



Trends in derelict fishing nets and fishing activity in northern Australia: Implications for trans-boundary fisheries management in the shared Arafura and Timor Seas



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ABSTRACT

Fishing is the major human activity within the 'semi-enclosed' Arafura and Timor Seas (ATS). Since the early 2000's, Australia's sparsely populated, remote northern shores have reported very high levels of foreign, fishing-related marine debris. Limited information is available about the temporal and spatial variation of this fishing debris or its origin. We examine trends in derelict fishing nets (and marine debris) at multiple sites in the Northern Territory and Gulf of Carpentaria and, explore its potential origin and relationship with fishing activity in the region. Further, we investigate temporal trends in domestic and foreign fishing activity (legal and illegal) in the ATS and also foreign fishing vessel sightings in the northern waters of the Australian Exclusive Economic Zone (AEEZ). Our results confirm that foreign fishing debris (nets, rope and gear) is the major source of marine debris (63%) on Australia's northern shores. Over the period 2003–2008, a total of 2305 derelict fishing nets were washed ashore; of these, 89% were identified of foreign origin (i.e. manufacture), compared to 11% attributed to Australian fishing vessels or fisheries. Industrial foreign and Indonesian-flagged fisheries – particularly, illegal, unreported and unregulated (IUU) trawling activity – and small-scale Indonesian IUU fisheries (primarily targeting shark) in the Arafura Sea are likely the major sources of these nets. Derelict nets comprised mostly trawl nets (71%) and gillnets/drift nets (12%); with 95% of all identified net sourced from the nations of Taiwan, Indonesia, Thailand and Korea. Our data also supports consistent under-reporting by these foreign trawl operators in the Indonesian Exclusive Economic Zone (IEEZ) of the ATS.

The arrival and increase in derelict nets in northern Australia post-2000 coincided with sharp increases in both industrial foreign fishing (illegal, legal) and Indonesian small-scale fisheries within the IEEZ waters of the ATS. Including, over the period 2000–2007, a 2-fold increase in 'non-motorised' vessels, and a 5-fold increase in the number of motorised vessels, particularly in vessels less than 5GT. Further, this major increase in fishing activity in the IEEZ corresponded to a 3-fold increase in foreign fishing vessels (FFVs) (legal, illegal) sightings in northern Australian waters. Within the AEEZ, derelict net loads and sightings of illegal FFVs, both peaked and reached a maximum in 2005 (188 kg km⁻¹ yr; 6956 vessels) and then sharply reduced (>80%) following major border control, surveillance and security operations in the northern Australia in 2005–2006. However, post-2007, illegal FFV sightings inside the AEEZ have increased again. Significantly, derelict nets and small-scale IUU fishing activity in the AEEZ is linked to a broader pattern of poverty, overfishing and displacement of small scale fishers in coastal fisheries in the Arafura Sea (and South East Asia), due primarily to the expansion of industrial (illegal, legal) trawl fisheries. Strengthening of regional fisheries management (particularly under the RPOA-IUU) is urgently required to tackle IUU fishing, the key source of fishing debris in the ATS. While fisheries capacity reduction is a critical priority, it needs to be supported by a regional multi-sectoral response framed within the context of food security and rural economic development.

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1. Introduction

Marine debris, particularly plastics and lost or discarded fishing gear, has widespread, wide-ranging and well-documented impacts on the ecosystems worldwide (Derraik, 2002; Gregory, 2009; Laist,

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1987, 1997). It not only has direct impacts on fish stocks, wildlife and coastal and marine habitats but also indirect impacts on their ecosystem goods and services, which can affect subsistence fishing, aesthetics and coastal tourism, aquaculture, shipping activities and human health and safety (Kershaw et al., 2011; Mouat et al., 2010; Raaymakers, 2007; UNEP, 2008). Thus, marine debris can result in significant social and economic costs to coastal populations. For example, for the 21 Asia–Pacific Economic Cooperation (APEC) economies, marine debris-related damage to marine industries (fishing, shipping and tourism) was estimated to be US\$1.265 billion per annum in 2008, with loss of tourism alone as a result of littered beaches estimated to be US\$622 million per annum (McIlgorm et al., 2011). Of particular concern is the accumulation of derelict fishing gear (DFG) that has been lost or disposed of at sea, particularly, ‘ghost fishing’, i.e. fishing nets or traps that continue to catch fish (target and non-target species) and wildlife long after they have become marine debris. Indeed, in some parts of the world, ghost net catch rates approach those of gear controlled by fishing operations (Brown et al., 2005; Macfadyen et al., 2009).

The South East Asian Sea region remains a major global priority in the monitoring and management of marine debris (UNEP 2008, Thompson et al. 2011). The data-poor region contains not only some of the world’s highest levels of human population density, population growth, coastal activity and coastal resource dependency but also includes the central Indo–Pacific or Coral Triangle region, which is a recognised marine biodiversity hotspot and global conservation priority (Briggs, 2005; Hughes et al., 2002; Roberts et al., 2002). On the edge of the Coral Triangle, the waters of the tropical and semi-enclosed Arafura and Timor Seas (ATS) are shared by Indonesia, Timor-Leste, Papua New Guinea (PNG) and Australia (Fig. 1). Within these seas, shallow, continental shelves (i.e. the Arafura Shelf, Sahul Shelf), semi-enclosed gulfs (i.e. the Gulf of Carpentaria, Joseph Bonaparte Gulf) and sea-level changes have resulted in strong regional-level connectivity in oceanographic processes, fisheries and biodiversity (particularly in the movements of pelagic and migratory species) as well as in marine pollutants such as debris (Alongi et al., 2011).

