



# The ugly face of tourism: Marine debris pollution linked to visitation in the southern Great Barrier Reef, Australia



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## ABSTRACT

Marine debris is one of the most significant issues facing oceans worldwide. The sources of this debris vary depending on proximity to urban centres and the nature of activities within an area. This paper examines the influence of tourism in the southern Great Barrier Reef (GBR), and its contribution to litter levels in the region. By conducting beach debris surveys on occupied and unoccupied islands, this study found that debris was prevalent throughout the region with significant differences in material types between locations. The greatest source of debris from publically accessible islands was tourist-related, with this source also influencing debris loads on nearby uninhabited islands. A focus on debris at Heron Island, showed that sites close to amenities had greater levels of tourist-sourced items like cigarette butts. These findings indicate the contribution of tourists to this problem and that working with operators and managers is needed to minimise visitor impacts.

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## 1. Introduction

Marine debris is commonly attributed to land-based sources, with water-borne sources thought to only make up around 20% of the total loads found in the world's oceans (UNEP, 2009). However, this may differ in areas with high recreational boating and/or commercial fishing/shipping activities and that have relatively low nearby urban populations. In these areas, oceanic-sourced debris may dominate (Kiessling, 2003; White, 2005). The Great Barrier Reef (GBR) on the east coast of Australia is an example of one such area, with relatively low to moderate-sized population centres occurring along the GBR coastline. This region is one of the natural wonders of the world (GBRMPA, 2011a) and thus is a popular tourism and recreational destination, with boating being the predominant means of access to the offshore reefs and coral cays. The region also has important commercial value, with >80% of the GBR marine park available for domestic and international commercial ship navigation (GBRMPA, 2015), and the region having 11 trading ports adjacent to the GBR World Heritage Area (GBRWHA; Department of State Development, 2015). Of these ports, four are established major commodity ports (Gladstone, Hay point, Abbot Point and Townsville) (GBRMPA, 2011b; Ports Australia, 2014) and there are ten major fishing industries operating in the region. Thus management of these multiple

users is complex and is reliant on government agencies at both state and federal levels.

When tourism is discussed in relation to marine debris, there is a preponderance to examine the impacts that this pollutant has on the tourism industry (McIlgorm et al., 2011; Jang et al., 2014). Both aesthetic and economic impacts can result from high marine debris loads, primarily through decreases in visitation and shoreline and water-based recreational activities (Ballance et al., 2000; Sheavly and Register, 2007). In Australia in 2011–12, the GBR was estimated to contribute over \$5 billion to the local economy (GBRMPA, 2014), the majority of which was derived from tourism. Therefore, any economic downturn in this industry can have serious repercussions not just on a local scale, but nationally. The consequences of this are even more dire considering that the cause in part could be from a factor that is manageable, such as with locally sourced marine debris.

Studies elsewhere in the world have shown that tourism and recreation are factors contributing to increased litter loads on beaches in summer months (Thiel et al., 2003; Hoellein et al., 2015) and high litter loads occur even in protected areas (Rodríguez-Rodríguez, 2012). However, most studies have been conducted in high-use areas with relatively large nearby urban centres. In areas with high conservation value with a more dispersed geographic visitation area, such as in the GBR, levels of marine debris would be expected to be low and therefore having less of an impact.

The Capricorn-Bunker group of Islands in the southern GBR, is an important nesting site for a wide variety of marine life, including six species of sea turtle (Heatwole and Lukoschek, 2008) and >25% of all

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tropical Australian seabirds (Congdon, 2008). This island group is composed of a number of well-developed platform reefs and vegetated sand cays that are mostly uninhabited (Hopley, 1982; Veron, 1996). For these reasons, adventure and nature tourists (including fishers) are attracted to the region. The main inhabited island is Heron Island, with a resort serviced by a catamaran and a helicopter, and an active university research station. There are also more intermittently inhabited islands, such as One Tree Island, with an operational research field station. Camping via private vessel or charter ferry service also occurs seasonally at Northwest, Masthead and Lady Musgrave Islands. Other islands in this group are restricted access all-year-round (i.e. Fairfax, Tryon and Wreck Islands) in order to preserve important habitats. Due to the close proximity to mainland Australia (~80 km), the Capricorn-Bunker group of islands is a common place for day-trip tourism by recreational boaters and fishers.

Recent studies have shown that a doubling of litter amounts on GBR beaches would result in a >90% perceived reduction in quality of life to residents living in the GBR catchment (Stoeckl et al., 2014) and up to a 60% reduction in the length of stay by tourists to the area (Esparon et al., 2015). Despite this, few studies have looked at the role tourism plays in actually contributing to the debris loads in the GBR region, especially at offshore locations. This study is the first to examine the role that tourism has on marine debris loads found on offshore islands in the southern GBR.

## 2. Methods

### 2.1. Sites

Four sites within the Capricorn-Bunker Group of Islands (Fig. 1) on the east coast of Australia were surveyed over a three-year period. Two sites (Wreck Is. & Tryon Is.) were isolated from direct tourism

activities and had restricted access, while the two other sites are popular tourist destinations (Heron Is. and Northwest Is.) (Table 1).

