

Turtles in Trouble – the argument for sea turtles as flagship species to catalyse action to tackle marine plastic pollution: case studies of cross sector partnerships from Australia and Galapagos

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Introduction

Plastic pollution in our oceans is a global issue that has gained a high level of public awareness in recent years. Estimates of the amount of plastic entering marine ecosystems annually range from 9-12 million tonnes (Jambeck et al. 2015). This pollution has a significant economic impact with damage to marine industries, tourism and cost of clean-up at about USD 13 billion (UNEP 2014) annually. Moreover, the greatest concentrations have been found in remote, well protected places (Kane et al. 2020). Environmental damage and impact on biodiversity is increasingly well documented with plastic being found in every marine habitat and food web tested. The scientific literature on the subject stretches back to the 1960s but it was not until significant accumulation of plastic in oceanic gyres was discovered in the late 1990s that impacts on seabirds and other marine vertebrates species received increased

research effort. The issue became further highlighted to the public and policy makers when the extent of microplastics, particles of plastic less than 5mm, in marine systems became recognised in the mid-2000s (Law & Thompson 2014). By the late 2000s, a growing body of research pointed to the scale of the problem but few if any policy responses were evident, even by the 2010s. In response, UNEP produced policy maker guidance intended to catalyse evidence-based change (UNEP 2016), but in the UK at least it was not until the BBC's Blue Planet 2 series highlighted the issue in 2017 that it was propelled into the spotlight. The BBC team used emotive, visually impactful stories narrated by Sir David Attenborough to illustrate the magnitude of the problem and it became, almost overnight, embedded in the public consciousness, with politicians and policy makers alike seemingly falling over themselves to champion change in subsequent weeks after the programme aired. Professor Richard Thompson, a prolific expert on the subject, said that "in my view, a few minutes of coverage by Blue Planet II has done more to raise awareness than the decades of underlying research could ever have done alone" (Thompson 2019).

While many parts of the world were as slow as the UK to accept the radical changes needed to happen in our relationship with plastic, at least two very contrasting places on opposite sides of the Pacific were, and continue to be, ahead of this curve and have done this without a figurehead like Sir David or a blockbuster TV production. In both cases, concern for turtles has driven research, innovation and outreach that have resulted in a groundswell of community support, leading to policy and broader behavioural change. We present summaries of these two ongoing case studies, supported by other examples globally, that suggest that turtles can be used as effective flagship species to maintain and support the momentum for change in our use of single use plastics provided by Blue Planet 2 and other media campaigns such as Plastic Ocean.

Case study 1

Australia

In 2006 Dr Kathy Townsend, then manager of research and education at the University of Queensland's Moreton Bay Research Station, was brought a young, sick green turtle that was found washed up on the beach by a member of the local indigenous Quandamooka community. After not responding to triage or a rehydration drip, the emaciated turtle died overnight and Kathy performed a necropsy. She found the 22cm 'lost years' age class turtle had over 40 items that were predominantly plastic in its gut with the cause of death probably due to gut impaction leading to infection and resultant septicaemia (Fig. 1). The volume of debris found in the gut of this young sea turtle was disturbing, as an individual of this size spends very little time near

