen consumer to high net	None	0	consumer of oxygen per unit area	Bentnic dead zones
producer	Low	1	Habitate with a small or	Habitata doopor than the photic
	LOW	1	Haditats with a small of	Habitats deeper than the photic
			intermittent oxygen deficit	zone
	Medium	2	No net surplus or consumption of oxygen	Shellfish beds
	High	3	Small net producer of oxygen	Offshore oligotrophic surface
				waters
	Extreme	4	Habitats that are large net annual oxygen producers per unit area	Surface waters with very high levels of primary production
Provision of biogenic habitat	materials to san	ae and/or	other habitats	
Includes both living and	Trace	0	No known or only trace amounts	Trenches
dead organic materials Note	11ucc		of biogenic habitat material	
every habitat is likely to have			produced for any habitat	
at least a trace of such	Low	1	Vary limited production of	Delegie hebitet below the shet!
activity	LOW	1	very mined production of	relagic habitat below the photic
acuvity.			biogenic material	zone in deep-ocean low
				productivity zones
	Medium	2	Moderate production of biogenic	Deep ocean surface waters
	High	3	High production	Inshore pelagic waters
	Factore	3		Dense estals had a l
	Extreme	4	very active production of	Dense cockie beds, horse mussels

			biogenic material that builds or	beds, kelp forest, shallow and
			maintains same or different	deepsea coral thickets, bryozoan
			habitat	reefs, vent communities
Provisioning Services	Category	Rank	Descriptive Notes	Example
Present tourism value				
This value is location	None	0	No present tourist activity or	Most deepsea habitats
specific so is not scored			value	-
nationally. It could be a	Low	1		
modifier to be taken into	Medium	2		
consideration at the final	High	3		
stage of tool application	Extreme	4	Very high levels of tourist activity	Rocky reefs at Poor Knights
			and value	Islands, surface waters of
				Kaikoura Canyon, nearshore
Presently hervestable food s	nacios support 8	for provis	sion	habitats in Leigh Marine Reserve
Includes commercial	None		No presently exploited marine	Saltmarsh hot vents
recreational. customarv and	rione	Ū	species	Sultimation, not vonto
illegally fished species.	Low	1	Habitats with a low level of	Shallow subtidal sediment flats
Includes nursery roles			current exploitation	supporting Geoduc fishery
played by some habitats.	Medium	2	Moderate levels of current	Flatfish and mullet spp. in
			exploitation	harbour subtidal habitats
	High	3	High level of exploitation	Intertidal reefs
	Extreme	4	Habitats supporting a very high	Demersal species on sand and
			level of exploitation	mud habitats in Hauraki Gulf,
				subtidal reefs
Sources of species presently	aquacultured		No species presently used	Soltmorph hot youts
hroudstock sourced from the	Low	0	No species presently used	Harbour intertidal reafs
wild	Medium	1	Moderate present source of	Snapper and kingfish from
		2	species	Hauraki Gulf habitats
	High	3	Important present source of species	Pacific oysters, cockles, pipis on intertidal flats
	Extreme	4	Very important present source of	Subtidal rocky reefs – blue cod,
			species	mussels, sea cucumber, groper,
				butterfish, lobsters
Presently used biological con	npounds			NC 41-116-4
At some stage in the near	None	0	No compounds presently utilised	Most habitats
juiure inis service may	Low	1	Minor present source of	Anti-cancer compound from
include wild genes			compounds	Kaikoura Canyon lin
	Medium	2	Moderate present source of	Types of collagen used from hoki
		_	compounds	fished from deep slope habitats
	High	3	Important present source of	Shallow subtidal reefs
			compounds	
	Extreme	4	Very important present source of	Numerous compounds from
			compounds	shallow reef red algae
Bacterially enhanced gas and	1 mineral deposi	its		
<i>Few, if any, habitats with intermediate levels.</i>	None	0	No role in formation of gas or mineral deposits	Most habitats
	Low	1		None known
	Medium	2		None known
	High	3		None known
	Extreme	4	Habitats with concentrated	Cold seeps and hot vents
Diadimonaity (fatana and f		1	Dacterial activity	
Euture use options for	Very low	0	Extremely low diversity habitate	
provisioning services	Low	1	L ow diversity habitats	Cobble beaches, trenches
Assumes high biodiversity	Medium	2		Ocean waters in photic zone

equals high option use.	High	3		Harbour sediment habitats
	Extreme	4	Very species diverse habitats	Coastal habitats between 10-30 m
				water depth

