Science Snapshot report **2021**

Seagrass

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Purpose

To investigate indicators of seagrass health in Tauranga Harbour and identify potential indicators for the long-term measurement of seagrass health in the Bay of Plenty.

Why is this important?

In the Bay of Plenty mapping of aerial photography has been used to calculate the coverage of seagrass in the marine environment. The mapping has identified significant losses of seagrass coverage over the past 70 years. Some estuaries such as Maketu estuary have lost all cover of seagrass, due to declining water and sediment quality.

The National Policy Statement for Freshwater Management requires Regional Councils to set robust contaminant limits to protect the health of freshwater ecosystems and estuarine environments. The health and presence of seagrass beds, or lack of, is an indicator of estuarine health. Understanding the health of ecosystems such as seagrass will provide further evidence to support sustainable freshwater limits on sediment and nutrients to ensure these ecosystems can thrive in the future.

Methods

A range of seagrass metrics and potential sediment stressors (Table 1) were collated to investigate the current seagrass health and environmental conditions at nine sites:

- Photo quadrats to assess percentage cover at each sampling site
- Sediment cores to determine sediment health (e.g. mud content)
- Seagrass samples to determine plant health using leaf and rhizome chemical and physical indicators
- Measured light availability in seagrass beds

The importance of seagrass beds

They provide key ecosystem services such as:

- **Habitat and food provision**
- **Nursery areas for a range of fish and macroinvertebrates, which increases biodiversity**
- **Accumulate and stabilise sediments and reduce erosion**
- **Removal of nutrients to help maintain water quality**
- **Carbon sequestration**

Table 1 – Seagrass health metrics and environmental indicators recorded in the survey.

Seagrass physical morphometrics	Environmental Indicators
Percentage cover	Light availability
Leaf length	Sediment median grain size
Leaf width	Sediment mud content
Above ground biomass (leafs)	Sediment water content
Below ground biomass (rhizomes)	Sediment organic matter
Above: below ground ratio	Sediment chlorophyll a
Seagrass nutrient storage	Sediment phaeopigment
Leaf nitrogen content	Sediment porosity
Leaf δ15N	
Leaf carbon content	
Leaf δ13C	
Leaf C:N ratio	
Rhizome non-structural carbohydrates	

For more information on Seagrass monitoring undertaken by Bay of Plenty Regional Council, contact the Science Team on 0800 884 880.

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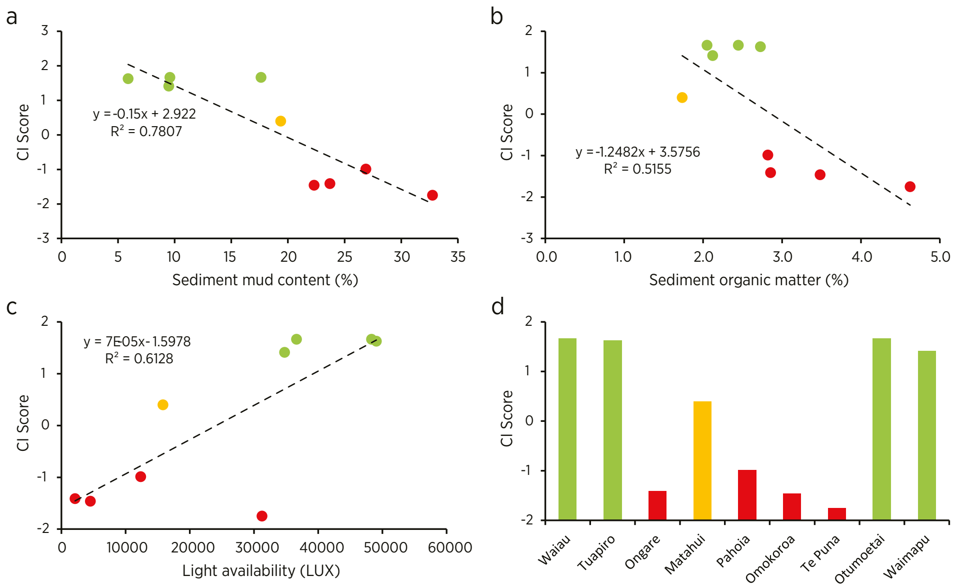
Results

- Mud, organic matter and light were combined using principal component analysis to create a single gradient of mud/ eutrophication impacts.
- The CI score indicates the environmental health gradient – a lower score indicates poorer health, with increasing mud and organic matter, and decreasing light availability (Figure 1)
- Four sites were graded as high (Waiau, Tuapiro, Otumoetai, Waimapu), one as intermediate (Matahui) and four as low (Ongare, Pahoia, Ōmokoroa, Te Puna).

