ISSN 1355-6746

# Chagos News

*The Periodical Newsletter of the*
***Chagos Conservation Trust***

**No.34** **July 2009**

## EDITORIAL

There has been a great increase in interest in Chagos over the past few months, fuelled partly by a growing recognition of the uncertain and worrying condition of coral reefs throughout the world. There have been many press articles, and March saw the publication of the Chagos Conservation Trust booklet promoting the idea of the Chagos Archipelago Marine Park, with a launch at the Royal Society in London.

Prof. Charles Sheppard was also an invited speaker at a conference at the Smithsonian in Washington, DC, whose theme was on tropical marine success stories. Charles presented the only paper on reefs, where he spoke about the recovery of Chagos.

In April, the Chagos Environment Network (CEN) met with the BIOT administration to discuss the way forward.

On the 6th of July an *Emergency Meeting on the Climate Change Threat to Coral Reefs* convened by the Zoological Society and the International Programme on the State of the Ocean will be hosted by the Royal Society. An impressive list of participants have been invited to attend, ranging from NASA, through many university and environmental organisations, to Oxfam, reflecting the concern for the peoples dependent on coral-supported ecosystems. This reflects the dire condition of the World's reefs.

A meeting is planned for the end of June at the Foreign and Commonwealth Office, which will involve guests from CCT, CEN, BIOT the FCO, DEFRA, DFID and several government ministers. The meeting is entitled *Collaboration on Environmental and Biodiversity Issues in the Overseas Territories*.

Preparations are also underway by Professor Charles Sheppard, assisted by Pete Raines, for the next Chagos research expedition – Chagos 2010. The main theme of this OTEP/Warwick University funded expedition will be to study how climate change is affecting the recovery and growth of corals, shoreline erosion, fish biomass estimates, changes in bird populations and paleoclimate work.

In this issue, CCT chairman William Marsden has written a report on the very important Royal Society launch of the CCT booklet which was produced to promote the idea of the Chagos Marine Park earlier this year.

On the 2006 Chagos expedition Dr Nick Graham collected data on reef fishes, and has written a brief resume of some of that work for this issue. Expedition participants continue to publish important material for many years afterwards and *Chagos News* will publish less technical reviews of many of them.

Two remarkable articles on Chagos turtles are included also by Nigel Wenban Smith and Dr Jeanne Mortimer. Both are startling in their different ways!

And Dr Chris Hillman has an article on a little discussed aspect: beach litter.

***Anne Sheppard***

## News Clips

There was a flurry of activity at the beginning of the year concerning the proposals for Chagos to become a large marine protected area. First of all, the article in the *Times* written by Frank Pope resulted in further news articles and renewed discussion about Chagos. Links to some of these are

http://www.independent.co.uk/environment/nature/giant-marine-park-plan-for-chagos-1604555.html

http://www.timesonline.co.uk/tol/comment/columnists/guest_contributors/article5569193.ece

http://www.economist.com/world/international/displaystory.cfm?story_id=13089462&fsrc=rss

http://www.newscientist.com/article/mg20126964.500-conservation-plan-would-keep-islanders-in-exile.html

Then the splendid and very well received launch of the Chagos booklet at the Royal Society resulted in further press coverage of Chagos and CCT. Links to these are below

http://www.wildlifeextra.com/go/news/chagos-archipelago827.html#cr

http://blog.protectplanetocean.org/2009/03/conservation-plans-for-chagos-unveiled.html

http://www.rspb.org.uk/news/details.asp?id=tcm:9-212261

http://www.express.co.uk/posts/view/88429/Conservation-plea-on-ocean-islands

http://www.commondreams.org/headline/2009/02/09-7

http://www.turkishweekly.net/media/126784/giant-marine-park-plan-for-chagos.html

The quality of these articles varies greatly! Many are fair and informative and others, the *New Scientist* one for example, are just reiterating old misinformation and have not bothered to check the facts. Some just want to bash the government and will use anything, including Chagos and CCT, to do it. And where the last one heard that flying foxes occur on Chagos is anybody's guess! Fortunately, it is easy for those who know Chagos to tell the good from the drivel.

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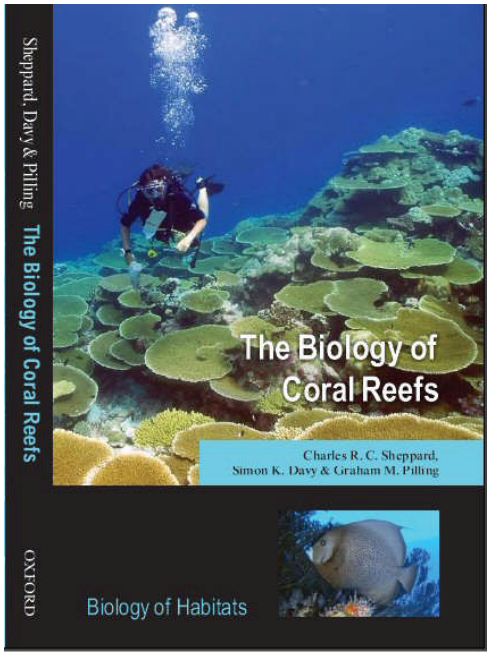
A new book on the *Biology of Coral Reefs* features on its cover one of the Chagos reefs, in this case western Ile Anglais of Salomon atoll. This photo shows the ocean-facing section at about 8 metres depth, covered in a rich growth of table corals, just above a vertical 'drop-off' which plunges to great depths. Chagos gets quite a lot of mentions in this book in fact, perhaps not surprising given its lead author: the book is by Sheppard, Davy and Pilling and was published in June 2009 by Oxford University Press. It can be found at: http://ukcatalogue.oup.com/product/9780198566366.do



**CCT AT THE ROYAL SOCIETY, MARCH 2009. Launch of the booklet *'The Chagos Archipelago: Its Nature and the Future'* and the paper *'Science in Chagos'***

On Monday 9 March there was an important presentation at The Royal Society of the ideas for the long-term conservation of the Chagos, outlined in CCT's new booklet and the supporting paper 'Science in Chagos'. The host organisation was the Chagos Conservation Trust (CCT), in association with the Chagos Environment Network whose members are: CCT, The Linnean Society of London, Pew Environment Group, the Royal Society, The Royal Society for the Protection of Birds (RSPB), Zoological Society of London (ZSL) and Professor Charles Sheppard (Warwick University).

Figure 1 In the beautiful lecture hall at the Royal Society.

William Marsden, CCT Chairman, in welcoming the distinguished participants and audience, said that the publications were aimed at contributing to greater awareness of the environmental and scientific importance of the Chagos Archipelago and the benefits to be gained from a long-term structure for its natural conservation.

Messages, conveyed to the meeting included:

Sir David Attenborough:
'*I was interested to read of the progress of the Chagos Environment Network and I wish you every success*.'

