Data collection protocol for mapping and monitoring mangrove communities in Queensland

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Background

There have been a number of key surveys undertaken of mangrove communities in Moreton Bay and other regions of Queensland over the last 4 decades. In response to concerns about the variation in data collection methods and in attempting to compare the findings from various research and survey activities undertaken on the extent, condition and health of mangrove communities in Moreton Bay, the Moreton Bay Mangrove Dieback Working Group was established in 2009 (membership included the University of Queensland; Queensland Herbarium; DERM (Marine Parks); EHMP; Griffith University; Port of Brisbane and DEEDI (Fisheries Queensland).

The Working Group has developed the Mangrove Data Collection Protocol for use as a Statewide standard of data points for future survey, monitoring and mapping works. The Protocol is applicable Queensland wide for determining the distribution and monitoring the health of mangrove communities.

The protocol is divided into three tables.

- Table 1 describes the reporting / monitoring zones to be used in Moreton Bay mangrove community studies, where applicable. In other Queensland regions, an existing zonal scheme should be adopted.
- Table 2 sets out the water quality, site and regional attributes that may be measured or referred to and the quality assurance process that needs to be undertaken for mapping projects.
- Table 3 lists the categories and descriptors for assessing mangrove health (condition), collated from a number of research programs and reports. The supporting references provide further detail and photographic examples of each category.

Development of a separate guide to in-field visual mangrove health assessment, with photographic and text descriptors of the mangrove health categories, would complement the protocol.

Research reports

Researchers are encouraged to provide a copy of any work undertaken on Mangrove communities or other fish habitats to Fisheries Queensland (DEEDI). A summary of each research report will be placed on the DEEDI website.

Contacts

For further information on the Mangrove data collection protocol and its application to research projects in Queensland contact Dawn Couchman at DEEDI on 07 3224 2249 or email dawn.couchman@deedi.qld.gov.au or contact the DEEDI customer information centre on 132523.

Links

Protection & Management of marine plants

Fish habitat management research program

Table 1 – Reporting / monitoring zones (e.g. Moreton Bay)

Term	Descriptor	Reference
A. Moreton Bay Estuaries reporting zones (EHMP) Figure 1 below	Nine (9) reporting zones, inclusive of the major waterways as defined for Moreton Bay Region (Caloundra to Nerang River). 1. Pumicestone Passage 2. Deception Bay – Caboolture River 3. Central Bay 4. Eastern Bay 5. Bramble Bay – Brisbane River, Oxley Creek, Bremer River, Cabbage Tree Creek, North Pine River 6. Eastern Banks 7. Waterloo Bay – Eprapah Creek, Tingalpa Creek 8. Southern Bay – The Logan / Albert Rivers, Pimpama River, Coomera River 9. Broadwater – Nerang River	EHMP annual technical report 2006 – 07 Estuarine / marine methods EHMP Report Card 2010 http://www.healthywaterways.org/inner.aspx?pageid=147

Table 2 - Description of data attributes / indicators

Term	Descriptor	Reference
	Water Quality	
pH	Term for potential hydrogen - a measure of free hydrogen ions or the acidity of water. *Measure surface and pore water pH* *Useful to specify where in the mangroves observations should be made.*	EHMP annual technical report 2006 – 07 Estuarine / marine methods
Surface water Salinity	Measure of concentration of inorganic ions, usually mineral salts in water. Measured indirectly with a YSI 6920 salinity sensor. Salinity is measured from conductivity which is highly dependent on water temperature – varies as much as 3% for each change of 1 degree Celsius.	EHMP annual technical report 2006 – 07 Estuarine / marine methods
Pore water salinity	Pore water samples are collected using an apparatus based on McKee et al (1988) which consists of an outer rigid plastic tube (15mm diam, sealed at lower end) and an inner plastic tube (5mm diam), both of which are perforated and connected to a 50mL syringe.	FHC Environmental Fisherman Islands and Whyte island mangrove Health Assessment 2008
Water temperature	Measure of ambient water temperature using a YSI 6920 sensor.	
Dissolved Oxygen	Measure of levels of dissolved oxygen in the water column using a multi probe YSI 6920 sensor. DO is measured as a concentration of oxygen in mg/l and recalculated using temperature to return percentage saturation (%)	EHMP annual technical report 2006 – 07 Estuarine / marine methods
Redox potential	Redox potential (Eh) measures the affinity of a substance for electrons compared to that of hydrogen (set at 0). Substances more strongly electronegative than hydrogen (and capable of oxidising) have positive redox potentials while those less electronegative than hydrogen (capable of reducing) have negative redox potentials. This determines whether soils are aerobic or anaerobic, and whether chemical compounds such as Fe oxides or nitrate have been chemically reduced or are present in their oxidized forms.	