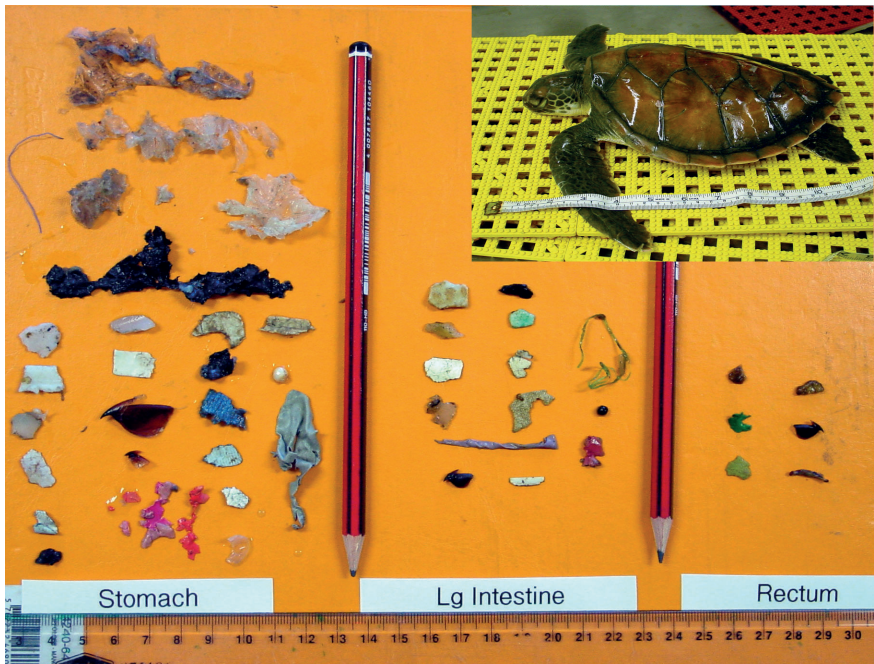


Fig. 1. The Moreton Bay 'lost years' green turtle examined by Dr Kathy Townsend.

the coastline, instead spending up to 15 years slowly drifting across ocean basins, feeding on food found in the top two metres of the ocean, hence the nickname 'lost years'. Subsequent necropsies of different age classes of turtles of different species brought to the station by volunteers often showed ingestion of plastic as the root cause of death. Over the next few years Kathy set out to understand the issue in more depth and build a data set that would allow more robust analysis. She recruited local community volunteers to both collect dead turtles for necropsy and conduct beach plastics surveys to determine how the types of plastic rubbish found in the local environment related to those occurring in turtle guts.

Central questions included whether the debris found in turtles' digestive tracts was similarly diverse to that on beaches, or if they were selecting for certain types and colours of marine debris. It was through this line of questioning that Kathy and her team found that plastic bags (and other film-like plastics) and balloons were the two items that were ingested most frequently by the sea turtles and hence were causing the greatest impact on the species (Schuyler et al. 2012). The team took a pragmatic approach: plastics are never going to be completely removed from society, so they set out to determine which items ones were causing the greatest impact on sea



Fig. 2. 'Turtles in Trouble' became a multi-partner research and outreach programme engaging students, corporate volunteers and schools in beach survey and necropsy.

turtles. Additional visual studies narrowed this selectivity down even further to discover that it was transparent and white plastic bags and white balloons that were favoured over all other colours (Schuyler et al. 2014).

During the course of the study the army of volunteers expanded in both number and source, including community members, school-age students, university students, corporate volunteers and local politicians. These volunteers contributed an estimated 4,800 person hours to the project in Moreton Bay and the surrounding area over a six year period. Partnering with local public aquaria, fishers, community groups, NGOs and government agencies to access supporting data, the 'Turtles in Trouble' project evolved into a jointly-owned investigation with multiple partners, champions and channels of communication (Fig. 2). The project attracted NGO, philanthropic, corporate and government research funding that built sufficiently to allow greater research capacity through studentships, leveraged funds and infrastructure. Results supported by powerful images, narratives and impactful first-hand experiences of participants drove media content, pushing the plastics issue higher up the political agenda, to the point at which it became a bipartisan issue, with both sides of Australian politics throwing their weight behind the campaign (Fig. 3). In 2010, the collaboration extended to the Australian Federal Government's research agency CSIRO. The CSIRO team successfully led a bid, with NGO partners, to extend the study area from Moreton Bay to



Fig. 3. Examples of sea turtle images used for the campaign to ban plastic bags in Australia between 2017 and 2019.

the whole of Australia. Surveying every 100km along the coast, the team conducted the world's first continental-scale coastal marine debris survey, including offshore surveys (Fig. 4). Necropsies on turtles were extended to other marine vertebrates, including sea birds, with Moreton Bay acting as a hub (Acampora et al. 2014; Roman et al. 2016, 2019). Through the CSIRO 'Teach Wild' programme more than 200 high school teachers were trained and over 7,000 school students were involved in beach surveys. To date, 246 sea turtles have been necropsied by Kathy and her team, with a further 706 records from the national standings database examined. This approach led to a global hotspots analysis of sea turtle ingestion of marine debris (Fig. 5). Results showed that over 30% of Australian sea turtles necropsied had ingested marine debris, with young of all species and particularly omnivorous species most impacted. Data suggested that on average 14 pieces of plastic resulted in a 50% mortality rate (LD50) and an individual turtle has a 22% chance of mortality from ingesting just one piece of plastic (Wilcox et al. 2018). Data from the CSIRO survey had previously shown that rubbish on Australian beaches was, contrary to popular belief, nearly all of

