

Davis Expedition Fund

Exploratory investigation of species distribution and diversity of plankton in mangrove habitats, Belize.



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Abstract of Project Report

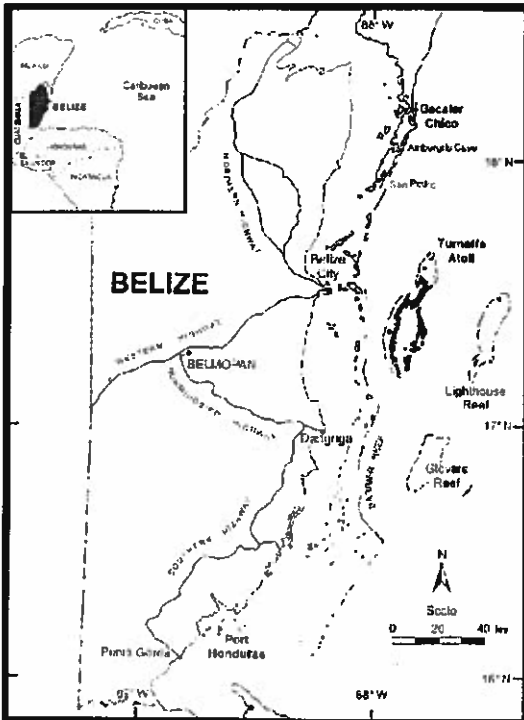
In March 2000 a two week exploratory expedition to Belize was conducted, in order to undertake a brief investigation of the species distribution and diversity of plankton in the mangrove habitats of Belize, Central America. Three sites were visited: Bacalar Chico off the northern coast, Turneffe Atoll outside the Barrier Reef off central Belize and Port Honduras in the very south. Basic methods used to sample the surface and middle of the water column respectively consisted of a small dip net 25 cm wide with mesh size 0.1 cm and a one litre bottle. Supplementary data was collected by light-traps deployed overnight. Water depth, temperature, salinity, pH and turbidity were measured at each station. Results analysed to date indicate that a combination of methods is required for the collection of plankton. In addition there appears to be a relationship between the abundance of zooplankton and turbidity, with the lowest overall number of animals recorded from Port Honduras, the most turbid of the study sites. Eggs were most abundant within the plankton samples. Larvae of fish and various crustaceans were also recorded, but remain to be identified along with adult zooplankton and the phytoplankton element of the samples.

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In March 2000 a two week exploratory expedition to Belize was conducted, in order to undertake a brief investigation of the species distribution and diversity of plankton in the mangrove habitats of Belize, Central America (below).



Background

Mangroves constitute an intertidal forest ecosystem, and are found in subtropical and tropical regions. They have many important attributes, including roles in shoreline protection, water quality maintenance, recreation and education (Mitsch & Gosselink, 1993). In particular they are reputed to play a vital part in maintaining fisheries through provision of habitat and nursery areas for fish, crustaceans and molluscs of economic value (Odum & Heald, 1975; Robertson & Duke, 1987; Morton, 1990).

The aim of this reconnaissance project was to conduct exploratory work on the aquatic component of the mangrove habitat, continuing from previous research on the distribution, vulnerability and management of mangrove in Central America (Furley & Ratter, 1992; Murray, 1996; Zisman, 1998). The earlier work acknowledged that little is known of the nature and distribution of important aquatic species within mangroves.

Methodology

Prior to departure from the UK a list of potential sites were drawn up, which on arrival in Belize were modified to three following consultation with Janet Gibson and Vincent Gillette of the Coastal Zone Management Institute (CZMI), and Pio Saqui of the Marine Natural Resources Centre. The three sites selected were Bacalar Chico in the north, Turneffe Atoll in the centre and Port Honduras at the southern end the Belize coastline. Due to the extensive distances between the sites, fieldwork was limited to 1-2 days at each.