Professor David Bellamy:
*"It has long been my dream that the whole Chagos Archipelago should become an International Marine Nature Reserve and Sanctuary… The whole ecological structure is under threat. Sadly the El Nino global episode of 1998 took its toll of the coral reefs but unlike elsewhere there was a rapid and spectacular recovery in the untainted waters of the Chagos. Fortunately, all is not yet lost, though time is short. The Powers-that-be, the international commune of conservation and locally-focussed bodies such as the Chagos Conservation Trust must work together in an effective mix of vision, sound science and good management. Chagossians too have an important role to play. The Archipelago will even more deserve, and perhaps at last obtain, the title of World Heritage site."*

Jay Nelson (Director, Global Ocean Legacy, Pew Environment Group):
*'The Chagos archipelago is a unique biological system now imperilled by illegal fishing, climate change and other threats. We believe it warrants special protection.*

*Whatever its future, maintaining the biological health of this ocean gem should be an environmental priority. We look forward to working with conservation organisations, the British government and other institutions, to help preserve the Chagos Islands and their surrounding waters.''*

**Professor Callum Roberts (York University)** gave the first illustrated presentation aimed at setting the global context and answering the question: Why have a marine protected area in the Chagos?

Against a background of pictures illustrating the abundant stocks of very large fish and their predators from the origins of European commercial sea fishing around 1000 years ago to recent times, Professor Roberts described the present realities. In contrast to the early

pictures of huge sea bass in the seas off the west coast of the USA and the fish stocks thronging even the coasts of the UK, the world's fish species had suffered in recent decades catastrophic declines levelling of at very low levels. This was the of result massively destructive and unsustainable fisheries exploitation. Populations of individual fish species had been reduced by 75% to 99%. Non-target as well as commercial, target fish had been destroyed.

Figure 2 Professor Callum Roberts (far right).

Where should we go from here? An essential first step to recovery was to re-establish refuges from exploitation where fish stocks could breed and grow. In the past there were always natural refuges due to remoteness, depth or the roughness of the bottom of the sea. These had gone because of modern exploitation. But experience shows that the creation of adequate, new refuges worked and led to the recovery of stocks.

To date far too few have been created; only 0.8% of the world's oceans are protected by marine protected areas (MPAs). Unless we create new refuges fish stocks will not exist. In the past two years the USA has taken greatly significant steps in the designation of two very large MPAs in the Pacific which alone account for 38% of the total ocean area protected. Britain, as a signatory to the International Convention on Biodiversity and other agreements, has a commitment to protect marine biodiversity and specifically to build up networks of marine protected areas by 2012.

The Chagos provides a magnificent opportunity for Britain to honour its undertakings by creating a world-class conservation area for the heritage and benefit of humankind.

**Professor Charles Sheppard (Warwick University)** introduced his presentation as focussing on the environmental importance of the Chagos Archipelago itself. He showed a map of the archipelago overlayed on England, on which it extends from the south of England to Yorkshire. Yet only 5 of the 20 banks and atolls have islands above water and all apart from Diego Garcia are minuscule.

Figure 3 Professor Charles Sheppard.

While the Chagos is one of the most pristine environments surviving in the world, not all its islands are in such good condition. Plantations developed in the 19th century for coconut oil and copra production led to the cutting down of virtually all the native vegetation and hardwood trees. Marine turtles were heavily exploited for their shells and meat. Rats came in on ships and still infest about half the islands, where ground nesting birds do not stand a chance. However, despite this, BIOT is an area of global importance for birds with 10 internationally recognised Important Bird Areas.

Under the water, the Chagos Archipelago is truly pristine. It is probably the only place in the Indian Ocean where coral reefs can still be seen to great depths in the abundance that they had 100 years ago. The 'El Nino' sea-warming of 1998 virtually destroyed 90% of the ocean's coral including that of the Chagos; but the Chagos corals are some of very few that are known to have made such a rapid recovery, taking them back almost to their pre-1998 abundance. This is because there are no other destructive factors such as sewage and pollution. Even Diego Garcia, which accounts for half the total land area of BIOT and where there is a military base, very effective measures have been taken to prevent any sea-water pollution.

Why is the health of coral important? Between 100 and 200 million people are dependent on reefs, not least for their food security and literally for their terrestrial security. In West African states bordering the Indian Ocean fisheries depending on coral ecologies are a crucial food source; and much mortality is related to starvation linked to the badly damaged marine environments.

Another reason for the importance of the Chagos for such neighbouring populations is that the archipelago acts as a stepping stone for life which flows across the ocean, mainly from east to west. This role as a stepping stone is also very important for birds and marine life generally.

Will the Chagos Islands survive global warming and the resultant sea-level rise? The Chagos is already affected.

Sea-level rise is already around 1 cm a year. The islands are only around 2 metres high. Erosion and inundations are proceeding. But the natural coastal defences provided by coral and vegetation provide some protection. If we manage the Chagos well we can buy 30 to 40 years, within which time there could hopefully be more progress on the broader climate change policies.

So for all the reasons mentioned, every ocean needs at least one important area protected from damage by direct human impacts. The Chagos is the prime candidate in the Indian Ocean.

**Graham Wynne, Chief Executive of RSPB**, in his talk, stressed these points:

'*Conserving biodiversity in the UK Overseas Territories is one of the principal parts of RSPB's international conservation work. And the Chagos is one of the most important places for biodiversity on Earth. Yet it seems to be out of sight and out of mind for the UK, despite the UK's international commitments for marine conservation and the new Marine Bill. We must raise its profile.*

Figure 4 RSPB Director Graham Wynne

*RSPB looks forward to working with very many interests, including Chagossians, to take this from the dream stage to substance. It will require a lot of work.*

*Whatever the political future of the Chagos Archipelago, the idea of creating a Chagos Conservation Area of global importance has to be a good idea. There can't be any losers providing it is done with sensitivity and intelligence. It will be in the best interests of neighbouring countries. It will be in the best interests of the United Kingdom in fulfilling its international*

*responsibilities. And it will be in the best interests of the global community.'*

Two prominent members of the Chagossian Community then spoke:

**Allen Vincatassin, Patron Diego Garcian Society**:

'*As I saw on my recent visit to Diego Garcia and the Chagos, the pristine environment of the archipelago has to be continuously preserved. We are keen to work in partnership with the Chagos Conservation Trust. Preservation of the environment goes beyond the sphere of politics. We are in this together.'*

**Roch Evenor, Secretary Chagos Support Association**:

'*We want the Chagos and its environment to stay as it is. And we want people to be back there as it is. There are difficulties and conservation is needed. Patrolling by only one boat is not enough. We want to work on all solutions for conservation of Chagos, hand in hand; but don't forget about the human aspect*.'

**Questions and Discussion**

David Snoxell (Coordinator, Chagos Islands All-Party Parliamentary Group) said that The All-Party Group has asked him to say that conservation was an extremely important subject for the Chagos and that the Group strongly supported this initiative for conservation in the Archipelago. Members of the Group also believed that the interests of the Chagossian people remained paramount.

Frank Ward (Royal Naval Birdwatching Society) asked whether CCT had undertaken discussions with the US Defense Department as to plans for their future presence in Diego Garcia since this was relevant to the ideas for a marine conservation area.

