Department of **Agriculture, Fisheries and Forestry**

Project Summaries
Fish habitat research and management program
Balancing community needs with those of fisheries resources and fish habitats - 2012 & beyond

Queensland Government

Contents

Appendix 1 Examples of projects

The following tables show examples of projects within each Research/ Management Stream of the Fish Habitat Research and Management Program (DAFF 2012) as at April 2012. A "*" indicates a monitoring, maintenance or rehabilitation project that also provides opportunities for further research.

Stream 1 – Fish habitat utilisation

Component	Title	Leader	Project site	Objectives	Management Benefits
Saltmarsh productivity and biomass.	Halophyte Vegetation Distribution in a Sub-Tropical Saltmarsh.	UQ Jock Mackenzie	Brisbane Airport, Tinchi Tamba and Boondall Wetlands, SEQ	Determine seasonal variation in saltmarsh production and biomass.	Increased knowledge of subtropical saltmarsh systems and processes. See project summary (Appendix 2).
Mangrove ecosystem productivity.	Community structure and ecology of mangrove-associated epiphytic algae – A Moreton Bay case study. (DPI&F) Marine Fish Habitat Scholarship award, 2005/6)	UQ Lucy Hurrey / Dr Catherine Lovelock	Moreton Bay, SEQ	Evaluate the influence of environmental factors on epiphytic algae communities on mangrove pneumatophores. Map the species distribution of epiphytic macroalgae. Determine algal biomass and seasonal/site variation in nutrient levels. Produce a faunal catalogue of the algal primary consumer community.	Increased knowledge of subtropical mangrove-algal assemblages. See project summary (Appendix 2).
	Tropical Mangrove forests and fish feeding: a test of the mangrove nursery-ground food hypothesis. (Resources utilisation by tropical estuary fish in mangrove habitats)	JCU Murray Bower / Dr Marcus Sheaves	Hinchinbrook Channel, North Qld	Determine which species or size classes of fish enter mangroves primarily for feeding and which enter primarily for refuge. For those fish that enter mangroves to feed, determine the importance of the foods consumed in the mangrove	Better understanding of the resources that tropical estuary fish use when they enter mangrove habitats. See project summary (Appendix 2).

Component	Title	Leader	Project site	Objectives	Management Benefits
Mangrove ecosystem productivity.	(DEEDI Marine Fish Habitat Scholarship award, 2009/10)			habitats as sources of nutrition. Determine which predators feed most heavily on (a) fish that enter mangroves primarily to feed and (b) on those that enter primarily for refuge. Determine whether predation does focus on times when fish cannot access mangrove habitats. Determine the extent to which predators preying on fish that utilise mangroves to feed rely on nutritional support from mangrove habitats.	
Algal growth factors and infauna.	The effects of environmental factors on *Caulerpa taxifolia* growth in Moreton Bay, Australia . (DPI&F Marine Fish Habitat Scholarship award 2006/7)	UQ Jessica Street / Dr Catherine Lovelock	Moreton Bay, SEQ	• Quantify the relationship between nutrients and *C. taxifolia* growth; • Quantify the relationship between sediment grain size and growth; • Quantify environmental conditions in Moreton Bay *C. taxifolia* meadows; • Compare benthic infaunal communities in seagrass and *C. taxifolia* meadows.	Better understanding of environmental drivers and fisheries values of *C.taxifolia* within fish habitats in Moreton Bay. See project summary (Appendix 2).
Mangrove dieback	Are mangrove faunal communities affected by sinking centre dieback in Moreton Bay?	UQ Honours Project Cassandra Dover / Dr Norm Duke	Moreton Bay, SEQ	Investigate/ establish correlations between faunal community composition and health conditions in affected areas. Identify whether seasonality influences composition patterns.	Improved understanding of fish habitat function in mangrove dieback areas. See project summary (Appendix 2).

Component	Title	Leader	Project site	Objectives	Management Benefits
Fish habitat mosaics	Trophic exchange in estuarine landscapes: the influence of different habitat mosaics on the diet of fish and prawns. (DPI&F Marine Fish Habitat Scholarship award 2007/8)	UQ Ashleigh Fowler / Assoc Prof Greg Skilleter	Moreton Bay, SEQ	Provide information on the diet of fish using different combinations of estuarine habitats, in winter and summer. Examine whether the diet of these species changes in relation to variation in the spatial arrangement of different habitats and whether this variation in diet is related to the relative abundance of key prey species. Determine whether degradation of estuarine habitats, or loss of structural complexity, affects feeding of these species.	Better understanding of the role of habitat mosaics in supporting fish stocks and fisheries productivity. See project summary (Appendix 2).
Impact of fish herbivory on algal and coral dynamics.	The role of herbivorous fish in regulating algal and coral dynamics in high latitude coral reef systems. (DEEDI Marine Fish Habitat Scholarship award 2008/9)	UQ Patrick Gartrell / Dr Ian Tibbetts	Moreton Bay coral reefs, SEQ	Identify fish biomass and diversity. Determine the impact of fish herbivory within Moreton Bay.	Better understanding of the role of fish herbivory in high latitude coral reef systems. See project summary (Appendix 2).
	Are coral reefs in Moreton Bay protected from algal overgrowth by the topdown process of grazing or the bottom-up process of nutrient availability? 2010 DEEDI Marine Fish Habitat Scholarship award	UQ James Brown / Dr Ian Tibbetts	Moreton Bay coral reefs, SEQ Peel Island and Myora Reef	Determine the relative strength of fish herbivory and nutrient limitation in regulating algal growth on coral reefs.	Better understanding of regulating processes in high latitude coral reef systems. See project summary (Appendix 2).

Component	Title	Leader	Project site	Objectives	Management Benefits
Artificial waterways	Project 1. The influence of urbanisation of waterways on the functioning of fish habitats. GU Research Hub Studies a) *Scavenging pressure in urbanised and natural waterways* *b) Types of scavengers and competitive interactions* *c) Sources of deposited organic matter in artificial and natural waterways* *d) The effect of increasing temperature and dissolved carbon dioxide on the decomposition of organic matter in urban waterways* *e)* Epibiota of jetties (*Moreau et al* 2008)	GU Professor Joe Lee	Gold Coast canals, SEQ	**Aims** (Studies a-e): a) To measure scavenging pressure in two different regions within the canal system (dead end canals and well flushed canals) and compare these to natural waterways; b) To identify scavengers and measure competitive interactions; c) To compare the sources of organic matter and bacterial loads in different artificial and natural habitats; d) To elucidate the combined effects of increasing temperature and decreasing pH on the degradation of labile organic matter in urban waterways (fate of decaying gelatinous plankton (jellyfish) in the canal environment, and how this process might impact on nutrient and organic matter fluxes between the benthic and pelagic sections of these artificial waterways); e) Sampling of epibiota on jetties in the tidal, urban canals to determine fish predation and food source dependence.	Better understanding of the role of artificial waterways in supporting fish stocks and fisheries productivity. The value of jetties to fish in urban waterways. See project summary (Appendix 2).
Artificial waterways	Project 2. Trophic and habitat value of urban canals to fish and crustaceans. Studies *a) Use of novel tracking*	GU Professor Joe Lee	Gold Coast canals, Tallebudgera Creek, SEQ	**Aims** (studies a) & b)(i and ii)): a) To study fish movement pattern in urban canals (Modelling and tracking the movement of juvenile bull shark in an urban watercourse);	Understanding the movement of juvenile crabs and fish in artificial waterways

Component	Title	Leader	Project site	Objectives	Management Benefits
Artificial waterways	*technology for assessing utilisation of urban canals by estuarine fish and crustaceans* *b) Trophic significance of urban canals to estuarine fish and crustaceans*			b)(i) To assess the contribution of autochthonous organic matter sources to the nutrition of fish and crustaceans in urban canals with the help of chemical tracers: • Samples of selected species of primary producers, fish and crustaceans and sediments samples collected from the Gold Coast canal system will be analysed to ascertain the main organic matter source sustaining the consumer assemblage; • Consumers on sandflats in the Broadwater adjoining the canal system will be samples to assess to what extent organic matter from the canals may exert ex situ influence on food chains in the estuary. b)(ii) To model the impact of urbanisation on the trophic structure and dynamics of estuarine sandflats.	Documenting the nursery significance of urban waterways. Trophic significance of urban habitats to estuarine fish and crustaceans - effect of anthropogenic disturbance. See project summary (Appendix 2).
Fish habitat mosaics	The functional importance of the pattern of habitat interspersion within a seascape *Develop a quantified model of the importance of structurally complex subtidal habitats and their interrelationship with other seascape elements in*	JCU Shaye Carman/ Assoc Prof Marcus Sheaves)	Hinchinbrook Channel, North Qld Deluge Inlet (Boyd's Ck) North Zoe Ck Mendel Ck on Hinchinbrook Island	Determine: • How access to potential subtidal refuges influences the structure of nekton assemblages using intermittently available structurally complex intertidal mangrove habitats; • How the proximity to structurally complex habitats influences nekton assemblage structure of	Improve our understanding of the importance of the role of complex subtidal habitats. See project summary (Appendix 2).

Component	Title	Leader	Project site	Objectives	Management Benefits
Fish habitat mosaics	*supporting key ecosystem functions of tropical estuaries and coasts.* (DEEDI Marine Fish Habitat Scholarship award, 2010/11)			other subtidal habitats; • The implications of these interdependencies for key ecosystem functions and processes, particularly food webs, predation pressure and nursery grounds.	
Fish habitat mosaics	Importance of coastal waters to juvenile blacktip[1] sharks. *Examine the spatial ecology of juvenile blacktip sharks in the Cleveland Bay FHA.* [1]*Carcharhinus tilstoni/limbatus* (DEEDI Marine Fish Habitat Scholarship award, 2010/11)	JCU Vinay Udyawer/ Dr Colin Simpfen-dorfer	Cleveland Bay, Townsville, North Qld	• Describe the movements and habitat use of juvenile blacktip sharks in the Cleveland Bay FHA; • Determine the level of protection provided to juvenile blacktip sharks by inshore areas closed to net fishing; • Examine how seasonal environmental changes affect the distribution and habitat use of juvenile blacktip sharks; • Compare the habitat use patterns of juvenile blacktip sharks to those of other shark species that occur in the Cleveland Bay FHA. Study used acoustic tags to monitor blacktip sharks using habitats within the acoustic monitoring stations (already deployed within the Cleveland Bay FHA).	Focuses on habitat protection of near shore habitats of this important recreational species and main species for commercial shark fishers of the Qld East Coast Inshore Finfish Fishery (ECIFF). See project summary (Appendix 2).
Fish habitat mosaics	Demersal fish-habitat associations on southern Queensland's continental shelf. *Determining habitat preferences of continental*	UQ Kate Fraser/ Dr John Kirkwood	SEQ (adjacent the Sunshine Coast in waters above/below 50m depth contour	• Determine distribution and relative abundance of fish species associated with various offshore habitat types (e.g., rocky reef, rubble, algal beds, sand); • Analyse spatial relationships between physical environmental	Revealing species fish habitat preferences to understand relationships between habitats of the broader fish habitat mosaic and those components required to sustain fisheries.

