Marine Habitat Assessment Decision Support (MarHADS) Tool

Background and Operating Instructions

Alison MacDiarmid[1], Paul Taylor[2], Megan Carbines[3], Judi Hewitt[2], Lesley Bolton-Ritchie[4], Anna Maharadz-Smith[5], Mike Townsend[2], Simon Thrush[2], Jarrod Walker[3]

[1]NIWA, Wellington; [2]NIWA, Hamilton; [3]Auckland Council, Auckland, [4]Environment Canterbury, Christchurch; [5]Hawkes Bay Regional Council, Napier

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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 report[1] 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.
3. The threatened and at risk species that may occur within particular habitats
4. Habitat quality
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.

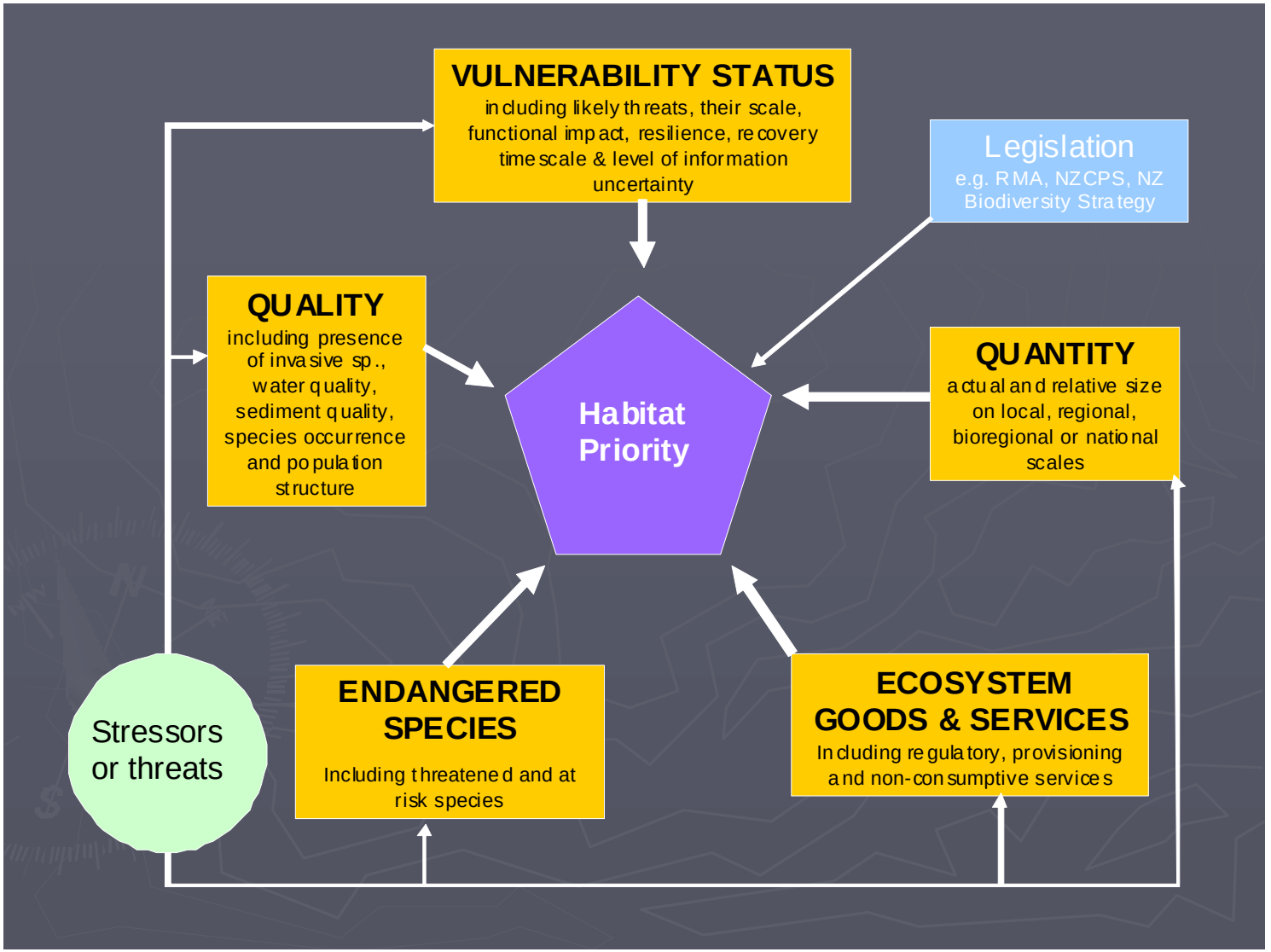

Figure 1: Conceptual view of the MarHADS tool indicating the five components used in assessing habitat significance.

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.

Table 1: The general habitat categories used in the assessment, their description and some examples

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

[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.