Conventional plankton sampling methods were not used due to the relatively shallow water present at the selected sites. Three basic methods of sampling were used: a small dip net 25 cm in width with a mesh size of 0.1 cm was used to sample surface waters; a bottle was used to collect 1 litre samples from the middle of the water column; a 1 litre volume funnel trap containing a light stick was suspended among the mangrove roots at each site and left overnight for a total of 12 hours. All samples taken were divided into several containers to allow the addition of alcohol as a preservative.

From Belize City the first site to be visited was Port Honduras, travelling by road to Punta Gorda. In this area of the coast mangroves cover approximately 75 km², while the embayment contains an additional 138 mangrove cayes. Port Honduras has recently been granted marine reserve status together with an area encompassing Gladden Spit and the Silk Cayes along the Belize Barrier Reef. For the purpose of this project samples were collected from the mouth of Monkey River (right), situated to the north of the bay. The river was accessed by one of three boats owned by the Toledo Institute of Development and the Environment (TIDE), and was approximately a two hour boat ride from Punta Gorda. Only a single visit was possible, due to heavy rain on the first of the two days spent in the region.



On returning to Belize City it was found that plans arranged prior to departure to Port Honduras had been modified, resulting in an unplanned stay of two nights in the city. Transport to Turneffe Atoll was in the form of the supply boat for the Marine Research Centre on Calabash Caye at the south-eastern side of the atoll. The Marine Research Centre is run by the University College of Belize and is in almost constant use by visiting researchers from overseas, as well



as local students from the university. The only form of transport to and from the mainland is a small skiff also used for survey work by the visitors, and trips are therefore limited to those deemed as essential. Turneffe Atoll lies 18 km beyond the Belize Barrier Reef and is the most extensive yet least studied atoll in the Caribbean. With the exception of the Northern (Vincent's) Lagoon, the area is not protected by government legislation and is slowly being developed. Approximately 450 cayes constitute the atoll, with a total mangrove coverage of just over 74 km². The Marine Research Centre lies on the eastern side of Calabash Caye and is surrounded by mangroves. Sampling was conducted with ease, approximately 250 m north of the centre in fringing mangroves (left). Due to the delay in Belize City and pre-arranged transport to Bacalar Chico, only a single night was spent at Calabash Caye.

Bacalar Chico is accessible from Belize City via San Pedro on Ambergris Caye, in turn reached by water taxi from the mainland. From San Pedro transport had been arranged with the ranger based at nearby Hol Chan Marine Reserve, to the park rangers' station at San Juan on the western side of Bacalar Chico. Like Hol Chan, Bacalar Chico is a Marine and Wildlife Reserve, covering a total area of approximately 100 km², within which there are extensive tracts of mangroves.

The Barrier Reef borders Bacalar Chico on the eastern side with the result that the mangroves are generally only accessible through channels running in from the other three sides. A narrow canal dug by the Maya 1500 years ago separates Ambergris Caye from Mexico, and gives access to the Laguna de Cantena, a large sheltered lagoon surrounded by mangroves. Sampling was conducted on the western side of Bacalar Chico, in close proximity to San Juan (right). A single sample was collected in order to allow comparison to the previous two sites. Bacalar Chico was left after a stay of two nights, on the penultimate day of the trip, and the final night spent in Belize City.



Due to logistical difficulties and time limits, two aspects of the original methodology (see original application submitted 14/01/00) were not completed. The first was the organic carbon and nitrogen concentrations of suspended particulate matter, for which samples could not be processed due to the lack of a vacuum pump. The second was the measurement of dissolved oxygen, for which the equipment was unavailable. Factors that were measured at each station are water depth, temperature, salinity, pH and turbidity.

Results

On return to the UK the plankton samples were filtered to separate zooplankton and phytoplankton. The former was sorted into basic groups. The figures for each of these groups are given in Table 1 below.

Table 1. Preliminary results of zooplankton samples taken at 3 sites in Belize.