The answer given was that CCT had not undertaken such discussions; its constitutional aims were limited to conservation, science and education. Professor Roberts added that he did not see the existence of the base as an impediment to the ideas for a conservation area.

Tim Bowler-Smith (Dept of Geography, University of Cambridge) suggested that the Chagos Conservation Trust, to gain public support and finance, should press for possibilities for people to visit and get to know the Chagos (which was very important environmentally yet unknown). In discussion, William Marsden said that the ideas in the new booklet envisaged limited, vessel-based visiting related to science and the environment, provided it did not disturb the nature.

In discussion it was argued that encouraging people to visit such a remote area did not make sense if the object was conservation. Professor Sheppard did not see a contradiction between conservation and limited visiting; the area was so remote that the analogy made in discussion with visiting the Great Barrier Reef (which was close to large urban areas) did not apply.

Figure 5 'Networking' after the formal meeting.

For further information contact the Secretary at secretary@chagos-trust.org or Tel: +44 (0)20 7738 7712 and visit www.chagos-trust.org

# Chagos reefs demonstrate resilience to climate disturbances in an Indian Ocean wide study

*Dr Nick Graham*
*ARC Centre of Excellence for Coral Reef Studies, James Cook University, Townsville, Queensland 4812, Australia*

In 1998 a huge El Niño event caused raised sea surface temperatures in tropical oceans around the world. In response, a great number of the world's reef corals 'bleached' and subsequently died. Coral bleaching is a stress response whereby the symbiotic relationship between the coral animal host and the single celled algae that live in their tissue breaks down. The algae are rejected from the corals, and as the algae provide most of the colour seen in a coral, the coral tissue becomes transparent, revealing the white skeleton underneath. Critically, as the algae provide the corals with most of their energy, the corals can only survive for a relatively short time (2-3 weeks) by feeding alone. Therefore, if the raised temperatures that cause bleaching remain high for sufficiently long, and the corals can not regain their algal populations, the corals die. The 1998 El Niño event resulted in a 16% reduction of live coral cover of the world's reefs. The worst hit region was the central and western Indian Ocean, where 46% of coral was lost. The inner Seychelles lost >90% of its coral, and Chagos was no exception, with similar mortality above 12-15m water depth.

Massive loss of live coral due to coral bleaching is thought to be a relatively new phenomenon linked to global warming. An increasing amount of research has therefore been assessing how reefs respond to such events. Much work has focused on changes in coral cover, which coral species are most susceptible to bleaching, and how the community composition of corals on reefs is changing. Research assessing the knock on effects for other components of the ecosystem has lagged behind. A key group to assess is the coral reef fish because they are the most biodiverse vertebrate community on earth, provide critical functions (such as controlling algal growth) to reefs, and are a key source of protein for tropical countries.

In response to the massive coral mortality in the Indian Ocean in 1998, a regional collaboration arose, whereby all comprehensive surveys of both coral cover and associated fish communities that had been conducted across the region in the mid-1990's were identified. This included studies in Kenya, Tanzania, Mauritius, Reunion, Seychelles, Maldives and Chagos. We then repeated these surveys in 2005/6, using identical methods as in the 1990's. Therefore data were available from before and after the 1998 El Niño event to allow us to assess how the coral reefs and associated fish assemblages had responded across the central and western Indian Ocean region.

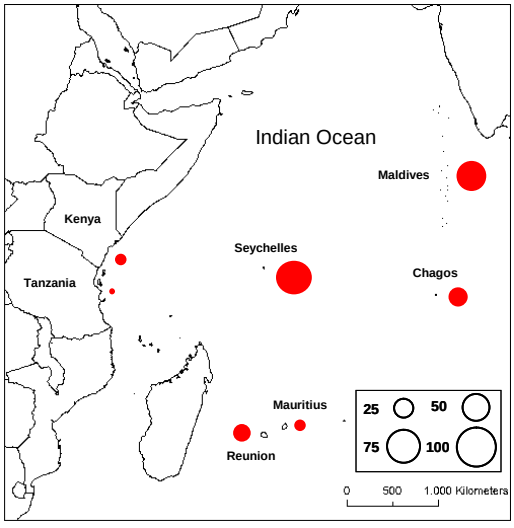



**Figure 1:** Map of the Indian Ocean showing declines (red bubbles) in coral cover between the mid-1990s and 2005. Adapted from Graham et al. (2008).

The impacts and subsequent recovery from the 1998 El Niño event varied across the region, with the greatest impacts in the Seychelles, Maldives and Chagos, and least in Kenya, Tanzania,

Mauritius and Reunion (Figure 1). The greatest impact in Seychelles, Maldives and Chagos was no surprise as these locations had suffered the greatest immediate impacts in 1998. What was apparent, however, was that although Seychelles reefs were showing little capacity to recover over those time scales, Chagos reefs were well on track for a rapid recovery. Indeed, many reefs in Chagos were at or nearing their pre-1998 coral cover levels, particularly with a high cover of table *Acropora* corals (Figure 2).

Fish responded in different ways to the loss of coral and associated coral structure depending on size and feeding group. Overall fish species richness declined across the region. The greatest declines in abundance were associated with those fish that feed directly on live coral. Plankton feeding fish, many of which are known to use live corals and coral structure as habitat to avoid predators, also declined in abundance across the region. Finally, if fish species were grouped by their maximum attainable size as adults, the abundance of fish smaller than 20cm in length declined. Interestingly most of this decline was driven by the Seychelles, and some sites in Kenya and Tanzania. Fish species richness and abundance of the above groups in Chagos had remained remarkably stable between the 1990's and 2005/6. Herbivorous fish, which may be expected to increase in abundance in response to the algae that grows on dead corals, did not show any indication of increasing or decreasing in abundance across the region.

It is clear that Chagos is recovering rapidly from the 1998 El Nino event, with coral cover returning and fish assemblages relatively unchanged compared to the mid-1990's. This can be thought of as resilience, which indicates key processes and functions were maintained on the reefs, allowing the system to absorb the impact and recover back to its coral dominated state. The reason for such resilience in Chagos is likely due to a combination of the lack of human disturbance to the reefs (i.e. very little fishing, pollution, sedimentation, nutrient input etc…), and due to the geography of the archipelago.

**Figure 2:** Recovering Chagos reef in 2006
*Photo Nick Graham*

As Chagos consists of a series of atolls surrounded by very deep clear water, and the reefs grow down to in excess of 50m of water, the loss of coral cover only affected shallow water (above 12-15m) corals. Corals surviving below this depth could help to produce the offspring need to re-populate the shallow reefs. The intact fish assemblages (and lack of nutrients) meanwhile were pre-conditioning the reefs for this coral settlement, by removing any algae that tried to grow. Such resilience to climate disturbances is rare to find in coral reefs around the world, and remote pristine areas, such as Chagos, provide important opportunities to learn lessons on how we can help other reefs recover, where human impacts are more prevalent.

