

# Tackling 'ghost nets': Local solutions to a global issue in northern Australia

By Riki Gunn, Britta Denise Hardesty and James Butler

*The work of Indigenous rangers along Australia's Gulf coast is helping to address the effects of marine debris on local wildlife, and raising awareness of greater efforts needed in the region to address a global issue*



**Figure 1.** Discarded fishing nets are a significant component of marine debris in the Gulf of Carpentaria – and are being removed through the cooperative effort of Indigenous rangers and multiple non-governmental and governmental agencies. Had these nets not been removed, they may have continued to fish indefinitely, possibly entrapping marine animals on an ongoing basis. The maximum weight of a single net mass found to date is estimated at 6 tonnes. (Photo © Dhimurru Aboriginal Corporation.)

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## Introduction

Australia's northern regions are some of the most remote and undeveloped environments in the world (e.g. Halpern *et al.* 2008) and are home to widely scattered Indigenous communities. Until about 25 years ago, coastal communities in the Gulf of Carpentaria region (the Gulf) found very little synthetic marine debris washing ashore on their beaches

(Djawa Yunupingu, pers. comm., 2004). However, since 1993, when sightings of such marine debris were first reported in the Northern Territory (Chatto *et al.* 1995), community concerns have been growing about the increasingly vast quantities of plastic waste, particularly derelict fishing nets, that are washing up on the shores of northern Australia (Fig. 1).

As plastics have become widely used around the world, plastic rubbish

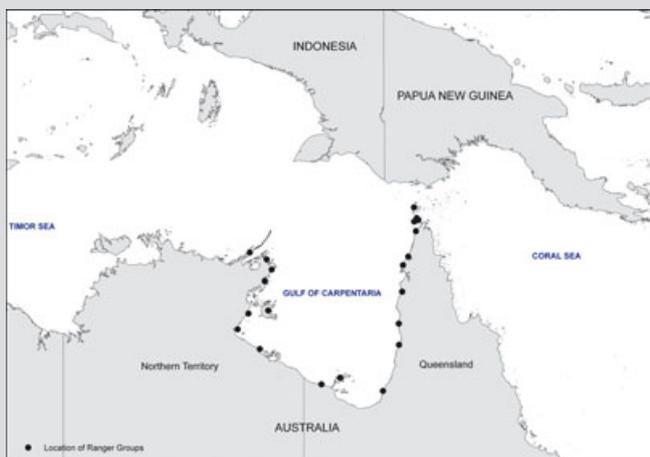
## Box 1. The social-geographic region

This monsoonal northern gulf region is populated primarily by Indigenous communities over a vast and mostly inaccessible coastline and is 85% owned by Indigenous people from more than 25 different settlements (Fig. 2). Access is difficult, with few or no sealed roads; and much of the area is restricted to boat or aeroplane access during the wet season when the few roads are unpassable due to flooding. Based upon census data in the last decade, the region holds fewer than 10 000 residents. Within the region lie four unconnected mining towns at least 1000 km apart. The non-Indigenous inhabitants of the region are mainly itinerant mining workers and a few pastoralists. Because the people inhabiting the region are so connected to sea with respect to culture and livelihood, impacts on the coastline exert a large influence for these remote and isolated communities.

This remote region is characterised by low literacy levels and a high welfare dependency, with some of the worst health issues in the country. Some of these issues are partially due to lack of access to and high costs of fresh food. The present community living style is a result of missionary influence over the last century. Although livelihood practices include subsistence fishing, government services and occasional mining activities, unemployment rates are amongst the highest in the country.

The key aspiration of the people is to be empowered to manage their own clan estates, referred to as 'country'. As explained by Burgess *et al.* (2009) "'Country'" encompasses an interdependent relationship between Indigenous peoples and their ancestral lands and seas...it consists of people, animals, plants, Dreamings; underground, earth, soils, minerals and waters, air...' (Fig. 3).

The empowerment of people to manage 'country' has evolved in the last two decades into a community driven movement known simply as 'caring for country' (P. Josif, pers. comm., 2010). The movement's objective is to promote '...long-term social, cultural, physical and sustainable economic development in rural and remote locations...' through engaging in integrated activities on Aboriginal lands and seas that contribute to the conservation of both cultural and environmental assets (Burgess *et al.* 2009).



**Figure 2.** The Gulf of Carpentaria coast. The CGNP currently involves approximately 90 rangers in 18 ranger groups across the region for beach cleanup and regular patrol activities.



