

Protecting the British Indian Ocean Territory

<http://biot.gov.io>



BIOT's unique wildlife

Fast facts

1. The British Indian Ocean Territory (BIOT) has over 1% of the world's coral reefs - c.60,000 km² of shallow limestone platform and coral reefs, **which is also the world's largest contiguous undamaged reef area**¹.
2. BIOT's vast coral reefs are composed of five coral atolls, including the mostly submerged Great Chagos Bank, which is **the largest atoll structure in the world** at some 13,000 km².
3. Reef fish are six times more abundant in BIOT than on any other reef in the Indian Ocean³.
4. An estimated 10% of all Indian Ocean seamounts are expected to be found in BIOT⁴.
5. Analyses of pollution levels (1996 and 2006) indicate BIOT belongs 'to one of the world's least contaminated coastal areas'⁵ and 'could be considered appropriate as a global reference baseline'⁶.
6. After bleaching in 1998 caused up to 90% mortality of Indian Ocean coral⁷, BIOT's reefs 'recovered more extensively and faster than any other known coral reef system in the Indian Ocean'⁸, likely due in part to a 'lack of multiple anthropogenic stresses that most other reef systems endure'⁹.
7. The **critically endangered hawksbill and endangered green turtle**, previously exploited in the archipelago, **now nest undisturbed throughout the two thirds of the BIOT's coastline** (which is of suitable habitat)¹⁰.
8. **Diego Garcia is thought to have amongst the highest recorded densities of coconut crab (also of global conservation concern) in the world**¹¹ (294 per hectare).
9. Eighteen seabird species breed in BIOT, **five in globally important numbers**, resulting in ten islands being classified as Important Bird Areas. **Diego Garcia qualifies as an internationally important site for birds (Ramsar site) as it holds more than 20,000 waterbirds annually**¹².
10. **Diego Garcia holds one of the Indian Ocean's largest breeding colonies of red-footed boobies**; which has grown from three or four pairs in 1984 to over 5,000 pairs in 2011, with recovery attributable to the low levels of disturbance on the eastern arm of the island ¹².

¹ Sheppard C. R. C. *et al.* Reefs and islands of the Chagos Archipelago, Indian Ocean: Why it is the world's largest no-take marine protected area. *Aquat. Conserv. Mar. Freshwat. Ecosyst.* 22, 233–261 (2012).

² Spalding, M.D. C. Ravilious and E.P. Green World Atlas of Coral Reefs.

³ Graham, N. A. J., and T.R. McClanahan (2013), 'The Last Call for Marine Wilderness?', *BioScience*, v. 63, no. 5, pp. 397-402.

⁴ Yesson C, Clark MR, Taylor M, Rogers AD. The global distribution of seamounts based on 30-second bathymetry data. *Deep Sea Research Part I: Oceanographic Research Papers*. 2011; 58:442–453

⁵ Price A.R.G., A. Harris, A. McGowan, A.J. Venkatachalam, & C.R.C. Sheppard (2010), 'Chagos feels the pinch: assessment of holothurian (sea cucumber) abundance, illegal harvesting and conservation prospects in British Indian Ocean Territory', *Aquatic Conservation: marine and freshwater ecosystems*, vol.20:117-126

⁶ Guitart C, Sheppard A, Frickers T, Price ARG, Readman JW. 2006. Negligible risks to corals from antifouling booster biocides and triazine herbicides in coastal waters of the Chagos archipelago. *Marine Pollution Bulletin* 54 : 226–246

⁷ Sheppard, C, R, C. Predicted recurrences of mass coral mortality in the Indian Ocean. 2013. *Nature* 425, 294-29

⁸ Gravestock, P and C.Sheppard. 2015. Valuing the ecosystem services of the Chagos: a review of challenges and estimates. *Marine Ecology Progress Series*. Vol. 530: 255–270, 2015.