This story is a synopsis of the following publication:

Graham NAJ, McClanahan TR, MacNeil MA, Wilson SK, Polunin NVC, Jennings S, Chabanet P, Clark S, Spalding MD, Letourneur Y, Bigot L, Galzin R, Öhman MC, Garpe KC, Edwards AJ, Sheppard CRC (2008) Climate warming, marine protected areas and the ocean-scale integrity of coral reef ecosystems. *PLoS ONE* **3(8):** e3039

For free online access to the publication, please visit:

http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0003039

## Beach-combing on Eagle Island

*Dr J.C. Hillman*

I was privileged to be a participant in the attempt to eradicate rats from Eagle Island in early 2006. While that attempt sadly failed, there were several positive benefits to the three months we spent on the islands, not least our report on the state of the environment of Eagle Island (Hillman 2007). This was based upon the observation of ten parameters at each of the 2,774 bait station positions scattered at 30m intervals over the entire island.

In addition we walked one part of the beach or another around Eagle Island everyday over three months in 2006 in order to reach our working area from camp at the north-western end. My eyes were always on the strand line – when they weren't admiring the incredible sunrise or sunset, or watching the Frigates standing high and then diving down, attacking Boobies returning home to Cow Island along the Eagle shores.

Never one to miss out on anything unusual, useful and free, I scanned the flotsam and jetsam stranded by earlier tides, and collected anything that might be of interest – where was it from, what could we learn from it?

Figure1 Driftline rubbish and Turtle nesting tracks.

*Photo Chris Hillman*

Empty plastic drinks bottles formed the bulk of it, along with polystyrene pieces, coconuts galore and large plastic fishing net floats. There were also incredible numbers of old flip flops – mainly lefts, and although all sizes were represented, the tiny children's ones suggested not all had been chucked off fishing boats or passing cargo vessels.

Figure 2 Driftline rubbish overgrown by 'Scavvy'

*Photo Chris Hillman*

Then there were the empty aerosol cans, chilli sauce and condiment jars, empty cigarette lighters, bits of Lego and other plastic children's toys, plastic fruit, plastic food trays and household cleaning fluid bottles and sprays. Where was it all from, who was chucking it out and how had it reached Eagle's shores in such large quantities? Studies elsewhere have recorded plastic as the main debris deposited at between 60-80% of the ocean-drift beach litter. A study on a similarly remote Hawaiian island – Tern Island – recorded 71% of the detritus as plastic over a 16 year period, with a quarter of this being related to the maritime industries such as fishing; ocean currents were also implicated in debris transport and deposition from distant dumping locations (Morishige et al. 2007).

The rubbish on Eagle hindered turtle nesting, especially when mixed with bulky fallen coconuts and palm fronds, all this sometimes prevented them from reaching the right level above the tides and then caused them to abandon the attempt. In a short period of time the rubbish was grown over by the *Scaevola* bushes ("Scavvy") and *Ipomoea* creeper at the beach edge, after the highest tides and the wind had moved it further inland (Figs.1 & 2).

Sadly time and the back-breaking task of attempting to eradicate the island's rat population precluded a proper rubbish survey, of taking transects up the beach and into the initial shoreline vegetation around the island in order to determine origins by labels and compass directions. A task for another day – but I did collect anything unusual that caught my eye and by the end of the three month stay had a few insights and even some useful information.

I have admired the Statue of Liberty in New York Harbour – and my photos later showed the strings of huge barges in the background, piled high with tonnes of municipal waste on their way out to sea to dump it far from shore through bottom-opening hatches. Doubtless some would sink to the bottom, some would float and rot, and some would float and not rot, and be taken by the currents - and winds in the case of high-floating styrofoam and empty plastic drinks bottles – to end up eventually eternally spiralling in the great central ocean gyres (Marks & Howden 2008; Morishige et al. 2007).

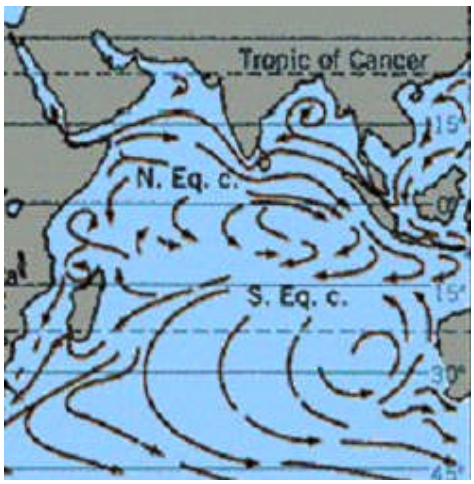



Figure 3 Indian Ocean surface currents
(from US Navy Oceanographic Office)

Doubtless other great sea-side metropolises have followed this excellent example and solution to a massive problem all around the world – including the Indian Ocean, resulting in an ever-increasing plastic rubbish raft or soup, gently circling at ocean's centre, depending upon the winds and currents.

Who knows whether the major coastal cities of Perth, Colombo, Karachi, Mumbai, Dar es Salaam, Durban, Mogadishu, Mombasa, and other ports around the periphery of the Indian Ocean have taken up the idea or not – certainly the nature and the amount observed on Eagle alone cannot be explained by the waste tipped overboard by the few fishing vessels that enter the BIOT ocean area or the cargo and other vessels that pass by distantly on routes between the Cape, Australia and the Far East. Nor is the character of the waste explained by the childless and very well-managed rubbish disposal system of the US base on nearby Diego Garcia.

Ocean surface currents and winds are little understood and changeable. However current knowledge indicates that the Chagos Islands group, located at around 6° south of the Equator, are washed by a variety of currents at different times of year. It is evident from Fig.3 that Chagos lies at the interface between the North and South Equatorial Currents, that wash Australian, SE Asian and African shores.

Another unusual find was two long-toothed plastic "Afro-Pick" combs (Fig.4). These combs have evolved for African hair, but are of course not limited to being used only on African hair. So while they might indicate an African origin for some of the rubbish along the strandline, they could also have come from almost anywhere. They are unlikely to have come from the earlier inhabitants of the island who all left in the 1930s before such plastic items were in common use.

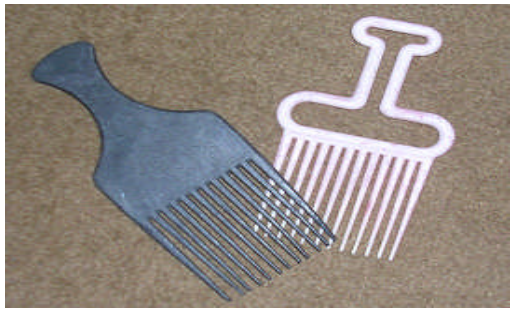


Figure 4 Afro-pick plastic combs from Eagle Is.