**Figure 3.** Geiza Ah Mat, a ranger, grieving over turtle bones found in a net at New Mapoon (Cape York). The slow death of a turtle on remote and isolated beach in the Gulf of Carpentaria is not an insignificant event. That turtle represents the cultural, social and economic fabric of society. Many species of turtle are important food resources and turtles are an important part of ceremony, dance, painting and local lore. Like all creatures, turtles are part of the broader concept of country. (Photo Gary Luchi.)

has become increasingly common in our oceans (see Mrosovsky *et al.* 2009). Millions of metric tonnes of plastic are produced each year (Thompson *et al.* 2004) and plastic debris can remain relatively intact for a century or more (Derraik 2002).

Such waste can have a direct impact upon populations of marine species at all levels of the food chain through ingestion, entrapment and strangulation (Kiessling 2002; Mrosovsky *et al.* 2009). Large plastic items also have the ability to smother coral reefs and

erode seagrass beds when their drifting path is interrupted (Kiessling 2002). The long time to degradation and the large input of plastics to the marine environment can result in sizable economic effects (Ofiara & Seneca 2001).

One of the key sources of marine debris in the Gulf results from derelict fishing nets comprised of plastic fibres (referred to as 'ghost nets'). These ghost nets are fishing nets that have been accidentally lost, deliberately discarded or simply abandoned at sea; hence, they are not connected directly to any active fishing operation. The appellation 'ghost nets' refers to the derelict action of the net; fishing 'as if by an unseen hand', i.e. ghost fishing. The ultimate aim of the Northern Gulf Resource Management Group's (NGRMG) Carpentaria Ghost Net Programme is threefold: (i) to find a solution to the ghost net problem; (ii) to identify the source of ghost nets; and (iii) to ameliorate their impacts.

Since 2005, the Carpentaria Ghost Nets Programme (CGNP), has been involved in the development of an innovative approach to begin addressing and managing this ecological threat; a threat which is particularly challenging because it encompasses a broad geographic and isolated region with a wide array of local and regional impacts (Fig. 2). Here, we describe the inception of the approach taken for a project that spans the entire Gulf of Carpentaria region, including the western islands of the Torres Strait, which is divided into 18 sub-regions according to Indigenous land-use and ownership (Box 1). In this article, we summarise our work to date and specifically address how utilising local knowledge can help balance local and regional aspirations with the search for global solutions to a widespread problem that has strong cultural, biodiversity, and commercial impacts.

## Size, Location and Nature of the Ghost Net Problem

### The Northern Gulf Region

The Gulf of Carpentaria spans Queensland and the Northern Territory in northern Australia and is comprised of approximately 3500 km of coastline. This Gulf is a large shallow embayment bordered by the Arafura Sea to the

west and north, and Torres Strait to the northeast (Fig. 2). Beyond the Arafura Sea is the countries of Indonesia, Timor Leste and Papua New Guinea. Therefore Australian waters within the Arafura Sea about the jurisdictions of these neighbouring countries.

The natural features of the Gulf, together with its remoteness from significant centres of human population, has made it a haven for a number of marine and coastal animals and includes species whose populations have declined elsewhere. In particular, the Gulf is home to six of the world's seven marine turtle species and four sawfish species, many of which are in decline globally. Two primary species of importance include the endemic Flatback Turtle (*Natator depressus*) and the Narrow Sawfish (*Anoxypristis cuspidata*) which is found in off-shore and coastal shelf waters. Furthermore, the Gulf has some of the largest marine turtle nesting areas in the Indo-Pacific region. For many of the marine species that inhabit these areas, their continued viability in other areas of their global distribution is threatened by human activities such as hunting, egg removal, feral animals, and fishing practices (National Research Council of the United States of America 1990).

The waters of the Gulf of Carpentaria experience high turbidity and seasonally high nutrient levels due to annual freshwater influxes during the monsoonal season, which supports an array of benthic (i.e. living at the sea floor) and pelagic (living in the open ocean water column) species (Department of Environment, Water, Heritage and the Arts 2008). A clockwise gyre current, centred northwest of Groote Eylandt, is a significant oceanic process in the Gulf which exacerbates the problem of ghost nets in the region as it can prohibit ghost nets from escaping the region. Thus, derelict nets in the Gulf become locked into an extended period of 'ghost fishing' until they are washed ashore (White 2003). Even once they have arrived on shore, if the nets are not removed they

may be washed back out to sea, to begin fishing a new.

### The marine debris issue

Synthetic netting was patented by Amita Net Making Company in Japan in 1963, and by 1978 this technology was shipped to China who provided the world with abundant, comparatively inexpensive nets ([www.Amita.co.jp](http://www.Amita.co.jp)). This synthetic netting, along with improvements in other gear technology, navigation equipment, and a better understanding of the biology of fish and their habitats, changed the face of fishing forever by increasing both the scale and efficiency of fishing activities (Kailola *et al.* 1993) and resulted in increased fishing effort worldwide. Such an increase in effort is likely to correspond with an increase in lost and abandoned nets. In addition, synthetic netting poses a greater waste problem than natural fibre nets because synthetic nets tend to be larger, more buoyant and persist much longer than nets made of organic materials such as hemp that degrade more quickly (Macfadyen *et al.* 2009). Thus, plastic netting results in an increased threat to wildlife that extends for a longer time period when lost or abandoned nets persist in the ocean gyre (Brown *et al.* 2005). In fact, under the Environment Protection and Biodiversity Act of 1999, marine debris is considered a key threatening process to many marine species (Department of Environment, Water, Heritage and the Arts 2008).

