



# **Mangrove and Conservation Value Assessment at Northern Turneffe**

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Report to the Belize Forest Department of the Ministry of Natural Resources

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### Acronyms

BERDS = Biodiversity and Environmental Resource Data System for Belize	N = North
BTFS = Belize Forest Studies	NAD = North American Datum
CD = Compact Disk	NPAPSP = National Protected Areas Policy and Systems Plan
CZM = Coastal Zone Management	pp = pages
CZMAI = Coastal Zone Management Institute	Tm = Thematic Mapper
DoE = Department of the Environment	TICAC = Turneffe Islands Coastal Advisory Committee
ha = Hectare	TOR = Terms of Reference
IUCN = International Conservation Union	UTM = Universal Transverse Mercator
Km = Kilometer	WCS = Wildlife Conservation Society
LIC = Land Information Center	WWF = World Wildlife Fund for Nature

# Mangrove and Conservation Value Assessment at Northern Turneffe

## 1. Introduction and Terms of Reference

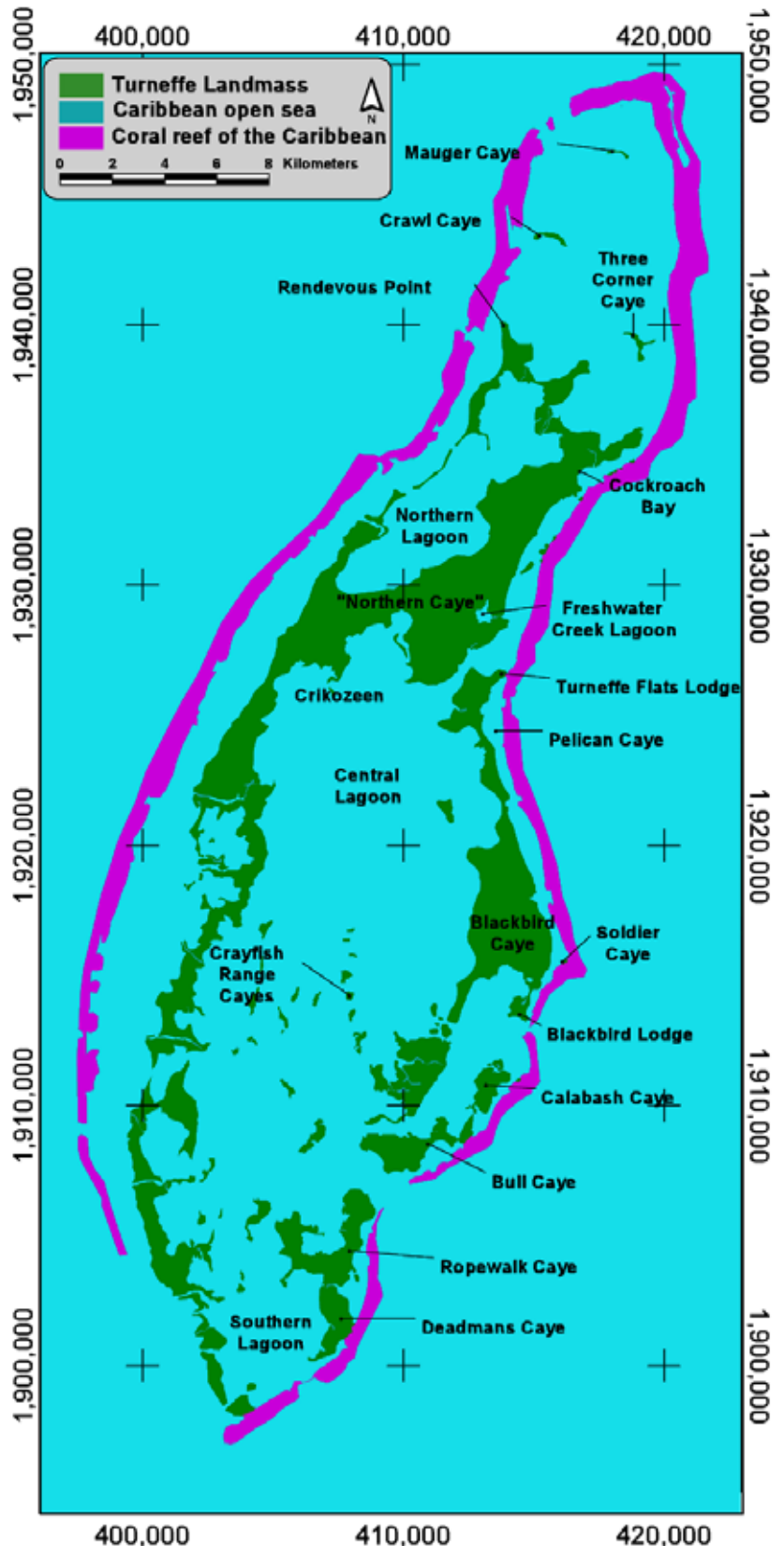
Mangroves and other critical and sensitive habitats are important for fisheries, protection of native and migratory wildlife, and coastal protection. It has been suggested that these areas should be afforded more meaningful protection than currently is in place. A recent assessment of the national protected area system has determined that the Turneffe Atoll is of high importance because of its many different marine and coastal ecosystems that occur in close proximity of each other. Northern Turneffe is important as the most important nesting site for the American Crocodile in Belize.

The purpose of the consultancy was to conduct an assessment of mangrove and littoral forests at Northern Turneffe Atoll (roughly identified as Northern Caye).

Specifically, the purpose of the consultancy was to:

- Map areas of standing and cleared mangroves on Turneffe Atoll
- Identify and list critical areas of mangroves and littoral forests that should be protected
- Research the land tenure of the area
- Identify and list critical habitat for sea birds, marine turtles, and crocodiles

Figure 1. Turneffe Islands listing locations mentioned in the text. All map projections in this report: UTM NAD 1927, zone 16N.



## 2. Acknowledgements

The study benefited from the kind help of George Hanson (Forest Department), Tineke Boomsma (Belize Tropical Forest Studies), Emil Cherrington (Coastal Zone Management Institute), Bruce Miller (Wildlife Conservation Society), Janet Gibson (Wildlife Conservation Society), Sergio Hoare (Wildlife Conservation Society), Melanie McField (World Wildlife Fund for Nature) Noreen Fairweather (Land Information Center), Martin Alegria (Department of the Environment) and the staff at the Lands and Survey Section of the Ministry of Natural Resources.

## 3. Methodology

### 3.1. Base line data search

Some base line data exist on Turneffe Atoll and related issues. These include some gray literature:

**CZMAI, 2003. Draft Cayes Development Policy.** (See appendix 1. This document is available as digital copy - 23 pp.)

This policy is an update from the 1995 draft. The greater part of the policy focuses on the less developed Cayes; the development issues of the 'urban' areas of San Pedro and Caye Caulker are more appropriately addressed through specific development planning guidelines. The Coastal Zone Management Strategy was endorsed by Cabinet in 2003. The Cayes Development Policy reflects and elaborates on the four pieces of legislation containing land use planning powers: provisions of this Strategy.

The document lists the

- the 1998 Coastal Zone Management Act (establishing the Coastal Zone Advisory Council),
- the Disaster Preparedness and Response Act (the National Emergency Mobilisation Organisation),
- the 1981 Land Utilisation Act (establishing the Land Utilisation Authority), and
- the 1957 Housing and Town Planning Act (the Central Housing and Planning Authority).

The first two of these Acts only have powers to draw up plans, which may include the zoning of particular land uses and land use densities, yet have no means to directly implement them. The last two also have development management powers, which means that they receive and assess applications for development. Another piece of legislation, the Environmental Protection Act (establishing the Department of the Environment), has the power to manage the development process, through environmental screening, yet has no planning powers. Moreover this last Act relies on the various other Government licensing agencies to refer applications to the Department of the Environment for appraisal.



The Land Utilisation Authority regulates the sub-division of property throughout the country and can declare (generally rural) areas to be Special Development Areas that are subject to land use development plans, drafted by the Physical Planning Section of the Lands and Surveys Department. The Central Housing and Planning Authority can declare a (generally urban) area as subject to its powers to control land use and building also through development plans. The National Emergency Mobilisation Organisation can declare areas that it considers vulnerable to disaster as subject to a Special Area Precautionary Plan, and the Coastal Zone Management Authority is responsible for the preparation of a CZM Plan; the Coastal Zone Management Advisory Council is required to review and approve the Coastal Zone Management Plan which may involve separate area-specific development guidelines.

Other Government and semi Government development management agencies include the Fisheries Department (licensing aquaculture), the Belize Tourism Board (licensing hotels; the Geology and Petroleum Department (licensing dredging, petroleum and mineral extraction), the Forest Department (licensing logging and the cutting of mangroves), the Belize Trade and Investment Service (Beltraide) (issuing fiscal incentives).

The Draft Cayes Development Policy has some very important policy statements regarding land tenure and ownership:

**C.1** Only applications from Belizeans are to be considered in leasing any Nationally owned cayes or part of a cayes.

**C.2** Lease holders on the cayes, particularly on the lesser developed ones, will be encouraged and assisted in obtaining titles. Long term Belizean occupants on National land that have no leases will be similarly encouraged to apply and obtain leases.

**C.4** A comprehensive development plan is to be attached to every lease of National land on cayes.

**C.5** The moratorium on the sale or grant of nationally owned cayes should be formalized or legislated.

**C.6** Assessment of all applications to sub-divide land on cayes must take the provisions of the CZM Plan into account.

**C.7** Development activities, as well as the development of leases and properties, are to be closely monitored to ensure compliance with the CZM Plan.

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**McGill, 1996 Draft Turneffe Islands Development Guidelines.** (Available as hardcopy of the original only. Lodged at the CZMAI: label CZM/iczm-904. This historically important document is in need of digitization)

This important document gives a general description, land tenure and occupation, land uses and provides a first recommendation on development

potential and development policy. These based on physical and social characteristics.

Many of the data gathered for this development guidelines study were subsequently digitized and stored as ArcView Shapefiles at the CZMAI. Most of these files were analyzed for this study. Consultant create some new files based on these data. All data are available from the accompanying resource CD.

Maps in the Turneffe Islands Development Guidelines include:

- Indicative map of existing land use
- Indicative map showing location of development sites
- Indicative vegetation map
- Indicative map showing areas identified as requiring particular conservation

The principal objectives of the document were the protection of fishing resources and the protection of usuary fishing rights. Importance is given to the “custodianship” of the fishermen. Titling of established fishing camps (in spite of an existing moratorium on handing out leases on Cayes) features strongly.

There is an extensive “database” of developments complete with description, ownership, development potential, development/zoning guidelines etc.

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**Turneffe Islands Coastal Advisory Committee, 2003 Turneffe Islands Development Guidelines (Draft).** (Available as hardcopy from WCS marine. More hardcopies should be around but they are difficult to locate. This document is in need of digitization)

This document essentially is an update on the 1996 McGill study. The document contains an extensive land tenure report including a list of lease approvals and expired/canceled leases. These data however have no spatial component, so the exact location of each of the leases remains vague. Of interest is also the anecdotal land tenure history.

The document remains in a draft stage as it has not been officially accepted.

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**Egan, S. 2005. Rationale for location of Draft Core and Buffer Biosphere Reserve Zones on Turneffe Atoll.** Email from Stefanie Egan, Graduate Student, San Francisco State University/Oceanic Society, San Francisco.

This study, attempts to identify core protection areas on Turneffe Atoll. A GIS (ArcView shapefile) dataset exists.

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**Meerman, J. C. 2005. National Protected Area System Analysis.** Series of reports to Ministry of Natural Resources.

This extensive study analyses the existing protected areas system in Belize, carries out gap analyses and gives recommendations for the rationalization of the protected areas system. The analysis includes Turneffe Atoll.

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**Meerman, J. C. & W. Sabido. 2001. Central American Ecosystems Map: Belize.** 2 reports. World Bank / Programme for Belize.

This ArcView shapefiles accompanying this report were updated in 2005 using 2004 landsat images (Meerman, 2005). The new classification integrates the Murray et al (1999) vegetation description.

The original shapefiles belonging to this dataset is troubled by inaccuracies resulting from original poor digitization of the Turneffe Landmass.

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**Murray, M. R., S. A. Zisman & C. D. Minty, 1999, Soil-plant relationships and a revised vegetation classification of Turneffe Atoll, Belize.,** Atoll Research Bulletin, 464, 32 pp. Report on the vegetation types existing on Turneffe Atoll. ArcView shapefiles of the classification exist and are located in the CZMAI database.

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**Platt, S. G., T. R. Rainwater & S. Nichols, 2004. A recent population assessment of the American Crocodile (*Crocodylus acutus*) in Turneffe Atoll, Belize.** Herpetological Bulletin 89: 26-32.

Establishes the known American Crocodile nesting sites. Field notes accompanying the report were digitized by Bruce Miller (WCS).

The report established that Turneffe Atoll has the largest concentration of nesting activity of the American Crocodile in Belize. The most important nesting beaches and the threats to these are listed. The report concludes that failure to protect the most important nesting beach on Turneffe Atoll could have potentially devastating consequences for the species in Belize.



### **3.2. Land Tenure investigation**

Much land tenure information is incorporated in the 1996 and 2003 Turneffe Islands Development Guidelines. In many cases this information is very detailed providing ownership but lacks precise (spatial) boundary maps. Some ArcView shapefiles containing land tenure information was available in the CZMAI files. However, these files generally lack ownership information and are troubled by bad digitization and missing projection and datum information.

Subsequently, an attempt was made to gather ownership / subdivision information from the Lands Department. Although the land registration is supposedly automated, it proved very difficult to locate registration plans using this automated system. Several plans were discovered by “accident” and not through the automated search feature. A total of 35 registrations were located. Because of the problems in locating all plans, the search was limited to the actual area of interest named in the Terms of Reference: Northern Turneffe. It is noteworthy to mention that most of the land given out on Turneffe appears to be located in South-eastern Turneffe: Blackbird Caye, Calabash Caye, Bull Caye, Ropewalk Caye, Deadman’s Caye. Hardcopies of all of the plans were acquired and all data were subsequently entered in a GIS layer. The data obtained are represented in table 1. These data are also available on the accompanying CD as the original GIS shapefile.

Digitizing the registration entries revealed that the surveyors working on Turneffe are often very careless with the use of coordinates. Each of the entries obtained contained UTM coordinates for all corner points. It has to be assumed that these UTM coordinates refer to coordinates in North American Datum 1927, Zone 16N (Central America). Nevertheless, this was never stated and plotting the coordinates frequently revealed impossible locations for the properties described. Noted errors most likely, can not always be attributed to the use of a wrong map datum. While such inaccuracies provided by the surveyors are serious enough, they were clearly not discovered during the authentication process at the Lands and Survey Department. The consequences for all of this are very serious since they can lead to legal problems in the delineation of lands.

The information thus obtained was combined in a number of ArcView shapefiles. The compilation of this for Northern Turneffe can be found in figure 2. Particular attention was paid to the Cockroach Bay area, reputedly a key American Crocodile nesting area (figures 1, 16).

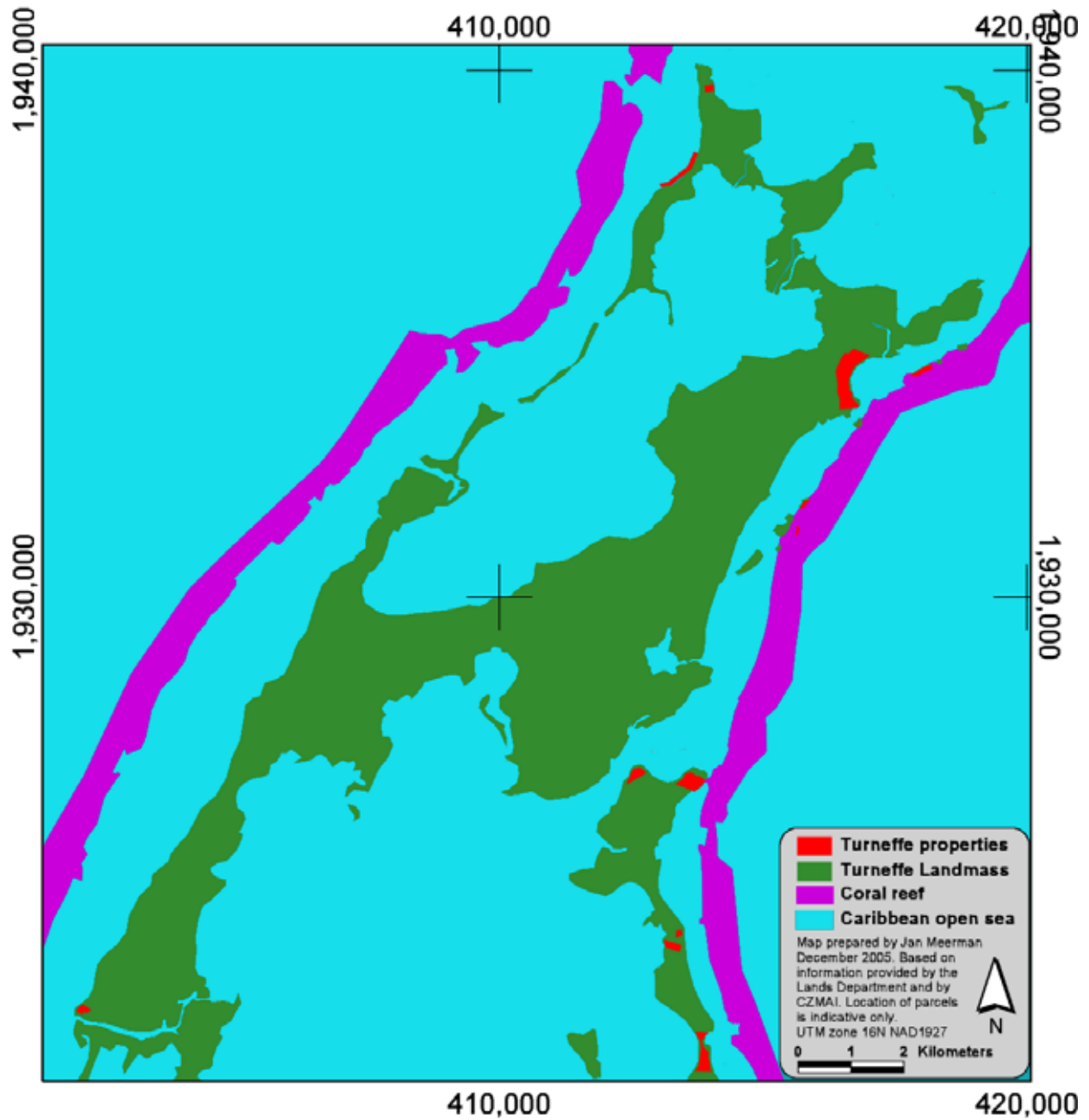


Figure 2. Detail of project area with identified properties indicated in red (status December 2005).

**Table 1. Survey entries found. Note: this focuses on Northern Turneffe but contains some data from other parts of Turneffe as well. These are included here for completeness only. All data available as ArcView Gis file on CD accompanying this document.**

<b>ENTRY</b>	<b>REG</b>	<b>ISLAND</b>	<b>REQUEST_BY</b>	<b>SURVEYED_BY</b>	<b>AUTHENTICATED</b>
8039	22	Cockroach Bay	Maria M. Guerra	E.H. Arzu	18-05-2004
7032	16	Calabash Caye	University of Belize	K.A. Gillett	11-12-2002
7465	14	Blackbird Caye	Austin E. Rodriguez	M.E. Sanchez	22-07-2003
7465	14	Blackbird Caye	Austin E. Rodriguez	M.E. Sanchez	22-07-2003
1640	3	Blackbird Caye	Ray Lightburn	A.R. Marin	17-02-1993
6812	25	NE Reef Cayes	Alfredo Aldana	C.W. Arnold	11-09-2002
7643	4	Cockroach Bay	Phillip R. ESpat	G.E. Valdez	15-10-2003
8708	18	Blackbird Caye	M.A. Aranda	J.A. Keith	28-04-2005
8708	18	Blackbird Caye	A.M. Enriquez	J.A. Keith	28-04-2005
7784	18	SW tip of Northern Caye	H.M. Gabourel	J.A. Keith	19-12-2003
7784	18	SW tip of Northern Caye	H.M. Gabourel	J.A. Keith	19-12-2003
8035	25	Blackbird Caye	Dalt Ltd	C.W. Arnold	13-05-2004
4478	3	Calabash Caye	Turneffe Island Resort	A.R. Marin Sr.	01-06-1999
8431	18	Cockroach Bay	Israel Marin	J.A. Keith	16-11-2004
8431	18	Cockroach Bay	Juan Willis Villanueva	J.A. Keith	16-11-2004
8617	22	Blackbird Caye	Ainslie Leslie	E.H. Arzu	04-03-2005
8617	22	Blackbird Caye	Miriam Neal	E,H. Arzu	04-03-2005
8550	16	Blackbird Caye	Roque Badillo	K.A. Gillett	31-01-2005
8626	22	Blackbird Caye	Kennylee Gonzalez	E.H. Arzu	10-03-2005
8371	4	NE Reef Cayes	Carlos Michael Barillas	G.E. Valdez	22-10-2004
8371	4	NE Reef Cayes	Carlos Michael Barillas	G.E. Valdez	22-10-2004
7941	22	Cockroach Bay	Josephine Sutherland	E.H. Arzu	24-03-2004
7941	22	Cockroach Bay	Ainslie Leslie	E.H. Arzu	24-03-2004
8329	17	NE Reef Cayes	Alfredo Aldana	J.E. Depaz	28-09-2004
2059	157	Blackbird Caye	Unknown	G.A. Perez	00-00-0000
1293	3	Blackbird Caye	Unknown	A.R. Marin	04-10-1991
6639	3	Calabash Caye	Marion Usher	A.R. Marin	01-07-2002
6639	3	Calabash Caye	Marion Usher	A.R. Marin	01-07-2002
8530	18:3	Blackbird Caye	E.A. Ariola	J.A. Keithe	14-01-2005
8530	18:2	Blackbird Caye	K. Drury	J. A. Keith	14-01-2005
8530	18	Blackbird Caye	R. Cocom	J. A. Keith	14-01-2005
1293	3	Blackbird Caye		J. A. Keith?	
8100	20:2	Cockroach Bay	B.B. Feinstein and Constr. Depot	D.W. McKay	17-06-2004
8100	20:1	Cockroach Bay	B.B. Feinstein and Constr. Depot	D.W. McKay	17-06-2004
8923	22	Cockroach Bay	Felipa Avilez	E.H. Arzu	29-07-2005
?	?	Blackbird Caye	Unknown-pegs found	Unknown Pegs found	?

### 3.3. Fieldwork

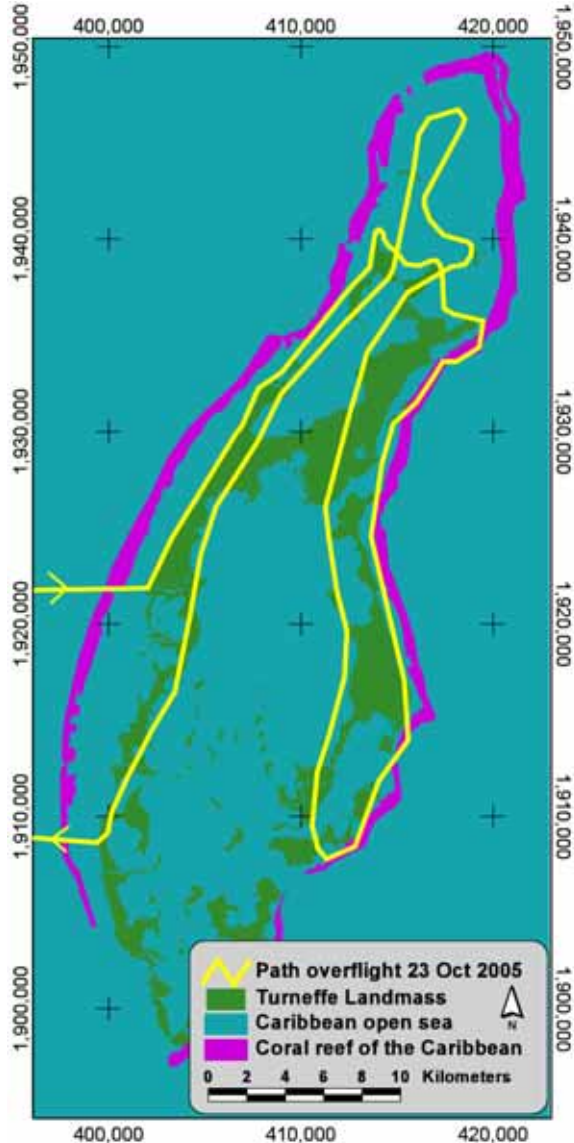


Figure 3. Turneffe Atoll and October 23, 2005 flight path of overflight

Following the baseline research, fieldwork was carried out. This field work consisted of an overflight of the area. This overflight was carried out on October 23, 2004 using a one engine plane from Javiers Flying Service in Belize City. Consultant was accompanied on this flight by George Hanson from the Forest Department.

The flight path covered the northern  $\frac{3}{4}$  of the Turneffe Atoll (see figure 3). On this flight a total of 220 digital pictures was taken. These pictures are provided on the accompanying resource CD. In Appendix 2, a map is presented with the location of each picture indicated. The numbers on this map correspond with the file number of the pictures.

The pictures taken during this overflight proved very effective in assessing the state of the mangrove cover and in locating developments.

Following this overflight, on the ground fieldwork was carried out on November 22 through November 24. Fieldwork had to be postponed twice due to proximity of Hurricane Wilma in the latter half of October and Tropical Storm Gamma on November the 21<sup>st</sup>. Both storms actually caused some damage to mangroves on Turneffe.

Data were collected throughout the coastal zone of Northern Turneffe (Figure 4). Fieldwork consisted mainly of assessing vegetation, investigating clearings and developments. Several brief interviews with fishing camp guardians were held in order to inquire for the presence of Crocodiles and Turtles. On the night of the 22-23<sup>rd</sup> of November a night drive was held all over the Northern Lagoon in search of Crocodiles. Biological data collected are all entered in the Biological and Environmental Data System of Belize (BERDS): <http://www.biodiversity.bz>. A complete listing is attached in appendix 4.

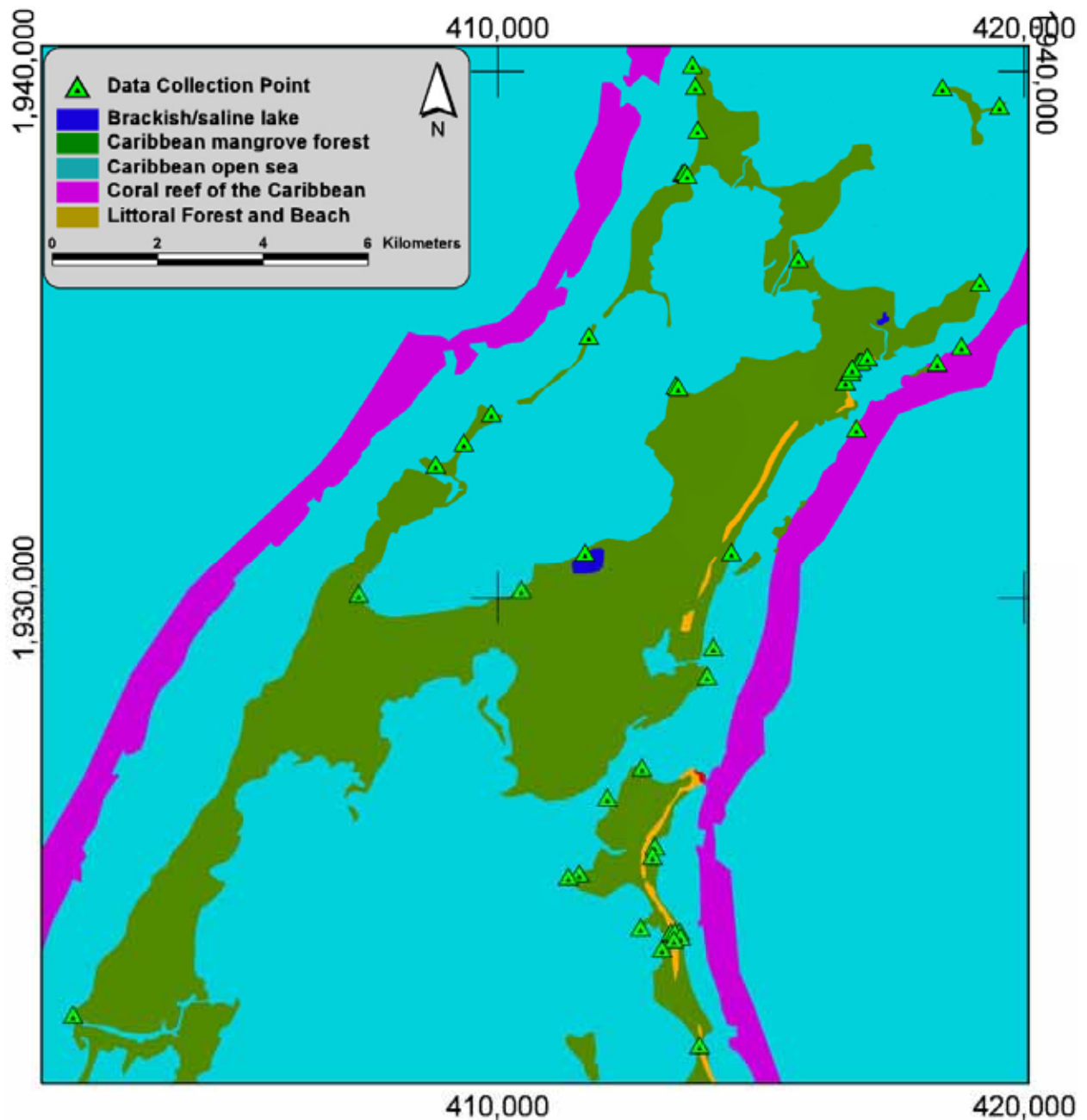


Figure 4. Data collection points of fieldwork conducted in November 2005. Note: Vegetation cover classification follows the standards set in the 2001 Central American Ecosystems Map (Meerman & Sabido).



