Summary Of Coral Cay Conservation's Fish And Coral Species Lists Compiled In Utila, Honduras

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This report is part of a series of documents detailing CCC's science programme in Utila (1999-2000).
The series is also available on CD-Rom.

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SUMMARY

?? The coral reefs of Honduras are of vital national and international importance, both ecologically and economically, but are threatened because of rapid economic and population growth.

?? During work on Utila between 1999 and 2000 (the '*Bay Islands 2000*' project), Coral Cay Conservation developed a programme of surveys, training and conservation education aimed at assessing the status of local reefs and improving environmental awareness amongst neighbouring communities.

?? This summary report provides an overview of the fish and coral species lists collated during the *Bay Islands 2000* project.

?? Species lists were compiled during the course of the *Bay Islands 2000* project during survey dives by CCC science staff and experienced volunteers.

?? A total of 201 species of fish were recorded, along with data on their abundance and frequency of sighting.

?? Several species considered uncommon or rare in the Western Caribbean where observed and the record of the northern stargazer (*Astroscopus guttatus*) may be a considerable range extension for this species.

?? The low median abundance and sighting frequency scores for commercially important species highlighted evidence of fishing pressure. The reduction of large, commercially important fish has long-term implications for fisherfolk.

?? Whale sharks, and their associated fauna, were seen and represent a major attraction for divers. However, the relatively low abundance and sighting frequency for other larger reef associated species may have implications for the attractiveness of Utila to dive tourists.

?? A total of 48 species of corals were recorded, along with data on their abundance and frequency of sighting.

?? During the study in Utila, several rare species were recorded which might become locally extinct without further protection.

?? This study led to five recommendations:

    ?? There should be further study of the biodiversity of Utila to fully document the species present in order to facilitate effective management of biodiversity.

    ?? There should be further study of the natural history of commercially important species, for example their spawning grounds and migration patterns, to facilitate effective management of biodiversity.

    ?? Consider the use of species-specific management practices to preserve species survival and genetic exchange.

    ?? Facilitate further research of the whale shark population of Central America.

    ?? Instigate a code of practice for the interaction of tourists and whale sharks.

    ?? Continue to aim to establish one or more additional multiple use marine protected areas around Utila, with an integrated monitoring programme to measure their efficacy, and strengthen the enforcement of regulations in the Turtle Harbour Wildlife Sanctuary. Establish regulations, and enforce existing legislation, to minimise the detrimental effects of coastal development on reef health.

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ABBREVIATIONS

BICA	-	Bay Islands Conservation Association
CCC	-	Coral Cay Conservation
COHDEFOR	-	Coorporación Hondureña de Desarrollo Forestal
IUCN	-	World Conservation Union
NGO	-	Non Government Organisation
PMAIB	-	Programa Manejo Ambiental Islas de la Bahía
PS	-	Project Scientist
SO	-	Science Officer
UNAH	-	Universidad Nacional Autonoma de Honduras
UNEP	-	United Nations Environment Programme

FIGURES AND TABLES

1. INTRODUCTION

Honduras covers approximately 112,000 km^2 of land on the widest part of the isthmus of Central America. Honduras represents the southern end of the Mesoamerican Barrier Reef System, although it's marine resources are less extensive and studied than nearby Belize and Mexico. However, the coastal zone contains mainland reef formations, mangroves, wetlands, seagrass beds and extensive fringing reefs around its offshore islands and has a key role in the economy of the country. These ecosystems have close links with the coastal zones of the other Mesoamerican countries. For example, in the Gulf of Honduras, the watershed of the Rio Ulúa is an order of magnitude greater than any river in southern Belize and hence has a significant impact on the Belize Barrier Reef (Heyman and Kjerfve, 1999).

Although the coral reefs of Honduras are of vital national and international importance, both ecologically and economically, they are threatened because of rapid economic and population growth. For example, the countries' coral reef ecosystems are being adversely affected by a range of anthropogenic activities including fishing pressure, sedimentation and pollution, which has resulted in a decrease of coral cover. The desire to generate urgently required revenue within Honduras has also led to increased tourism which provides an over-arching stress to marine resources since most tourists spend time in the coastal zone. Recent coral bleaching events and storm damage has exacerbated these effects by acting synergistically to reduce reef health further. Such impacts represent substantial long- and short-term threats to the ecological balance and health of reef ecosystems which, if left unchecked, will ultimately lead to reduced income for coastal communities and other stakeholders relying on fishing and marine-based tourism. Furthermore, any natural or anthropogenic impacts on reef health will inevitably affect other countries in Latin America, and *vice versa*, since the marine resources are linked via currents and the functioning of the system transcends geo-political boundaries.

Effective coastal zone management, including conservation of coral reefs, requires a holistic and multi-sectorial approach, which is often a highly technical and costly process and one that many developing countries cannot adequately afford. With appropriate training, non-scientifically trained, self-financing volunteer divers have been shown to be able to provide useful data for coastal zone management at little or no cost to the host country (Hunter and Maragos, 1992; Mumby *et al*., 1995; Wells, 1995; Darwall and Dulvy, 1996 and Erdmann *et al*., 1997). This technique has been pioneered and successfully applied by Coral Cay Conservation (CCC), a British not-for-profit organisation.

Founded in 1986, CCC is dedicated to '*providing resources to protect livelihoods and alleviate poverty through the protection, restoration and sustainable use of coral reefs and tropical forests*' in collaboration with government and non-governmental organisations within a host country. CCC does not charge the host country for the services it provides and is primarily self-financed through a pioneering volunteer participatory scheme whereby international volunteers are given the opportunity to join a phase of each project in return for a financial contribution towards the project costs. Upon arrival at a project site, volunteers undergo a training programme in marine life identification and underwater survey techniques, under the guidance of qualified project scientists, prior to assisting in the acquisition of data. Finances generated from the volunteer programme allow CCC to provide a range of services, including data acquisition, assimilation and synthesis, conservation education, technical skills training and other capacity building programmes. Readers are referred to Harborne *et al*. (In press) for an overview of CCC's full role in Utila, which was wider than the collection of the data presented in this series of reports. CCC is associated with the Coral Cay Conservation Trust (the only British-based charity dedicated to protecting coral reefs) and the USA-based Coral Cay Conservation Foundation.

The Bay Island of Utila (Figure 1) has been the focus of tourism development in Honduras for many years and the industry is very much aware of the value of conserving the coral reefs and fostering sustainable development. Therefore, between 1995 and 1998, teams of Honduran and British undergraduates participated in 'Project Utila'. The aim of this project was to continuously monitor the state of the coral reefs surrounding Utila in order to provide data that could be used to assist with effective management of the marine resources. One of the outputs of Project Utila was the recommendation that the survey work should be expanded to include a detailed systematic survey of Utila's marine resources with the aim of establishing an environmental database and a management plan for these resources. Unfortunately, the Project Utila team was unable to continue the project beyond 1998 and sought another means of continuing the work.

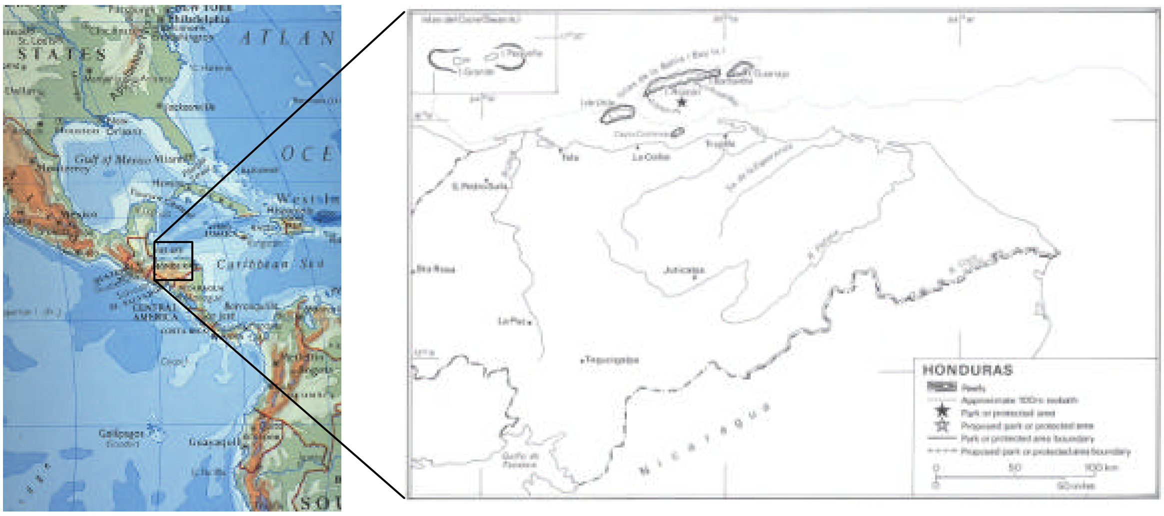

Figure 1. The location of (a) Honduras and (b) the locations of the Bay Islands (Utila, Roatán and Guanaja).