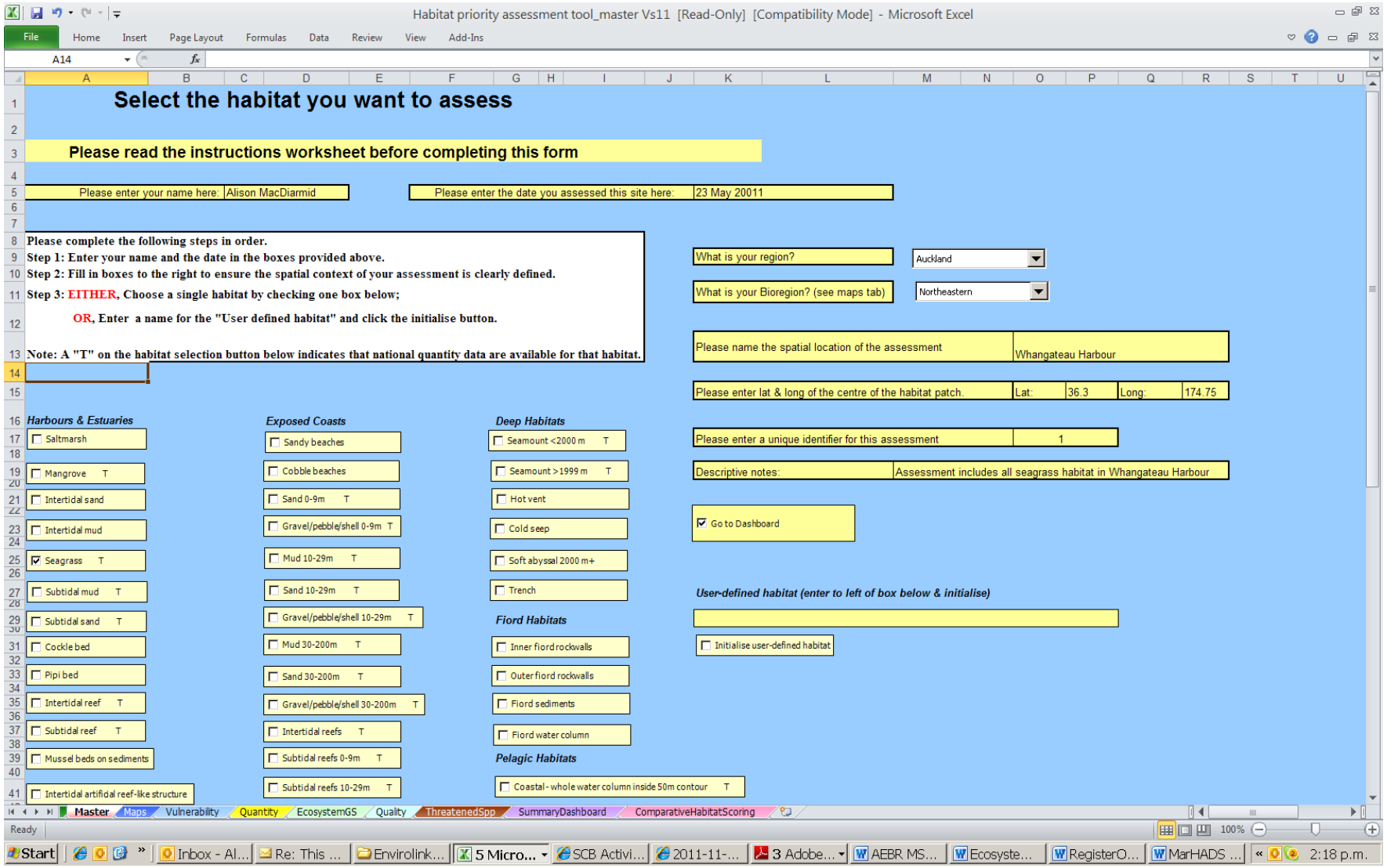

Figure 2: Screenshot of the *Master* sheet showing it filled out for an assessment of seagrass habitat in the Whangateau Harbour.

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 *Master* 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.

Table 2: Sources of data for habitat area information. Principal NIWA contact is Anne-Laure Verdier (a.verdier@niwa.co.nz)

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 includes only three classes of sediment. Some areas remain unclassified, especially areas shallower than 5m.
Subtidal sand	
Subtidal gravel, pebbles, shell	
Seamounts	Dataset constructed by NIWA

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.

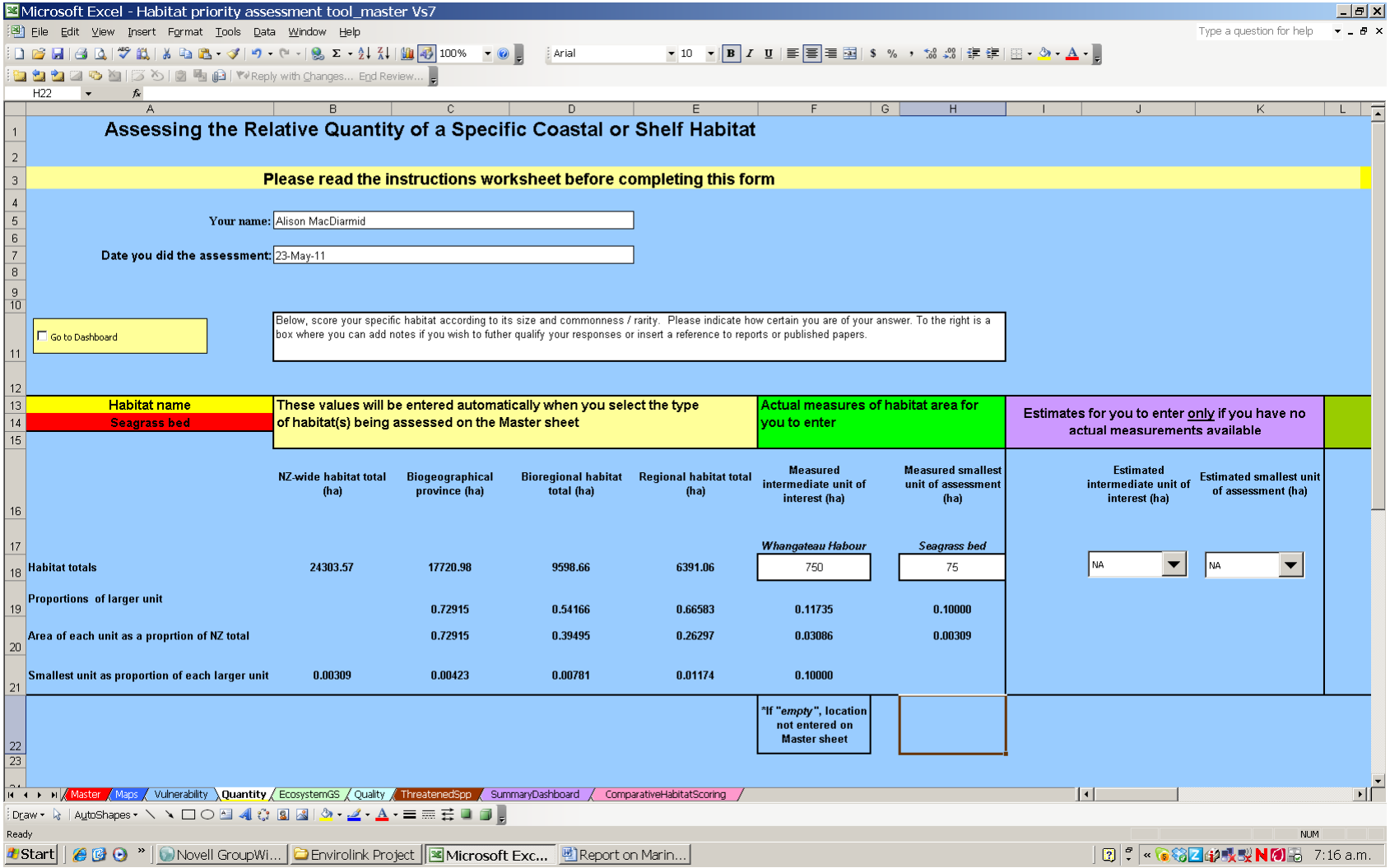

Figure 3: Screenshot of the *Quantity* sheet showing it filled out for an assessment of seagrass habitat in the Whangateau Harbour

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 each vulnerability measure used to assess how threats affect NZ marine habitats (based on Table 2 in Halpern et al 2007).

Vulnerability Measure	*Category*	*Rank*	*Descriptive Notes*	*Example*
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 level	2	Multiple species affected; entire trophic level changes	Over harvest of multiple species within the same trophic guild
	>1 trophic level	3	Multiple species affected; multiple trophic levels change	Over harvest of key species from multiple trophic guilds
	Entire ecosystem	4	Cascading effect that affects entire ecosystem	Increase in ocean temperature or acidification
Susceptibility				
	Not susceptible	0		
	Low	1	No significant change in biomass, structure or diversity until extreme threat levels	Trawling on shallow sediment communities on an exposed coast
	Medium	2	Moderate intensities or frequencies causes change	Effects of industrial pollution discharges on coastal habitats
	High	3	Threat causes significant but not catastrophic effects; some capacity for adaptation	Effects of acidification on growth of 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 episodic toxic pollution
	10-100	3		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 permanent	4		Deep-sea coral recovery after trawl 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