## 4. Results

### 4.1. Mangrove and Littoral Forest Health

One of the most noticeable features of Northern Turneffe is the massive damage to mangrove. Much of the Red Mangrove appears to have died completely. In many cases even the root system appears to be dead and there is very little regeneration from the base of dead trees. There is however, abundant regeneration from seedlings.

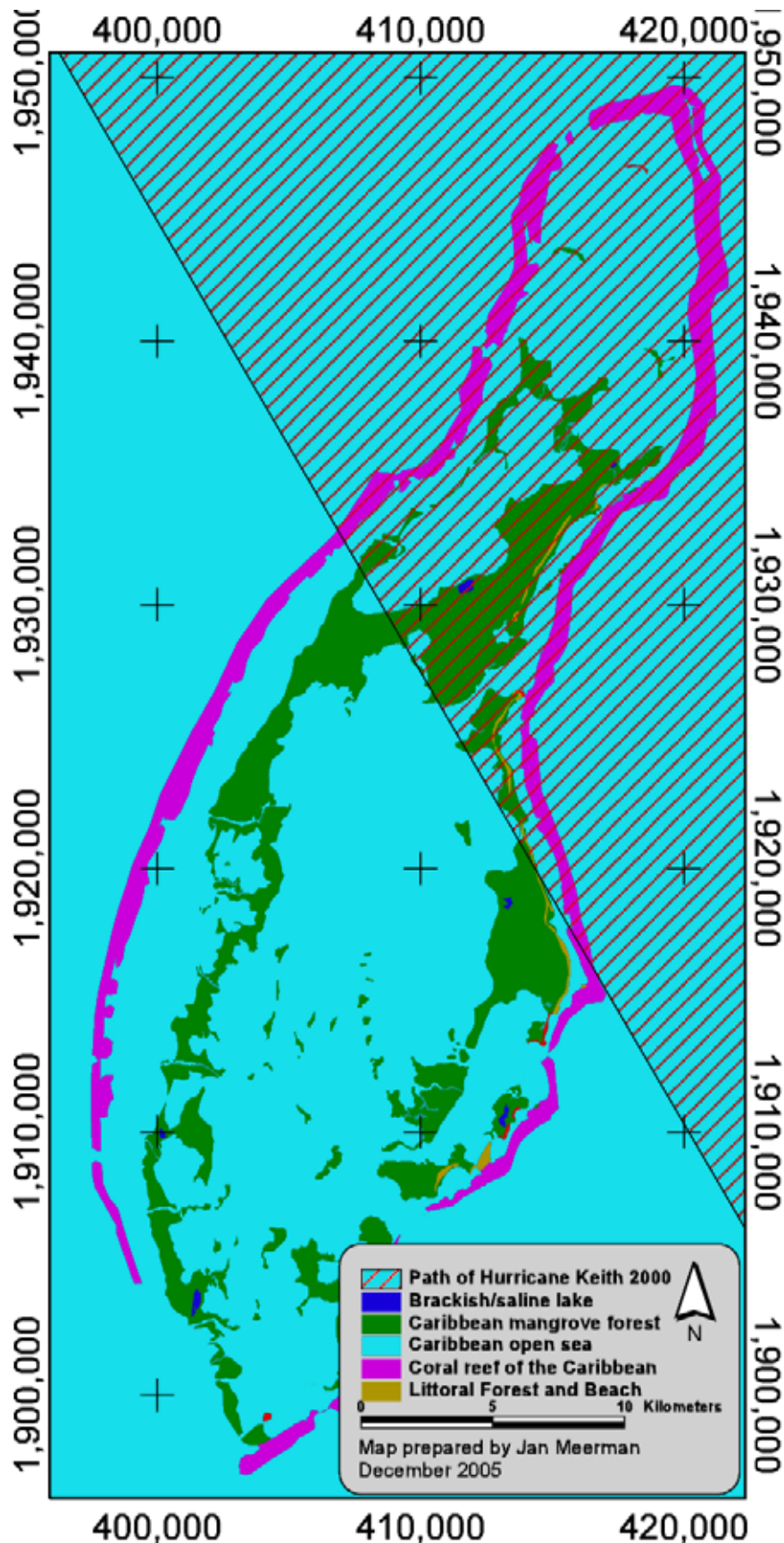


**Figure 5. Dead Red Mangrove stand on NW Turneffe Atoll. Notice the near total destruction and limited regeneration with very few live trees remaining.**

Away from the coastline, where mangrove stands were dominated by Black Mangrove, a noticeable feature is the heavy ground cover of the subshrub *Batis maritima*. Apparently the increased light level caused by the destruction of the canopy has benefited this plant species. The distinctive bluish green color of the plant make the plants stand out even when seen from the air.



**Figure 6. Dead Black Mangrove Stand on NE Turneffe Atoll. Notice the heavy undergrowth of *Batis maritima*.**



This destruction of Mangrove is the result of Hurricane Keith which passed through the area from September 29 to October 1, 2000. Based on an analysis of the aerial pictures and field work data, approximately 4,000 ha (9,800 acres) or 35% of the landmass of the Atoll was affected (Figure 7).

While the damage is serious, it has to be considered part of the natural cycle on exposed Cayes like Turneffe.

Much of the damage seen has to be attributed to the effects of wind force itself. Trees were uprooted, branches were defoliated, friction caused by the wind caused branches to "burn", constant twisting of branches caused bark to detach etc. The death of so many of the root systems can possibly be explained by pathogens entering the roots after the above ground parts of the plants were sufficiently damaged to let these pathogens through.

**Figure 7. Area of Turneffe Atoll affected by Hurricane Keith in 2000**



On some locations the effects of direct wave action could be seen. Initially, during the overflight these locations were marked as “potential mangrove clearing activities” But field work proved them to be the result of direct wave action on the shore in places where there were breaks in the barrier reef (Figure 8)(on map Figure 9 listed as “Storm Damage” and “Wave Damage”).



**Figure 8. Wave action damage to shoreline Mangrove on E. Turneffe Atoll. The location is a small cove behind a gap in the barrier reef**

However, there are several impacts to mangrove not from natural causes. Figure 9 shows the location of these features based on both the overflight and subsequent fieldwork.

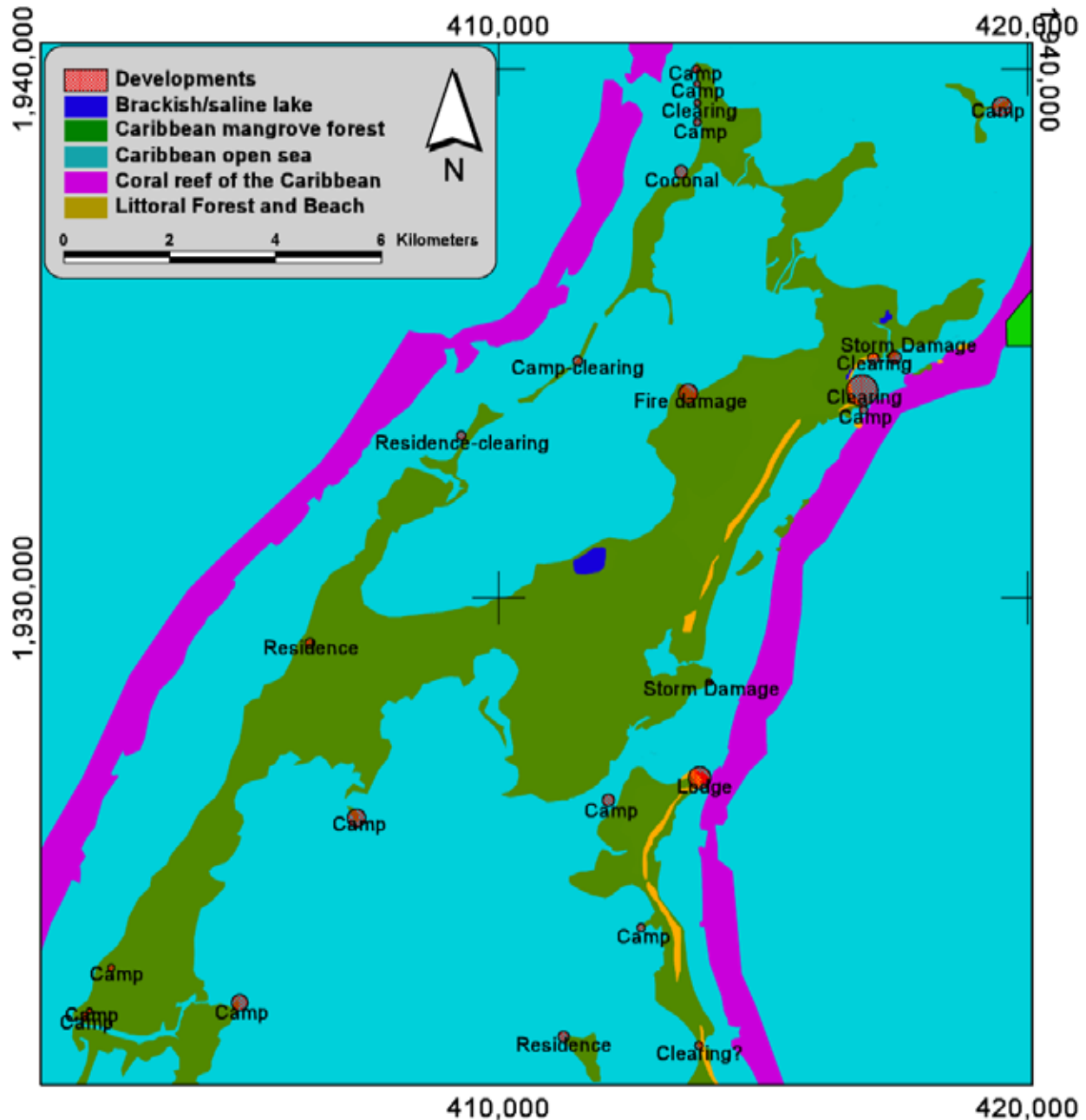


Figure 9. Map of Northern Turneffe noting features affecting natural vegetation

There are various fishing camps in the area. Most are located on the west coast of the atoll and inside Central Lagoon. Most fishing camps have been established for a long time and most users have cleared the vegetation around these camps. Other than this, the main impact the fishermen have on the terrestrial ecosystem seems to be the intensive cutting of Chit palms (*Thrinax radiata*) for the use of construction material. This harvesting was noted throughout the Atoll and exerts quite a heavy pressure on the

population of this slow growing palm. Another main impact of the fishing camps could be the fact that most of them have dogs. These dogs (while occasionally becoming a prey of Crocodiles) must exert at least some pressure on crocodiles and turtles coming ashore for nesting purposes.



**Figure 10. Recent Mangrove Clearing in Cockroach Bay**

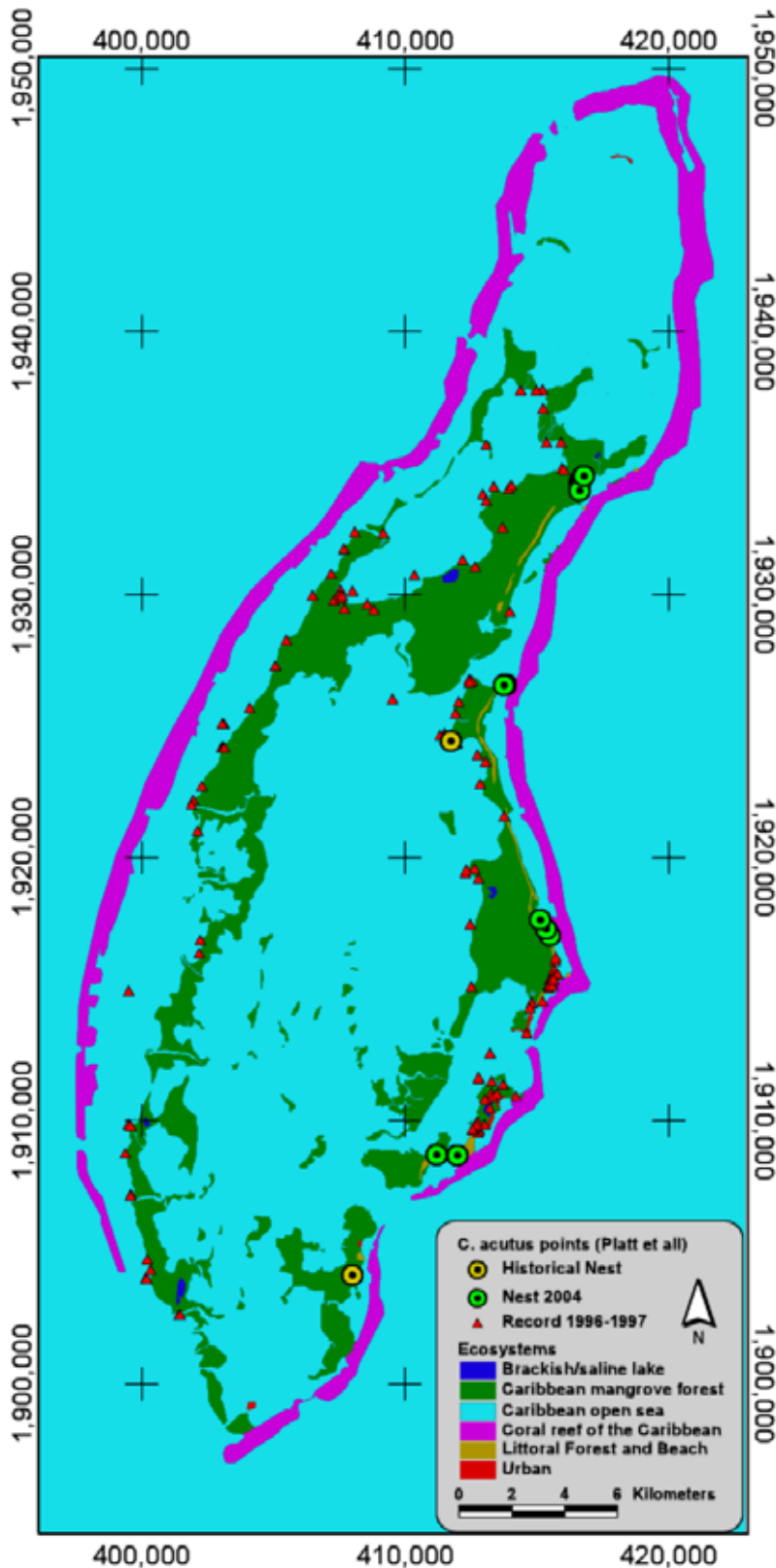
The most obvious recent clearing of Mangroves was seen in Cockroach Bay. The largest was carried out on two parcels of land recently acquired (registration 7941:22, see table 1 later in this document for the owners). This clearing is clearly visible from the air. According to information from the Forest Department, no Mangrove Clearing Permit was requested or issued for this clearing.

Further ground truthing revealed that much of the littoral forest on this particular

site has also been cleared essentially leaving the coconut trees in an effort to clear the beach.

Similar mangrove clearing and opening up of the littoral forest was also noted on several locations outside the study area on Blackbird Caye.

## 4.2. Crocodiles



Of the two crocodile species occurring in Belize, the American Crocodile (*Crocodylus acutus*) is the rarest. Internationally (IUCN) the species is listed as “Near Threatened”. Nationally, the species is endangered (Meerman, 2005).

Thanks to the work of Platt et al (2000a, 2000b, 2004a, 2004b) we have a very good idea of where the crocodiles occur and which areas are critical for their nesting.

It appears that Turneffe Atoll is the last stronghold of the species in Belize. While found in low numbers along much of the coast of Belize, it is only from Turneffe that good numbers are being reported. It is only one of the few if not only location where recruitment is still taking place. It has even been suggested that most of the American Crocodiles seen elsewhere along the coast of Belize are actually specimens originating from Turneffe (Platt & Thobarjarnson, 2000a).

Based on survey data (figure 1T1), we know that American Crocodiles can be seen pretty much all over Turneffe. However, there appear to be some key areas. One includes

**Figure 11. American Crocodile Sightings (Adults, juveniles 1996-7) and nests (2004); from data provided by Steven Platt - WCS.**

Calabash Caye, another Southern and Northern Blackbird Caye, certain locations along Northern Lagoon, etc (but note that during our own, one evening survey on the Northern Lagoon of 22<sup>nd</sup> of November, we did not see a single Crocodile).

Nesting has only been confirmed from the eastern shores of Turneffe. The key sites being Cockroach Bay, Northern Blackbird Caye, Southern Blackbird Caye and Bull Caye. Recent historical nesting records exist from Northern Blackbird (central lagoon shore) and Deadman's Caye. By far the most important location is Cockroach Bay. On average 65% of all the reported nests on Turneffe were found here.

What makes Cockroach Bay so attractive for the Crocodiles?

While the American Crocodile is known to be salt water tolerant, it needs fresh water every now and then. Particularly the young crocodiles are incapable of surviving in pure salt water (Platt & Thobarjarnson, 2000a). For this reason the crocodiles need a more or less permanent source of fresh or at least brackish water.

Secondly, for their reproduction, American Crocodiles depend on sandy ridges. They tend to dig nesting holes in the sand similar to those of Marine Turtles. This in contrast to the Morelets Crocodile (*Crocodylus moreleti*) who creates mound nests.

Through a number of geological and geophysical oddities, high sandy beaches are rare on Turneffe. The close proximity of the reef prevents high wave action and allows a broad belt of mangrove to line the coast line. During unusual heavy seas this mangrove belt acts as a buffer, protecting the coast. With especially heavy seas such as during a hurricane, sand carried in by the waves gets filtered by the mangrove belt and deposited just behind this Red Mangrove belt. Occasionally, a breach in the reef is established and wave action, now unimpeded, starts eating away at the coast line. At some stage, the protecting mangrove belt can be destroyed and the littoral forest ridge is exposed and becomes beach. This process is happening on several locations along the Turneffe coast but is particularly well developed at Cockroach Bay (Figure 12).

This process is still going on. Platt (2004) reports fresh sand deposits on the Cockroach Bay ridge following hurricane activity. Also, during our fieldwork, we could confirm fresh sand deposits probably resulting from tropical storm Gamma just days earlier. This constant sand build up creates a high enough ridge to prevent any crocodile nests from drowning during regular high tides and also it prevents the formation of a thick ground cover vegetation layer.

In addition to this, there exists a small brackish water lagoon just behind the beach ridge of Cockroach Bay. This brackish lagoon, while insufficiently large to hold enough prey for a sizeable crocodile population, it creates an ideal resting place for crocodiles to recuperate after a day in the sea. And what's more important, with its many shallow puddles and side lagoons, it provides a perfect nursery for the species.

At Cockroach Bay, the American Crocodile finds everything it needs at a one stop location:

- Shelter during rough weather
- Place to re-hydrate after prolonged presence in salt water
- High sandy ridge suitable for nesting burrows
- Nursery area



**Figure 12.**

2004 Landsat tm image of the eastern shores of Turneffe Islands. Insets show enlarged sections of adjacent features. Notice how inlets/bays are associated with breaches in the reef. The increased wave action at these spots “eats” away into the land mass creating the bays. Where the wave action has removed the Coastal Red Mangrove Belt, the higher sand bar with littoral forest is exposed and a beach is created.

Northern Caye:

1 = Cockroach Bay. Beach and littoral forest exposed.

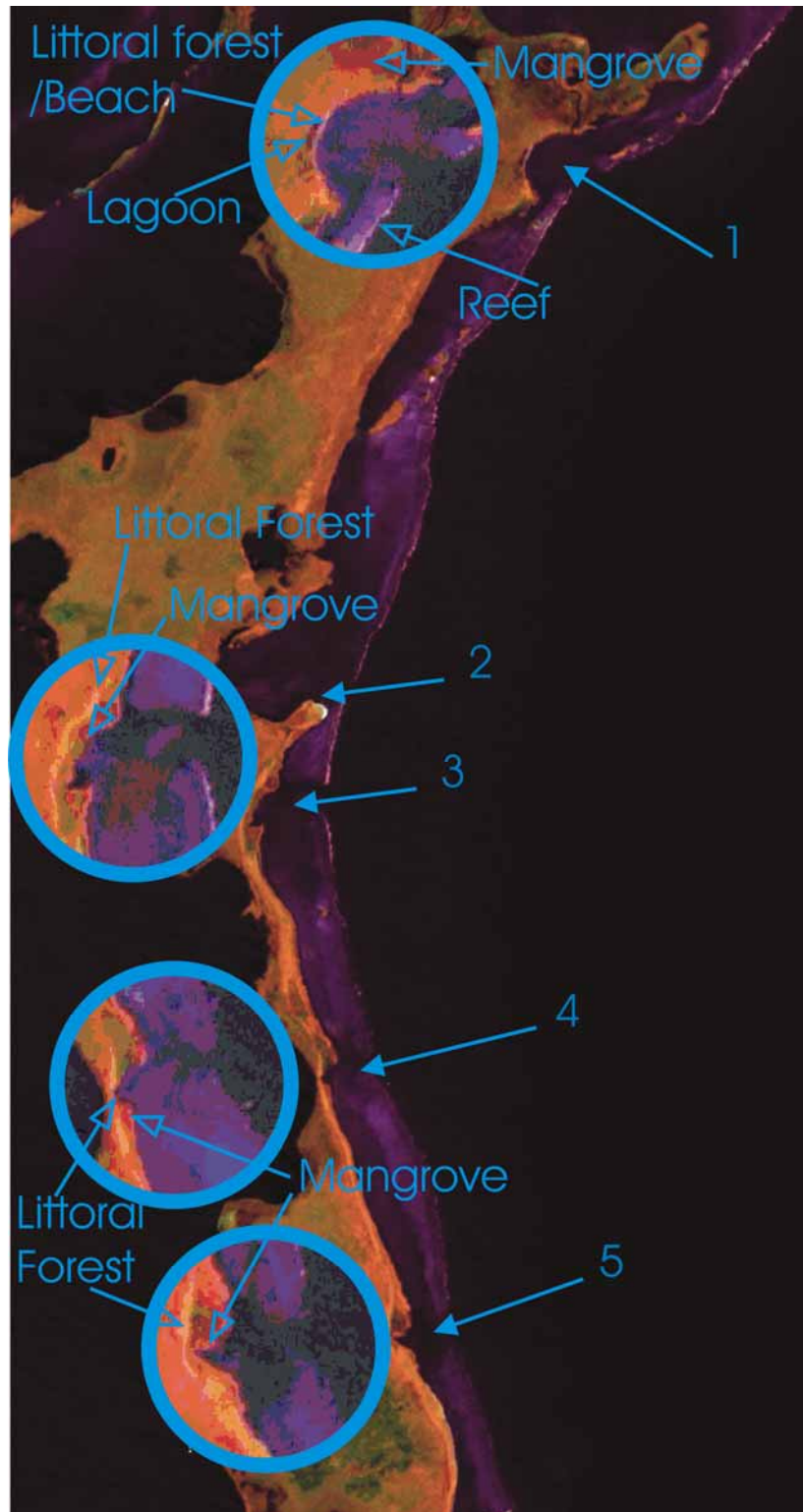
Blackbird Caye:

2 = Turneffe Flats Resort. High beach deposited by unimpeded wave action (no cutout)

3 = Cove below Turneffe Flats. Breach has not opened the littoral forest ridge but exposed a Black Mangrove Forest.

4 = Breach exposing littoral forest ridge. Potential Crocodile/turtle nesting beach. But already subdivided. Property partly cleared.

5 = Breach digging into Mangrove belt. Mangrove recently cleared by developers to expose the beach / littoral forest.



Essentially, what is happening at Cockroach Bay is that during the day, the Crocodiles hang out in the small lagoon just behind the beach. At night the crocodiles leave the lagoon, crossing the narrow beach ridge and disperse in the sea (Figure 13)



**Figure 13. Schematic overview of the crocodile activity at Cockroach Bay.**

At the same time, the brackish lagoon probably functions as a courting location and nesting opportunities are close at hand. In 2004, no less than 11 nests were found here (Platt et al. 2004). During our fieldwork, old nesting locations were obscured by fresh sand deposits following tropical storm Gamma a few days earlier. Nevertheless one old nest was found.

Turtles have been known to be nesting here (pers. comm. George Hanson who remembers 5-6 nests in 1995-1996) but are otherwise little documented. A cursory search revealed one empty turtle egg shell, showing that also recently sea turtles had used this beach for nesting.



**Figure 14. Forest Department Officer George Hanson on Cockroach Bay Beach showing abundant crocodile tracks from lagoon to sea (in background)**



Once in the sea, the distances of travel by the American Crocodiles are essentially unknown. Several of the caretakers at the fishing camps we visited indicated that Crocodiles were not uncommon visitors at their docks. Probably they are attracted there by fish offal thrown there by the fishermen. There is evidence that, at least at the lodges crocodiles are actively being fed (Figure 15).



**Figure 15. American Crocodile being fed at Blackbird Caye Resort, Turneffe Atoll (Picture Tamas B. Varga)**

### 4.3. Cockroach Bay Situation.

With the obvious importance of cockroach bay for the conservation of the American Crocodile on Turneffe Islands, the minister of Natural Resources; Hon. John Briceño took affirmative action, recalled 2 leases and (as a temporary measure) declared 20 acres at Cockroach Bay a public, viz. Crocodile Reserve (figure 16).