In order to build on the work and achievements of Project Utila, the *Bay Islands 2000* project, therefore, was initiated as a collaborative Honduran / British partnership project between Coorporación Hondureña de Desarrollo Forestal (COHDEFOR), the Universidad Nacional Autonoma de Honduras (UNAH) and the Bay Islands Conservation Association (BICA). The *Bay Islands 2000* project was subsequently accepted as a partner of the Ministry of Tourism's 'Bay Islands Environmental Management Project' (Programa Manejo Ambiental Islas de la Bahía; PMAIB).

The project was established initially in Utila in June 1999 with the aims to:

1. undertake a systematic and detailed survey of the marine resources of Utila and provide data for the development of an integrated coastal zone management plan for the protection and sustainable utilisation of Utila's coral reefs;
2. continue and expand monitoring programmes previously established on the reefs of Utila by Project Utila;
3. establish an environmental database at UNAH for the Bay Islands;
4. provide SCUBA and scientific training and research opportunities for Honduran project counterparts;
5. provide conservation education opportunities for local communities.

This report provides a summary of the species lists of fish and corals collated by the *Bay Islands 2000* project in Utila between June 1999 and August 2000.

2. PROJECT BACKGROUND

Note that a review of the status of the coastal zone of Honduras has recently been published (Harborne *et al.*, 2001). Readers are referred to this paper for further background information.

2.1 The coastal zone of Honduras

Honduras lies within the wider Caribbean region that stretches from the Gulf of Mexico to the French Guiana - Brazil border. This region has well known interactions throughout its area and the marine resources of Honduras are inextricably linked to a much larger area via water exchange. Such links lead to, for example, Sullivan Sealey and Bustamante (1999) defining the Tropical Northwestern Atlantic as the largest biogeographical province in the western hemisphere and places Honduras within the large, complex Central Caribbean 'ecoregion'. However, although there are obvious oceanographic connections between Honduras and neighbouring reefs in Central America, and also the wider Caribbean, little is known about migration of adult populations or larval interchange.

The Caribbean coast of Honduras itself stretches from the border with Guatemala in the west to the border with Nicaragua in the east and also encompasses a number of offshore island systems including the Islas de la Bahía (Bay Islands) archipelago. Hence this coastline encompasses more than 91% (735 km) of the country's 820 km coastline (Merrill, 1995) and includes coral reefs, mangrove forests, seagrass beds, estuaries, coastal lagoons, wetlands and tropical coastal fisheries. Such ecosystems are possible because of the tropical climate that is affected by seasonal easterly tradewinds, which cause a rainy season for approximately eight months and a dry season from November to February.

There has been limited research in the coastal zone of Honduras and, for example, the marine resources of the mainland are very poorly studied and there is virtually no published literature on the presence or absence of coral reefs (UNEP/IUCN, 1988). However, Kramer *et al*. (2000) and Cortés (1997) state that because of high levels of runoff there are only scattered, poorly developed coral communities around Puerto Cortés, La Ceiba and Trujillo. It is also known that there are extensive continental mangrove forest and wetland systems along the central section of coastline and bordering the Gulf of Honduras but severe degradation from overfishing, mangrove clearance and pollution has been reported (Sullivan Sealey and Bustamante, 1999). The extensive mangrove system contains a number of lagoons, riverine estuaries as well as offshore mangrove cays (MacKenzie, Jr and Stehlik, 1996). The eastern Mosquitia region of mainland Honduras also has a complex environment of reefs, lagoons, wetlands and barrier beaches in an expansive savanna which plays a key role in fisheries health (Sullivan Sealey and Bustamante, 1999) and is an important breeding ground for waterbirds. The inaccessibility of the Mosquitia region has limited deforestation and agriculture and part of it is further protected by the Río Plátano Biosphere Reserve (Richards, 1996).

The Caribbean coastline of Honduras includes a highly developed small island reef system which can be divided into three groups, the Bay Islands and Cayos Cochinos archipelago, the Mosquitia cays and banks and the small Swan Islands with a coastline length of only 6 km (Cortés, 1997; Sullivan Sealey and Bustamante, 1999). The Bay Islands group, on the edge of the 75 km wide continental shelf, has a number of smaller cays but is dominated by three major islands; Utila, Roatán and Guanaja. These islands are the centre of both reef related tourism and the fishing industry in Honduras and in addition to the coral reefs they also contain significant mangrove wetlands.

There is only limited published information describing the reefs of Honduras (UNEP/IUCN, 1988), although the Cayos Cochinos archipelago has been relatively well studied by scientists working at the Cayos Cochinos Research Station. However, wind generated wave energies are generally higher on more exposed northern coasts and subsequently, for example, the north coasts of the larger islands of the Cayos Cochinos are dominated by massive colonies such as *Montastraea annularis* (Ogden and Ogden, 1998). In contrast, lee areas support a more diverse coral assemblage. Currently unpublished reef mapping work in the Bay Islands by the Ministry of Tourism's 'Bay Islands Environmental Management Project' and Coral Cay Conservation has extended knowledge of the extent and complexity of the reef systems in this area significantly.

The reefs of the Swan Islands and the Mosquitia cays and banks are poorly known because of their inaccessibility and the results of research visits are mainly restricted to unpublished grey literature. Cortés (1997) reports that the Mosquitia cays are surrounded by fringing reefs and patch reefs in lagoonal areas. An expedition in 1960 to the Swan Islands indicated that coral growth may be less abundant than on the reefs of Panama (UNEP/IUCN, 1988) and there is some evidence that the biota of some taxa are less diverse than the Bay Islands because they have a lower habitat diversity and less protection from severe storms (Keith, 1992). More recent anecdotal reports indicate that, because of their isolation and use for only small-scale artisanal fishing, the coral health and fish populations of the Swan Islands may be higher than those of the Bay Islands and Cayos Cochinos. However, the reefs are likely to have suffered significantly from wave damage in 1998 because of the proximity of the Swan Islands to the path of Hurricane Mitch.

The need for coastal zone management and sustainable development in Honduras is well documented and recognised both nationally and internationally. Marine protection in Honduras dates back to the 'Ley de Pescar' decree of May 1959 which declared coral reefs as 'protected areas'. More recently, a particularly significant step for marine conservation in Central America was the signing of the Tulum Declaration in 1997, when Mexico, Belize, Guatemala and Mexico agreed to work towards regional conservation of the Mesoamerican Barrier Reef System. Instigating such initiatives inevitably relies on the support of local stakeholders and despite the continued problems, Honduran ecologists are encouraged by the increasing environmental consciousness among many sectors of the community (Merrill, 1995). For example, there is some evidence that local communities appreciate the benefit of marine protected areas. A study by Barahona and Guzman (1998) showed that 77% of survey respondents believed it was important to protect the marine and terrestrial habitats of Cayos Cochinos and 66% thought that commercially important species were more abundant since fisheries restrictions were enforced.

The national government recognises the ecological and economic needs to conserve marine resources but is severely limited by capacity, funding and expertise. However, in order to co-ordinate and expand local and national initiatives, the Ministry of Tourism has established the 'Bay Islands Environmental Management Project' (Programa Manejo Ambiental de las Islas de la Bahía; PMAIB). This multi-faceted project is funded by a US$19.1 million loan from the Inter-American Development Bank, along with further funding from national government to a total of US$27 million, and has four sub-programmes covering natural resources, sanitation, real estate census and institutional strengthening. Conservation in the Bay Islands will be further strengthened by the World Bank / Global Environment Facility project 'Conservation and sustainable use of the Mesoamerican Barrier Reef System'. This project's objective is to assist the countries of Belize, Guatemala, Honduras and Mexico manage the Mesoamerican Barrier Reef System as a shared, regional ecosystem, safeguard its biodiversity values and functional integrity and create a framework for its sustainable use (Kramer *et al.*, 2000).