The presence of ghost nets in the marine environment may be caused by a number of factors, and net loss can differ within and between fisheries. For example, it is estimated that more than two thousand nets are lost per year in one Northern Spain gillnet fishery, whereas another gillnet fishery in the same region reports annual net losses of approximately one hundred nets (Macfadyen *et al.* 2009). During poor weather, gear may be lost at sea; gear conflicts can result in net loss, illegal fishing may result in marine disposal of nets, and vandalism or theft

may further exacerbate the problem. In addition, poor access to shore-side collection facilities has been noted as a reason for increased numbers of lost or discarded nets (Macfadyen *et al.* 2009).

Lost or abandoned nets result in an array of impacts. Marine debris rafts can impede navigation, ghost fishing depletes fish stocks which results in economic losses to fisheries, and the cost of replacing lost nets impacts fishery profits. Other impacts of nets include continued catching of non-target species such as turtles, seabirds and marine mammals, many of which may be already in decline and are currently protected under legislation measures. Furthermore, ghost fishing can also alter the benthic environment and introduce alien species, and costs of beach clean up and removal may further impact businesses (Macfadyen *et al.* 2009).

The Gulf of Carpentaria is particularly vulnerable to ghost net impacts due to the previously mentioned gyre and this vulnerability is exacerbated by the region's proximity to numerous intensive fisheries in the Arafura and neighbouring seas. Fisheries in the region include those managed by Australia, Timor Leste, Indonesia and Papua New Guinea, in addition to foreign vessels that may be operating under flags of these and other countries (McLoughlin *et al.* 1994). Some of the important fisheries active in the region include prawn, mackerel, squid, demersal fin fish, shark and tuna.

While the Gulf region supports a rich and dynamic ecosystem and the geographic isolation is advantageous for biodiversity and species persistence, the same remoteness makes it difficult both to survey and to enforce management in an effort to mitigate threats to biodiversity (Kiessling 2003). While the Carpentaria Ghost-Net Programme addresses a global issue and the vision is towards understanding and ameliorating the impact of ghost nets internationally, the present management response described here takes place at the local scale as

locally Indigenous communities wish to clear nets from beaches as part of their customary responsibilities for looking after 'country' (Box 1). Hence, the desire to protect the environment provides an opportunity for communities and natural resource management agencies to develop partnerships in reducing ghost net impacts to marine fauna.

### CGNP Develops Relationships with Local Communities

In the mid 1990s, sporadic beach cleanups were initiated with three Indigenous ranger groups in the Gulf (Dhimurru, Aninidilyakwa and Napranum) who concentrated their efforts on beach removal of marine debris. As with many new on-ground projects, data collection was irregular. Hence,

patchy records remain of these early clean up efforts. By 2002, the World Wildlife Fund (WWF) developed and published the first identification tool guide to identify net samples (Hamilton *et al.* 2004). With this WWF Net Kit and the introduction of a marine debris monitoring program in the Northern Territory began the first opportunity for systematic data collection and recording of the types of ghost nets that were washing upon Australia's northern shores (White 2003, 2004) (Fig. 4).

By 2004, after 2 years of investigation into issues and mutual concerns around ghost nets, there was widespread recognition that ghost nets were a considerable issue across the entire Gulf and that a more consolidated approach was needed to understand and seriously and systematically tackle the problem.



**Figure 4.** Gumurr Marthakal rangers using the WWF Net Kit to identify ghost net marine debris. (Photo Jane Dermer.)

Thus, a consolidated approach to the issue began with a 2-day workshop with a primary goal of identifying mutually beneficial solutions to as many stakeholders involved in the issue as possible. Of the 75 people present, there were at least two representatives from each of 15 Indigenous communities from the Gulf. Additional stakeholders included representatives from science, government, nature conservation and commercial fishing industries. At the forum, an alliance of 18 Indigenous communities surrounding the Gulf of Carpentaria and Western Torres Straits and three non-government organisations was formed. The Carpentaria Ghost Nets Programme, as the alliance was named, has since mobilised a mixture of Indigenous ranger groups, council workers, community members and volunteers to achieve the following aims:

- 1 Restore 'sea country' (see Box 1) in the Gulf to its presumed former health by securing external funding and other resources for communities to remove ghost nets.
- 2 Coordinate Indigenous community efforts so that they can support each other in achieving the first aim.