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	shelf fish species using baited remote underwater video stations (BRUVS). (DEEDI Marine Fish Habitat Scholarship award, 2010/11)		offshore from Point Cartwright to Caloundra Head).	variables and fish species abundance data to determine correlations between the two; • Identify habitat preferences of both targeted and non-targeted fish species; • Recommend to management which habitat-types require protection to ensure sustainability of particular fish species.	See project summary (Appendix 2).
Fish habitat mosaics	What is the relative importance of different nursery habitats to recruitment of adult snapper (*Pagrus auratus*) in southern Queensland? (DAFF Marine Fish Habitat Scholarship award, 2011/2012)	UQ Jarrad Oxley/ Dr John Kirkwood	SEQ five regions (Hervey Bay, Great Sandy Straits, Sunshine Coast, Moreton Bay & Gold Coast)	• Determine spatial and inter-annual variability in otolith microchemistry amongst juvenile snapper in estuarine habitats; • Identify the chemical signatures of those estuarine habitats in the cores of adult snapper otoliths; • Use this information to identify the estuarine nursery habitats from which snapper in the southern Queensland fishery were recruited; • Recommend to management which specific nursery habitats require protection to supply recruits to the adult stock.	The importance of various nursery habitats in providing recruits to the adult stock. By identifying the nursery habitats utilised by snapper, this research will provide management with knowledge required to better protect habitat crucial to the recovery of snapper stocks.
Fish habitat mosaics	The functional importance of intertidal snags as fish nurseries and their role in compensating for loss of seagrass. (DAFF Marine Fish Habitat Scholarship award, 2011/12)	JCU Michael Bradley/ Assoc Prof Marcus Sheaves	Hinchinbrook Channel, North Qld Herbert River, Deluge Inlet (Boyd's Ck), North Zoe Ck and Mendel	• Assess nekton assemblage structure in intertidal and immediately subtidal woody snags at low and high tides. • Assess assemblages in intertidal and immediately subtidal seagrass and open sand/mud habitats. • Investigate trophic and predator-prey relationships around woody	Improve our understanding the importance of intertidal and subtidal woody snags as coastal nurseries to fish (e.g. juvenile snappers and groupers).

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			Ck on Hinchinbrook Island, and Lucinda beach.	snags at low and high tide collecting key fish and prey species for diet and stable isotope analysis. • Conduct series of exclusion experiments to investigate the trophic and predation implications of excluding different parts of the assemblage from woody snags. • Conduct literature search on tropical estuary food webs, predator spectra and pressures, nursery grounds etc to assess patterns of utilisation for key ecosystem functions and processes, particularly food webs, predation refuge and nursery ground value.	
Fish habitat mosaics	Understanding the value of different mangrove zones to fisheries species and ecosystem processes. (DAFF Marine Fish Habitat Scholarship award, 2011/12)	JCU Jacob Tapp/ Assoc Prof Marcus Sheaves	Hinchinbrook Channel, North Qld Hinchinbrook Island and impacted areas in Ross River Townsville, and Bowling Green Bay.	Develop a quantified understanding of the utilisation of different mangrove habitats by fish and crustaceans as a basis for evaluating, comparing and understanding the relative fisheries and ecological values of different mangrove forest zones. • Determine the utilisation of different mangrove zones by fish and crustaceans relative to tidal inundation patterns; • Develop a detailed understanding of the nursery ground and food web implications of differential use of different mangrove zones by biota;	Improve our understanding of the utilisation of different mangrove habitats by fish and crustaceans.

Component	Title	Leader	Project site	Objectives	Management Benefits
Fish habitat mosaics				• Determine the implications of these patterns of utilisation and functioning for key ecosystem functions and processes, and for the relative fisheries and ecological values of different mangrove zones.	

Stream 2 – Impacts on fish habitats

Component	Title	Leader	Project site	Objectives	Management Benefits
Effect of pruning of mangroves on fisheries productivity.	Effects of different pruning regimes on the management of mangroves and fish habitat in the Burnett River.*	Bundaberg City Council	Sites in Burnett River, SEQ	To determine the effects of different levels of mangrove trimming on: • the fish habitat values of the surrounding substratum; • the survival, growth and health of trimmed trees; • the rate of growth of mangroves (i.e. to determine how frequently maintenance trimming is required).	Councils will have access to emerging best practice as part of a marine plant management strategy. Understanding pruning/ crown lifting effects including mangrove recruitment/fish habitat productivity.
	Effects of pruning mangroves on fish habitat productivity.	Mirvac	Brisbane River, SEQ	Effect on flower and fruit production, effects on benthic fauna.	
Effect of crown lifting mangroves on fisheries productivity.	Trimming trial - crown lifting of mangroves.*	Southbank Corporation	Southbank, Brisbane River, SEQ	To determine the effects of crown lifting on mangrove survival.	
Investigation of the physiology and recovery of mangrove dieback in Queensland.	Investigation of mangrove dieback.	PoBC	Whyte Island, Moreton Bay, SEQ	To determine the causes of and solutions for mangrove dieback at Whyte Island.	Improved understanding of the causes of and solutions for mangrove dieback.
	Investigation of mangrove dieback.	DPI&F	Pioneer River, Mackay, Central Qld	To determine the causes of and solutions for mangrove dieback in the Pioneer River.	
	Investigation of mangrove dieback.	BCC	Luggage Point STP outfall, SEQ	To investigate the causes of and solutions for mangrove dieback at Luggage Point STP outfall, Brisbane.	

Component	Title	Leader	Project site	Objectives	Management Benefits
Investigation of the physiology and recovery of mangrove dieback in Queensland.	Sinking centres in Moreton Bay mangroves: a project to map current areas of unusual anoxic ponds and mangrove dieback in tidal wetlands of the bay area.	UQ Norm Duke	Moreton Bay, SEQ	To map mangrove areas affected by sinking centres dieback showing extent and area of damaged and undamaged tidal wetlands.	Access the Mangrove Dieback report online
	Recent severe dieback of mangroves - Is 'sinking centre' dieback contributing to serious loss of fish habitat? (DPI&F Marine Fish Habitat Scholarship award 2007/8)	UQ Marine Blancher / Dr Norm Duke	Moreton Bay, SEQ	• Assess the extent and structure of the mangrove dieback in Moreton Bay. • Establish correlations between the elevation profile and the canopy/ soil condition from healthy to sunken areas in Moreton Bay's mangroves. • Determine past and actual dieback and sinking processes. • Develop a conceptual model predicting the potential for mangrove recovery.	See project summary (Appendix 2).
Vessel mooring impacts on seagrass.	The impact of existing boat moorings on seagrass communities in Moreton Bay, Australia (DEEDI Marine Fish Habitat Scholarship award 2008/9)	UQ Kate Maguire / Assoc. Professor Greg Skilleter	Moreton Bay, SEQ	• Map the distribution of vessel moorings and estimate area of damage to seagrass using remote sensing. • Ground truth estimates using field surveys. • Determine potential impacts of vessel moorings on seagrass. • Assess the role of moorings in a broader regional context as a source of disturbance compared to other sources.	Improved understanding of the impacts of vessel moorings on fish habitats. Links to trials of environmentally-friendly moorings (Stream 3). See project summary (Appendix 2, Stream 2).

Component	Title	Leader	Project site	Objectives	Management Benefits
Insect control measures and their implication for marine plants.	The suitability of native mangroves as hosts for the lantana bug *Aconophora compressa*	NRW	Brisbane River, SEQ	To determine the suitability of two native mangrove species as hosts for an introduced bio-control agent.	Better understanding of potential implications of bio-control agents and their release on non-target marine plants. See project summary (Appendix 2).
Impacts of coastal development on declared FHAs.	Impervious coverage and land-use characteristics surrounding Lakes Weyba and Coombabah, South East Queensland.	GU Ruth Young / Professor Joe Lee, Dr John Beumer	Coombabah Lake declared FHA, Gold Coast and Lake Weyba declared FHA, Noosa.	To determine the change in catchment development and its runoff impacts on the fisheries values of the receiving lakes.	Enhanced understanding of coastal catchment development and management of downstream lake systems. See project summary (Appendix 2).
Impacts of coastal development on declared FHAs.	Acid sulphate soil status of selected intertidal habitats within the Caboolture River section of the Deception Bay declared FHA.*	NRW	Deception Bay, SEQ	To determine the relative impacts of coastal development on intertidal habitats within and adjacent to declared FHAs through: • improved resolution of ASS mapping in the Caboolture River section of the Deception Bay declared FHA; • gaining a better understanding of ASS issues in intertidal areas.	Improved understanding of coastal soil processes and their implications for declared FHAs. See project summary (Appendix 2).
Impacts of coastal development on fisheries resources and fish habitats.	Louisa Creek mangrove health audit.*	Babcock & Brown Infrastructure (Dalrymple Bay Coal Terminal)	Louisa Creek, Hay Point, Central Qld	To undertake a fisheries resources monitoring program providing: • An assessment of the current ecological health of Louisa Creek, its mangroves and associated faunal communities; • A statistically rigorous baseline data set against which future changes can be assessed.	Better understanding of direct and indirect implications of coastal development on fisheries resources and fish habitats. See project summary (Appendix 2).

Component	Title	Leader	Project site	Objectives	Management Benefits
Impacts of coastal development on fisheries resources and fish habitats.	Fisheries monitoring program in Boathaven Bay.	DEEDI / JCU	Boat Haven Bay, Airlie Beach, Central Qld	To undertake a structured program of fisheries resources monitoring in the Boathaven Bay which will: • Characterise baseline fisheries resources of the development site; • Monitor these resources during and after the development phase; • Determine changes in these resources over time; • Describe impacts on the resources attributable to the development against a nearby undeveloped/reference site; • Identify consequences of impacts on associated fisheries.	Better understanding of direct and indirect implications of coastal development on fisheries resources and fish habitats. See project summary (Appendix 2).
	Impact of urbanisation on the trophodynamics of estuarine sand flats.	GU Professor Joe Lee	Gold Coast Broadwater, SEQ	To investigate how the trophic structure and pattern of essential nutrient (C, N) flow on estuarine sand flats may be affected by urbanisation.	Organic enrichment impacts on food web dynamics - assessment of the effects of organic loading on estuaries. See project summary (Appendix 2)
	Impact of sediment resuspension events on tropical coastal seagrass beds - light attenuation and subsequent seagrass growth responses. (DEEDI Marine Fish Habitat Scholarship award 2009/10)	JCU Gavin Coombes / Dr Peter Ridd	Cleveland Bay, Townsville, North Qld	To undertake fundamental research on the growth response of tropical seagrass to natural light variation with: • regular and opportunistic surveys of seagrass demographic rates; • continuous monitoring of environmental parameters. To develop, test and validate parametric and non-parametric statistical models to predict light levels on seagrass beds in relation to wave energy and water depth.	Better understanding of the relationship between local wave-driven re-suspension of sediment and reduced light intensity on tropical coastal seagrass beds.

Component	Title	Leader	Project site	Objectives	Management Benefits
Impacts of coastal development on fisheries resources and fish habitats.				To provide a comparison of these contrasting statistical approaches and an assessment of the likelihood these models could distinguish natural re-suspension events from anthropogenic events.	
Use of created fish habitats to manage land use impacts.	Value of created mangrove wetland for urban stormwater purification. Gold Coast City Council project update	GU Professor Joe Lee	Gold Coast Broadwater (Southport Parklands Project site), SEQ	To evaluate the efficacy of planted mangroves as a filter for stormwater-borne pollutants.	Better understanding of the use of planted mangroves as a filter for urban stormwater runoff control. See project summary (Appendix 2). See project summary (Appendix 2).