In addition to international programmes, there is an NGO movement in Honduras but it is relatively nascent. However, there are, for example, groups present in the Bay Islands and their activities are reviewed by Forest (1998). Further assistance for coastal zone conservation initiatives in Honduras is increasingly being provided by international NGOs and for example, the Wildlife Conservation Society has assisted management planning in the Bay Island's existing reserves and the Municipalities of Utila and Roatán, along with PMAIB, have been assisted with data collection, technical advice, training and environmental education programmes by Coral Cay Conservation (Harborne *et al*., in press).

Environmental legislation in Honduras is relatively extensive and Forest (1998) reviews a series of coastal regulations relating to the Bay. The Honduran government has also set several regulations on its fisheries (MacKenzie, Jr and Stehlik, 1996). Despite the range of regulations, enforcement capacity is extremely limited and many stakeholders are able to ignore germane legislation with impunity (Fielding, 2000a). However, the recent recognition of the importance of reserves for conservation means that a total of 15% of Honduras (1.7 million hectares) is now protected via 106 'natural areas' including national parks, wildlife refuges, biological reserves, national forests, anthropological reserves, protected watersheds, natural monuments, cultural monuments and multiple-use areas (Hodges, 1997). Within this system, there are 25 marine protected areas covering 4,300 km^2 (Kramer *et al*., 2000). Indeed, in 1997 legislation was passed declaring most of the Bay Islands as a marine park with varying levels of restrictions on resource use. Among other objectives, this park aimed to strengthen the municipal reserves of Turtle Harbour in Utila and Sandy Bay in Roatán which were designated in 1982. However, although the whole perimeter of Roatán and Guanaja and parts of Utila were included, enforcement is limited and the forestry department, which is responsible for protected areas, has virtually no capacity on the islands. Furthermore, many stakeholders are unaware of the reserve's status or its consequences.

2.2 The Bay Islands

Foreign tourists are attracted to Honduras by, for example, the opportunities for SCUBA diving in the Bay Islands and impressive Mayan ruins. The importance of the income from this industry is well recognised and the Bay Islands were designated as an important tourism zone by the Honduran congress as early as 1982 and laws to promote this industry were passed in the 1990s (Rijsberman, 1999). Between 1987 and 1991, tourist arrivals in Honduras grew at average annual rates of approximately 15%, which exceeded global trends (Fielding, 2000b). By 1993, the annual number of international tourists to the Bay Islands (approximately 30,000, with a high season from September to December) exceeded the local population (Fielding, 2000a).

The Bay Islands, stretching in an arc between 29 and 56 km off the coast of Honduras, sit upon the Bonacca Ridge, an extension of the Sierra de Omoa Mountains. The Bonacca Ridge forms the edge of the Honduran shelf and, as a result, on the northern, ocean-facing side of the islands, shallow water extends only a short distance before the shelf-break. There are also several terrestrial ecological zones in the Bay Islands, including pine and oak savanna, arid tropical forest, beach vegetation, mangrove swamps and uplifted, fossilised coral or iron shore. Most of the dense forest has been removed to provide building materials and the only areas left are on the island of Barbareta and in the hills of Roatán and Guanaja. The height of the islands generally increases from west to east, from the lowland swamps of Utila to the low ridges of Roatán and the two peaks of Guanaja. The Bay Islands were once host to many animal species that have now been hunted to extinction.

The Bay Islands are generally surrounded by fringing reefs, but the north coast of Roatán, the largest and best known island, is dominated by a nearly continuous barrier and fringing reef (UNEP/IUCN, 1988). In contrast, the south coast of Roatán supports a discontinuous fringing reef broken up by channels and bights that were formed by erosion during glacial events. Reefs on both coasts have a relatively narrow landward lagoon dominated by seagrass and additional information on zonation is provided in UNEP/IUCN (1988), Fenner (1993) and Kramer *et al*. (2000). Similarly, on the reefs of Utila, zonation is much more pronounced to the north of the island and the reefs of the leeward side typically comprise of a narrow shelf characterised by a poorly developed reef crest and with little reef development beyond a depth of 25 m. Since Hurricane Mitch and the bleaching events of 1995 and 1998, coral cover is generally low, for example rarely being higher than 30% on Utila and only reaching 50% at the west end of Roatán (Kramer *et al*., 2000). In addition to the fringing reefs, throughout the Bay Islands and Cayos Cochinos there are numerous seamounts which are poorly studied but some are known to have relatively high coral cover and fish populations. These seamounts are also important locations for local fisherfolk and at least some are important as fish spawning areas (Fine, 1992).

Reefs in the Bay Islands and coastal areas are subject to the same threats as those faced by many other islands throughout the Caribbean. These threats, accentuated by rapid development of coastal areas and the influx of overseas investors wishing to build homes on the islands, include:

Sedimentation and watershed management

Corals require clear, sediment free water to ensure sufficient sunlight for photosynthesis by symbiotic algae. Similarly, physical smothering by sediment can kill coral colonies. After Hurricane Mitch and during the following 'rainy season' high levels of sediment from the mainland were evident around the Bay Islands. In the future, attempts to provide access from the sea to many of the proposed development sites may include dredging shallow channels through the reefs and / or lagoons. Dredging often results in direct disturbance of nearby habitats and wider sedimentation of adjacent coral reefs. Indeed, anecdotal reports by local researchers indicate that sedimentation caused by erosion from road building and hotel construction is one of the most important impacts to reefs of the Bay Islands (Fielding, 2000b).

Further inland, Honduras lost 1.8 million hectares of forest from 1964 to 1988 and it has continued to decline, partly from agriculture but also from the focus on logging rather than management (Merrill, 1995). As in many other countries, such deforestation threatens the health of marine resources by increasing sediment loads but such links are poorly understood in Honduras. Since Honduras is a water-rich country with numerous rivers draining the highlands, this threat is significant. For example, the large river Ulúa drains into the Caribbean west of the Bay Islands after flowing 400 km through the economically important Valle de Sula (Merrill, 1995).

Mangrove deforestation

On small islands, where good building land is at a premium, it is likely that there will be demands to remove areas of mangrove forest. Deforestation of the limited areas of mangrove will result in a loss of important nesting habitats for birds and other important terrestrial species and will remove breeding and nursery grounds for commercially important marine species such as conch and lobster.

Effluent and waste run-off

Increased nutrient levels, especially close to large towns and cities, is now regarded as a significant reef stressor throughout the Mesoamerica Barrier Reef System. Most buildings in the Bay Islands employ septic tanks to store and treat human waste, many of which are situated on low land immediately adjacent to the coast. Improper installation and maintenance of these septic systems may pollute the ground water system (causing a health risk) and leach out into the marine environment causing nutrification and excessive algal growth along the reefs. The need for better public access to water supplies and sewerage has been a major element of development programmes in Honduras and throughout Central America.

Physical damage

There is an extremely high level of diver activity around the Bay Islands (particularly Utila and the western end of Roatán), often by inexperienced or trainee divers. Physical damage from divers and boat anchors can be significant at popular dive sites. However, in Utila, the local community has done an exemplary job of installing and maintaining mooring buoys for the local dive shops to utilise (thus limiting anchor damage). If not properly controlled, diving activity may result in significant physical damage to the Bay Islands' reefs. Furthermore, cruise shipping has been promoted in the Bay Islands and the first cruise ship arrived in Utila in 2000 (Fielding, 2000b). However, this represents a significant environmental threat and case studies from elsewhere in the region show negative effects from dredging, coastal development, mechanical damage to marine resources and sewage (Fielding, 2000b).

Fishing pressure

The population of the Bay Islands is now supplemented by hundreds of tourists each month who all enjoy eating the local fish catch and this has placed significant pressures on local fisheries. For example, finfish, particularly groupers (Serranidae), snappers (Lutjanidae), grunts (Haemulidae) and jacks (Carangidae) are targeted by artisanal fisherfolk via a variety of traditional techniques. Although quantitative data are sparse, intensive fishing effort has clearly impacted populations and now, for example, fishermen in the Bay Islands favour more remote offshore banks compared to the heavily exploited fringing reefs. Furthermore, decreases of herbivorous fish populations, in conjunction with the disease induced loss of sea urchins and decreasing water quality, also contributes to increasing reef coverage by algae, to the detriment of corals.

