Saltmarsh habitats – Queensland's fisheries haven under threat of coastal squeeze

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ABSTRACT

Saltmarshes are important intertidal wetland plant communities, made up of a mosaic of protected succulent herbs, grasses, low shrubs and saltpans. These form fish habitats commonly found in upper intertidal zones adjacent to the more terrestrial vegetation and act as the interface between coastal development and mangrove communities. Saltmarshes are known to contribute to fisheries productivity by providing direct habitat to juvenile fish and invertebrates. Production of detritus and nutrients also adds to the food web cycle in estuarine areas adjacent to the saltmarsh. Crab and gastropod larvae released within the saltmarsh community provide an important diet for juvenile fish. Saltmarshes also provide key habitats for other organisms such as insects, bats and birds. Saltmarsh vegetation tolerates extreme environmental conditions that are often very salty and hot with soils low in oxygen. To highlight the fisheries values of these highly adapted saltmarsh plants, Fisheries Queensland has published a user friendly field guide, the first of its kind, describing 32 different Queensland species. The guide enables students, teachers, scientists, consultants, managers, and anyone with an interest in tidal vegetation to identify saltmarsh plants. Rising sea levels will further 'squeeze' saltmarsh communities between coastal development and invading mangroves. Effective promotion and management of the values of saltmarsh areas are critical to ensure future fisheries productivity.

INTRODUCTION

Along the East Coast of Queensland and in the Gulf of Carpentaria, saltmarsh communities face the harsh environment of low soil moisture and hyper saline conditions. There is little shade and these low growing plants are exposed to extremes of temperature and wind. Despite this challenging environment, saltmarshes have diverse fauna and plant communities. Approximately 7, 000 km^2 of saltmarsh occur in Queensland, of which the Gulf accounts for approximately 70%. The coastal areas of the Great Barrier Reef Marine Park World Heritage Area contain some 1660 km2 of saltmarsh (Goudkamp and Chin 2006), with more than 25 species.

Research in Moreton Bay (south east Queensland) by Morton et al (1987) documented fish use of saltmarshes, finding 19 species (juvenile and adult), 11 of which were estuarine species of economic importance. A major component of the fish sampled included bream and two species of mullet. Connolly (1999) investigated fish use of saltmarshes confirming a species-rich and abundant fish community uses subtropical saltmarsh flats.

Saltmarshes are an important component of the marine fish habitat mosaic, generating fisheries benefits and supporting local and regional fisheries productivity. Johns (2010) and Challen (2006) reported saltmarshes contribute to fisheries productivity providing:

- direct habitat for juvenile fish and invertebrates;
- detritus and nutrients to the food web in estuarine areas adjacent to saltmarsh (Connolly 1999);
- food web support for larval crab and gastropod production and fish - crab larvae the main food item on the saltmarsh for juvenile fish with intensive feeding by glassfish visiting the saltmarsh, especially on the second night after a spring high tide (Hollingsworth & Connolly 2005; Mazumder *et al* 2004).

In Queensland, all marine plants are protected under the *Fisheries Act 1994* (Fisheries Act) and the highly visible vegetated areas (saltmarshes, mangroves, seagrasses), together with 'bare' intertidal areas, often covered with microscopic algae, support fisheries productivity and comprise the larger marine fish habitat mosaic. Fisheries Queensland, a service of the Department of

Employment, Economic Development and Innovation (DEEDI), manages and protects marine fish habitats, including saltmarsh communities, using the IDAS framework of the *Sustainable Planning Act 2009* (Planning Act) and the Fisheries Act. Penalties and restoration notices apply for unauthorised disturbance. Self-assessable development codes allow limited minor impacts to marine fish habitats. Larger disturbance requires a development approval assessed by DEEDI.

Applications for marine plant removal (e.g. saltmarsh disturbance by reclamation/filling) are assessed on an individual basis and are considered for approval with conditions, or refusal. Assessment is such that fish habitat losses are to be avoided, minimised and mitigated, with any residual losses addressed using offsets in accordance with the Marine Fish Habitat Offsets Policy.

