MANGROVE ENVIRONMENTS OF THE MARY RIVER.

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Abstract

The Mary River of South-east Queensland forms a large and relatively unstudied tidal estuary which exhibits a wide range of mangrove environments. Mangrove habitats are described as a series of geomorphic units, and the assemblages of mangroves occupying these geomorphic units are described.

Introduction

The Mary River is one of the largest estuaries in southeast Queensland, and the estuarine section between Maryborough and River Heads supports a range of mangrove habitats A total of eleven mangrove species have been recorded on the Mary River, these being *Rhizophora stylosa* Griff., *Ceriops tagal* (Perr.) C.B. Rob, var *australis* C.T. White, *Avicennia marina* (Forsk.) Vierh., *Aegiceras corniculatum* (L.) Blanco, *Excoecaria agallocha* L., *Bruguiera gymnorhiza* (L.) Lamk., *Osbornia octodonta* F. Muell., *Lumnitzera racemosa* Willd., *Aegialitis annulata* R. Br., *Xylocarpus granatum* Koen. and *Xylocarpus australasicus* Ridl. Associates in the mangrove include *Hibiscus tiliaceuus, Acrostichum speciosum, Amyena mackayense* and *Casuarina glauca* Sieb. ex Spreng.

Major estuaries immediately to the north and south of the Mary River have wave-dominated entrance conditions and have reached a high degree of maturity when assessed under the Roy (1984) model. The estuaries of the Burran and Burnett rivers, immediately to the north of the Mary, dissect extensive Pleistocene and Holocene beach ridge complexes which the Burnett River clearly feeds.

The Mary River contrasts starkly to these estuaries in form and process. The river is protected from waves by Fraser Island to the east, Big Woody Island to the north-east and the shallow flats of the Great Sandy Strait to the south-east. The longest fetch in any direction from the mouth is fifteen kilometres. The only waves entering the estuary are shallow fetch wind waves to one metre.

Though mesotidal, the Mary River displays the forms of a macrotidal or tide-dominated estuary due to the virtual absence of wave energy. The characteristics of the Mary River as a tide-dominated estuary may be described with reference to the model of Dalrymple, Zaitlin and Boyd (1992) which recognises three zones to an estuary, these being a marine-dominated zone, a central zone of relatively low energy where fluvial and tidal currents meet, and an inner river-dominated zone. A distinct break in the negative exponential decline of channel cross-sectional area with distance upstream occurs immediately before Brothers Island and represents the beginning of the Central zone (figure 2). The characteristics of each of the zones on the Mary River may be defined as follows.

(i) The lower marine zone is funnel-shaped and contains extensive elongate bars (Buttenshaw Bank and Horseshoe Bank). Though exposed at low tide, the elongate bars are of insufficient elevation to be colonised by mangroves. The extensive mangroves of the marine zone occur at the margins of the funnel. These consist, in the south, of intertidal Holocene fluvial deposits between what are probable Pleistocene fluvial deposits and igneous rock outcrops of the south head. To the north, the funnel is bordered by the "big swamp" deltaic condition of the Susan River which shares its mouth with the Mary.

(ii) The upper marine zone is initiated north of Tandora by intertidal deposits fringing Quaternary floodplains. Elongate bars here form extensive intertidal deposits colonised by mangroves (Crab Islands, Brothers Island).

(iii) The Central zone corresponds to the "meandering" section of the "straight, meandering, straight" central zone of

Plate 1: The funnel mouth, or lower marine zone of the Mary River Estuary. (Photographs reproduced courtesy of the Department of Natural Resources, Queensland)

Dalrymple, Zaitlin and Boyd (1992) model and the "sinuous" segment described by Chappell and Woodroffe (1985) for Northern Territory tidal rivers. Mangrove environments consist of steep channel-bank deposits fringing extensive floodplains and wider prograding point bars. The segment ends somewhat artificially 59 km upstream at the Mary River Barrage where the central zone meets the "fluvial" or "freshwater" section of the river. Completed in June 1982, the Mary River barrage was designed to prevent the intrusion of saline tidal water into the freshwater section of the estuary. Previously the Mary River was tidal to the town of Tiaro, 80 km upstream of the mouth.