Stream 3 – Innovative structure design for fish habitats

Component	Title	Leader	Project site	Objectives	Management Benefits
Installation of fish friendly floodgates	Enhancing fish passage and water quality.*	Mathew Johnston, DEEDI	Maroochy River catchment, SEQ	To monitor the impacts of self-regulated floodgates for fish passage and water quality	Sugar cane industry, local governments, Main Roads, etc to incorporate fish friendly floodgates in waterway barriers and related structures to optimise fish passage and enhance water quality.
Use of environmentally-friendly buoy	Environmentally-friendly mooring trials in Moreton Bay.	SEQ Catchments / DEEDI /	Moreton Bay, SEQ	To trial and assess the effectiveness of environmentally-friendly buoy mooring designs in:	Information for vessel owners, boating industry, managers and planners on

Component	Title	Leader	Project site	Objectives	Management Benefits
moorings for vessels		DERM		• safely securing vessels; and • reducing disturbance of fish habitats.	demonstrated suitability of innovative technology to safely moor vessels in Queensland waters while reducing impacts on fish habitats. Environmentally friendly moorings webpage See also 2009 Queensland Coastal Conference paper
Use and optimum arrangement of different materials for bank stabilisation.	Hand-placement of rocks around mangroves.*	Brisbane Boys College	Brisbane Boys Rowing Club, Keith St, St. Lucia, Brisbane, SEQ	To determine if an arrangement of gabions in front of fringing mangroves would: • provide some protection to the mangroves from further erosion; • achieve design objectives from an engineering viewpoint.	Councils will have access to emerging best practice and will have the ability to incorporate this into DA conditions.
	Gabions in continuous line in front of mangroves.*	BCC	Rotary Park, Park St, St. Lucia, Brisbane, SEQ	To determine if an arrangement of gabions in front of fringing mangroves would: • provide some protection to the mangroves from further erosion; • impact upon the mangroves behind the gabions by scouring; • achieve design objectives from an engineering viewpoint.	
	Gabions with gaps, in front of mangroves.*	BCC	Guyatt Park, St. Lucia, Brisbane,	To determine if an arrangement of gabions in front of fringing mangroves, with gaps between gabion blocks,	

Component	Title	Leader	Project site	Objectives	Management Benefits
Use and optimum arrangement of different materials for bank stabilisation.			SEQ	would: • reduce ponding and stagnation of water; • reduce trapping of fish at low tide; • impact upon the mangroves behind the gabions by scouring or excessive deposition of fines; • achieve design objectives from an engineering viewpoint.	Councils will have access to emerging best practice and will have the ability to incorporate this into DA conditions.
	Use of geo-fabric to stabilise bare foreshores.*	Max Winders Pty Ltd	Oyster Cove, Hope Island, SEQ	To determine whether geo-fabric meshed into the substratum will be effective in reducing erosion on the foreshores of Saltwater Creek.	
	Use of commercial product "A-Jacks" as artificial reef in front of mangroves.*	GU	Public park, Hope Island, SEQ	To determine which arrangement of "A-Jacks" and other erosion control structures in front of fringing mangroves, will: • impact upon trapping of fish at low tide; • impact upon the mangroves by scouring or excessive deposition of fines; • achieve design objectives from an engineering viewpoint.	See project summary (Appendix 2)

Stream 4 – Rehabilitation of fish habitats

Component	Title	Leader	Project site	Objectives	Management Benefits
Value of rehabilitated habitats to fish and other aquatic fauna.	East Trinity acid sulfate soils rehabilitation program: monitoring the recovery of fish habitats and associated fisheries values*	DEEDI	East Trinity, Cairns, North Qld	Assess the effectiveness of special flood gates allowing rehabilitation and restoration of tidal flow to parts of a 700 hectare tidal wetland at East Trinity in north Queensland by determining:	Documented recovery of fish and crab populations and of the recolonisation of the marine plant community following

Component	Title	Leader	Project site	Objectives	Management Benefits
Value of rehabilitated habitats to fish and other aquatic fauna.				• the value of rehabilitated fish habitats after ASS remediation; • the recovery of marine plant communities after ASS remediation.	controlled return of tidal regime. Includes fish habitat utilisation (Stream 1) information. See project summary (Appendix 2).
	Fish use of restored fish habitats.*	Greening Australia	Oxbow, Bulimba Creek, Brisbane, SEQ	To determine the habitat use by local fish and aquatic invertebrates in and adjacent to the Bulimba Creek Oxbow Rehabilitation Site.	Assessment of the extent of utilisation of rehabilitated fish habitats. Includes fish habitat utilisation (Stream 1) information. See project summary (Appendix 2).
	Fish use of restored fish habitats. (Provide further scientific evidence of the ecological success of the Bulimba Creek Oxbow and based on earlier work conducted by Paul Whatmore)	Bulimba Creek Catchment Coordinating Committee / David Bright (Sunshine Coast University)	Bulimba Creek Oxbow, Brisbane, SEQ	• A manuscript documenting the diversity of aquatic fauna as well as an assessment of the ecological health of the Bulimba Creek Oxbow; • Provide further scientific evidence of the ecological success of the Bulimba Creek Oxbow; • Create a full colour poster and booklet with information on the Bulimba Creek Oxbow and photographs of the aquatic species found there, and • Stage a community day where members of the public are invited to the Bulimba Creek Oxbow for a discussion of the species diversity and a demonstration of sampling techniques.	Assessment of fish use of rehabilitated fish habitats. Includes fish habitat utilisation (Stream 1) information. See Project update (Appendix 2). 30 fish and nekton species restored to area, with 78% of total fish found during study being juveniles. See also Bulimba Creek Catchment Coordinating Committee .

Component	Title	Leader	Project site	Objectives	Management Benefits
Optimum methods for coastal wetland restoration.	Restoration of Bremner Rd salt marsh wetland ecosystem within the Hays Inlet wetland Key Coastal Site, SEQ*	Sean Galvin SEQ Catchments	Hays Inlet, Redcliffe, SEQ	To rehabilitate a degraded coastal wetland. To monitor rehabilitation activities.	Stakeholders will have access to best practice technology for fish habitat rehabilitation.
	Duplication of the Hornibrook Highway*	DTMR	Rothwell rehabilitation site, SEQ	Undertake transplantation for saltmarsh rehabilitation Monitor success of rehabilitation, including fish habitat use	Includes fish habitat utilisation (Stream 1) information. See project summary (Appendix 2).
	Townsville Port Access Road and required Biodiversity Management Plan for Environmental Reserve 2009 - 2014 (EPBC Act Requirement).	DTMR funding with EPA as trustee of new Nature Conservation Reserve.	Ross River, Townsville, North Qld	Establish and manage a 530 ha environmental Reserve on the South bank of Ross River. Undertaking rehabilitation and restoration: • periodic rubbish removal by TCC, Port of Townsville, DEEDI and NRW; • Weed management actions; • Fish passage in culvert designs.	Stakeholders will have access to best practice technology for fish habitat rehabilitation.
	Gateway Bridge Duplication project	Gateway Motorway Alliance	Brisbane River Royal Queensland Golf Course, SEQ	Creation of offset areas in 2005 and vegetation of new areas with saltmarsh and samphire species to complement the functionality of the Golf Course; • Expansion of mangrove habitat through bund wall removal Outcomes reported see also 2009 Queensland Coastal Conference poster paper	

Component	Title	Leader	Project site	Objectives	Management Benefits
Optimum methods for salt couch transplantation.	Saltcouch transplanting to bare areas.*	Greening Australia Corporation	Bulimba Oxbow, Bulimba, SEQ	To establish best practice for transplanting of saltcouch associated with rehabilitation of tidal sites.	Stakeholders will have access to best practice technology for fish habitat rehabilitation.
	Saltcouch transplanting to bare areas.*	DEEDI	Brisbane Airport Corporation, SEQ	To establish best practice for transplanting of saltcouch associated with rehabilitation of tidal sites.	
Optimum bank profiles for drains to encourage colonisation by fringing mangroves.	Reprofiling of 'canal' banks.*	GCCC	Tidal canal adjacent Lot 50 RP810126, Hawker St / Judeller Rd., Currumbin, SEQ	To determine whether profiling of drain to create profiles with a particular slope and width between HAT and MSL would promote colonisation by mangroves.	Councils will have access to emerging best practice and will have the ability to incorporate this into DA conditions.
	Reprofiling of existing drain.*	GCCC	Drain through Lot 2 RP188929, Township Dr, West Burleigh, SEQ	To determine whether profiling of drain to create profiles with a particular slope and 10 m width between HAT and MSL would promote colonisation by mangroves.	
	Reprofiling of new drain.*	GCCC	Drain relocated within Lot 1 RP137859, Steiglitz Wharf Rd/ Kleinsmidth Rd, Steiglitz, SEQ	To determine whether profiling of drain to create profiles with a particular slope and 20m width between HAT and MSL would promote colonisation by mangroves.	
Recovery and Rehabilitation Works	Oxbow Wetlands Recovery and Rehabilitation Works.	Bulimba Creek Catchment Coordinating	Bulimba Creek Oxbow, Brisbane, SEQ	Aim: To provide Fish Habitat management services through rehabilitation, recovery and revegetation works, including establishment of 180	Outcomes assist enhancement and management of tidal marine plant community

Component	Title	Leader	Project site	Objectives	Management Benefits
Recovery and Rehabilitation Works		Committee		plants, on terrestrial floodplains adjacent to tidal Oxbow and mangrove communities: • Rehabilitate wetland buffer near the Port Road to provide additional habitat within (3.4 ha) comprising the western area of the Bulimba Creek Oxbow wetland within Lot 376 on S31312. 1. South-west Oxbow loop: Major weed removal, recovery of previous plantings, Glycine treatments and infill diversity planting (80 tubestocks). 2. Northern areas of central loop: Major exotic vine infestation. 3. D5B Riparian buffer: Full weeding and selective herbicide treatments, recovery of previously planted natives, infill and minor extension plantings to east (100 tubestocks including structure eucalypts).	chiefly through ongoing site maintenance and site recovery. See Project summary (Appendix 2).

Stream 5 – Habitat data for response management

Component	Title	Leader	Project site	Objectives	Management Benefits
Permanent Base Plot Monitoring.	Monitoring mangrove and associated communities in Moreton Bay, South east Queensland.	DERM - Qld Herbarium	Moreton Bay, SEQ	The Queensland Herbarium is aiming to establish 20 long-term monitoring plots across the mangrove communities of Moreton Bay. The plots are designed to monitor mangrove and associated community dynamics over time. The plots are distributed across Moreton Bay to detect change across the geographic extent of the study area.	Information will be assist mapping, planning and management of estuarine fish habitats of mainland (western bay) and island (central and eastern bay sites). The Project will provide accurate information to

Component	Title	Leader	Project site	Objectives	Management Benefits
Permanent Base Plot Monitoring.				The plots include nine (9) different vegetation types which expert advice indicated were the most likely to change due to rising sea levels, climate change and physical or anthropogenic effects.	determine local changes to mangrove and saltmarsh communities, over time.
Fish habitat vulnerability and climate change project.	Mapping the vulnerability of Queensland's fish habitats.	DAFF/ DEHP Qld Herbarium	Moreton Bay, SEQ	Mapping the vulnerability of Queensland's fish habitats in response to predicated sea level rise scenarios.	Develop maps indicating climate change impacts on fish habitats (to be used by government agencies).
Mangrove dieback and mangrove health.	Data collection protocol for mapping and monitoring mangroves in Queensland.	DAFF/ DEHP Qld Herbarium	Moreton Bay, SEQ	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 DAFF (Fisheries Queensland).	Production of a Data collection protocol and Mangrove Dieback Conceptual model
Mangrove health	Effects of the January 2011 Flood on the Mangrove Communities Along the Brisbane River	DEHP (DERM) – Qld Herbarium	Brisbane River, SEQ	A summary of the effect of the January 2011 flood on the mangroves along the Brisbane River.	A record of the extent of mangrove loss or damage resulting from mangroves. See Dowling, R. M. (2012). Report on the effects of the January 2011 flood on the Mangrove communities

Component	Title	Leader	Project site	Objectives	Management Benefits
					along the Brisbane River: Department of Environment and Resource Management, Queensland Government. Brisbane River Flood 2011 report

Appendix 2 Summaries of completed projects

Copies of full project reports are available from DAFF on request (phone 13 25 23).