Term	Descriptor	Reference
Surface and pore water nutrients – N & P	Samples are collected using specific field techniques and analyzed by Qld Health	EHMP annual technical report 2006 – 07 Estuarine / marine methods
Chlorophyll *a*	Measure used to determine phytoplankton biomass as an indicator of the nutrient and light conditions present	EHMP annual technical report 2006 – 07 Estuarine / marine methods
Turbidity	Measure of light scattering by suspended particles in water, providing an indirect measure of light penetration. A YSI 6920 turbidity sensor is used. Output is recorded in Nephelometric Turbidity Units (NTUs)	EHMP annual technical report 2006 – 07 Estuarine / marine methods
Water clarity	A Secchi disk is used to measure light penetration.	EHMP annual technical report 2006 – 07 Estuarine / marine methods
	Sample site characteristics	
Sediment type	Dominant substratum at the site e.g.: • Fines / mud - <0.06 mm • Sand – 0.06 – 2 mm • Gravel – 2 – 16 mm • Pebble – 16 – 64 mm • Cobble – 64 – 256 mm • Boulder - > 256 mm • Bed rock / Reef Measured using a sediment grab or visual assessment at low tide	Fisheries guidelines for conducting an inventory of instream structures in coastal Queensland (Lawrence et al 2009)
Seedling density / abundance	Seedling abundance categories Very abundant: 100% of space is covered. Seedlings form a dense carpet, no gaps. Abundant: Most space covered, some gaps. Common: Seedlings are common but do not form a carpet. Sparse: < than 1 seedling per square meter Absent: No seedlings present	FRC Environmental Fisherman Islands and Whyte Island Mangrove Health Assessment 2008 For Port of Brisbane
Tree diameter	Measure diameter of mangrove trees at breast height (dbh) May demonstrate a strong link between girth & age	

Term	Descriptor	Reference
Epiphytic algae cover	Abundance of epiphytic macroalgae on mangrove pneumatophores Very abundant > 75% cover (heavy coating) Abundant 50-75% cover (easily visible) Common 10-50% cover (some algae visible) Rare < 10% cover	FRC Environmental Fisherman Islands and Whyte Island Mangrove Health Assessment 2008 For Port of Brisbane
Macroalgae mat density and abundance	Mat-forming algae abundance as % cover of sediment Very abundant > 75% sediment covered Abundant 50-75% sediment covered Common 10-50% sediment covered Rare < 10% sediment covered	FRC Environmental Fisherman Islands and Whyte Island Mangrove Health Assessment 2008 for Port of Brisbane
Seagrass wrack presence	Measure of amount (percent cover & depth) of seagrass wrack present and height of berm created by the seagrass wrack	FRC Environmental Fisherman Islands and Whyte Island Mangrove Health Assessment 2008 for Port of Brisbane
Light intensity beneath the canopy	Measured using a ST – 1301 light meter This value will vary on season, time of day and cloud cover etc and is subject to variation at the one site and from day to day and over a day.	Marine Blancher, May 2008 Honours Thesis
Light percentage	Measured by dividing under canopy light intensity with open-canopy light intensity.	Marine Blancher, May 2008 Honours Thesis
Macrofauna abundance	Number of crab holes covering the sediment Very abundant > 50% sediment covered Abundant 25-50% sediment covered Common < 25% sediment covered Rare No macrofauna or crab holes evident Crabs are considered a key stone species and are used as an indicator of productivity & importance of site to support marine fauna. .Active crab holes are abetter measure of crab activity than all crab holes.	FRC Environmental Fisherman Islands and Whyte Island Mangrove Health Assessment 2008 for Port of Brisbane.