Non-consumptive	umptive Category Rank Descriptive Notes		Example	
Viscol en entre en las des				
Visual amenity value (landsc	ape/ seascape)	0		All deepwater habitate
and not included in the	Low	0		All deepwater habitats
national assessment	Low	1		
Regions to complete if and	Ligh	2		
how they feel is appropriate	High Excentional	3		Specific accestel legalities
Spiritual and Inspirational v	Exceptional	4		Specific coastal localities
Not assassed nationally	Nono	0		
Regions to complete if and	Low	0		
how they feel is appropriate	Low	1		
now they jeet is appropriate	Illich	2		
	High Executional	3		
	Exceptional	4		
Existence value				
Not appaged nationally	None	0		
Regions to complete if and	Low	1		
how they feel is appropriate	Low	2		
now they feel is appropriate	Illich	2		
	High Executional	3		
	Exceptional	4		
Coastal non-water recreation	I (Includes beach	walking, t	ide pooling, horse riding, sand yachti	ng, etc)
Not assessed nationally	None	0	No activities known	All non-coastal habitats
Regions to complete if and	Low	1		
how they feel is appropriate	Medium	2		
	High	3		
	Exceptional	4	Very high non-water recreational	Specific coastal locations
	1		use	1
Water recreation (Surfing, sw	vimming, canoein	g, water s	kiing, sailing, boating etc)	
Not assessed nationally	None	0	No water recreation activities	All deepwater benthic habitats.
Regions to complete if and	Low	1		
how they feel is appropriate	Medium	2		
	High	3		
	Exceptional	4	Very high water recreational use	Specific inshore coastal habitats
Current foci for education W	veighted towards	accessible	habitat	
Location dependent thus not	None	0	No current educational focus	All deep benthic habitats
assessed nationally or could	Low	1		
be a modifier to be taken into	Medium	2		
consideration at the final	High	3		
stage of tool application	Exceptional	4	Persistent very high focus for educational activities	Wellington South Coast, Kaikoura Peninsular
Current focus for scientific r	esearch			
Location dependent thus not	None	0		
assessed nationally or could	Low	1		
be a modifier to be taken into	Medium	2		
consideration at the final	High	3		
stage of tool application	Exceptional	4		
	T T			
Currently watched wildlife (from land air bo	ats and un	derwater)	I
Includes everything from	None		No species watched	Trenchs
whales to worms	Low	1	Very occasional rare wildlife	Offshore oligotrophic surface
manes to worms	LOW	1	watching activities	waters
	Medium	2	Minor though persistent role	Mangrove forest
	High	3	Important site for watching one	Harbour intertidal sand and mud

			type of wildlife	flats
	Exceptional	4	Abundant and varied marine wildlife to watch	Shallow subtidal reefs on exposed coasts. Fiord rock-walls. Surface waters at slope edge, especially when these are near shore.
Biological indicators of ecosy	stem health			
Usefulness of present	None	0	No currently used indicators	Trenchs
indicators to regional councils	Low	1	Infrequently used indicators available	Cold seeps, hot vents
	Medium	2	Some highly specific indicators available but not generalisable	Seagrass beds, pipi and cockle beds
	High	3	Several indicators available and generalisable, but not readily accessible	Subtidal reefs
	Exceptional	4	Several indicators, frequently used, readily accessible and generalisable	Intertidal reefs, mud and sand