⁹ Graham NAJ, McClanahan TR, MacNeil MA, Wilson SK, Polunin NVC, et al. (2008) Climate Warming, Marine Protected Areas and the Ocean-Scale Integrity of Coral Reef Ecosystems. *PLoS ONE* 3(8): e3039. doi:10.1371/journal.pone.0003039

¹⁰ Mortimer, J.A. and M. Day (1999), 'Sea turtle populations and habitats in the Chagos Archipelago', in *Ecology of the Chagos Archipelago* (ed. C.R.C. Sheppard & M.R.D. Seaward), Linnean Society, p.159

¹¹ Vogt, S. (2004), 'Coconut Crab (*Birgus latro*) Survey on Diego Garcia', in *Diego Garcia Integrated Natural Resources Management Plan* (September 2005), <http://www.zianet.com/tedmorris/dg/2005NRMP-Appendixg-coconutcrabsurveys.pdf> (accessed 25/11/2016).

¹² Carr P. Important Bird Areas – the British Indian Ocean Territory. *British Birds*. 2011b; 104:642–666.

Contents

The British Indian Ocean Territory Marine Protected Area	1
The unique and special BIOT MPA	1
Protecting the BIOT MPA	2
Managing threats to BIOT's biodiversity	3
Picking up the plastics	3
Fisheries management	4
Understanding and monitoring	5
Restoring habitats	6
How to help	7



The British Indian Ocean Territory Marine Protected Area

The unique and special BIOT MPA

In 2010, the UK Government created one of the largest Marine Protected Areas on the planet inside the British Indian Ocean Territory, halting commercial fishing across 640,000km² of the Indian Ocean. This unique and special place is a safe refuge for 310 species of coral, 821 species of fish and 355 species of molluscs, some of which are found nowhere else in the world.

Healthy reefs – the importance of sharks

Over 60 species in BIOT are on the International Union for the Conservation of Nature's (IUCN) 'red list' - species which are of global conservation concern. Many of these globally threatened or vulnerable species are sharks.

At the top of the food chain, scientists suspect that these beautiful predators play a fundamental role in maintaining healthy coral reefs – for example where black-tip reef sharks are abundant, they may exert a 'top-down' pressure on their prey species¹³, such as emperors and snappers. However, on reefs without sharks, numbers of their prey species, also known as *mesopredators* (fish in the middle of the food chain), increase. This may seem positive, but scientists have found that where there are less sharks there are also less herbivorous fish¹⁴, because the increased numbers of mesopredators consume more smaller fish and their larvae. The real impact of all of this is felt at the bottom of the food chain where the herbivores, such as parrotfish, maintain coral reef growth by eating algae: without this grazing pressure, newly growing and small corals are vulnerable to being smothered by overgrowth of algae.

Although many species of shark are globally threatened, those protected by the BIOT MPA are able to contribute to supporting vibrant and flourishing reefs.



Grey reef shark



Healthy reef



Silvertip shark



Paddle tail snapper

¹³ Papastamatiou, Y.P.; J.E. Caselle; A.M. Friedlander; C.G. Lowe (September 16, 2009). "Distribution, size frequency, and sex ratios of blacktip reef sharks *Carcharhinus melanopterus* at Palmyra Atoll: a predator-dominated ecosystem". *Journal of Fish Biology*. 75 <https://pdfs.semanticscholar.org/6e6a/69ada908d31bf59c68237de4e0f80d603db6.pdf>

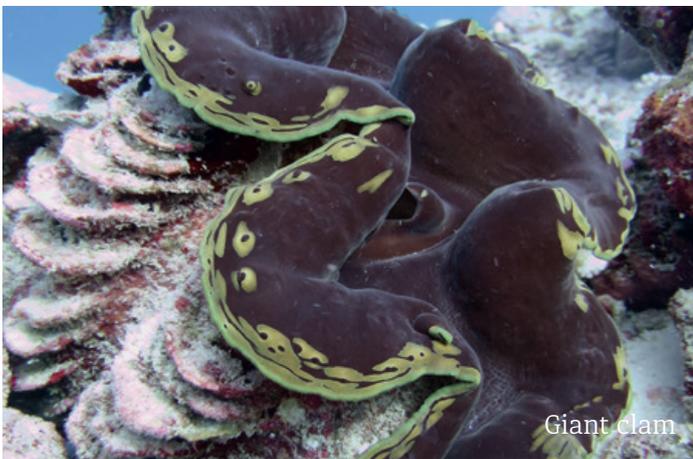
¹⁴ Ruppert JLW, Travers MJ, Smith LL, Fortin M-J, Meekan MG (2013) Caught in the Middle: Combined Impacts of Shark Removal and Coral Loss on the Fish Communities of Coral Reefs. *PLoS ONE* 8(9): e74648. <https://doi.org/10.1371/journal.pone.0074648>

