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Seabirds and plastics don't mix: Examining the differences in marine plastic ingestion in wedge-tailed shearwater chicks at near-shore and offshore locations

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ABSTRACT

Plastic ingestion by wedge-tailed shearwaters (WTS) nesting at near-shore and offshore sites along the east coast of Australia were investigated. Ingestion rates were at 20% in near-shore lavaged WTS, where the beaches were significantly more polluted, compared to 8% in birds at offshore sites. The material and colour of recovered plastics at offshore sites differed significantly between beach surveys and that ingested by seabirds in the same area. This pattern was not evident near-shore. Hence, in near-shore environments birds may feed locally and are influenced by nearby plastics, compared to birds offshore. The origins of marine debris between near-shore and offshore beaches differed; with land-based sources unsurprisingly having more influence on near-shore sites. The findings of this study indicate the need for localised data to address and manage this pollutant, with nesting seabirds at greater risk in near-shore environments. A preliminary modified ecological quality objective for WTS is presented.

1. Introduction

As a major marine pollutant and one of the main threats facing oceans worldwide (UNEP, 2005), marine debris (i.e., any item of anthropogenic origin) has the potential to cause harm to wildlife through entanglement and ingestion (NOAA, 2014). Plastics are the most commonly recovered material type in surveys around Australia (Haynes, 1997; Wilson and Verlis, 2017) and globally (Galgani et al., 2015). The ingestion of debris can lead to morbidity and mortality (Auman et al., 1997; OSPAR Commission, 2008; Kühn et al., 2015) and in the case of plastic ingestion, can potentially expose animals to chemical contaminants adsorbed to the plastic from the water, or from chemicals intrinsically present within the plastic itself (Colabuono et al., 2010; van Franeker et al., 2011; Tanaka et al., 2013). More than 56% of studied seabird species have interacted with marine debris (Gall and Thompson, 2015), with subsequent undesirable health effects observed in several species (Connor and Smith, 1982; Lavers et al., 2014). The specific cues for intentional ingestion of marine debris by seabirds are unknown but are theorised to be related to feeding behaviours and/or the resemblance of marine debris to natural food items (Bourne and Bourne and Imber, 1982; Day et al., 1985; Moser and Lee, 1992; Robards et al., 1995) or due to a chemical scent mimicking prey cues (Savoca et al., 2016).

Procellariiforms such as the wedge-tailed shearwater (*Ardenna pacifica*) may have an increased risk of marine debris ingestion because of their feeding behaviours, a stomach physiology that restricts clearing of gizzard contents, and their limited regurgitation unless feeding chicks (Day et al., 1985; Sileo et al., 1990; van Franeker and Meijboom, 2002; Hutton et al., 2008; Colabuono et al., 2009). Specifically, wedge-tailed shearwater (WTS) feeding behaviour may increase their risk for encountering marine debris, as they contact dip, dip, surface seize and pursuit-plunge for food (Harrison et al., 1983; Marchant and Higgins, 1990) and are known to scavenge behind fishing trawlers (Marchant and Higgins, 1990; Burger, 2001). These shearwaters may also target ocean convergence zones and other areas that favour higher productivity that could also act to concentrate debris (Burger, 2001; McDuie et al., 2015). This has the potential to expose WTS to an increased risk of plastics ingestion. Current studies indicate lower levels of marine debris ingestion in WTS compared to other shearwater species, such as short-tail shearwaters (*Puffinus tenuirostris*) (Carey, 2011; Cousin et al., 2014), flesh-footed (*Puffinus carneipes*) (Lavers et al., 2014) and Cory's shearwater (*Calonectris borealis*) (Petry et al., 2009).