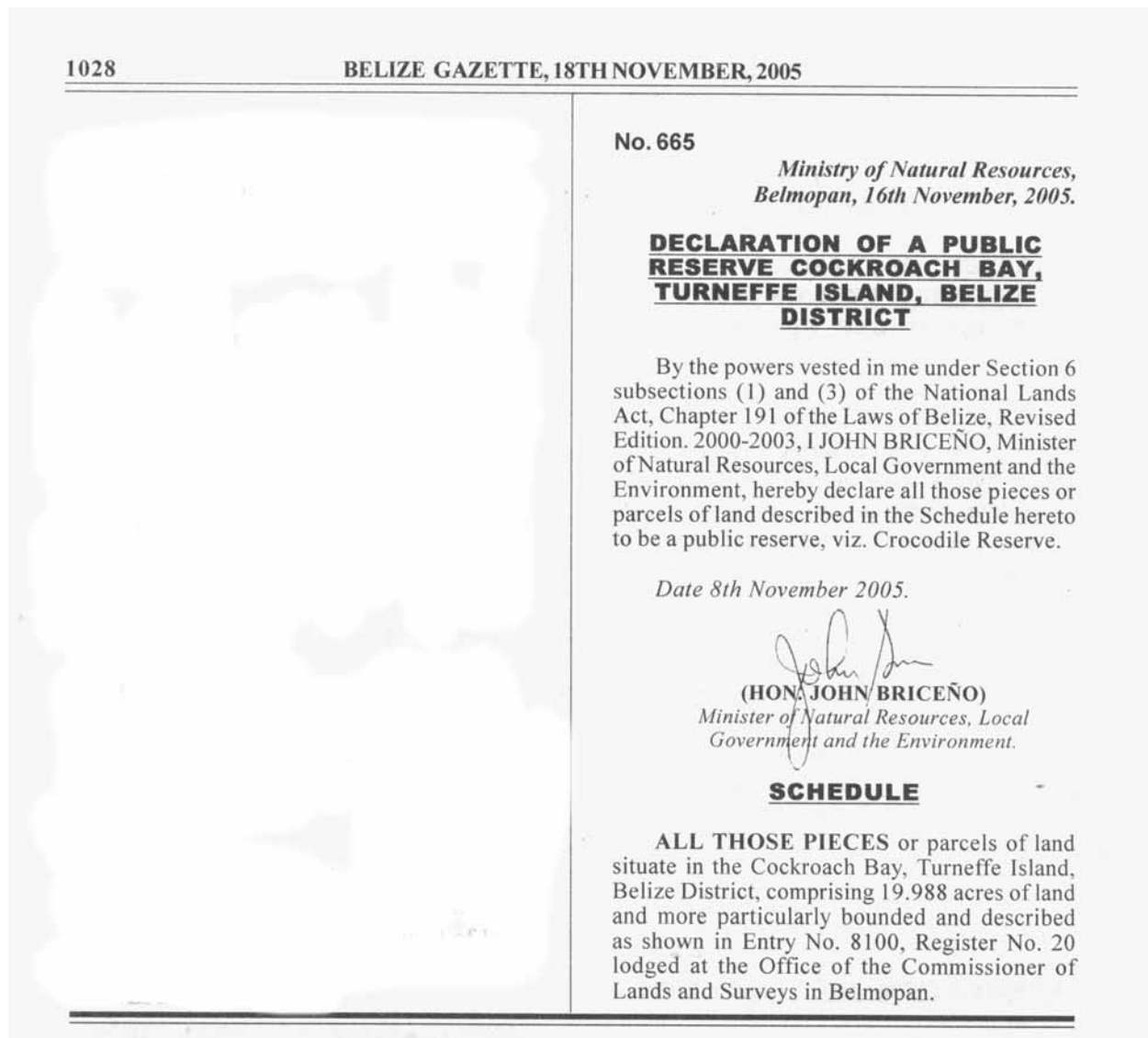


Figure 16. Gazetted description of Cockroach Bay Public/Crocodile Reserve

The importance of this act can not be under estimated. Nevertheless, the declaration of the reserve does not mean that the crocodiles at Cockroach Bay are now safe.

A land registration search has revealed that essentially all of the Cockroach bay shoreline has been surveyed and leases have been given out. In total 9 parcels of land have been traced, 2 of which have now been recalled (the two 8100/20 parcels) and declared the public/crocodile reserve (Figure 16).

With the property map superimposed on the ecosystems map and the known crocodile nests indicated (Figure 17), it becomes immediately clear that:

- The critical lagoon is not entirely covered by the new Public/Crocodile Reserve
- The new reserve does not incorporate all the recorded nesting locations
- There are still 7 properties directly adjacent or within the immediate proximity of the areas critical to the crocodiles
- There are still 7 properties which can be expected to be developed in ways incompatible with the continued existence of the crocodiles.
- All but one (as far as we know) of these properties are currently on the international market.

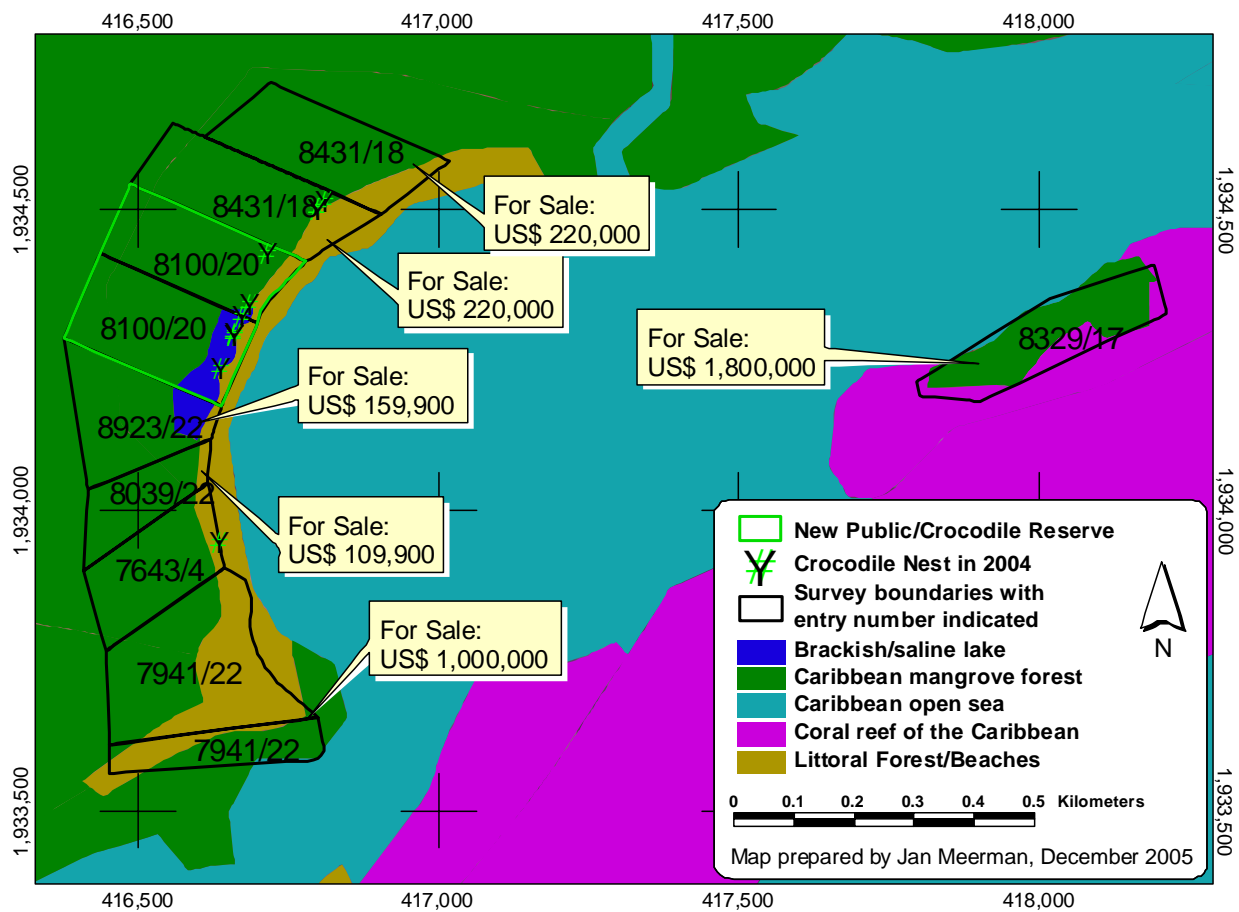


Figure 17. Property Map of Cockroach Bay and surroundings. Situation November 2005.

The exact list of the persons requesting the registration of these particular parcels (the “owners”) are listed in table 1.

**Table 2. List of some properties on Turneffe Atoll with real estate links indicated (December 2005)**

Location	Entry-Registration - Date	Size	Survey Requested by:	Asking price	Real Estate hyperlink
Cockroach Bay	8431:18 16/11/04	10 + 10 Acres	Israel Marin + Juan W. Villanueva	US\$ 220,000 each	<a href="http://www.privateislandsonline.com/cockroachcaye.htm">http://www.privateislandsonline.com/cockroachcaye.htm</a>
Cockroach Bay	7941:22 24/03/04	5.006 + 14.774 acres	Ainslie Leslie + Josephine Sutherland	US\$ 1,000.000 together	<a href="http://belize-real-estate-sales.com/19_78_acres_on_turneffe_island">http://belize-real-estate-sales.com/19_78_acres_on_turneffe_island</a>
Cockroach Bay	8039:22 18/05/04	5.157 acres	Maria M. Guerra	US\$ 109,900	<a href="http://belize-real-estate-sales.com/5_157_acres_on_turneffe_island">http://belize-real-estate-sales.com/5_157_acres_on_turneffe_island</a>
Cockroach Bay	8923:22 29/07/05	8.832 acres	Felipa Avilez	US\$ 159,900	<a href="http://belize-real-estate-sales.com/8_832_acres_on_turneffe_island">http://belize-real-estate-sales.com/8_832_acres_on_turneffe_island</a>
Cockroach Bay	7643:4 15/10/03	7,985 acres	Phillip R. Espat		
Cockroach caye	8329:17 28/09/04	9 acres	Alfredo Aldana	US\$ 1,800,000	<a href="http://www.reefrealty.net/">http://www.reefrealty.net/</a>
Turneffe exact loc. unknown	?	7 Acres	?	USD\$285,000	<a href="http://belize-real-estate-sales.com/turneffe_island_7_acre_penisular_lot">http://belize-real-estate-sales.com/turneffe_island_7_acre_penisular_lot</a>
Blackbird Caye	7465:14	5.01 Acre	A.E. Rodriguez	449,900 US\$	<a href="http://www.isolanaturale.com/?gclid=CNWi-ezX0YECFU4OOAodoA1kJQ">http://www.isolanaturale.com/?gclid=CNWi-ezX0YECFU4OOAodoA1kJQ</a>

What is immediately clear is that the handing out these leases on Turneffe is in direct conflict with the following policy statements of the (2003) Caye Development Policy:

**C.4** A comprehensive development plan is to be attached to every lease of National land on Cayes.

**C.5** The moratorium on the sale or grant of nationally owned Cayes should be formalized or legislated.

**C.6** Assessment of all applications to sub-divide land on Cayes must take the provisions of the CZM Plan into account.

**C.7** Development activities, as well as the development of leases and properties, are to be closely monitored to ensure compliance with the CZM Plan.

Also the 2003 Turneffe Islands Development Guidelines list:

- Reactivate the moratorium on the sale of small national cayes
- Institute a temporary moratorium on the sale of all national land on Turneffe until the Biosphere Management Plan is complete (or until December 2005)

- Due to the importance of mangroves as providers of ecological services for the Atoll and its main industries (fishing and tourism), the Mangrove Protection Act of 1989 should be strictly enforced.
- Clearing of vegetation should be kept to a minimum and valuable littoral forest should be identified and reserved.

As far as known, there was never a development plan submitted for each of these properties which should never have been given out following the moratorium on giving out land on Cayes. These developments ignore any plan developed by CZM and are certainly not compliant with any plan.

Furthermore, the two lots with registration 7941:22 are the same as mentioned earlier when reporting illegal mangrove clearing. The site is ostensibly being developed for a lodge but the fact that it is already on the real estate market, seems to refute this statement. Also a lodge at this location would be in need for an Environmental Impact Assessment. A check at the Department of the Environment in November 2005 revealed that there is no such an Environmental Impact Assessment has been carried out or applied for.

While there exist a “policy” that every Belizean has a right to a piece of the jewel. The remote location does not imply that these properties are being acquired for residential or even enjoyment purposes. This conclusion is confirmed by the fact that the properties became available on the international market as soon as they were surveyed. From a national development perspective there is no compelling reason to put these national assets on the international market.



#### 4.4. Other Wildlife

The **American Crocodile** is certainly one of the flagship species for northern Turneffe. Database records are presented in figure 11. But several observations were made during the November 2005 fieldwork, the locations of which being indicated on figure 19. However, there are other species of interest as well.

One important species is the **Manatee**. No direct observations were made during the fieldwork but some data was obtained through CZMAI and these were plotted in Figure 19. Turneffe is not a location with a high density of Manatee sightings but nonetheless the species is present in reasonable numbers.

As mentioned before, **marine turtles** are thought to be coming to shore and lay eggs all along the eastern shores of Turneffe Atoll. One hatched egg was found in Cockroach Bay. But otherwise, information on sea-turtles in Northern Turneffe is very sketchy. CZMAI has data on supposed nesting activities on several of the islands near Cockroach Caye, but these are without identification and numbers. Forest Officer George Hanson, reported a number of Turtle nests on Cockroach Bay in 1995-1996. Clearly a lot of work is still to be conducted in this field.

Bird colonies could not be monitored during the fieldwork in October and November since no birds were breeding at that time. A critical habitats map produced by the CZMAI indicates several locations with Herons and Terns. But the map is too indistinct to be very specific.

Only **Ospreys** were present at their nests during November, probably in preparation of the actual breeding season. A total of 4 active nests were counted which are depicted on figure 19.

Another bird that was mapped is the **White-crowned Pigeon**, a typical species for Caribbean Islands. This species was seen on Cockroach Caye but is to be expected on all islands including in the littoral forest of the main islands.

Another species of great interest is the **Turneffe Parrotsnake** (*Leptophis mexicanus hoeveri*, figure 18). This taxon is **endemic** to Turneffe Atoll. The species is usually uniformly green but axanthic mutants which are uniform blue are relatively common. This is a striking and unique species. A total of 7 individuals (5 blue, 2 green) were observed on Both Northern Caye and Black Bird Caye (Fig. 19). The specimens were generally observed in littoral forest/coconal habitats. While apparently relatively common, the extremely limited distribution and its preference for a scarce habitat should mark it as extremely vulnerable.



**Figure 18. The Turneffe Parrotsnake *Leptophis mexicanus hoeveri* (juvenile). Picture by Jan Meerman.**

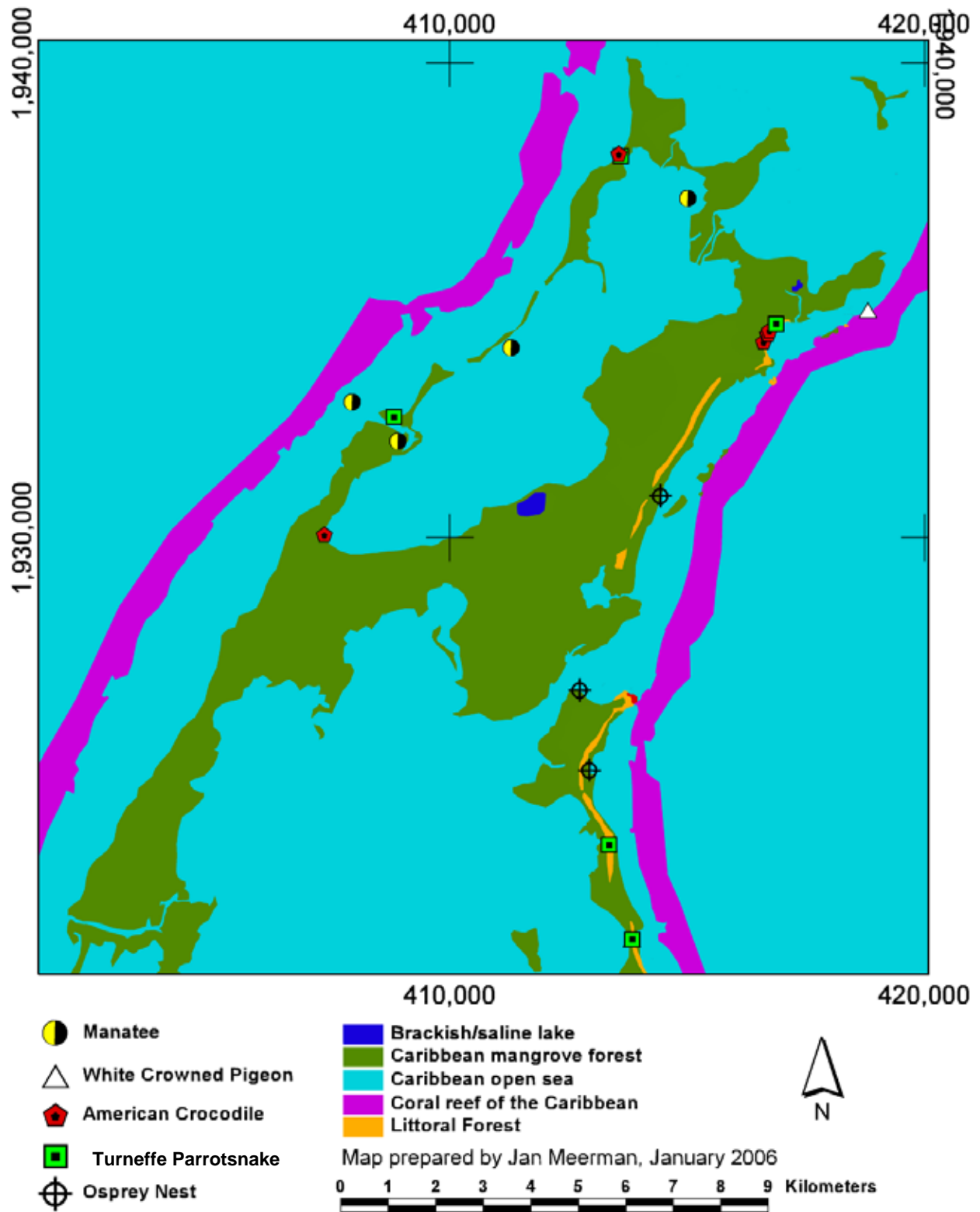


Figure 19. Other species of interest noted during fieldwork in November 2005 (but Manatee data courtesy of CZMAI)



## 5. Conclusions and Recommendations

### 5.1. Northern Turneffe Recommendations

The present study was commissioned to consider Northern Turneffe Islands only, and as such this was the only area for which fieldwork was carried out. At this stage, the conclusions and recommendations will restrict themselves to Northern Turneffe, essentially the “Northern Caye” landmass. It should be remembered however that a comprehensive conservation and development planning should incorporate all of Turneffe Atoll, including marine components.

The main conclusion of this study is that there are several areas of northern Turneffe Atoll being affected by human activities. The most numerous are the various fishing camps scattered along the shore lines. While these sites clearly have an impact, their use is traditional and potentially compatible with the sustainable use of the area. New developments on Northern Turneffe include land development for speculation purposes. The most important of these developments are the cluster along Cockroach Bay. These developments go against all established policy statements for the Cayes in general and for Turneffe in particular. What is more, these developments are taking place on one of the most sensitive sites of the entire Island mass. As an intermediate measure, part of this area has recently been declared a reserve, but in spite of this, if development here is allowed to continue, they will almost certainly herald a potentially fatal decline in the American Crocodile population, not only on Turneffe but in all of Belize.

Based on the data collected during this study and following the temporary measure formed by the declaration of the public/crocodile reserve in Cockroach Bay, there is ample reason for declaring much of Northern Turneffe a conservation zone. Actually, most of the landmass of “Northern Caye” can be declared a conservation zone while respecting private properties and usuary rights on the western shores. The small reef islands on the east are also critical given their importance for turtle and sea bird nesting sites, but most of them are already given out in private hands (Fig. 17, table 2). Restrictive regulations for the development of these islands (as in the Special Development Area model) could assist in the maintenance of their most important functions. The same is true for much of Cockroach Bay (Fig. 17, table 2). But reversal of tenure back into the state is of more critical importance here.

This Northern Turneffe conservation area would thus encompass not only Cockroach Bay but also cover most if not all of the various ecosystem types found on the Atoll including some critically endangered littoral forest segments (important for the endemic Turneffe Parrot Snake and other wildlife) and several important high energy mangrove channels/rivers that are potentially important for the maintenance of the fishing industry. See figure 20 for further notes.

Note that this recommendation does not directly incorporate marine and reef components (which were not part of the current study, but it is advisable to incorporate the marine recommendations made in the NPAPSP study into any final design of the conservation area). In particular, it would make sense to incorporate spawning aggregations into this.

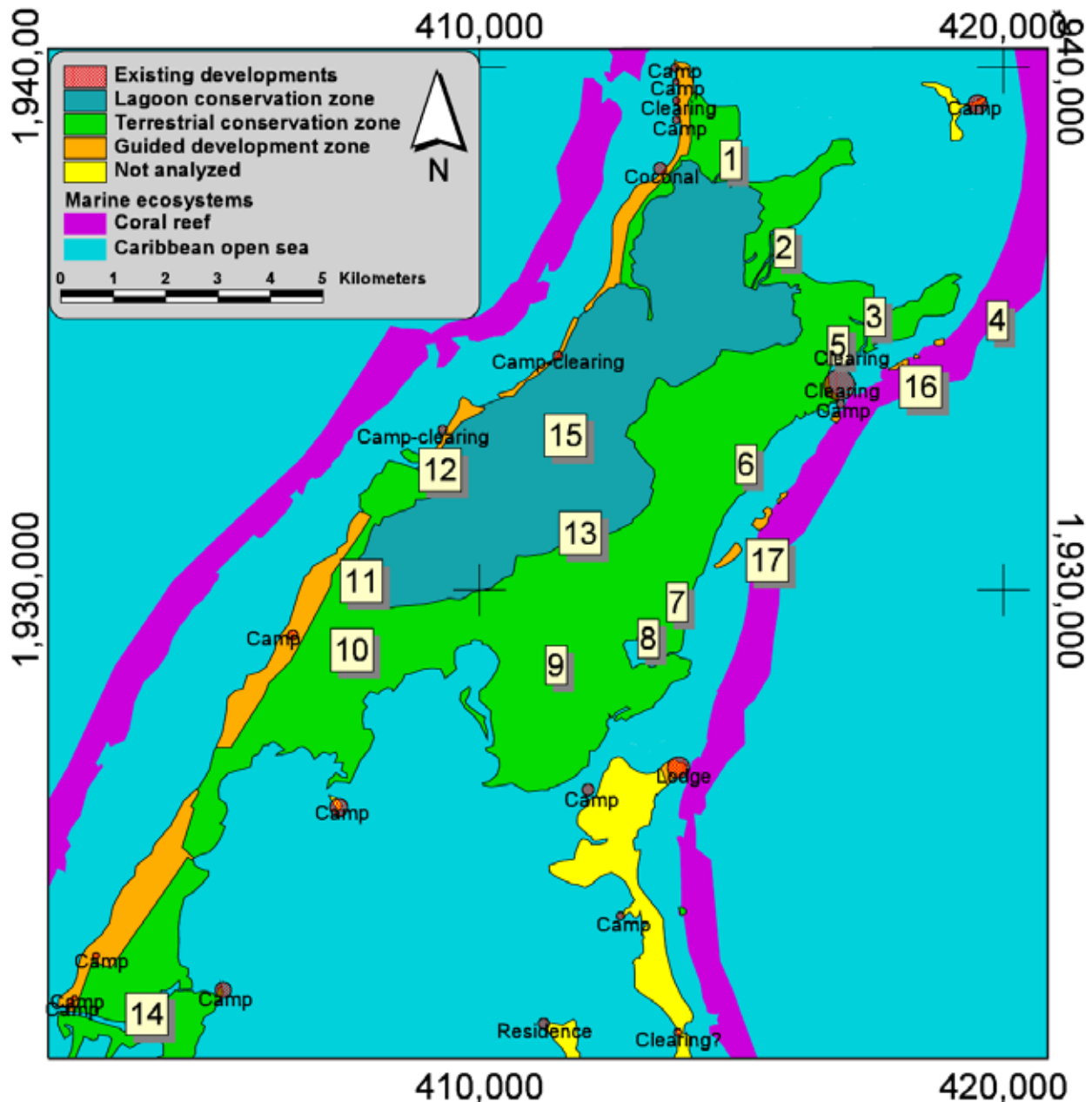


Figure 20. Proposed conservation zones in Northern Turneffe (schematic and not considering actual reef components) with conservation features indicated.

- 1 = High energy mangrove channels potentially important for fishery resources
- 2 = High energy mangrove channels
- 3 = High energy mangrove lagoons and channels
- 4 = Spawning aggregation
- 5 = Crocodile - Turtle nesting site
- 6 & 7 = Littoral forest for Turneffe Parrot Snake and other wildlife
- 8 = High energy mangrove lagoon and channel

- 9 = Broken Palmetto Thicket (viz. Murrey et al)
- 10 = Broken Palmetto-Buttonwood Thicket (viz. Murrey et al. 1999)
- 11 = High crocodile density (nesting?)
- 12 = High energy mangrove channels
- 13 = Northern Lagoon (Crocodiles, Manatees)
- 14 = High energy mangrove channels
- 15 = Northern Lagoon
- 16 & 17 = Turtle nesting & birds

Any declaration of new protected areas should be carried out as part of the upcoming National Protected Areas Plan implementation. Any classification should follow the IUCN model as recommended within the NPAPSP. Depending on the areas included and the stakeholder input, conservation categories suitable for Northern Turneffe could be:

- CATEGORY Ib: Protected area managed mainly for wilderness protection.
- CATEGORY V: Protected area managed mainly for landscape/seascape conservation and recreation.
- CATEGORY VI: Protected area managed mainly for the sustainable use of natural ecosystems.

While the above recommendations were made based principally on the present study, these recommendations were not made in isolation. The various previous recommendations and analysis gave very similar results (see chapter 5.2).

In addition, it is recommended that regular monitoring is established for:

- Crocodiles
- Sea Turtles
- Turneffe Parrot Snakes
- Marine Birds
- Manatees
- Mangroves

This small list does not intend to exclude other species (Dolphins and other marine organisms). Partly this monitoring is already in place (Manatees) but coordination of these efforts is advisable. A good system that allows such coordination is the Biodiversity and Environmental Resource Data System for Belize (BERDS): <http://www.biodiversity.bz>

The principle of monitoring should be to gather data that can be used in management decisions. The monitoring of mangroves in this context is a bit problematic, since much of the mangroves on Northern Turneffe are regenerating following hurricane damage. Monitoring activities in this case should particularly satisfy scientific interest, since no particular activities to promote regeneration are proposed at this stage.

## **5.2. The previous zonation proposals**

In the recent past several attempts have been made to come to a zoning of Turneffe Atoll including zoning for conservation. Three of these are discussed here.

- Turneffe Islands Draft Development Guidelines (McGill, 1996) and its successor the Turneffe Development Guidelines (TICAC, 2003)(Figure 21). These plans recognizes two zones:
  - Conservation
  - Minimal development potential beyond what recommended as special development sites.

The plan considers only the terrestrial parts of Turneffe and primarily looks at the height of the land to decide on development potential. Low lying or semi-permanently inundated mangrove is rightfully classified as having low development potential.

Areas earmarked for conservation includes:

- the entire Northern Lagoon and shores,
  - The bulk of Northern Caye including Cockroach Bay, Freshwater Creek Lagoon and surroundings,
  - Cayes east and southeast of Cockroach Bay.
  - Pelican Caye,
  - Soldier Caye,
  - the low-lying sections of Calabash Caye and the
  - Crayfish Range and associated Cayes in the Central Lagoon.
- Biosphere zonation developed by Oceanic Society (Egan, 2005)(Figure 22). This plan considers primarily the coastal marine components of Turneffe. Criteria used include the Platt et al. 2000-2004 Crocodiles studies, the presence of spawning aggregations, coral diversity, vegetation diversity, manatee occurrence, bird nesting and lobster abundance. Core areas recognized include:
    - The four spawning aggregations
    - Cockroach Bay
    - The Turneffe Flats property
    - Pelican Caye
    - Crocodile Beach on Blackbird Caye
    - Calabash Caye
  - The MARXAN analysis carried out as part of the National Protected Areas System Plan (Meerman, 2005)(Figure 23). This study analyzed Belize based on the attributes of 10 km<sup>2</sup> hexagons. This study took both terrestrial and marine attributes into account. In the case of Turneffe, land tenure was not taken into account (they were simply not available for this study). The MARXAN system favors areas where several ecosystems and/or other conservation features occur in close proximity. This study recognized much of Turneffe as being of high conservation importance recognizing particularly the northern and eastern portions of the Atoll.

These three studies all had a very different approach and consequently the outcomes differ. Nevertheless, there are some common denominators such as the importance of Calabash Caye, parts of the Blackbird Caye Area, and Cockroach Bay.