The impact of floods is clearly evident in the central zone. Tree damage and flotsam is evident particularly amongst stands of *Excoecaria agallocha*, while bank-slumping following flood excavation is found amongst frontal stands of *Aegiceras corniculatum*. Units of flood-deposited sands form discrete units of channel-bank deposits throughout the central zone.

Geomorphic Units on the Mary River.

Vegetated intertidal environments of the Mary River have been classified in terms of form and process using terminology from Semenuik (1982), Thom (1967) and Davie (1985).

(a) The Marine Zone

The marine zone consists of a greater range of geomorphic units than the central zone.

(i) The Tidal Flat
Wide intertidal flats are characteristic of the mouths of tide-dominated estuaries (Chappell & Woodroffe 1985, Vertessey 1990), and the wide intertidal flat of the channel mouth is the most extensive of the geomorphic units of the Mary River. As previously mentioned, the northern banks are dominated by wind-blown waves, and a beach occurs in front of the *Rhizophora* zone.

The landward zonation of *Avicennia-*

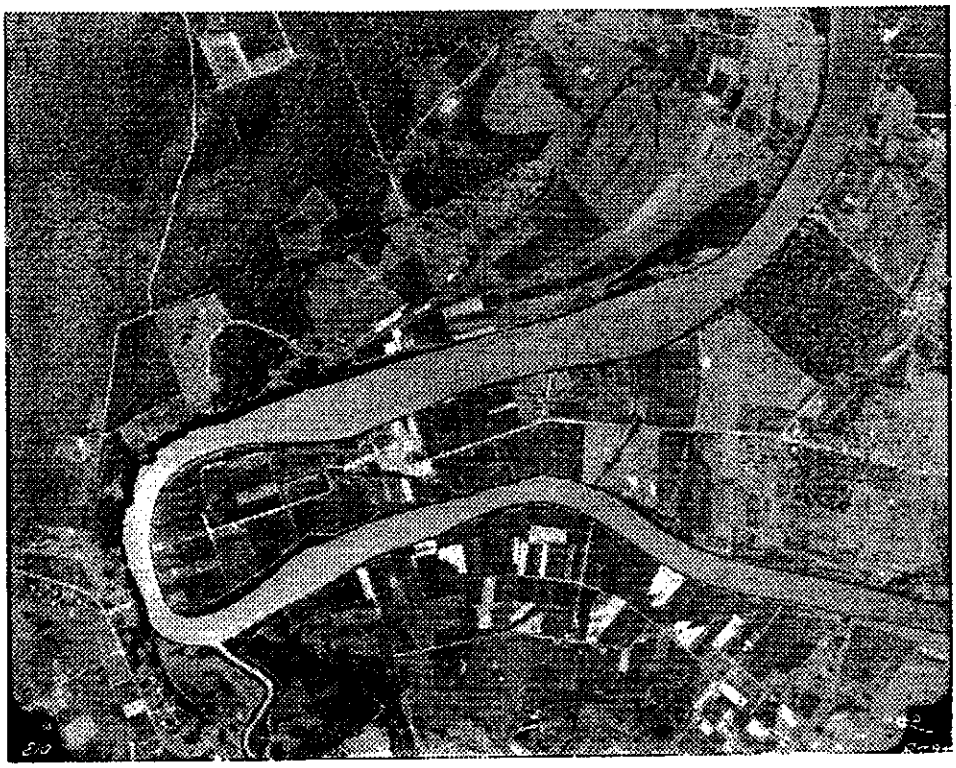

Plate 2: A meandering section of the central zone of the Mary River Estuary. (Photograph reproduced courtesy of the Department of Natural Resources, Queensland)