### Making the partnership work

Working in a large remote region brings many challenges to the project including seasonal restrictions due to poor local roads (which means that most of the work has to be done either during the dry season or with the use of a vessel); limited access to equipment (which depends on the communities' proximity to towns, mines or their own organisational set-up); limited numeracy and literacy in English amongst individuals (although some speak up to eight languages); and limited access to a workforce on demand (which depends on proximity to a large town and governance of local organisations).

The CGNP has worked to overcome these issues by: (i) developing a culture of engagement built on a solid

foundation of trust; (ii) providing resources and/or infrastructure; and (iii) building capacity for rangers. By actively listening and soliciting feedback early on in the project's development, the CGNP has been better able to understand the local region and hence meet local needs. This creates an engagement based on trust which means partners are better poised to achieve success in working towards a shared goal (Box 2, Fig. 5). The CGNP also assists rangers in removing nets by building the infrastructure that enables the local people to address the problem in the country. This includes assistance such as providing vehicles for local transport of resources and ghost net removal, providing the tools and training required for data collection, and coordinating repeated visits for multiple ranger groups across the broad geographic region. The capacity building supported by the CGNP and other agencies enables rangers to perform other important work that is important to 'healthy country' such as border protection, quarantine services and control of invasive weeds and feral animals. These combined activities broaden their overall skill set and, importantly, increases pride in their land and livelihoods.

### Identifying sources of the nets

The CGNP staff and rangers have been using the WWF Net Kit to identify nets to region of origin wherever possible. The diverse ranger groups have provided an excellent opportunity to road test the WWF Net Kit for accuracy and practicality in the field. This Net Kit has been an invaluable tool for improving the rangers' understanding of the nature and global extent of this problem. In at least one community to date, the WWF Net Kit has also been used as an educational resource and opportunity for teaching school children the importance of learning numeracy (measuring net samples), literacy (reading the guide), geography

(where the nets are coming from), as well as creating an opportunity for traditional knowledge to be passed on (working with elders).

Data collected to date by the CGNP have allowed us to identify the abundance and distribution of ghost nets in the Gulf. In doing so, we have ascertained the probable origin of approximately 45% of the nets based on the WWF Net Identification Kit. Nets found to date have originated from at least six countries (Fig. 6). Samples of all ghost nets removed have been catalogued to create baseline data from which future targeted ghost net prevention and mitigation methods can be measured.

## Achievements to date

### Physical and environmental

As of November 2009, approximately 5532 ghost nets (amounting to about 90 000 m of net) were removed (along with other accumulated rubbish) from both the shore and shallow waters along the Gulf. This is important because an estimated 73–90% of marine debris (by weight) in the Gulf is derived from ghost nets (Kiessling 2003) and failure to remove nets can result in nets returning to the sea to continue the ghost fishing cycle. Wildlife found and recorded as entangled in ghost nets include Hawksbill, Green, Olive Ridley and Flatback turtles, a Dugong (*Dugong dugon*) a Water Buffalo (*Bubalis bubalis*), and a crocodile (*Crocodylus porosus*), as well as a sawfish, hammerhead sharks, sea snakes, and hundreds to thousands of crabs. All of these taxa are known to occur inshore in shallow waters. Aside from crabs, marine turtles account for 90% of marine life recorded in the nets, with Olive Ridley and Hawksbill turtles accounting for 87 of the total number of marine turtles ensnared, identified to species and documented by the Carpentaria Ghost Net Programme: not all animals ensnared have historically been recorded, though recent improvements and standardisation in

## Box 2. Two-way learning

**Two-way** learning takes place not only in terms of learning and communication styles, but also through humour, innovation and flexibility. The CGNP works individually with each group to design tailor made solutions and we create tools that use humour to convey messages and respect personal differences. We adapt. On-ground activities are planned individually by each ranger group with support from project officers. Tools such as data sheets must also respect variations and limitations of individuals and groups yet still aim to establish reliable, repeatable data collection information. Visuals and humour are two of the strategies used to overcome these difficulties. For example, in our field manual we use comic figures to describe certain aspects of the data collection or to drive home a particular point. This resonates with the ranger groups and helps to keep them interested and engaged in the project.

Through a culture of engagement that respects that everyone has knowledge to share it is possible to design flexible and tailor-made solutions to achieve common goals: we are learning from people who understand their local region and its people; and the rangers are learning skills that they can continue to use for working on country. Although the work is physically demanding and requires applying new skills learned, the fact that more than 90 rangers have taken up this work demonstrates the depth of this culture of engagement and pride in working on country.