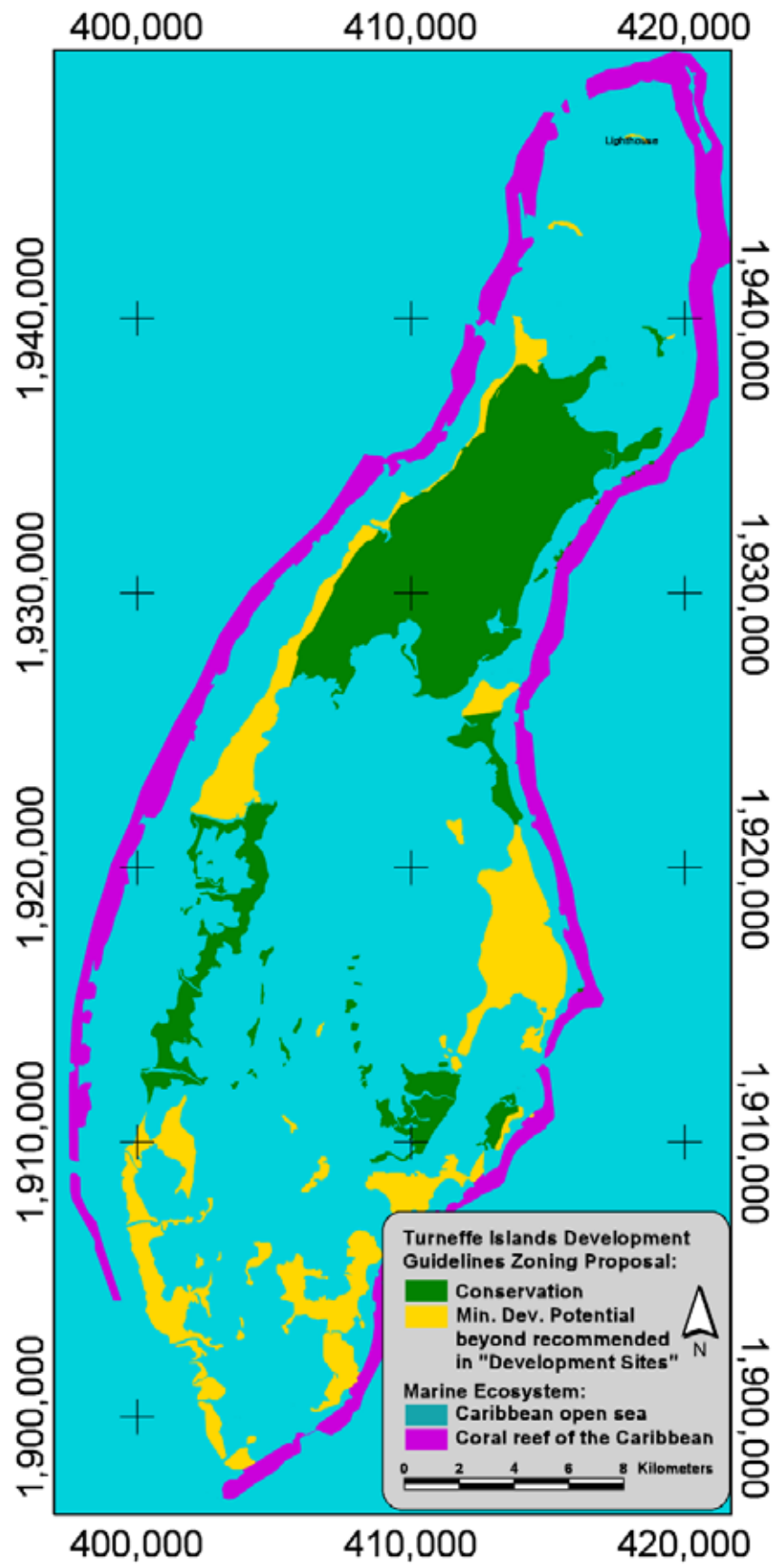


Figure 21. Proposed Development Zoning based on the 2003 Turneffe Islands Development Guidelines.

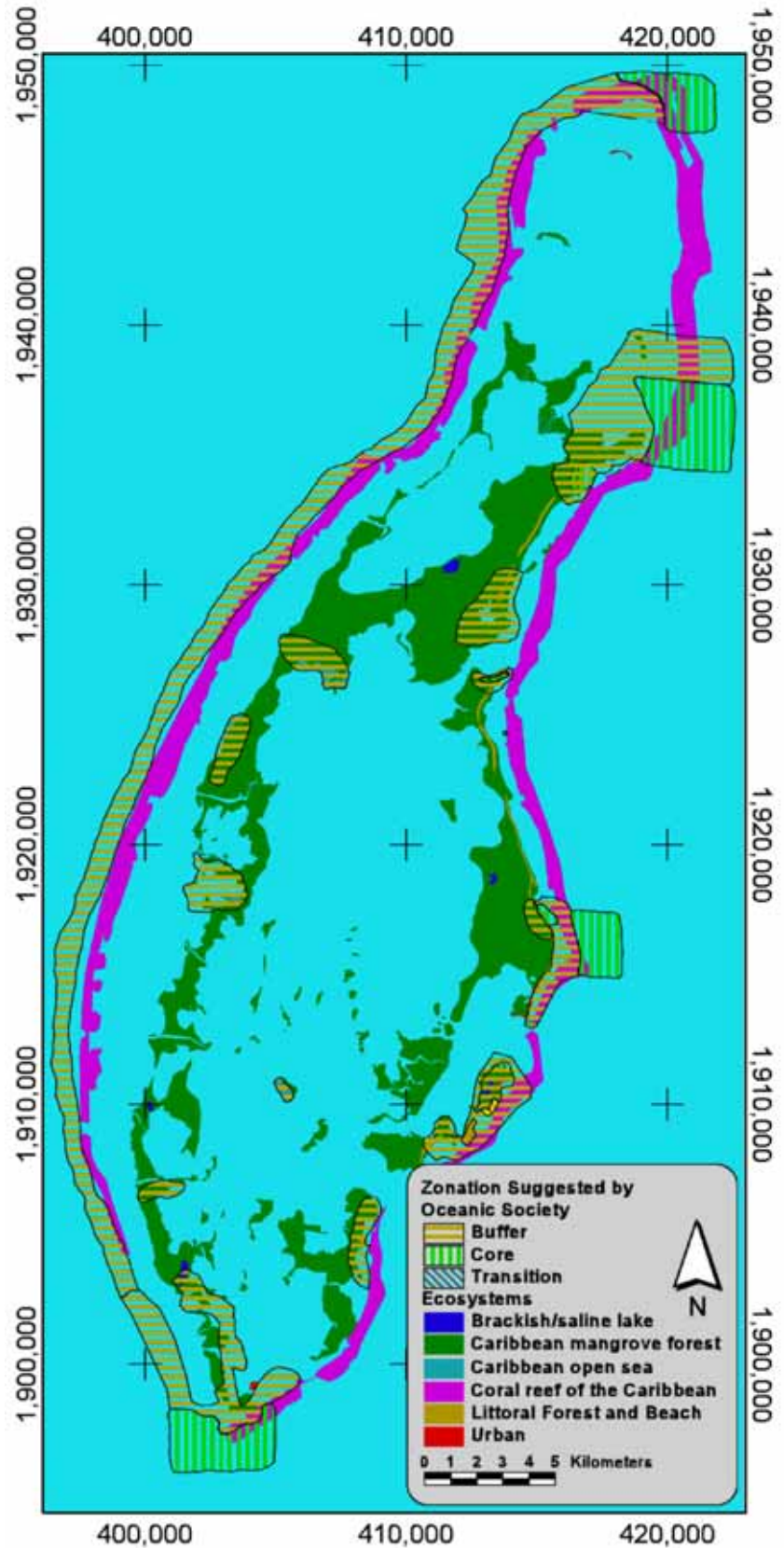


Figure 22. Proposed Biosphere Zonation developed by Oceanic Society 2004

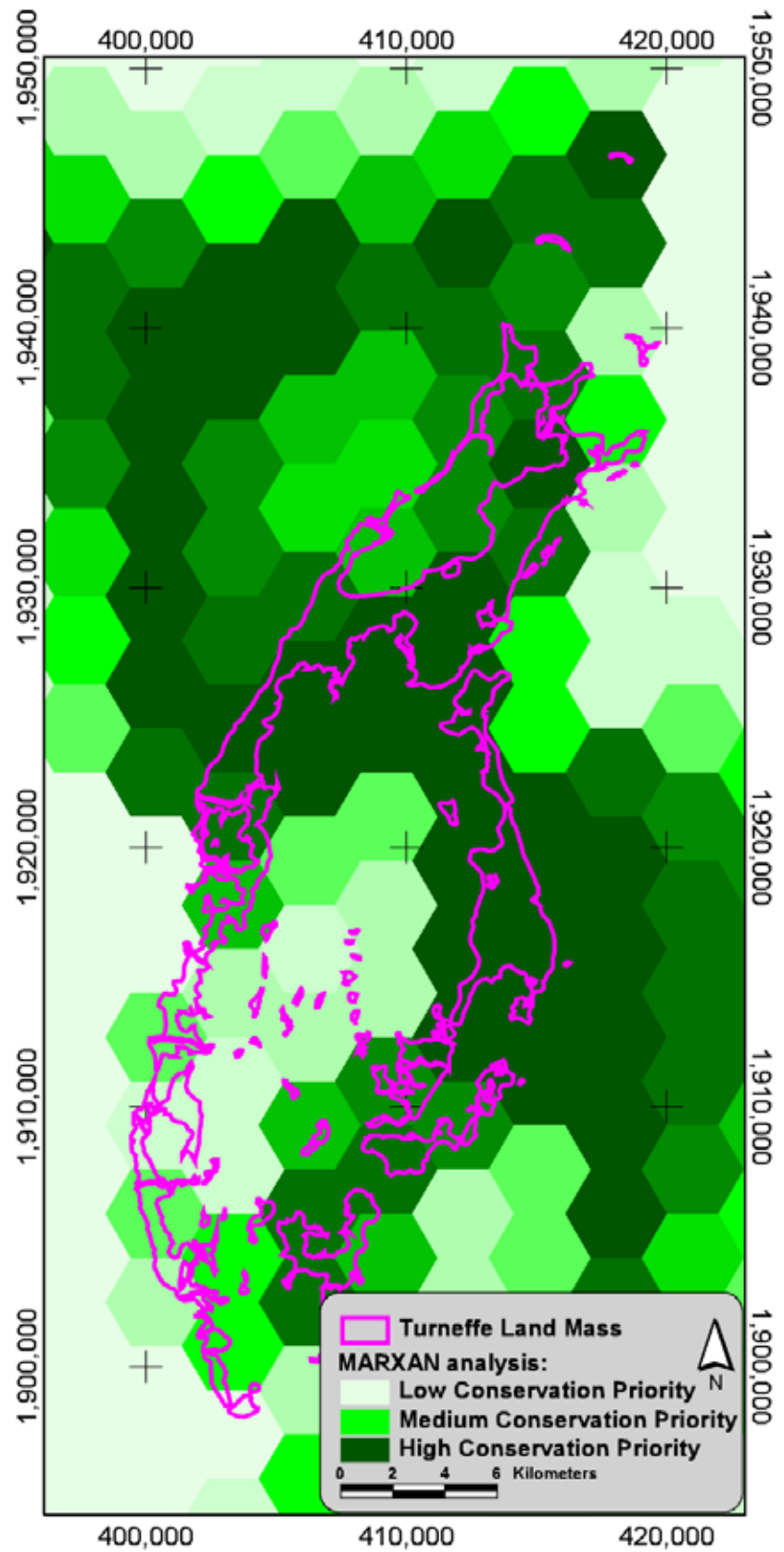


Figure 23. MARXAN Analysis of conservation priorities based on the National Protected Areas Policy and System Assessment: Meerman, 2005.



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## DRAFT CAYES DEVELOPMENT POLICY

CZMAI  
logo

(October 2003)

Belize's barrier reef, cayes and atolls include about 1,065 cayes and their surrounding coastal waters that are regarded as one of the country's greatest assets. They are sought after by investors, developers, tourists, fisherfolk and people who simply need a place to live, both nationals and foreigners. While development is necessary from an economic point of view it is seen to be causing development pressures that are having an increasingly damaging impact. The first Cayes Development Policy was prepared in 1995 with the basic objective of ensuring sustainable use and the long-term protection of the natural resources of the coastal zone. It has now been up-dated to reflect the more recent changes in use, investment, policy and the demands of the civil society.

The greater part of the policy focuses on the less developed cayes; the development issues of the 'urban' areas of San Pedro and Caye Caulker are more appropriately addressed through specific development planning guidelines.

### CONSIDERATIONS GUIDING THE POLICY

**The Coastal Zone Management Strategy, endorsed by Cabinet in 2003. The Cayes Development Policy reflects and elaborates on the provisions of the Strategy.**

*The Strategy has been prepared in order to facilitate the improved management of national coastal resources. It focuses on the need to promote economic growth in context with sound environmental practices, stakeholder participation and collaboration, equitable allocation of resources, improved scientific knowledge.*

**The economic, ecological and scientific importance of the cayes for tourism, recreation, fishing, forestry, coastal protection, mineral and petroleum resources development and as a habitat for important wildlife (rare, endangered, threatened species) both at national and international levels.**

*The cayes are now known throughout the world for their beauty, their wildlife, and the opportunities they offer for recreation, sport and research. Perhaps not so emphasised is their sensitive ecological balance together with their crucial importance as a significant economic factor through tourism and fishing. This policy will help establish an equitable and long-term equilibrium between these values and uses.*

**The frequently identified need to develop a culture of low-impact and high spending tourism in order to create an up-market adventure destination.**

*With a view to establishing a sustainable equilibrium between the often competing uses and habitats on the cayes it is considered necessary to promote tourism activities and development that complements the environment rather than destabilizes it. Moreover this policy will encourage Belizean involvement and investment in the tourism industry.*

**Recognition of the projected implications of climate change and consequent sea level rise.**

*Comprehensive research has been undertaken, both nationally and internationally, into the anticipated implications of global climate change. This is of particular relevance to Belize with its extensive low lying lands (both cayes and mainland), and susceptibility to natural catastrophe such as hurricanes and floods.*

**Correlation with existing legislation, as well as existing and draft policies and guidelines, that directly or indirectly govern the use and development of the cayes.**

*Over fifty pieces of primary legislation, and many more subsidiary pieces and guidelines, govern or advise a wide variety of coastal zone activities. This policy reflects all current and draft legislation and policy, and makes recommendation on their uses, adaptation and implementation.*

**Recognition of the different types of cayes and their individual characteristics that dictate the form of use or development that is appropriate and sustainable.**

*No two cayes are the same: basic factors of ownership, occupation, location, natural features, habitat and history influence their potential use. This policy reflects such considerations and recognises that no blanket approach would be suited to the many individual characteristics.*

**The awareness that the cayes represent one of the most valuable resources of Belize and that the use and exploitation of that resource should benefit all Belizeans in an open and transparent manner.**

*The cayes are recognised both nationally and abroad as being one of the fundamental components of the qualities that are summed up as The Jewel. As such they essentially belong to the nation, and the nation has the right to have a say on how they are used now and in the future.*

**POLICY OBJECTIVES**

**To motivate and encourage both local and foreign investment in coastal resources.**

*Much of this translates into the acquisition or leasing of land on the cayes and the development of these lands and surrounding waters. Such developments should be encouraged and facilitated to contribute to and complement the cayes and their established occupants. They should not be a source of conflict between foreign investors and local interests with, in some cases, the loss of customary rights and inappropriate development.*

**To promote development without compromising national identity and time-honoured rights.**

*The cayes and waters have been used by Belizeans for hundreds of years. Traditional practices and styles have been developed over the years, which have resulted in forms of use that effectively based on the potentials and constraints of the natural environment and reflect a local culture peculiar to the Belizean cayes.*

**To balance development with sound conservation management.**

*The cayes are particularly fragile and vulnerable on account of their (often) small size and characteristic ecology, and there is already evidence of damage at many locations.*

**To strengthen and support Government procedures for receiving and reviewing development proposals for the cayes, and the resources available to carry out those procedures.**

*There are several Government departments and statutory bodies responsible for implementing the legislation and guidelines mentioned above. This policy aims to strengthen interagency co-ordination and cooperation and facilitate the public's access and use of the procedures for submitting development proposals.*

**To ensure that the existing and customary users and occupants of the cayes have a right to security of their interests.**

*The cayes are a rapidly changing environment. As a reflection of their varied interests and competing uses the cayes are becoming increasingly exposed to international interests and valuation (monetary and otherwise). In the face of this it is important to guarantee that those that make their living from the cayes and their surrounding waters maintain a secure future.*

**The policy is set out under seven topics:**

<b>A.</b>	<b>LAND USE AND DEVELOPMENT MANAGEMENT</b>
<b>B.</b>	<b>SHIPPING, COMMERCIAL DEVELOPMENT AND HOUSING</b>
<b>C.</b>	<b>LAND TENURE AND OWNERSHIP</b>
<b>D.</b>	<b>CLEARANCE, EXTRACTION, DRILLING AND INFRASTRUCTURE</b>
<b>E.</b>	<b>RECREATION, TOURISM AND CULTURAL HERITAGE</b>
<b>F.</b>	<b>PROTECTED AREAS, FISHING AND WILDLIFE</b>
<b>G.</b>	<b>FRESH WATER, WASTE DISPOSAL AND HAZARDOUS SUBSTANCES STORAGE</b>

## LAND USE AND DEVELOPMENT MANAGEMENT

Four pieces of legislation contain land use planning powers: the Coastal Zone Management Act (establishing the Coastal Zone Advisory Council), the Disaster Preparedness and Response Act (the National Emergency Mobilisation Organisation), the Land Utilisation Act (establishing the Land Utilisation Authority), and the Housing and Town Planning Act (the Central Housing and Planning Authority). The first two of these Acts only have powers to draw up plans, which may include the zoning of particular land uses and land use densities, yet have no means to directly implement them. The second two also have development management powers, which means that they receive and assess applications for development. Another piece of legislation, the Environmental Protection Act (establishing the Department of the Environment), has the power to manage the development process, through environmental screening, yet has no planning powers. Moreover this last Act relies on the various other Government licensing agencies to refer applications to the Department of the Environment for appraisal.

The Land Utilisation Authority regulates the sub-division of property throughout the country and can declare (generally rural) areas to be Special Development Areas that are subject to land use development plans, drafted by the Physical Planning Section of the Lands and Surveys Department (see also Policy C: Land Tenure and Ownership). The Central Housing and Planning Authority can declare a (generally urban) area as subject to its powers to control land use and building also through development plans (see also Policy B: Shipping, Commercial Development and Housing). The National Emergency Mobilisation Organisation can declare areas that it considers vulnerable to disaster as subject to a Special Area Precautionary Plan, and the Coastal Zone Management Authority is responsible for the preparation of a CZM Plan; the Coastal Zone Management Advisory Council is required to review and approve the Coastal Zone Management Plan which may involve separate area-specific development guidelines.

Other Government and quasi Government development management agencies include the Fisheries Department (licensing aquaculture), the Belize Tourism Board (licensing hotels; see also Policy E: Recreation, Tourism and Cultural Heritage), the Geology and Petroleum Department (licensing petroleum and mineral extraction), the Forest Department (licensing logging and the cutting of mangroves; see also Policy D: Clearance, Extraction and Infrastructure), the Belize Trade and Investment Service (Beltraide) (issuing fiscal incentives; see also Policy B: Shipping, Commercial Development and Housing), the Ministry of Investment (responsible for export processing zones), and the city, town and village councils (licensing trade and liquor).

POLICY POSITION	JUSTIFICATION	RESPONSIBILITY	MECHANISM
<p><b>A.1</b> Development guidelines will be drafted and put into effect for all of the nine coastal planning regions. The guidelines will be consistent with other statutory development planning initiatives on the mainland.</p>	<p>The parts of the Belizean coastal zone that contain cayes has been divided into nine regions: 'Northern', 'Ambergris Caye', 'Caye Caulker', 'Belize City Cayes', 'Turneffe', 'Lighthouse Reef', 'Dangriga Tobacco Caye', 'Placencia', and 'Southern'. This is intended to facilitate the preparation of development guidelines with strong input from coastal advisory committees for each region.</p>	<p>CZMAI Coastal Advisory Committees CZM Advisory Council CZM Authority Relevant permitting agencies (Forest Department, Geology and Petroleum Department, Department of the Environment, Fisheries Department)</p>	<p>The CZMAI has divided the coastal zone into nine coastal regions and will oversee the drafting of development guidelines for all regions according to standardised procedures based on maximised stakeholder involvement. The CZMAI will ensure that all guidelines are subject to thorough assessment by the relevant agencies, are submitted to the appropriate authorities for implementation, and incorporated into development management procedures. The CZMAI will ensure that all guidelines are monitored and reviewed.</p>



<p><b>A.2</b></p> <p>Coastal advisory committees will be appointed for each of the eight coastal planning regions to advise, recommend and monitor development plans and guidelines (Ambergris Caye is excepted)</p>	<p>So as to ensure that the regional development planning programme is founded on reliable information, maximised consensus and viable means of implementation it is crucial that the relevant stakeholders, community representatives, NGOs, and government officers are brought together to constitute coastal advisory committees for each region.</p>	<p>CZMA CACs</p>	<p>The CZMAI will take the lead in identifying and inviting parties for committee membership. This will be undertaken in close liaison with the Physical Planning Section, the Housing and Planning Department, and the National Emergency Management Organisation. Terms of reference and procedures for the committees will be initially drafted by CZMAI.</p>
<p><b>A.3</b></p> <p>Where development on cayes is envisaged, it will be encouraged to take place at appropriate locations in order to maximise benefits, complement their unique qualities, and minimise possible disadvantage and damage.</p>	<p>Development on low lands incurs costs to the developer, to the public and to the environment: the developer may pay to have the land filled and otherwise prepare. Yet the land will still remain susceptible to inundation; the public will have to pay the residual infrastructure and social costs; and the degradation of the environment will eventually heighten these costs and may, at the same time, actually drive down the value of the surrounding land.</p>	<ul style="list-style-type: none"> <li>• CZMAI</li> <li>• Land Utilisation Authority</li> <li>• Central Housing &amp; Planning Authority</li> <li>• National Emergency Management Organisation</li> <li>• Fisheries Department</li> <li>• Beltraide</li> <li>• Department of the Environment</li> <li>Physical Planning Section</li> <li>Forest Department</li> <li>• Town and village councils</li> </ul>	<p>In the issuing of licences and incentives close attention will be paid to location advantages and disadvantages, and the costs and benefits possibly involved. Matters such as access, land suitability, neighbouring uses, landscape values, wildlife habitats, and erosion potential will be of particular importance.</p>
<p><b>A.4</b></p> <p>Coordination will be strengthened among all agencies involved in coastal development issues.</p>	<p>To maximise efficiency and accountability in the public sector, and the opportunities of the private sector, a system must be put in place through which inter-agency duplication, omission, and contradiction is eradicated and the full sustainable potential of the cayes is realised.</p>	<ul style="list-style-type: none"> <li>• CZMAI</li> <li>• Land Utilisation Authority</li> <li>• National Estate Section</li> <li>• Central Housing &amp; Planning Authority</li> <li>• Geology &amp; Petroleum Department</li> <li>• National Emergency Management Organisation</li> <li>• Fisheries Department</li> <li>• Beltraide</li> <li>• Department of the Environment</li> <li>• Town and village councils</li> </ul>	<p>A variety of committees exist to advise the development process on the cayes, e.g. the Land Utilisation Authority, the National Environmental Appraisal Committee, and the CZM Advisory Council. Attendance at these committees should include representation from all interested parties. Also the various licensing procedures that are not subject to committee assessment (e.g. mining, dredging, aquaculture, mangrove, fiscal incentives, and hotel licensing) should be included in inter-agency assessment. Attention should be paid to means to expedite decisions on applications.</p>

<p><b>A.5</b></p> <p>The assessment of, and decisions on, applications for development on the cayes shall be subject to greater transparency and accountability.</p>	<p>The growing civil society movement has identified the need for a high degree of transparency and accountability in the Government decision-making processes. This is a crucial component in effective democracy. The ability of the general public to be informed on what is being proposed for their neighbourhood, and the country in general, leads to a more consensual form of development and can sidestep needless conflicts.</p>	<ul style="list-style-type: none"> <li>● CZMAI</li> <li>● Land Utilisation Authority</li> <li>● National Estate Section</li> <li>● Lands &amp; Surveys Department</li> <li>Physical Planning Section</li> <li>● Beltraide</li> <li>● Department of the Environment</li> <li>● Forest Department</li> <li>● Geology &amp; Petroleum Department</li> <li>● Belize Tourism Board</li> <li>● Town and village councils</li> <li>● National NGOs</li> </ul>	<p>Notification of applications for development licenses and *incentives*, and for leases and major subdivisions of National Land should be published in the media, through news bulletin indicating scope of activities. The decisions regarding development applications should be available for public view.</p>
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<p><b>A.6</b></p> <p>The principle of low-density development will be applied in the subdivision of land, the construction of resorts, and the carrying out of other development projects.</p>	<p>As the cayes are essentially a fragile environment they can not easily support the same level or density of development as the main land without creating the potential for the degradation of the natural values of the area. The exception would be already developed, high-density areas such as Ambergris Caye and Caye Caulker.</p>	<ul style="list-style-type: none"> <li>● CZMAI</li> <li>● Land Utilisation Authority</li> <li>Physical Planning Section</li> <li>● National Estate Section</li> <li>● Beltraide</li> <li>● National Environmental Appraisal Committee</li> <li>● Geology &amp; Petroleum Department</li> <li>● Belize Tourism Board</li> <li>Forest Department</li> </ul>	<p>Attention will be paid to ensure that the size of lots and buildings do not make a heavy impact on the land and the sea, or create an overly high level of demand on the infrastructure and utilities.</p>
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\* Definitions of low and high density are necessary to address high density developments and will be included in a glossary

<p><b>A.7</b></p> <p>Provision will be made to enable high density residential development to take place in cases where there is exceptional public need on the condition that tangible off-site mitigation is carried out.</p>	<p>Due to their physical constraints, high economy and prevalence of high valued property several of the larger cayes (Ambergris and Caulker) have outstanding public housing needs. Provision must be made to enable carefully planned yet high density public housing developments to take place on the strict condition that related off-site mitigation schemes, consisting of the conservation or rehabilitation of meaningfully sized areas of land, are carried out simultaneously with the development</p>	<ul style="list-style-type: none"> <li>● Physical Planning Section</li> <li>● CZMAI</li> <li>● Land Utilisation Authority</li> <li>● Housing and Planning Department</li> <li>● National Estate Section</li> <li>National Environmental Appraisal Committee</li> <li>● Town and village councils</li> <li>● Development funding agencies</li> <li>● Area Representatives</li> <li>Geology &amp; Petroleum</li> <li>Forest Department</li> </ul>	<p>Plans for proposals of such high density public housing schemes will be distributed to the relevant agencies for assessment. Assessment must take into account the following: evidence of the need for high density development; the proposed location and its characteristics; any over-all accumulative effects that the development may result in; the value and sustainability of the off-site mitigation</p>
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<p><b>A.8</b></p> <p><b>Aesthetic appearance and practicality of construction material will be encouraged in all developments of the cayes, particularly in regard to beach aesthetics.</b></p>	<p><b>The prevalent materials, size and style of building on the cayes have evolved over many years as an appropriate response to the demands of use and nature. This can be considered as generally suitable to demand yet also crucial to the aesthetic and landscape value of the cayes: a vital consideration in the tourism industry. The Strata Act should be taken into account where small lots with large public spaces exist or are allowed.</b></p>	<ul style="list-style-type: none"> <li>● <b>CHPA</b></li> <li>● <b>CZMAI</b></li> <li>● <b>Land Utilisation Authority</b></li> <li>● <b>National Estate Section</b></li> <li>● <b>Beltraide</b></li> <li>● <b>National Environmental Appraisal Committee</b></li> <li>● <b>Central Housing &amp; Planning Authority</b></li> <li>● <b>Belize Tourism Board</b></li> <li>● <b>Town and village councils</b></li> <li>● <b>Development funding agencies</b></li> <li>● <b>Insurance agencies</b></li> <li>● <b>Geology and Petroleum Department</b></li> <li>● <b>Forest Department</b></li> </ul>	<p><b>All applications for development licenses or incentives will be assessed to ensure that matters of aesthetic appearance and the localised suitability of materials are taken this into account.</b></p>
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## SHIPPING, COMMERCIAL DEVELOPMENT AND HOUSING

The primary pieces of shipping legislation are the Harbours and Merchant Shipping Act, the Registration of Merchant Ships (Amendment) Act, and the Belize Port Authority Act. Regulations from the Belize Tourist Board Act regulate pleasure craft / cruise ships, which is augmented by a draft Cruise Ship Policy (see also Policy E: Recreation, Tourism and Cultural Heritage). Shipping is also subject to the provisions of MARPOL.

