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Identification and Assessment of Scleractinians at Tarou Point, Dominica, West Indies

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Tarou Point, located on the west coast of Dominica in the West Indies, is a volcanic outcrop covered with coral assemblages. Four different sections within Tarou Point were surveyed for scleractinian species richness and frequency distribution analyses. Twenty-two species of scleractinians were identified, among which Porites astreoides, Agaracia agaricites, Siderastrea siderea, *and* Meandrina meandrites *represented the highest average abundance over all sections observed. The deep portion of section B showed the highest species diversity, while sections North D and the deep portion of section A represented the lowest. Frequency distribution trends among species depend on factors including substrate type and availability, light, depth, wave energy, and sedimentation. Tarou Point has historical, cultural, socioeconomical, and environmental significance. It is used both for artesanal fishing and as a growing recreational diving destination. Increased use of this area is leading to intense pressures on the marine environment. Tarou Point serves as one example of the prominent trend occurring throughout Dominica, in which coastal migration and the rise of tourism are placing increased pressures on coastal and marine resources. It is hoped that these data will serve as a baseline for future monitoring of Tarou Point's coral assemblages and benthic environment, as well as facilitate management and monitoring enforcement of coastal and marine resources throughout the island.*

Keywords coastal management, coral assessment, Dominica, marine resource conservation, scleractinians, small island developing states

Introduction

Dominica is located in the Lesser Antilles chain of the Caribbean and is a young volcanic island, formed 25 million years ago. As such, Dominica is characterized by rugged terrain and a very steep and narrow continental shelf, with a coastline measuring only 153 km in length and a shelf width of about 1 km (west coast), to 5 km (east coast). Because of these unique geological features, most of the island's beaches are not the vast white, sandy beaches characteristic of most Caribbean islands, but instead are rocky

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and narrow (James, 2001). Dominica has a total area of 750 square km, and while it is the largest island in the Organization of Eastern Caribbean States (OECS), it is still subject to the challenges encountered by all small island developing states (SIDS), including isolation, small size, limited resources, vulnerability to natural disasters (i.e., hurricanes) and anthropogenic impacts, economic instability, and dependency on international trade. Due to the mountainous interior of the island, 80–90% of the population, which in 1995 was estimated at 83,000, lives along the coastline, which is roughly 148 km in length (UNSD, 1995). These numbers are growing as the trend in coastal migration continues today. Because of the narrow, steep shelf, marine habitats such as coral reefs, which require sunlight and shallow, clear waters, are located very close to the shoreline. Thus the increasing population and development along the coast are intensifying the pressures placed on coastal and marine resources, endangering critical marine habitats, and contributing to several major environmental problems on the island, including pollution and overfishing. However, even though the increasing pressure on coastal areas is evident, little is known about the marine environment of Dominica. Only a few preliminary studies have been conducted on the reef fish and benthic composition on the island (Summers, 1985; Lucas, 2001; Lehman, 2001), and while coral assemblages line the rocky substrates along the entire western coast of the island, little quantitative research has been done on their community structure and distribution. This research represents a pioneering study that will focus on the coral reef assemblages at Tarou Point, which is located south of the village of Tarou on the west coast of the island (Figure 1). This rocky site projects westward approximately 100 m into the Caribbean Sea and drops to a depth of approximately 12 m and is a remnant of an ancient lava flow originating from Morne Trois Pitons, the remains of a former volcano. This study identifies the percentage of live cover and species abundance of scleractinians, or stony corals, at Tarou Point.

Scleractinians are sessile cnidarians capable of forming colonies and secreting calcium-carbonate exoskeletons, which contribute to the construction of coral reefs. A coral polyp requires specific conditions for optimal growth, including a stable substrate for settlement and nutrient-poor waters that are well illuminated and have low sedimentation rates. Scleractinians are steriothermal organisms, thereby existing only within a narrow temperature range of approximately 18–30°C, with 26°C being most optimal (Veron,