Stream 1 – Fish habitat utilisation

Halophyte vegetation distribution in a sub-tropical saltmarsh

Jock Mackenzie
University of Queensland and Department of Primary Industries and Fisheries, Queensland, Australia, 2006.

Halophyte species distribution and plant cover in sub-tropical varies along an increasing elevation gradient. Salinity, tide and soil moisture content were significantly associated with halophyte distribution and were directly related to the presence of species at different elevation ranges. Other factors such as biotic interactions and tide force also have significant influence on halophyte distribution. The presence of mangrove forests at the lower limit of sub-tropical saltmarsh is an important factor that distinguishes these saltmarshes from those elsewhere. Combining halophyte distribution data with abiotic associations is indicative of influential physical and biological processes present in sub-tropical saltmarsh. These are examined and discussed. This information is synthesised in a conceptual framework and diagram. This conceptual framework of saltmarsh processes will enable more informed decision making with regard to saltmarsh ecology and management in the future.

Community structure and ecology of mangrove-associated epiphytic algae: A Moreton Bay case study

(DPI&F Marine Fish Habitat Scholarship award, 2005/6)

Lucy Hurrey
University of Queensland, 2006.

Mangroves are critical for sustaining coastal productivity. An important component of mangrove ecosystems is the epiphytic algae group which attaches to mangrove pneumatophores. The purpose of the study was to examine the factors controlling the biomass and distribution of epiphytic mangrove macroalgae in Moreton Bay, Queensland, Australia. As coastal ecosystems are increasingly threatened by nutrient enrichment, the study aimed to determine the algal community response to variation in nutrient availability. An additional objective was to produce a faunal catalogue of the algal primary consumer community.

In order to determine the effects of nutrient availability on the pneumatophore algal community, variation in epiphytic algal biomass as well as the relative abundance of the component species was examined at nine sites within Moreton Bay. The role of nutrients in stimulating growth rates of the algal community was also examined in the laboratory and the field. Fauna were collected from in and around the mangrove algal community.

Geomorphological setting played a significant role in structuring algal communities. Similarities in algal biomass, frequency and relative abundance were observed across sites belonging to the same mangrove setting. Relative growth rates within the laboratory were variable with species and nutrient concentration. *Cladophoropsis sundanensis* had the highest relative growth rates, suggesting nutrient limitation. However, in the field, no nutrient limitation was observed. Tissue nutrient content varied over time and with species as did the N:P ratio. Mangrove-algal fauna were most diverse in tide dominated settings. Burrowing crustaceans and tree-climbing molluscs dominated in river settings, while carbonate island sites had few fauna. This study provides the first assessment of the potential importance of the epiphytic algal community within Moreton Bay and the effects of nutrient enrichment on the epiphytic community.

Publications resulting from this project
Hurrey, L 2006, *Epiphytic algae in Moreton Bay: the influence of mangrove environment and nutrient availability on community structure and growth,* Honours thesis MARS 6028, University of Queensland.

The effects of environmental factors on *Caulerpa taxifolia* growth in Moreton Bay, Australia

(DPI&F Marine Fish Habitat Scholarship award, 2006/7)

Jessica Street
University of Queensland, 2007.

Seagrasses are an important habitat in Moreton Bay, Queensland. However, seagrass distribution is decreasing and the distribution of *Caulerpa taxifolia* increasing. Nine *C. taxifolia* beds across Moreton Bay were surveyed to determine environmental factors influencing growth and distribution. Light and nutrient availability were identified as the main factors and were tested in two experiments. The results indicated that light availability was the key factor, with a decrease in light resulting in taller fronds. Nutrients had no effect on growth, frond height or biomass. Benthic infaunal communities of adjacent *C. taxifolia* and seagrass beds, and bare sediment were also identified to determine the effects the presence of *C. taxifolia* has. Overall, seagrass had significantly greater species richness, with *C. taxifolia* providing a poor habitat.

Publications resulting from this project
Street, J 2007, *Environmental drivers of* Caulerpa taxifolia *growth and shifts in benthic infauna communities, Moreton Bay, Australia,* Honours thesis, University of Queensland.

Opportunistic predation by small fishes on epibiota of jetty pilings in urban waterways

S. Moreau, C. Pe´ ron, K. A. Pitt, R.M. Connolly, S. Y. Lee and T. Meziane

(Published Abstract from Moreau et al/ *Journal of Fish Biology* 72 (2008))

Epibiota were sampled on nine small jetties in the tidal, urban canals of south-east Queensland, Australia, to determine if the small fishes that are associated with these

jetties prey on the epibiota on the pilings of the jetties and whether these fishes depend on the epibiota as a source of food. Epibiota was dominated by barnacles, filamentous and foliose algae and ranged in thickness from 4 to 11 mm. The two species of fishes that associated most closely with jetty pilings, *Pandaka lidwilli* (Gobiidae) and *Monodactylus argenteus* (Monodactylidae), were sampled twice during the day and twice during the night for analysis of stomach contents. During the day, the diet of *P. lidwilli* was dominated by amphipods (c. 70%, by mass of organic content), with copepods, bivalves and bryozoans each contributing <10%. At night, amphipods contributed less (c. 45%) and copepods more (c. 35%). The diet of *M. argenteus* was dominated by filamentous algae (55%) and amphipods (20%) during the day and filamentous algae (70%) and barnacle cirri (23%) at night. Epibiota, therefore, made a substantial contribution to the diet of the fishes but were not the sole source of food for either species. As jetties were the only structures that supported epibiota in the area, fishes probably sourced their epibiota from the pilings of the jetties. Whether fishes depended on the epibiota was, therefore, tested using a manipulative before-after-control-impact (BACI) study. Three jetties were assigned randomly to each of three treatments: (1) epibiota removed from pilings, (2) epibiota cut and damaged (a procedural control) and (3) epibiota left undisturbed. Abundances of *P. lidwilli* and *M. argenteus* around jetty pilings remained similar across all treatments from before to after the removal of epibiota. These results indicate that although fishes consumed epibiota on the jetties, they did not depend on the epibiota of the jetties for food.

Trophic exchange in estuarine landscapes: the influence of different habitat mosaics on the diet of fish and prawns

(DPI&F Marine Fish Habitat Scholarship award, 2007/8)

Ashleigh Fowler
University of Queensland, 2008.

Research has demonstrated that the spatial arrangement of different habitat types influences the distribution and abundance of many different animals in terrestrial and marine systems. This study investigated how variations in the proximity and density of intertidal seagrass beds to adjacent mangrove forests influenced the abundance and composition of nekton assemblages and how the diet of fish changed as a function of these mosaics. This study found that connectivity between seagrass beds and mangrove forests was important in terms of overall abundance of nekton, with dense seagrass beds close to mangrove forests supporting greater numbers of fish and prawns than dense seagrass further away from the mangroves. When seagrass beds were sparse, however, the reverse was found, with distal seagrass beds supporting more individuals of fish and prawns than proximal seagrass beds. While the responses of nekton to different combinations of seagrass-mangrove mosaics are species specific, the findings of this study suggest that they result from a trade-off between the risk of predation during movement and the benefits from being able to access a range of different resources. This study highlights the importance of habitat connectivity and the need to conserve habitat mosaics instead of individual habitats irrespective of the surrounding matrix.

Publications resulting from this project

Fowler, A 2008, *Trophic exchange in estuarine landscapes: the influence of different habitat mosaics on the diet of fish*, Honours thesis, University of Queensland.

Are mangrove faunal communities affected by sinking centre dieback in Moreton Bay?

Cassandra Dover
University of Queensland, 2008.

Mangrove epifaunal communities were investigated along a progressive habitat gradient to determine whether sinking centres are affecting their compositions. The study identified that crustacean and mollusc species richness, density and biomass is significantly reduced in areas impacted by sinking centres. Reductions in species richness, density and biomass are linked directly to the loss of physical habitat and food availability. The mollusc species *Salinator solida* had significantly higher abundance and biomass in sinking centres which was linked to the increased algae growth occurring in these areas.

Publications resulting from this project
Dover, C 2008, *Are epifaunal community composition affected by 'sinking centre' dieback in Moreton Bay mangroves?* Honours thesis, University of Queensland.

The role of herbivorous fish in regulating algal and coral dynamics in high latitude coral reef systems

(DEEDI Marine Fish Habitat Scholarship award, 2008/2009)

Patrick Gartrell
University of Queensland, 2009

Herbivory has been shown to be an extremely important process on reef ecosystems worldwide by regulating algal abundance and determining processes of benthic community succession. Comparatively little work has been conducted on high latitudinal reefs such as Moreton Bay in regard to herbivory. Moreton Bay is an essential resource for both tourism and fisheries that rely on the coral reef framework of the ecosystem. The objective of this study was to 1) quantify the biomass of the reef grazing community in Moreton Bay, and (2) quantify the amount of grazing contributed to ichthyofaunal communities. I conducted underwater visual surveys to identify herbivorous fishes present and estimated their length to determine biomass from length-weight relationships. Algal settlement tiles placed in exclusion cages were deployed to experimentally quantify the proportion of grazing attributable to large roving herbivores. Five families of herbivorous fishes were found with Moreton Bay (rabbitfish, damselfish, surgeonfish, parrotfish and blennies) however, rabbitfish and damselfish were dominant. Data analysis indicated that Peel Island and Myora Reef only had significance over time whereas Green Island had significant difference over time, exclusion treatments and interaction between both parameters ($P>0.05$).

Publications resulting from this project
Gartrell, P 2009, *Grazers and Grazing in a high latitude coral reef systems (Moreton Bay)*, Honours thesis, University of Queensland.

Top-down and bottom-up regulation of the Epilithic Algal Community (EAC) on two declared Fish Habitat Areas (FHAs) within Moreton Bay.

(DEEDI Marine Fish Habitat Scholarship award, 2009/2010)

James Brown
University of Queensland, 2010

Top-down and bottom-up regulation of coral reef algal communities, in the form of herbivory and nutrient limitation, are the most important and easily managed factors effecting resilience of coral reefs. This study takes the first step towards understanding how these processes pertain to the algal-coral relationship within Moreton Bay. Field studies were undertaken using underwater visual surveys to determine the herbivorous fish biomass at two declared Fish Habitat Areas and how they correlated with algal cover. Both reefs were indicative of healthy coral dominated systems even though herbivore biomass existed at low densities, 5.72 ± 1.27 and 7.72 ± 1.21 g.m-2, at Peel Island and Myora Reef respectively. Grazer biomass was only significantly negatively correlated to algal cover at Peel Island, suggesting that different processes occur at individual sites. In two experiments over 20 days algal tiles were subjected to different nutrient concentrations to determine if increased nutrients lead to higher algal biomass. Algal biomass only significantly increased when nitrogen and phosphorus both exceeded nutrient thresholds (~1.0 µM DIN and 0.1 µM SRP) for macroalgal growth. Addition of only one nutrient was not sufficient to stimulate a significant increase in algal biomass from ambient levels. This study suggests that nutrient limitation is an important factor in regulating algal biomass on Moreton Bay reefs, while herbivory may only have a small part to play. Further studies must be undertaken to elucidate the causal factors that are responsible for the maintenance of coral reef resilience in Moreton Bay. Top-down and bottom-up regulation of the Epilithic Algal Community (EAC) on two declared Fish Habitat Areas (FHAs) within Moreton Bay.