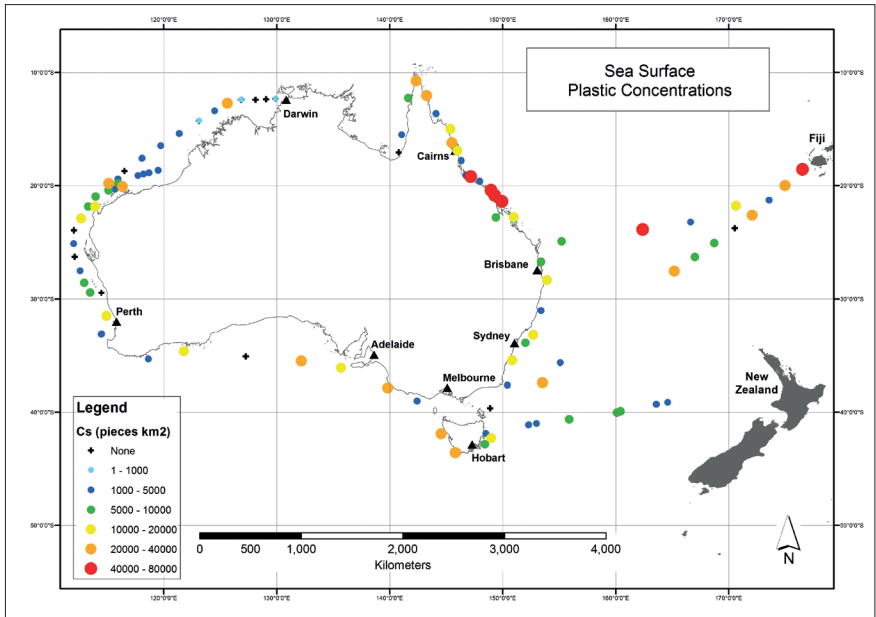


Fig. 4. TeachWild beach and offshore survey results (Ref CSIRO Earthwatch).

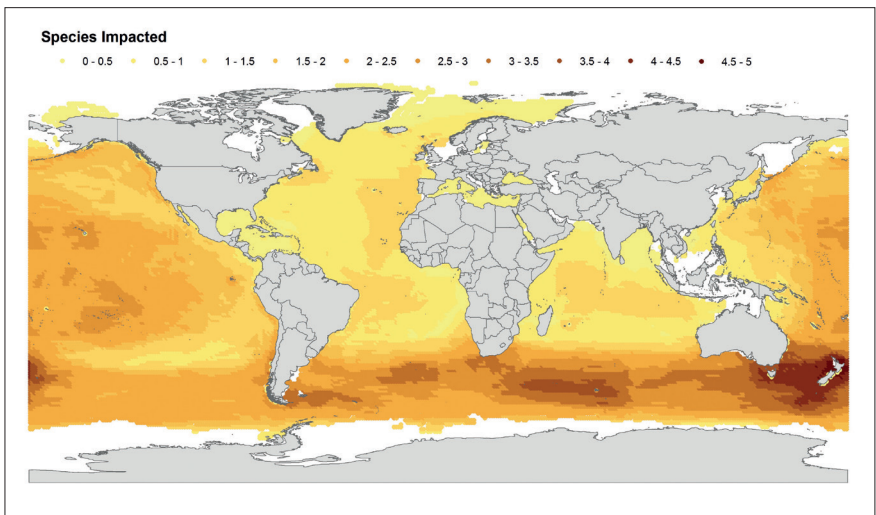


Fig. 5. Global risk analysis for sea turtles ingesting marine debris, showing the Indian Ocean and the east coasts of Australia, Africa, and the USA are among the global hotspots for sea turtle marine debris ingestion (Schuyler et al. 2016).

local origin (Hardesty et al. 2016). Therefore, the key underlying message was that Australian rubbish was killing Australian turtles.