Figure 1 – Site environmental quality gradient (CI) as identified by PC1 in Figure 11 correlated against the environmental predictors mud content (a), organic matter (b) , and light availability (c), and the site names and scores (d). A more negative CI score indicates increasing eutrophication gradient.



Seagrass response to environmental gradient

- Sediment mud content showed positive relationships to leaf width, and negative relationships to leaf d15N, nitrogen %, d13C and C:N ratio (Table 2).
- Organic matter content showed positive relationships to leaf width, C:N ratio, and negative relationships to above/below ground ratio and d15N.
- Light availability showed positive relationships to leaf length and leaf d13C.
- The combined environmental health grade showed negative relationships to leaf width and positive relationships to d15N.

Figure 2 – Example of seagrass quadrat coverage in summer from the three quarterly monitoring sites in summer 2019 (Tuapiro Point, Waiau, Waimapu).

*Table 2 – Pearsons correlation matrix showing pair-wise relationships between seagrass health etrics and environmental predictor variables. Significant results are displayed in bold. Significance levels are shown with stars (p<0.05 = *, p<0.01 = **, p<0.001=***).*

Seagrass health metrics	Median Grain	Mud	Water Content	OM	Chl a	Phaeo	Porosity	Light LUX	EnvPCA
Seagrass cover	0.11	-0.13	-0.17	-0.19	**0.35*** **	0.2	0.1	0.11	0.08
Leaf length	0.11	0.08	-0.01	-0.07	-0.01	0.01	-0.04	**0.25***	0.2
Leaf width	-0.12	**0.66*** **	0.03	**0.22***	0.17	**0.40*** **	**0.38*** **	-0.15	**-0.31** **
Leaf biomass	0.15	0.1	-0.17	-0.16	**0.45*** **	**0.33** **	0.16	-0.03	0.03
Rhizome biomass	-0.18	0.13	**0.25***	0.19	**0.34** **	**0.27***	0.15	-0.02	-0.17
A/B Ratio	0.27**	0.02	**-0.43*** **	**-0.37*** **	0	0.02	0.02	-0.05	0.16
d¹⁵N	**0.39*** **	**-0.31** **	**-0.48*** **	**-0.40*** **	**-0.27***	**-0.38*** **	**-0.66*** **	0.16	**0.33** **
Nitrogen%	-0.18	**-0.24***	0.19	0.19	0.06	-0.06	-0.2	0.05	-0.13
d¹³C	**-0.31** **	**-0.40*** **	**0.39*** **	0.2	**-0.67*** **	**-0.62*** **	**-0.36*** **	**0.39*** **	0.18
Carbon%	0.06	0.11	0.08	-0.02	0.1	0.08	-0.14	0.04	-0.03
C:N ratio	**-0.24***	**-0.30** **	0.19	**0.24***	0.02	-0.1	-0.14	0.03	-0.16

Ecological Quality Status

- A principal component was used to create a single metric of seagrass health using both physical and nutrient status indicators
- Selected variables include: percentage cover, rhizome biomass, leaf biomass, total biomass, leaf nitrogen, leaf C:N ratio.
- The calculation of ecological quality ratio (EQR) resulted in one site being ranked as very good, two sites as good, four sites as fair, and two sites as poor (Figure 3/4).
- Sites graded as high had high percentage cover, leaf biomass, and rhizome biomass.
- Sites graded as poor had low rhizome biomass, and low leaf C:N ratio and d13C. This can indicate a combination of nutrient enrichment, and low light conditions.
- Some sites with high environmental quality were graded as poor health – it may indicate missing environmental metrics e.g. heavy metals, grazing, smothering by macroalgae, or it may indicate plasticity in the seagrass.
- Further work is required to refine a suitable combined ecological quality status, including a better understanding of factors influencing seagrass health.