Quality of information	uality of information Category Rank Descriptive Notes		Example	
Certainty				
	None	0	Vague hunch or gut-feeling only	No published or unpublished
				work available
	Low	1	No empirical work exists of this	
			ecosystem service specifically,	
			perhaps some general knowledge	
	Medium	2	Some empirical work exists or	New emerging work on the role
			expert has some personal	of mangrove forests in storm
			knowledge	surge amelioration
	High	3	Body of empirical work exists or	
			the expert has direct personal	
			research experience	
	Absolutely	4	Extensive empirical work exists	Stock assessment reports on the
	certain		or the expert has extensive	fisheries production from the
			personal research knowledge	Hauraki Gulf

6.2 Operation in the MarHADS tool

- Click on the *EcosystemGS* sheet (Figure 5)
- The national assessment of services delivered by your habitat was pasted on this page from hidden sheets when you selected your habitat type on the *Master* sheet
- If you have local data available, undertake your assessment of the regulatory, provisioning and non-consumptive services provided by your particular area of habitat by selecting the appropriate level of service from the dropdown box with reference to the descriptions and notes in Table 3. Note that the level of service should be evaluated on a per area basis over the course of a year.
- The level of service for the local assessment (if undertaken) and from the national assessment is automatically copied to the *Summary Dashboard* sheet. Also on the *Summary Dashboard* is the average level of service for each category of service.

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	you have nominated your habitat on the	Master sheet, the tool gives estimate	es of the magnitude of services provided by this habitat f	rom a national assessment of ecosystem go	ods and services. You may wish to use the	se same scores in
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Figure 5: Screenshot of the *Ecosystem Goods & Services* assessment sheet

7.0 Quality of Habitat

7.1 Background

The present state of quality of the habitat in question is an important consideration that councils need to take into account if assessing if it should be afforded some level of protection from consented impacts. Usually if a habitat is in a more-or-less pristine state then it more likely to be afforded a high level of protection. Knowing the present quality of a habitat also allows reassessment at some later date to determine if any remedial action has been effective.

Regional councils usually have some data on water quality and sediment quality even if few other data on aspects on marine ecosystems are unavailable. For this reason the participating councils were strongly in favour of including these measurements in the MarHADS tool.

The number of invasive species present may also be an indication of habitat quality. There is some evidence that diverse marine communities and/or those with a full range of size and age classes are less prone to invasions by alien species than disturbed habitats without the expected range of species, and size and age classes. In experimental communities of sessile marine invertebrates, increased species richness significantly decreased invasion success, apparently because species-rich communities more completely and efficiently used available space, the limiting resource in this system¹⁰. On the other hand, invasive species, once present, may hasten loss of biodiversity^{11,12}.

Port surveys undertaken on behalf of MAF-BNZ indicate the port-by-port distribution of invasive species around New Zealand. While these lists of invasive species are most relevant to habitats within the port area itself, they provide an indication of species to look out for in the habitat of interest even though it may be some distance away from the port or ports in the region. The port-by-port lists are included in the tool and may be selected and sorted to derive a list of interest to your assessment. The species in the list are colour coded as I^o (species imposing high risk), II^o (species imposing intermediate risk) and III^o (species imposing little or no known risk).

7.2 Operation in MarHADS

There are 5 sections to complete in the Quality sheet (Figure 6) 1. Invasive Species

- Click on the grey 'Click to construct list of invasives' box.
- Select the ports that you wish to draw your summary from (Figure 7)
- Click 'Go'
- From the summary you created (e.g. Fig 8), manually enter the number of 1°, 11°, or 111° species into the appropriate cells on line 18
- Identify any I^o, II^o, or III^o species occurring in your habitat of interest and select the appropriate range from the drop down lists on row 16 of the Quality sheet.
- Your counts of the number of invasive species occurring in your habitat of interest are displayed as proportions of the summary and national totals.