Expansion of coastal development, coupled with projected sea level rise due to climate change, increases the risk of loss of saltmarsh fish habitats. When damaged, saltmarshes take many years to recover (Adam 1995). Protection and management of fish habitats (including saltmarsh) under DEEDI policies are key components of the Queensland Fisheries Strategy (2009-2014) to support coastal fisheries productivity.

BACKGROUND

Climate change and fish habitat loss are significant management issues affecting future fisheries productivity supported by marine fish habitats. Climate change pressures are likely to 'squeeze' the seaward extent of saltmarsh along the entire Queensland coast, due to:

- specialised plant growth, restricted to upper intertidal zones above the mangrove fringe;
- forecast of sea level rise and rate of rise;
- development (more than 80 percent of Queenslanders live on the coast (DERM 2011a); and
- colonisation by invading mangroves.

Marine and estuarine wetlands are expected to migrate in response to a predicted 81 cm rise in sea-level over the next 100 years (IPCC 2007, cited by DERM (2011b)). Marine wetlands have distinct tidal zones of saltmarsh and saltpan (upper intertidal), mangroves (high, mid and low intertidal) and seagrasses (low intertidal and subtidal). As sea level rises, habitats will migrate inland. Saltmarshes are therefore at risk of being lost and replaced as they are the highest tidal habitat and proximal to terrestrial development. Sheaves *et al* (2007) detail physical (e.g. sea level), biological (e.g. species) and functional (e.g. fisheries production) aspects of the coastal ecosystem mosaic (CEM) to be impacted by global climate change, finding that where physical processes are impacted, subsequent flow-on effects to biological and functional components will occur within the CEM. Lovelock and Ellison (2007) reported future reductions in areas of mangroves, saltmarsh and salt flats in response to sea level rise if the soil surface elevation build-up in wetlands cannot keep pace with rising sea level. Areas having a low tidal range, reduced rainfall, insufficient sediment inputs to build surface elevation and sediment subsidence due to groundwater depletion (Lovelock and Ellison (*ibid*)) are likely to experience wetland changes.

Where saltmarsh is restricted along its landward edge by development, it can be squeezed against these obstacles by landward-shifting mangroves (Saintilan and Williams (1999), cited by Johns (*op cit*)) and replaced. Low (2011) identified saltmarsh vulnerability due to rising sea levels and mangrove encroachment if these occur more rapidly than saltmarsh colonisation of paperbark forests or freshwater sedgelands, thus resulting in saltmarsh contraction. Low (*ibid*) noted current mangrove expansion in Australia is due to other factors and not sea level rise.. Johns (*op cit*) identified mangrove invasion of saltmarsh requires further research to understand factors including:

- changes in rainfall patterns;
- agricultural activities; and
- urban activities generating increased sediment and nutrient runoff.

Saltmarsh 'retreat' and adaptation opportunities

Retention of the marine/terrestrial interface is a key 'retreat' management objective, to counteract saltmarsh habitat contraction or loss. The Queensland Wetland Buffer Planning Guideline (DERM

2011b) establishes 'Wetland Support Areas' (WSA) for long term planning of wetland migration and functionality (e.g. 50 years). A WSA adjacent or connected to a wetland can allow for its migration, triggered by shoreline erosion following changed weather patterns and sea level rise (DERM *ibid*).

Fisheries Queensland (DEEDI) recommends minimum natural vegetation buffer zone widths of 100 metres from the Highest Astronomical Tide (HAT) and 50 metres from freshwater wetlands for fish habitat management purposes (Bavins *et al* 2000). DEEDI recognises where the minimum buffer zone width is unavailable or insufficient to accommodate fish habitat impacts (e.g. rising sea levels, natural riverbank erosion), alternate management measures such as fencing, vegetative barriers, signage and boardwalks above marsh areas (Bavins *et al*, *ibid*) are appropriate.