Publications resulting from this project

Brown, J 2010, *Top-down and bottom-up regulation of the Epilithic Algal Community (EAC) on two declared Fish Habitat Areas (FHA's) within Moreton Bay,* Honours thesis, University of Queensland.

Tropical Mangrove forests and fish feeding: a test of the mangrove nursery-ground food hypothesis

(DEEDI Marine Fish Habitat Scholarship award, 2009/2010)

Murray Bower
James Cook University, 2010

A high percentage of mangrove-associated fish were found to be juveniles (96%) and a higher percentage, including juvenile and adults, were found to be small (99% < 120mm FL). Stomach fullness indices for species of interest (SOI) suggested there was no pattern of preferential feeding associated with inundation of mangrove forests and no clear difference when compared to times when forests were not accessible. Few fish other than the bream, *Acanthopagrus berda*, had consumed mangrove-derived prey and none of those had substantial amounts of mangrove prey in their stomachs. Stable isotope analysis indicated there was little uptake of mangrove-

derived carbon among mangrove-associated species. Results fail to find support for the long-standing paradigm that mangrove forests provide nursery services to fishes by the provision of an abundant source of food. The high proportion of juveniles and predominance of small fishes, combined with the absence of distinct feeding or prey patterns suggests that these fishes are visiting mangrove forests for reasons other than feeding. Possibilities include refuge from predation, velocity refuge or shallow water refuge. While these findings fail to support one component of the generalised nursery hypothesis for mangrove forests in the Hinchinbrook Channel, they in no way suggest that mangrove forests do not provide important nursery functions and play an as yet not understood but vital and integral part of the coastal ecosystems.

Publications resulting from this project

Bower, M 2010, *Tropical Mangrove forests and fish feeding: a test of the mangrove nursery-ground food hypothesis*, Honours thesis, James Cook University.

The spatial ecology of Australian blacktip sharks (*Carcharhinus tilstoni*) within a nursery area and the effects of extreme weather

(DEEDI Marine Fish Habitat Scholarship award, 2010/2011)

Vinay Udyawer
James Cook University, 2011

The Australian blacktip shark (*Carcharinus tilstoni*) is a major target of commercial shark fishers in the Queensland East Coast Inshore Finfish Fishery (ECIFF). Despite this species being the subject to a large amount of previous research, relatively little is known about its early life history. Cleveland Bay is one near shore environment that is known to act as a nursery ground for juvenile Australian blacktip sharks. Space use for this species within Cleveland Bay was examined using residency and home range analyses. These sharks were found to utilise this bay for at least 7-8 months after birth. The extent of their movements was also compared with the Great Barrier Reef Marine Park (GBRMPA) zones within Cleveland Bay. The efficacy of Conservation Protection Zones was tested and found that these areas do afford a degree of protection to these juveniles; however the protection they afford reduces as juveniles occupy the bay for longer.

This project also looked at the effects of extreme weather on the movements of elasmobranchs within Cleveland Bay. The use of environmental cues as indicators for this behaviour is examined using movement data for six elasmobranch species, including four sharks (*Carcharhinus tilstoni*, *C. sorrah*, *C. amboinensis* & *C. melanopterus*) and two ray species (*Rhyncobatus* spp. & *Glaucotegus typus*). No significant difference was found in the size of home ranges, before and after the storm events for all species monitored during the storm. Environmental parameters including barometric pressure, wind speed, and wave height were investigated in conjunction with presence data and threshold values were estimated for flight responses. Individuals were recorded leaving the study site prior to or during storm events. Interestingly, flight behaviour was observed in young-of-the-year and juvenile individuals that have not experienced such conditions before, which may suggest that this behavioural response is innate. The majority of the animals that left prior to the arrival of storm events returned to the study site after the passage of the cyclones, which further validates this behaviour as a flight response to extreme storm conditions.

Publications resulting from this project
Udyawer, V 2011, *The spatial ecology of Australian blacktip sharks (Carcharhinus tilstoni) within a nursery area and the effects of extreme weather*, Honours thesis, James Cook University.

The functional importance of the pattern of habitat interspersion within a seascape

(DEEDI Marine Fish Habitat Scholarship award, 2010/2011)

Shaye Carman
James Cook University, 2011

The pattern of habitat interspersion and connectivity within seascapes is a major driver influencing and structuring ecological communities. Woody debris represents a crucial form of complex structure in unmanaged marine and freshwater ecosystems, providing essential habitat for a variety of benthic macro-invertebrates, and forage (Diehl 1988, Shea and Peterson 2007)and refuge for many valuable fishery species. While it has been identified as essential fish habitat, few studies have investigated the influence and importance of complex structure on the function of coastal marine ecosystems and the organisms which inhabit these environments.

Complex intertidal structure was investigated at three tropical north Queensland sandy intertidal areas, to determine the functional importance of woody debris structured habitat within open sandy seascapes in influencing assemblage-level patterns of tropical fish species. Seine netting was conducted on the rising tide to sampled open sandy seascapes, while scoop netting at low tide was to sampled scour pools containing woody debris. As these habitats varied both spatially and temporally, separate gears were required to sample the fish assemblages present in each. Indicator Species Analysis (ISA) was performed to determine species consistency across habitats in woody debris interspersed sandy seascapes. Patterns in species composition were different between woody debris structured habitats and adjacent habitats where woody debris was absent, suggesting that habitat selection is species specific. Species such as *Sillago burrus* and *Sillago sihama* were strongly sand-associated, occurring exclusively in open sandy habitats and demonstrated high consistency throughout the sampling sites. In contrast *Lutjanus fulviflamma* and *Epinephelus coioides* were found to be consistently present in woody debris indicating they are structure-associated species preferring heterogeneous habitats in which shelter is present. Guilds of sub-species among structure-associated and sand-associated species reflect the different functional roles of particular habitats to specific species, based on ecological and life history characteristics.

The importance of adjacent subtidal woody debris to nekton assemblages utilising mangrove forests was investigated at Deluge Inlet and Benjamin Point within the Hinchinbrook Channel, QLD, Australia. Daytime video sampling was conducted using HD underwater cameras, at two subtidal habitat types (adjacent WD present & absent) and over three tidal phases per habitat per location. Multidimensional Scaling Ordinations were performed to investigate differences in habitat type among study locations, and tidal phases. Mangrove habitats with adjacent subtidal woody debris had different fish assemblage composition to areas without subtidal woody debris. This response was species-specific. Where some species demonstrated increased occurrence, others showed little to no influence with structure. The strong selection by specific fish for habitats containing mangrove-woody debris relations highlights the

significance of estuarine heterogeneity in creating essential fish habitats and increasing the functional biodiversity of the system. The implications of this study suggest that management should focus on habitats, which in turn supports the effective conservation of inhabiting organisms. Whereby, understanding, identifying and protecting critical and/or essential habitats is likely to be the most effect avenue for successful ecosystem management.

Publications resulting from this project

Carman, S 2011, *The Functional Importance of the Pattern of Habitat Interspersion within a Seascape on Subtropical Fish Assemblages*, Honours thesis, James Cook University.

Demersal fish-habitat associations on southern Queensland's continental shelf

(DEEDI Marine Fish Habitat Scholarship award, 2010/2011)

Kate Fraser
University of Queensland, 2011

Knowledge of the associations between fish assemblages and specific habitat types can contribute to the development of marine zoning plans for conservation and fisheries management. Despite their economic importance for fisheries, and their conservation significance, very little is known of the fish assemblages present on the continental shelf of southern Queensland. To address this information deficit, I investigated fish-habitat relationships on the continental shelf adjacent to the Sunshine Coast, Queensland in the austral winter of 2011. I deployed Baited Remote Underwater Video Stations (BRUVS) to survey demersal fish assemblages over three different benthic habitat types (rock, gravel and sand) at two depth ranges (30 – 45 m and 55 – 70 m). A total of 112 species of fish from 38 families were recorded in 85 BRUVS samples. Six fish assemblages were identified through multi-dimensional scaling using PRIMER software, and PERMANOVA analysis showed that there were significant differences in the composition of fish assemblages between different habitats. A significant interaction between depth and habitat type implied that the differences between habitats were not consistent between the two depth ranges. SIMPER analysis revealed which species contributed to the similarities within each fish assemblage, and to the dissimilarities between each pair of assemblages. Fish species richness increased with the structural complexity of habitat. This research demonstrated the effectiveness of BRUVS for fisheries surveys at depths beyond SCUBA diving limits, and addressed the paucity of knowledge about fish-habitat relations in deeper waters.

Publications resulting from this project

Fraser, K 2011, *Demersal fish-habitat associations on southern Queensland's continental shelf*, Honours thesis, University of Queensland.

Stream 2 – Impacts on fish habitats

Acid sulfate soil status of selected intertidal habitats within the Caboolture River section of the Deception Bay Fish Habitat Area

Malcolm DT, Pointon SM, Manders JA and Hall IR.
Department of Natural Resources and Water, Indooroopilly, Queensland, Australia, June 2006.

Population growth in south east Queensland has resulted in continuing pressure to develop low-lying coastal areas which may contain Acid Sulfate Soil (ASS). Release of sulfuric acid and metal ions from disturbed ASS can cause serious environmental impacts, including long-term harm to fish and fish habitats.

In 2005/2006, the Department of Natural Resources and Water (DNRW) investigated the occurrence of ASS within the Caboolture River section of the declared Deception Bay Fish Habitat Area (FHA). The project, funded through the Department of Primary Industries and Fisheries' (DPI&F) Urban Fish Habitat Management Research Program (UFHMRP), aimed to:

- improve the resolution of ASS mapping in the Caboolture River area
- gain a better understanding of ASS issues in intertidal areas.

Sites were sampled from just above Highest Astronomical Tide (HAT) to Low Water Mark (LWM) in the upper, mid and lower reaches of the Caboolture River. ASS were recorded from almost every site, including locations above HAT and covered by several metres of non-ASS sediment. The ASS found were predominantly Potential Acid Sulfate Soils (PASS); however, evidence of Actual Acid Sulfate Soils (AASS) was present in the form of jarosite, indicating that oxidation of sulfides had occurred in the area previously. In addition, an area of monosulfide oxidation near Beachmere was identified which, in combination with water ponding, may have contributed to local mangrove dieback at the mouth of the Caboolture River.

The study recommended that:

- further ASS investigation should be an important component of the future management of potential development impacts on the Deception Bay FHA
- areas with evidence of AASS and the Beachmere monosulfide area should be regarded with particular concern
- ASS disturbance should be minimised to avoid impacts on sensitive environmental areas.

The suitability of native mangroves as hosts for the lantana bug *Aconophora compressa*

K. Dhileepan and Elizabeth L. Snow
Alan Fletcher Research Station, Department of Natural Resources, Mines and Water, PO Box 36, Sherwood, Qld 4075, Australia, June 2006.

Aconophora compressa (Hemiptera: Membracidae) a biological control agent introduced against the weed *Lantana camara* (Verbenaceae) has since then been observed on several non-target plant species, including a native mangrove *Avicennia*

marina (Avicenniaceae). Though all stages of *A. compressa* were evident on *A. marina*, only *L. camara* and *Citharexylum spinosum* (Verbenaceae) an introduced non-target ornamental seemed to sustain *A. compressa* populations on their own in the field. It is speculated that the incidence of *A. compressa* on *A. marina* was due to spill-over from either *C. spinosum* or *L. camara*. In this study we evaluated the potential of *A. marina* and *Aegiceras corniculatum* (Mysinaceae), two non-target native mangrove species to sustain *A. compressa* populations on its own using field cages. The results obtained in this study are in contrast to previous glasshouse and quarantine trials and provide evidence that the two non-target mangrove species could sustain the development and survival of *A. compressa* under field conditions. While it has been shown that development can occur on these mangrove species, the long-term suitability of mangroves has only partially been determined in this study, emphasising the need for long-term field studies on the abundance of *A. compressa* on both mangrove species.