The Belize Port Authority is responsible for the country's various ports, navigation and the inspection and licensing of vessels. The BDF Maritime Wing assists the Authority in this. The Belize Tourist Board (see also Policy A: Land Use and Development Management), while it oversees the cruise ship industry, does not license its marine operation. Town and village councils can also pass bylaws relating to the passage of boats around built up areas.

Commercial development is regulated by the Ministry of Trade and Investment, largely through the trade licensing boards now administered by the local municipal authorities. The Ministry is also responsible for the Belize Trade and Investment Development Service (Beltraide), which has been established to assist and facilitate investment (see also Policy A: Land Use and Development Management, and Policy E: Recreation, Tourism and Cultural Heritage).

### POLICY POSITION

### JUSTIFICATION

### RESPONSIBILITY

### MECHANISM

<p><b>B.1</b> Boating speed limits, or 'no wake' zones, will be mandated for areas identified as having a particularly high degree of human use, are susceptible to flooding and erosion, and which have a high presence of manatees and other wildlife vulnerable to fast moving vessels.</p>	<p>Speeding boats can have a damaging effect on some cayes and parts of others that are particularly low or have erodible coastlines. Also for some time injury to bathers and fatalities to manatees have been reported.</p>	<ul style="list-style-type: none"> <li>• Belize Port Authority</li> <li>• Belize Tourism Board</li> <li>• Town and village councils</li> </ul> <p>Forest CZMAI Relevant NGOs</p>	<p>Areas requiring boat speed limits will have to be identified, based on such criteria as danger to swimmers, danger to wildlife, danger to other boats, and boating hazards. Means of imposing speed restrictions, maintaining signage, and monitoring the impact will need to be explored.</p>
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<p><b>B.2</b></p> <p><b>* BTB</b></p> <p>The Cruise Ship Policy and all regulations on commercial and recreational vessels will be integrated into general Governmental licensing procedures.</p>	<p>The use of the cayes and coastal waters by cruise ships, recreational and commercial vessels has, increased enormously in the last decade. Comprehensive implementation of these policies and regulations are becoming more pressing due to the large amount of passengers, some demanding a high level of refreshment and entertainment and thereby putting a strain on limited facilities and resources.</p>	<ul style="list-style-type: none"> <li>● Belize Tourism Board</li> <li>● Belize Port Authority</li> <li>● Belize Cruiseship Industry Association</li> <li>Department of the Environment</li> </ul>	<p>The provisions of the policy should be integrated into the procedures used by the Belize Tourism Board and the Belize Port Authority in the licensing and monitoring of all cruise ships.</p>
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<p><b>B.3</b></p> <p>The issuance of trade and liquor licences and fiscal incentives will reflect the need to support Belizean businesses and enterprises that will not detract from the natural attractions and environment of the cayes</p>	<p>The trade licensing and fiscal incentive processes are a vital instrument in assuring that business development is commensurate with the recommendations made in this policy. Enterprises, however large or small, should contribute to the socio-economic development of the cayes.</p>	<ul style="list-style-type: none"> <li>● Town and village councils</li> <li>● Beltraide</li> <li>● National NGOs</li> <li>● Department of the Environment</li> </ul>	<p>All applications for licenses from the municipal authorities, and fiscal incentives from Beltraide, should be screened to ensure that the relevant enterprise would not damage or detract from its surroundings. Emphasis should also be laid on the need to promote local Belizean businesses.</p>
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<p><b>B.4</b></p> <p>Housing on the cayes will respond to increasing demand by adopting designs and standards appropriate to their location and not based entirely on mainland models.</p>	<p>Housing on the cayes is subject to certain constraints not so readily experienced on the mainland: limited land, limited utility supply, high material transportation costs, limited construction workforce, high land values, particular hurricane vulnerability. Yet housing demand is increasing (particularly on the more developed cayes). Housing design, materials and lot sizes should be adaptable and should take into the consideration the above factors.</p>	<ul style="list-style-type: none"> <li>● Housing &amp; Planning Department</li> <li>● Ministry of Works</li> <li>● Development financing agencies</li> <li>● Insurance agencies</li> </ul>	<p>Housing should be based on designs that are sturdy, affordable, commodious and easily insurable yet complement the caye environment. Existing or proposed building codes should take these considerations into account. The statutory and private sector construction agencies should be encouraged to diversify their building designs and take on aesthetic considerations, through the building codes and through a more flexible approach by the development financing and insurance sectors.</p>
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<p><b>B.5</b></p> <p>Insurance and development funding agencies will develop more flexible policies and criteria required in insuring, financing and underwriting development in the cays.</p> <p>* <b>recommendations to change the focus of this policy to that of stringent insurance policies to discourage development in vulnerable areas or delete this entire section?</b></p>	<p>The insurance industry and development financing agencies use criteria to underwrite their policies and loans, which can be ill suited to the characteristics and needs of the cays. Examples are the need to use stipulated building materials that may be inappropriate to the site, and the inability to insure buildings and enterprises that do not meet the criteria. Moreover many fishermen, operating in a vital national industry, find it impossible to insure their businesses or use them as effective collateral.</p>	<ul style="list-style-type: none"> <li>● Development financing agencies</li> <li>● Insurance agencies</li> </ul>	<p>The insurance and development financing agencies should explore means to allow more businesses and residents to apply for assistance in financing and insurance for their enterprises. Criteria for collateral should be made more flexible and there should be a greater emphasis on long-term conditions.</p>
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## LAND TENURE AND OWNERSHIP

Most of the cayes still belong to the country of Belize, either as National Land or as protected areas. Nationally owned cayes (apart from protected ones or forest reserves) are subject to the provisions of the National Lands Act that stipulates the procedures and conditions by which they are leased, granted or reserved. The protection of cayes is administered through the National Parks Systems Act, under which they may be declared as National Parks, Nature Reserves, Natural Monuments or Wildlife Sanctuaries (see also Policy F: Protected Areas, Fishing and Wildlife Protection). Parts of some cayes are included in Marine Reserves under the Fisheries Act and parts of others are designated as Forest Reserves through the Forest Act.

Private ownership in cayes is registered at the Land Titles Unit or at the Land Registry. The subdivision of land into lots, and its subsequent use and development is regulated through the Land Utilisation Act (property can also be subdivided under the Strata Act). Applications are submitted through the Physical Planning Section that makes assessment and recommendation to the Land Utilisation Authority (see also Policy A: Land Use and Development Management). The Government, through the Land Acquisition (Public Purposes) Act or the Land Acquisition (Promoters) Act, may compulsorily acquire private land, if suitable purposes can be proved.

In 1992 all the cayes were declared as a 'designated area' under the Aliens Landholding Act. This requires any foreigner wishing to lease or purchase any national land to first obtain an Alien Landholding License from the Minister of Natural Resources and the Environment. A license registers the intended use and/or means of development of the land. Conformity with the conditions of the license, which may include restrictive covenants, is required for is non-voidance.

POLICY POSITION	JUSTIFICATION	RESPONSIBILITY	MECHANISM
<p><b>C.1</b></p> <p>Only applications from Belizeans are to be considered in leasing any Nationally owned cayes or part of a cayes.</p>	<p>The guiding principle of affording maximised advantage to local Belizeans in the enjoyment and development of the country's resources should be continued with added emphasis. This should not, however, discourage foreign investment, which should be channelled through Belizean proprietorship wherever possible.</p>	<ul style="list-style-type: none"> <li>• Lands &amp; Surveys Department</li> </ul>	<p>All applications to lease all or part of a Nationally owned cayes are to be screened to ensure that the applicant is a Belizean subject.</p>

<p><b>C.2</b></p> <p>Lease holders on the cayes, particularly on the lesser developed ones, will be encouraged and assisted in obtaining titles. Long term Belizean occupants on National land that have no leases will be similarly encouraged to apply and obtain leases.</p>	<p>Many fishermen and other individuals both reside and earn their living on Nationally owned parts of the cayes. Yet many have never applied for leases and have highly unsafe tenure. This is harmful to their long term security and affords them no access to collateral for loans or insurance.</p>	<ul style="list-style-type: none"> <li>• Lands &amp; Surveys Department</li> </ul>	<p>A programme aimed at all occupants of National land on the cayes should be launched to advise them, through either the media or site visits, to apply for formal lease certificates and, where appropriate, titles. The possibility of the involvement of the Land Management Project should be explored.</p>
<p><b>C.3</b></p> <p>Lease holders and Belizean property owners will be given advice on the mechanics of the property market and the valuation of land.</p>	<p>The cayes represent one of the greatest land assets in Belize. Their value on the open market is immense, yet few Belizean occupants are aware of the true value of the land on either monetary and heritage grounds. Consequently there is a growing trend in displacement by wealthier and better-informed parties.</p>	<ul style="list-style-type: none"> <li>• National and local NGOs</li> <li>• Lands &amp; Surveys Department</li> <li>• Educational institutions</li> </ul>	<p>A specific project to address the issue should be prepared, which may be a component of a larger national project. Access to funding from sources, which may be international, should be identified and secured.</p>
<p><b>C.4</b></p> <p>A comprehensive development plan is to be attached to every lease of National land on cayes.</p>	<p>Policy on National lands in the past required that leases on any cayes should be accompanied by a comprehensive development plan. This was considered as an optimal measure to ensure that nationally owned cayes are used and developed to the best advantage of the nation's interests. This policy will be re-enforced.</p>	<ul style="list-style-type: none"> <li>• Lands &amp; Surveys Department</li> <li>• Physical Planning Section</li> </ul>	<p>A development plan defining the nature and scale of use of each lease will be attached to the issuance of all leases, of all or parts of Nationally owned cayes. The contents of the plan may be proposed by the applicant with the National Estate Office but must be recommended by the Physical Planning Section to ensure compliance with the provisions of this policy.</p>
<p><b>C.5</b></p> <p>The moratorium on the sale or grant of Nationally owned cayes should be formalized or legislated.</p>	<p>The policy of retaining all nationally owned cayes in the National Estate should be continued. No monetary figure attached to the sale of cayes (purchase price of leases not reflecting even one tenth of their open market value) could reflect their true value to the future generations of Belize. In addition the retention of ultimate ownership will facilitate the control of their development.</p>	<ul style="list-style-type: none"> <li>• Lands &amp; Surveys Department</li> </ul>	<p>All applicants to lease all or part of any cayes will be informed that there will be no options for the purchase of the lease. Leases may, however, be renewable for up to 50 years.</p>

<p><b>C.6</b></p> <p>Assessment of all applications to sub-divide land on cayes must take the provisions of the CZM Plan into account.</p>	<p>The Land Utilisation Authority has the role of regulating the sub-division of private lands throughout the country. As such it performs a vital function in determining the means whereby privately owned cayes may be developed. Furthermore the use of binding covenants, attached as conditions to approval, provide a means to ensure that the land is used according to its best potential.</p>	<ul style="list-style-type: none"> <li>● Land Utilisation Authority</li> <li>● Physical Planning Section</li> </ul>	<p>All applications to the Land Utilisation Authority to sub-divide property shall be assessed with regard to all the provisions of the CZM Plan. Conditions will be attached, as legally binding covenants, to approval as deemed necessary.</p>
<p><b>C.7</b></p> <p>Development activities, as well as the development of leases and properties, are to be closely monitored to ensure compliance with the CZM Plan.</p>	<p>Several statutory and voluntary agencies make regular or occasional inspections on activities on cayes and in the coastal zone in general. However resources are strained and inter-agency communication unsystematic. Most advantageous would be a systematic inspection schedule, yet in its absence a mechanism for standardised inter-agency reporting would be highly instrumental.</p>	<ul style="list-style-type: none"> <li>● Fisheries Department</li> <li>● Lands &amp; Surveys Department</li> <li>● Physical Planning Section</li> <li>● CZMAI</li> <li>● Department of the Environment</li> <li>● Belize Port Authority</li> <li>● National and local NGOs</li> <li>Forestry</li> <li>Geology and Petroleum Department</li> </ul>	<p>The CZMAI will be responsible, through the Coastal Advisory Council, for drafting and initiating a standardised reporting system. The system will include standardized report format or means of recording information, forwarding it to all relevant agencies, and storing it.</p>
<p><b>C.8</b></p> <p>A cayes database is to be established to include information on use, ownership, value and physical and ecological characteristics</p>	<p>Collated data on the use, scale of use, leasing, ownership and marketing, and natural characteristics of the cayes is lacking. Without this information it is extremely difficult to gauge development trends, prospective opportunities, or the potential natural and monetary value of the cayes.</p>	<ul style="list-style-type: none"> <li>● CZMAI</li> </ul>	<p>The CZMAI will establish a database through the coastal planning program in close collaboration with the relevant agencies and stakeholders.</p>

## CLEARANCE, EXTRACTION, DRILLING AND INFRASTRUCTURE

The clearance and/or use of vegetation are regulated by the Forest Department under the Forest Act and the Protection of Mangroves Regulations. The first applies, in the context of the cayes, to the extraction of timber from the littoral forest; the second to the cutting of mangroves (guided by the draft National Mangrove Management Plan). The National Lands Act plays a role through its requirement for a shore-side reserve along all the seafront and lagoon front of National lands, and also the Land Utilisation Act through the attachment of conditions to the approval of the sub-division of property (see also Policy A: Land Use and Development Management).

The Geology and Petroleum Department has responsibility for mineral extraction (dredging) and drilling through the Mines and Minerals Act, the Petroleum Act, and subsidiary regulations (see also Policy A: Land Use and Development Management). A draft Marine Dredging Policy will provide guidelines for dredging. Any oil spills are the responsibility of the National Emergency Management Organization, the Belize Port Authority, the Department of the Environment, and other applicable permitting agencies.

The Physical Planning Section of the Lands and Surveys Department through the National Lands Act and the Private Works Construction Act regulates the construction of piers, jetties, seawalls and other coastal structures. The Ministry of Works regulates public roads and bridges.

POLICY POSITION	JUSTIFICATION	RESPONSIBILITY	MECHANISM
<p><b>D.1</b> In areas subject to development, the clearance of natural vegetation should be kept to the minimum necessary for meaningful occupation. In all cases attention will be paid to maximising the retention of areas identified as supporting wildlife and controlling erosion.</p>	<p>The absolute removal of all vegetation on a cayes leads to erosion, accelerated rain run-off, depleted freshwater reserves, the loss of wildlife, and landscape deterioration.</p>	<ul style="list-style-type: none"> <li>• Forest Department</li> <li>• Land Utilisation Authority</li> <li>• Department of the Environment</li> <li>• National and local NGOs</li> <li>Central Housing and Planning</li> </ul>	<p>A general guideline is the retention of an adequate % of the natural vegetation on a site subject to development, while ensuring that the remaining vegetation, is properly managed.</p>



<p><b>D.2</b> Forested areas that are used by fishermen and others for timber extraction and other forest products will be managed on a sustainable basis.</p>	<p>Certain parts of the cayes are habitually used by fishermen and others to cut poles or leaves for a variety of purposes. This policy seeks to promote means by which this use can be continued on a sustainable basis to the benefit of the users and the environment.</p>	<ul style="list-style-type: none"> <li>• Forest Department</li> <li>• Fisheries Department</li> <li>• CZMAI</li> <li>• National and local NGOs</li> </ul>	<p>The responsible agencies should identify and map the areas of habitual timber extraction on the cayes. Discussion should be undertaken with local fishermen and other interested, legally established parties concerning the best means of management and agreements entered into with registered groups over management responsibilities.</p>
<p><b>D.3</b> The restoration and rehabilitation of damaged coastal areas shall be undertaken.</p>	<p>Development pressures and natural events have resulted in loss or damage to habitats over large areas of the coast. Rehabilitation of these areas, together with restoration is vital for coastal protection, wildlife habitat, and coastal aesthetic values and should be encouraged.</p>	<ul style="list-style-type: none"> <li>• CZMAI</li> <li>• Forest Department</li> <li>• Fisheries Department</li> <li>• National and local NGOs</li> <li>• Town and village councils</li> <li>• Geology and Petroleum</li> </ul>	<p>A programme to identify sites that have sustained damage and that require restoration and rehabilitation shall be initiated and facilitated through the combined efforts of CZMAI and Forest Department. Relevant government departments, local councils and interested NGOs should be encouraged to collaborate.</p>
<p><b>D.4</b> Enforcement of the Protection of Mangroves Regulations should be enhanced.</p>	<p>The regulations provide a means to ensure that removal or retention of mangroves can be rationalised according to development or protective needs. Furthermore, significant work has been completed for the classification of mangrove areas that have been identified as nursery areas, active nesting sites, resting or breeding areas for colonies or concentrations of birds.</p>	<ul style="list-style-type: none"> <li>• Forest Department</li> <li>• CZMAI</li> <li>• National and local NGOs</li> </ul>	<p>The Forest Department has the legal responsibility for managing mangroves, and is and is prepared to collaborate with other relevant and interested agencies to assist in the monitoring of mangrove areas.</p>
<p><b>D.5</b> The requirement for a beach reserve alongside all watercourses and bodies will be strictly adhered to. The appropriate width of reserves should be determined either by development plans or standards applied by statutory licensing agencies. Furthermore, extended reserves will be required in</p>	<p>The traditional 66 feet reserve, as required in the National Lands Act and through the Land Utilisation Authority, is largely impractical. Ideally a reserve offers an effective and easily accommodated means to protect both waterside vegetation (and thereby the banks or beach and the quality of water), and public access to water bodies.</p>	<p>CZMAI</p> <ul style="list-style-type: none"> <li>• Land Utilisation Authority</li> <li>• National Estate Section</li> <li>• Physical Planning Section</li> </ul> <p>Forest Department CACs</p>	<p>The laws governing the traditional 66 feet reserve (primarily the National Lands Act, but also the Land Utilisation Act) should be reviewed in order to better define the purposes, legal standing, and means of establishing and maintaining the reserves.</p>

<p><b>mangrove habitats and areas of possible erosion.</b></p>			
<p><b>D.6</b>  <b>Construction setbacks will be required for all buildings on the seafront. The setback should consist of a minimum of 66 feet, where practicable.</b></p>	<p><b>The area where the sea meets the land is a transition zone characterized by complex physical and biological processes, including varying long-term and short-term currents. It is also the area most immediately susceptible to sea level rise. Construction in this zone can have significant negative impacts on shoreline stability, and on the integrity and investments that have been committed.</b></p>	<ul style="list-style-type: none"> <li>● <b>Housing &amp; Planning Department</b></li> <li>● <b>Town and village councils</b></li> <li>● <b>Land Utilization Authority</b></li> <li>● <b>Local planning committees</b></li> </ul>	<p><b>The Housing and Planning Department, and all agencies implementing its delegated powers (town and village councils and local planning committees) should revise its planning provisions to ensure the adequacy of all provisions for construction setbacks. The Land Utilization Authority should ensure that appropriate reference is made to the need for such setbacks in its approval process.</b></p>
<p><b>D.7</b>  <b>There will be no construction of groynes, seawalls, causeways or other solid coastal structures without a full investigation into the environmental consequences and approval from the relevant authority.</b></p>	<p><b>Such structures cause major changes in the speed and direction of waves and offshore currents, resulting in changes to the coastal morphology that are often damaging to both the natural environment and to development projects.</b></p>	<ul style="list-style-type: none"> <li>● <b>Physical Planning Section</b></li> <li>● <b>Town and village councils</b></li> <li>● <b>Ministry of Works / engineering consultants</b></li> <li>● <b>CZMAI</b></li> </ul> <p><b>Department of the Environment</b></p>	<p><b>All applications to the Physical Planning Section and the relevant municipal authorities should be assessed in light of the need to avoid any erosion or un-due deposition, or alteration of currents. Local councils, along with the CZMAI, should be encouraged and authorized to assist in monitoring. Guidance on appropriate construction should be sought from the Professional Association of Engineers and/or coastal engineers.</b></p>
<p><b>D.8</b>  <b>Piers will be sited to avoid deposition, erosion and obstruction, and only with permission from the Physical Planning Section.</b></p>	<p><b>On some larger cayes the un-planned proliferation of piers has already caused problems including alteration of beach profiles and channel depths, navigation hazards, loss of aesthetic appeal and recreational values, and personal accident. Many of these problems could be avoided through limiting the number of piers to approximately one per one thousand feet.</b></p>	<ul style="list-style-type: none"> <li>● <b>Physical Planning Section</b></li> <li>● <b>Fisheries Department</b></li> <li>● <b>CZMAI</b></li> <li>● <b>Town and village councils</b></li> </ul>	<p><b>The current policy on piers should be reviewed to allow a more comprehensive approach. Piers should be sited at points with ready public access or, where this is not possible, they should be required to allow public use. The relevant Government or municipal bodies should be encouraged to establish and maintain community/public piers or marinas.</b></p>

<p><b>D.9</b></p> <p><b>* GPD</b></p> <p>The Geology and Petroleum Department shall continue to ensure that all dredging and sand mining activities are subject to strict assessment and licensing.</p> <p><b>Geology please make the necessary changes to this section (corrections were lost through computer problems)</b></p>	<p>Dredging and sand mining can have a major impact on the shape, size and stability of cayes by altering water currents and disturbing sediments that may subsequently be deposited in other areas. Sandy beaches and small cayes naturally tend to exist in a dynamic equilibrium, with seasonal changes in erosion and deposition patterns, dredging and sand mining can disrupt these processes and cause major changes, such as the total erosion of a beach, the silting up of a channel, or the degradation of fisheries.</p>	<ul style="list-style-type: none"> <li>● Geology &amp; Petroleum Department</li> </ul>	<p>Recognising the resource limitations of the Geology and Petroleum Department it is recommended that greater reliance be put on the management functions of town and village councils, and the role of interested NGOs and community based organisations to monitor mineral extraction for the department. The Department should explore the possibilities of using a model similar to that used by the Department of the Environment in delegated monitoring powers.</p>
<p><b>D.10</b></p> <p>Dredging will not be used to create land that did not have a previous legal existence except with the permission of, and in accordance with, the relevant authorities.</p>	<p>Any land created through dredging and/or filling which lies outside of the legal boundary of a private property is National Land, due to the national ownership of the seabed, and as such can only be created and dealt with through the appropriate channels.</p>	<p>Forest Department</p> <ul style="list-style-type: none"> <li>● Fisheries Department</li> <li>● CZMAI</li> <li>● Geology &amp; Petroleum Department</li> <li>● Department of the Environment</li> <li>● Physical Planning Section</li> <li>● National Estate Section</li> </ul>	<p>Land creation should only be permitted in cases of demonstrated need and for public benefit. Attention will be required to ensure that any dredging is environmentally safe, and that the land created will not be subject to inundation or poor drainage.</p>
<p><b>D.11</b></p> <p>The Marine Dredging Policy will be developed to complement the draft Cayes Development Policy.</p>	<p>The policy identifies the appropriate methods and approaches to be used in dredging that would minimise environmental damage without impeding efficiency.</p>	<p>Fisheries Department</p> <p>Forest Department</p> <ul style="list-style-type: none"> <li>● Geology &amp; Petroleum Department</li> <li>● Department of the Environment</li> <li>● Ministry of Works</li> </ul> <p>CZMAI</p> <p>Physical Planning Section</p>	<p>The policy will be integrated into the draft Cayes Development policy, draft Mineral Resource policy, the Mines and Minerals Act and the Petroleum Act for all extraction operations.</p>

<p><b>D.12</b></p> <p>Sites for marine dredging for fill shall be identified at suitable locations in the coastal waters. These will be used for managed extraction.</p>	<p>There is a constant requirement, driven by tourism, for fill material dredged from the marine environment. However it is also recognised that some areas have more suitable material and at greater quantities than others, and that factors such as potential environmental and ecological damage need to be considered in extraction. The ability for effective on-site management is also critical.</p>	<ul style="list-style-type: none"> <li>• Geology &amp; Petroleum Department</li> <li>• Department of the Environment</li> <li>• Physical Planning Section</li> <li>• Ministry of Works</li> <li>• Town and village councils</li> <li>• Private developers</li> </ul> <p>CZMAI Fisheries</p>	<p>Once research has been undertaken the Geology and Petroleum Department should designate the appropriate sites, determine maximum volumes of extraction, and establish a participatory monitoring regime. All applications for dredging should be directed to the most appropriate sites.</p>
<p><b>D.13</b></p> <p>Applications for the creation and maintenance of channels and canals will only be processed after careful assessment according to their projected need and location.</p>	<p>The proponent of any channel should carefully consider both the level of use and location before applying to the Geology and Petroleum Department for a licence. Experience and research shows that channels are best created on the leeward side of any caye in order to minimise erosion and siltation, and potential impacts to coral reefs. However access is often demanded on the windward (reef) side.</p>	<ul style="list-style-type: none"> <li>• Geology &amp; Petroleum Department</li> <li>• Department of the Environment</li> <li>• Fisheries</li> <li>• CZMAI</li> <li>• Physical Planning Section</li> <li>• Ministry of Works</li> <li>• Private developers</li> </ul>	<p>Applicants for the award of contracts for extraction operations will undertake the necessary assessments prior to the issuing of licenses and/or permits. Environmental compliance plans will reflect the findings of the research.</p>
<p><b>D.14</b></p> <p>All petroleum exploration and exploitation is subject to the provisions of the Petroleum Act and the Environmental Protection Act.</p>	<p>There would be a considerable risk to the cayes should any accident occur during abstraction and transportation of petroleum. The cayes and in particular the Belize Barrier Reef system are an important part of the economy and integrity of the coastal zone.</p>	<ul style="list-style-type: none"> <li>• Geology &amp; Petroleum Department</li> <li>• Department of the Environment</li> </ul> <p>NEMO Fisheries CZMAI</p>	<p>Department of the Environment, Fisheries, Forest Department and CZMAI will be notified of any applications for exploration in the coastal zone.</p>

<p><b>D.15</b></p> <p><b>Docking facilities and heavily used commercial piers should be encouraged to be sited on the leeward sides of cayes.</b></p>	<p>The leeward side of cayes generally presents greater security against prevailing winds, thereby offering a safer environment for docking of marine transport. It also allows the windward side to retain a more natural appearance by avoiding the over-development of piers and other related structures.</p>	<ul style="list-style-type: none"> <li>● Physical Planning Section</li> <li>● Town and village councils</li> <li>● Fisheries Department</li> <li>● CZMAI</li> </ul>	<p>Applications for piers and related structures should be advised to assess the possibility of siting such structures on the leeward side of cayes. Attention should be given to optimal locations with regard to minimising any need for the clearance of mangroves and dredging.</p>
<p><b>D.16</b></p> <p>The use of motor vehicles on cayes should be discouraged except for golf carts, provided that adequate provision is made for the safe disposal and storage of batteries and fuel.</p>	<p>Only two cayes, Ambergris Caye and Caye Caulker, can be considered as having sufficient development and size to warrant the use of conventional vehicles, and on both of these limitations are placed on vehicle importation. The use of conventional vehicles brings about a series of negative impacts that outweigh the benefits: compaction of sand /soil; accelerated rain run-off; erosion; water, air and noise pollution; congestion; demands on valuable space; and hazardous fuel transportation and storage.</p>	<ul style="list-style-type: none"> <li>● Department of Transport</li> <li>● Town and village councils</li> </ul> <p>Department of the Environment Local Planning Committees or Transport Committees</p>	<p>Initiatives should be adopted such as the use of strict quotas on vehicle importation, regulation of vehicle use with minimal variances, incentives for the importation and use of golf carts, control of fuel and battery storage and disposal, and greater reflection in primary legislation of the schemes already employed in such places as San Pedro (where by-laws are used).</p>

## RECREATION, TOURISM AND CULTURAL HERITAGE

Hotels are licensed by the Belize Tourist Board and there are statutory regulations stipulating the standards for the various categories of hotel (see also Policy A: Land Use and Development Management, and Policy B: Shipping, Commercial Development and Housing). The board is also responsible for the licensing of tour guides. The Belize Tourism Industry Association and other national and local NGOs have an input into policies and practices relating to tourism and eco-tourism (see also Policy D: Shipping, Commercial Development and Housing). City, town and village councils have responsibility for recreational amenities within their areas, and the Sports Council has a major role in promoting both sport and recreational amenities throughout the country.