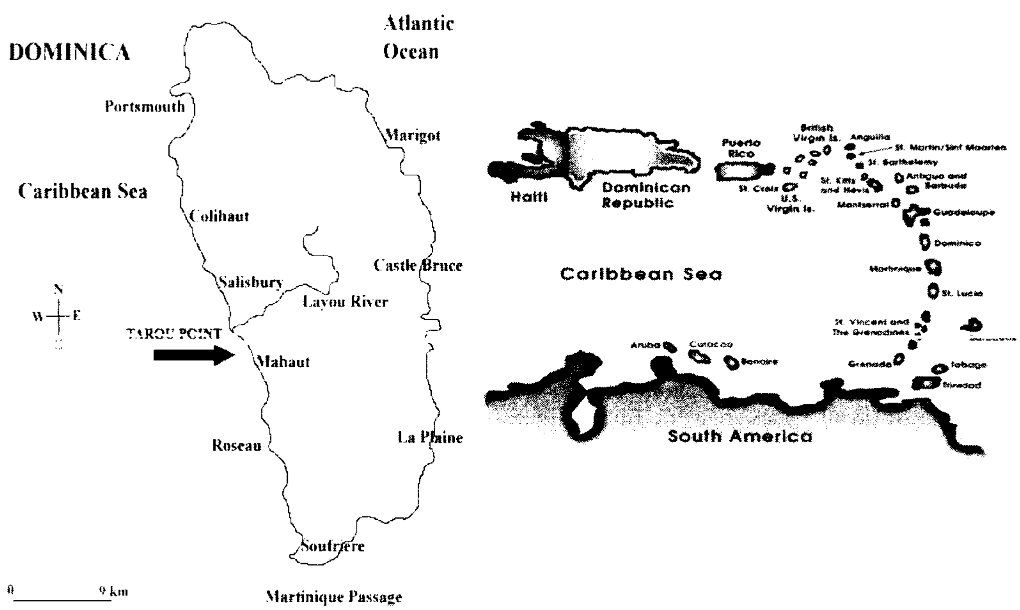

Figure 1. Tarou Point.

1995). While the tropical waters of Dominica provide stony corals with most of these conditions, the narrow shelf drops off sharply, thus limiting the amount of available well-illuminated space for coral reef formation. There is little evidence here of coral buildup, in which corals build on top of corals, which would constitute a biogeneous substrate and thus define a true reef (in geological terms). Instead, most coral growth here occurs on igneous rock. The areas most optimal for coral growth on the west coast of Dominica are areas with rocky outcrops or boulder fields that provide stable substrate for coral growth (Tarou Point, Point Guignard, Grand Savanne) or Scotts Head, at the southwest corner of Dominica, which is not in close proximity to large rivers and thus avoids high sediment input.

Tarou Point was chosen as the study site because (1) it represents the characteristic coral growth formation of Dominica, (2) is of concern due to high fishing and diving pressure, and (3) has historical, cultural, socioeconomic, and environmental significance. Pre-Columbian inhabitants of Dominica used the rocks at Tarou Point to grind stone tools (L. Honychurch, personal communication, 2001). French settlers named it Islet Tarreau after a bird that lives on nearby cliffs. Tarou Point owes its current nickname, Rodney's Rock, to Admiral George Rodney of England, who led his Navy into victory over the French at the Battle of The Saints off the north coast of Dominica in 1782. Unfounded rumors still persist that the English (or the French, depending on the source) lit up the rock like a warship to frighten their enemy's fleet. Today, Tarou Point is used for artesanal fishing (fish pots and line fishing) and is also gaining popularity as a recreational diving site. The boulders found here are encrusted with coral, sponges, and macroalgae, providing diverse structural microhabitats for many benthic organisms, including several reef fish, some of which are believed to be under heavy pressure due to overfishing. This research represents a pioneering study at Tarou Point that presents the scleractinian species identified, the percentage of live cover of the species, and their frequency distribution at this site. It is hoped that the information collected from these studies will be used as a data resource from which future monitoring programs of the marine environment at Tarou Point, and other areas on the island, can be employed.

Methods and Materials

In order to estimate percentage live coral cover and scleractinian species frequency of distribution, a predetermined sampling size of 20 m^2 was used for all observations (S. C. Steiner, personal communication, 2001). A 1 m^2 quadrat, divided into 100 10 × 10 cm squares (each square representing 1%), was used for all surveys, thus facilitating estimations of percent cover. Twenty quadrat surveys were completed at each section. For the purpose of comparative studies, the rock was divided into four sections (Figure 2). Section A is a wall that drops from the surface to a wide area of rocky substrate encrusted by coral, sponge, and macroalgae. Depth ranges from 0–5 m. Section B is a wall that drops from the surface and gradually decreases in slope to meet a sandy bottom. Depth ranges from 0–12 m. Section C is a wall that drops to a sandy bottom. Depth ranges from 0–10 m. Section D is composed of two submerged rocky towers, North D and South D, that sit in 15 m of water. The smaller tower (North D) rises 5 m and the larger (South D) rises 10 m. Both sit on a sandy bottom. The length of substrate available at each section was measured to determine the sampling method. Sections A and C were found to be approximately 60 m, while site B was 40 m. North D and South D pillars were both found to be 10 m in length. The circumference of North D was 20 m, while that of South D was 30 m. The distribution of quadrats and placement method used (i.e., transect tape, line, or random) thus depended on the area available and the substrate inclination of each section. When two 30 m transect tapes or lines were employed (i.e., for a total 60 m transect at one depth), quadrats were laid down along the line every