Recent severe dieback of mangroves - Is 'sinking centre' dieback contributing to serious loss of fish habitat?

(DPI&F Marine Fish Habitat Scholarship award, 2007/8)

Marine Blancher
University of Queensland, 2008

An unusual form of mangrove dieback, linked to unprecedented large areas of soil subsidence defined as 'sinking centres', is currently taking place in the Moreton Bay region, Queensland, Australia. Sinking centres are shallow pools characterised as hypersaline and alkaline environments, where high amounts of ammonium accumulate. As shown in an explanatory conceptual diagram, soil redox potential was lower in new sinking areas and higher in older sinking areas. Possible in situ causes investigated included higher soil biodegradation in areas of mangrove dieback and a decline in living root biomass in mangrove soil. It was found that only the death of the larger roots, positively correlated with the lack of burrowing animals for soil aeration and the increase of salinity, contributes to soil subsidence in Moreton Bay. Within the bay, Whyte Island and Boondall Wetlands were identified as restoration priorities, in terms of sinking and recovery risk.

Publications resulting from this project

Blancher, M 2008, *Description of soil collapse associated with current severe mangrove dieback in Moreton Bay: investigation of causes and impacts,* Honours thesis, University of Queensland.

Port of Airlie Marina Development Project - Fisheries resources monitoring in Boathaven Bay

Dr Neil Gribble, Susan Chalmers, Cassandra Rose and Matt Vickers (2010)

Summary

The Port of Airlie (POA) marina development is a large tourism and residential development currently underway in Airlie Beach, Central Queensland. As part of the offset and mitigation process agreed to by the Proponents of the development,

Sustainable Fisheries and Aquaculture, Department of Employment, Economic Development and Innovation (DEEDI) carried out baseline surveys to monitor the impacts of construction of the marina on the fisheries resources of the area.

Over two years of surveys, 2006-2008, the benthic communities present at the potential 'impact' marina development site, Boathaven Bay, did not differ significantly from those present at the three 'control' sites, Funnel Bay, Charlies Bay and Trammel Bay. Similarly for the 'impact' Boathaven Bay and the 'control' Charlies Bay there was no significant difference in the abundance of the fish or crustacean assemblages, given very high inherent variability in catches. The seven surveys that were conducted over the two years provided a statistically 'adequate' description of the four bays; with the control bays appropriate for detecting changes in the impact bay. The time-series of surveys showed no consistent or significant change in benthic, fish or crustacean assemblages with time among the four bays.

Given the natural variability observed in the benthic assemblages, distinct changes would need to occur in the patterns of distribution and abundance before it would be possible to discriminate real changes due to an impact. Multivariate analyses showed no such distinct changes that could be attributed unambiguously to the impact of the POA marina development prior to reopening the POA marina basin to the sea (removal of the sheet pile wall). The degree of sampling and replication in the surveys provided sufficient contrast that if there was an impact, multivariate analyses would have shown it. Univariate analyses of summary variables, such as species indices, demonstrated the confounding interactions present in such a large and complex dataset.

The mesh size of nets used in these surveys sampled the smaller size classes and juveniles of fish taken as larger fish in the commercial and recreational fisheries. There was no indication of a decline of these smaller size classes over the last five surveys. The first two surveys were influenced by random captures of large schools of small inshore schooling fish (bait fish).

An external factor or events influenced the local commercial fishing industry during the 2003-2005 period, prior to the commencement of the POA marina development. The subsequent decline in catches was accompanied by (or caused by) a decline in fishing effort not solely by a decline in CPUE (catch per unit effort). The timing of the decline in catches did not coincide with the start of the POA marina development nor was there a major decline in juvenile fish in the Boathaven Bay area during the period of the construction, therefore there is no evidence for either correlation or 'cause and effect' between the decline and the POA development.

The findings that the benthic fauna, fish and crustacean assemblages in and around the POA marina development did not differ significantly from those at three other nearby bays strongly indicated that the commencement and the monitored construction stages of the POA marina development did not have pronounced adverse impacts on the adjacent fisheries resources. Once the POA marina basin is reopened to the waters of Boathaven Bay, these baseline data collected on benthos, fish, and commercial crabs in the 'impact' bay and the three 'control' bays, will provide a statistically robust contrast for multivariate analysis of any future fisheries resource impact from the POA marina development.

Publications resulting from this project
Dr Neil Gribble, Susan Chalmers, Cassandra Rose, Matt Vickers (2010) Port of Airlie Marina Development Project Fisheries resources monitoring in Boathaven Bay, Department of Employment, Economic Development and Innovation, 65 pp.

including
Appendix A Literature Review
Susan Chalmers (2007) Ecosystem processes of Boathaven Bay and surrounds in regards to the fisheries resources of the area. Literature Review for Graduate Certificate of Research Methods, Tropical Biology, James Cook University, 17 pp.

Appendix B Port of Airlie Marine Wildlife Salvage Report
Daniel Blunt (2007) Port of Airlie Marine Wildlife Salvage Report, Golding Contractors Pty Ltd, 10 pp.

Appendix C Reconnaissance Survey
Chalmers S. (2008) Port of Airlie Marina development project: Monitoring of ecosystems and fisheries resources of Muddy (Boathaven Bay). Minor Project Report for Graduate Certificate of Research Methods, Tropical Biology, James Cook University.

Impervious coverage and land-use characteristics surrounding Lakes Weyba and Coombabah, south east Queensland

Ruth Young and Joe Lee
Griffith University, Gold Coast Campus, 2005

As a result of increasing urbanisation pressures on Southeast Queensland's coastal wetlands, a quantitative measure of urbanisation to be applied to wetland urban impact studies is needed. Impervious cover e.g. road surfaces, roofs, parking areas, within a catchment is strongly correlated with the amount of urbanisation in the catchment. The extent of impervious cover may be a suitable measure of urbanisation.

A Griffith University study compared the surrounding land-use characteristics and percent catchment impervious cover between two coastal wetland systems in South East Queensland, moderately urbanised and less urbanised. Lake Coombabah, Cold Coast, the moderately urbanised wetland had 33.44% of its catchment designated fur urban land-use. For the less urbanised wetland, Lake Weyba, Noosa, 12.54% of its catchment is urban. Lake Coombabah had a significantly higher mean percent of catchment impervious cover than that of Lake Weyba. Both lakes are declared Fish Habitat Areas.

Percent catchment impervious cover is therefore a quantitative measure of urbanisation in future wetland urban impact studies. A standard method of documenting this measure can now be developed to identify urban impacts on declared FHAs and manage coastal urbanisation in an ecologically sustainable manner.

Publications resulting from this project
Young, RA 2008, *Biotic responses to urbanisation in mangrove dominated estuaries,* PhD thesis, Griffith University.

Lee S.Y. Connolly, R.M., Dale, P.E.R., Dunn, R.J.K., Knight, J.M., Lemckert, C.J., McKinnon, S., Powell, B., Teasdale, P.R.1, Welsh, D.T. and Young, R. (2006) *The impact of urbanisation on coastal wetlands: a case study of Coombabah Lake, southeast Queensland,* Cooperative Research Centre for Coastal Zone, Estuary and Waterway Management, Technical Report 54, 219 pp. (see Report)

Louisa Creek mangrove health audit

Babcock & Brown Infrastructure, September 2007

The mangrove communities lining Louisa Creek were dominated by *R. stylosa* and *C. tagal*, however they were diverse assemblages of mangroves containing 19 species. The ecological health of the mangrove forests was primarily fair to good, with relatively small areas of poor to very poor health. Low ecological health was associated with dead and dying mangroves and dumped household refuse; together with elevated levels of nutrients in the sediment and water column, and elevated hydrocarbon contaminants in the sediment.

Of the sites quantitatively surveyed, communities near the creek mouth, adjacent to Timberlands residential estate and at the upstream extremity of the estuary appeared to provide the best habitat for fauna and be of highest value to estuarine fisheries. Mangrove communities adjacent to the 'unofficial' boat ramp, near the township of Louisa Creek, and the Sarina Rubbish Dump provided fair habitat and were likely to be of moderate value to fisheries.

The sediment near Timberlands was in poorer condition than that adjacent to the boat ramp, in terms of nutrient and THP hydrocarbon concentrations. Adjacent to Timberlands, TN and TP concentrations were higher than those recorded at nearby Gregory River and several sites in moderately eutrophic Moreton Bay. Concentrations of TPH hydrocarbons C29-36 fraction were slightly elevated adjacent to Timberlands compared to the guidelines and five (out of five) Moreton Bay sites. An oily slick was evident on water slowly flowing to the creek near Timberlands and the Sarina Rubbish Dump.

Nutrient concentrations at both of the survey sites were very high at the time of sampling. As with concentrations of nutrients and contaminants in the sediment, the concentrations of nutrients in the water column tended to be higher adjacent to Timberlands than the boat ramp. High levels of inorganic oxidised nitrogen indicate that a proportion of these nutrients may be derived from human sources.

The elevated results obtained in this study are likely to have been associated with runoff from nearby residential estates, together with upstream catchment land uses such as agriculture and farming. Heavy rainfall occurred prior to, and during, the sampling event and is likely to have flushed hydrocarbons and nutrients into Louisa Creek.

Publications resulting from this project

FRC Environmental 2007, *Ecological surveys of mangrove communities lining Louisa Creek, Dalrymple Bay*, report prepared for Connell Hatch, September 2007.

The impact of existing boat moorings on seagrass communities in Moreton Bay, Australia

(DEEDI Marine Fish Habitat Scholarship award, 2008/2009)

Kate Maguire
University of Queensland, 2010

This study examined the regional impact of recreational boat moorings on subtidal soft sediment communities within Moreton Bay, Australia. The localised effects of boat moorings were assessed in two habitats commonly encountered in boat mooring areas: seagrass meadows and unvegetated sediments. Within these habitats, detailed ecological sampling quantified the differences in habitat structure and macrofaunal assemblages in the sediment directly adjacent to boat moorings to that in two different control treatments; the first of which was located within the boundary of the boat mooring area but away from the disturbance of the mooring chain, and the second of which was located outside the boundary of the mooring area. The average area of substratum perturbed around individual boat moorings was estimated at a single mooring area by visually tracing around barren seagrass "haloes" in ArcGIS. This estimate was then used to determine the total area of substratum affected by boat moorings within Moreton Bay. It found that the presence of boat moorings had a significant impact on the composition of macrobenthic assemblages and habitat characteristics in seagrass habitats, but not unvegetated habitats. Although boat moorings were a significant source of disturbance to seagrass communities on a local scale, the fact that the total aerial coverage of boat mooring areas within Moreton Bay is such a negligible proportion of the Marine Park means that they are unlikely to be a considerable source of disturbance within a regional context.

Publications resulting from this project
Maguire, K 2010, *Assessing regional impacts of recreational boat moorings on soft sediment communities*, Honours thesis, University of Queensland.