Site	Sample method	Eggs	Fish larvae	Crab larvae	Lobster larvae	Shrimp larvae	Other larvae	Adult plankton
Port Honduras	Dip net	0	0	0	0	0	0	0
	Water bottle	15	0	2	0	0	0	10
	Funnel trap	18	0	0	0	5	0	29
Turneffe Atoll	Dip net	0	1	0	3	1	0	5
	Water bottle	21	0	1	0	1	1	13
	Funnel trap	110	2	28	1	3	7	180
Bacalar Chico	Dip net	0	0	0	0	0	0	24
	Water bottle	235	0	15	2	16	0	80
	Funnel trap	>1500	3	40	1	15	1	181

The results in Table 1 indicate that in terms of absolute abundance of individuals, the funnel trap, which was set out overnight with a light source inside, is the most successful method overall. However, it is difficult to quantify this sampling method as an unknown amount of water passes through the trap. The water bottle method, in which samples were collected from the water column in a 1 litre bottle, is quantitative. The dip net compares poorly to the other methods used here, probably due to the mesh size of 0.1 cm. Both the zooplankton and phytoplankton remain to be identified in detail.

At each station measurements were taken for the environmental variables temperature (T), salinity (S), pH and turbidity (Ty). The results for these are shown in Table 2 below.

Table 2. Environmental factors measured at 3 sites in Belize

Station	Water depth /m	T / °C	S / ‰	pH	Ty / FTU
Port Honduras	0.2	29.8	35	8.5	165
Turneffe Atoll	0.3	28.2	34.5	8.6	105
Bacalar Chico	0.3	29.0	35	8.5	95

None of the environmental factors measured seem to vary significantly between the three sites, with the exception of turbidity.

The lowest turbidity readings are recorded from Bacalar Chico, which also had the highest overall abundance of all groups of zooplankton. By comparison, the highest turbidity values coincide with the lowest overall number of animals, at Port Honduras.

Conclusions

The results of this study indicate that a combination of methods are required for the collection of zooplankton, in order to enable quantification and collect a large abundance of organisms. In addition, there may be a relationship between turbidity and the abundance of early life stages of marine animals. Conclusions cannot be made at present in relation to the phytoplankton as the results are pending.

From the results gained so far there certainly seems to be a basis for further work in the area. However, due to the difficulties experienced during the present study it is proposed to conduct work at a single site in order to enable more efficient sampling to be completed. From this study Turneffe Atoll is recommended as the best site to continue work, in particular for logistical reasons. A follow-up expedition is planned for July 2000.

Bibliography

- Furley, P.A. & Ratter, J.A. (eds) (1992) *Mangrove distribution, vulnerability and management in Central America*. ODA-OFI Forestry Research Programme R4736, Edinburgh, 86p.
- Mitsch, W.J. & Gosselink, J.G. (1993) *Wetlands*. Van Nostrand Reinhold, New York, 722p.
- Morton, R.M. (1990) Community structure, density and standing crop of fishes in a subtropical Australian mangrove area. *Marine Biology*, **105**, 385-394.
- Murray, M.R. (1996) *The Environmental Effects of Mangrove Clearance in Belize, Central America*. PhD Thesis, University of Edinburgh.
- Odum, W.E. & Heald, E.J. (1975) The detritus-based food web of an estuarine mangrove community. In Cronin, L.E. (ed.) *Estuarine Research*. Academic Press Inc., New York, p.265-286.
- Robertson, A.I. & Duke, N.C. (1987) Mangroves as nursery sites: comparisons of the abundance and species composition of fish and crustaceans in mangroves and other nearshore habitats in tropical Australia. *Marine Biology*, **96**, 193-205.
- Zisman, S. (1998) *Sustainability or Status Quo: An Assessment of Elite Influence in the Political Ecology of Belizean Mangroves*. PhD Thesis, University of Edinburgh.