Incredible invertebrates – corals and clams, worms and snails

Globally, a third of reef-building corals are threatened with extinction¹⁵ but of the reefs in good condition in the Indian Ocean, between 25-50% are in BIOT's waters¹. Coral polyps may be amongst BIOT's smallest invertebrates but are also the most important – by building a communal skeleton they create the habitat which supports BIOT's incredible biodiversity, from giant clams (another IUCN red-listed species), to the tiny and colourful Christmas tree worms and the enormous gastropod, Triton's trumpet. This beautiful sea snail keeps reefs healthy by eating crown-of-thorns starfish, which predate corals.

Feeding the fish

BIOT is the only place in the Indian Ocean (and possibly the world) where populations of red-footed and brown boobies are increasing. This is evidence of a healthy marine system, as these birds depend on the ocean for food. Perhaps more surprisingly, recent scientific study in BIOT has revealed that the birds also benefit the fish of the coral reef. Around islands with dense seabird populations, the fish populations are up to 50% higher than those around islands without birds, due to the increased levels of nutrients (from seabird droppings) seeping off the island and increasing reef productivity¹⁶.



Protecting the MPA

Despite BIOT's isolation, there are still threats to wildlife. The Administration of the British Indian Ocean Territory (BIOTA) seeks to ensure that BIOT can continue to act as a reference site for global conservation efforts and as a natural laboratory, where undisturbed species and habitats can be studied and observed. Working with stakeholders and partners, BIOTA is reducing impacts, undertaking monitoring and working to mitigate such threats.

¹⁵ Carpenter K, Abrar M, Aeby G, Aronson RB, Banks S, Bruckner A, Chiriboga A, Cortes J, Delbeel C, De Vantier L, et al. One-third of reef-building Corals face elevated extinction risk from climate change and local impacts. *Science*. 2008;321:560-563
¹⁶ <https://www.zsl.org/sites/default/files/media/2016-10/RCUK%202016%20Abstract%20Booklet.pdf>

Managing threats to BIOT's biodiversity

Picking up the plastics

Over 260 million tonnes of plastic is produced every year¹⁷, and it is thought about 8 million tonnes¹⁸ end up in the world's oceans annually.

Floating plastics are often mistaken for food items particularly by both birds and turtles¹⁹. A global 2012 study found that over 30% of seabirds studied had plastic in their digestive system and estimated that by 2050 this will increase to 99% of all bird species²⁰. Birds also mistakenly feed plastics to their offspring, as they regurgitate their catch directly into their chicks' beaks. Entanglement is another problem; marine mammals and turtles are at particular risk from getting waste trapped around heads, fins or flippers.

Great circular currents, called gyres, sweep up plastics and trap them in the still water inside the rotating current, forming great 'garbage patches'. Fragmenting into smaller pieces as a result of wave action, exposure to UV and physical abrasion, the trapped plastics break down, and may attract and accumulate contaminants such as heavy metals and polychlorinated biphenyls (PCBs). This soup of microplastics can be ingested by fish and may even find its way into the human food chain.



How you can help

Some scientists have described the islands closest to the 'garbage patches' as natural nets, suggesting removing the rubbish as it washes up onto the beaches as one of the most effective ways to assist with removing plastics from the ocean²¹. Regular beach clean-ups on BIOT's beaches helps to achieve this as well as keep the beaches clear of obstructions for nesting turtles. In 2016, BIOT personnel also assisted with a survey of plastics on different beaches on BIOT – happily, microplastics seemed to be absent from many of BIOT's beaches, which is positive news!