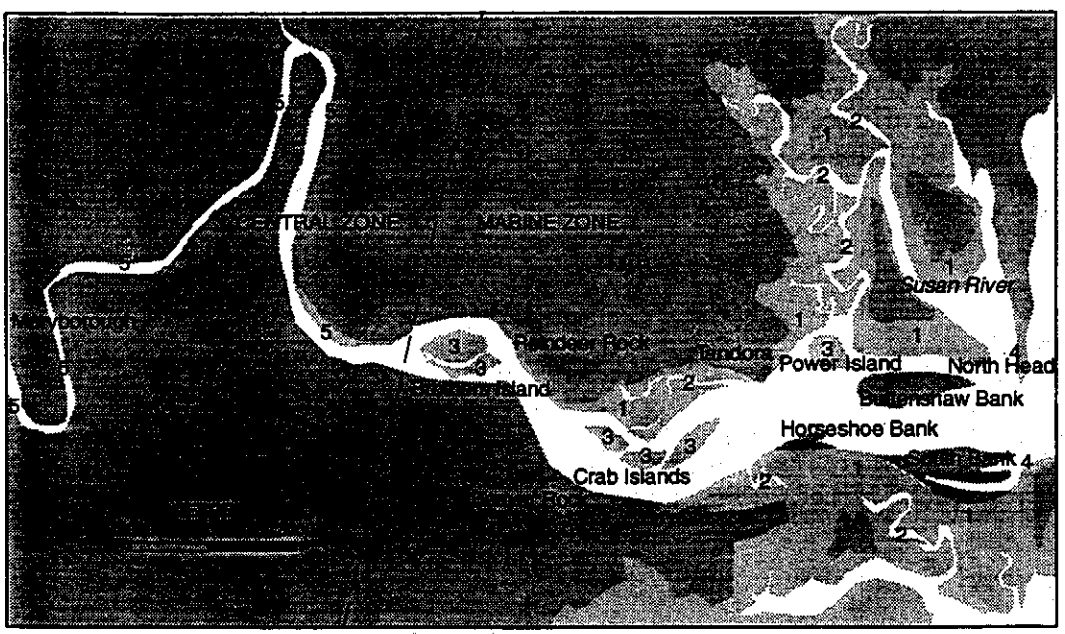

Figure 1: Location of names and geomorphic units referred to in the text.

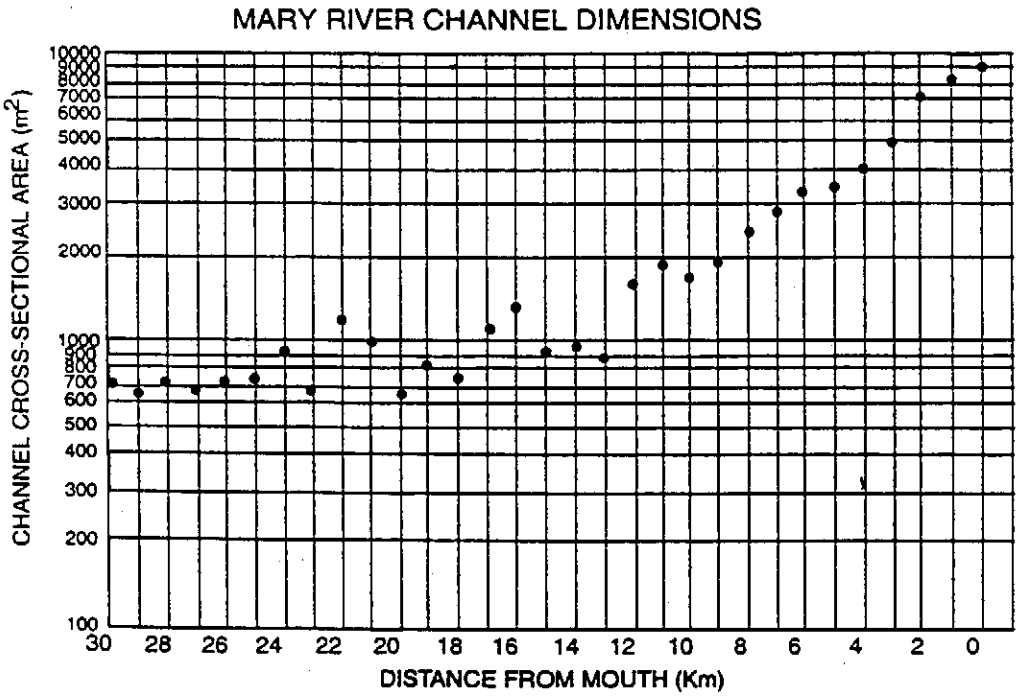

Figure 2: Decline in cross-sectional channel area with distance from the mouth on the Mary River.

Rhizophora-Ceriops-Avicennia frequently described in the literature concerning tropical and subtropical mangroves (Macnae 1966, Chapman 1976), is evident on the Mary River, though toward the headward extent of the Marine zone the zonation is obscured by fluvial scarping and the increasing occurrence of *Aegiceras corniculatum, Excoecaria agallocha* and *Bruguiera gymnorhiza.*

(ii) The Rocky Intertidal Shore
Rock intertidal shorefaces occur at the mouth of the Mary River due to the outcropping of the silicified mudstone beds of the Maryborough formation. They are characterised by particularly coarse gravels and boulders up to 30 cm in diameter. Substrates are well drained and shallow soils are colonised by a wide variety of species listed in Table 2.