Human-generated waste and its origins aside – this was not all that we found along the Eagle strand line. One of the more unusual were the mangrove propagules. Mangroves, being terrestrial denizens of tidal water areas, have developed a number of mechanisms for distributing their seeds. The World Mangrove Atlas (Spalding, Blasco & Field 1997) mentions two mangroves for the Chagos Archipelago, but only one is known from Eagle Island – *Lumnitzera racemosa*. This now forms a dense area north of the old settlement location along the western coast. This low-lying area, while very close to the beach, has no permanent tidal links with the sea, but clearly does receive sea water at certain storm events and at some very high tides. *Lumnitzera* only has a simple little conical fruit. The second species – *Pemphis acidula* – is generally a small coastal shrub with tiny 5mm fruit capsules, and has not been recorded for Eagle Island, although it is known from three other islands of the Great Chagos Bank (Sheppard and Topp 1999).

However, over a period of about five days in early March 2006, considerable numbers of *Avicennia marina* propagules washed up on the western side of the island. These take the form of a large developed seed with the initial leaves, terminal bud and early rooting system clearly evident (Fig.5). Those that are lucky enough to land in the right habitat and soil conditions develop a root system immediately to hold themselves in place. To the best of my knowledge the species has never been recorded for Chagos, and nor did we discover any successfully established seedlings. They require a mud bottom, usually estuarine and tidal, in which to develop.

The species is known to be circum-peripheral to the Indian Ocean (Spalding, Blasco & Field 1997), so the propagules could have originated almost anywhere from western Australia, around through Asia to the Madagascan and East African coasts. Their appearance on the western coast is unlikely to give any idea as to origin since strong currents washed along both sides of the island, from the south over the time we were there.

Figure 5 *Avicennia marina* propagules
*Photo Chris Hillman*

A number of other fruits appeared in the strand line. These included those of the Takamaka tree, *Callophyllum inophyllum* - present on many of the islands including Eagle, so no great surprise there. Fruits were also collected of the Sea Heart - *Entada gigas*, the Sea Bean - *Dioclea* (*Mucuna*?) sp. and of the Latania Palm – *Latania* sp. (Figs. 6 & 7).

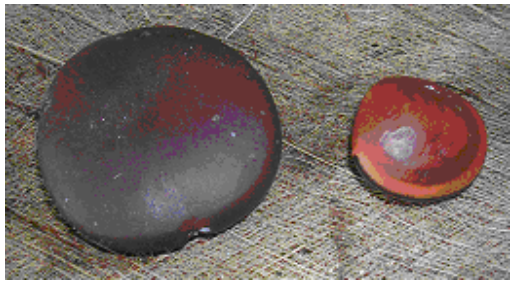


Figure 6 Fruits of *Entada gigas* (left) and *Dioclea*(*Mucuna* ?) sp. (right) *Photo Chris Hillman*

*Entada* is a pan-tropical forest creeper commonly found in sea drift so could have come, again from a wide variety of African and South American locations (Aluka 2008), but it has not yet become recorded growing in Chagos anywhere. Similarly, the Sea Bean is difficult to identify and could be of the genus *Dioclea* or *Mucuna*, known from a variety of African, Madagascar, South American and Pacific locations (Smithsonian 2008).

The Latania Palm is another widespread tropical genus. There are no records for

Chagos as yet, although a species is known from Mauritius, some 2,200 km to the south west of Eagle.

Figure 7 Fruits of *Dioclea* (*Mucuna*?) sp (rear) and the Latania Palm, *Latania* sp. (front)
*Photo Chris Hillman*

The information is inconclusive as to where the Chagos ocean drift rubbish is coming from. It could still be from almost any location around the periphery of the Indian Ocean and more detailed surveys and analysis are required. What the information does indicate is that Chagos beach rubbish comes from a wide variety of sources, underlying the Archipelago's importance as a mid-ocean catchment point for anything adrift on the surface of the sea – be it marine fauna or flora, terrestrial seeds washed out to sea – or man's rubbish dumped in the ocean. Conservation of the Chagos Archipelago requires work on the islands and globally in order to maintain the islands' environmental quality.

I am very grateful to Charlotte Couch of Kew Gardens for identifying the driftline fruits as far as is possible.

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## THE SHARK WHISPERER

*Nigel Wenban-Smith*

The sun shone. With scarcely a breath of wind, the *Germain*'s sails hung limp and wavelets slapped gently at her hull. The only activity on deck was that of the schooner's cook, cutting up the carcase of a freshly-caught Green Turtle, ready for the evening meal of *carangaïe.* This stew, accompanied by rice, has been recollected vividly in the writings of Father Roger Dussercle, to whom it seemed usually to be offered as he sailed queasily aboard small boats in the heavy swells just beyond the reefs of Peros Banhos – "I can easily manage the flesh, the tripes too, but the green and gluey fat I instinctively reject .... just imagine ...!"

Adrien, one of the schooner's crew, was also one of the best swimmers and divers among the population of Salomon; as such, he was frequently asked to swim down to free anchors caught fast in the clefts of rocks and coral heads. He was noted too for his empathy with fish of all kinds and, not least, for his apparent immunity from attack by sharks. Only occasionally, however, when the mood took him, would he demonstrate his extraordinary capacity to be accepted by these animals, the classic example of cold

killing machines and quite different from marine mammals, such as dolphins, which have been proved ready on occasion to rescue humans from sharks.

On that calm day, the *Germain*'s passengers included the Salomon manager's daughter and son, Marcelle Lagesse and Paul Caboche. What they witnessed has been described in Madame Lagesse's charming reflections on life, including her early life in the Chagos, *Notes d'un Carnet.*

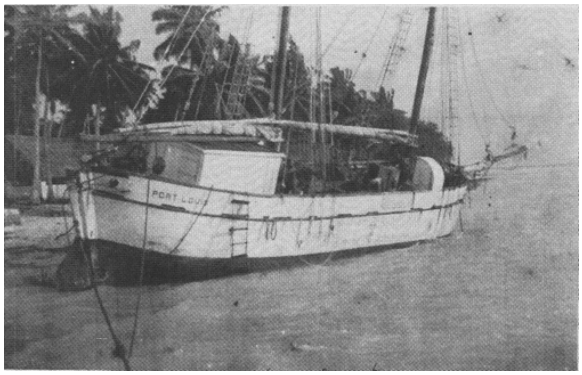

Figure 1 The *Germain* at anchor in Salomon Atoll
*Photo Paul Caboche*

The languid scene was disturbed as Adrien climbed to his feet, wrapped the turtle's discarded entrails around his body and then, intoning a strange chanting sound, leapt into the sea. As he came to the surface, sharks too emerged from the depths, one after another. Adrien's chanting continued, sometimes louder, at others scarcely more than a whisper, mingling mysteriously with the rhythm of the rippling wavelets. The sharks surrounded the swimmer, passing to and fro beneath him and then coming to the surface open-jawed, before descending again to the depths. Whenever one of them came within his reach, he would stretch out an arm and slap its side, as a horseman might slap the flank of his steed. Then, he ceased his chanting and uttered some brief, guttural remarks, doubtless in a Madagascan dialect, before swimming back to the schooner, gripping the rope ladder, climbing nimbly onto the deck and, leaning over the rail, paused to sing for a few minutes longer.