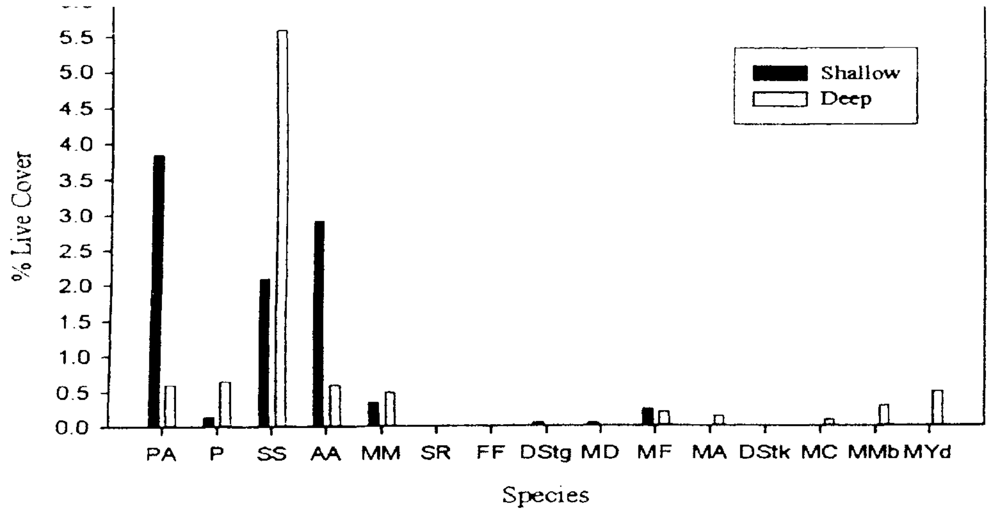

Figure 2.

3 m. However, in areas of limited substrate, 3 m intervals were condensed to 2 m increments. In some instances a random placement method of <1 m intervals, without a transect, was used. In the case of South D, only 5 quadrat surveys were conducted to account for the limited space. In some cases, an additional SCUBA diver was needed to hold the quadrats in place (i.e., along vertical wall sections of deep B, shallow and deep C, and the wall of South D). Both shallow (0–5 m) and deep (6–7 m) surveys of scleractinians in each section were carried out through snorkel and SCUBA observation, respectively. Surveys at North D and South D were done through SCUBA observation only, at a depth range of 5–11 m. A summary of observation depths and sampling methods used were recorded (Table 1). The in situ identification of scleractinian species, previously

Table 1
Sampling methods

Section	Depth (m)	Quadrat (Q) interval	Placement method	SCUBA diver holding quadrat
A shallow	3–4	3	transect tape placed and weighed down with rocks	N
A deep	6–7	3	transect line nailed to substrate	N
B shallow	4–5	<1	random-quadrats placed at given intervals at consistent depth	N
B deep	6–7	3	transect line	Y
C shallow	3–4	2	random	Y
C deep	6–7	2	Q 1–10 transect line; Q 11–20 random	Y
D north	10–11	2	5Q, random	N
D south wall	9–10	2	10Q, random	Y
D south top	5	2	5Q, random	N

Table 2
Scleractinian species identified at Tarou Point

Porites astreoides (PA)	*Leptioseris cucullata (LC)*	*Montastraea faveolata (MF)*
Porites porites (PP)	*Favia fragum (FF)*	*Stephanocoenia iniercepta (SI)*
Porites colonensis (PC)	*Diploria clivosa (DC)*	*Madracis decactis (MD)*
Siderostrea siderea (SS)	*Diploria strigosa (DStg)*	*Madracis mirabilis (MMb)*
Siderasinea radians (SR)	*Diploria labrynthiformis (DL)*	*Myctsophyllia danaana (MyD)*
Agaricia agarices (AA)	*Dichocoenia stokesii (DStk)*	*Colpophyllia natans (CN)*
Agaricia humilis (AH)	*Montastraea annularis (MA)*	
Meandrina meandrites (MM)	*Montastraea cavernosa (MC)*	

reported by Humann (1993) (Table 2), as well as estimations of percentage live cover (counting coral colonies within each quadrat), were recorded on underwater slates during each observation period. Shannon-Weaver diversity indices were calculated for each of the sections to analyze species diversity and evenness in frequency distribution within each section (i.e., shallow versus deep) and among all sections (Shannon & Weaver, 1948) (Table 3).