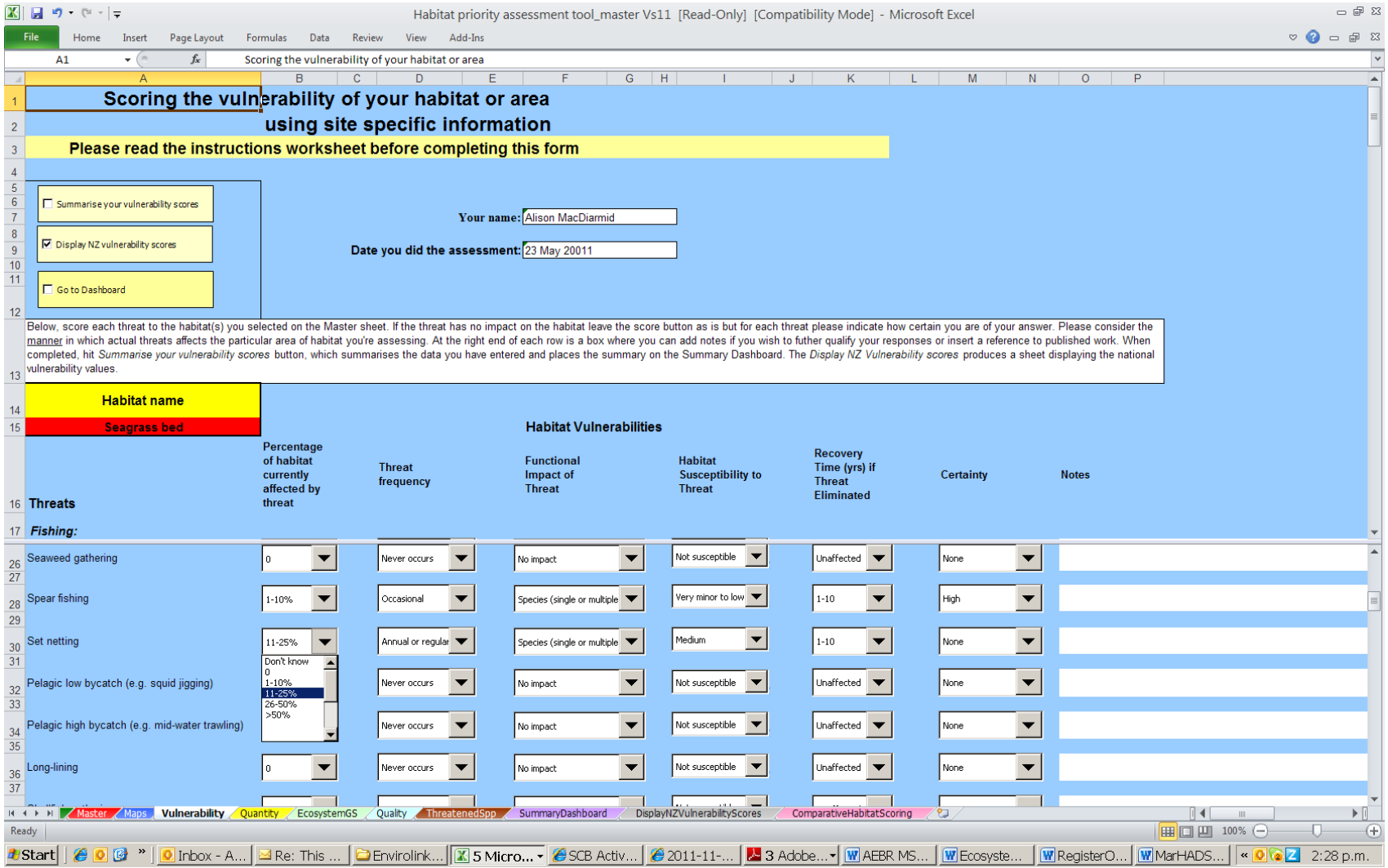

Figure 4: Screenshot of the *Vulnerability* sheet at the start of an assessment of threats to seagrass habitats in the Whangateau Harbour

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

Regulatory Services	*Category*	*Rank*	*Descriptive Notes*	*Example*
Climate regulation				
This includes contribution to DMS production, biological contribution to evapo-transpiration, and heat absorbance or reflectance but not carbon sequestration which is assessed separately. Note every habitat is likely to have at least a trace of such activity.	Trace	0	Minimal climate regulatory role	Deep benthic habitats. Pelagic habitats below photic zone
	Low	1	Very limited climate regulatory role	Offshore, oligotrophic surface waters
	Medium	2	Minor though persistent role	Shallow subtidal reefs
	High	3	Important role	Intertidal reefs
	Extreme	4	Critical climate regulatory role	Highly productive inshore surface waters. Mangrove forest
Physically mediated sediment capture, stabilization				
Capture of sediment by virtue of shape or density of organisms. Note every habitat is likely to have at least a trace of such activity.	Trace	0	Almost no role in sediment capture	Deep ocean below photic zone
	Low	1	Very limited role in trapping and stabilizing sediments	Hard canyons
	Medium	2	Minor though persistent role	Cobble beaches
	High	3	Important role	Mussel beds on sediments
	Extreme	4	Very active role in trapping and stabilizing sediments	Mangrove forest, intertidal mud flats
Biologically mediated sediment capture and stabilization				
Capture and stabilization of sediments by virtue of active biological processes. Note every habitat is likely to have at least a trace of such activity.	Trace	0	Almost no role in sediment capture	Surface shelf pelagic waters
	Low	1	Very limited role in trapping and stabilizing sediments	Cobble beaches
	Medium	2	Minor though persistent role	Biogenic calcareous reefs
	High	3	Important role	Shallow coastal waters
	Extreme	4	Very active role in trapping and stabilizing sediments	Dense mangrove forest, saltmarsh
Carbon capture & sequestration				
The capture and/or sequestration of carbon. Note every habitat is likely to have at least a trace of such activity.	Trace	0	Trace carbon sequestration role	Ocean waters below photic zone
	Low	1	Limited capture & sequestration of carbon	Offshore, oligotrophic surface waters
	Medium	2	Minor though persistent role. May capture carbon but limited role in sequestration.	Productive waters of the Hauraki Gulf
	High	3	Important role in capture and sequestration	Dense, long-lived mangrove forest
	Extreme	4	Very active fixation of carbon by oceanic algae and carbonate animals and eventual deposition in shell banks or in deep water	Dense cockle beds, dense vent mussel and tube worm beds around hot vents and cold seeps
Pollutant capture & sequestration				
Biological and physical capture. Note every habitat is likely to have at least a trace of such activity.	Trace	0	Trace role in pollution capture	Cobble beaches
	Low	1	Very limited uptake and storage of pollutants	Habitats with impoverished fauna & flora
	Medium	2	Minor though persistent role	Subtidal reefs
	High	3	Important role	Shelf muds
	Extreme	4	Very active uptake and storage of pollutants	Dense populations of filter and deposit feeders
Pollutant detoxification				
Biochemical change in toxicity. Note no habitat is likely to be at zero level.	Trace	0	Trace levels of detoxification	Deoxygenated and/or highly toxic environments
	Low	1	Limited or intermittent role	Deep shelf habitats
	Medium	2	Medium persistent role	Mid shelf habitats
	High	3	Important role in processing and degrading of pollutants	Saltmarsh, mangrove forest
	Extreme	4	Very high, rapid processing &	Diverse high biomass habitats or