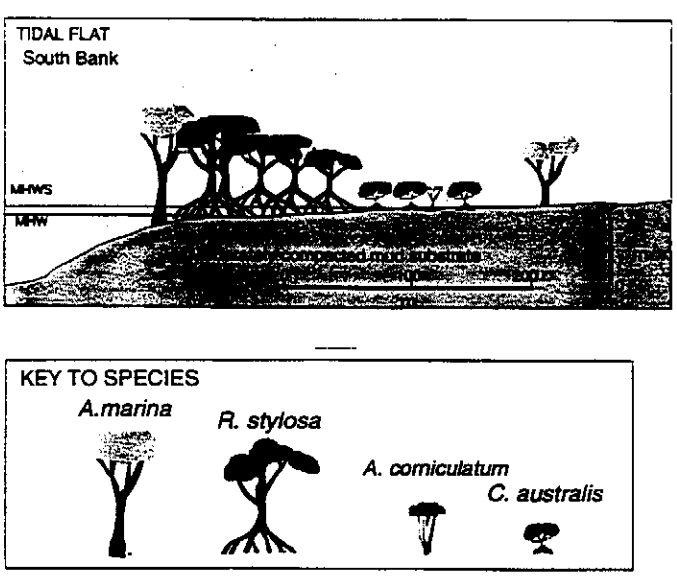

Figure 3: Schematic cross-section of a tidal flat

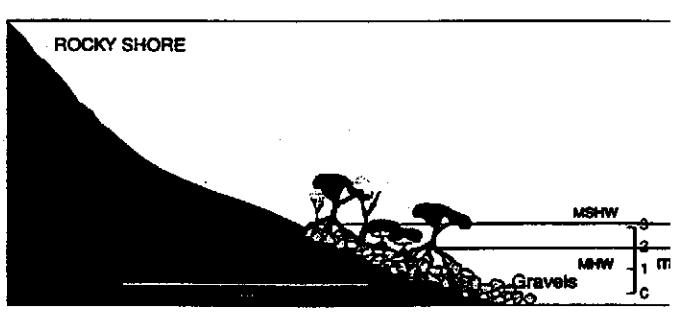

Figure 4: Schematic cross-section of a rocky shore. (Reference Fig. 3)

(iii) Mid-Channel Islands.
A series of mid-channel islands occur in the headward end of the Marine zone, beginning with Powers Island at the Northern junction with the Susan River,

extending through the Crab Islands and finally Brothers Island at the junction of the Marine and Central zones. Although large shoals within the funnel mouth are exposed at low tide, none are of sufficient elevation to be colonised by mangroves.

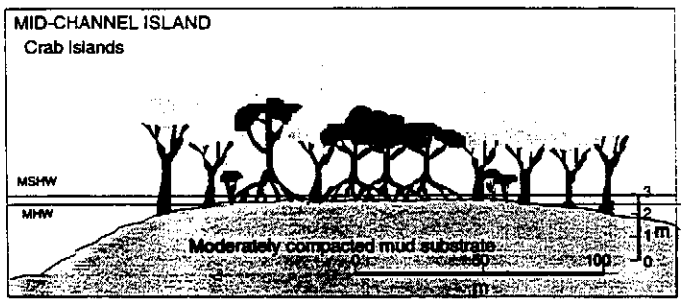

Figure 5: Schematic cross-section of a mid-channel island. (Reference Fig. 3)

(iv) Tidal Creeks
A number of tidal creeks dissect the tidal flats of the marine zone. The convex bank of the tidal creek is generally colonised by *Avicennia marina,* which grades into a Rhizophoraceae dominated community(*Rhizophora stylosa, Ceriops tagal)* at higher elevations. The convex bank opposite is colonised by a Rhizophoraceae community corresponding to that occurring on the concave bank.

