

message in a bottle

Regular readers of *African Birdlife* will know that I am a fan of sub-Antarctic islands and that I work on plastic pollution. Indeed, it was plastics that got me to the islands for the first time. When I finished Honours way back in 1983, I had to choose between getting a 'real job' as a biologist at the State Museum in Windhoek and studying the impacts of plastic ingestion on seabirds. This was a time when plastic ingestion was more of a curiosity than a concern and people weren't queuing up to study the problem. For me, the main appeal of the project was that it meant going to Marion and Gough. Needless to say, the islands won.

In 1984 I visited Gough Island, where I collected samples from Great Shearwaters that provided the first evidence

above A water bottle on Inaccessible Island. The wide size range of goose barnacles indicates it has been adrift for some time; most newly arrived bottles lack any fouling organisms and have been dumped from ships plying the South Atlantic.

that polychlorinated biphenyl (PCB) concentrations were linked to plastic ingestion. On the return journey, we had three hours ashore on Inaccessible Island and I recorded all the litter washed up along about a kilometre of the boulder beach between Blenden Hall and West Point. I have repeated this exercise on subsequent visits to the island to track how the amount of litter has changed over time. It resulted in a short letter to *Nature* in 1993 entitled 'Marine litter keeps increasing', which noted how litter on Inaccessible continued to grow, even though the dumping of plastics and other persistent wastes had been banned in terms of the International Convention for the Prevention of Pollution from Ships (MARPOL) at the end of 1988.

Unsurprisingly, with every visit it is clear that the amount of litter on the beach has continued to increase. This doesn't necessarily mean that the quantity of jetsam is increasing – much of the litter on the island has been there for years. I still recognise some of the more exotic floats from the 1980s and the

oldest dated item we found in 2018 was a large plastic canister made in March 1971. Indeed, there are still bits of metal and wood from the *Blenden Hall*, the ill-fated British East Indiaman that wrecked there in 1821.

With no beach cleaning, litter continues to mount up. In 2018, Maëlle Connan and I spent nearly a week scoring all the litter along the same stretch of beach that I managed to cover in three hours in 1984. Because we collected all the litter into a series of caches along the shoreline, Ben Dilley and I were able to check how much new litter arrived during the next few months, after Maëlle had left the island.

Perhaps the most striking change over the years has been the rapid growth in the quantity of soft-drink and water bottles washed ashore. The number of these bottles has increased almost twice as fast as other litter types during the past 30 years, despite the fact that bottles 'disappear' (either blowing inland or offshore, or being buried) faster than more robust items such as fishing floats

and ropes. Bottles comprised about a third of the accumulated litter items on the beach when we arrived in 2018, but nearly three quarters of the items that washed ashore while we were on the island. This increase is perhaps not surprising given that nearly 500 billion drink bottles are produced every year globally.

One of the fun things we do when scoring litter on the island is to try and work out where it comes from. This is useful for tailoring measures to reduce litter. For example, in the 1980s much of it came from the local fishery, but this has decreased greatly as the fishery has tightened up on its solid-waste management. A lot of litter is still related to fishing activity, with most coming from South America, 3000 kilometres to the west. Fish trays from Argentina and Uruguay are particularly common, but all manner of things wash ashore. In 2018 we had a motorcycle helmet from Brazil, three computer monitors and eight car bumpers, including those from a 1984 Mercedes, a 1997 Renault and a 2006 VW.

It is widely accepted that 80 per cent of plastic pollution in the sea comes from land-based sources. However, this figure is a very crude estimate and it is clear that the proportion varies depending on where you are. Part of the challenge is deciding where 'general' waste comes from. Food packaging and domestic refuse such as cosmetic and detergent bottles could come from ships or from land-based sources. Bottles offer a useful way to track litter origins because many contain information on when and where they were manufactured.

In 2018, we determined the origins of more than 1000 bottles on Inaccessible Island and compared this with data from previous visits. This showed a marked shift from South America to Asia as being the main source of litter on the island. Litter from Asia increased from being only nine per cent of general waste in the 1980s to 44 per cent in 2009 and 74 per cent in 2018. In fact, among newly arrived litter, Asia accounted for 84 per cent of it in 2018, with two-thirds of all bottles coming from China.



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Maëlle Connan checks to see where a water bottle on Inaccessible Island comes from and when it was manufactured.

China is assumed to be the major contributor of plastics into the oceans, accounting for more than a quarter of plastic from land-based sources. However, most litter entering the sea from China should drift to the North Pacific Gyre (the so-called 'great garbage patch'). A small proportion of litter from South-east Asia is expected to drift to the South Atlantic via the Indian Ocean and the Agulhas Current, but this should take at least four to five years. This doesn't match the observation that almost all newly arrived bottles on Inaccessible Island in 2018 were less than two years old; if anything, Asian bottles were made more recently than those from South America. We concluded that most of the Asian bottles must have been dumped from ships (*Proc. Natl. Acad. Sci. U.S.A.* doi: 10.1073/pnas.1909816116).

The general relevance of our findings is shown by a similar study along the east coast of Australia, which revealed that about half of all the bottles found on beaches came from foreign sources (Smith et al. 2018, *Mar. Pollut. Bull.* 126: 304–307). We have since done surveys along the coasts of South Africa and Kenya and found that foreign water bottles in particular account for a large proportion of drink bottles at beaches away from urban source areas. Interestingly, the same brands keep turning up on beaches throughout the southern hemisphere.

Such studies highlight the need to address the ongoing illegal disposal of

plastics and other persistent waste from ships. The International Maritime Organisation needs to tighten regulations to ensure that ships use port reception facilities for such waste, rather than taking the easy option of simply dumping their rubbish at sea.

Ultimately, we need to rethink the use of disposable plastic drink bottles. In South Africa, PETCO is one of the best industry-led recycling programmes for such bottles in the world, recovering almost two-thirds of all polyethylene terephthalate (PET) drink bottles. However, with an annual production of about four billion bottles that still leaves more than one billion bottles going to landfill or into the environment every year. Consumers can drive change in this industry by not buying drinks in non-reusable bottles. If you must still buy a disposable bottle, make sure it ends up being recycled.

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