Fishing is the major trans-boundary marine activity in the ATS region (Wagey et al., 2009), with many populations within the region being highly dependent on fish as a source of micronutrients, protein, employment and income (Allison, 2011; Alonso et al., 2012; Mills et al., 2013). Indonesia is currently ranked as the world’s second or third most important fishing nation, with a reported catch of 5.8 million tonnes of fish and shellfish in 2012 [considerably more if illegal, unreported and unregulated (IUU) fishing is also considered] (Buchary et al., 2006; Pitcher et al., 2007), with many of Indonesia’s most productive fisheries occurring within ATS (Resosudarmo et al., 2009). In sharp contrast, relatively low levels of commercial fisheries exploitation and indigenous subsistence and cultural harvesting occur along the sparsely populated coastline of northern Australia (Blaber et al., 2009; Field et al., 2009; Williams, 2007). The region (in particular, the Arafura Sea) is also a major hotspot for IUU fishing, which involves both small-scale Indonesian fishermen and foreign fleets of large vessels (Budimartono et al., 2015; Field et al., 2009; Resosudarmo et al., 2009; Salini et al., 2007; Wagey et al., 2009). Small-scale Indonesian fishers have been regularly fishing in northern Australia waters, particularly prior to the establishment of the 200-km Australian Exclusive Economic Zone (AEEZ) in 1979 (Campbell and Wilson, 1993; Fox and Barlow, 1996; Fox, 2009; Stacey, 2007). But illegal incursions has significantly escalated over the past decade (Field et al., 2009), with the decline of local fish stocks in the region (Ainsworth et al., 2008; Fox, 2009; Varkey et al., 2010).

Despite very low levels of commercial fishing activity Australia’s sparsely populated undeveloped, northern shores have, until recently, recorded some of the highest levels of fishing-related

debris and ocean debris and in the world (Kiessling, 2003; Kiessling and Hamilton, 2001; White, 2003a, 2004). Up to 3 tonnes km⁻¹ (of derelict fishing nets) have being recorded (Heathcote et al., 2011; Kiessling, 2003; Wilcox et al., 2013)—as high as that recorded in any other area in Oceania and Southeast Asia (Kiessling, 2003). Derelict fishing nets were first recorded in northern Australia in 1995 (Chatto et al., 1995). Since then, large numbers of derelict nets and increasing numbers of marine turtle entanglements and mortality have been of significant concern to traditional indigenous owners, particularly in Eastern Arnhem Land (northwest coast of the Gulf of Carpentaria) (Alderman et al., 1999; Roeger, 2002; Sloan et al., 1998), with recent modelling suggesting major potential impacts on turtle populations (Wilcox et al., 2014). Although the source of these derelict nets and debris is unknown, the type of nets recorded suggested most of them (>80%) are from Southeast Asia, likely transported via the Indonesian Throughflow (ITF) (White, 2003a, 2006). While other potential sources of marine-based debris exist in northern Australia (i.e. recreational boats, cargo ships, coastal barges, surveillance vessels, offshore oil platforms, rigs and supply vessels, passenger cruise ships, etc.), fishing debris tends to be the most widely and consistently reported type of debris and is of greatest concern to coastal communities in northern Australia (Kiessling, 2003).

Although a few isolated, short-term studies have monitored marine debris in Indonesia (Nash, 1991, 1992; Unepetty and Evans, 1997a,b; Willoughby, 1986; Willoughby et al., 1997), PNG (Smith, 2012) and Australia (Haynes, 1997; Jones, 1995; White, 2003a, 2006; Whiting, 1998), most debris programs in tropical northern Australia have focused on beach clean-ups of ‘ghost nets’ (Gunn et al., 2010; Heathcote et al., 2011), monitoring net entanglements and wildlife rescue, in particular, of turtles (Chatto et al., 1995; Drysdale et al., 2009; Leitch, 1997; Limpus and Miller, 2002; Roeger, 2002; Roeger et al., 2005). More recent studies have focused on estimating and modelling the potential impact of derelict nets on turtle populations (Wilcox et al., 2013, 2014). Thus, there remains a critical lack of systematic monitoring and analysis of long-term trends and impacts, drivers and sources and pathways in ATS (Griffin, 2008; Wilcox et al., 2013). In particular, the source of derelict nets and the relationship between derelict foreign fishing nets and foreign fishing activity (particularly IUU fishing) in ATS remain unknown.

This study represents the first large-scale, quantitative, temporal and spatial assessment of marine debris, discarded foreign fishing nets and foreign fishing activity (including IUU fishing) within the ATS region. We used standardised scientific protocols for debris collection (White, 2003b) and net classification (Hamilton et al., 2002) to analyse trends in marine debris and derelict fishing net surveys over a 6-year period (2003–2008) at multiple sites along the shoreline of the Northern Territory as well as investigated temporal trends in foreign fishing activity (legal and illegal) in AEEZ and IEEZ waters of the ATS and foreign fishing vessel sightings in the northern AEEZ. We used this information to explore the sources of marine debris and its relationship with fishing activity, including IUU fishing, with an aim to understand, mitigate and manage this serious trans-boundary threat to biodiversity, fisheries resources and coastal livelihoods in ATS.

2. Materials and methods

2.1. Study region

The ATS region has a complex bathymetry, climate and water circulation, with diverse shallow- and deep-water habitats, and it is dominated by two shallow continental seas: the semi-enclosed Arafura Sea (approximately 30–90 m deep) and the less-enclosed

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