The sharks continued, mesmerised, to circle round. Finally, Adrien disentangled himself from the turtle guts and tossed them into the sea with a brief word of command. The sharks seized them in a trice, dived and were gone. "Good kids", remarked Adrien.

Sadly, Adrien was one of the many islanders smitten by filariasis. In his case, the disease resulted in the swelling of one leg, which gradually doubled in girth. At first, this did not seem to incommode him, but eventually there was no choice but to find him shelter in a charitable institution in Mauritius. Years later, Madame Lagesse encountered him there, by now laid flat by his elephantiasis, and wondered what ancestral spiritual power he possessed, no doubt from his native Madagascar. Whatever it was, he never divulged its secret. "Do you remember those days, Adrien, aboard the *Germain* - and the sharks?" Giving her a sidelong glance, he let out a short deep laugh and muttered a warning: "Not in front of the nuns!" As one of these approached, clicking the beads of her rosary, he gave a wink and, speaking more loudly, said simply "I'm quite well, thank you."

Figure 2 The *Germain* under sail
*Photo Paul Caboche*

## History of Turtle Exploitation in Chagos

*Dr Jeanne A. Mortimer*

Two species of sea turtles occur at Chagos in significant numbers - the green turtle *(Chelonia mydas)* and the hawksbill *(Eretmochelys imbricata).* Both have featured prominently throughout human history in Chagos beginning with passing ships that captured turtles prior to human settlement, right up to the present day (Fig. 1). Permanent settlement of Chagos began in the late 1780s when the first coconut plantations were established at Diego Garcia. Throughout the 1800s coconuts were intensely planted and harvested on all atolls in the Chagos group (Stoddart, 1971). Given the intensity of the coconut industry on these small islands during a period of almost two centuries, the human impact on the turtle populations was significant. And it was exacerbated by the importation of cats, dogs, pigs (Stoddart, 1971) and rats, all of which prey on turtle eggs and hatchlings. As early as the 1840s, the Egmont islands were reportedly overrun by pigs (Mortimer & Day, 1999).


Figure 1 Sea turtles have always been important to people of Chagos and today feature prominently on the BIOT coat of arms

During that period, the plantation workers, who included contracted labour from Mauritius and Seychelles, greatly relished the meat and eggs of green turtles --"to the point of being a fetish" according to Frazier (1977). Hawksbill turtles were also intensely exploited, but not for meat which is often considered poisonous by peoples in the Indian Ocean. Rather, they were killed for their shell. "Tortoiseshell," which comprises the thick translucent scales covering the carapace and plastron of this turtle, was exported as raw scales to Europe for a handsome price. Trade statistics quantifying the export of Chagos tortoiseshell are available for the 20th century, but unfortunately not before then. Nevertheless, historical documents indicate that exploitation of hawksbill shell in the Indian Ocean occurred throughout the period of human settlement (Unienville, 1838; Bourne, 1886). In his historical account of the global tortoiseshell trade, Parsons (1972) reported Chagos to be a "significant producer" of raw hawksbill shell.

As early as the mid-1800s, there were people concerned that hawksbills were already being over-exploited. Possibly in response to this concern, and in a misguided effort to "conserve" the hawksbill resource, it became fashionable in certain parts of the world to remove the tortoiseshell without actually killing the animals. This cruel process is described in the following extract from Charles Darwin's "Voyage of the Beagle" (1897 edition):

*"Captain Moresby* [who visited Chagos during the 1830s and 1840s] *informs me that in the Chagos archipelago in this same ocean, the natives, by a horrible process, take the shell from the back of the living turtle. "It is covered with burning charcoal, which causes the outer shell to curl upwards; it is then forced off with a knife, and before it becomes cold flattened between boards. After this barbarous process the animal is suffered to regain its native element, where after a certain time, a new shell is formed; it is, however, too thin to be of any service, and the animal always appears languishing and sickly'."*

Other historical accounts indicate that this gruesome practice was also carried out in the Caribbean in Nicaragua during the 1800s. Fortunately, this custom appears to have largely died out by the 20th century, and be replaced by a tendency for people to simply kill turtles outright before removing the scales. But, either way, wherever nesting females were killed in large numbers, as was the case at small inhabited islands such as those in Chagos, the typical result was over-exploitation and population decline.

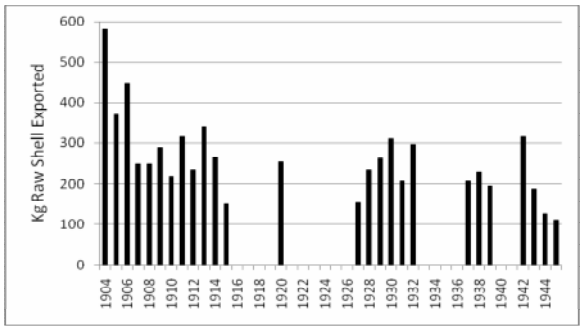


Figure 2 Statistics documenting kilograms of raw shell exported annually from Chagos into Mauritius during the period between 1904 and 1945. Data are from "The Blue Book for the Colony of Mauritius". Two kilos of shell are approximately equivalent to one adult turtle.

Statistics are available that document the export of tortoiseshell from Chagos over the period 1904-1945. Two main sources of export data are available from that period. These include: a) the annual *"Blue Books for the Colony of Mauritius"* published by the Mauritius Government, and b) figures given in reports by visiting magistrates to the islands. Nigel Wenban-Smith *(pers. comm.)* is currently engaged in more detailed study of these statistics; but for this report I deemed the *Blue Books* to be the more reliable source of data. Statistics for total shell exported are available for 26 of the 42 years and these are graphed in Figure 2. The export data appear to be particularly reliable for 21 of the 26 years, and these are considered in more detail in Table 1. For some years, only total export figures are presented. But for 12 years during 1904-15, and for six years during 1927-32, the data compare the tortoiseshell production at five atolls: Diego Garcia, Peros Banhos, Salomon, Eagle Island (Great Chagos Bank), and Egmont (Table 1). These data indicate that more than two-thirds of all tortoiseshell originated at Diego Garcia and Peros Banhos combined. And this accords with the surveys I conducted in 1996 (Mortimer & Day, 1999) and in 2006 (Mortimer, 2007) which determined that more than three-quarters of all hawksbill nesting in Chagos occurs at Diego Garcia and Peros Banhos atolls combined.

The trade statistics indicate a general decline in the amount of shell exported per year between 1904 and 1945 (Fig. 2). With the arrival of plastic in the early 1940s, demand for tortoiseshell fell; and this would account for the reduced trade with traditional European markets in the mid-1940s (Fig. 2). But, prior to World War II, the price offered per kilo of shell remained fairly consistent (around Rs 25 per kilo). So the downward trend in exports during most of that period (Table 1) probably reflects a decline in the size of the hawksbill nesting population that was caused by over-exploitation.