**Cruise ships are regulated through the Cruise Ship Compliance Plan and the Cruise Ship Policy (expand this section with input from BTB).**

Archaeological sites and artefacts, and historical wrecks, are protected as part of the national heritage through the Ancient Monuments and Antiquities Ordinance and the Abandoned Wrecks Act and NICH Act. The cayes have been used by people at least since earliest Mayan times.

POLICY POSITION	JUSTIFICATION	RESPONSIBILITY	MECHANISM
<p><b>E.1</b></p> <p>Encourage and facilitate increased recreation for Belizeans on the cayes.</p>	<p>Trips to the cayes are expensive and not readily accessible to a large portion of the population. Improved recreational opportunities would greatly enhance the quality of experience and increase their sense of ownership of this part of the national patrimony.</p>	<ul style="list-style-type: none"> <li>• Belize Tourism Board</li> <li>• National and local NGOs</li> <li>• Tour operators &amp; water taxis</li> </ul> <p>BTIA BCIA Relevant government agencies</p>	<p>Tour operators and water taxis should be encouraged by such agencies as the Belize Tourism Board, the Belize Tourism Industry Association to offer affordable trips to the cayes for Belizeans. Public holidays or weekends, could be targeted. Local government, NGO, CBO and the private sector should be encouraged to assist in the establishment of recreational facilities. There should be reallocation of budgetary resources from Government and relevant statutory bodies, such as BTB to increase tourism product development.</p>
<p><b>E.2</b></p> <p>National lands on Cayes (whole or parts of larger cayes) that are commonly used by Belizeans for recreation should be retained for public use.</p>	<p>Such cayes include Goff's, English, Rendezvous, Sergeant's and Hunting cayes. These cayes should be specifically designated as a protected area or reserve for recreation purposes, with a comprehensive management plan for each.</p>	<ul style="list-style-type: none"> <li>• National Estate Section</li> <li>• Belize Tourism Board</li> <li>• CZMAI</li> </ul> <p>Forestry</p>	<p>The identification of all the cayes that are, or have the potential for being, public recreation areas should part of the coastal planning process. These cayes should be designated appropriately and management should be exercised by capable and accountable agencies</p>



<p><b>E.3</b></p> <p><b>Carrying capacity and Limits of Acceptable Change shall be determined to monitor visitation on cayes and surrounding waters.</b></p>	<p>Each caye has its own physical and infrastructural potentials and limitations, as well as certain levels of ecological tolerance, and the expectations among its residents and visitors. Visitor levels should be tailored to these constraints and opportunities.</p>	<ul style="list-style-type: none"> <li>● Belize Tourism Board</li> <li>● Town and village councils</li> <li>● National and local NGOs</li> </ul> <p><b>CZMAI</b>  <b>Forestry</b>  <b>Tour operators and guides</b>  <b>Fisheries</b></p>	<p>Cayes should be categorised as ‘high-use’ (requiring improved facilities), ‘moderate-use’ (avoiding over-commercialisation), and ‘low -use’ (implying strict limitation on development or activities). Tour operators and guides will be requested to provide comprehensive data on tours. This data will be correlated with the physical, biological and infrastructural characteristics of each site to determine levels of carrying capacity and limits of acceptable change.</p>
<p><b>E.4</b></p> <p><b>Opportunities for enhanced diversification, promotion and marketing of the economic basis of the cayes (mainly fisheries products and tourism) will be explored with particular emphasis on possible benefits for local fishermen and residents.</b></p>	<p>The cayes are the major destination for tourists coming to Belize, and the source of a high proportion of fish products. These factors are reflected by the almost total reliance among caye dwellers and users of coastal resources. However as a supplementary to these sectors, and as an alternative to broaden the local economy, incentives and training are required in such areas as professional and technological services, crafts, tour guiding.</p>	<ul style="list-style-type: none"> <li>● Ministry of Trade &amp; Investment</li> <li>● Beltraide</li> <li>● Belize Tourism Board</li> <li>● Fisheries Department</li> <li>● Fishermen’s Cooperatives</li> <li>● National and local NGOs</li> </ul>	<p>The potential in diversifying the economy of the cayes should be explored by the public and NGO agencies responsible for facilitating and marketing investment possibilities in the cayes. Once the potential has been assessed, policies directing incentives and assistance could be targeted at proposed sectoral activities in the cayes. Exploration of diversified activities should take both the terrestrial and marine areas into account.</p>
<p><b>E.5 * BTB and BTIA to review and provide input on wording</b></p> <p><b>Promote maximised Belizean opportunity in all levels of the tourism industry, from ownership and management to servicing.</b></p>	<p>Tourism is one of the mainstays of the national economy, yet local Belizean ownership in this industry is relatively limited. This skew in the industry may undermine its support among the public and ultimately damage its prospects for growth.</p>	<ul style="list-style-type: none"> <li>● Belize Tourism Board</li> <li>● Belize Tourism Industry Association</li> <li>● Beltraide</li> </ul>	<p>A concerted programme to restrain exclusive foreign ownership together with targeted incentives to facilitate local Belizean opportunity in ownership and management should be embarked upon. Such a programme should also promote the involvement of fishermen who may be interested in any tourism service.</p>

<p><b>E.6</b>  <b>Develop mechanisms to strengthen and enhance the tour guides training programs to account for basic, intermediate and advanced levels.</b></p>	<p><b>The cayes offer a great opportunity for tour guiding. Trained tour guides act as both ambassadors for the country and stewards of the coastal resources, thus the need for continuous capacity building. Tour guides are also important actors in maintaining Belize's competitive edge in the global tourism market.</b></p>	<ul style="list-style-type: none"> <li>• <b>Belize Tourism Board</b></li> <li>• <b>National and local NGOs</b></li> </ul> <p><b>BTIA</b>  <b>Belize Tourism Training Unit</b></p>	<p><b>The BTTU, Belize Tourism Board and BTIA should continue to expand its delivery of tourism training services and seek means to sustain the provision of these services. There should be an emphasis on the special natural characteristics of the caye environment and the appropriate ways to develop them for responsible tourism.</b></p>
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**\* recommendations to add a policy focus on maintaining the unique culture of the cayes, to discuss further with Andy Palacio.**

## PROTECTED AREAS, FISHING AND WILDLIFE

A number of nationally owned cayes, or parts of cayes, have been declared, or are proposed as National Parks, Nature Reserves, Natural Monuments or Wildlife Sanctuaries under the National Protected Areas Systems Act (see also Policy C: Land Tenure and Ownership, and Policy D: Clearance, Extraction and Infrastructure). Parts of others have been declared as forest reserves through the Forest Act or as part of marine reserves under the Fisheries Act, and some are designated as Reserves under the National Lands Act.

The Barrier Reef has been declared a World Heritage Site and several marine areas have declared as Marine Reserves through the Fisheries Act.

The policy addresses the importance of giving protected status to areas with significant mangrove stands, littoral forest and wildlife habitats. It also focuses on the listing of certain reefs and wetlands, which include cayes, under the Ramsar and World Heritage Conventions, the protection of natural and geological formations of unique beauty and value, and the need to consider further areas for declaration and improved protection management.

Exploitation of fish, turtles and commercially important invertebrates are regulated under the Fisheries Act. The capture of larger marine mammals, including several species found in and around the cayes, is regulated by the Forest Department through the Wildlife Protection Act. A National Protected Areas System Policy and Plan process is currently underway geared towards providing a framework for the establishment, and management of protected areas.

Several national and local NGOs, particularly the Belize Audubon Society and the Belize Zoo, takes an active interest in the well-being of wildlife and their habitats (see also Policy C: Land Tenure and Ownership). Producer's organisations, such as the fishermen's co-operatives take the lead in representing the interests of the fishing industry. (**check with Fisheries re: Fisheries Act**).

POLICY POSITION	JUSTIFICATION	RESPONSIBILITY	MECHANISM
<p><b>F.1</b> Areas that include mangroves and other vegetation types that have been identified as requiring protection will be prioritised for full declaration with accompanying management plans.</p>	<p>Mangroves and other critical and sensitive habitats are important for fisheries, protection of native and migratory wildlife and coastal protection. These areas should be afforded meaningful protection.</p>	<ul style="list-style-type: none"> <li>• Forest Department</li> <li>• Fisheries Department</li> <li>• National and local NGOs</li> </ul> <p>CZMAI</p>	<p>The Fisheries and Forest departments, with assistance from the CZMAI, will conduct an exercise to review and map all mangrove and other vegetation types to identify critical and sensitive habitats and explore means to include them in existing or proposed protected areas.</p>

<p><b>F.2</b> Promote global recognition of the reefs and wetlands in and around cayes of unique and important value.</p>	<p>Such international recognition of the importance of the cayes and associated ecosystems may facilitate international assistance in their management.</p>	<ul style="list-style-type: none"> <li>● Fisheries Department</li> <li>● Forest Department</li> <li>● National and local NGOs</li> </ul> <p>CZMAI</p>	<p>The Fisheries and Forest departments, with assistance from the CZMAI and within the scope of the National Protected Areas System Plan process, will conduct an exercise to identify and assess all significant wetlands and reefs in and around the cayes for possible international listing.</p>
<p><b>F.3</b> Engage stakeholders and interested parties in the process of declaration and management of protected areas.</p>	<p>In order for the protected areas to remain both effective and popular, great attention must be paid to systems of designation and management that are based upon consensus, accountability, and the involvement of the stakeholders, Government departments, and interested NGOs.</p>	<ul style="list-style-type: none"> <li>● Fisheries Department</li> <li>● Forest Department</li> <li>● National and local NGOs</li> </ul> <p>Lands Department CZMAI</p>	<p>All protected areas and other reserves will be founded on local support and should have practical and identifiable means of management that are consistent with the strategic aim of balancing conservation with development.</p>
<p><b>F.5 * Fisheries to review and comment</b> While the provisions of the Fisheries Act will be strictly enforced throughout the coastal zone, traditional fishing rights should be identified and respected in waters around the cayes where they do not conflict with the Act.</p>	<p>The cayes and their adjacent waters have been the focus of Belizean subsistence and relatively small-scale commercial fishing for generations. These fishing grounds and their ancillary land uses should be clearly identified and managed for sustainability to ensure long term benefit for those traditionally reliant on their resources.</p>	<ul style="list-style-type: none"> <li>● Fisheries Department</li> <li>● Fishermen's Co-operatives</li> </ul>	<p>Fishermen in some areas or communities have expressed an interest in defining traditional fishing grounds with a view to establishing management mechanisms. The Fisheries Department should explore these proposals for feasibility.</p>
<p><b>F.6</b> <b>* Fisheries to review and comment</b> Recreational, or sport fishing will be promoted within ecological and economic guidelines.</p>	<p>Sport fishing is a high revenue generation activity and as such it could bring substantial benefits to those dependent on the cayes for their livelihood, however the activity should be managed to ensure that it does not compete with other marine uses and has the opportunity for low investment participation.</p>	<ul style="list-style-type: none"> <li>● Belize Tourism Board</li> <li>● National and local NGOs</li> <li>●</li> </ul> <p>CZMAI</p>	<p>Tour guides will be encouraged to promote sport fishing and tour operators should receive training. Possibilities of training programmes in liaison with resorts and operators that already promote sport fishing should be explored.</p>

<p><b>F.7</b></p> <p>The full range of protection afforded by the Wildlife Protection Act will be provided to the native and migrant fauna and to flora that are unique to the cayes or surrounding waters.</p>	<p>Many of the native species of fauna and flora currently found on the cayes are becoming increasingly rare in the Caribbean region and in the rest of the world. As such the Belizean cayes offer the opportunity to become a treasured repository for these threatened species.</p>	<ul style="list-style-type: none"> <li>• Forest Department</li> <li>• National and local NGOs</li> </ul>	<p>Forest Department is responsible for enforcing the protection and management of flora and fauna, and is prepared to collaborate with other relevant and interested agencies.</p>
<p><b>F.8 check with Archaeology for their input</b></p> <p>All archaeological sites and abandoned wrecks in the cayes and surrounding waters will be identified and considered for registration and protection as provided for through the NICH Act and the Abandoned Wrecks Act.</p>	<p>The cayes and surroundings waters hold a wealth of archaeological sites and abandoned wrecks, the great majority un-registered that can contribute to both the cultural heritage of the country and, if suitably managed, to tourism attraction.</p> <p>Exploration of possible archaeological sites and abandoned wrecks should be properly managed to ensure high scientific standards and patrimony of any objects found.</p>	<ul style="list-style-type: none"> <li>• IRMAC</li> <li>• National and local NGOs</li> </ul> <p>Belize Port Authority</p>	<p>Undertake an inventory and mapping of all sites of significance. Once a comprehensive assessment of sites is completed, options for management can be explored.</p>
<p><b>F.9</b></p> <p>Build knowledge through scientific research on the coastal resources in and around the cayes.</p>	<p>Despite significant research there still exists gaps in knowledge and guidance for research priorities and researchers. Underpinning the effective implementation of the Cayes Development Policy is the need for reliable and up to date information.</p>	<p>CZMAI Fisheries Forest University of Belize Department of the Environment Geology and Petroleum Other relevant research institutions</p>	<p>Identify research priorities and conduct targeted research needs, strengthen clearinghouse mechanisms for marine and coastal information, establish and maintain cayes database.</p>

## FRESH WATER, WASTE DISPOSAL AND HAZARDOUS SUBSTANCES STORAGE

The Public Utilities Commission, through the Water Industry Act, is the statutory regulator of water provision, and is responsible for ensuring that water supply licensees manage their own treatment and distribution systems. The only comprehensive water supply system that operates on the cayes is in San Pedro, though one is scheduled for Caye Caulker. Elsewhere rainwater and ground water are the primary sources. The Public Health Bureau, in the Ministry of Health, is responsible for monitoring the quality of drinking water, the disposal of liquid waste, and issues related to general public health. City and town councils are currently responsible for the collection and disposal of solid waste though the Solid Waste Management Authority is being established to be responsible for a comprehensive waste disposal system. Management of water resources the remit of the Hydrology section of the National Meteorological Service.

Primary responsibility for the control of all forms of pollution lies with the Department of the Environment, through the Environmental Protection Act and its regulations (see also Policy A: Land Use and Development Management). The marketing, storage, use and disposal of pesticides and herbicides are regulated by the Pesticides Control Board of the Department of Agriculture.

Several village councils and NGOs operating at both national and local levels, also take a particular interest in waste disposal issues.

POLICY POSITION	JUSTIFICATION	RESPONSIBILITY	MECHANISM
<p><b>G.1</b> Water supply systems for all coastal developments, especially tourism and residential developments will explore the use of environmentally acceptable alternatives to groundwater extraction.</p>	<p>The need for good potable water on the cayes is increasing and creating a demand for reliable, clean systems. While it is essential that these systems meet growing demand, it is important that they are also non-polluting.</p>	<ul style="list-style-type: none"> <li>● Public Utilities Commission</li> <li>● Belize Tourism Board</li> <li>● Land Utilisation Authority</li> </ul> <p>MNREI (Department of Environment)</p>	<p>Conditions attached by the MNREI in licensing water abstractions, by the Belize Tourism Board in licensing of hotels, by the Land Utilisation Authority in approval of sub-division on the cayes (except those with central water supply systems) and Department of the Environment through the EIA process should include requirements on non-polluting means of potable water supply (and waste disposal). Such conditions should generate more research on viable means of non-polluting supply.</p>
<p><b>G.2</b> Rainfall catchment systems should be installed for all coastal tourism or residential developments, whether large or small.</p>	<p>Rainfall catchment systems are probably the most effective, cleanest, cheapest and non-polluting freshwater systems available. Vast quantities of potable water are wasted when not collected. Guttering also helps to avoid erosion and pot holing around structures.</p>	<ul style="list-style-type: none"> <li>● Public Utilities Commission</li> <li>● Housing &amp; Planning Department</li> <li>● Town and village councils</li> <li>● Development funding agencies</li> <li>● Architectural businesses &amp; construction industry</li> <li>● Belize Tourism Board</li> </ul> <p>MNREI (DoE)</p>	<p>Conditions should be attached to the licensing, permitting and funding of resort and housing developments on the cayes and their water supply systems requiring the use of rainfall catchment systems in order to reduce the demand for other, more costly forms of potable water generation and supply.</p>



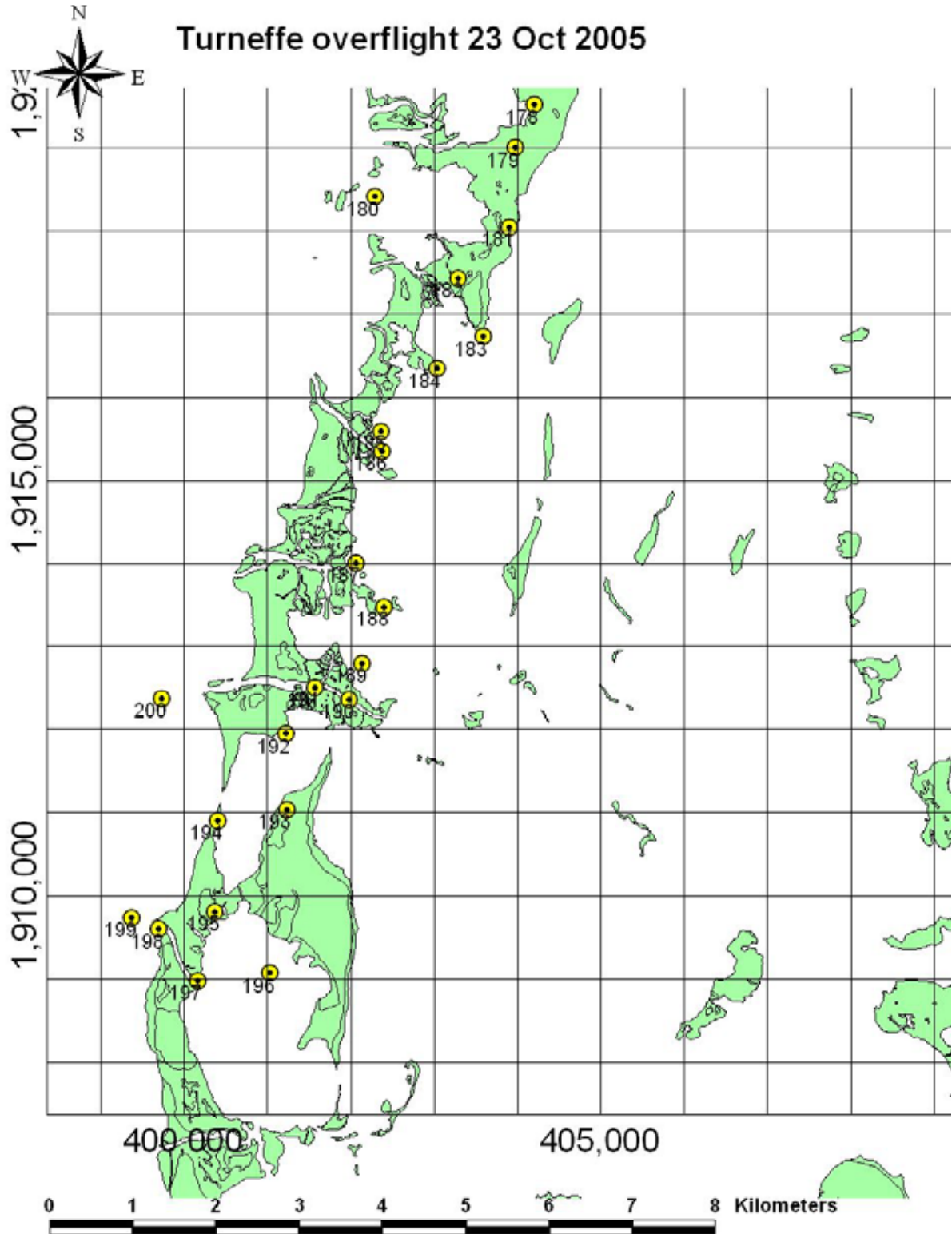
<p><b>G.3</b> Where wells are to be dug to provide ground water, thorough research and monitoring should be undertaken.</p>	<p>Limited information is available on the size and carrying capacity of the freshwater lenses of the cayes. However it is known from cases in other regions that such ground water supplies can rapidly become depleted, with subsequent damage through salt-water intrusion.</p>	<ul style="list-style-type: none"> <li>● Public Utilities Commission</li> <li>● Ministry of Rural Development</li> <li>● Hydrology Department MNREI (DoE)</li> </ul>	<p>The Public Utilities Commission should take into account possible impacts on groundwater in the licensing of all water supply/abstraction systems and the MNREI in the licensing of water abstraction. Businesses or individuals should seek professional advice before undertaking operations in order to determine the viability and usefulness of the work. A system should be devised to regulate the sinking of wells if such a system is absent.</p>
<p><b>G.4</b> Desalination and / or reverse osmosis plants will only be installed if other methods can not provide sufficient water of the required quality</p>	<p>Such plants can produce polluting side effects and consequently there is the need to explore other alternatives so that any effluent is safely disposed of and appropriate monitoring methods are established.</p>	<ul style="list-style-type: none"> <li>● Public Utilities Commission</li> <li>● Department of the Environment CZMAI</li> </ul>	<p>Approval by Department of the Environment for any installation of reverse osmosis plants should take the availability of other means of potable water supply into account. The Department will conduct monitoring of effluent from these systems with support from relevant and interested agencies.</p>
<p><b>G.5</b> The disposal of solid waste generated on the cayes should be guided by the provision of the Solid Waste Management Plan and the principles of reduce, recycle and re-use.</p>	<p>Maximum effort should be made to reduce the amount of waste generated on the cayes as their generally small size and fragile environment limits the amount of land available for disposal. Their comparative inaccessibility requires complex and expensive waste transport arrangements with the mainland. Furthermore the cayes are particularly vulnerable to ground water pollution and accumulations of waste detract significantly from their aesthetic appeal.</p>	<ul style="list-style-type: none"> <li>● Department of the Environment</li> <li>● Town and village councils</li> <li>● Public Health Department</li> <li>● Solid Waste Management Authority</li> </ul>	<p>A concerted effort to fast track the implementation of the Solid Waste Plan (coastal component) otherwise encourage incineration, composting and transportation to officially approved collection points or disposal sites. The frequent use of coastal waters as dumping grounds will be discouraged and penalties for non-compliance explored.</p>

<p><b>G.6</b></p> <p><b>Develop and implement beach management programs</b></p>	<p>To enhance public health, aesthetics, and recreational use of our beaches and in general the tourism product.</p>	<ul style="list-style-type: none"> <li>• Department of the Environment</li> <li>• Town and village councils</li> <li>• Public Health Department</li> <li>• National and local NGOs</li> </ul> <p>BTB Ministry of Local Government CZMAI</p>	<p>CZMAI, BTB, PHB and the Department of the Environment should develop and jointly implement beach management programs. Regular beach clean-ups should be organised in coordination with the tourism industry and the voluntary sector.</p>
<p><b>G.7</b></p> <p>Sewerage disposal systems in the cayes, including septic tanks and composting toilets, will be subject to a comprehensive assessment before installation.</p>	<p>Nutrients from sewage can pollute the freshwater lens and, should they leak through the ground water system to the adjacent marine environment, can damage the coral reef by promoting algal growth. Moreover sewage is extremely hazardous to human health and will undermine the tourism value of the cayes.</p>	<ul style="list-style-type: none"> <li>• Department of the Environment</li> <li>• Town and village councils</li> <li>• Public Health Department</li> </ul>	<p>Sewage disposal for individual houses, small resorts and low density sub-divisions will be guided by the coastal planning guidelines and individual septic tanks will be utilized as long as they are properly designed and built to ensure that there is no leakage into the water table and the marine environment. Larger resorts and sub-divisions will use one of the following:</p> <p>(a) any existing municipal or community sewerage system;</p> <p>(b) a simple but well-established type of package plant with extended aeration, activated sludge, biological contractors, etc.</p> <p>(c) stabilisation ponds. <b>Check with Public Health for their input.</b></p>
<p><b>G.8</b></p> <p>The use of composting toilets will be encouraged in appropriate locations on the cayes and only following thorough assessment.</p>	<p>The compost generated from the toilets can be used to fertilise cultivated land or can be thinly spread through other vegetation.</p>	<ul style="list-style-type: none"> <li>• Department of the Environment</li> <li>• Town and village councils</li> <li>• Public Health Department</li> <li>• Belize Tourism Board</li> </ul>	<p>Those agencies that have licensing remits should consider requesting applicants to explore the possibility of using composting toilets, especially those in sensitive locations.</p>

<p><b>G.9</b></p> <p>The storage and disposal of dangerous liquid wastes, including chemicals and hazardous substances, should be carefully assessed by the relevant authorities. In addition grey water treatment systems will be installed wherever possible.</p>	<p>The limited size and the vulnerable ecology of the cayes and surrounding coastal waters means that pollution problems on them tend to be far more acute than on the mainland, and that the effects can be spread rapidly to the marine environment.</p>	<ul style="list-style-type: none"> <li>● Department of the Environment</li> <li>● Pesticides Control Board</li> <li>● Town and village councils</li> <li>● Public Health Department</li> <li>● Public Utilities Commission</li> <li>● Belize Water Services Ltd</li> </ul>	<p>All places storing and / or disposing of dangerous chemicals, liquid waste and other hazardous substances should be registered with the Department of the Environment. All places storing pesticides or herbicides should be licensed by the Pesticides Control Board. The Public Utilities Commission and/or the licensed company responsible for sewage disposal systems for built up areas (Belize Water Services Ltd), should be able to offer guidance on suitable liquid waste disposal systems for smaller enterprises. Town and village councils have the duty to monitor the efficiency of these systems operating in their respective areas.</p>
<p><b>G.10</b></p> <p>The use of fertilisers, pesticides, herbicides and fungicides on cayes should be discouraged. If the use of pesticides is unavoidable it is recommended that biodegradable agents are used and that the requirements of the Pesticides Control Board will be strictly adhered to.</p>	<p>The sandy infertile soil of the cayes and the high insect population tend to encourage the use of nutrients and chemicals that can grossly alter the natural cayes environment. In many cases alternative approaches are available such as general cleanliness, sand raking, and the positioning of buildings to catch maximum breeze. Clearance of mangroves to reduce insect habitation should only be undertaken as a last resort and then only in moderation and in conformity with the requirements of the Forest Department.</p>	<ul style="list-style-type: none"> <li>● Pesticides Control Board</li> <li>● Department of the Environment</li> <li>● Public Health Department</li> <li>● CZMAI</li> <li>● Town and village councils</li> <li>● Forest Department</li> </ul>	<p>The Pesticides Control Board should be assisted in regulating and monitoring the use, storage and disposal of pesticides, herbicides and fungicides on the cayes. The Board should explore the possibilities of engaging the assistance of other relevant and interested agencies in monitoring.</p>

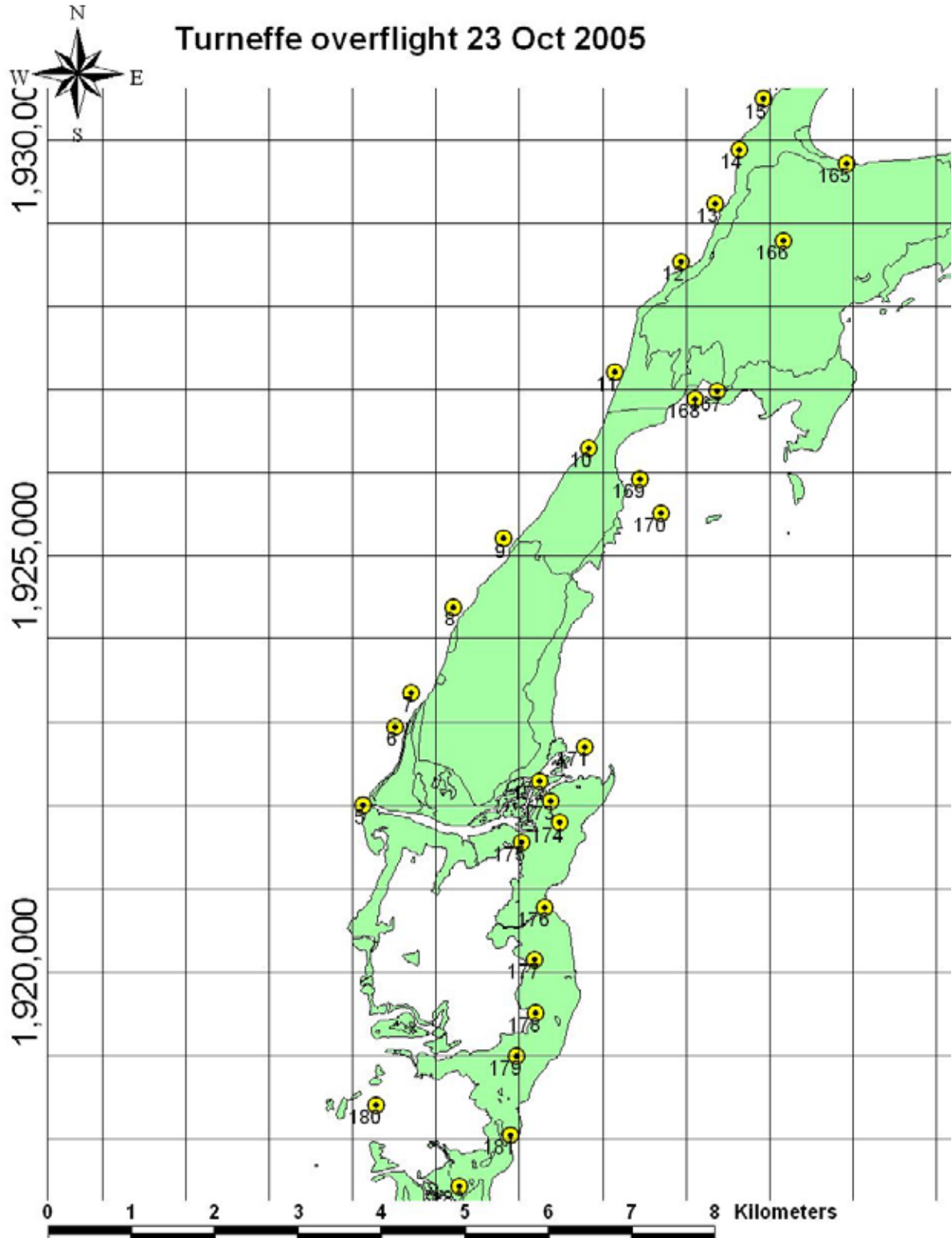
## Appendix 2

Each dot indicates the location shown in a picture taken during the overflight. The number of the location corresponds with the picture file name.