Similarly, lobster and conch are a significant fishery resource on reef formations bordering the islands and mainland (Tewfik *et al.*, 1998). These species are caught by both artisanal and industrial fisherfolk and indeed Honduras maintains the largest lobster fleet of all Central American countries with 190 vessels by the early 1990s (Ehrhardt, 2000). Although detailed data are lacking, the lobster and conch fisheries are generally considered to be over-exploited.

Coral bleaching

Coral bleaching events occur during occasional periods when climate conditions raise seawater temperatures and solar irradiance (summarised in Westmacott *et al.*, 2000). Coral bleaching, the paling of coral tissue from the loss of symbiotic zooxanthellae, has presumably occurred previously in Honduras but evidence of severe events prior to the mid-1990s is sparse. However, a mass bleaching event was recorded in 1995 by Guzmán and Guevara (1998) which affected 73% of scleractinians along with over 90% of all hydrocorals, zoanthids and octocorals. More detailed information is available for the more severe mass bleaching event in 1998 when high sea-surface temperatures affected Honduras in September and October. Interestingly there is some evidence that the water movements caused by Hurricane Mitch may have reduced sea-surface temperatures and allowed some corals to recover. However, the effects of bleaching were severe, leading to an average regional coral mortality of 18% on shallow reefs and 14% on forereefs along with subsequent increases in the prevalence of diseases and will have long-term ecological and socio-economic consequences (Kramer *et al.*, 2000; Kramer and Kramer, 2000). Although the community of the Bay Islands cannot change global warming, there is evidence to suggest that a well managed reef will recover quicker than a stressed one.

Coral disease

Caribbean corals have been affected by a number of diseases, defined as an impairment of an organism's vital functions or systems. Diseases have many causes, especially micro-organisms, and can affect not only an individual organism but also the community in which it lives. Diseases can alter the reproductive potential of a population, alter interactions among populations and cause mortalities, leading to changes in ecosystem composition, structure, processes and function. Corals become susceptible to diseases from natural and human-induced physical and chemical changes in water conditions; abrasion or smothering by sediment; changes in temperature and salinity and increased exposure to nutrients and toxic chemicals. Many of these causes are present around the Bay Islands. Furthermore, Kramer and Kramer, 2000) present evidence that Hurricane Mitch increased the prevalence of disease in the Bay Islands.

Hurricane damage

Honduras lies within the hurricane belt but hurricanes are relatively infrequent. However, damage has been reported from, for example, Hurricane Fifi in 1974 which killed 8,000 people (Merrill, 1995; Ogden and Ogden, 1998). Hurricane Mitch in 1998 (category 5 with occasional wind speeds greater than 250 km per hour) is regarded as the most deadly hurricane to strike the western hemisphere for the last two centuries (Fielding, 2000a). Hurricane Mitch had significant effects on the marine resources of Honduras, particularly as it occurred shortly after a mass coral bleaching event. Kramer *et al*. (2000) report losses in coral cover of 15-20% across the Central American region and damage to 50-70% of corals in parts of Honduras, although recent mortality was only moderately high (<25%). Physical damage (broken, knocked over and abraded colonies) from the hurricane's direct action was approximately 11% of corals on shallow reefs and 2% on deep reefs in Honduras (Kramer and Kramer, 2000). Damage was particularly severe in the Bay Islands as the hurricane slowed and stalled close to Guanaja for two days. Secondary effects, such as the extensive run-off of low salinity, sediment-laden water into the Gulf of Honduras are more difficult to quantify in the short-term (Kramer and Kramer, 2000).

Shipping and offshore effects

Heyman and Kjerfve (2001) state that industrial shipping is one of the largest and potentially most environmentally damaging industries in the Gulf of Honduras. Puerto Cortés, on the western coast of mainland Honduras, is one of the largest ports in the region and a spill from one of the many petroleum or chemical vessels could be catastrophic.

This combination of threats to reef health underscores the need to control land-based sources of stress through better land-use planning and environmental management.

2.3 Utila

Utila is the smallest of the three main Bay Islands and is 11 km long and 5km wide with almost two-thirds of its area covered by swamp. Two small hills on the eastern side of the island, Stuart's Hill and Pumpkin Hill, are of volcanic origin. Almost all Utilans (population approximately 2000) live in East Harbour on the south side of the island. On the southwest side of the island lie 12 small islands, referred to as the Cays. The Cays are home to approximately 400 people, mostly on Suc-Suc and Pigeon Cay.

As recently as 1992, Utila was a quiet island community that relied mainly on local industries such as fishing and farming as it's main source of income. Also, for many years the men-folk of Utila have worked overseas on ships and oil rigs, sending their salaries home to their families. However, the community has developed rapidly over recent years as a fledgling tourism industry has expanded into a major aspect of the island's economy. Many tourists visit Utila to get SCUBA certifications and it is now known as the cheapest place in the world to learn to dive. Approximately 14 dive shops supply training facilities to thousands of international travellers who visit the island each year to learn to dive and enjoy the island's reefs, bars, restaurants and night-clubs. Whilst this industry brings additional income into the local economy and provides livelihoods for many islanders, it has had an impact upon the 'traditional' way of life.

2.4 Aims and objectives

During work on Utila, CCC developed a programme of surveys, training and conservation education aimed at assessing the status of local reefs and improving environmental awareness amongst neighbouring communities (Harborne *et al*., In press). The primary aims of the project were to: map the benthic and fish communities; provide data on reef health and threats to current reef health; continue the monitoring programme of Project Utila; generate basic fish and coral species lists; provide basic socio-economic data on diving pressure; providing training opportunities for local counter-parts and environmental awareness programmes (Table 1).

Table 1. Main aims, objectives and anticipated outputs of the *Bay Islands 2000* project in Utila.

AIM	OBJECTIVE	ANTICIPATED OUTPUTS
✍ Resource assessment.	✍ Undertake a scientific survey of Utila's reefs to document the benthic and fish communities. ✍ Conduct studies on climatic, oceanographic and anthropogenic variables affecting the reefs. ✍ Provide management tools and recommendations.	✍ Baseline database and description of reef communities. ✍✍ Documentation of gross climatic, oceanographic and anthropogenic variables.✍ ✍✍ Habitat map using aerial photography. ✍✍ Management recommendations.
✍ Reef health assessment.	✍✍ Undertake 'Reef Check' surveys to quantitatively assess benthic and fish communities and anthropogenic impacts. ✍ Establish a Reef Check database for Utila. Provide data for the global Reef Check databases. ✍ Continue monitoring the sites established by 'Project Utila'. ✍ Provide management tools and recommendations.	✍✍ Quantitative assessment of reef health. ✍✍ Data set for comparison with future surveys.✍ ✍✍ Information on the change of benthic communities over time.✍ ✍✍ Management recommendations.
✍ Taxonomy.	✍✍ Complete a basic biodiversity assessment by generating fish and coral species lists	✍✍ Quantitative assessment of reef biodiversity. ✍✍ Data set for comparison with future surveys.
✍ Socio-economics.	✍✍ Undertake a basic assessment of diving pressure around Utila. ✍ Provide management tools and recommendations.	✍✍ Quantitative assessment of diving pressure. ✍✍ Data set for comparison with future surveys.✍ ✍✍ Management recommendations.
✍ Training and conservation education.	✍✍ Provide scientific and SCUBA training for CCC volunteers and local counterparts. ✍✍ Heighten awareness of marine resources, their use and protection. ✍✍ Begin to develop a sense of community stewardship in managing the coastal zone.	✍✍ Trained project members. ✍✍ Advice on coastal zone management issues around Utila. ✍ Increased awareness amongst local communities.

The results of CCC's work in Utila are documented in a series of reports. This report is concerned with the biodiversity assessment, via fish and coral species lists gathered during the 'taxonomy' component of the fieldwork.

3. METHODS

3.1 Rationale

Many of the reefs that CCC survey are poorly explored and comprehensive species lists are rarely available. Indeed, species lists for the entire country are often incomplete. Although CCC volunteers and science staff do not usually have the expertise to document the total bio-diversity, it is possible to produce species lists of fish and corals observed during survey work. These lists assist the aims of the overall project by providing additional reasons for conservation initiatives, such as the presence of rare species, and may lead to documenting the presence of species not previously recorded from the area or country.