Results

The overall scleractinian species richness found at Tarou Point was 22 species. When compared against the background data of 32 species found along the entire west coast of Dominica (Steiner & Borger, 2000), Tarou Point represents a relatively diverse site. The majority of the species identified at Tarou Point were massive or encrusting species, such as *P. atreoides, A. agaricites, M. meandrites,* and *S. siderea,* which were the four species found at the highest average abundance over all sections observed. The frequency distributions of scleractinians for each section, along with the average frequency distribution per species over all sections, were also recorded (Figures 2–6). These were examined for the existence of possible distribution patterns between and/or within sections. Various small-colony species such as *Favia fragum* and *Siderastrea radians,* which

Table 3
Results of Shannon-Weaver diversity indices

Section	H'max	H'	J
A shallow	2.08	1.45	.70
A deep	2.30	1.34	.58
B shallow	2.40	1.58	.66
B deep	2.48	1.96	.78
C shallow	2.48	1.84	.74
C deep	2.08	1.83	.88
D north	2.08	1.33	.64
D south	2.30	1.51	.66

H'max = maximum possible species diversity within area (H'max = lnS, where S = number of scleractinian species found per section); H'max range: 0 < H'max < S, where S represents maximum diversity.

H' = actual (calculated) scleractinian species diversity (' = –ΣPi (lnPi), where Pi = %species cover/S)

J species evenness (J = H'/H'max); J range: 0 < J < 1, where 1 represents highest evenness of species distribution.

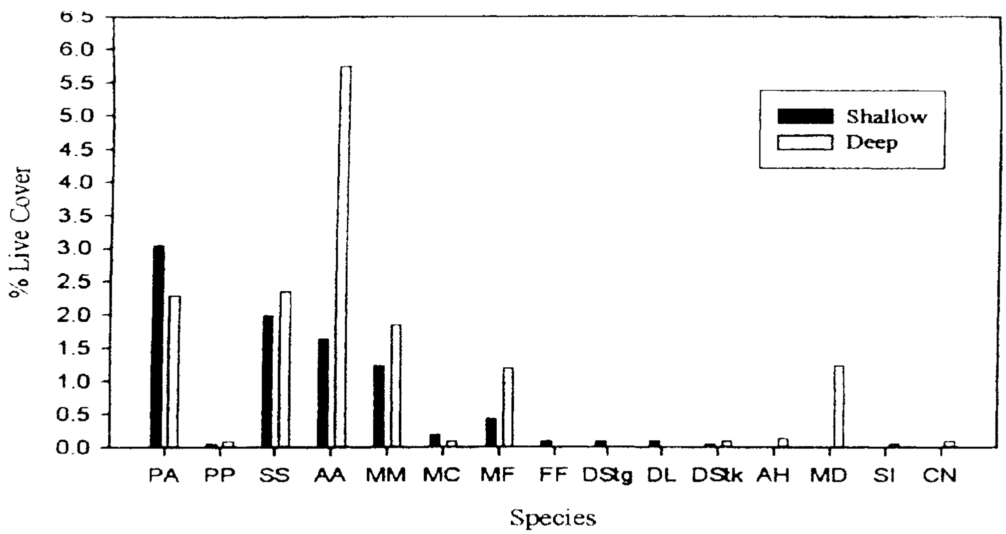

Figure 3.

were present in some surveys but never represented a 1% cover area, were still included on each of the figures.

Shallow Water Habitats

The species that covered the most area (in terms of percentage of live cover) within the shallow portions of sections A and B was *Porites astreoides,* while this species, along with *Agaracia agaricites,* were the most abundant in the shallow section of C, covering a total area of 4.0–4.5%. Other species commonly found included *Meandrina meandrites* and *Siderastrea siderea.* Scleractinians are polymorphic organisms and thus have species-specific responses to environmental and biotic parameters, as well as adaptive variability among individuals within a population. This polymorphic behavior was observed among the colonies of *P. astreoides* and *A. agaricites.* Section C consisted of a rocky wall located in a heavy surge zone, while section A was also characterized by high wave