Historical records report that the majority of green turtles taken in Chagos were used for local consumption (Frazier, 1977). But according to the *Blue Books,* some green turtles were also exported to Mauritius. For example, an estimated two dozen live green turtles were sent to Mauritius each year between 1917 and 1935 (Stoddart, 1976 cited in Mortimer & Day, 1999) and eight and 71 green turtles were sent to Mauritius in 1933 and 1936, respectively (*Blue Books* records). Turtle oil (probably from green turtles) was also exported to Mauritius, with an estimated 17 to 79 liters exported annually between 1910 and 1914, and 221 liters in 1933.

As was the case for hawksbills, green turtle nesting numbers have declined significantly over the period of human settlement in Chagos. Horsburgh (1809, in Frazier, 1977) reported the capture of 20 green turtles at Salomon atoll during a period of four days in 1786. These would have been nesting animals, as no

Table 1. Statistics from the 21 years for which export data appear to be most reliable. Data from 21 years are presented for the following three time periods: 1904-15, 1927-32, and 1937-39. Figures for total kg exported and average number of kg exported annually are presented for each of the three time periods. Comparison of tortoiseshell production for each of five atolls is presented for 1904-15 and 1927-32.

| | % of Total Shell Exported | | | | | Total Kg | # Years | Average Kg / Year |
|---|---|---|---|---|---|---|---|---|
| Years | Diego Garcia | Peros Banhos | Salomon | Eagle Island | Egmont Islands | | | |
| 1904-15 | 54% | 17% | 9% | 10% | 10% | 4,070 | 12 | 313 |
| 1927-32 | 42% | 32% | 12% | 6% | 8% | 1,466 | 6 | 244 |
| 1937-39 | Na | na | na | na | na | 632 | 3 | 211 |

green turtle foraging habitat has been recorded at Salomon atoll (Mortimer & Day, 1999). Nowadays, however, such a take would be impossible, given that fewer than five green turtles are estimated to nest annually at Salomon atoll (Mortimer & Day, 1999).

Today, the only permanent human habitation on Chagos is the military base at Diego Garcia which occupies less than 25% of the land area of the atoll. The movements of base personnel are restricted and all wildlife is strictly protected. This protection appears to be paying off. In 1970, Frazier (1977) estimated the nesting population to number some 300 females of each species. Data collected in 1996 indicate that twice as many turtles may nest annually - an estimated 400-800 green turtles and 300-700 hawksbills (Mortimer & Day, 1999). The discrepancy may reflect increased nesting activity in response to decreased slaughter at the nesting beach. Comparative data collected during surveys conducted in 1996 (Mortimer & Day, 1999) and in 2006 (Mortimer, 2007) suggest that numbers of nesting hawksbills have increased at Diego Garcia over that more recent ten year period. The Chagos islands now comprise a turtle nesting site of global significance. With continued protection nesting numbers can be expected to increase even further in the coming years.

**Acknowledgements:**
I am grateful to Nigel Wenban-Smith for sharing with me his data on the shell trade and for comments on the manuscript.

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Figure 3. Author catching a Chagos hawksbill for tag-and-release research. *Photo Charles Sheppard*

## Science resulting from Chagos research expeditions

*Prof Charles Sheppard*
*Warwick University*

*2. Fighting for space on Chagos reefs*

It might not look like it using our human time frame, but corals on a reef fight vigorously for space. This was first discovered on Caribbean reefs (Lang 1973) where corals were seen to have a ranked hierarchy of dominance. The first study of this in the IndoPacific was done in the two northern atolls of Chagos (Sheppard 1979) where over 50 of the commonest species were examined for their ability to fight others, in order to determine the role of this form of competition in structuring the coral community on the reefs.

Coral aggression is seen where two species grow close to each other. Figure 1 shows the endemic Chagos brain coral preventing a much faster growing table coral from overtopping it. If the table was allowed to overtop it, then the brain coral would become shaded and killed.

How does the brain coral do this? On a reef with a lot of coral, killed bands along an edge of one coral colony is a common sight. The killed band occurs along the edge lying closest to another coral that is higher in the dominance hierarchy. In each square metre on a healthy, crowded reef, a dozen such coral interactions may be counted.

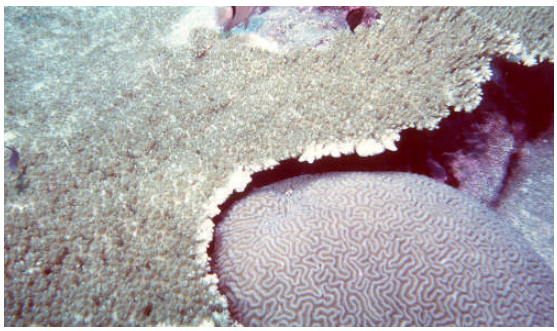

**Figure 1**. The Chagos brain coral *Ctenella chagius* preventing its own overgrowth by fending off a table coral. *Photo Charles Sheppard*

Several weapons are used. Dominant species can extend digesting filaments over a neighbour, through a gap made in its body wall (Figure 2, top). This is a short-range but very rapid mechanism which usually takes place at night. In the morning all that a diver sees is the dead, coral skeleton of the subordinate colony on the side closest to the aggressor. Corals using this mechanism can 'reach' out by only about 2-4 cm, but one night is all it takes.

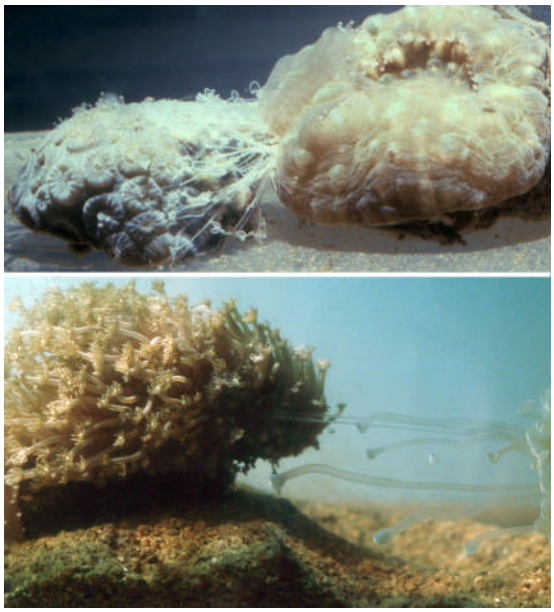

*Photo Charles Sheppard*

**Figure 2 Top**. The coral on the right has extended digestive filaments through an opening in its body wall, over the target coral on the left. It is digesting away its tissues after only about 4 hours in the first night after contact.
**Figure 2 Bottom.** The coral on the right has developed long sweeper tentacles over the preceding two weeks, with which to attack and kill the coral on the left.

To look at this further, a series of open flow aquaria were set up in Peros Banhos in 1978 in which corals were juxtaposed to see which ones killed which others. Some were consistently dominant, while others were always at the bottom of the pecking order.

A second method of attack takes a longer time, but has a much longer reach, up to 10-20 cm. Here the dominant coral develops 'sweeper

tentacles' over a couple of weeks. These are loaded with stinging cells, which are swept onto the nearby target, killing any part within range (Figure 2 bottom).