3.2 Protocol

Species lists were compiled during the course of the *Bay Islands 2000* project during survey dives by CCC science staff, who are trained tropical marine biologists, and experienced volunteers. During baseline, Reef Check and monitoring surveys (see Harborne *et al*., 2001; Young *et al*., 2001 and Afzal *et al*., 2001 respectively for full details of the methodologies) and recreational dives, CCC science staff compiled lists of fish and coral species encountered at each survey site. Species were only added when CCC staff had either seen the fish themselves or trusted the sighting of an experienced volunteer. 'Possible' sightings are not included in the lists given in this report.

The fish and coral species lists were prepared by compiling species records from all areas surveyed in Utila. These areas covered the range of habitat types found in Utila from dense massive and encrusting coral habitat to seagrass areas. Additionally, surveys covered several distinct geomorphological classes from 30 m in depth, including escarpment, forereef and reef crest.

In order to provide a general estimate of the abundance of each species, a median abundance was calculated from the semi-quantitative data collected during baseline surveys (Harborne *et al*., 2001). These data are recorded using a scale of 0 (0 fish), 1 (1-5), 2 (6-20), 3 (21-50), 4 (51-25) and 5 (250+). Total sample size was 784 surveys, with each survey covering an average of 160 m^2.

Median abundance was calculated using the following formula:

$$\text{Median Abundance} ? (\text{lower limit of interval}) ? \left(\frac{(0.5n - \text{cum.freq.})}{(\text{number of observations in interval})} \right) ? (\text{interval size})$$

Where 'cum. freq.' refers to the cumulative frequency of the previous classes and 'interval' refers to the rating on the 0-5 ordinal scale containing the $0.5n^{th}$ record. Species records were then ranked, from commonest to rarest, according to their median abundance. Finally, a sighting frequency was calculated by dividing the number of times the species was present by the total sample size.

4. RESULTS

4.1 Species lists

Tables 2 and 3 show the species lists for fish and corals respectively. Note that Latin and common names for fish species are from Humann (1996) and Latin and common names for coral species are from Humann (1993). 'NA' refers to species not observed during surveys and identified by CCC science staff. Median abundance is calculated from semi-quantitative data and, therefore, a value of 0.5 is *not* the number of fish but the median score that was assigned across all surveys (i.e. in this case midway between 0 (0 fish) and 1 (1-5 fish)).

In Table 2, *Hypoplectrus* spp. (hamlets) are listed as separate species even thought there is academic debate about their evolution (Humann, 1996). It should also be noted that, in Table 2, the list is not intended as exhaustive for cryptic species such as gobys (Gobiidae) and blennys (Blenniidae) but the species that have been identified are included for completion.

Table 2. Fish species list, median abundance, abundance rank and sighting frequency from the *Bay Islands 2000* project in Utila.

	Latin Name	Common Name	Median Abundance	Rank	Sighting frequency
	Acanthuridae				
1	*Acanthurus bahianus*	Ocean surgeon fish	0.4	6	44.6%
2	*Acanthurus chirurgus*	Doctorfish	0.2	22	23.7%
3	*Acanthurus coeruleus*	Blue tang	0.4	5	45.4%
	Albulidae				
4	*Albula vulpes*	Bonefish	<0.1	176	0.4%
	Apogonidae				
5	*Apogon binotatus*	Barred cardinalfish	<0.1	168	0.8%
6	*Apogon maculatus*	Flamefish	<0.1	105	0.3%
7	*Apogon pseudomaculatus*	Twospot cardinalfish	NA	NA	NA
8	*Apogon townsendi*	Belted cardinalfish	<0.1	99	0.4%
9	*Astrapogon stellatus*	Conchfish	NA	NA	NA
	Aulostomidae				
10	*Aulostomus maculatus*	Trumpetfish	<0.1	64	4.7%
	Balistidae				
11	*Aluterus scriptus*	Scrawled filefish	<0.1	85	0.8%
12	*Balistes vetula*	Queen triggerfish	<0.1	51	7.4%
13	*Cantherhines macroceros*	Whitespotted filefish	<0.1	108	0.1%
14	*Cantherhines pullus*	Orangespotted filefish	<0.1	140	1.9%
15	*Canthidemis sufflamen*	Ocean triggerfish	<0.1	115	0.1%
16	*Melichthys niger*	Black durgon	0.1	34	13.1%
17	*Monacanthus tuckeri*	Slender filefish	NA	NA	NA
	Batrachoididae				
18	*Batrachoides gilberti*	Large eye toadfish	NA	NA	NA
	Belonidae				
19	*Ablennes hians*	Flat needlefish	<0.1	173	0.5%
20	*Tylosurus crocodilus*	Houndfish	NA	NA	NA
	Bothidae				
21	*Bothus lunatus*	Peacock flounder	<0.1	93	0.6%
	Carcharhinidae				
22	*Carcharhinus perezi*	Reef shark	NA	NA	NA
23	*Carcharhinus limbatus*	Blacktip shark	NA	NA	NA
24	*Carcharhinus falciformis*	Silky shark	NA	NA	NA
25	*Carcharhinus leucas*	Bull shark	NA	NA	NA
	Carangidae				
26	*Caranx batholomaei*	Yellow jack	<0.1	79	3.3%
27	*Caranx crysos*	Blue runner	<0.1	127	0.1%
28	*Caranx hippos*	Crevalle jack	NA	NA	NA
29	*Caranx latus*	Horse-eye jack	<0.1	158	1.1%
30	*Caranx ruber*	Bar jack	0.2	21	25.9%
31	*Elagatis bipinnulata*	Rainbow Runner	NA	NA	NA
32	*Trachinotus falcatus*	Permit	<0.1	172	0.5%
	Centropomidae				
33	*Centropomus undecimalis*	Common snook	<0.1	180	0.1%
	Chaetodontidae				
34	*Chaetodon aculeatus*	Longsnout butterflyfish	<0.1	75	3.7%
35	*Chaetodon capistratus*	Foureye butterflyfish	0.5	3	50.8%
36	*Chaetodon ocellatus*	Spotfin butterflyfish	0.1	30	17.6%
37	*Chaetodon striatus*	Banded butterflyfish	0.1	31	16.2%
	Cirrhitidae				
38	*Amblycirrhitus pinos*	Redspotted hawkfish	<0.1	91	0.6%
	Clinidae		0.1	29	17.7%
39	*Acanthemblemaria spinosa*	Spinyhead blenny	NA	NA	NA
40	*Chaenopsis ocellata*	Bluethroat pikeblenny	NA	NA	NA
41	*Emblemaria pandionis*	Sailfin blenny	NA	NA	NA
42	*Lucayablennius zingaro*	Arrow blenny	NA	NA	NA