In addressing future coastal development, the Queensland Coastal Plan (DERM 2011a) will support retention of potential retreat areas for landward wetland migration (within the HAT plus 80 cm zone). An updated sea-level rise of 80 cm and planning period by 2100 and coastal hazard areas based on projected sea-level rise (i.e. coastal erosion, storm tide inundation and permanent inundation) are adopted in the Plan (DERM *ibid*). Where a relevant storm-tide inundation assessment has not been completed for a proposed development, the coastal hazard area is taken to be all land between high water mark and a minimum default defined storm-tide event level of:

- 1.5 metres above the level of HAT for all development in South East Queensland
- 2 metres above the level of HAT elsewhere in Queensland for development that is not a development commitment (DERM *ibid*).

Lovelock *et al* (2009) summarised management options for tidal wetlands adaptation, including:

- barrier removal for landward migration of tidal wetlands and limiting barrier construction;
- coastal wetland and hinterland elevation mapping;
- improved models of coastal wetland migration;
- remove and limit additional (negative) drivers (e.g. pollution, nutrient enrichment)
- manage catchments for processes that modify surface elevation (e.g. groundwater extraction);
- restore degraded tidal wetlands; and
- protect/ restore tidal wetlands with high adaptation capacity (e.g suitable topography)

These options would assist saltmarsh management for future fisheries productivity when integrated with local planning opportunities. To understand projected climate change related shifts in saltmarsh and mangrove communities, a DEEDI climate change and fish habitat vulnerability project (supported by the Queensland Climate Change Centre of Excellence) is currently determining models of Moreton Bay sea level rise using different scenarios. DEEDI is consulting local governments about the modelling, and for support to achieve fish habitat planning outcomes.

Other management strategies include promoting the importance of saltmarsh habitats throughout the community. DEEDI promotes the value of saltmarshes as a major contributor to fisheries productivity using management, research and education. Marine plant management strategies developed jointly with local governments meet community infrastructure needs and reflect best management practices for fish habitats. The Urban Fish Habitat Management Research Program (DEEDI 2010), directing projects funded by offsets, provides research streams relevant to saltmarsh habitats. Educational strategies also promote the importance saltmarshes and marine fish habitats within the community.

Saltmarsh community structure and ecosystem values

Saltmarshes in Queensland estuaries cover more than a third of the total saltmarsh area in Australia (15,195 km^2) (De Vries *et al.*, 2002, cited by Johns (*op cit*)). Saltmarsh fish habitats of the Gulf of Carpentaria total 5,033 km^2 and are relatively undisturbed. In East Coast communities, for example, in the Tweed Moreton Bioregion in south east Queensland (SEQ) only 84 km^2 of saltmarsh remains, highlighting the impacts of coastal development (Johns *op cit*). In New South Wales saltmarsh is listed as an 'Endangered Ecological Community' (*Threatened Species Conservation Act 1995)*, with only 4% of the saltmarsh community remaining around Botany Bay.

Saltmarshes occupy the upper intertidal zone (Figure 1). Challen (*op cit*) outlined different saltmarsh community subsets of coastal Queensland, as follows:

- saltpans (Figure 2);
- saline grasslands (Figure 3); and
- samphire dominated saltmarsh (Figure 4).

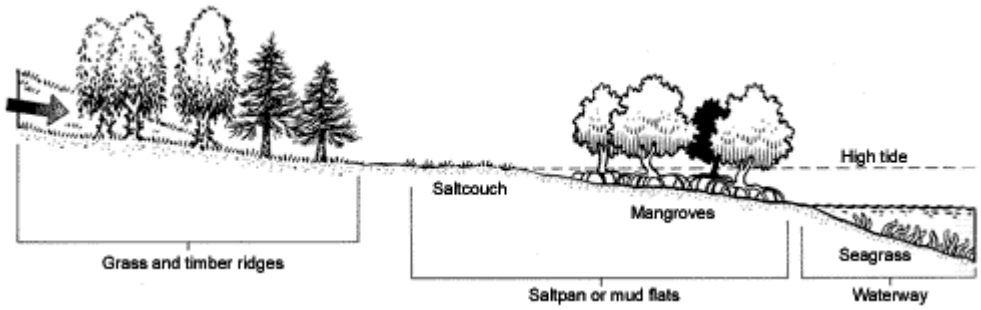

Figure 1 Saltmarshes occur landward of mangrove communities high in the intertidal zone.