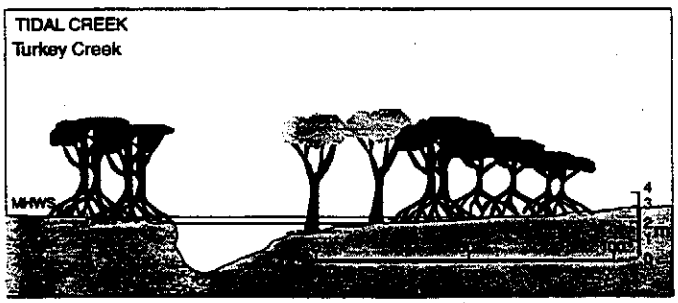

Figure 6: Schematic cross-section of a tidal creek. (Reference Fig.3)

(b) The Central Zone

The channel-fringing flats of the central zone occur in a variety of forms. Many such flats have been scarped by flood disharge leading to widespread slumping, and bands of mangroves may slip to below tolerable levels of inundation leading to dieback. More commonly, banks are concave and stable, though steeply sloping.

The three dominant species throughout this zone are *Avicennia marina, Aegiceras corniculatum,* and *Excoecaria agallocha* which characteristically grows as a landward fringe in dry soils.

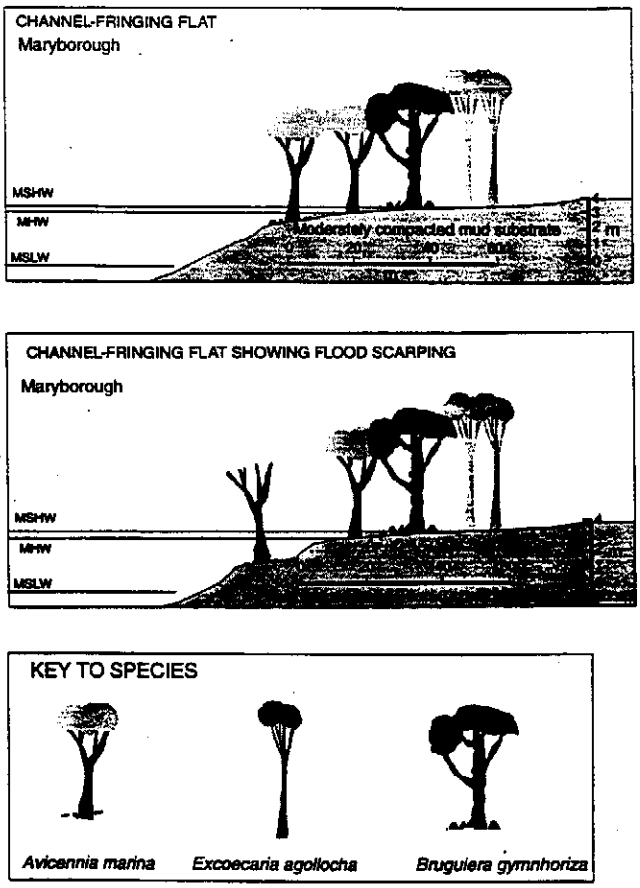

Figure 7: Channel-fringing environments of the central zone of the Mary River.

Summary and conclusions

(i) Classification of the Mary River.

The association of the Mary River with the Great Sandy Strait and the protection from wave action this affords, allows the Mary River to be classified as a tide-dominated estuary in an intermediate stage of development, according to the terminology of Dalrymple et al. 1992. The Mary River displays a range of intertidal environments

GEOMORPHIC UNIT	ORIGIN: MAIN PROCESSES	DETAILS OF PROCESS
Hinterland Fringe	Marine reworking and terrestrial sedimentation.	Marine reworking of colluvial depositts. Marine deposition of muddy sediments.
Tidal Flat	Marine/tidal sedimentation.	Tidal discharge accretes fluvial sediments gradually to MHWS levels. Frontal sediments reworked by wind-blown waves winnowing finer sediments.
Tidal Creek	Marine erosion.	Marine erosion of tidal flat by drainage incisions.
Mid-channel Island	Tidal sedimentation.	Shoaling of fluvial sediments to above MHW elevation.
Riverine Channel-Flat	Fluvial/tidal sedimentation and erosion.	Fluvially dominated sedimentation during floods and high tides. Frontal areas may experience scarping and slumping, particularly following floods.
Rocky Intertidal Shore	Marine erosion and reworking.	Formed by marine erosion of spurs of rock terrain and marine reworking of the colluvial slope.