¹⁷ Plastic Debris in the World's Oceans, Greenpeace, 2006

¹⁸ <http://science.sciencemag.org/content/347/6223/768>

¹⁹ Sarah E. Nelms, Emily M. Duncan, Annette C. Broderick, Tamara S. Galloway, Matthew H. Godfrey, Mark Hamann, Penelope K. Lindeque, Brendan J. Godley; Plastic and marine turtles: a review and call for research. ICES J Mar Sci 2016; 73 (2): 165-181. doi: 10.1093/icesjms/fsv165

²⁰ Wilcox C, Van Seville E, Hardesty BD. Threat of plastic pollution to seabirds is global, pervasive, and increasing. Proceedings of the National Academy of Sciences of the United States of America. 2015;112(38):11899-11904. doi:10.1073/pnas.1502108112.

²¹ <https://www.sott.net/article/212814-New-garbage-patch-discovered-in-Indian-Ocean>

Fisheries management

Commercial fishing in the Indian Ocean has depleted fish populations. Targeted species, such as yellowfin tuna, black marlin and longtail tuna, are now known to be overfished and unless catch reductions are enforced, numbers will continue to shrink²². Shark populations in BIOT are thought to have shrunk by 90% from 1975, due to illegal poaching²³. Even sea cucumber numbers in BIOT's outer islands have declined due to illegal fishing²⁴.

It has been estimated that the 2010 ban on commercial fishing within the confines of BIOT's Marine Protected Area may have prevented over 45,000 sharks from being caught²⁵. However, small fishing vessels are still caught fishing illegally in BIOT waters so the BIOT Administration's patrol vessel, the Grampian Frontier, provides an essential deterrent by intercepting these vessels. The Masters of the vessels may then face prosecution which can result in the confiscation of the catch and gear.

BIOTA is also taking action to monitor the number of Fish Aggregation Devices (FADs) drifting into BIOT waters. Hundreds of these devices, which usually consist of a bamboo frame, hung with ropes and nets, are deployed in the Indian Ocean every year. Once adrift, FADs attract fish so that large schools can easily be swept up by encircling nets. FADs in BIOT waters can't be used for fishing, but can damage reefs and trap animals if washed ashore - so BIOTA removes these devices.

What can you catch?

BIOTA also has a number of limitations on the recreational fishery on Diego Garcia to protect the reefs:

- No traps or nets are permitted, a maximum of two rods and three hooks may be used.
- Fish may be caught for personal consumption only, specifically within 3 days.
- Barter, sale or profit is not permitted.
- Sharks or large game fish must be released alive.
- Record your catch to help BIOTA monitor the fishery



Fish Aggregation Device



Grampian Frontier



BIOT's fish populations thriving in absence of fishing

²² <http://www.iotc.org/science/status-summary-species-tuna-and-tuna-species-under-iotc-mandate-well-other-species-impacted-iotc>

²³ Graham, NAJ, Spalding, MD and Sheppard, CRC (2010). Reef shark declines in remote atolls highlight the need for multi-faceted conservation action. *Aquatic Conservation: Marine and Freshwater Ecosystems* 20(5): 543-548

²⁴ Price A, Harris A, McGowan A, Venkatachalam A, Sheppard C. 2010. Chagos feels the pinch: assessment of holothurian (sea cucumber) abundance, illegal harvesting and conservation prospects in British Indian Ocean Territory. *Aquatic Conservation: Marine and Freshwater Ecosystems* 20: 117-126.

²⁵ Heather J. Koldewey, David Curnick, Simon Harding, Lucy R. Harrison, Matthew Gollock. Potential benefits to fisheries and biodiversity of the Chagos Archipelago/British Indian Ocean Territory as a no-take marine reserve. *Marine Pollution Bulletin*, 2010, pp. 1906-1915

Understanding and monitoring threats

Corals have a narrow temperature tolerance – if oceans heat by just 1 or 2°C, corals expel the algae living in their tissues, turn white and eventually die if temperatures do not fall. In 2015 and 2016, bleaching caused mass mortality of BIOT’s coral reefs. Although this was a natural event, bleaching may be worsened by climate change and over the last two years impacts have been so severe that scientists think that in some locations up to 85% of BIOT’s corals may have died.