			detoxification of pollutants	high density of filter feeders
Storm surge amelioration				
Slows or dampens effects of occasional storm surge.	None	0	No impact on storm surge	No biological buffer zone present
	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	Inshore sand habitats
	Extreme	4	Presence eliminates or drastically ameliorates the effects of storm surge	Wide, intact, mature, mangrove forests
Erosion dampening				
Generic dampening effect on erosion. May occur along shoreline or deeper part of habitat e.g channel side or bottoms.	None	0	No impact on waves or erosion	No biological buffer zone present
	Low	1	Very limited impact on waves or erosion	Habitats 10-30 m depth
	Medium	2	Minor though persistent role	Thick beds of giant kelp
	High	3	Important role	Shellfish lining channels
	Extreme	4	Presence eliminates or drastically ameliorates the effects of waves & erosion	Wide, intact, mature, mangrove forests
Storage of nutrients				
Storage of nutrients for short to longer time periods.	Trace	0	No known or only trace amounts of storage capacity	Cobble beaches
	Low	1	Habitats with low levels of biological activity	Offshore, oligotrophic surface waters
	Medium	2		Shelf muds
	High	3		Shallow shelf reefs, kelp forest
	Extreme	4	Habitats with very high levels of biological activity and capacity to store nutrients	Very dense cockle or oyster beds
Cycling of nutrients				
Uptake and release of nutrients often in modified form	Trace	0	Trace amounts of nutrient cycling	Cobble beaches
	Low	1		Saltmarsh, mangrove forest
	Medium	2		Seagrass, shellfish beds, kelp forest
	High	3		Shelf mud habitats
	Extreme	4	Rapid and extensive recycling of nutrients	Shallow sandy habitats
Net annual oxygen production per unit area				
Scale ranges from high net oxygen consumer to high net producer	None	0	Anoxic habitats. Permanent large consumer of oxygen per unit area	Benthic ‘dead zones’
	Low	1	Habitats with a small or intermittent oxygen deficit	Habitats deeper than the photic 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 same and/or other habitats				
Includes both living and dead organic materials. Note every habitat is likely to have at least a trace of such activity.	Trace	0	No known or only trace amounts of biogenic habitat material produced for any habitat	Trenches
	Low	1	Very limited production of biogenic material	Pelagic habitat below the photic zone in deep-ocean low productivity zones
	Medium	2	Moderate production of biogenic materials	Deep ocean surface waters
	High	3	High production	Inshore pelagic waters
	Extreme	4	Very active production of	Dense cockle beds, horse mussels

			biogenic material that builds or maintains same or different habitat	beds, kelp forest, shallow and deepsea coral thickets, bryozoan reefs, vent communities

Provisioning Services	*Category*	*Rank*	*Descriptive Notes*	*Example*
Present tourism value				
This value is location specific so is not scored nationally. It could be a modifier to be taken into consideration at the final stage of tool application	None	0	No present tourist activity or value	Most deepsea habitats
	Low	1		
	Medium	2		
	High	3		
	Extreme	4	Very high levels of tourist activity and value	Rocky reefs at Poor Knights Islands, surface waters of Kaikoura Canyon, nearshore habitats in Leigh Marine Reserve
Presently harvestable food species support &/or provision				
Includes commercial, recreational, customary and illegally fished species. Includes nursery roles played by some habitats.	None	0	No presently exploited marine species	Saltmarsh, hot vents
	Low	1	Habitats with a low level of current exploitation	Shallow subtidal sediment flats supporting Geoduc fishery
	Medium	2	Moderate levels of current exploitation	Flatfish and mullet spp. in harbour subtidal habitats
	High	3	High level of exploitation	Intertidal reefs
	Extreme	4	Habitats supporting a very high level of exploitation	Demersal species on sand and mud habitats in Hauraki Gulf , subtidal reefs
Sources of species presently aquacultured				
Includes spat or seed and broodstock sourced from the wild	None	0	No species presently used	Saltmarsh, hot vents
	Low	1	Minor present source of species	Harbour intertidal reefs
	Medium	2	Moderate present source of species	Snapper and kingfish from Hauraki Gulf habitats
	High	3	Important present source of species	Pacific oysters, cockles, pipis on intertidal flats
	Extreme	4	Very important present source of species	Subtidal rocky reefs – blue cod, mussels, sea cucumber, groper, butterfish, lobsters
Presently used biological compounds				
At some stage in the near future this service may include wild genes	None	0	No compounds presently utilised	Most habitats
	Low	1	Minor present source of compounds	Anti-cancer compound from yellow-slimy sponge from Kaikoura Canyon lip
	Medium	2	Moderate present source of compounds	Types of collagen used from hoki fished from deep slope habitats
	High	3	Important present source of compounds	Shallow subtidal reefs
	Extreme	4	Very important present source of compounds	Numerous compounds from shallow reef red algae
Bacterially enhanced gas and mineral deposits				
Few, if any, habitats with intermediate levels.	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 bacterial activity	Cold seeps and hot vents
Biodiversity (future proofing service)				
Future use options for provisioning services. Assumes high biodiversity	Very low	0	Extremely low diversity habitats	
	Low	1	Low diversity habitats	Cobble beaches, trenches
	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 Services	*Category*	*Rank*	*Descriptive Notes*	*Example*
Visual amenity value (landscape/ seascape)				
Note this is location specific and not included in the national assessment. . Regions to complete if and how they feel is appropriate.	None	0		All deepwater habitats
	Low	1		
	Medium	2		
	High	3		
	Exceptional	4		Specific coastal localities
Spiritual and Inspirational value				
Not assessed nationally. . Regions to complete if and how they feel is appropriate	None	0		
	Low	1		
	Medium	2		
	High	3		
	Exceptional	4		
Existence value				
Not assessed nationally. . Regions to complete if and how they feel is appropriate	None	0		
	Low	1		
	Medium	2		
	High	3		
	Exceptional	4		
Coastal non-water recreation (Includes beach walking, tide pooling, horse riding, sand yachting, etc**)**				
Not assessed nationally. . Regions to complete if and how they feel is appropriate	None	0	No activities known	All non-coastal habitats
	Low	1		
	Medium	2		
	High	3		
	Exceptional	4	Very high non-water recreational use	Specific coastal locations
Water recreation (Surfing, swimming, canoeing, water skiing, sailing, boating etc**)**				
Not assessed nationally. . Regions to complete if and how they feel is appropriate	None	0	No water recreation activities	All deepwater benthic habitats.
	Low	1		
	Medium	2		
	High	3		
	Exceptional	4	Very high water recreational use	Specific inshore coastal habitats
Current foci for education Weighted towards accessible habitat				
Location dependent thus not assessed nationally or could be a modifier to be taken into consideration at the final stage of tool application	None	0	No current educational focus	All deep benthic habitats
	Low	1		
	Medium	2		
	High	3		
	Exceptional	4	Persistent very high focus for educational activities	Wellington South Coast, Kaikoura Peninsular
Current focus for scientific research				
Location dependent thus not assessed nationally or could be a modifier to be taken into consideration at the final stage of tool application	None	0		
	Low	1		
	Medium	2		
	High	3		
	Exceptional	4		
Currently watched wildlife (from land, air, boats and underwater)				
Includes everything from whales to worms	None	0	No species watched	Trenchs
	Low	1	Very occasional, rare wildlife watching activities	Offshore, oligotrophic surface 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 ecosystem health				
Usefulness of present indicators to regional councils	None	0	No currently used indicators	Trenchs
	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	*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 expert has some personal knowledge	New emerging work on the role of mangrove forests in storm surge amelioration
	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	Stock assessment reports on the fisheries production from the 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.