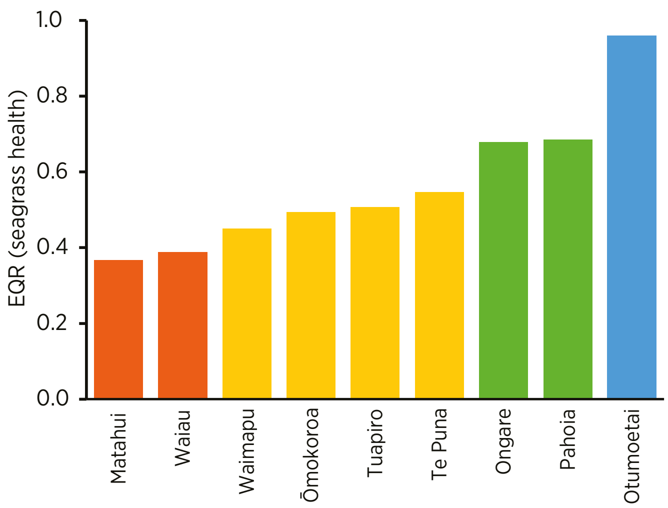


Figure 3 – Seagrass health grading (EQR) from low to high.

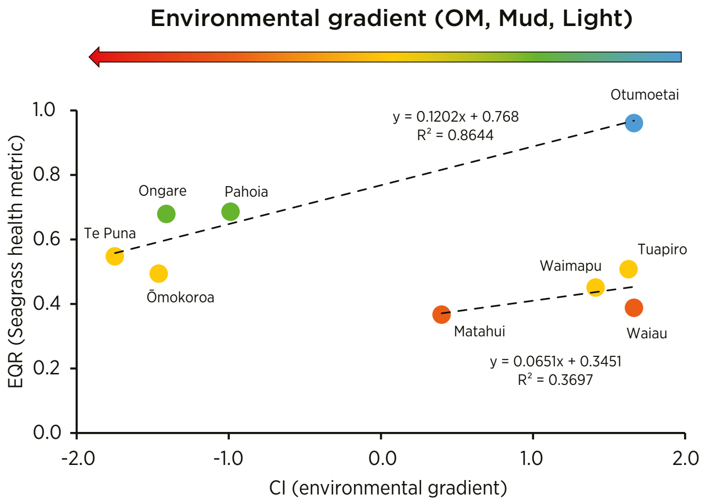


Figure 4 – Relationship between the seagrass health EQR and the environmental gradient CI scores. More negative CI scores indicate a lower environmental quality indicative of eutrophication. Site colour coding represents EQS (ecological quality status).

Outcome

Table 3 – Summary of the intertidal seagrass health metrics recommended for regular monitoring programme.

Physical Health Metric	Chemical Health Metric	Disease/algae	Habitat quality
Meadow extent (drone/satellite/plane)	Leaf C and N	Fungal wasting disease	Sediment grain size
Seagrass percentage cover	Leaf C: N ratio	Epiphyte coverage	Sediment nutrient content (TN, TP, TOC)
Leaf biomass	Leaf d13C and d15N	Macroalgae coverage	Sedimentation rates
Leaf length and width	Rhizome sucrose		Light conditions (PAR, Turbidity)
Rhizome biomass			
Ratio of above and below ground biomass			
Herbivory			

A baseline survey of a number of sites across all Bay of Plenty estuaries should be conducted, and ongoing monitoring of these sites continued annually for a period of five years before the timeframes are reviewed. The annual monitoring should be conducted within tight timeframes, targeting the summer period when percentage cover and biomass is generally at its peak, due to significant seasonal changes in a range of seagrass health indicators.

Current and future threats to seagrass

- **Land use change (increased sedimentation and nutrients)**
- **Coastal disturbance (boating, anchoring, coastal development)**
- **Climate change and sea level rise**
- **Overgrazing by waterfowl**
- **Smothering by macroalgal blooms (e.g. sea lettuce or neptunes necklace)**
- **Fungal wasting disease**

Research gaps

- Identifying cultural values of seagrass
- Mapping suitable seagrass habitat, under existing and future climate change scenarios
- Utilisation of seagrass habitat locally by benthic and pelagic communities
- Genetic variability of seagrass species
- Feasibility of seagrass transplantation or seed harvesting

For the full report, visit boprc.govt.nz/publications or click here

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