Data from *Turtles in Trouble*, and *Teachwild* as the CSIRO survey was known, continue to underpin advocacy, media campaigns and ultimately Australia's response to marine debris. More than 11 peer reviewed publications have resulted, with media audiences reaching millions across the world and data sets informing risk and plastic studies beyond Australia (Schuyler et al. 2014a, 2014b; Vegter et al. 2014; Hardesty et al. 2016; Schuyler et al. 2016; Van Sebille et al. 2019).

Campaigners in Australia will acknowledge that there is a long way to go in changing ingrained behaviours in some of the populace but policy changes indicate a significant shift in political attitude. Additionally, the focussed, pragmatic approach that the team took in identifying those plastic products that had the greatest impact on the overall health of the sea turtles allowed for targeted campaigns which resulted in a wide range of legislative changes from local council to federal levels. For example: mass helium balloon releases were banned in Queensland in 2011, and in 2019 the Australian Bureau of Meteorology converted from white to blue weather balloons in a response to the research conducted around colour selectivity of sea turtles – a policy that could be taken up by weather stations globally. In just over 10 years after the first sea turtle was necropsied to reveal a wide range of plastic items, single use plastic bags have been banned in all states bar Western Australia, and container deposit schemes have been introduced in most states. The issue was raised to such importance that it was a key talking point in the Australian Federal and State electoral debates of 2019. Marine debris is now regularly included as an issue of concern in environmental management plans.

Case study 2

Galapagos, Ecuador

In 2016, Juan Pablo Muñoz-Pérez, a researcher at the Galápagos Science Center (GSC), Isla San Cristobal, Galápagos submitted a proposal to the Galapagos Conservation Trust (GCT) in the UK for funding to investigate the sources and drivers of marine debris on Galápagos beaches. While gathering data for a turtle ecology project, Juan Pablo had been increasingly concerned about the levels of plastic contamination on beaches, particularly on the exposed high energy south eastern rocky and sandy areas of San Cristóbal Island. Juan Pablo's 2016 proposal was guided by the Australian CSIRO marine debris team who had visited Galápagos the same year at the invitation of the Directorate of the Galapagos National Park (DGNP). DGNP is the authority responsible for all management aspects of the Galápagos National Park (GNP) and the Galápagos Marine Reserve (GMR). The director



Fig. 6. From 2017-2019 the 'Science to Solutions' workshops were held in Ecuador, bringing together international experts, local agencies and communities focussed on marine plastic pollution in Galapagos.

at DGNP was becoming increasingly concerned at the unknown level of risk that marine debris posed to the unique biodiversity and integrity of the GMR and what the most appropriate response to it should be.

Subsequently, results from early investigations into the litter on Galápagos beaches suggested that it originated from all over the world including Costa Rica, Panamá, Russia, India, Chile, and Colombia and with the majority of records from Ecuador, Perú and Asia (Muñoz-Pérez & Hardesty 2016; Muñoz-Pérez 2017). Faced with such a global influx the scale of the problem seemed overwhelming and risked paralysing the response of already over stretched authorities. A consultation process was initiated by GCT which resulted in a series of workshops in 2017-2019 hosted by USFQ, DGNP and the Charles Darwin Research Centre (CDRS). The 'Science to Solutions' workshops brought together international experts with local authorities and sought initially to build consensus on the scale of the issue, what existing initiatives and capacity were in place, and also to learn from international experience (Fig. 6). The outcome was a greater understanding of what was required, and a network was formed under the banner of 'Plastic Pollution

Free Galapagos'. Outputs included a joint vision to become a showcase reserve for the world's best practice in management of marine debris and a roadmap with a draft research plan to achieve this, based on a series of pilot projects. Pilot project results have now focussed efforts on three main sources of debris, in order of significance of input:

- i) the catchments of Southern Ecuador and Northern Peru
- ii) industrial fishing fleets in international waters surrounding GMR and
- iii) to a much smaller degree, the residents and tourist population of the islands themselves (Van Sebille et al. 2019).