¹⁰ Stachowicz, J.J., Whitlatch, R.B., Osman, R.W. (1999). Species diversity and invasion resistance in a marine ccosystem. *Science* 286, 1577-1579

¹¹Casas, G. Scrosati, R., Luz Piriz, M. (2004). The invasive kelp *Undaria pinnatifida* (Phaeophyceae, Laminariales) reduces native seaweed diversity in Nuevo Gulf (Patagonia, Argentina). Biological Invasions 6: 411–416 ¹² Piazzi, L., Ceccherelli, G., Cinelli, F. (2001). Threat to macroalgal diversity: effects of the introduced green alga

¹² Piazzi, L., Ceccherelli, G., Cinelli, F. (2001). Threat to macroalgal diversity: effects of the introduced green alga *Caulerpa racemosa* in the Mediterranean. Marine Ecology Progress Series, Vol. 210, p. 149-159

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7 Re	move list of invasives	Click to construct list of	rou nunc.							
8		Invasives	Date you did the assessment:	23-May-11						
10	Habitat nam	e								
			Score the quality of your habitat as	a function of invasive species preser	t, water quality, sediment quality, biota prese	ent and provide an overall				
11	Seagrass be	d	assessment. Where requested, pl can add notes if you wish.	ease indicate the quality of the inform	ation used in the assessment. At the right en	nd of row 16 is a is a box where you				
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Figure 6: Screenshot of the *Quality* assessment sheet



Figure 7: Screenshot of the *Quality* assessment sheet after clicking 'Construct list of invasives' box and selecting all Auckland ports apart from those on west coast.

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Algae	Green algae	AG	Caulerpa taxifolia														
Algae	Red algae	AG	Cryptonemia aff. crenulata														
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Algae	Brown algae	AG	Undaria pinnatifida														
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Chordata	Fish	FH	Gobiopterus semivestita														
Chordata	Fish	FH	Omobranchus anolius														
Crustacean	Amphipod	AM	Apocorophium acutum														
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Figure 8: List of invasive species known from ports in the eastern part of the Auckland region.

2. Water Quality

- Using any data you have available select the present level of nutrients, ammonium, water clarity, temperature, dissolved oxygen, pH, and salinity with regard to difference from that expected or any national or international standard.
- Indicate your level of confidence in your evaluation for each criterion from the options available in the pull-down list.
- 3. Sediment Quality
 - Using any data you have available select the present level of contamination by heavy metals, hydrocarbons and organic matter, and the redox depth with regard to difference from that expected or any national or international standard.
 - Indicate your level of confidence in your evaluation for each criterion from the options available in the pull-down list.

4. Biota

- Using any data you have available, select the option from the pull down that best reflects the range of species and age/size structures present with regard to that expected for the habitat.
- Indicate your level of confidence in your evaluation from the options available in the pulldown list.

5. Habitat

- Using any data you have available, select the option from the pull down list that best reflects the present state of the habitat features and functions of the area you are evaluating with regard to that expected for the habitat.
- Habitat features is this context are the major biotic and physical elements that define the structure of this habitat. Habitat functions are the dominant processes that normally occur in this habitat. For example in a kelp forest primary production is the dominant process, while in a shellfish bed filter feeding predominates. Are these features and functions largely intact or highly modified from that expected?
- Indicate your level of confidence in your evaluation from the options available in the pulldown list.

8.0 Threatened Species

8.1 Background

Over 400 marine species occurring in New Zealand's Exclusive Economic Zone (EEZ) have been classified as threatened or at risk to some degree. Under the RMA and the Coastal Policy Statement (2010) regional councils must take into account the presence of threatened or endangered species when preparing regional plans and making decisions about permitted activities.

The threat status of New Zealand's marine fauna and flora are summarized in a series of recent publications^{13,14,15}. We have collated the information from these publications and assembled a NZ wide list of endangered species by threat ranking¹⁶. These rankings include three of the Department of Conservations at risk categories (nationally critical, nationally endangered, nationally vulnerable) and two of DOC's at risk categories (declining, naturally uncommon). We have also included the IUCN status of species that DOC otherwise classifies as migrants.

8.2 Operation in the MarHADS tool

- Click on the *Threatened Species* sheet (Figure 9)
- From the drop-down boxes select 'Yes' for every threatened or at risk species occurring in your habitat of interest.
- Ok, nothing else to do. The tool has automatically inserted the number in each category occurring in your habitat into the *Summary Dashboard* sheet

 $^{^{13}}$ Baker et al. (2009). Conservation status of New Zealand marine mammals (suborders Cetacea and Pinnipedia), 2009. New Zealand Journal of Marine and Freshwater Research, 44: 2, 101 — 115

¹⁴ Freeman et al. (2010). Conservation status of New Zealand marine invertebrates, 2009. New Zealand Journal of Marine and Freshwater Research, 44: 3, 129 – 148

¹⁵ Hitchmough et al. 2007. New Zealand Threat Classification System lists 2005. Department of Conservation, Wellington New Zealand, 134 pp.