	Latin Name	Common Name	Median Abundance	Rank	Sighting frequency
43	*Malacoctenus boehlkei*	Diamond blenny	NA	NA	NA
44	*Malacoctenus macropus*	Rosy blenny	NA	NA	NA
45	*Malacoctenus triangulatus*	Saddled blenny	NA	NA	NA
✍					
✍	**Congridae**				
47	*Heteroconger halis*	Garden eel	NA	NA	NA
	Dasyatidae				
48	*Dasyatis americana*	Southern stingray	<0.1	96	0.4%
	Echeneidae				
49	*Echenesis naucrates*	Remora	<0.1	177	0.3%
✍	**Elopidae**				
50	*Megalops atlanticus*	Tarpon	<0.1	110	0.1%
	Ephippidae				
51	*Chaetodipterus faber*	Atlantic spadefish	<0.1	179	0.3%
	Exocoetidae				
52	*Hemiramphus brasiliensis*	Ballyhoo / Balao	NA	NA	NA
53	*Hirundichthys speculiger*	Mirrorwing flyingfish	NA	NA	NA
	Gerreidae				
54	*Eucinostomus lefroyi*	Mottled mojarra	NA	NA	NA
55	*Gerres cinereus*	Yellowfin mojarra	<0.1	116	
	Gobiidae		0.2	17	
56	*Coryphopterus dicrus*	Colon goby	NA	NA	NA
57	*Coryphopterus eidolon*	Pallid goby	NA	NA	NA
58	*Coryphopterus glaucofraenum*	Bridled goby	NA	NA	NA
59	*Coryphopterus lipernes*	Peppermint goby	NA	NA	NA
60	*Coryphopterus personatus*	Masked goby	NA	NA	NA
61	*Gnatholepsis thompsoni*	Goldspot goby	NA	NA	NA
62	*Gobionellus saepepallens*	Dash goby	NA	NA	NA
63	*Gobiosoma dilepsis*	Orangesided goby	NA	NA	NA
64	*Gobiosoma evelynae*	Sharknose goby	NA	NA	NA
65	*Gobiosoma genie*	Cleaning goby	NA	NA	NA
66	*Gobiosoma horsti*	Yellowline goby	NA	NA	NA
67	*Gobiosoma illecebrosum*	Barsnout goby	NA	NA	NA
68	*Gobiosoma oceanops*	Neon goby	NA	NA	NA
69	*Gobiosoma prochilos*	Broadstripe goby	NA	NA	NA
70	*Lophogobius cyprinoides*	Crested goby	NA	NA	NA
	Grammatidae				
71	*Gramma loreto*	Fairy basslet	0.3	9	39.2%
72	*Gramma melacara*	Blackcap basslet	<0.1	52	2.2%
73	*Liopropoma rubre*	Peppermint bass	<0.1	114	0.1%
	Haemulidae				
74	*Anisotremus surinamensis*	Black margate	<0.1	170	0.6%
75	*Anisotremus virginicus*	Porkfish	<0.1	151	1.4%
76	*Haemulon album*	Margate	<0.1	155	1.3%
77	*Haemulon aurolineatum*	Tomtate	<0.1	129	2.3%
78	*Haemulon carbonarium*	Caesar grunt	<0.1	58	6.3%
79	*Haemulon sciurus*	Bluestriped grunt	0.1	35	13.0%
80	*Haemulon flavolineatum*	French grunt	0.2	16	30.2%
81	*Haemulon macrostomium*	Spanish grunt	<0.1	132	2.2%
82	*Haemulon melanurum*	Cottonwick	<0.1	141	1.9%
83	*Haemulon plumieri*	White grunt	0.1	38	12.0%
	Holocentridae				
84	*Holocentrus adscensionis*	Squirrelfish	0.2	20	27.0%
85	*Holocentrus coruscus*	Reef squirrelfish	<0.1	90	2.9%
86	*Holocentrus rufus*	Longspine squirrelfish	0.3	12	33.7%
87	*Holocentrus vexillarius*	Dusky squirrelfish	<0.1	83	3.2%
88	*Myripristis jacobus*	Blackbar soldierfish	<0.1	66	2.3%
89	*Neoniphon marianus*	Longjaw squirrelfish	<0.1	56	6.3%
	Inermiidae				
90	*Inermia vittata*	Boga	<0.1	163	1.0%

	Latin Name	Common Name	Median Abundance	Rank	Sighting frequency
	Kyphosidae				
91	*Kyphosus sectatrix / incisor*	Bermuda chub	<0.1	65	4.7%
	Labridae				
92	*Bodianus rufus*	Spanish hogfish	0.1	28	17.7%
93	*Clepticus parrai*	Creole wrasse	0.1	25	18.8%
94	*Halichoeres bivittus*	Slippery dick	0.1	31	11.9%
95	*Halichoeres cyanocephalus*	Yellowcheek wrasse	NA	NA	NA
96	*Halichoeres garnoti*	Yellowhead wrasse	0.3	11	37.2%
97	*Halichoeres maculipinna*	Clown wrasse	<0.1	57	6.3%
98	*Halichoeres radiatus*	Puddingwife	<0.1	139	1.9%
99	*Lachnolaimus maximus*	Hogfish	<0.1	80	3.3%
100	*Thalassoma bifasciatum*	Bluehead wrasse	0.4	4	46.9%
101	*Xyrichtys martinicensis*	Rosy razorfish	<0.1	133	2.2%
	Lutjanidae				
102	*Lutjanus analis*	Mutton snapper	<0.1	134	2.2%
103	*Lutjanus apodus*	Schoolmaster	0.1	44	9.9%
104	*Lutjanus cyanopterus*	Cubera snapper	<0.1	137	2.0%
105	*Lutjanus griseus*	Gray snapper	<0.1	143	1.8%
106	*Lutjanus joco*	Dog snapper	<0.1	154	1.4%
107	*Lutjanus mahogoni*	Mahogany snapper	<0.1	118	2.4%
108	*Lutjanus synagris*	Lane snapper	<0.1	166	0.8%
109	*Ocyurus chrysurus*	Yellowtail snapper	0.2	18	29.7%
	Malacanthidae				
110	*Malancanthus plumieri*	Sand tilefish	<0.1	54	4.5%
	Mobulidae				
111	*Manta birostris*	Atlantic manta	<0.1	106	0.3%
	Mullidae				
112	*Mulloidichthys martinicus*	Yellow goatfish	<0.1	71	4.2%
113	*Pseudupeneus maculatus*	Spotted goatfish	<0.1	50	7.9%
	Muraenidae				
114	*Gymnothorax funebris*	Green moray	<0.1	87	0.8%
115	*Gymnothorax miliaris*	Goldentail moray	<0.1	92	0.6%
116	*Gymnothorax moringa*	Spotted moray	<0.1)	73	1.7%
	Myliobatidae				
117	*Aetobatus narinari*	Spotted eagle ray	<0.1	160	1.0%
	Opistognathidae				
118	*Opistognathus aurifrons*	Yellowhead jawfish	<0.1	153	1.4%
119	*Opistognathus macrognathus*	Banded jawfish	NA	NA	NA
	Ostraciidae				
120	*Lactophrys bicaudalis*	Spotted trunkfish	<0.1	135	2.0%
121	*Lactophyrs polygonia*	Honeycomb cowfish	<0.1	146	1.7%
122	*Lactophrys quadriconis*	Scrawled cowfish	<0.1	169	0.6%
123	*Lactophrys trigonus*	Trunkfish	<0.1	158	1.0%
124	*Lactophrys triqueter*	Smooth trunkfish	<0.1	82	3.2%
	Pempheridae				
125	*Pempheris schomburgki*	Glassy sweeper	NA	NA	NA
	Pomacanthidae				
126	*Holacanthus ciliaris*	Queen angelfish	0.1	41	11.5%
127	*Holacanthus tricolor*	Rock beauty	0.2	15	30.6%
128	*Pomacanthus arcuatus*	Gray angelfish	0.1	37	12.1%
129	*Pomacanthus paru*	French angelfish	<0.1	67	4.5%
	Pomacentridae				
130	*Abudefduf saxatilis*	Sergeant major	0.1	42	11.0%
131	*Abudefduf taurus*	Night sergeant	<0.1	165	0.8%
132	*Chromis cyanea*	Blue chromis	0.5	2	51.8%
133	*Chromis insolata*	Sunshinefish	<0.1	142	1.8%
134	*Chromis multilineata*	Brown chromis	0.1	43	10.2%
135	*Microspathodon chrysurus*	Yellowtail damselfish	0.3	8	41.1%
136	*Stegastes diencaeus*	Longfin damselfish	0.1	46	9.7%
137	*Stegastes fuscus*	Dusky damselfish	0.3	13	33.7%