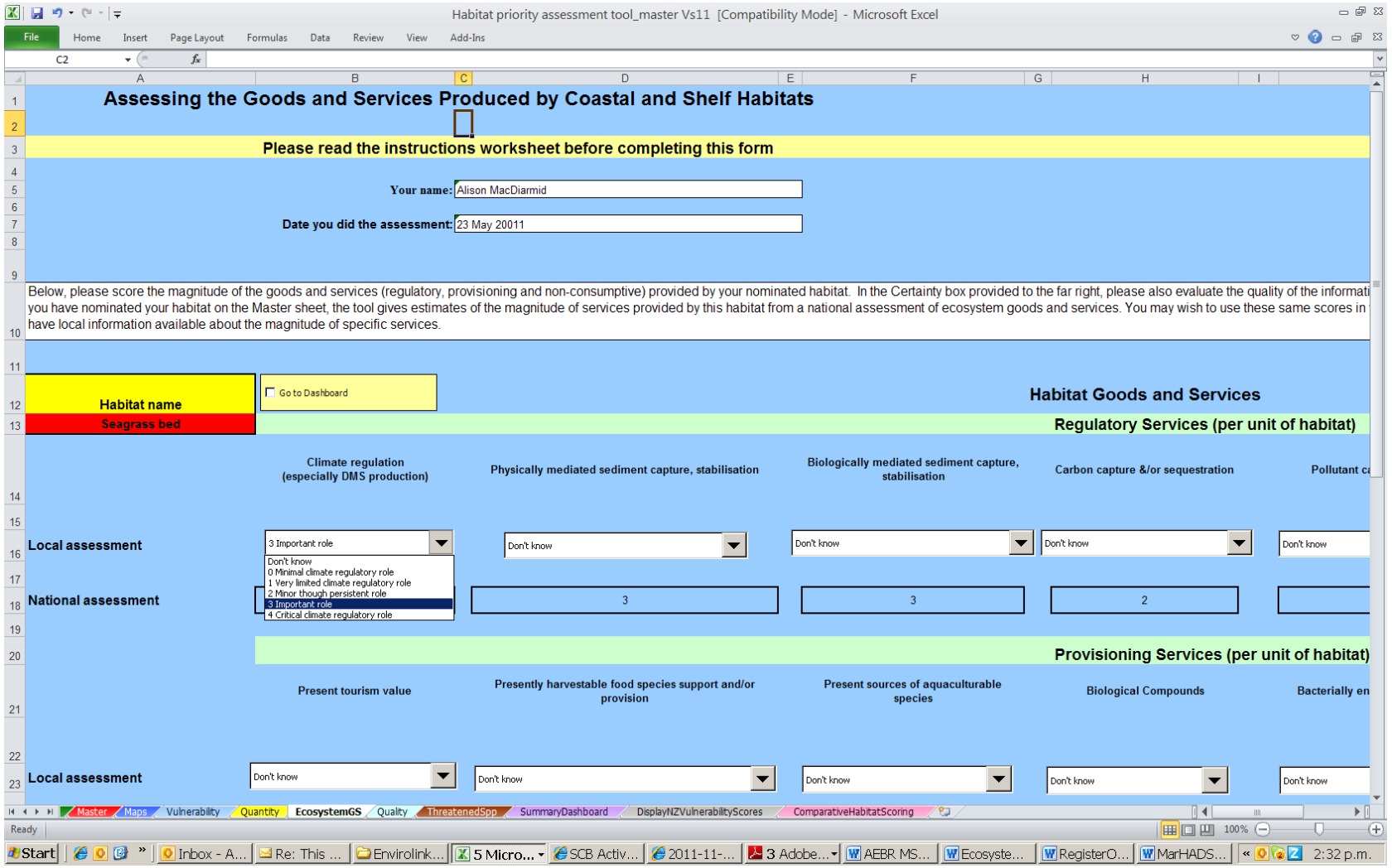

Figure 5: Screenshot of the *Ecosystem Goods & Services* assessment sheet

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 system[10]. 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 I^o, $II^{o,}$ or III^o 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

[11] Casas, 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 *Caulerpa racemosa* in the Mediterranean. Marine Ecology Progress Series, Vol. 210 , p. 149-159