Many of the human impacts occurring in other parts of the world are absent in BIOT, therefore scientists working in the territory are able to more easily understand why and how coral reefs react to such impacts. This is vital, as knowing how coral reefs recover in a largely unimpacted state, means BIOT can be used as a global reference site for other coral reefs and help towards identifying the most effective management of coral reefs elsewhere in the world.



Bleached corals in BIOT in 2015

Getting involved with scientific expeditions

Between 2010 and 2015, 14 scientific expeditions to BIOT have taken place, involving 82 scientists from 37 organisations and 11 countries²⁶. Another 6 expeditions took place in 2016²⁷ and many more are planned. Volunteers have been a key part of some of this work, in particular assisting with helping to fit satellite tags to turtles²⁸, sharks and other animals so that scientists can track animal movements in real-time and understand how they use the MPA.



Diego Garcia personnel assisting scientists with turtle tagging. Photo credit: Graeme Hayes

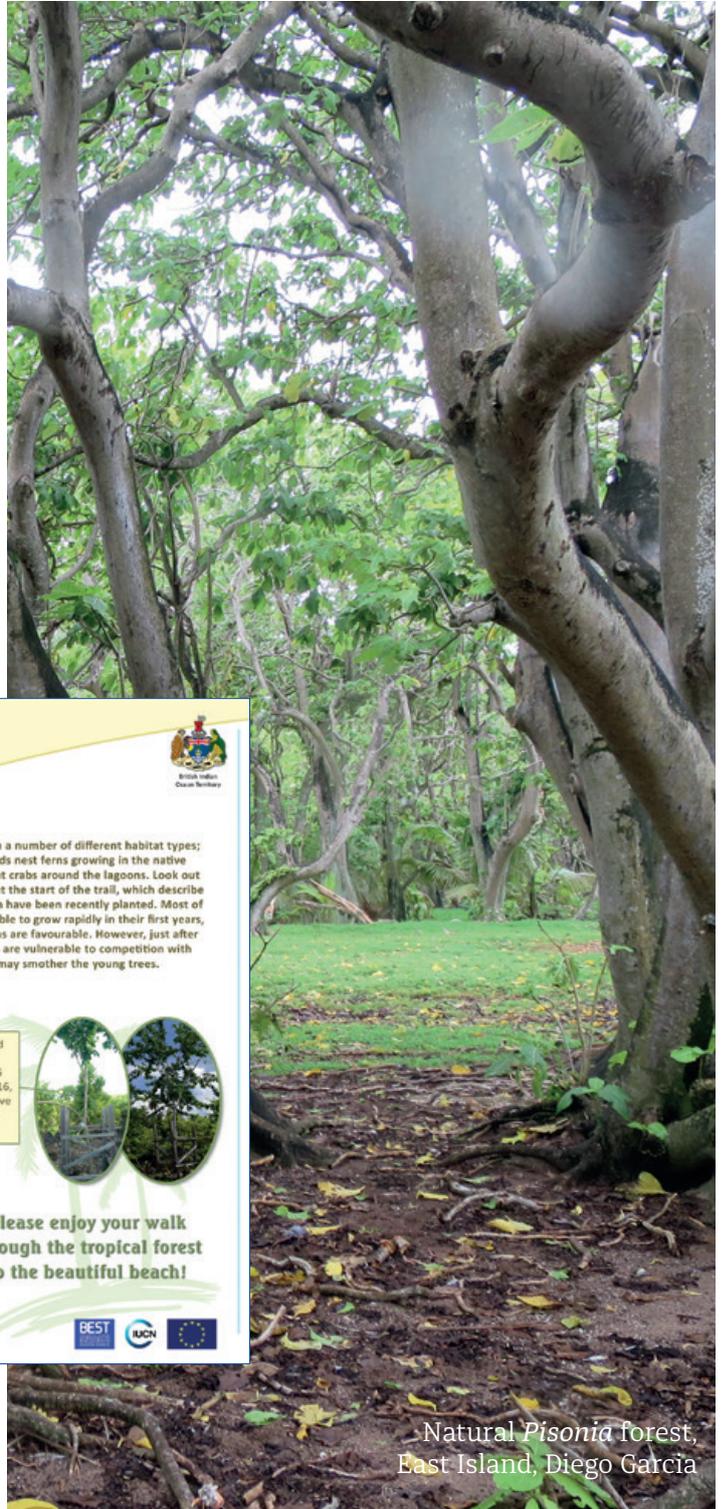
²⁶ <https://www.zsl.org/blogs/chagos-expedition/happy-biodiversity-birthday-chagos>