	Latin Name	Common Name	Median Abundance	Rank	Sighting frequency
138	*Stegastes leucostictus*	Beaugregory	0.1	27	18.5%
139	*Stegastes partitus*	Bicolor damselfish	1.3	2	73.6%
140	*Stegastes planifrons*	Threespot damselfish	0.1	14	33.2%
141	*Stegastes variabilis*	Cocoa damselfish	0.1	40	11.6%
	Priacanthidae				
142	*Priacanthus arenatus*	Bigeye	<0.1	148	1.7%
143	*Priacanthus cruentatus*	Glasseye snapper	<0.1	77	1.1%
	Rhincodontidae				
144	*Ginglymostoma cirratum*	Nurse shark	<0.1	102	0.3%
145	*Rhincodon typus*	Whale shark	NA	NA	NA
	Scaridae				
146	*Scarus coeruleus*	Blue parrotfish	<0.1	167	0.8%
147	*Scarus guacamaia*	Rainbow parrotfish	<0.1	55	6.5%
148	*Scarus iserti*	Striped parrotfish	0.2	19	29.0%
149	*Scarus taeniopterus*	Princess parrotfish	0.1	32	14.9%
150	*Scarus vetula*	Queen parrotfish	<0.1	98	2.7%
151	*Sparisoma atomarium*	Greenblotch parrotfish	<0.1	81	3.3%
152	*Sparisoma aurofrenatum*	Redband parrotfish	0.1	24	19.5%
153	*Sparisoma chrysopterum*	Redtail parrotfish	<0.1	53	7.0%
154	*Sparisoma radians*	Bucktooth parrotfish	<0.1	88	3.1%
155	*Sparisoma rubripinne*	Yellowtail parrotfish	<0.1	49	8.5%
156	*Sparisoma viride*	Stoplight parrotfish	0.4	7	41.6%
	Sciaenidae				
157	*Equetus punctatus*	Spotted drum	<0.1	72	1.8%
158	*Equetus umbrosus*	Cubbyu	NA	NA	NA
159	*Odontoscion dentex*	Reef croaker	<0.1	97	0.4%
	Scombridae				
160	*Scomberomorous regalis*	Cero	<0.1	156	1.3%
161	*Scomberomorous cavalla*	King mackerel	NA	NA	NA
	Scorpaenidae				
162	*Scorpaena plumieri*	Spotted scorpionfish	<0.1	86	0.8%
	Serranidae				
163	*Hypoplectrus chlorurus*	Yellowtail hamlet	<0.1	70	4.2%
164	*Hypoplectrus gemma*	Blue hamlet	<0.1	150	1.5%
165	*Hypoplectrus gummingatta*	Golden hamlet	<0.1	174	0.5%
166	*Hypoplectrus guttavarius*	Shy hamlet	<0.1	111	2.4%
167	*Hypoplectrus indigo*	Indigo hamlet	<0.1	48	9.1%
168	*Hypoplectrus nigricans*	Black hamlet	<0.1	131	2.3%
169	*Hypoplectrus puella*	Barred hamlet	0.3	10	38.5%
170	*Hypoplectrus sp.*	Masked hamlet	<0.1	164	0.9%
171	*Hypoplectrus unicolor*	Butter hamlet	<0.1	78	1.1%
172	*Cephalopholis cruentata*	Graysby	0.1	26	18.5%
173	*Cephalopholis fulvus*	Coney	0.1	23	20.9%
174	*Epinephelus adscensionis*	Rock hind	<0.1	61	5.7%
175	*Epinephelus guttatus*	Red hind	<0.1	62	5.7%
176	*Epinephelus itajara*	Jewfish	NA	NA	NA
177	*Epinephelus striatus*	Nassau grouper	<0.1	136	2.0%
178	*Mycteroperca bonaci*	Black grouper	<0.1	147	1.7%
179	*Mycteroperca interstitialis*	Yellowmouth grouper	<0.1	94	0.5%
180	*Mycteroperca tigris*	Tiger grouper	<0.1	138	1.9%
181	*Mycteroperca venenosa*	Yellowfin grouper	<0.1	149	1.5%
182	*Rypticus saponaceus*	Greater soapfish	<0.1	95	2.8%
183	*Serranus baldwini*	Lantern bass	<0.1	152	1.4%
184	*Serranus tabacarius*	Tobaccofish	<0.1	59	6.0%
185	*Serranus tigrinus*	Harlequin bass	0.1	36	12.6%
186	*Serranus tortugarium*	Chalk bass	<0.1	84	3.2%
	Sparidae				
187	*Calamus bajonado*	Jolthead porgy	NA	NA	NA
188	*Calamus calamus*	Saucereye porgy	0.1	45	9.8%
	Sphyraenidae				
189	*Sphyraeana barracuda*	Great barracuda	<0.1	74	4.0%
190	*Sphyraeana picudilla*	Southern sennet	NA	NA	NA

	Latin Name	Common Name	Median Abundance	Rank	Sighting frequency
	Syngnathidae				
191	*Micrognathus ensenadae*	Harlequin pipefish	NA	NA	NA
192	*Hippocampus erectus*	Lined seahorse	NA	NA	NA
	Synodontidae				
193	*Synodus intermedius*	Sand diver	<0.1	63	5.4%
194	*Synodus saurus*	Bluestriped lizardfish	<0.1	145	1.8%
	Tetraodontidae				
195	*Canthigaster rostrata*	Sharpnose puffer	0.1	33	13.8%
196	*Diodon holocanthus*	Balloonfish	<0.1	68	2.2%
197	*Diodon hystrix*	Porcupinefish	0.1	47	0.8%
198	*Sphoeroides spengleri*	Bandtail puffer	<0.1	76	3.6%
199	*Sphoeroides testudineus*	Checkered puffer	NA	NA	NA
	Uranoscopidae				
200	*Astroscopus guttatus*	Northern Stargazer	NA	NA	NA
	Urolophidae				
201	*Urolophus jamaicensis*	Yellow stingray	<0.1	89	0.6%

Table 3. Coral species list, median abundance, rank and sighting frequency from the *Bay Islands 2000* project in Utila.

	Latin Name	Common Name	Median Abundance	Rank	Sighting frequency
	Acroporidae				
1	*Acropora palmata*	Elkhorn coral	<0.1	39	6.9%
2	*Acropora cervicornis*	Staghorn coral	0.2	23	24.7%
3	*Acropora prolifera*	Fused staghorn coral	<0.1	44	1.5%
	Poritidae				
4	*Porites porites*	Club finger coral	0.2	16	31.6%
5	*Porites furcata*	Finger coral	0.1	25	20.7%
6	*Porites divaricata*	Thin finger coral	0.1	34	10.2%
7	*Porites branneri*	Blue crust coral	<0.1	46	0.1%
8	*Porites astreoides*	Mustard hill coral	1.8	1	78.7%
9	*Porites colonensis*	Honeycomb plate coral	NA	NA	NA
	Faviidae				
10	*Montastraea annularis*	Mountainous star coral	1.5	2	79.7%
11	*Montastraea cavernosa*	Cavernous star coral	1.2	4	78.2%
12	*Favia fragum*	Golfball coral	0.1	32	13.3%
13	*Diploria strigosa*	Smooth brain coral	1.0	5	66.5%
14	*Diploria clivosa*	Knobby brain coral	<0.1	40	7.0%
15	*D.labyrinthiformis*	Grooved brain coral	0.4	10	46.3%
16	*Manicina areolata*	Rose coral	0.1	35	10.1%
17	*Colpophyllia natans*	Giant brain coral	0.3	13	37.9%
	Meandrinidae				
18	*Dendrogyra cylindrus*	Pillar coral	0.1	26	19.6%
19	*Meandrina meandrites*	Butterprint brain coral	0.5	9	50.3%
	Pocilloporidae				
20	*Madracis mirabilis*	Yellow pencil coral	0.1	28	16.3%
21	*Madracis Formosa*	Eight-Ray fingercoral	<0.1	39	7.3%
22	*Madracis decactis*	Green cactus coral	0.2	19	27.0%
23	*Madracis pharensis*	Star coral	NA	NA	NA
	Astrocoeniinae				
24	*Stephanocoenia michelinii*	Blushing star coral	0.2	18	28.8%
	Meandrinidae				
25	*Dichocoenia stokesii*	Elliptical star coral	0.6	8	52.6%
	Siderasteidae				
26	*Siderastrea siderea*	Smooth starlet coral	0.9	6	64.3%
27	*Siderastrea radians*	Rough starlet coral	0.4	11	45.9%
	Agariciidae				
28	*Agaricia agaricites*	Leaf coral	1.5	3	75.0%
29	*A.agaricites forma purpurea*	Purple leaf coral	<0.1	37	7.9%
30	*Agaricia tenuifolia*	Ribbon coral	0.4	12	41.6%
32	*Agaricia fragilis*	Fragile saucer coral	0.1	29	16.1%
33	*A.grahamae/lamarcki*	Sheet coral	0.2	20	26.9%
34	*Leptoseris cucullata*	Saucer coral	0.2	21	25.6%
35	*Agaricia humilis*	Lowrelief lettuce coral	NA	NA	NA
	Mussidae				
36	*Mycetophyllia danaana*	Fat fungus coral	0.2	15	32.0%
37	*Mycetophyllia aliciae*	Thin fungus coral	0.2	24	23.7%
38	*Mycetophyllia ferox*	Grooved fungus coral	<0.1	36	8.0%
39	*M.lamarckiana*	Fungus coral	0.3	14	33.8%
40	*Isophyllia sinuosa*	Sinuous cactus coral	<0.1	42	5.9%
41	*Isophyllastrea rigida*	Rough star coral	0.1	31	14.7%
42	*Scolymia cubensis*	Solitary disk coral	0.1	27	17.9%
43	*Mussa angulosa*	Large flower coral	0.1	33	10.7%
44	*Eusmilia fastigiata*	Small flower coral	0.2	17	30.5%
	Milleporidae				
45	*Millepora complanata*	Blade fire coral	0.9	7	63.6%
46	*Millepora alcicornis*	Branching fire coral	0.2	22	25.4%
	Stylasteridae				
47	*Stylaster roseus*	Rose lace coral	<0.1	44	5.5%

4.2 Comparative species lists

Table 4 summarises previous fish and coral species lists generated in Honduras and published in either peer-reviewed literature or websites.