**Figure 5.** Gumurr Marthakal rangers from the Wessell Island Group and Project Officer Lisa Hamblin planning field work in Marthakal sea country. 'Sea country' or 'saltwater country' is an Indigenous expression denoting all coastal and marine ecosystems including their clan estates. (Photo CGNP.)

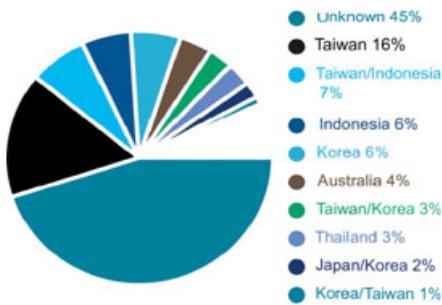
record keeping have been put in place to address this issue. Other entangled turtles recorded to date include 12 Green turtles and three Flatback turtles. Given the threatened status of some turtle species, losing even small numbers to ghost nets and other marine debris can potentially have impacts at the population level. Since the project's inception, 52% of ensnared

turtles have been rescued and released alive.

### **Social achievements and benefits**

Bringing Indigenous communities together to find novel solutions to complex problems has been an important aim and achievement of the project to date. The CGNP coincided with a

groundswell of activity surrounding the desire for Indigenous people to work on country to perform conservation and land management activities. This ghost net issue became the impetus to create an extensive network of Indigenous rangers. Rangers are employed from more than three-quarters of the coastal communities in the region. To date, training has



**Figure 6.** Nets being assigned by rangers to each region of origin using the WWF Net Kit.

involved more than 90 working rangers and more than 50 other community members, including volunteers and council workers who are actively engaged in the program. In total, beach cleanups have been scattered throughout the region across approximately 1200 km or 34% of the region's 3500 km coastline.

The success achieved to date has required the attainment of a novel set of skills and knowledge for rangers. Consequently, the project has been instrumental in building the rangers' capacity and knowledge and includes transferable skills such as project planning and implementation, data collection, and, fundamentally, ghost net identification. The project is also assisting in the establishment of institutional frameworks such as 'fee for service' which is way of remunerating for service performed, while simultaneously removing the 'handout' mentality fostered by decades of welfare dependency. Opening channels of communication between culturally disparate communities creates opportunities for rangers to exchange knowledge through meetings, summits, job skill acquisition and attendance at exchange programs. This better enables rangers to steer the course and direction of the ghost nets project and their own futures.

Although the work is demanding and was previously outside the realm of experience for most of the rangers involved in the project, the uptake by the rangers demonstrates the high

level of individual motivation and the desire to contribute to the management of their country, in addition to the importance and success of this project. The approximately 90 rangers involved in the CGNP are now resourced and trained in technology and skills that can be transferable to other job sectors including data collection methodology (both written and electronic) and the use of tools such as GPS tracking technology that will enable them to perform regular patrols by both land and sea to remove and catalogue incoming nets as well as continue to restore previously untouched coastline. Incidentally, raising awareness about the ghost net issue has also raised the profile of the rangers as being 'doers' and has increased the desire of people in the region to participate in the program, thus extending the programs' capability and likelihood of increased success.

Similar initiatives have shown considerable health and well-being benefits. For example, in the Northern Territory the 'Healthy Country, Healthy People' initiative has demonstrated that rangers taking part in customary and contemporary land and sea management practices, particularly those living in traditional homelands, were much healthier; health benefits included lower rates of diabetes and lower risks of cardiovascular disease (Burgess *et al.* 2009; Garnett *et al.* 2009). This has confirmed assertions that 'caring for country' activities can have significant mutual benefits for Aboriginal health and biodiversity (Burgess *et al.* 2005). Hence, we are hopeful and optimistic that the CGNP is having similar benefits for the ranger groups involved.

Another means of growing the CGNP project has been through developing a novel industry which provides income from artwork. An entire cottage industry is being developed (GhostNet Gear) in which ghost net debris is fashioned into baskets, bags, wall hangings and an array of other imaginative tangibles (Box 3, Fig. 7a-c). Indigenous women and