²⁷ <http://biot.gov.io/wp-content/uploads/Scientific-Expeditions-to-the-British-Indian-Ocean-Territory-2016.pdf>

²⁸ Esteban N, Mortimer JA, Hays GC. 2017 How numbers of nesting sea turtles can be overestimated by nearly a factor of two. Proc. R. Soc. B 284: 20162581. <http://dx.doi.org/10.1098/rspb.2016.2581>

Restoring habitats

Whilst marine habitats are considered to be largely near-pristine, large parts of BIOT's terrestrial environment have suffered from human interference, principally through the introduction of invasive species and the development of coconut plantations²⁹. Restoring the native hardwood forests by cutting down coconut palms and replanting with native saplings is an enormous task, but trial work has begun on the island of Diego Garcia and BIOTA is learning valuable lessons for future management. BIOTA is currently testing evidence from forest restoration in the Seychelles that retaining some coconut palms to provide shade to new saplings improves growth rates and reduces the amount of ongoing maintenance needed³⁰. Volunteers have been an essential part of making the forest restoration work a success – visit the Plantation Trail in the Southern Restoration Site on Diego Garcia to find out more and how to get involved.



**Welcome to
The Plantation Trail**

Plantation Trail

Diego Garcia Southern Restoration Site

You are now entering the Diego Garcia Southern Restoration Site, where native trees are gradually being replanted to restore the forest habitat to its natural state.

Almost all our management here, including the construction of this trail, has been achieved through the hard work of volunteers and is still in progress. If you would like to help, please get in touch with the British Indian Ocean Territory Administration (BIOTA) Environment Officer, based at the HQ building in Downtown.

Trail Route

The trail passes through a number of different habitat types; you'll be able to see birds nest ferns growing in the native forest areas and coconut crabs around the lagoons. Look out for the species boards at the start of the trail, which describe the types of trees which have been recently planted. Most of these native trees are able to grow rapidly in their first years, if the growing conditions are favourable. However, just after planting the small trees are vulnerable to competition with invasive species which may smother the young trees.

Hernandia sonora (left) and *Pisonia bijuga* (right) trees photographed in June 2015 and again in November 2016, showing the same trees have more than doubled in size between these dates.

In many places the volunteer group has cut down species such as wild mulberry, to help give the native trees space to grow, so you'll also see some areas which remain under active management along the trail.

The walk to the beach takes just over 10 minutes and as a part of the trail is circular you'll be able to see different areas on your way back.

**Please enjoy your walk
through the tropical forest
to the beautiful beach!**

BEST IUCN EU

Natural *Pisonia* forest,
East Island, Diego Garcia

²⁹ Carr, P. A guide to the birds of the British Indian Ocean Territory. 2011.

³⁰ von Brandis RG. 2012. Rehabilitation of abandoned coconut plantations at D'Arros Island, Republic of Seychelles. Ocean & Coastal Management 69:340-346.

How to help

The BIOT Administration is working hard to ensure the effective protection of such a unique and precious place and is fortunate to be supported in this work by some of our partners such as the Chagos Conservation Trust (CCT), the Zoological Society of London (ZSL) and a large number of scientific institutions. BIOT's Interim Conservation Management plan (found on the BIOT website: <http://biot.gov.io>) provides further reading and more details on some of the actions underway.

If you are interested in helping out with any of BIOTA's work, please get in touch with the Environment Officer, based in the Quarterdeck building in Downtown, or if you are simply interested in learning more about BIOT's amazing wildlife, make sure to look out for the information boards describing different species and habitats around Diego Garcia.





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Text: Helen Stevens, Environment Officer, BIOT (2015-2017)
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