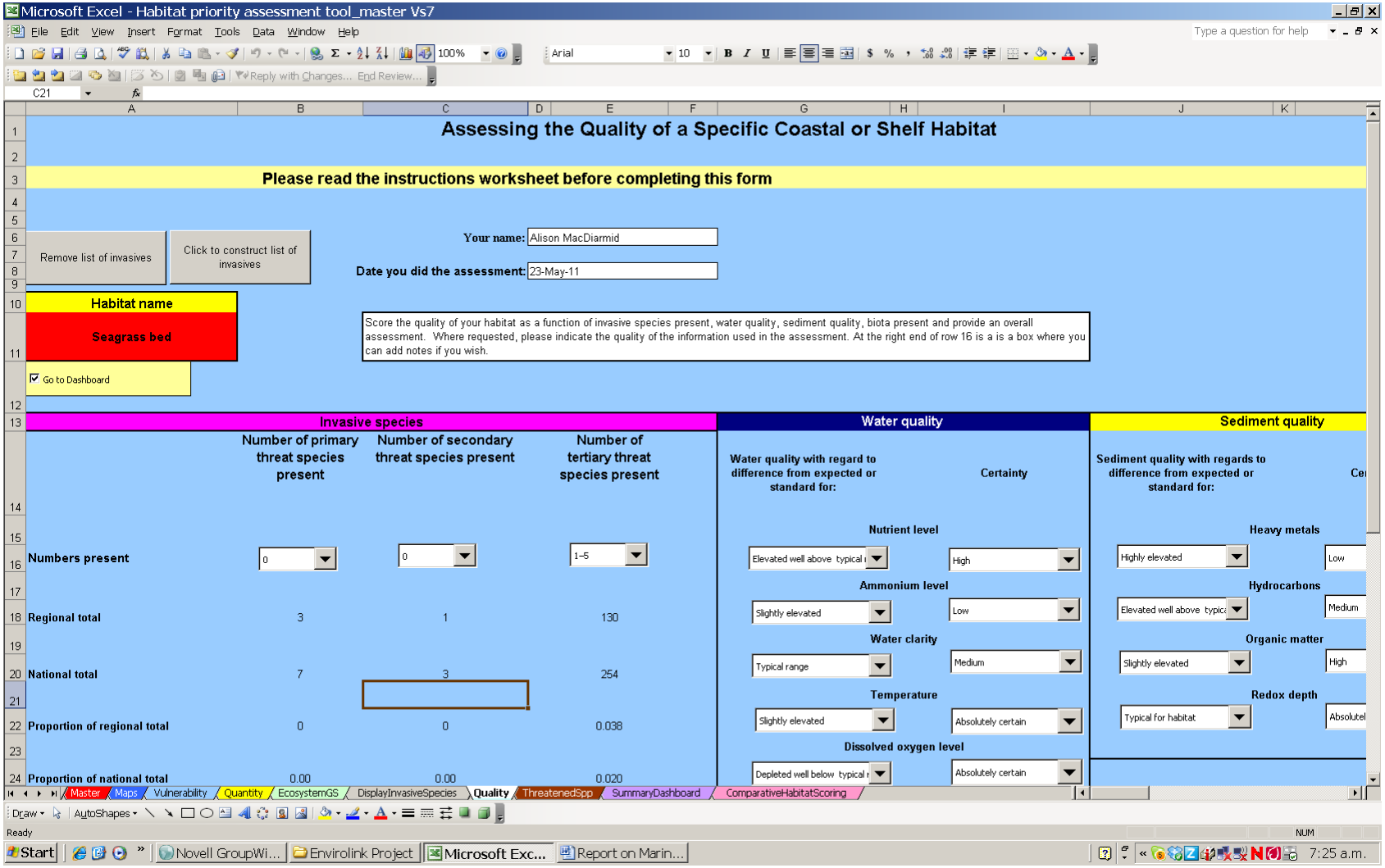

Figure 6: Screenshot of the *Quality* assessment sheet

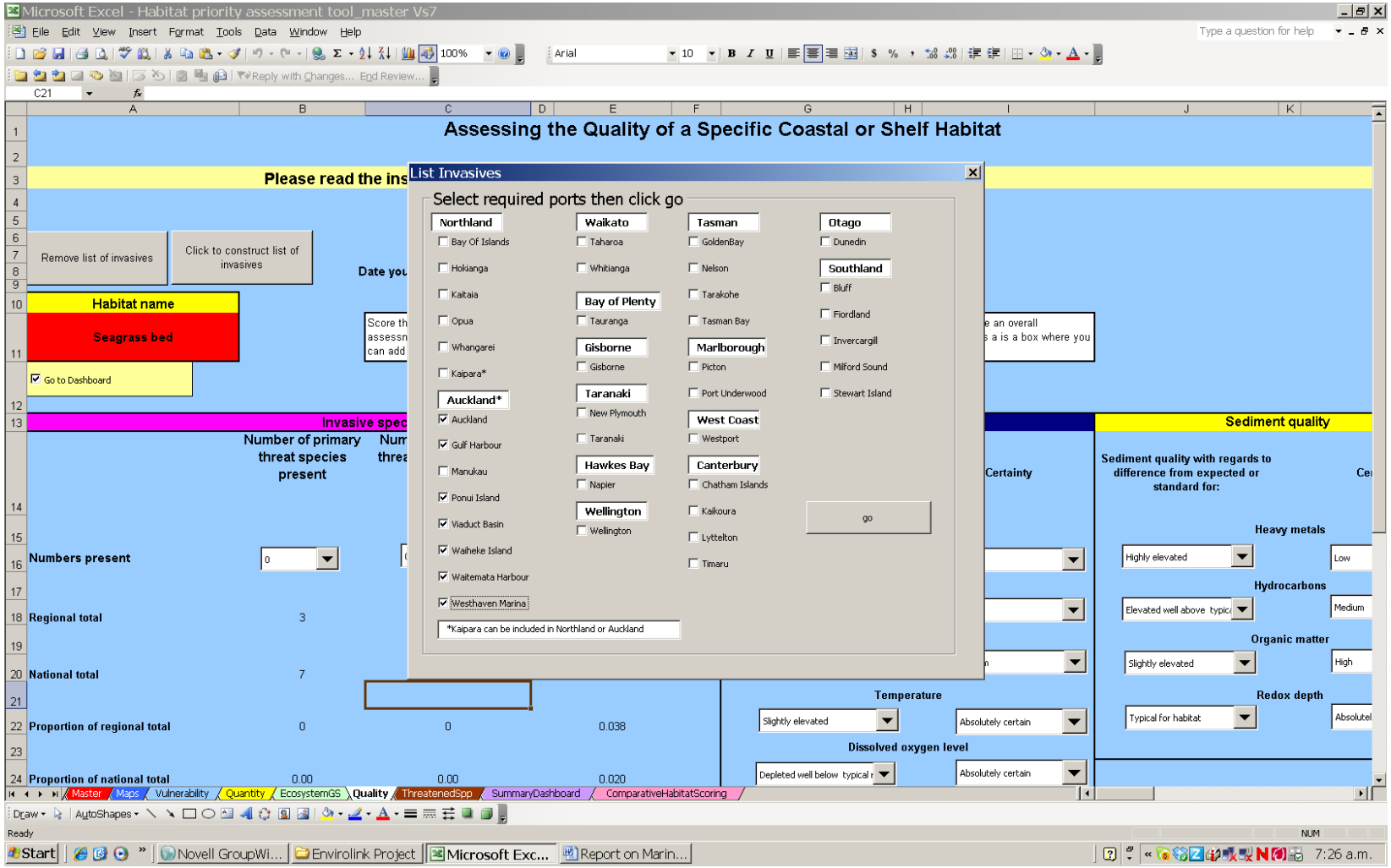

Figure 7: Screenshot of the *Quality* assessment sheet after clicking 'Construct list of invasives' box and selecting all Auckland ports apart from those on west coast.