¹⁶ Townsend AJ, de Lange PJ, Duffy CAJ, Miskelly CM, Molloy J, Norton DA 2008. New Zealand threat classification system manual, Wellington, Department of Conservation.

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9		From the drop-down boxes select 'Ye	s' for every threatened or at ris	k species occurring in your habitat of interest.			
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15		outprogond opp.			Canterbury, Otago and Solander Island		
16 N	lo 🔽	Chionelasmus crosnieri	Arthropoda	Primitive acorn barnacle	Kermadec Ridges and Norfolk Ridge	Freeman et al 2010	
17 N	lo 🔽	Cirroctopus hochbergi	Mollusca	Four-blotched umbrella octopus	Slope depths off east coasts North Island	Freeman et al 2010	
18 N	lo 💌	(ble idiotice	Arthropoda	Stalked barnacle	Intertidal to slope depths around mainland	Freeman et al 2010	
N	lo 🔻		Mollusca	Giant squid	Slope depths around North island and	Freeman et al 2010	
19		Idioteuthis cordiformis			northern half of South Island	Freeman et al 2010	
N		Opisthoteuthis chathamensis	Mollusca	Roughy umbrella octopus	south of East cape, northern and southern	110011101101 01 2010	
20			Malluasa	Croupl magnet	Chatham Rise	Erromon et al 2010	
21 N		Smeagol climoi	Mallusca	Cravel maggot	Vehington Soun coast graver beaches	Freeman et al 2010	
22 N		Smeagol manneringi	Mullusca	Graver maggot	Kalkoura gravel beaches	Freeman et al 2010	
23 N		Volcanolepas osheai	Annropoda	O Sneas vent barnacie	Kermaded Ridge	Freemañ et al 2010	
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24					Kaikoura intertidal reef		
25		Dione arcuata	Macroalgae	Red seaweed - Bangiales	Restricted to the braided rivers and	DoC's 2005 Threatened Species lis	1
IN	•	Himantopus novaezelandiae	Bird	Black stilt	wetlands of the Mackenzie Basin, South		
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Figure 9: Screenshot of the Threatened species assessment sheet

9.0 Summary Dashboard

To assist the overall evaluation of your chosen habitat the assessments and scores from each of the assessment sheets are summarized in six colour coded sections on the Summary Dashboard (Figure 10).

Summary

The top section (sky blue) summarises the key information from the *Master* sheet including the name of the habitat, the location of the habitat, the name of the assessor, the date of the assessment and the unique identifier code assigned to this assessment.

Quantity

Section 1 (bright yellow) summarises information from the Quantity sheet relating to the spatial area of your habitat patch (or patches). For those habitats for which reliable data are available the area of the habitat assessed is expressed as a proportion of the user defined sub-area of the region, the region, the bioregion, the biogeographical province and the national area of the habitat.

For those habitats for which no habitats areas are available regionally or nationally then your regional assessment of habitat commonness and the national commonness rating for the habitat in question is provided.

Vulnerability

Section 2 (turquoise) summarises the assessment of habitat vulnerability. The total number of threats affecting the assessed habitat is provided along with the mean vulnerability score over all threats (Range 0-4), the mean vulnerability score over active threats only (range 0-4), the mean certainty score (range 0-1) and the mean weighted vulnerability score (weighted by the certainty scores).

Also listed are the top ten threats in descending rank order of their mean vulnerability scores.

Quality

Section 3 (grey/blue) summarises five categories of information from the quality sheet.

a) Invasive species.