Figure 2: A saltpan, Barney Point, Gladstone, largely unvegetated with samphires (succulents) present.

Figure 3: A saline grassland community (saltcouch dominated) Calliope River, Gladstone.

Figure 4: A samphire dominated saltmarsh community, Lota, Brisbane.

Diversity between saltmarsh communities reflects rainfall, topography and tidal influences

(periodicity and range). Increased species diversity is noted moving south along the coast. Johns (*op cit*) reported the general functional importance of saltmarshes found in Queensland including:

- playing a major role as nutrient sinks;
- providing habitats for a wide range of juvenile fish and bird species, and
- buffering and filtering sediments and nutrients.

Further fisheries research to build on that conducted in SEQ is urgently needed in other parts of the East Coast and the Gulf of Carpentaria to confirm and document the benefits of those saltmarsh communities

Cultural values of saltmarsh

Saltmarsh wetlands may contain Indigenous cultural heritage sites including fish traps, stone and earth arrangements, middens, hearths and stone artefacts. The most common cultural heritage sites identified in saltmarsh areas are shell middens and stone artefacts linked to occupation camps, often on higher ground, adjacent to saltmarsh areas. Some saltmarsh areas have cultural values as story places and sites for cultural activities. Non Indigenous cultural heritage areas are also present in these areas mostly linked to pastoralists, agricultural and timber industries.

DISCUSSION

Halophytic (salt tolerant) saltmarsh vegetation has adapted to soils flooded only on king or spring tides, surviving the extremes of high salt and low oxygen soil levels due to infrequent tidal innundation (Johns *op cit*). This adaptive strength enables the plants to survive harsh conditions. However it may also prove to be a weakness should altered tidal regimes result due to climate change. Unplanned coastal development and mangrove encroachment may result in further contraction or loss of saltmarsh communities.

Planning and provision of fish habitat retreats in marine/terrestrial interface would support species requirements and address climate related migration of marine fish habitats, specifically for saltmarshes. Saltmarsh fish habitats must be managed using statutory instruments (State Coastal Plan, the Planning and Fisheries Acts) to prevent and offset losses due to anthropogenic changes

To recognise and promote the importance of saltmarshes, DEEDI has produced educational materials for target audience groups including communities, schools and government agencies. Materials include a Queensland saltmarsh plant identification guide, poster and signage.

The *Field Guide to Common Saltmarsh Plants of Queensland* (John 2010) assists easy identification of key marine plant species in saltmarsh fish habitats. It is as an important educational tool for students, government agencies, developers and members of the public. The guide is available at no cost and features 32 saltmarsh plant species, with detailed descriptions, identification keys and information on species distribution and flowering. The *Common Saltmarsh Plants of Queensland* poster featuring all plant species is also available free from DEEDI. In 2010, DEEDI produced educational saltmarsh signage designs for installation at key locations.

Diverse communication strategies have allowed DEEDI to raise the profile of saltmarshes in supporting fisheries productivity. This is indicated through an ongoing demand for educational resources and subsequent distribution of more than 3000 copies of the field guide since 2006, and release of an updated 2010 edition

TAKE HOME MESSAGES

Saltmarshes are a key component of the marine fish habitat mosaic and continue to require statutory protection through appropriate planning, e.g. buffers, from coastal development pressures, to provide nursery and feeding habitats for fish species. Research will improve knowledge of saltmarsh requirements to address projected climate change related sea-level rise.

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