Other methods are used too. One, mostly seen in soft corals, involves the secretion of toxins such as terpines which can kill almost anything within a short range, though due to dispersion in the water this range is usually quite short. Some of these soft corals can damage human skin if handled.

Aggression is not everything, and subordinate corals must obviously have compensating abilities or they surely would become extinct on the reef. Compensating factors might include fast growth, faster breeding, or the ability to live in deeper, darker parts of the reef. Corals that perform less well in all these things will simply become extinct; after all, the fossil record shows that many more species have come and gone over past ages than are here today.

After the mass mortality from warming a decade ago, a large amount of bare space was suddenly created. Very few aggressive interactions took place between the scarce and scattered survivors. Then, juvenile corals, especially of 'weedy' species, settled in huge numbers on the newly created space (Harris and Sheppard 2008). These have grown, and now that coral cover is rising again (Figure 3, Sheppard et al 2008), they have become abundant enough for interactions to again help shape the community. (Editor's note: The cover of the book shown on page 2 shows one of these fast growing species – these will likely become less abundant as time goes on as other species begin to outcompete them). The arms race is becoming important again, giving rise to a higher diversity on the reef.

What is the relevance of this slow motion warfare in Chagos now? Such interactions generate bare space between colonies. There is greater spatial movement and change than might be expected, such that while a quarter of a typical reef might contain 'bare space', the location of each patch continually changes as one coral slowly destroys another (Sheppard 1985).

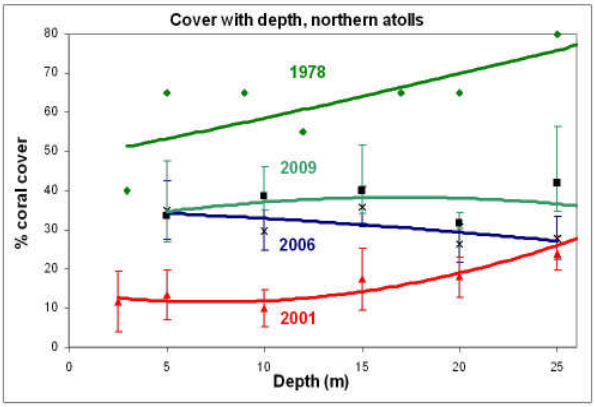


Figure 3. Each line shows total coral cover on Chagos seaward facing reefs, in 1978, 2001, 2006 and 2009 showing progressive recovery. X-axis is depth to 25 metres. The shallowest parts were affected most in 1998 but are recovering fastest. Many 2009 values now overlap with 1998 values (bars are standard error bars).

This is being examined because it gives many clues about how a reef should develop, and this will bring useful information to all those marine park and coral reef managers in many of the devastated parts of the tropical ocean.

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## Membership News

*Chagos News* is the main vehicle through which the Chagos Conservation Trust tells you what the Trust is up to, and it keeps you informed about the latest research and news regarding the Chagos. We are considering ways in which we might increase this sort of information which we send out to you, the members.

The printing and postage of the *News* is a major cost to CCT, especially as we have so many overseas members. One possible change we are considering is emailing you your copy. If any of you would be happy, or even prefer, to receive your copy of *Chagos News* by email instead of a printed copy, please let me (editor@chagos-trust.org) know. There is no intention of discontinuing the paper version. An emailed edition would have the advantage of being in glorious colour for every issue, whereas we can only afford this with the paper version from time to time. The emailed version could also have extra colour photographs.

Please consider this proposal and let me know if you are happy to have a colour version of *Chagos News* by email in future. I reiterate that there is no plan to discontinue the paper version.

This information will be emailed to all members who have given an email address to the membership secretary, if you have not given an email address and would like to do so, please send it to membership@chagos-trust.org

Less shipment so less $CO_2$ production – saves coral!
Less trees cut down so less $CO_2$ emitted – saves coral!
Less cost so more money for CCT – saves coral!
Less worn shoe leather for the postman – saves cows – more $CH_4$ – less coral! ...oops!"

Photo Anne Sheppard

At the back of this newsletter is another Chagos Factsheet from the series which is available on a postcard CD from CCT, priced £5/$7.50 for members and £6.50/$10 for non-members

**CCT AGM 2009**

This year's AGM will be held, as before, at the Royal Over-Seas League, Over-Seas House, Park Place, St James's Street, London SW1A 1LR, on Tuesday 24 November 2009. Full details concerning elections etc will be emailed to members nearer the time. For your diaries, we plan to hold AGMs in future on the last Tuesday in November.

**A note from the Treasurer:**

We are highly dependent on our income from subscriptions. With the best will in the world, it's easy to forget to renew/ update the amount when needed. So we need you, please, to check:
1. Have you renewed your subscription for 2009? (It's payable for each calendar year, unless you signed up after 1st September, then you're covered to Dec the following year)
2. Have you uprated your subscription to £20/$40? (We increased it on 1 Jan 08, but some have paid only £10 and some have plumped for a quirky £15!)
3. Have you signed a GAD? (Gift Aid Declarations only apply to UK taxpayers, but if you are one, please do! It costs you nothing and brings us £1.20 for every £1 you pay or donate).

**Chagos News**
We are always very pleased to receive submissions for *Chagos News* from members. Articles or photographs for consideration should be submitted to chagosnews@chagos-trust.org

A Hawksbill turtle seen in the pristine waters off Diego Garcia

## The pristine waters of the British Indian Ocean Territory

Pollutant levels in Chagos waters and marine life are exceptionally low. Analyses in 1996 suggested that "The marine environment of the Chagos Archipelago as a whole is exceptionally pristine" and was the cleanest water tested so far[1,2] in the world.

Hydrocarbons found are almost entirely of biological (natural) origin. Oils, and pyrogenic (combustion) hydrocarbons are present only in parts per billion, while some particularly toxic organic pollutants such as PCBs, lindane and dieldrin are present in parts per trillion only. Many others screened showed no trace at all, even in bird livers and other tissues which concentrate pollutants. The identity of those chemicals that were detected suggest that they are wind borne, rather than of local origin.

Toxic metals were similarly low, orders of magnitude lower than most areas. One exception was in Salomon where small quantities of nickel were concentrated in some marine life, which probably came from the fungicide used in the coconut plantation forty years previously.

The 2006 Chagos expedition again sampled lagoon water, this time of Diego Garcia, focussing on a range of 'booster biocides'—chemicals from antifouling paints which are highly toxic to marine life, and terrestrial herbicides. These inhibit the photosynthesis of plants, and are very damaging to corals. Analytical sensitivity was such that during sampling, no sunscreen, perfume or deodorants could be worn in case this caused contamination! Samples were processed on the island and then analysed in Plymouth Marine Laboratory. Again, concentrations found were at mostly below detection limits of 1 part per trillion, using the most sensitive instrumentation available. We conclude that Chagos water "…**could be considered appropriate as a global reference baseline**"[3]


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