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Baseline

Trace element content of seagrasses in the Leschenault Estuary, Western Australia

Kieryn Kilminster *

Department of Water, Government of Western Australia, P.O. Box K822, Perth, WA 6842, Australia

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ABSTRACT

Estuarine environments are particularly vulnerable to human impacts. In this study, trace elements in *Ruppia megacarpa*, *Halophila ovalis*, sediment and porewater were analysed to assess the potential contamination of the Leschenault Estuary, Western Australia, from a primarily agricultural drain. Sediment concentrations of Cd, Cu, Mn, and Ni and were highest nearest the drain while Al, As, Cr, Fe and Zn and were highest further from the drain. *H. ovalis* showed greater accumulation of Fe, Al, and As than *R. megacarpa*. Concentrations of Fe, Al, As, and Ni were generally higher in below-ground plant parts than above, suggesting uptake of these trace elements via the sediment-route pathway. This study suggested that the drain was a source of Cu and Mn, with these elements entering the estuary through water inflows. As and Fe, were highest furthest from the drain suggesting input of trace elements from sources other than the drain under study.

Seagrasses, a dominant estuarine benthic primary producer, may be particularly vulnerable to anthropogenic stress, including trace element (TE) contamination, as human populations continue to grow around estuaries (Ralph et al., 2006). The relative abundance and spatial distribution of TEs in seagrass tissues is relatively straight-forward to assess, however it is more difficult to draw from these studies information regarding the source, load and the likely ecophysiological effect on the plants (Ralph et al., 2006). TE bioavailability is influenced by (but not limited to) salinity, redox, pH and temperature (Batley, 1987), and consequently a high concentration of TE in the sediment does not necessarily mean that those elements are highly bioavailable to the aquatic plants (Ralph et al., 2006). TE uptake by the plants themselves is also known to vary according to element, plant species, age and tissue compartment of the seagrass, as well as season (Lafabrie et al., 2007, 2008; Luy et al., 2012; Lyngby et al., 1982; Prange and Dennison, 2000; Pulich et al., 1976).

Many estuaries also have relatively long residence times for water entering the estuary, so is probable that exposure time to anthropogenic contaminants is higher for seagrasses in estuaries than in the coastal nearshore environment. Seagrasses have previously been utilised as bio-indicators, with in situ contaminants accumulating in their tissues. For example, TE concentration of seagrass tissue has been used to assess spatial contamination at various locations world-wide, including *Zostera marina* in the Limford, Denmark (Brix et al., 1983), *Posidonia oceanica* in the Mediterranean (Lafabrie et al., 2008, 2009; Luy et al., 2012), and *Halophila stipulacea* in Greece (Malea, 1994).

Concern was raised about the impact of TE contamination on both seagrass health and sediment quality from discharge points in the Leschenault Estuary, Western Australia (McKenna, 2007). Parkfield drain is primarily an agricultural drain, but was also identified as discharging water impacted by disturbed acid sulfate soils in the winter of 2007 (Kilminster et al., 2011). This study assessed the TE concentrations in seagrass tissues, sediment and porewater at sites in a transect from the Parkfield drain outfall, with the aim of determining the likely impact of this drain on the estuary. Two species were investigated in this study: *Ruppia megacarpa* and *Halophila ovalis*.

The study site (Fig. 1) was the northern half of the Leschenault Estuary – near the town of Bunbury (population approximately 58,000) in south-west Western Australia. The estuary is fed by the Preston and Collie Rivers, through predominantly agricultural catchments. The estuary is approximately 11 km long and 2 km wide, with an average depth of <2 m (McComb et al., 2000). The shallow elongated waterbody lies north–south and is separated from the Indian Ocean by a sand dune peninsula. The catchment for the Leschenault Estuary has an area of 1981 square kilometres, with runoff discharging through the estuary to the ocean via "the cut", an artificial mouth of the estuary constructed in 1951. The construction of "the cut" changed the estuary from a tidally influenced estuary to one dominated by wave influences (McKenna, 2007). Other artificial changes to the estuary include the construction of Parkfield Drain in 1977, which drains the mixed land-use catchment (including intensive horticulture, grazing and extractive

* Tel.: +61 8 6364 7839; fax: +61 8 6364 6515.
E-mail address: kieryn.kilminster@water.wa.gov.au