Results have also generated the development and application of innovative monitoring and mitigation methodologies including the use of drones and development of sophisticated modelling tools to direct clean up. Novel multidisciplinary approaches are providing useful research as well as outreach tools. The latter include combining archaeology and oceanography to investigate both the sources and drivers of plastic pollution (Schofield et al. 2020). This 'marine garbology' approach is showing real potential as a citizen science method that can engage audiences both within and outside Galapagos. The final workshop in the Science to Solutions series led by Exeter University brought together regional stakeholders, recognising the problem can only be fixed through an international effort. This will require significant funding – currently not secured. However, despite being impacted by the COVID-19 Pandemic, fundraising from philanthropic, corporate and government sources are scaling. Central to funding and outreach campaigns are compelling images supplied by Juan Pablo and others (Fig. 7) featuring the impact of plastic waste on turtles. The University of Utrecht for example (lead oceanography partner) is running a successful crowd-funded campaign to buy drifter buoys to ground truth predictive models (<https://www.uu.nl/en/organisation/alumni/contribute/pay-it-forward-2020/contribute-to-rid-our-oceans-of-plastic>). The campaign landing page features a green turtle struggling to free itself from abandoned fishing gear. Within its first few weeks the campaign had reached 93% of the target set for the full twelve months.



Fig. 7. Images featuring impact on sea turtles lead fundraising and outreach campaigns in support of the Plastic Pollution Free Galapagos programme.

a) Green sea turtle entangled in fishing nets at Española Island. Neck close to being sliced. Photos by Manuel Yépez.



b) Green sea turtle entangled in abandoned fishing gear at Darwin Island. Photo by Jonathan Green.



c) Plastic pieces from the stomach contents of one dead juvenile green sea turtle at San Cristóbal Island.

Discussion

Compelling narratives and images highlighting the risks to turtle populations have had a similar effect to Blue Planet 2 in the UK at a local level in both Australia and Galapagos, Ecuador, with public pressure accelerating the translation of research results into Governmental decision-making processes and ultimately legislation. It is clear that both the Australian and Galapagos programmes have subsequently benefitted from the 'Blue Planet 2 effect'. In Australia a highly popular TV documentary aired in 2017 was called the 'War on Waste', produced by the political satirical team known as 'The Chaser'. The programme made this very serious topic widely accessible and was the Australian equivalent of 'Blue Planet 2' in terms of its impact and awareness raising.

It is, however, also very clear that the progress made prior to release of the documentary programmes in shifting local public opinion, and building momentum towards and also achieving legislative change, was considerable. In both cases a range of marine vertebrates are included in the impact studies including seabirds, fish, pinnipeds (seals or walruses) and, in Galapagos, marine iguanas. Despite this, in both cases the focus for outreach and

fundraising has become sea turtles, with images, videos and narratives of interactions with plastic pollution either through ingestion or entanglement resonating strongly with audiences.

This has been seen across the world with the plight of turtles from the Maldives (<https://oliveridleyproject.org/marine-turtle-rescue-centre>) to the Mediterranean and Caribbean being used to focus attention on the need to reduce usage of domestic single use plastics. In 2015 marine scientist Dr Christine Figgner of the University of Texas posted a video taken of removing a straw from a male olive ridley sea turtle. It has been viewed more than 40 million times and became central to the 'no straw' campaign. Dr Figgner's experience with the video and success in influencing public opinion, corporate practice and legislation was marked in comparison to the low impact she had had in previous years when publishing results in the scientific literature only (Figgner 2018). The story was picked up by global media and was quoted widely by manufacturers and outlets as the reasoning behind moving to no straws or use of biodegradable paper straws. The role of social media channels was central to this shift in attitudes to straws. Eagle et al. (2016) describe specifically the role of social marketing and the use of marine turtles as an icon in behaviour-changing campaigns and point out this is often underutilised by sustainable tourism outlets.

Using the definition of a flagship species as a species selected to act as an ambassador, icon or symbol for a defined habitat, issue, campaign or environmental cause, it is clear that sea turtles (of whatever species) can be become effective flagship contenders for anti-plastic pollution campaigns, even bridging the gap between political ideologies.

Sir Peter Scott is credited with promoting the first and arguably most recognised flagship species symbol for NGO World Wildlife Fund. He said "We wanted an animal that is beautiful, is endangered, and one loved by many people in the world for its appealing qualities". Given the evidence to date, it would seem that sea turtles very much meet these criteria for marine conservation issues and plastic pollution in particular. At a time when 'evidence complacency' (Sutherland & Wordley 2017) is commonplace, while misinformation and 'fake news' are used as a matter of course in political debates across the world, then if the momentum provided by the 'Blue Planet 2 effect' is to be maintained, uniting behind a sea turtle symbol has been demonstrated to be highly effective.

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