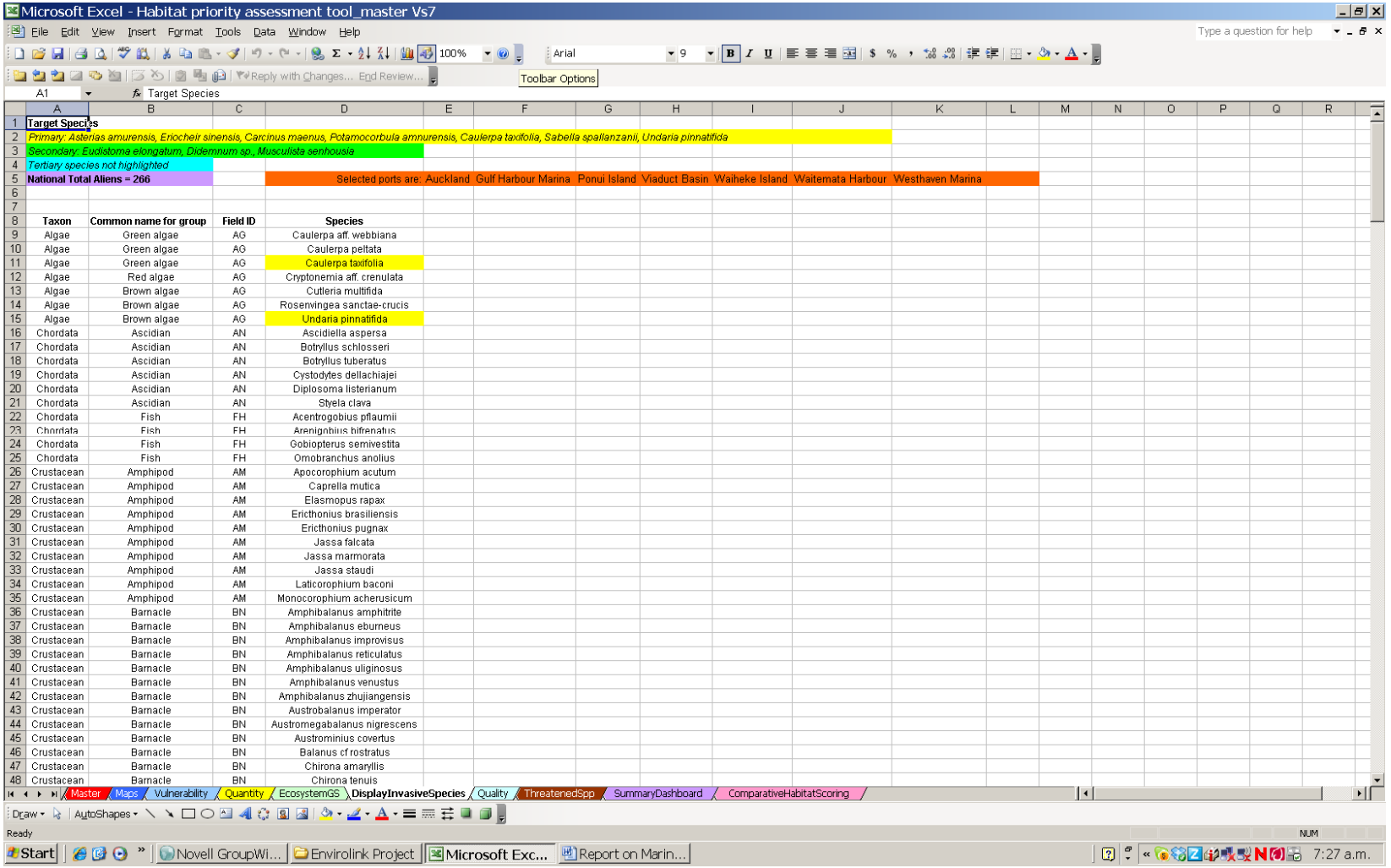

Figure 8: List of invasive species known from ports in the eastern part of the Auckland region.

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 pull-down 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 pull-down 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 ranking[16]. 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.

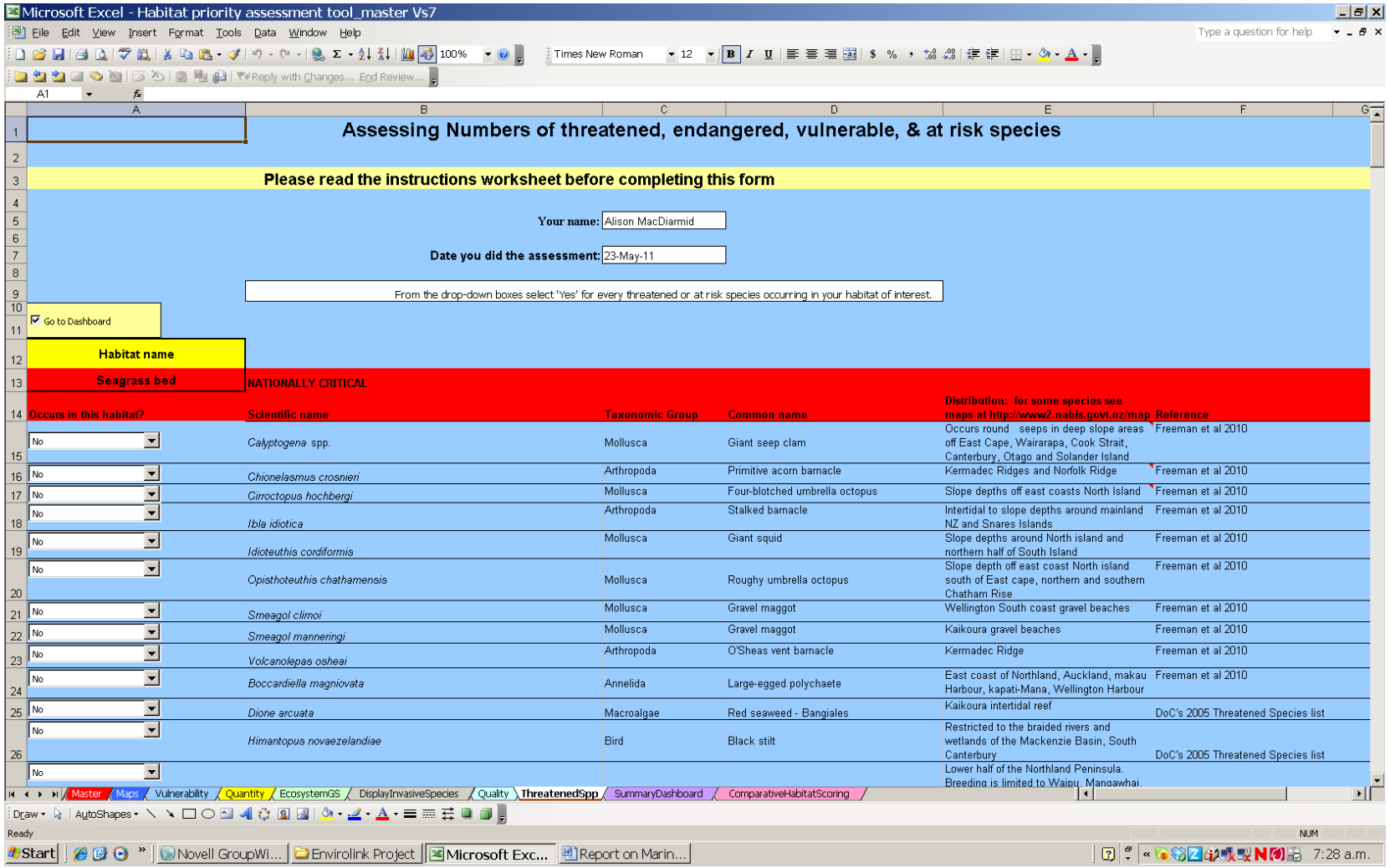

Figure 9: Screenshot of the *Threatened species* assessment sheet

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.