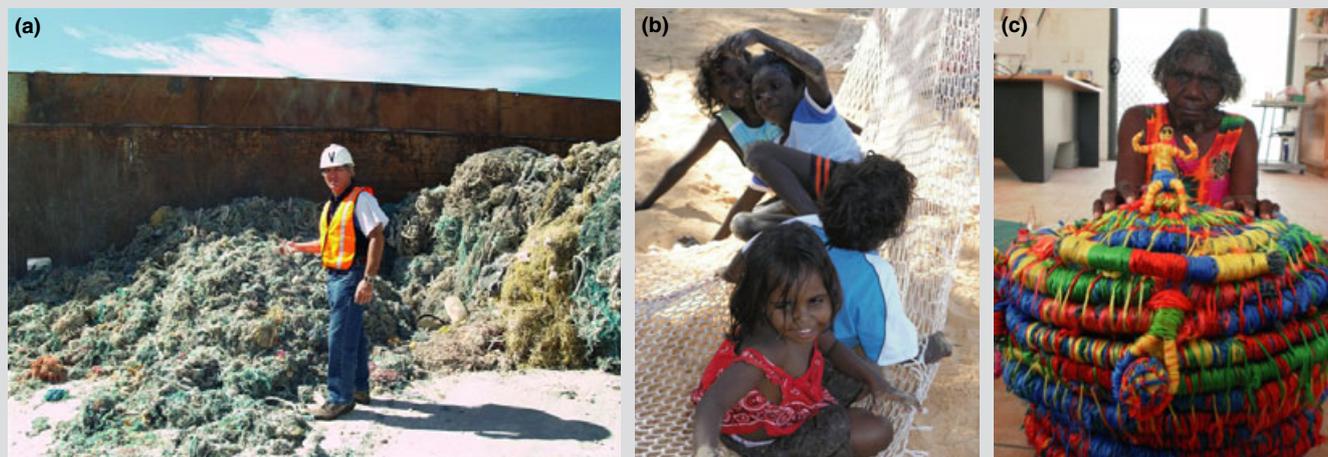
men are gaining new livelihood skills in four remote communities across northern Queensland, and a recent exhibition brought more than sales to these artists: media recognition facilitated regional, state wide and international education and recognition about the ghost nets issue. In addition, this newly developed GhostNet Gear enterprise has attracted the attention of the Centre for Remote and Rural Mental Health Queensland. The CGNP is now working with health professionals to provide creative recovery workshops that use craftworks. In this case, basket weaving for improved mental health.

### Raising the Profile of the Issue at Home and Abroad

As the analysis of the origin of ghost nets has shown using the WWF Net Kit, only 4% of ghost nets that have washed ashore in the Gulf of Carpentaria are of Australian origin. The other 48% of identified countries contributing to the problem include Thailand, South Korea, Japan, Indonesia and India. Hence, international fisheries may be contributing to the problem disproportionately. Consequently, while the CGNP and its ranger activities could be seen as a successful local response to a symptom of the problem, addressing the underlying cause and ultimately solving the ghost net and marine debris problem will require multiple approaches that lead to an integrated response to tackle the international and regional pressure of ghost net loss.

The CGNP's perspective can be conceptualised through the driver-pressure-state-impact-response framework (e.g. Bowen & Riley 2003) (Fig. 8). For the ghost net problem the driver, international demand for fish protein, is creating a pressure at the international and regional scale in the form of fishing effort and net loss. Ghost nets are exacerbating the declining state of threatened species at the regional (northern Australia) and local (Gulf of Carpentaria

### Box 3. Creative solutions: GhostNet Gear



**Figure 7.** (a) Ghost net debris for recycling (b) Kid's choice for their favourite ghost nets reuse product: a hammock (c) A top selling basket made by Cecelia Peter from recycled ghost net materials. [Photos (a) Gary Luchi; (b) Jane Dermer; and (c) Sue Ryan.]

**Disposal** of ghost nets has proven to be a very difficult proposition due to the remoteness of northern Australia from major markets. Mostly the nets have been taken to local landfill sites where they are eventually buried or burnt *in situ*. The project team investigated all avenues of current recycling initiatives, including visiting the USA on a Churchill Fellowship to develop other potential opportunities for recycling. Because all Australian factory outlets are located thousands of kilometres away in the southern states, the cost of freight transport of the raw product is a prohibitive factor [>>\$1700 to freight 2× baulker bags (~200 kg) of net pieces from Cairns to Adelaide, for example]. Our conclusion was that if anything was to be done to re-use ghost nets then it would have to be a product that has a ready market and made near the source.

In 2006, the CGNP held an Engineering Competition: 'Design for a Sea Change', to find a solution to this dilemma. The winning entry was a woven guitar strap that utilised not only the ghost net material but also other marine debris such as thongs & tyres. The guitar strap concept was favoured because it could be expanded into other products such as bags which could be made within Indigenous communities with little or no initial outlay by the community. The collection of marine debris, as part of the CGNP, would deliver the raw materials for this initiative. Importantly, increasing the publicity of 'GhostNet Gear' increases public awareness and education around this issue.

Two workshops developing this concept were trialed with two different art mentors in completely different communities. The first workshop was an obvious success as 6 months later the CGNP received a request for labels for the bags which the local artisans were selling locally for \$30–\$40 each through a tourist outlet. The second workshop produced a range of items including a large communal showpiece and three baskets. At a subsequent exhibition showcasing the baskets two were sold to art galleries; the first sold for \$2500 to a London collector and the other to an Australian collector for \$1600. There is now interest for further exhibitions from galleries in Sydney, London and Germany and GhostNet Gear is in demand.