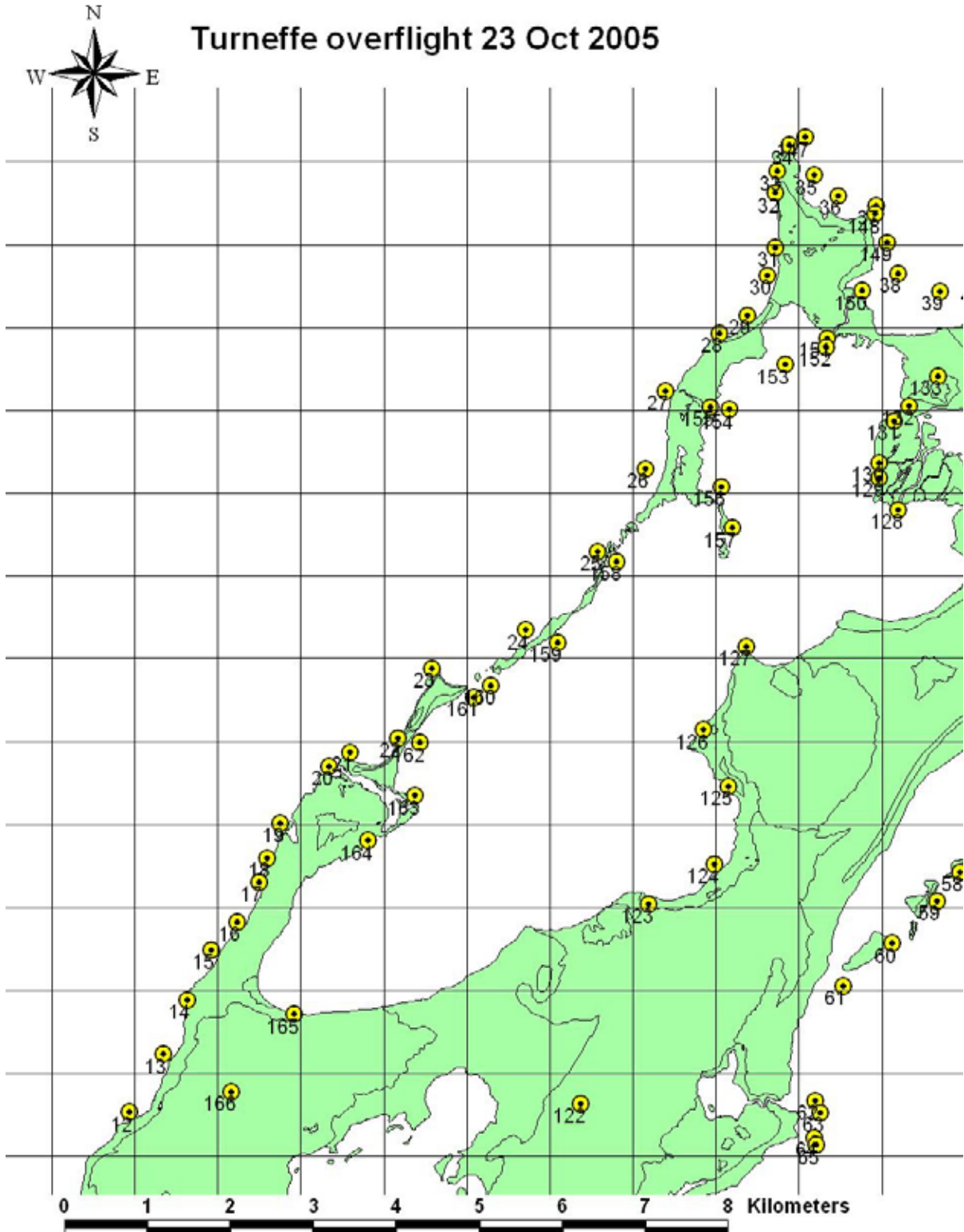
## Appendix 2

Each dot indicates the location shown in a picture taken during the overflight. The number of the location corresponds with the picture file name.



## Appendix 2

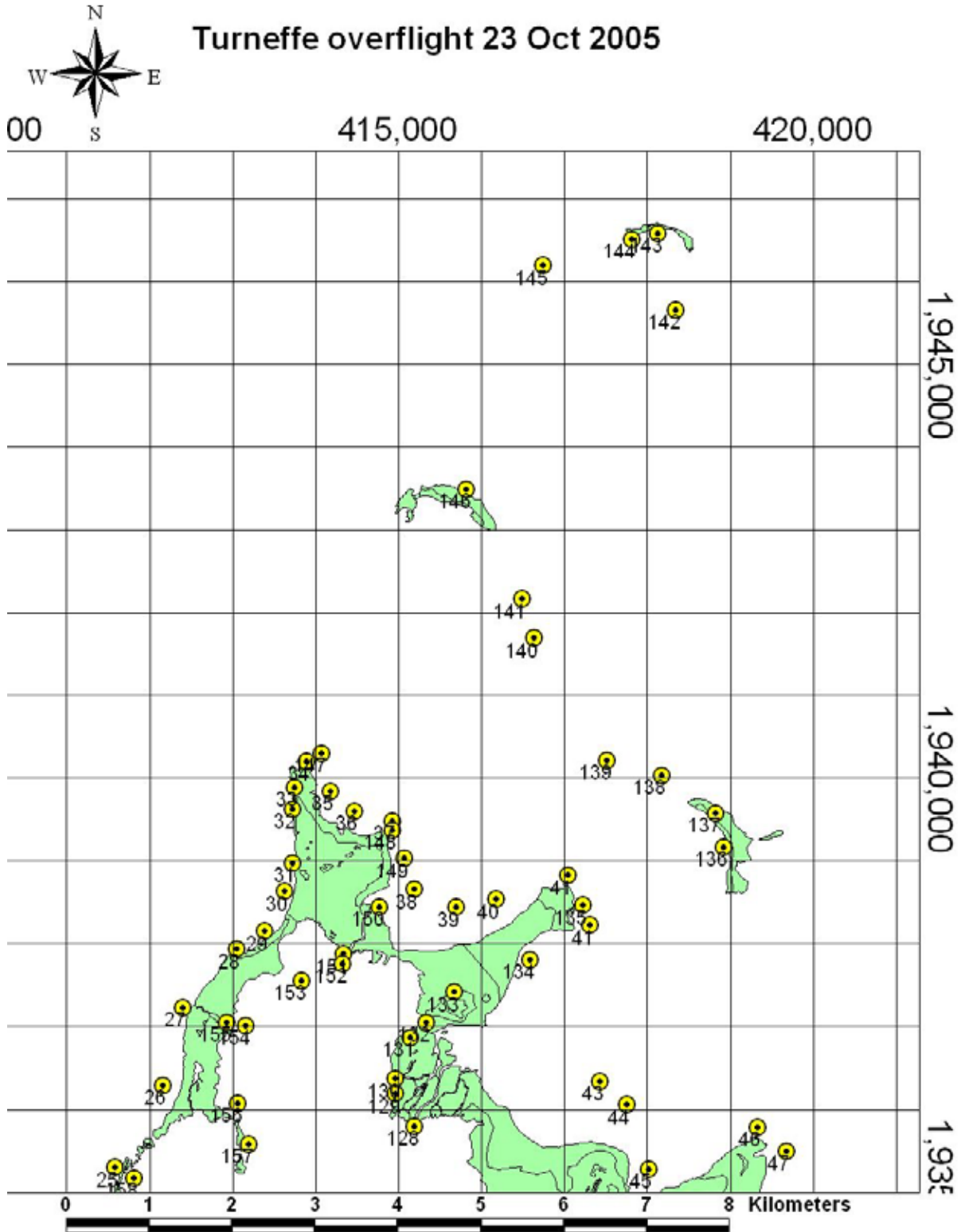
Each dot indicates the location shown in a picture taken during the overflight. The number of the location corresponds with the picture file name.





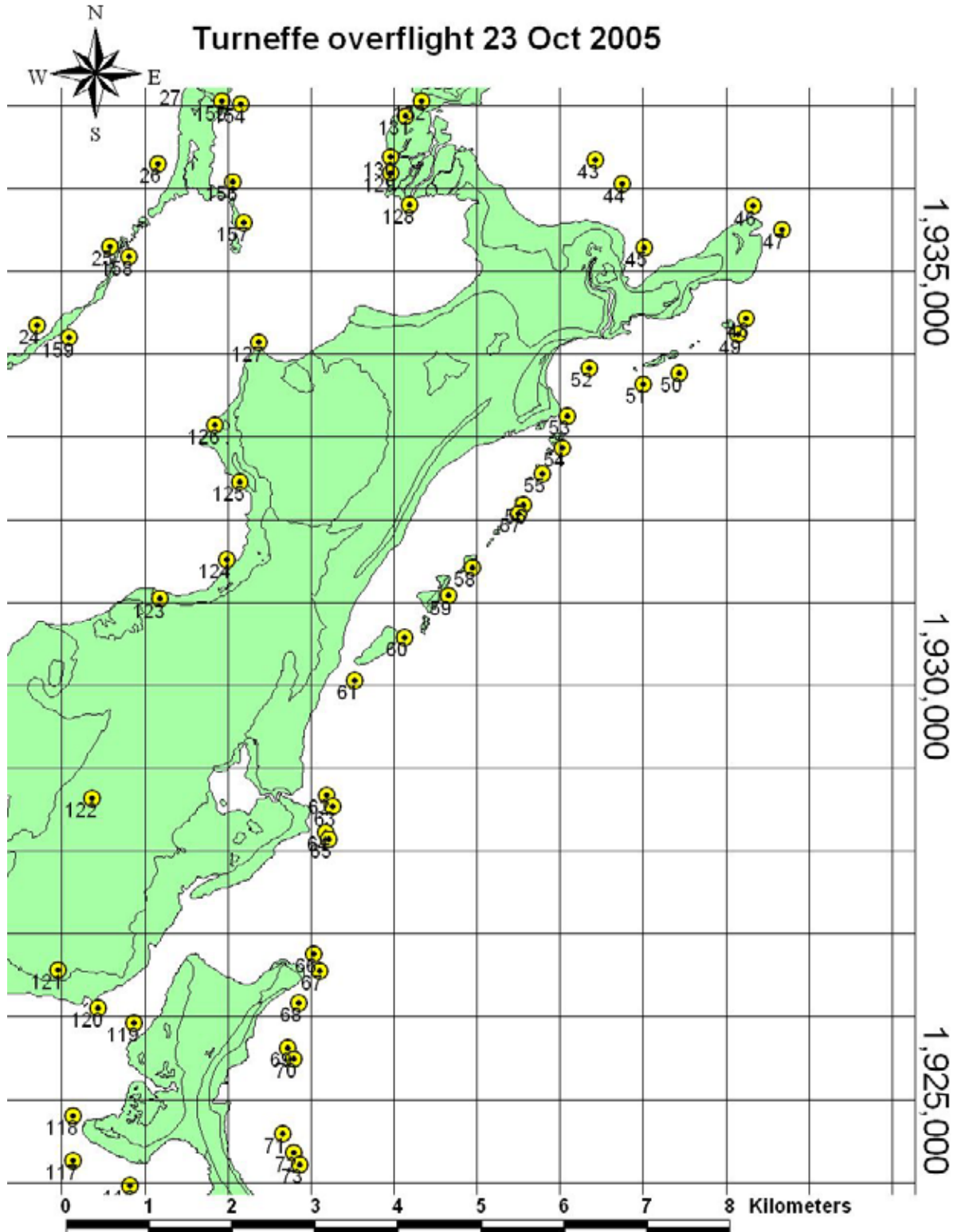
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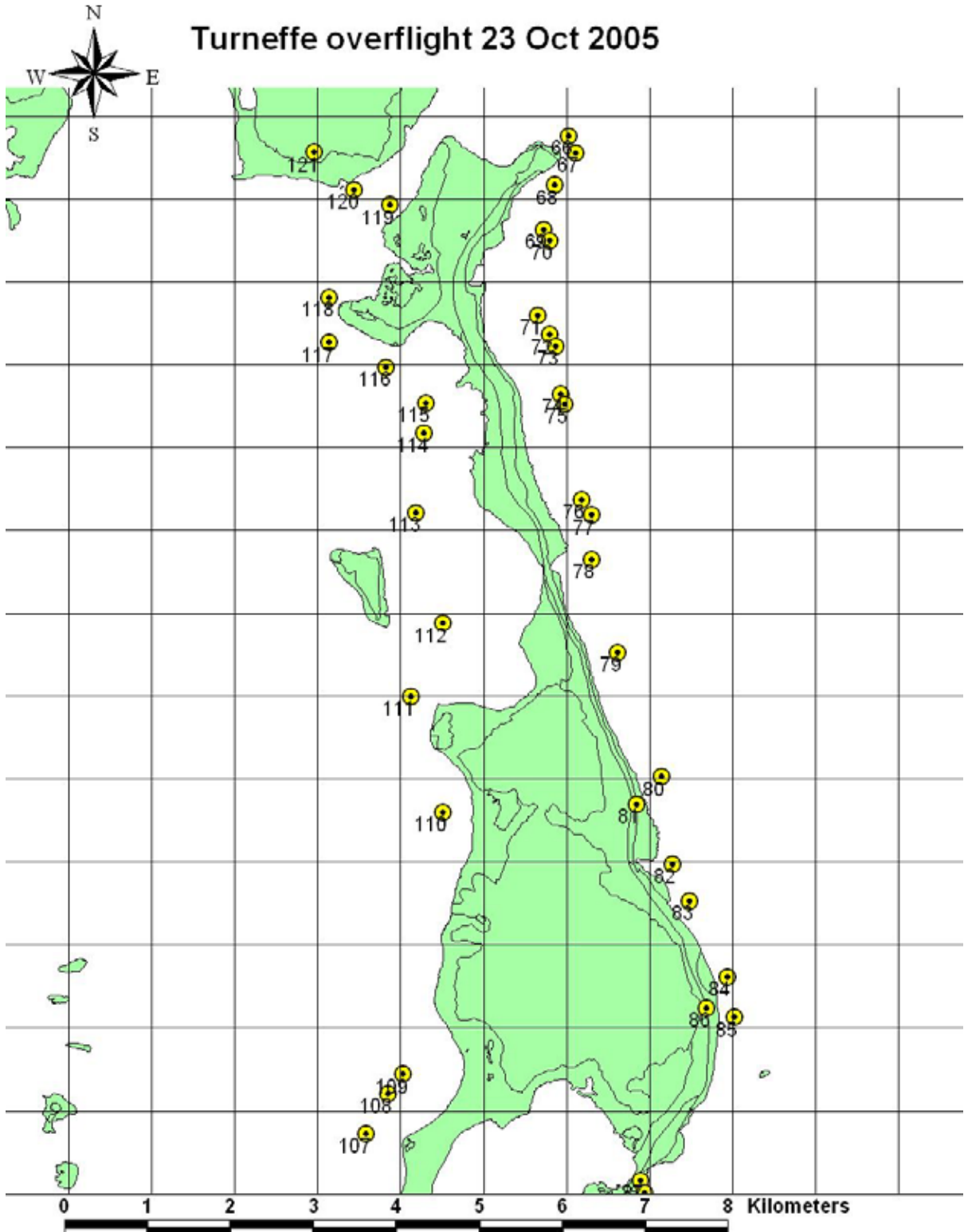
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Each dot indicates the location shown in a picture taken during the overflight. The number of the location corresponds with the picture file name.



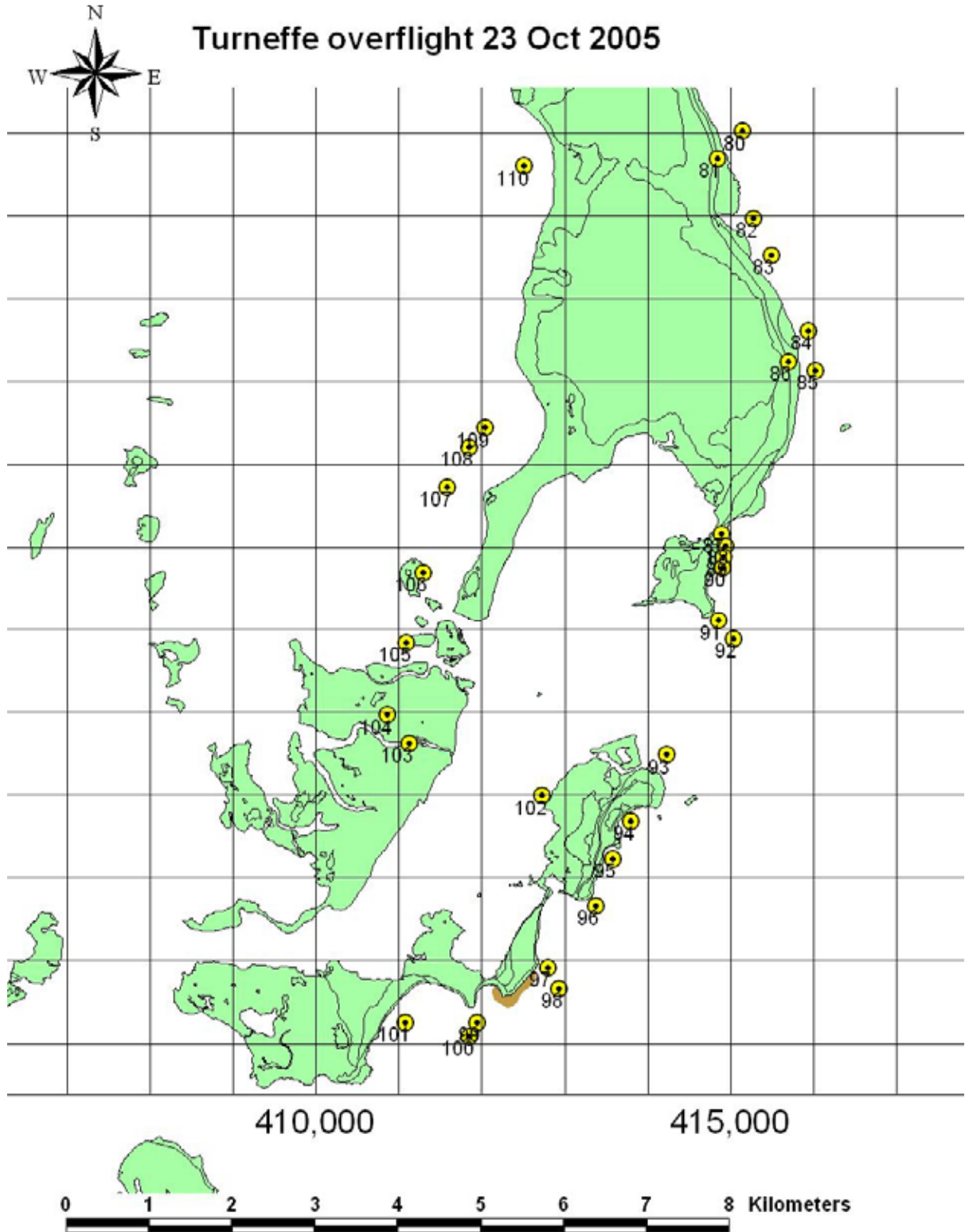
## Appendix 2

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## Appendix 2

Each dot indicates the location shown in a picture taken during the overflight. The number of the location corresponds with the picture file name.



**From:** Oceanic Society [oceanicsociety@btl.net]  
**Sent:** Saturday, January 08, 2005 5:37 PM  
**To:** Eden Garcia; mcfield@wwfca.org; Mustafa Toure  
**Subject:** Zone rationale from Stefanie Eagan

Stefanie Egan  
stefanieegan@hotmail.com  
Graduate Student, San Francisco State University/Oceanic Society, San Francisco  
December 2004

Universal Transverse Mercator Grid Zone 16  
Projections Transverse Mercator  
Spheroid Clarke 1866  
Horizontal Datum N. American 1927  
Unit of Measurement Meter

#### Rationale for location of Draft Core and Buffer Biosphere Reserve Zones on Turneffe Atoll

I designated core and buffer zones based on resource locations. Zone delineations are meant to represent location only and do not suggest size. My intention is for these draft zone maps to be just starting points for discussion among those involved in resource management for, and knowledgeable about the resources of Turneffe. I look forward to receiving and incorporating feedback on these drafts.

#### Core Zones:

I placed core zones around the crocodile (*C. acutus*) nesting sites (based on data by Steven Platt and John Thorbjarnarson), and spawning aggregation sites (as indicated by threat maps) as these are areas that could be very adversely impacted by human activity. The core zones are areas that should be off limits to human intervention/activity-- these areas do not necessarily need to be off-limits year-round, but access should at least be restricted during nesting and spawning seasons.

#### Buffer Zones:

According to biosphere reserve zone guidelines, buffer zones should "buffer" the core zones, so I have designated the areas surround the core zones as buffer areas. In addition, buffer zones need to comprise "representative areas" of the atoll-- as such I tried to ensure that the different vegetation types (as designated in the vegetation shapefile provided by CZMAI. This shapefile was created by CZMAI based on 1991 fieldwork conducted by the Department of Geography of the University of Edinburgh, and the Royal Botanic Garden of Edinburgh) are included in the buffer zones. Further, since buffer zones are areas in which education and compatible recreation can take place, certain buffer zones are around educational/recreational areas.

#### Detailed descriptions of rationales for each buffer zone:

Calabash area buffer zone: an area of recreation, education. It is also an area designated as at high risk for mangrove clearing; the lagoon in this area has been identified as a unique ecosystem. A coral-rich area.

Three Corner Caye/Dog Flea Caye Buffer Zone: Buffers a core zone and provides protection to an area identified as being at high risk for development.

Pigeon Caye Bogue area buffer zone: Buffers a *C. acutus* nesting site; provides protection for an area identified as at high risk for development and mangrove clearing. Represents an area of broken palmetto.

Big Caye Bokel area buffer zone: Buffers a core zone; protects an area identified as at risk for development and mangrove clearing; a coral rich area.

Blackbird Caye Buffer Zone: Buffers two core zones and a separate *C. acutus* nesting site; a coral-rich area; education facility located in this area which is compatible with buffer zone definition; represents a forested area.

Western buffer zone on Blackbird Caye: buffers western area of core zone

Douglas Caye buffer zone: offers protection for an area identified as having a regular population of manatees (based on a recommendation by Suzanne Holguin- graduate student and manatee researcher for Oceanic Society)

Northeast Blackbird area buffer zone: buffers a core offers protection for an area identified as having a regular population of manatees (as suggested by Suzanher for Oceanic Society)

Western reef of Turneffe: offers protection for the fringing reef- a sensitive, coral-rich area - northern part buffers a core area.

Northwestern area of Central Lagoon: offers protection for an area identified as having a regular population of manatees (based on a recommendation by Suzanne Holguin- graduate student and manatee researcher for Oceanic Society); represents an area of broken palmetto/wood thicket.

Crickozeen Creek area buffer zone: offers protection for an area identified as having a regular population of manatees (based on a recommendation by Suzanne Holguin- graduate student and manatee researcher for Oceanic Society); represents an area of palmetto.

Northern Bogue area buffer zone: identified as an area at risk of development, mangrove clearing and dredging; represents an area of savanna.

Pelican Caye buffer zone: Draft Turneffe Island Management Plan suggested this area receive protection as it is an important nesting and brooding area for birds.

Shag Caye buffer zone: A lobster-rich area, (as identified by Anhil Marin; a long-time fisherman of Turneffe)- seeing significant declines in lobster numbers

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**Appendix 4.** Flora and Fauna Recorded during November 2005 Fieldwork on Turneffe Islands

Scientific Name	UTM Northing	UTM Easting	Notes	Year	Month	Day
<i>Acoelorrhaphe wrightii</i>	1934012	413421	Northern Turneffe REA 2005	2005	11	23
<i>Acrostichum aureum</i>	1934012	413421	Northern Turneffe REA 2005	2005	11	23
<i>Ageratum littorale</i>	1921531	413830	Northern Turneffe REA 2005	2005	11	24
<i>Ardea herodias</i>	1939694	418445	Northern Turneffe REA 2005	2005	11	23
<i>Arenaria interpres</i>	1939694	418445	Northern Turneffe REA 2005	2005	11	23
<i>Aristolochia pentandra</i>	1934790	418802	Northern Turneffe REA 2005	2005	11	23
<i>Ascia monuste monuste</i>	1933513	409873	Northern Turneffe REA 2005	2005	11	22
<i>Avicennia germinans</i>	1925293	412986	Northern Turneffe REA 2005	2005	11	24
<i>Avicennia germinans</i>	1928516	413976	Northern Turneffe REA 2005	2005	11	24
<i>Avicennia germinans</i>	1929058	414092	Northern Turneffe REA 2005	2005	11	23
<i>Avicennia germinans</i>	1930064	407354	Northern Turneffe REA 2005	2005	11	22
<i>Avicennia germinans</i>	1930872	411654	Northern Turneffe REA 2005	2005	11	23
<i>Avicennia germinans</i>	1932536	408822	Northern Turneffe REA 2005	2005	11	22
<i>Avicennia germinans</i>	1932953	409353	Northern Turneffe REA 2005	2005	11	22
<i>Avicennia germinans</i>	1934978	411723	Northern Turneffe REA 2005	2005	11	22
<i>Avicennia germinans</i>	1938889	413794	Northern Turneffe REA 2005	2005	11	22
<i>Avicennia germinans</i>	1943588	415592	Nest. Northern Turneffe REA 2005	2005	11	22
<i>Basiliscus vittatus</i>	1921531	413830	Northern Turneffe REA 2005	2005	11	24
<i>Batis maritima</i>	1925293	412986	Northern Turneffe REA 2005	2005	11	24
<i>Batis maritima</i>	1930872	411654	Northern Turneffe REA 2005	2005	11	23
<i>Batis maritima</i>	1934978	411723	Northern Turneffe REA 2005	2005	11	22
<i>Battus polydamas polydamas</i>	1934790	418802	Northern Turneffe REA 2005	2005	11	23
<i>Borrhchia arborescens</i>	1932536	408822	Northern Turneffe REA 2005	2005	11	22
<i>Brachypelma vagans</i>	1923526	413344	Northern Turneffe REA 2005	2005	11	24
<i>Brachypelma vagans</i>	1932536	408822	Northern Turneffe REA 2005	2005	11	22
<i>Brachypelma vagans</i>	1938061	413509	Northern Turneffe REA 2005	2005	11	22
<i>Brassavola nodosa</i>	1934012	413421	Northern Turneffe REA 2005	2005	11	23
<i>Bufo marinus</i>	1923678	413448	Northern Turneffe REA 2005	2005	11	24
<i>Bursera simaruba</i>	1934790	418802	Northern Turneffe REA 2005	2005	11	23
<i>Butorides virescens</i>	1934978	411723	Northern Turneffe REA 2005	2005	11	22
<i>Butorides virescens</i>	1936442	415706	Northern Turneffe REA 2005	2005	11	23
<i>Capparis flexuosa</i>	1934790	418802	Northern Turneffe REA 2005	2005	11	23
<i>Ceryle alcyon</i>	1930879	414436	Northern Turneffe REA 2005	2005	11	23
<i>Ceryle alcyon</i>	1932536	408822	Northern Turneffe REA 2005	2005	11	22

UTM in NAD 1927, Zone 16 N.