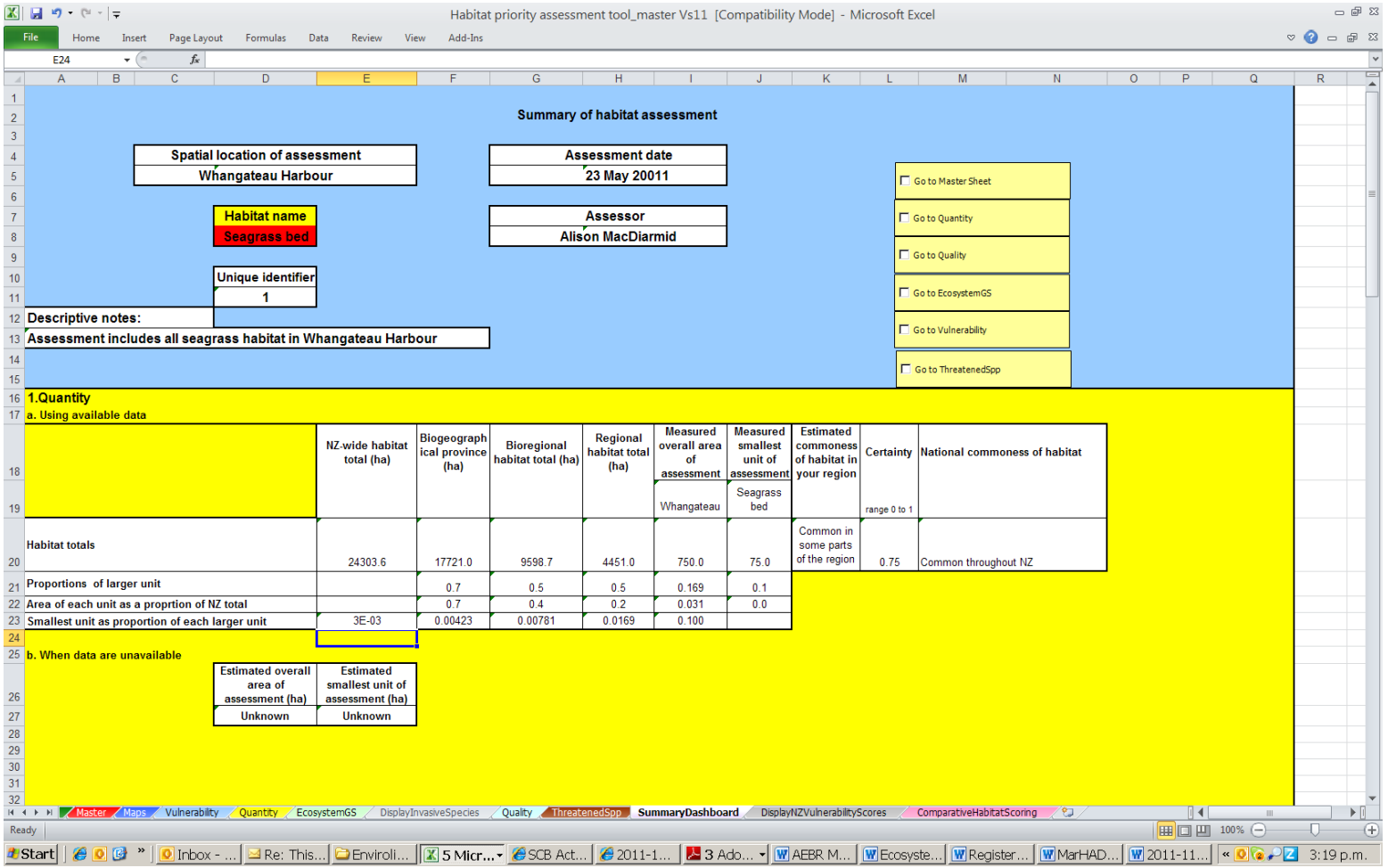

Figure 10: Screenshot of the *Summary Dashboard* sheet showing the summary of results for an assessment of seagrass habitats in the Whangateau Harbour, Auckland region

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

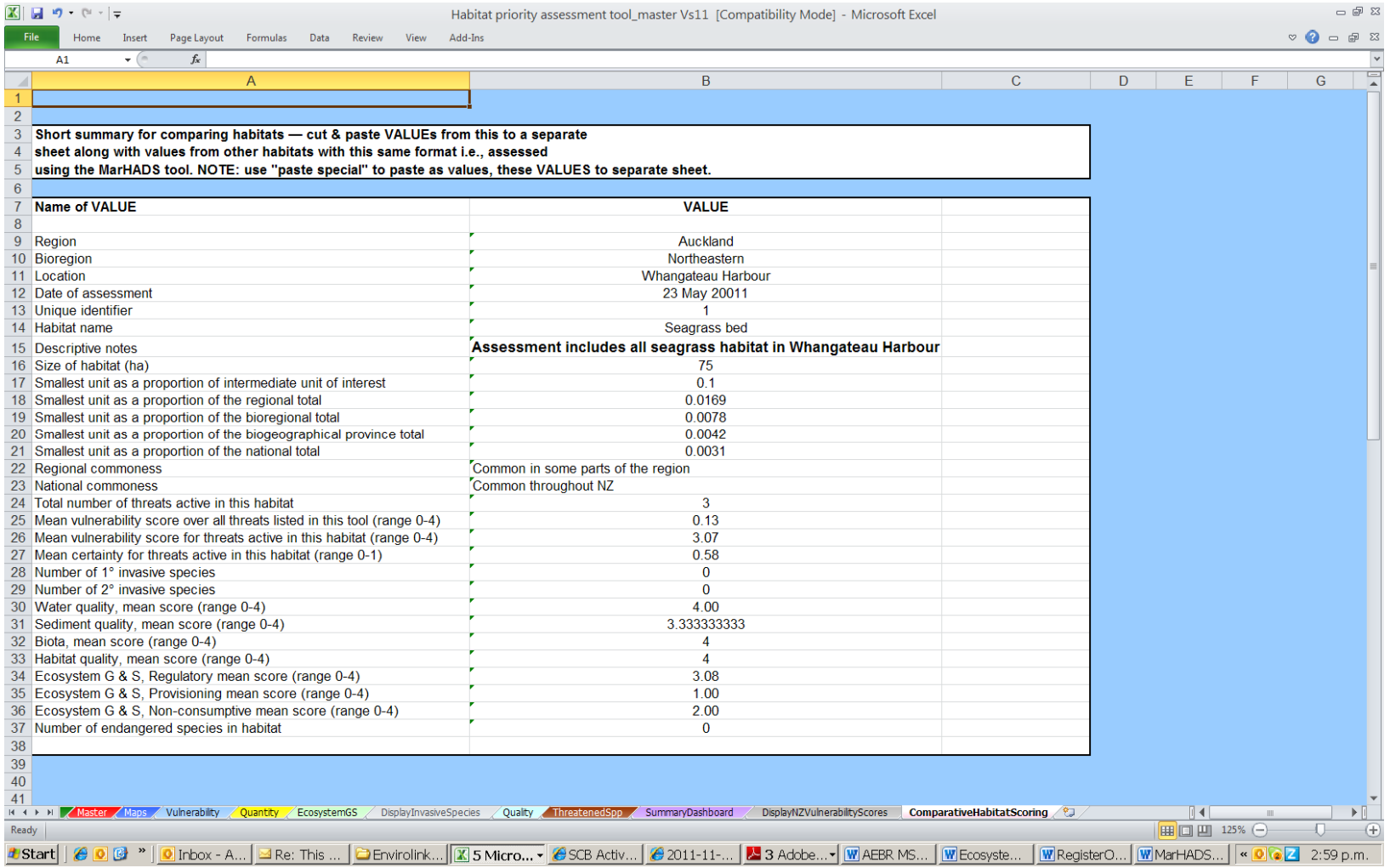

Figure 11: Screenshot of the *Comparative Habitat Scoring* sheet showing the results for an assessment of seagrass habitats in the Whangateau Harbour, Auckland region