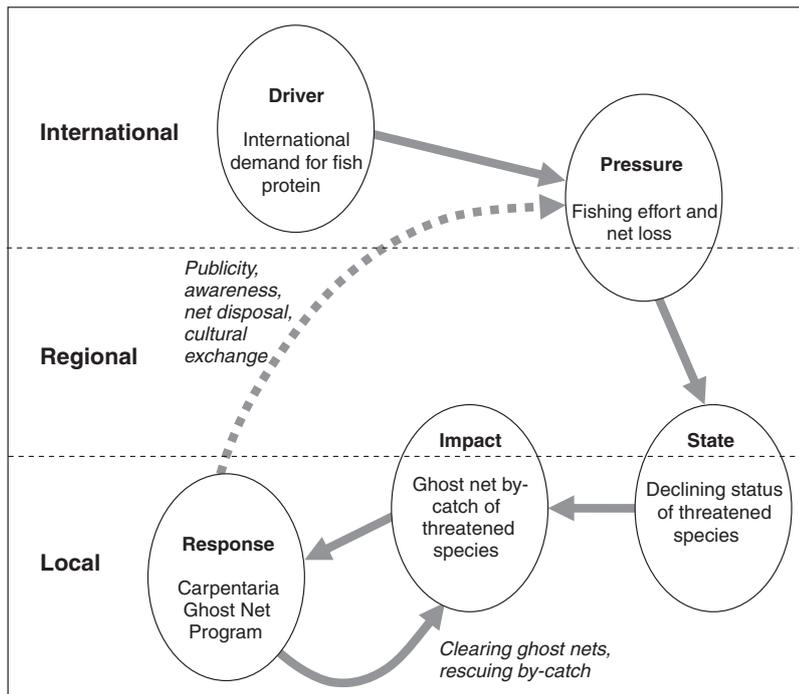
The inventiveness and scope of 'GhostNet Gear' products is as large as the imagination and supply of nets. Ghost net fibres are not confined to being woven or knotted but can also be melted and used for a variety of innovative purposes. The potential for this project to escalate and lead to both an ecologically sensitive enterprise in Indigenous communities and land conservation is very high. The concept is also marketable and could be employed internationally to create incentives for fishers to take their nets home.

Indigenous communities) scale, resulting in a regional and local impact on those species. While rangers are responding to the local impact by clearing ghost nets from beaches and rescuing by-catch, the international and national source of the pressure still needs to be addressed. The CGNP is aiming to contribute to this by not

only attempting to identify the sources of ghost nets, but also by encouraging publicity, awareness-raising and cultural exchange within and beyond Australia.

To date, for example Australian media coverage has raised the profile of the ghost nets issue by bringing it into the public eye. This, combined

with policy development arising from the provision of CGNP information to government (see DEWHA 2008, 2009), has contributed to a growing national and regional awareness of the problem. Information CGNP has provided to the Australian government has already contributed to increased surveillance and deterrence in the



**Figure 8.** The ghost net problem viewed from the CGNP perspective through the driver-pressure-state-impact-response framework, relative to spatial scales. Publicity, awareness, net disposal and cultural exchange are the cross-scale responses on which the CGNP is now focussing, but effective action requires partnership at the relevant national and international scale. [Diagram adapted from Bowen and Riley (2003).]

bilateral regions of the Arafura Sea of illegal unregistered and unreported fishing vessels: correspondingly, there has been a recent decline of reported floating gill nets and illegal fishing vessels.

Regionally and internationally there are significant efforts already in place to prevent and mitigate the impacts of marine debris. For example, measures to reduce marine debris such as gear buy backs, bins in ports, gear marking, zoning, etc., have been implemented throughout the world (Macfadyen *et al.* 2009). In addition, measures to reduce wildlife impacts have been implemented such as turtle exclusion devices fitted to prawn nets to reduce unwanted by-catch, fishery observer programs to document by-catch as well as to train fishers in proper handling techniques for ensnared wildlife, and acoustic devices that are regularly used to deter cetaceans. Overall, however, the quantity of marine debris (including ghost nets)

continues to increase. Given that the majority of measures implemented to date tend to be top-down government approaches to management and the quantity of marine debris is still increasing, current regulation and fisheries management efforts appear to be insufficient in stopping the ghost net issue.