Short term response of estuarine sandflat trophodynamics to pulse anthropogenic physical disturbance: Support for the intermediate Disturbance Hypothesis

Ka-Man Lee, SY Lee and Rod M Connolly

(Published Abstract from Estuarine Coastal and Shelf Science
K.-M. Lee et al. / *Estuarine, Coastal and Shelf Science* 92 (2011))

"Many anthropogenic activities physically disturb urbanised coastal habitats. The functional response of ecosystems to physical disturbances remains largely unknown due to the lack of suitable quantitative tools for assessing impacts. We conducted a manipulative field experiment to investigate the short-term (i.e. temporally sensitive) response of estuarine sandflat trophodynamics to pulse anthropogenic physical

disturbance, using combined chemical tracer (13C), compartmental modelling and network analysis techniques. Pulse physical disturbance, as sediment pumping for an infaunal bait species, was applied at two disturbance intensities at the commencement of the experiment, in 0.09 m2 quadrats. Six compartments and three trophic levels in the estuarine sandflat food web were sampled, including the microphytobenthos, four meiofaunal groups, and soldier crabs (*Mictyris longicarpus*). Compared with undisturbed controls, in the low disturbance intensity treatment: 1) carbon flow rates between compartments increased, 2) carbon cycling increased, 3) more carbon was retained in the food web, and 4) system indices reflecting ecosystem functioning and resilience were higher. Low disturbance intensity facilitated carbon transfer between organisms and apparently increased resilience. Conversely, high disturbance intensity reduced carbon flow among compartments and carbon cycling, thus lowering resilience. This is the first study with field data quantifying structural and functional changes of sandflat food webs in response to physical disturbance and showed that both ecosystem structure and processes may support the Intermediate Disturbance Hypothesis. This alternative approach to assessing the immediate functional response of estuarine trophic interactions to physical disturbances allows impact detection not possible using conventional approaches."

Combining process indices from network analysis with structural population measures to indicate response of estuarine trophodynamics to pulse organic enrichment

Ka-Man Lee, S.Y. Lee, Rod M. Connolly

(Published Abstract from Ka-Man Lee *et al*/ *Ecological Indicators* 18 (2012) 652–658)

"Indicators of ecosystem structures and processes are important in estuarine health studies but are rarely assessed simultaneously. Organic enrichment affects the abundance and diversity of meio- and macrofauna, but its impact on food web dynamics is less well known. We used a manipulative field experiment combining stable isotope enrichment with compartmental modelling (WinSAAM) and ecological network analysis (EcoNet) to investigate the impacts of organic enrichment on the food web structure and dynamics of an estuarine sandflat, and to evaluate the combined use of structural and process indicators in estuaries. Organic enrichment was achieved by addition of powdered algae to increase organic content (OC) from 0.8% (background) to 3, 5 and 10%. Six dominant compartments including microphytobenthos, meiofauna and soldier crabs (*Mictyris longicarpus*) were sampled. Increasing organic content decreased the total abundance of meiofauna and number of meiofaunal taxa. C flow rates and indices reflecting system functioning, however, showed non-linear responses. Carbon flow rates between compartments and the proportion of carbon cycling within the system both decreased from background to enrichment at 3 and 5% OC, but then increased at 10% OC. On these measures the highest OC treatment was most similar to background controls, which could be misinterpreted as a sign of health of highly enriched sites. Additional interpretation of indicators for the 10% treatment showed, however, that the high proportion of internal cycling was a result of a much reduced number of compartments (i.e. some taxa had been lost). The combination of trophodynamic process indices and structural population measures together provided the more comprehensive and robust assessment of the effects of organic loading on estuaries."

Monitoring the condition of sediment and associated fauna within a created mangrove wetland

Adam Sillars and Joe Lee (Griffith School of Environment, Griffith University)
Kris Boody (Gold Coast City Council)

Executive Summary

A created mangrove habitat was developed to filter storm water runoff from the Southport catchment in Nind Street, where two separate fresh stormwater drainage outlets discharge water through the habitat. The polluted water is to be taken up and cleaned by the mangroves, which will hopefully result in cleaner water being released into the Broadwater. It is proposed that this habitat will also provide a safe, structured sanctuary for a number of marine and terrestrial flora and fauna.

Mangroves are defined as 'woody plants that grow at the interface between the land and sea in tropical and sub-tropical latitudes, where they exist in conditions of high salinity, extreme tides, strong winds, high temperatures and muddy, anaerobic soils'. They also house an abundance of flora including algae, seagrasses and coastal plants, as well as large biodiversity's of fauna species including birds, marine vertebrates and invertebrates. Therefore mangroves have been found to create unique ecological environments. Mangroves have also been found to support local food webs through their contribution to primary productivity.

The aim of this project was to monitor the condition of sediment and the associated fauna within this created mangrove habitat. Baseline surveys of the sediment condition in relation to the amount of nutrients present was investigated and found that more nutrients were present in the unplanted mangrove cells. Also the cells located around the stormwater outlets had the highest spikes in total nutrient concentrations. Baseline flora surveys were carried out, which found a high abundance of microalgae throughout the site. Also 2 seagrass species and 14 coastal plants including dune plants, saltmarsh and mangroves were found to be successfully colonising and self-recruiting throughout the habitat. Baseline fauna surveys were conducted to see which animals were living within the created mangrove habitat. It was found that a total of 15 avian species, 16 marine invertebrates species (9 mollusc, 4 crustacean and 3 worm species) and 12 marine vertebrates species, consisting of 11 fish and 1 stingaree species. Stable isotope analysis was also carried out to determine if the animals within this habitat rely on the mangroves as a direct food source, however it was found that they do not.

Monitoring of Growth and Condition of Mangroves

Jesse Dixon and Joe Lee (Griffith School of Environment, Griffith University)
Kris Boody (Gold Coast City Council)

Executive Summary

The project being undertaken is to monitor the growth and condition of mangrove plants in the Broadwater Parklands Mangrove Habitat site. This includes the uptake of nutrients and heavy metals by the mangroves found on site. The project seeks to analyse water quality and the presence and concentrations of nutrients and heavy

metals in stormwater, the sediment and leaves in the Broadwater Parklands Mangrove Habitat site. It also seeks to determine if there is any gradient in the concentration of nutrients and heavy metals from the point of the two stormwater outlets to the end of the site, which empties out into the Boradwater.

The expected outcomes of this report are to establish baseline date for the nutrients and heavy metals present in water, sediment and leaf samples; to determine if there is a gradient of concentrations between either end of the site; to determine the ratio of plant biomass to heavy metal/nutrient uptake from the sediment and to determine, via background research, what the estimated concentration of various heavy metals the mangrove species can absorb before noticeable plant death occurs.

The results of this report provide a set of baseline date for future analyses to be compared against to determine any change, over time in the concentrations of nutrients and metals in the sediment and leaves for the above tested sites. Where possible, any noticeable trends have been recorded with potential causes for these trends provided. Two chemicals of note are total nitrogen and total phosphorus, as these chemicals tested above the Queensland Water Quality Guideline limits, and so, these chemicals need to be paid attention to in future analyses of the site. Two potential problems with the site include insect activity, as it has been noted where in come cases entire leaves have been eaten by insects and the potential problem that this site may act not as a chemical sink (as hoped) but as a secondary, acute source, which could pose potential dangers to the local environment. Continued monitoring of the Southport Broadwater Parklands Mangrove Habitat Site is recommended.

Stream 3 – Innovative structure design for fish habitats

Use of commercial product “A-Jacks” as artificial reef in front of mangroves

Grant Gabriel
Griffith University (initial assessment report, 2004)

Three styles of erosion protection were installed adjacent to the erosion prone Charles Holm Park on the Gold Coast: traditional rock riprap, geo-textile bags (not assessed in this report) and A-Jacks concrete armour units.

Riprap and A-Jacks were both effective in controlling erosion; however, riprap had greater environmental impacts.

While every care was taken for existing mangroves when installing riprap with hand placement around tree bases, subsequent recruitment of mangroves is prevented due to the hard armouring of the foreshore. The A-Jacks units were installed seaward of the foreshore and pose very little threat to existing marine vegetation, apart from removal of large fallen trees in the works area, The major environmental issue with the A-Jacks units is its tendency to become a natural fish and rubbish trap. The edges of the wall quickly accumulated sand and silt. This caused the substrate at the landward edges of the structure to rise forming a pool. This was expected to happen and measures were taken to allow fish to escape from the pool by means of "fish pipes". However, these were not installed low enough for fish to escape, were not long enough to be completely effective and there were not enough of them.

The methods used in this trial minimised the damage that was caused on the foreshore of the river by using a barge, thereby avoiding damage to the river banks by operation of heavy machinery. It is recommended that a 3-year study is completed so that the effects of the erosion control devices can be more fully understood.

Stream 4 – Rehabilitation of fish habitats

Fish and other aquatic fauna use of restored fish habitats (Bulimba Creek Oxbow)

Paul Whatmore
Greening Australia Queensland Incorporated, February 2006.

The abstract of Paul Whatmore's 2006 Report (Preliminary nekton survey of the Bulimba Creek Oxbow (Paul Whatmore, February 2006)) is provided below:

"Originally heavily polluted with industrial waste, in 2003 the Bulimba Creek Oxbow (BCO) was the focus of major ecological refurbishment efforts. In October and November 2005, nekton species were collected from the BCO using a variety of sampling techniques. Species richness, diversity and proportionality were recorded and compared by sampling technique. In general, species richness and diversity were high, considering the prior state of the BCO, indicating refurbishment efforts were successful. With increasing public, commercial and political focus on the conservation and economic value of estuaries, projects like the BCO are of continued and increasing importance."

Following the success of wetland rehabilitation projects at Bulimba Creek Oxbow, Department of Primary industries and Fisheries (DPI&F) provided funding to Greening Australia Queensland Incorporated (GAQ) for fisheries research in 2005/2006. Information on the value of rehabilitated habitats to fish and other aquatic fauna and fish and other aquatic fauna use of restored fish habitats at the Bulimba Creek Oxbow was required. DPI&F provided $14,300 (GST inclusive) to GAQ specifically for survey design and background research and monitoring, sampling and analyses. GAQ awarded the total DPI&F funds to a nekton survey of fauna in the oxbow water column and a study of the success of the remodelling of the eco hydrological functions of the Oxbow site (conducted by researcher Paul Whatmore, University of Queensland).

Results from sampling during October and November 2005 are available in a Report of the Preliminary nekton survey of the Bulimba Creek Oxbow (Paul Whatmore, February 2006). Sampling was conducted at the main channel outlet (a culvert) to Bulimba Creek. Comparisons of catch were made based on types of sampling gear and different mesh sizes used in the study (seine nets, gill nets and traps). Findings were: juveniles dominated total catch; and tidal range was reduced and may restrict movement and recruitment of fish into and within the Oxbow due to the reduced tidal flow. Tidal flow into and out of the Oxbow relies on external tides greater than 1.85 m (Whatmore, 2006). Factors such as the importance of tidal flow in influencing ecological health at the Oxbow are discussed in the Report.

The preliminary nekton survey identifies re-establishment of tidal flow to the Oxbow as the most important factor in rehabilitation of the Oxbow (Whatmore, 2006) and the important role of the culvert in providing passage for fish and macroinvertebrates.

Additional nekton sampling is planned for the future by the chief researcher, Paul Whatmore, to examine temporal and spatial comparisons and is to be advised further.