Term	Descriptor	Reference
	Regional site characteristics	
Coastal vegetation Map units	**1. Mangrove communities** 1A(i) *Aegiceras corniculatum* closed-scrub, open-scrub, low closed-scrub, low open-scrub 1B(i) *Avicennia marina* closed-forest, open-forest, woodland, low closed forest, low open-forest, low woodland, low open-woodland 1B(ii)a *Avicennia marina* closed-scrub, open-scrub 1B(ii)b *Avicennia marina* tall shrubland, tall open-shrubland 1B(ii)c *Avicennia marina* tall shrubland, tall open-shrubland that are dying due to waterlogging 1B(iii) *Avicennia marina* low open-scrub, low shrubland, low open shrubland 1C(i) *Bruguiera gymnorrhiza* closed-forest, open-forest, low closed-forest, low open-forest 1C(ii) *Bruguiera gymnorrhiza*, *Casuarina glauca* closed-forest, open-forest 1D(i) *Ceriops tagal* closed-scrub, open-scrub, tall shrubland, tall open shrubland 1D(ii) *Ceriops tagal* low open-scrub, low shrubland, low open-shrubland 1E(i) *Rhizophora stylosa* closed-scrub, open-scrub, tall shrubland, tall open-shrubland 1F(i) *Aegiceras corniculatum*, *Avicennia marina*, *Rhizophora stylosa*, *Bruguiera gymnorrhiza* closed-scrub, open-scrub, low closed-scrub, low open-scrub 1F(ii) *Avicennia marina*, *Aegiceras corniculatum* closed-scrub, open-scrub 1F(iii) *Avicennia marina*, *Bruguiera gymnorrhiza*, *Excoecaria agallocha* open-forest, low open-forest	Coastal Wetlands of South-east Queensland Mapping and Survey, February 2001. This document was produced by the Queensland Herbarium, 1998. Authored by Ralph Dowling and Kathy Stephens.
	2. Claypan 2 Claypan of marine clay. Usually devoid of vegetation **3. Samphire communities** 3A(i) *Sarcocornia* spp., *Suaeda australis*, *Suaeda arbusculoides* dwarf closed shrubland, dwarf shrubland, dwarf open-shrubland, dwarf sparse-shrubland	

Term	Descriptor	Reference
	4. Grassland communities 4A(i) *Sporobolus virginicus* closed grassland, grassland 4B(i) *Paspalum vaginatum* closed grassland, grassland 4C(i) *Phragmites australis* closed grassland, grassland 4D(i) *Triglochin striatum*, *Sporobolus virginicus* closed grassland, **5. Swamp oak communities** 5A(i)a *Casuarina glauca* open-forest, woodland 5A(i)b *Casuarina glauca* open-woodland 5A(ii)a *Casuarina glauca* low open-forest, low woodland 5A(ii)b *Casuarina glauca* low open-woodland 5B(i) *Casuarina glauca*, *Melaleuca quinquenervia* open-forest, woodland, low open-forest 5B(ii) *Casuarina glauca*, *Melaleuca quinquenervia* open-forest, low open forest (dying) 5C(i) *Casuarina glauca*, *Bruguiera gymnorrhiza*, *Excoecaria agallocha* low open-forest 5C(ii) *Casuarina glauca*, *Avicennia marina* low open-forest 5C(iii) *Casuarina glauca*, *Avicennia marina*, *Aegiceras corniculatum* open forest, woodland.	
Riparian habitat	A specific DERM developed program for assessing riparian vegetation presence and identification of modified and unmodified areas using GPS linked data collected from a boat and input to the software tool. The Riparian Assessment Program (RAP) is utilized twice a year to assess the ratio between natural and total distance along the rivers Indicator of potential human impacts	EHMP annual technical report 2006 – 07 Estuarine / marine methods
Topography	Can be measured using leveling SV instrument A simple dumpy level should suffice as an inexpensive and readily available piece of equipment. Where it is not possible to relate a survey to a permanent survey mark or even establish a temporary survey mark, relative temporal and spatial changes in elevation can be recorded by simply establishing a fixed start point for surveys.	Marine Blancher, May 2008 Honours Thesis

Term	Descriptor	Reference
Shoreline Video Assessment method (SVAM	A shoreline video assessment method developed by UQ Dr Norm Duke at the Mangrove Hub for use by Mangrove Watch groups. A rapid assessment technique used in estuarine areas to provide a snapshot of bank condition and modification as well as mangrove species present. The video footage is analysed by the UQ mangrove hub	UQ Mangrove Hub Norm Duke & Jock McKenzie
	Data reliability	
Ensuring mapping reliability	Reliability coding for GIS mapping / polygons is standard to allow for correct interpretation of results. For example: Reliability codes are attached to each polygon. This code consists of two components which assigns a separate value to both the linework and attribute accuracy. The first value (L) relates to the accuracy of the boundaries where: A = High confidence in accuracy of polygon boundary. B = Moderate confidence in accuracy of polygon boundary. C = Low confidence in accuracy of polygon boundary. The second value in the reliability code (V) relates to the accuracy of the polygon attributes (ie the vegetation units and their proportions): A = High confidence in accuracy of polygon attributes. B = Moderate confidence in accuracy of polygon attributes. C = Low confidence in accuracy of polygon attributes. The information attached to each polygon therefore consists of three parts: 1. Map Unit Code from the legend 2. Percentage of the polygon occupied by each of the map units making up the polygon. 3. Reliability Code	Coastal Wetlands of South-east Queensland Mapping and Survey, February 2001.

Table 3 - Mangrove health classification units

Table 3 lists the categories and descriptors for assessing mangrove health (condition). These have been collated from a number of research programs and reports. The supporting references provide further detail and photographic examples of each category. Development of a separate guide to in-field visual mangrove health assessment, with photographic and text descriptors of the mangrove health categories, would be useful.