Increasing the profile of this problem in cross-country talks is an important potential driver for providing additional top-down regulation and developing incentives to mitigate this issue. However, bottom-up changes to the culture of net disposal are also important, particularly when combined with increased incentives for disposing of nets in an appropriate fashion. In South Korea for example, there is a buy back program for old nets and other marine debris to encourage return rather than discarding of old nets or marine rubbish found at sea (Macfadyen *et al.* 2009). One example of success in this area to date in Australia involves a proactive

northern prawn fishery company who, as a result of understanding the ghost net problem, independently elected to change their net colour for a short period of time (approximately 2 years) to a colour that can be uniquely assigned to their company (O'Brien M, pers. comm., 2007). The understanding is that if derelict nets are found that can be attributed to them, the company can take direct internal action to address the problem. This simple change in practices can have far-reaching implications and is one we hope will be widely adopted by other forward-thinking companies not only in Australia, but internationally as well.

## Emerging and Future Directions

The CGNP has grown in both scope and development over the 5 years since its inception. From a small grassroots approach to a multi-faceted project that has gained international recognition. Our current focus for the future includes not only increasing community engagement to encompass additional ranger groups, expanding our geographic extent and activities such as the GhostNet Gear enterprise (Box 3) but most importantly, it includes finding ways to improve fishing practices both locally and internationally. Because such a large proportion of the nets originate overseas (Fig. 6), one key response is to facilitate a cultural exchange between overseas fishers and local rangers so that both understand the challenges and impacts each faces in their respective cultures and livelihoods. We have a new partnership for example, with an Indonesian sea turtle conservation and monitoring Non-Government Organisation in Aceh, Sumatra (see <http://www.acehturtleconservation.org/>). Our first activity will be to send two Indigenous rangers from Australia's Wessel Islands to Aceh to engage with local Indonesian fishermen and commence a process of cross cultural exchange.

When complete, our dataset will document the survey effort, community involvement, nets encountered (with origin as assessed using the WWF Net Kit) as well as wildlife entanglement across the entire Gulf of Carpentaria. These data will be provided to the relevant agencies including the Coordinating Body to the Seas of East Asia (COBSEA) unit of the United Nations Environmental Program to assist in the development of targeted preventative measures to stop the source of ghost nets by international agencies. To ensure the adoption is based upon the strongest information possible, we are striving to standardise data collection and employ quality control practises amongst ranger groups. By working with the Australian Commonwealth Scientific and Industrial Research Organization (CSIRO) to improve the rigour of data collection and depth of data analysis, we will be better able to address multiple questions around ghost nets such as the origin and pathways of travel of discarded net debris and their potential impacts on marine fauna.

## Conclusion

The Carpentaria Ghost Net Programme is an initiative which focuses on a multi-scale problem of global significance. The project began by building a local response to the impact of ghost nets which has generated significant collaboration across a large geographical area of northern Australia and amongst numerous disparate Indigenous communities and partners. By building on a common desire amongst these communities to 'care for their country', a large network of Indigenous ranger groups that contributes to resolving the ghost nets issue has been established. This network has generated remarkable engagement, participation, commitment and livelihood benefits amongst the communities and ranger groups which can be consolidated and expanded in coming years. The CGNP's additional focus will be the reduction of ghost nets lost

or discarded at sea. By putting in place long term management measures to ensure consistent monitoring efforts, we can track ghost net debris arrival and change through time. By encouraging and continuing a culture of care, we can strengthen communities' abilities to address these issues at a local level while undertaking global outreach. By embracing two-way learning and facilitating novel approaches to problem solving, we work with various cultures to facilitate and enable local gains. Our take-home message is that one cannot isolate the environment from cultural and socioeconomic issues of the region. Like the unique ghost net baskets, the strength to find solutions will come from the interweaving of partnerships, both at home and abroad.

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**Summary** We describe the inception and development of the Carpentaria Ghost Nets Programme, located across the Gulf of Carpentaria, which spans north Queensland and the Northern Territory. The program has grown from a small grass-roots idea addressing issues around marine debris to become an internationally acknowledged project headed by the Northern Gulf Resource Management Group. This program, involving more than 18 Indigenous communities and over 90 Indigenous rangers, has become a way of building bridges across cultures and communities for a shared, common interest in land and sea protection. By incorporating traditional values and approaches to managing an international issue at a local scale, we have worked with local communities to increase pride and ownership on country whilst providing transferrable job skills. Success of this program ultimately depends upon the continued active engagements of the Indigenous communities and ranger groups. The project aims to address the fundamental issue of tackling the ghost nets problem at its source through cross-cultural interactions between rangers and fishermen, increasing public, political and economic awareness, and ultimately reducing the incidental and intentional loss of fishing nets that act as ghost nets and result in tremendous biological, cultural and economic impacts. By putting in place long term management measures to ensure monitoring efforts, we can track ghost net debris arrival and changes through time, providing information to policy and cultural changes at regional and international scales.

**Key words:** *derelict fishing nets, GhostNet Gear, indigenous livelihoods, marine debris, threatened species management.*