### 2.2. Shoreline debris surveys

All sites were surveyed on both the windward and leeward sides except Tryon Island where only the windward side was sampled. Sampling took place between September 2011 and December 2013. Broadly, shorelines were divided into three zones to determine variation of debris within that shoreline. In each zone, three replicated 50 metre-long belt transects were laid parallel to the shore ( $n = 9$  transects per shoreline) and debris was collected from the high tide mark up to the foredune (approximately 10 m) (Fig. 2). A 5 m gap was left between transects within a zone and at least a 30 m gap was left to demarcate zones.

The start and end of each transect were marked with wooden stakes and a GPS point was recorded to enable repeat sampling to occur over subsequent collection periods. All human derived products were collected from the surface in each transect and placed in labelled bags for later analysis. The minimum size of debris collected was 1-cm (e.g., Corbin and Singh, 1993; Debrot et al., 1999). Heavy items (i.e. dunnage) were often left in-place with length, width, and weight measurements taken (where possible), and marked with the date of the survey and transect location using a permanent marker, so as not to resample in future surveys.

### 2.3. Sample analysis

In the laboratory, collected items were classed according to one of 12 material categories modified from Cheshire et al. (2009) in the UNEP guidelines. These included six plastic types (hard, sheet, fibrous, foamed, rope and medical) and six non-plastic types (fabric, metal,

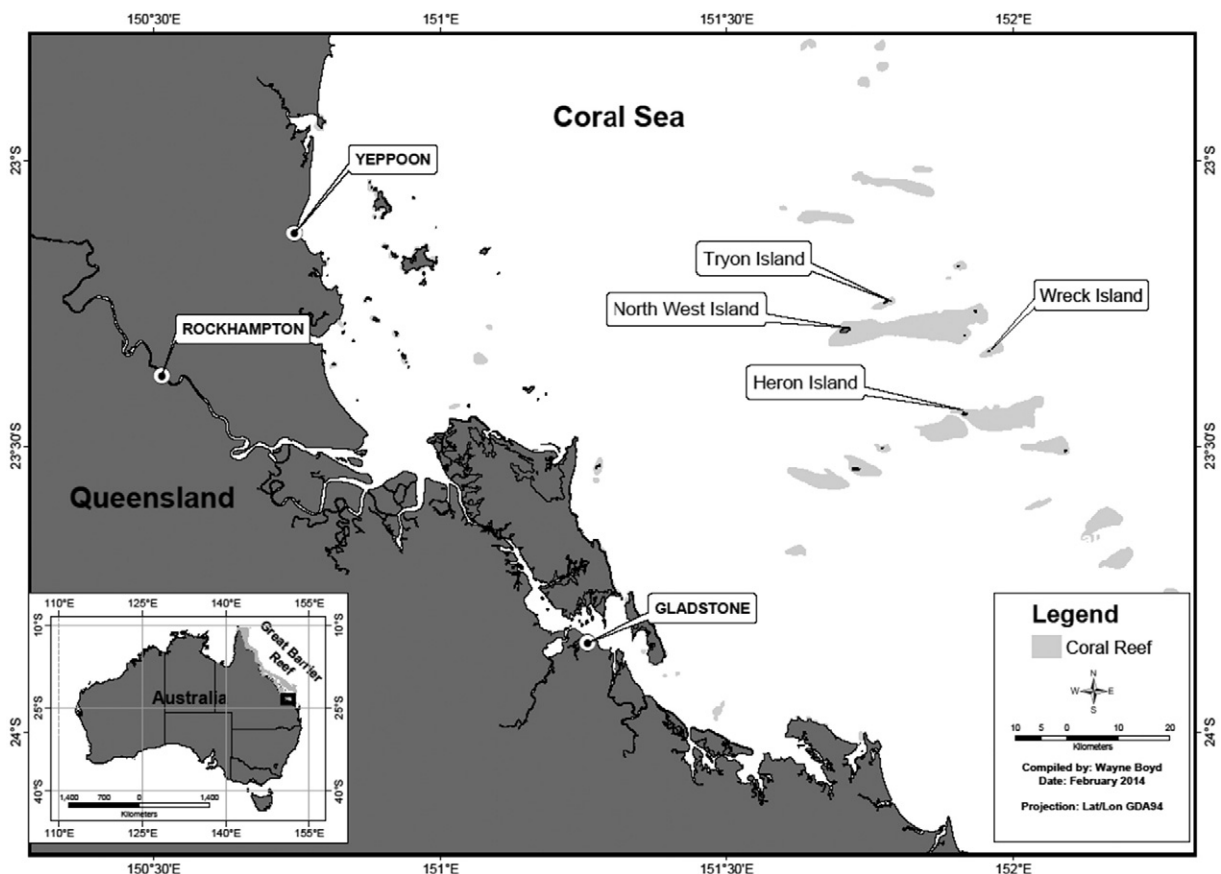


Fig. 1. Marine debris survey locations in the southern Great Barrier Reef, Australia.

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