Effects of Acid Sulfate Soils Remediation on Aquatic Ecology and Water Quality at East Trinity, North Queensland

D. J. Russell and K. M. Preston Sustainable Fisheries Program Animal Science, Northern Fisheries Centre, DEEDI, Cairns

Reclamation of about 700 ha of mostly tidal wetlands in at East Trinity in north Queensland in the early 1970s disturbed potential acid sulfate soils resulting in acid and associated heavy metals leaching into coastal waterways. The wetlands were isolated from tidal inundation through the construction of a levee with tidal gates on the major creeks. The Queensland Government purchased the East Trinity site in 2000 and a management plan involving reintroduction of tidal flows and strategic application of agricultural lime was subsequently developed to remediate the acid sulfate soils. The fish, crustaceans and water quality in the bunded area of Hills and Firewood creeks at East Trinity and a control creek were monitored monthly over a 16-month period to quantify differences that occurred following these changes to onsite management practices.

The semi-impounded reaches of both Firewood and Hills creeks now support healthy populations of fish and crustaceans. When the species diversity of fish caught in gill nets was compared between Hills, Firewood and the control creek no large differences were found. Overall, 38 fish species were sampled in the semi-impounded reaches of the East Trinity creeks, compared to 33 sampled in a similar study in 2002/03. The abundance of smaller and juvenile fish caught in cast net sampling in Firewood and Hills creeks was higher downstream than above the bund wall. Semi-impounded reaches of both creeks had healthy populations of mostly juvenile male mud crabs, and tagging studies showed little evidence of crabs moving between creeks although they appear to roam within the same creek.

There were no fish kills observed during this study and both pH and dissolved metals including iron and aluminium were lower than has been recorded in past surveys. The average pH (7.15) in Firewood Creek was lower than those in the other two systems and the minimum value was 5.6. The concentrations of some trace elements in the transplanted oysters initially increased two months after deployment and then subsequently fell between the second and third months, suggesting that they were capable of metal depuration.

The reintroduction of tidal flows to the upstream reaches of Firewood and Hills creeks increased the upstream distribution of mangrove propagules thereby promoting recolonisation of the stream banks and adjacent low lying areas. Remnant mangroves stands are also contributing mangrove recolonisation of the site. Management strategies that are currently being implemented at East Trinity appear to be enhancing the fisheries productivity of the area.

Publications resulting from this project

Russell, DJ and Preston, KM 2005 Effects of Acid Sulfate Soils Remediation on Aquatic Ecology and Water Quality at East Trinity, North Queensland, Department of Primary Industries and Fisheries, QI05060, 131 pp.

Duplication of Houghton/Hornibrook Highway – saltmarsh rehabilitation

Department of Transport and Main Roads – 2009 and 2010 report excerpts *(reproduced with permission from* frc environmental and Department of Transport and Main Roads)

2009 Report excerpt

The duplication of the Houghton Highway (Hornibrook Bridge) by the Department of Transport and Main Roads (DTMR), resulted in the disturbance of some patches of saltmarsh. There has been little work transplanting saltmarsh in south east Queensland, and little is known regarding the cost or best techniques to use. A site was identified on Bremner Road, Rothwell that needed rehabilitation, and saltmarsh plants were transplanted here from the DTMR site. A variety of techniques for transplanting saltmarsh species were trialed, to significantly add to this knowledge base.

In March 2008 we transplanted four saltmarsh species using hand and mechanical techniques. The four species transplanted were: *Sporobolus virginicus* (marine couch), *Sesuvium portulacastrum* (sea purslane), *Suaeda australis* (Australian seablite) and *Sarcocornia quinqueflora* (common samphire).

After 12 months, many of the hand transplanted plants were surviving well, especially *S.quinqueflora*, and all species had improved in condition. While survival of *S.quinqueflora* was higher, the condition of *S. portulacastrum* and *S. australis* plants was generally better than *S. quinqueflora*. Many of the hand transplanted plants that remained damp or were in wet areas had died, whereas plants that were slightly elevated survived well. Saltmarsh plants in organic geotextile matting also survived better than those without.

After 12 months, the mechanically transplanted plants continued to improve in overall condition. Over this period canopy height increased in these plots, and total cover remained above 50%.

Twelve months after transplanting, the total area rehabilitated mechanically was 193 m^2, compared to 4.8 m^2 rehabilitated by hand. In terms of transplanting effort (man hours) and survival, mechanical transplanting was more efficient (1.538 m^2/man-hour) than transplanting by hand (0.044 m^2/man-hour).

There was also a significant increase in the habitat value of the rehabilitated area after 12 months, with the number of crab burrows, gastropods and other terrestrial fauna (ants, grubs, spiders, mites and beetles) in the rehabilitated area significantly higher than in control areas and than in the same area before rehabilitation.

The rehabilitated areas will be monitored again after 18 and 24 months to assess survival and growth, and so that corrective action can be taken as needed should there be any problems.

2010 Report excerpt

“Two years after transplanting, most of the hand transplanted saltmarsh plugs were surviving well, especially those plugs that were in well drained areas. While *Sarcocornia quinqueflora* had the highest survival rates, its condition was generally

not as good as the condition of *Sesuvium portulacastrum* and *Suaeda australis* plants. Saltmarsh plants on organic geotextile matting also survived better than those without.

In the mechanically transplanted plots, after two years, the condition of both plots with a mixture of species and plots of *Sporobolus virginicus plants* was fair to good. In general, coverage in both the mixed and *Sporobolus virginicus* plots was lowest in winter.

Two years after transplanting, the total area rehabilitated mechanically was 43.0 m^2, compared to 4.0 m^2 by hand. In terms of transplanting effort (man hours), mechanical transplanting rehabilitated more saltmarsh (0.34 m^2/man hour) than hand transplanting (0.04m^2/ man hour). That is, mechanical transplanting was more cost effective however hand planting was still successful, and may be useful in small areas, or where isolated plants area available, and/ or where access by mechanical equipment is limited.

In summary, transplanting saltmarsh for the Houghton Highway saltmarsh rehabilitation trials to the Bremner Road site, has:

- Improved the quality of estuarine habitat for flora and fauna
- Reduced the amount of sediment-laden runoff into Saltwater Creek, and
- Increased the abundance and community composition of benthic epifauna."

Publications resulting from this project

FRC Environmental 2009, *Houghton Highway saltmarsh rehabilitation trials: 12 month monitoring event - March 2009*, report to the Department of Transport and Main Roads, FRC Environmental, Wellington Point, Queensland, March 2009.

FRC Environmental 2010, *Houghton Highway saltmarsh rehabilitation trials: Two years after transplanting March 2010* report to the Department of Transport and Main Roads, FRC Environmental, Wellington Point, Queensland, March 2010.

Bulimba Creek Oxbow Nekton Research Report 2011

Excerpts - Project overview

The Bulimba Creek Oxbow is an important rehabilitation and scientific study site located within 10km of the Brisbane City Centre. Once a highly degraded, polluted and bunded-off wetland, it is now a recovering and productive marine species nursery. With the support of various partners and funders, B4C has coordinated research at this site since 2005, in order to examine the potential of restoration works in highly disturbed, urban estuarine areas. As of 2010, 32 nekton (fish and prawn) species had been found within the Bulimba Creek Oxbow, a diversity level higher than several surrounding estuarine areas in Moreton Bay. In 2011, DEEDI partnered with B4C to continue scientific monitoring of the Oxbow through funding of research by Sunshine Coast University and a Community Education Day.

Six Month Research Update by David Bright (Molecular Biologist, Sunshine Coast University)

The present Bulimba Creek Oxbow Nekton survey began in April, 2011. Over the last six months, and over a range of tidal conditions, sampling of the Oxbow has resulted in capture of 15 previously recorded species of fish. Interestingly, three new species, two fish- the Bony Bream and Obtuse Barracuda (Striped Sea-Pike) - and a freshwater prawn, have been captured. These results highlight two points about the role the Oxbow plays in the Bulimba Creek system. Firstly, that recurrence of previously identified species indicates that these fish have established stable populations within the Oxbow. This suggests that that Oxbow has not only improved from the previous degraded state and improvements have been sustained. Secondly, the discovery of new species in the Oxbow suggests that the Oxbow ecology may still be evolving and improving towards a more natural system.

The survey team would like to continue to survey the Bulimba Creek Oxbow as it would be interesting to assess whether or not there is distinct seasonal variance in species type and or quantity of individuals of a species. Previous work highlighted the role of the Oxbow as a nursery for juvenile fish. Comparing the sample data with known breeding patterns will be conducted. Understanding the role areas such as the Oxbow have on estuarine systems would help in promoting the importance of restoration and conservation of such areas in future.

A secondary goal of the survey will be to try to establish an estimate of the aquatic biomass of the Oxbow. Biomass is another tool used to assess the health of an ecosystem. This baseline may be a useful tool for comparison in future studies of the area.

Oxbow Wetlands Recovery and Rehabilitation Works

Summary (provided by the Bulimba Creek Catchment Coordinating Committee)

Project Overview
Aim: To provide for Fish Habitat management services through rehabilitation, recovery and revegetation works, including establishment of 180 plants, on terrestrial floodplains adjacent to tidal Oxbow and mangrove communities.

Site 1: S-W Oxbow loop road area – recovery of original revegetation infested with vines to waterline. Clearing exotic species and revegetation with 80 tubestocks.
Site 2: West central road loop – Clearing major weed infestations, small planting.
Site 3: D5B north-east riparian zone to Bulimba Creek. Recovery of planted natives, and expansion of site to include revegetation with small planting.

Community Involvement
- Assistance by Community Services personnel and B4C volunteers
- Site orientation tours to Chinese Engineers and 3 high schools
- Open catchment event attended by stakeholders and corporate organisations including PortConnect, Powerlink, DTMR, DEEDI, Council and bushcare groups.
-

Work Analysis

Site 1: Initial heavy removal of invasive Glycine vines covering previous plantings, use of mechanical hedge trimmer and chainsaws required. Clearing weeds from buffer zone and mulching and planting. Herbicide follow-up treatments required.
Site 2: Heavy clearing of Glycine and exotic grasses. Mulching (blanket required), Follow-up herbicide treatments. Planting was tripled in-kind.
Site 3: Riparian zone: recovery of previous planted species, whipper-snipping, spraying and manual weed removals, re-guarding and staking. Planting of 60 species in guards and special treatment of Madeira vine infestation.

Challenges

1. Glycine vines proved extremely labour intensive to remove
2. Ticks were a major problem for workers in some weed areas.
3. Wet conditions and tidal times proved difficult to access site in line with required weed treatments and schedules
4. Some hare damage to new plants required guards and deter application to tubestock

References

Department of Agriculture, Fisheries and Forestry 2012 *Fish Habitat Research and Management Program, Balancing community needs with those of fisheries resources and fish habitats – 2012 & beyond,* 11 pp.

Acronyms

AASS – Actual Acid Sulfate Soil

ASS – Acid Sulfate Soil

BCC – Brisbane City Council

DAFF – Department of Agriculture, Fisheries and Forestry

DEEDI – (the former) Department of Employment, Economic Development and Innovation

DEHP – Department of Environment and Heritage Protection

DERM – (the former) Department of Environment and Resource Management

DPI&F – (the former) Department of Primary Industries and Fisheries

DTMR – Department of Transport and Main Roads (the former Department of Main Roads)

EPA – (the former) Environmental Protection Agency

EPBC (Act) – *Environment Protection and Biodiversity Conservation Act 1999*

FHA – Fish Habitat Area

FHRM Program – Fish Habitat Research and Management Program

GAQ – Greening Australia Queensland

GCCC – Gold Coast City Council

GU – Griffith University

HAT – Highest Astronomical Tide

JCU – James Cook University

LWM – Low Water Mark

MSL – Mean Sea Level

NRW – (the former) Department of Natural Resources and Water

PASS – Potential Acid Sulfate Soil

PoBC – Port of Brisbane Corporation

SEQ – South East Queensland

TCC – Townsville City Council

UQ – University of Queensland