The number of I^o, II^o and III^o invasive species occurring in the assessed habitat are listed as is the proportion of the national totals these represent.

b) Water quality

An overall assessment of water quality (range 0-4) is provided by taking the mean score of the seven aspects of water quality which were individually assessed (nutrient and ammonium levels, water clarity, temperature, dissolved oxygen, pH, and salinity). The mean certainty score (range 0-1) is also provided.

c) Sediment quality

An overall assessment of sediment quality (range 0-4) is provided by taking the mean score of the four aspects of sediment which were individually assessed. The mean certainty score (range 0-1) is also provided.

d) Biota

The score (range 0-4) for the present state of the biota in the habitat is displayed here. The certainty score (range 0-1) is also provided.

e) Habitat

The score (range 0-4) for the present state of the habitat is displayed here. The certainty score (range 0-1) is also provided.

Endangered and at risk species

Section 4 (tan coloured) summarises the number of threatened species in each of six categories occurring in the habitat assessed and expresses these as proportions of the national total of species in each category.

Ecosystem Goods and Services

Section 5 (light green) summarises the assessments of the goods and services provided by the habitat assessed.

For each of three categories of service (regulatory, provisioning, and non-consumptive) the mean score of the category of service for the habitat is provided along with the certainty score.

Additionally the level of the goods and services provided by the habitat both locally and nationally are given.



Figure 10: Screenshot of the *Summary Dashboard* sheet showing the summary of results for an assessment of seagrass habitats in the Whangateau Harbour, Auckland region

10.0 Comparison Sheet

Background

This assessment may be but one of many that will be undertaken in your region. To assist in comparing the output from multiple assessments, the information in the summary dashboard has been rearranged on this sheet. You may wish to copy and paste this information to a spreadsheet that contains similar data from a number of assessments.

Operation in the MarHADS tool

- Click on the Comparative Habitat Scoring Sheet (Figure 11)
- Save this assessment to a new file name
- Copy and paste special (values) the information on this sheet to a spreadsheet that contains similar data from a number of assessments

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4 sheet along with values from other habitats with this same format i	.e., assessed					
5 using the MarHADS tool, NOTE: use "paste special" to paste as val	ues, these VALUES to separate sheet.					
6						
7 Name of VALUE	VALLIE					
8	WILD'L					
9 Region	Auckland					
10 Bioregion	Northeastern					
11 Location	Whangateau Harbour					=
12 Date of assessment	23 May 20011					
13 Unique identifier	1					
14 Habitat name	Seagrass bed					
15 Descriptive notes	Assessment includes all seagrass habitat in Whangateau Harbour					
16 Size of habitat (ha)						
17 Smallest unit as a proportion of intermediate unit of interest	01					
18 Smallest unit as a proportion of the regional total	0.0169					
19 Smallest unit as a proportion of the bioregional total	0.0078					
20 Smallest unit as a proportion of the biogeographical province total	0.0042					
21 Smallest unit as a proportion of the national total	0 0031					
22 Regional commoness	Common in some parts of the region					
23 National commoness	Common throughout NZ					
24 Total number of threats active in this habitat	3					
25 Mean vulnerability score over all threats listed in this tool (range 0-4)	0.13					
26 Mean vulnerability score for threats active in this habitat (range 0-4)	3.07					
27 Mean certainty for threats active in this habitat (range 0-1)	0.58					
28 Number of 1° invasive species	0					
29 Number of 2° invasive species	0					
30 Water quality, mean score (range 0-4)	4.00					
31 Sediment quality, mean score (range 0-4)	3.333333333					
32 Biota, mean score (range 0-4)	4					
33 Habitat quality, mean score (range 0-4)	4					
34 Ecosystem G & S, Regulatory mean score (range 0-4)	3.08					
35 Ecosystem G & S, Provisioning mean score (range 0-4)	1.00					
36 Ecosystem G & S, Non-consumptive mean score (range 0-4)	2.00					
37 Number of endangered species in habitat	0					
38						
39						
40						
41						-
Masser Maps Vulnerability Quantity EcosystemGS DisplayInvasiveSpe	cies Quaity InteatenedSpp SummaryDashboard DisplayNZVulnerabilityScores Compa	rativeHabitatScoring 2				
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