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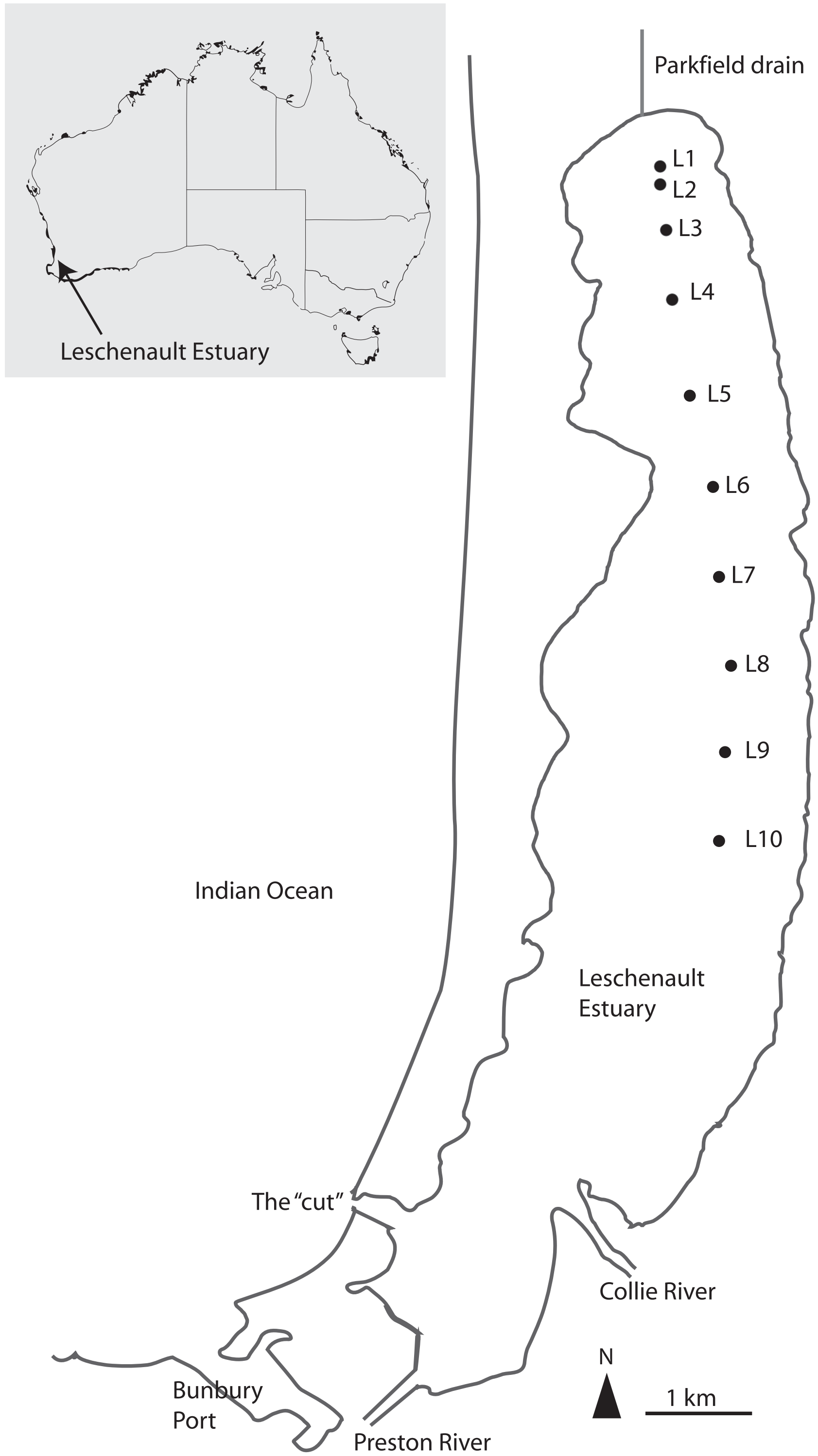

Fig. 1. Diagram of study sites within the upper Leschenault Estuary. Site L1 was at the northern end, closest to discharge from Parkfield Drain. Site L10 was furthest south and closest to the marine influence from "the cut". *Ruppia megacarpa* was dominant at sites L1–L4, and *Halophila ovalis* was dominant at sites L5–L9. Site L10 was unvegetated.

industries) directly into the north of the estuary (McKenna, 2007). The western shore of the estuary consists of uninhabited natural vegetation, while urban land uses stretch down the eastern shore, with higher urban density from about the mid-point of the estuary continuing further south towards the town of Bunbury. Industrial land uses are more common in the land to the east of the southern half of the estuary and a number of stormwater drains also enter the estuary in this region.

In this study, TE concentrations within *H. ovalis*, *R. megacarpa*, sediment and porewater were investigated in the upper Leschenault Estuary. Ten sites (L1–L10) were located along a transect starting near the outflow of Parkfield drain which ran approximately north to south (from 33.2043S, 155.7016E to 33.2693S, 115.7066E) (Fig. 1). The dominant macrophyte was *R. megacarpa* at sites L1–L4, and *H. ovalis* at sites L5–L9. Site L10 was unvegetated. Site L3 had an abundance of macroalgae also present, mainly