Table 4. Number of species for different taxa reported from the Bay Islands. Results from this study are in italics.

Reference	Area	Taxa	Number of Species
Bay Islands 2000 project	*Utila*	*Fish*	*201*
Clifton, K.E., Clifton L.M. (1998)	Cayos Cochinos Marine Reserve	Fish	226
REEF (www.reef.org)	Utila	Fish	290
Bay Islands 2000 project	*Utila*	*Hermatypic corals*	*48*
Fenner, D.P. (1993)	Roatan	Hermatypic corals	41
Guzman, H. (1998)	Cayos Cochinos Marine Reserve	Hermatypic corals	66
Jaap, W.C., Halas, J. (1982)	Roatan	Hermatypic corals	47
Guzman, H. (1998)	Cayos Cochinos Marine Reserve	Octocorals	44
Tortora, L.R., Keith, D.E. (1980)	Swan Islands	Octocorals	12
Kieth, D. (1992)	Roatán	Octocorals	23

5. DISCUSSION

The reefs of Utila support diverse populations of reef fish. The total of 201 species of fish seen during this study, representing 53 families, is similar with published lists for other areas of Honduras (Clifton and Clifton, 1998) and previous studies in the Bay Islands. Furthermore, additional surveys by taxonomists will inevitably record additional species, particularly cryptic species such as gobies and blennies. Several species considered uncommon or rare in the Western Caribbean, while not common, where observed (e.g. whitespotted filefish, reef croaker, cubbyu, blue hamlet and yellowcheek wrasse; Humann 1996). The record of the northern stargazer (*Astroscopus guttatus*) by CCC science staff and local divers confirms an earlier report from Cayos Cochinos and may be a considerable range extension for this species. It is hoped that this checklist, along with other species lists from the Bay Islands, will act as a basis for future biodiversity assessments.

Fishing is an important industry in Utila and fisherfolk target a range of fish species, particularly groupers, jacks, snappers and grunts (reviewed by Harborne *et al*., 2001). The low median abundance and sighting frequency scores for commercially important species highlighted evidence of this fishing activity. Although many of these species are top trophic level predators and, therefore, were not expected to be present in large numbers, the median abundance and sighting frequencies reported are low. These results show that the fish communities have been fished in Utila since studies have shown that species at higher trophic levels are generally good indicators of fishing pressure (Russ, 1991). For example, Nassau grouper (*Epinephalus striatus*), was reported with a sighting frequency of just 2% over all habitat types. Nassau grouper are a valuable catch and populations are reported to be in decline in many areas of the Caribbean (Roberts, 1995). Similarly, the horse-eye jack (*Caranx latus*) had a median abundance and sighting frequency of <0.1 and 1.1%, respectively. Although it is difficult to assess what fish abundances are naturally, both these examples illustrate that the larger, piscivorous species have been exploited in the near shore marine habitats of Utila. Such exploitation has been exacerbated by extirpation of mass spawning aggregations (e.g. Fine 1992). The reduction of large, commercially important fish has long-term implications for fisherfolk.

Data showed that, because of fishing pressure, apex predators were also rare around Utila. For example, only two nurse sharks were seen during surveys. The only other sharks seen, four species observed in the genus *Carcharhinus* and the whale shark, (*Rhincodon typus*), were all associated with the pelagic environment and not observed during surveys. The whale sharks found around the island tend to be associated with a number of other species of fish, which together form an interesting food chain and often allow the whale shark to be easily located. Planktivorous silversides, herring and anchovies school within patches of plankton close to the surface in the deep waters off the island. These are followed by schools of *bonitas* (*Euthinnus afinis, Euthinnus alleteratus* and *Auxis thazard*), that leap from the water in pursuit of the silversides. Whale sharks are associated with these schools of fish and feed on the plankton, silversides and *bonitas*. Several species of associated fauna were observed following the silversides, *bonitas* and whale sharks. Manta rays (*Manta birostris*), bull sharks (*Carcharhinus leucas*), reef sharks (*Carcharhinus perezi*), blacktip sharks (*Carcharhinus limbatus*) and silky sharks (*Carcharhinus falciformis*) were observed in the blue water following the *bonitas*.

The whale sharks and their associated fauna represent a major attraction for divers. However, the relatively low abundance and sighting frequency for other larger reef associated species may have implications for the tourism industry. Diving related tourism in one of the main sources of income generation for Utila (Harborne *et al.*, 2001) and relies on healthy reefs to attract tourists. Many divers want to see big fish and the rarity of larger species of fish may be detrimental to dive tourism growth and sustainability (Roberts and Hawkins, 2000).

In addition to the fish species observed, a total of 48 species of corals were recorded during the *Bay Islands 2000* project in Utila, which is comparable to other studies in Honduras. Note that the variation between published lists, particularly the high species count for Cayos Cochinos (Guzman, 1998), should be viewed with caution since the area of each study differs considerably, survey effort was not standardised and different authors used different taxonomic criteria. During the study in Utila, several rare species were recorded including blue crust coral (*Porites branneri*) and fused staghorn (*Acropora prolifera*) (Humann, 1993). With the continuing presence of threats to the reefs of Utila (reviewed by Harborne *et al.*, 2001), rare species may become locally extinct without further protection.

6. RECOMMENDATIONS

Compilation of CCC's fish and coral species lists from Utila has provided a preliminary checklist for future studies and highlights the need to preserve species biodiversity.

Recommendation 1: There should be further study of the biodiversity of Utila to fully document the species present in order to facilitate effective management of biodiversity.

In addition to documenting biodiversity, understanding the natural history of commercially important species, such as the Nassau grouper (*Epinephalus striatus*), is an essential step in preventing exploitation and conserving the integrity of the fisheries. Significant damage to the integrity of the grouper fishery has already been documented in the Bay Islands by uncontrolled fishing of a spawning aggregation (Fine, 1992).

Recommendation 2: There should be further study of the natural history of commercially important species, for example their spawning grounds and migration patterns, to facilitate effective management of biodiversity.

Recommendation 3: Consider the use of species-specific management practices to preserve species survival and genetic exchange.

Whale sharks (*Rhincodon typus*) are found off Utila in variable numbers throughout the year and are an important species for the tourism industry. Further research into migratory patterns and behaviour is crucial for the management of this species (Harborne *et al.*, 2001).

Recommendation 3: Facilitate further research of the whale shark population of Central America.

Recommendation 4: Instigate a code of practice for the interaction of tourists and whale sharks.

Similarly to most reefs in Central America, there are a suite of threats to reef health and biodiversity in Utila and pressure from, for example, fishing, development and diving, combined with effects from natural events such as coral bleaching, are likely to increase. One or more marine protected areas around Utila would help to maintain reef health. Such reserves would also provide additional ecological and economic benefits, such as increased fish catches and income for local communities (Clark, 1996).

Recommendation 5: Continue to aim to establish one or more additional multiple use marine protected areas around Utila, with an integrated monitoring programme to measure their efficacy, and strengthen the enforcement of regulations in the Turtle Harbour Wildlife Sanctuary. Establish regulations, and enforce existing legislation, to minimise the detrimental effects of coastal development on reef health.

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