Table 3 - Mangrove health category and descriptors after Duke (D) *et al* 2010, Saintilan (S) 2010 and FRC (F) Environmental 2008/2010

Mangrove health category	Mangrove health descriptor	Topography	Equivalent categories
1. Healthy Mangrove (**D**)	Living trees and shrubbery; high density; green leaves with no yellowing, curling etc. and little evidence of damage by insects. No abnormal leaf loss. May have < 20% of canopy affected by yellowing / curling or damage by insects and limited epicormic growth.	No sinking or ponds	Unponded (**S**) Good (1) & Fair (2) (**F**)
2. Unhealthy Mangrove (**D**)	Living trees and shrubbery; low density, unnaturally open canopy, may have dieback as receding canopies; no dead trees (or few). Many yellowing / curled leaves, reduced canopy cover, high insect damage. Abundant epicormic growth.	No sinking or ponds.	Defoliating (**S**) Poor (3) (**F**)
3. Recent Mangrove Dieback (**D**)	Dead trees/shrubs and/or excessive receding canopies; stark white dead trees and shrubs with fine limbs. Leaves brown or absent with no new growth.	No sinking or ponds.	Defoliated (**S**) Recently dead (4) (**F**)
4. Old Mangrove Dieback (**D**)	Dieback of mangroves without sinking – dead trees/shrubs and/or excessive receding canopies, no sinking ponds. Stumps of dead trees and shrubs, few/no fine limbs. No leaves or twigs, in some cases there are no small branches. Trees have been dead for years.	No sinking or ponds	Unponded (**S**) Dead (5) (**F**)
5. Recent Mangrove Sinking (**D**)	Ponded areas of shallow water, or dried up (darkened with old algae growth). Notable presence often of unusual remnant, isolated mangrove fringes. Obvious dead mangrove trees with limbs.	Ponds and sinking	Defoliating/ed ponded (**S**)

Mangrove health category	Mangrove health descriptor	Topography	Equivalent categories
6. Old Mangrove Sinking (**D**)	Ponded areas of shallow water, or dried up (darkened with old algae growth). Notable presence often of unusual remnant, isolated mangrove fringes. Advanced decaying tree stumps or no tree remnants.	Ponds and sinking	Dead mangrove ponded (**S**)
7. Small Mangrove Ponds (**D**)	Ponded areas of shallow water, or dried up (darkened with old algae growth). Notable presence often of unusual remnant, isolated mangrove fringes. Small ponds with fringing mangrove trees and small saltmarsh patches.	Ponds	Healthy mangrove ponded (**S)**
8. Patchy Saltmarsh/Salt pan Ponds (**D**)	Ponded areas of shallow water, or dried up (darkened with old algae growth). Notable presence often of unusual remnant, isolated mangrove fringes. *Patchy Saltmarsh/Saltpan Ponds*- small ponds in saltpan area, each surrounded by stunted saltmarsh and occasional mangrove shrubs.	Ponds	Unvegetated ponds within saltmarsh (**S)**
9. Stable Mangrove Ponds (**D**)	Ponded areas of shallow water, or dried up (darkened with old algae growth). Notable presence often of unusual remnant, isolated mangrove fringes. Stable ponds bordered by healthy mangroves.	Ponds	Unvegetated ponds within mangrove (**S**)
10. Sinking Saltmarsh/Salt pan (**D**)	Ponded areas of shallow water, or dried up (darkened with old algae growth). Notable presence often of unusual remnant, isolated mangrove fringes. Large pools, often fringed with saltmarsh.	Ponds and sinking	Ponded (**S**)
11. Healthy Saltmarsh/Salt pan (**D**)	Only in the upper intertidal zone. No signs of ponding.	No ponds	Unponded (**S**)
12. Mangrove regrowth (**F)**	Canopy-cover low but new trees evident, new growth shooting from the base or trunks of older trees. Previous disturbance event sometimes evident.	No ponds	

References

Dowling, R. & Stephens K (2001). Coastal Wetlands of South-east Queensland Mapping and Survey.

Duke, N., Haller, A., Brisbane, S., Wood, A. and Rogers, B (August 2010). Sinking Centres in Moreton Bay Mangroves. Maps showing areas of unusual anoxic ponds and mangrove dieback in tidal wetlands of the Bay area in 2003 – 08. School of Biological Sciences, University of Queensland.

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Lawrence, M. Sully, D., Beumer, J., and Couchman, D. (2009). Fisheries Guidelines for conducting an inventory of instream structures in coastal Queensland, QDPI Fish Habitat Guideline FHG 007, 64pp.

Saintilan, N. (2010). Review report for Fisheries Queensland.