**Appendix 4. Flora and Fauna Recorded during November 2005 Fieldwork on Turneffe Islands**

<i>Ceryle alcyon</i>	1936442	415706 Northern Turneffe REA 2005	2005	11	23
<i>Chrysobalanus icaco</i>	1930064	407354 Northern Turneffe REA 2005	2005	11	22
<i>Chrysobalanus icaco</i>	1934012	413421 Northern Turneffe REA 2005	2005	11	23
<i>Coccoloba uvifera</i>	1921531	413830 Northern Turneffe REA 2005	2005	11	24
<i>Coccoloba uvifera</i>	1923678	413448 Northern Turneffe REA 2005	2005	11	24
<i>Cocos nucifera</i>	1921531	413830 Northern Turneffe REA 2005	2005	11	24
<i>Cocos nucifera</i>	1923526	413344 Northern Turneffe REA 2005	2005	11	24
<i>Cocos nucifera</i>	1923678	413448 Northern Turneffe REA 2005	2005	11	24
<i>Cocos nucifera</i>	1932536	408822 Northern Turneffe REA 2005	2005	11	22
<i>Cocos nucifera</i>	1933513	409873 Northern Turneffe REA 2005	2005	11	22
<i>Cocos nucifera</i>	1938061	413509 Northern Turneffe REA 2005	2005	11	22
<i>Columba leucocephala</i>	1921531	413830 Northern Turneffe REA 2005	2005	11	24
<i>Columba leucocephala</i>	1934790	418802 Northern Turneffe REA 2005	2005	11	23
<i>Conocarpus erecta</i>	1934012	413421 Northern Turneffe REA 2005	2005	11	23
<i>Conocarpus erecta</i>	1934790	418802 Northern Turneffe REA 2005	2005	11	23
<i>Conocarpus erecta</i>	1938031	413596 Northern Turneffe REA 2005	2005	11	22
<i>Conocarpus erecta</i>	1938061	413509 Northern Turneffe REA 2005	2005	11	22
<i>Cordia sebastena</i>	1923678	413448 Northern Turneffe REA 2005	2005	11	24
<i>Cordia sebastena</i>	1934790	418802 Northern Turneffe REA 2005	2005	11	23
<i>Cordia sebastena</i>	1933513	409873 Northern Turneffe REA 2005	2005	11	22
<i>Cordia sebastena</i>	1938061	413509 Northern Turneffe REA 2005	2005	11	22
<i>Crocodylus acutus</i>	1930064	407354 Tracks. Northern Turneffe REA 2005	2005	11	22
<i>Crocodylus acutus</i>	1934122	416606 Northern Turneffe REA 2005	2005	11	23
<i>Crocodylus acutus</i>	1934287	416687 Northern Turneffe REA 2005	2005	11	23
<i>Crocodylus acutus</i>	1934292	416702 Northern Turneffe REA 2005	2005	11	23
<i>Crocodylus acutus</i>	1934361	416732 Northern Turneffe REA 2005	2005	11	23
<i>Crocodylus acutus</i>	1938031	413596 Tracks: Northern Turneffe REA 2005	2005	11	22
<i>Crocodylus acutus</i>	1938079	413554 Sunning on beach. Northern Turneffe REA	2005	11	22
<i>Ctenosaura similis</i>	1938031	413596 Northern Turneffe REA 2005	2005	11	22
<i>Ctenosaura similis</i>	1938061	413509 Northern Turneffe REA 2005	2005	11	22
<i>Danaus erissimus montezuma</i>	1921531	413830 Northern Turneffe REA 2005	2005	11	24
<i>Danaus plexippus plexippus</i>	1921531	413830 Northern Turneffe REA 2005	2005	11	24
<i>Danaus plexippus plexippus</i>	1930152	410447 Northern Turneffe REA 2005	2005	11	23
<i>Danaus plexippus plexippus</i>	1934790	418802 Northern Turneffe REA 2005	2005	11	23
<i>Dendroica petechia</i>	1936442	415706 Northern Turneffe REA 2005	2005	11	23

**Appendix 4. Flora and Fauna Recorded during November 2005 Fieldwork on Turneffe Islands**

<i>Dryadula phaetusa</i>	1921531	413830 Northern Turneffe REA 2005	2005	11	24
<i>Dryas iulia moderata</i>	1923678	413448 Northern Turneffe REA 2005	2005	11	24
<i>Dryas iulia moderata</i>	1933513	409873 Northern Turneffe REA 2005	2005	11	22
<i>Egretta alba</i>	1943588	415592 Northern Turneffe REA 2005	2005	11	22
<i>Egretta tricolor</i>	1936442	415706 Northern Turneffe REA 2005	2005	11	23
<i>Erithalis fruticosa</i>	1933513	409873 Northern Turneffe REA 2005	2005	11	22
<i>Erithalis fruticosa</i>	1934790	418802 Northern Turneffe REA 2005	2005	11	23
<i>Erithalis fruticosa</i>	1938061	413509 Northern Turneffe REA 2005	2005	11	22
<i>Fimbristylis cymosa</i>	1934978	411723 Northern Turneffe REA 2005	2005	11	22
<i>Fregata magnificens</i>	1934978	411723 Northern Turneffe REA 2005	2005	11	22
<i>Halodule beaudettei</i>	1928516	413976 Northern Turneffe REA 2005	2005	11	24
<i>Halodule beaudettei</i>	1930879	414436 Northern Turneffe REA 2005	2005	11	23
<i>Heliconius charithonia vasquezai</i>	1933513	409873 Northern Turneffe REA 2005	2005	11	22
<i>Hirundo rustica</i>	1934978	411723 Northern Turneffe REA 2005	2005	11	22
<i>Ipomoea alba</i>	1934790	418802 Northern Turneffe REA 2005	2005	11	23
<i>Junonia evarete zonalis</i>	1921531	413830 Northern Turneffe REA 2005	2005	11	24
<i>Junonia evarete zonalis</i>	1938031	413596 Northern Turneffe REA 2005	2005	11	22
<i>Laguncularia racemosa</i>	1930064	407354 Northern Turneffe REA 2005	2005	11	22
<i>Laguncularia racemosa</i>	1930872	411654 Northern Turneffe REA 2005	2005	11	23
<i>Laguncularia racemosa</i>	1938061	413509 Northern Turneffe REA 2005	2005	11	22
<i>Lantana involucrata</i>	1921531	413830 Northern Turneffe REA 2005	2005	11	24
<i>Lantana involucrata</i>	1923678	413448 Northern Turneffe REA 2005	2005	11	24
<i>Lantana involucrata</i>	1933513	409873 Northern Turneffe REA 2005	2005	11	22
<i>Lantana involucrata</i>	1938031	413596 Northern Turneffe REA 2005	2005	11	22
<i>Leptophis mexicanus hoeversi</i>	1921531	413830 Green morph. Northern Turneffe REA 2005	2005	11	24
<i>Leptophis mexicanus hoeversi</i>	1923526	413344 Green Morph. Northern Turneffe REA 2005	2005	11	24
<i>Leptophis mexicanus hoeversi</i>	1932536	408822 Blue morph. Northern Turneffe REA 2005	2005	11	22
<i>Leptophis mexicanus hoeversi</i>	1934492	416858 Blue morphs. Northern Turneffe REA 2005	2005	11	23
<i>Leptophis mexicanus hoeversi</i>	1938031	413596 Blue morph. Northern Turneffe REA 2005	2005	11	22
<i>Manilkara zapota</i>	1923575	413467 Northern Turneffe REA 2005	2005	11	24
<i>Manilkara zapota</i>	1930064	407354 Northern Turneffe REA 2005	2005	11	22
<i>Manilkara zapota</i>	1934012	413421 Northern Turneffe REA 2005	2005	11	23
<i>Manilkara zapota</i>	1938061	413509 Northern Turneffe REA 2005	2005	11	22
<i>Marmosa mexicana</i>	1930872	411654 ID, uncertain. Tracks only, see picture. Nor	2005	11	23
<i>Megalops atlanticus</i>	1936442	415706 Northern Turneffe REA 2005	2005	11	23

#### Appendix 4. Flora and Fauna Recorded during November 2005 Fieldwork on Turneffe Islands

<i>Melanerpes aurifrons</i>	1934978	411723 Northern Turneffe REA 2005	2005	11	22
<i>Metopium brownei</i>	1923678	413448 Northern Turneffe REA 2005	2005	11	24
<i>Metopium brownei</i>	1933513	409873 Northern Turneffe REA 2005	2005	11	22
<i>Mimus gilvus</i>	1932536	408822 Northern Turneffe REA 2005	2005	11	22
<i>Myrica cerifera</i>	1930064	407354 Northern Turneffe REA 2005	2005	11	22
<i>Myrica cerifera</i>	1934012	413421 Northern Turneffe REA 2005	2005	11	23
<i>Myrmecophylla tibicinis</i>	1934012	413421 Northern Turneffe REA 2005	2005	11	23
<i>Neea psychotrioides</i>	1923678	413448 Northern Turneffe REA 2005	2005	11	24
<i>Norops sagrei</i>	1923678	413448 Northern Turneffe REA 2005	2005	11	24
<i>Norops sagrei</i>	1925293	412986 Northern Turneffe REA 2005	2005	11	24
<i>Norops sagrei</i>	1928516	413976 Northern Turneffe REA 2005	2005	11	24
<i>Norops sagrei</i>	1934978	411723 Northern Turneffe REA 2005	2005	11	22
<i>Norops sagrei</i>	1936442	415706 Northern Turneffe REA 2005	2005	11	23
<i>Nycticorax violaceus</i>	1936442	415706 Northern Turneffe REA 2005	2005	11	23
<i>Pandion haliaetus</i>	1925107	412936 Active nest. Northern Turneffe REA 2005	2005	11	24
<i>Pandion haliaetus</i>	1926785	412735 Active nest. Northern Turneffe REA 2005	2005	11	24
<i>Pandion haliaetus</i>	1930879	414436 Northern Turneffe REA 2005	2005	11	23
<i>Pandion haliaetus</i>	1943588	415592 Nest. Northern Turneffe REA 2005	2005	11	22
<i>Passiflora ciliata</i>	1930064	407354 Northern Turneffe REA 2005	2005	11	22
<i>Passiflora suberosa</i>	1923678	413448 Northern Turneffe REA 2005	2005	11	24
<i>Passiflora suberosa</i>	1938031	413596 Northern Turneffe REA 2005	2005	11	22
<i>Pelecanus occidentalis</i>	1925293	412986 Northern Turneffe REA 2005	2005	11	24
<i>Pelecanus occidentalis</i>	1934978	411723 Northern Turneffe REA 2005	2005	11	22
<i>Phallacocorax auritus</i>	1934978	411723 Northern Turneffe REA 2005	2005	11	22
<i>Phallacocorax auritus</i>	1943588	415592 Northern Turneffe REA 2005	2005	11	22
<i>Phyllodactylus tuberculosus</i>	1932536	408822 Northern Turneffe REA 2005	2005	11	22
<i>Pithecellobium keyense</i>	1921531	413830 Northern Turneffe REA 2005	2005	11	24
<i>Pithecellobium keyense</i>	1923678	413448 Northern Turneffe REA 2005	2005	11	24
<i>Pithecellobium keyense</i>	1933513	409873 Northern Turneffe REA 2005	2005	11	22
<i>Pithecellobium keyense</i>	1938061	413509 Northern Turneffe REA 2005	2005	11	22
<i>Portulaca oleracea</i>	1934978	411723 Northern Turneffe REA 2005	2005	11	22
<i>Pouteria campechiana</i>	1921531	413830 Northern Turneffe REA 2005	2005	11	24
<i>Pouteria campechiana</i>	1923678	413448 Northern Turneffe REA 2005	2005	11	24
<i>Procyon lotor shufeldti</i>	1921531	413830 Seen. Northern Turneffe REA 2005	2005	11	24
<i>Procyon lotor shufeldti</i>	1930872	411654 Tracks. Northern Turneffe REA 2005	2005	11	23

**Appendix 4. Flora and Fauna Recorded during November 2005 Fieldwork on Turneffe Islands**

<i>Procyon lotor shufeldti</i>	1938031	413596 Tracks. Northern Turneffe REA 2005	2005	11	22
<i>Psychotria nervosa</i>	1923678	413448 Northern Turneffe REA 2005	2005	11	24
<i>Quiscalus mexicanus</i>	1930064	407354 Northern Turneffe REA 2005	2005	11	22
<i>Quiscalus mexicanus</i>	1934012	413421 Northern Turneffe REA 2005	2005	11	23
<i>Quiscalus mexicanus</i>	1934978	411723 Northern Turneffe REA 2005	2005	11	22
<i>Rhizophora mangle</i>	1923656	413290 Northern Turneffe REA 2005	2005	11	24
<i>Rhizophora mangle</i>	1924781	411549 Northern Turneffe REA 2005	2005	11	24
<i>Rhizophora mangle</i>	1928516	413976 Northern Turneffe REA 2005	2005	11	24
<i>Rhizophora mangle</i>	1929058	414092 Northern Turneffe REA 2005	2005	11	23
<i>Rhizophora mangle</i>	1930064	407354 Northern Turneffe REA 2005	2005	11	22
<i>Rhizophora mangle</i>	1930872	411654 Northern Turneffe REA 2005	2005	11	23
<i>Rhizophora mangle</i>	1932536	408822 Northern Turneffe REA 2005	2005	11	22
<i>Rhizophora mangle</i>	1933513	409873 Northern Turneffe REA 2005	2005	11	22
<i>Rhizophora mangle</i>	1934978	411723 Northern Turneffe REA 2005	2005	11	22
<i>Rhizophora mangle</i>	1943588	415592 Northern Turneffe REA 2005	2005	11	22
<i>Rivina humilis</i>	1934790	418802 Northern Turneffe REA 2005	2005	11	23
<i>Salicornia bigelovii</i>	1930872	411654 Northern Turneffe REA 2005	2005	11	23
<i>Salicornia bigelovii</i>	1932953	409353 Northern Turneffe REA 2005	2005	11	22
<i>Salicornia bigelovii</i>	1934978	411723 Northern Turneffe REA 2005	2005	11	22
<i>Seiurus noveboracensis</i>	1932953	409353 Northern Turneffe REA 2005	2005	11	22
<i>Sesuvium portulacastrum</i>	1934978	411723 Northern Turneffe REA 2005	2005	11	22
<i>Sideroxylon americanum</i>	1933513	409873 Northern Turneffe REA 2005	2005	11	22
<i>Sideroxylon americanum</i>	1934790	418802 Northern Turneffe REA 2005	2005	11	23
<i>Sideroxylon americanum</i>	1938061	413509 Northern Turneffe REA 2005	2005	11	22
<i>Simarouba glauca</i>	1923678	413448 Northern Turneffe REA 2005	2005	11	24
<i>Siproeta stelenes bipagiata</i>	1921531	413830 Northern Turneffe REA 2005	2005	11	24
<i>Siproeta stelenes bipagiata</i>	1934790	418802 Northern Turneffe REA 2005	2005	11	23
<i>Solanum donianum</i>	1921531	413830 Northern Turneffe REA 2005	2005	11	24
<i>Solanum donianum</i>	1933513	409873 Northern Turneffe REA 2005	2005	11	22
<i>Solanum donianum</i>	1938061	413509 Northern Turneffe REA 2005	2005	11	22
<i>Spartina spartinae</i>	1930872	411654 Northern Turneffe REA 2005	2005	11	23
<i>Spartina spartinae</i>	1932536	408822 Northern Turneffe REA 2005	2005	11	22
<i>Spartina spartinae</i>	1934012	413421 Northern Turneffe REA 2005	2005	11	23
<i>Spartina spartinae</i>	1938061	413509 Northern Turneffe REA 2005	2005	11	22
<i>Sphyraena barracuda</i>	1936442	415706 Northern Turneffe REA 2005	2005	11	23

**Appendix 4.** Flora and Fauna Recorded during November 2005 Fieldwork on Turneffe Islands

<i>Sterna maxima</i>	1934978	411723 Northern Turneffe REA 2005	2005	11	22
<i>Thalassia testudinum</i>	1925293	412986 Northern Turneffe REA 2005	2005	11	24
<i>Thalassia testudinum</i>	1928516	413976 Northern Turneffe REA 2005	2005	11	24
<i>Thalassia testudinum</i>	1929058	414092 Northern Turneffe REA 2005	2005	11	23
<i>Thalassia testudinum</i>	1930879	414436 Northern Turneffe REA 2005	2005	11	23
<i>Thespesia populnea</i>	1930064	407354 Northern Turneffe REA 2005	2005	11	22
<i>Thrinax radiata</i>	1933513	409873 Northern Turneffe REA 2005	2005	11	22
<i>Thrinax radiata</i>	1934012	413421 Northern Turneffe REA 2005	2005	11	23
<i>Thrinax radiata</i>	1934790	418802 Northern Turneffe REA 2005	2005	11	23
<i>Thrinax radiata</i>	1938061	413509 Northern Turneffe REA 2005	2005	11	22
<i>Tournefortia gnaphalodes</i>	1934790	418802 Northern Turneffe REA 2005	2005	11	23
<i>Trema micrantha</i>	1921531	413830 Northern Turneffe REA 2005	2005	11	24
<i>Tursiops truncatus</i>	1938061	413250 Northern Turneffe REA 2005	2005	11	22
<i>Tyrannus forficatus</i>	1938031	413596 Northern Turneffe REA 2005	2005	11	22
<i>Urbanus dorantes</i>	1938031	413596 Northern Turneffe REA 2005	2005	11	22
<i>Vireo magister</i>	1934012	413421 Northern Turneffe REA 2005	2005	11	23



## Appendix 5: Contac Sheet for Pictures taken during overflight (and dive)



irn\_dive\_001.JP

11/28/2005



irn\_dive\_002.JP

11/28/2005



irn\_dive\_003.JP

11/28/2005



irn\_dive\_004.JP

11/28/2005



irn\_dive\_005.JP

11/28/2005



irn\_dive\_006.JP

11/28/2005



irn\_dive\_007.JP

11/28/2005



irn\_dive\_008.JP

11/28/2005



irn\_dive\_009.JP

11/28/2005



irn\_dive\_010.JP

11/28/2005



irn\_dive\_011.JP

11/28/2005



irn\_dive\_012.JP

11/28/2005



irn\_dive\_013.JP

11/28/2005



irn\_dive\_014.JP

11/28/2005



irn\_dive\_015.JP

11/28/2005



irn\_dive\_016.JP

11/28/2005



irn\_dive\_017.JP

11/28/2005



irn\_dive\_018.JP

11/28/2005

## Appendix 5: Contac Sheet for Pictures taken during overflight (and dive)



rn\_flight\_001.JF

10/26/2005



rn\_flight\_002.JF

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rn\_flight\_003.JF

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rn\_flight\_004.JF

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rn\_flight\_005.JF

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rn\_flight\_006.JF

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rn\_flight\_007.JF

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rn\_flight\_008.JF

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rn\_flight\_009.JF

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rn\_flight\_010.JF

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rn\_flight\_011.JF

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rn\_flight\_012.JF

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rn\_flight\_013.JF

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rn\_flight\_014.JF

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rn\_flight\_015.JF

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rn\_flight\_016.JF

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rn\_flight\_017.JF

10/26/2005



rn\_flight\_018.JF

10/26/2005

## Appendix 5: Contac Sheet for Pictures taken during overflight (and dive)



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10/26/2005



rn\_flight\_020.JF

10/26/2005



rn\_flight\_021.JF

10/26/2005



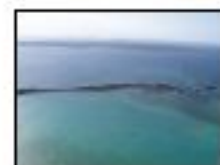
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rn\_flight\_023.JF

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rn\_flight\_024.JF

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rn\_flight\_025.JF

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rn\_flight\_026.JF

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rn\_flight\_027.JF

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rn\_flight\_028.JF

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rn\_flight\_029.JF

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rn\_flight\_030.JF

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rn\_flight\_031.JF

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rn\_flight\_032.JF

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rn\_flight\_033.JF

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rn\_flight\_034.JF

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rn\_flight\_035.JF

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rn\_flight\_036.JF

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## Appendix 5: Contac Sheet for Pictures taken during overflight (and dive)



rn\_flight\_037.JF

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rn\_flight\_038.JF

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rn\_flight\_039.JF

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rn\_flight\_040.JF

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rn\_flight\_041.JF

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rn\_flight\_042.JF

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rn\_flight\_043.JF

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rn\_flight\_044.JF

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rn\_flight\_045.JF

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rn\_flight\_046.JF

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rn\_flight\_047.JF

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rn\_flight\_048.JF

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rn\_flight\_049.JF

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rn\_flight\_050.JF

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rn\_flight\_051.JF

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rn\_flight\_052.JF

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rn\_flight\_053.JF

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rn\_flight\_053b.jj

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## Appendix 5: Contac Sheet for Pictures taken during overflight (and dive)



rn\_flight\_054.JF

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rn\_flight\_055.JF

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rn\_flight\_056.JF

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rn\_flight\_057.JF

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rn\_flight\_058.JF

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rn\_flight\_059.JF

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rn\_flight\_060.JF

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rn\_flight\_061.JF

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rn\_flight\_062.JF

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rn\_flight\_063.JF

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rn\_flight\_064.JF

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rn\_flight\_065.JF

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rn\_flight\_066.JF

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rn\_flight\_067.JF

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rn\_flight\_068.JF

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rn\_flight\_069.JF

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rn\_flight\_070.JF

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rn\_flight\_071.JF

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## Appendix 5: Contac Sheet for Pictures taken during overflight (and dive)



rn\_flight\_072.JF

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rn\_flight\_073.JF

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rn\_flight\_074.JF

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rn\_flight\_075.JF

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rn\_flight\_076.JF

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rn\_flight\_077.JF

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rn\_flight\_078.JF

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rn\_flight\_079.JF

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rn\_flight\_080.JF

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rn\_flight\_081.JF

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rn\_flight\_082.JF

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rn\_flight\_083.JF

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rn\_flight\_084.JF

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rn\_flight\_085.JF

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rn\_flight\_086.JF

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rn\_flight\_087.JF

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rn\_flight\_088.JF

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rn\_flight\_089.JF

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## Appendix 5: Contac Sheet for Pictures taken during overflight (and dive)



rn\_flight\_090.JF

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rn\_flight\_091.JF

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rn\_flight\_092.JF

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rn\_flight\_093.JF

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rn\_flight\_094.JF

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rn\_flight\_095.JF

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rn\_flight\_096.JF

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rn\_flight\_097.JF

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rn\_flight\_098.JF

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rn\_flight\_099.JF

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rn\_flight\_100.JF

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rn\_flight\_101.JF

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rn\_flight\_102.JF

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rn\_flight\_103.JF

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rn\_flight\_104.JF

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rn\_flight\_105.JF

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rn\_flight\_106.JF

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rn\_flight\_107.JF

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## Appendix 5: Contac Sheet for Pictures taken during overflight (and dive)



rn\_flight\_108.JF

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rn\_flight\_109.JF

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rn\_flight\_110.JF

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rn\_flight\_111.JF

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rn\_flight\_112.JF

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rn\_flight\_113.JF

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rn\_flight\_114.JF

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rn\_flight\_115.JF

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rn\_flight\_116.JF

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rn\_flight\_117.JF

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rn\_flight\_118.JF

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rn\_flight\_119.JF

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rn\_flight\_120.JF

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rn\_flight\_121.JF

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rn\_flight\_122.JF

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rn\_flight\_123.JF

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rn\_flight\_124.JF

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rn\_flight\_125.JF

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## Appendix 5: Contac Sheet for Pictures taken during overflight (and dive)



rn\_flight\_126.JF

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rn\_flight\_127.JF

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rn\_flight\_128.JF

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rn\_flight\_129.JF

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rn\_flight\_130.JF

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rn\_flight\_131.JF

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rn\_flight\_132.JF

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rn\_flight\_133.JF

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rn\_flight\_134.JF

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rn\_flight\_135.JF

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rn\_flight\_136.JF

10/26/2005



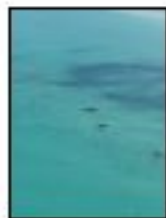
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10/26/2005



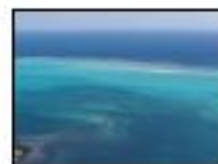
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rn\_flight\_141.JF

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rn\_flight\_142.JF

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rn\_flight\_143.JF

10/26/2005

## Appendix 5: Contac Sheet for Pictures taken during overflight (and dive)



rn\_flight\_144.JF

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rn\_flight\_145.JF

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rn\_flight\_146.JF

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rn\_flight\_147.JF

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rn\_flight\_148.JF

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rn\_flight\_152.JF

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rn\_flight\_153.JF

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rn\_flight\_154.JF

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rn\_flight\_156.JF

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rn\_flight\_159.JF

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rn\_flight\_160.JF

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rn\_flight\_161.JF

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## Appendix 5: Contac Sheet for Pictures taken during overflight (and dive)



rn\_flight\_162.JF

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rn\_flight\_163.JF

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rn\_flight\_164.JF

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rn\_flight\_165.JF

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rn\_flight\_166.JF

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rn\_flight\_167.JF

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rn\_flight\_168.JF

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rn\_flight\_169.JF

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rn\_flight\_170.JF

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rn\_flight\_171.JF

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rn\_flight\_172.JF

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rn\_flight\_172\_s,

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rn\_flight\_173.JF

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rn\_flight\_174.JF

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rn\_flight\_175.JF

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rn\_flight\_176.JF

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rn\_flight\_177.JF

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rn\_flight\_178.JF

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## Appendix 5: Contac Sheet for Pictures taken during overflight (and dive)



rn\_flight\_179.JF

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rn\_flight\_180.JF

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rn\_flight\_181.JF

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rn\_flight\_182.JF

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rn\_flight\_183.JF

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rn\_flight\_184.JF

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rn\_flight\_185.JF

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rn\_flight\_186.JF

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rn\_flight\_187.JF

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rn\_flight\_188.JF

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rn\_flight\_189.JF

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rn\_flight\_190.JF

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rn\_flight\_191.JF

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rn\_flight\_192.JF

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rn\_flight\_193.JF

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rn\_flight\_194.JF

10/26/2005



rn\_flight\_195.JF

10/26/2005



rn\_flight\_196.JF

10/26/2005

## Appendix 5: Contac Sheet for Pictures taken during overflight (and dive)



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10/26/2005



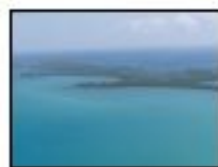
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10/26/2005



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10/26/2005



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10/26/2005



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10/26/2005



rn\_flight\_202.JF

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rn\_flight\_203.JF

10/26/2005



rn\_flight\_204.JF

10/26/2005



rn\_flight\_205.JF

10/26/2005



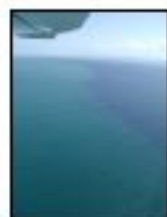
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10/26/2005



rn\_flight\_207.JF

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rn\_flight\_208.JF

10/26/2005



rn\_flight\_209.JF

10/26/2005



rn\_flight\_210.JF

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rn\_flight\_211.JF

10/26/2005



rn\_flight\_212.JF

10/26/2005



rn\_flight\_213.JF

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rn\_flight\_214.JF

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