Table 1. Geomorphic Units and physiographic processes in intertidal environments of the Mary River.

Geomrphic Unit	Substrate Texture	Primary Groundwater Origin	Salinity	Soil water Content	Vegetation Assemblage
Hinterland Fringe	Poorly sorted gravels, sands and muds.	A mixture of seawater and freshwater seepage from the hinterland.	Up to 100 p.p.t. in drought conditions, fresher following seepage.	Infrequently flooded during spring tides. generally dry.	*A. marina, A. annulata, X. granatum, X. australasicus.*
Tidal Flat	Fine sands and muds.	Recharged daily to fortnightly at levels up to MHWN & MHWS respectively.	Evaporation develops a gradient of increasing salinity from saline to hypersaline.	Waterlogged most of the time.	Seaward; *A. marina, R. stylosa.* Landward: *R. stylosa, A marina, C. australis, A. annulata.*
Tidal Creek	Bioturbated and root-structured muds.	Recharged daily to fortnightly by tidal creek water.	Saline soil water.	Waterlogged most of the time.	*A. marina, A. corniculatum, C. tagal, R. stylosa.*

Mid Channel Island	Muds and muddy sand.	Recharged with estuarine water of varying salinity.	Brackish to saline depending on salinity of estuarine water.	Waterlogged most of the time.	*A. marina, R. stylosa,* and headward; *B gymnorhiza, E. agallocha, A. corniculatum*
Riverine Channel Flat	Fine sands and muds.	Fluvial discharge salinised by tidal saltwater intrusion.	Brackish to saline depending on degree of saline intrusion.	Grading from waterlogged to relatively dry landward.	*A. marina, A. corniculum, E. agallocha, B. gymnorhiza.*
Rocky Intertidal Slope.	Gravel sheets	Daily to fortnightly inundations of marine water.	Saline, increasing with evaporation.	Waterlogged during high tide, well drained during ebb tide.	*A. marina, R. stylosa, A. corniculatum. E. agallocha.*

Table 2. Geochemical properties and vegetation assemblages associated with geomorphic units on the Mary River.

rare in the subtropical east coast, where most estuaries are mature or approaching maturity.

A unique feature of the Mary River is its association with the tidal prism of the Great Sandy Strait which links the river hydrologically and sedimentologically with a wider quasi-estuarine system. One may depict a situation in which sufficient quantities of Mary River sediment would close the Great Sandy Strait creating extensive deltaic mangrove environments between Fraser Island and the mainland.

(ii) Classification of estuarine environments.

The division of the Mary River into Marine and Central sections may be made on the basis of a break in slope of the negative exponential decline of cross-sectional channel area with distance inland. The Mary River has no freshwater section of its estuary due to the construction of a barrage in 1982 which effectively truncated the estuary at the end of the central zone by prohibiting tidal exchange beyond this point.

(iii) Geomorphic Units

Wide intertidal flats are extensive on the lower Mary. Here, salinities may rise to levels exceedingly high levels, a characteristic held in common with many tropical estuaries (Thom 1967, Chappell and Woodroffe 1985), and extensive hypersaline supratidal flats may occur landward of the mangrove zone. Mid-channel islands are common due to the shoaling of tidally distributed sediment.

The stronger tidal currents of the Mary River have, in conjunction with the extensive width of the intertidal flats, produced extensive tidal creeks. Clear differences exist in the mangrove vegetation of concave and convex banks on tidal creeks on the Mary River, with convex banks often supporting a pure stand of *Avicennia marina* and convex banks colonised by mixed associations of members of the Rhizophoraceae into which *Avicennia* grades.

Within the central zone, channel fringing mangrove environments occur generally on the concave banks, with flood-scarped convex banks providing no suitable intertidal environment for mangrove colonisation. The concave environments correspond to Habitats type I and II in the scheme of Davie (1985), with a clear landward zonation in species assemblage, from *Avicennia* to *Excoecaria, Bruguiera* and *Aegiceras* . These are the freshest environments and landwardly are the driest intertidal environments to be found on the Mary River.

The Rocky Tidal Shore, described for Western Australian estuaries by Semenuik et.al. (1982) occurs on the Mary where silicified mudstone beds outcrop on both the north and south heads of the estuary.The unit supports a highly diverse group of species including *Avicennia, Aegiceras, Rhizophora* and *Ceriops*.

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