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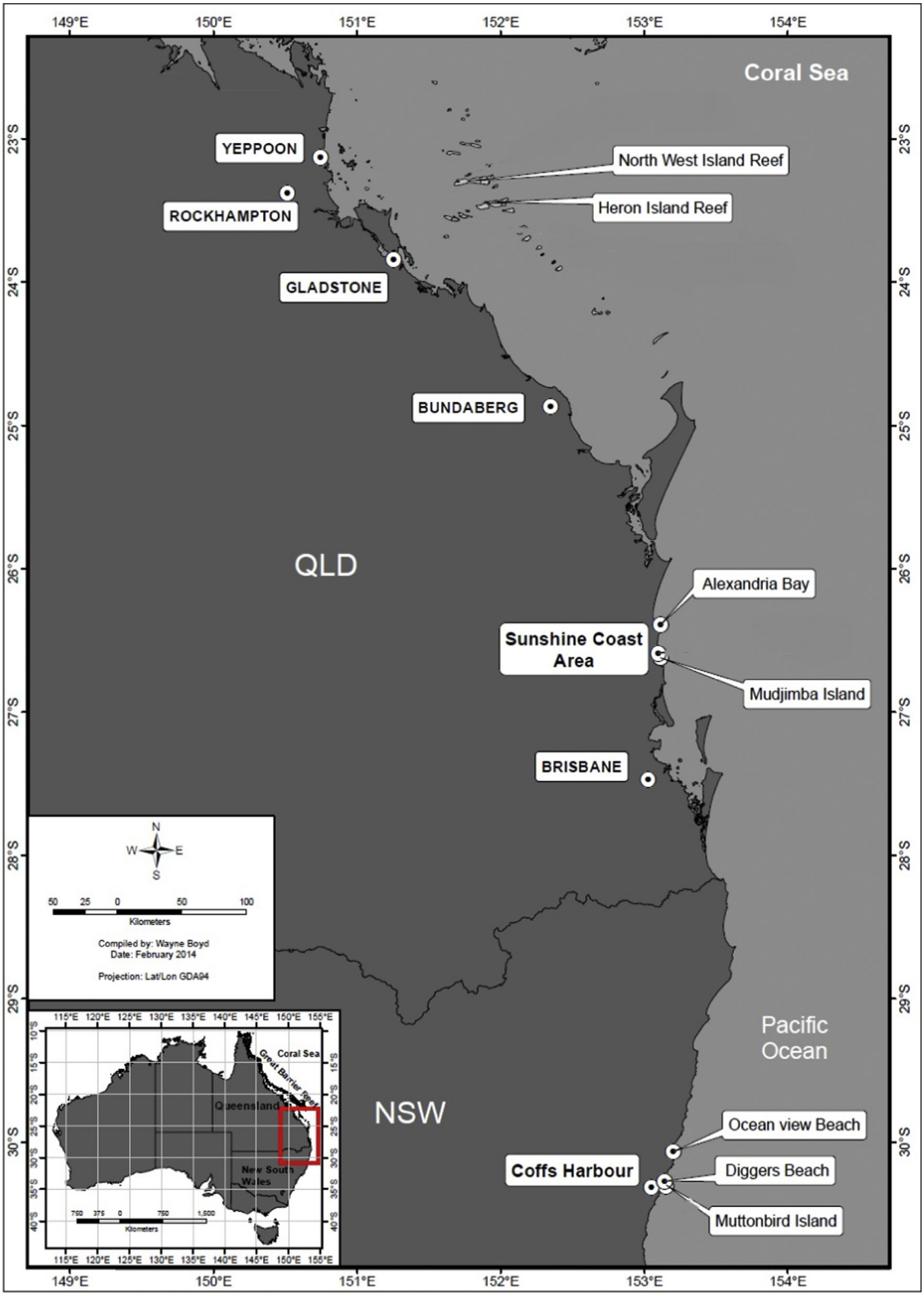

Fig. 1. Location of study sites along the east coast of Australia.

These variations are likely influenced by differences in foraging, migration and nesting behaviours as well as geographic locational differences (i.e. proximity to debris).

Debris accumulation and distribution in the marine environment can be influenced by a number of different factors. These can include the local wind and currents within an area, the geography and bathymetry of the area and possible points of entry, including distance from population centres and oceanic trade routes (Barnes et al., 2009). Oceanic currents and circulation can also influence marine debris movement, with wind stress the main driving force of upper ocean circulation (Howell et al., 2012; Zhang, 2017). Eddies and eddy fields can act to concentrate plastics and other organisms, like plankton, as