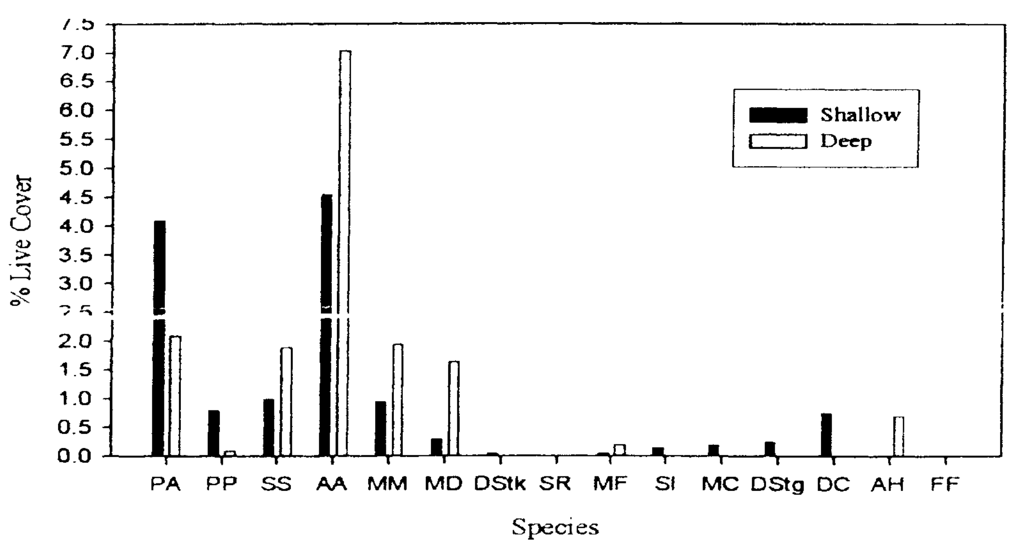

Figure 4.

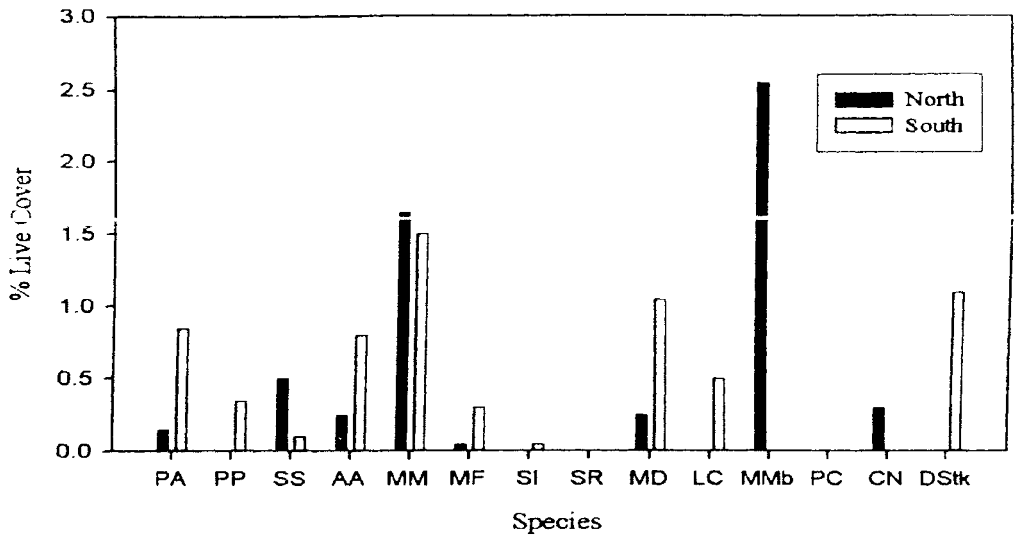

Figure 5.

energy. Colonies of *P. astreoides* observed in the shallow, surging waters of sections A and C were relatively flat and encrusting, while those found at section B, which consisted of a flat, submerged rocky ledge, were more mound-like. Because section B is completely submerged and flat, it does not suffer as much wave action or disturbance as the shallow sections of A and C. However, this section also receives less light penetration than the other areas. Forming mounds may be an adaptive advantage for *P. astreoides*, in order to increase its surface area exposed to light in section B. *A. agaricites* also has the ability to take on many growth forms (Humann, 1993). Thick or flat encrusting plates, thick bifacial upright lobes, and thick plates with bifacial extensions were all observed during this study. Polymorphism may be what enables these two species to be so successful in these shallow sampling sites. They are sturdy enough to withstand the rough conditions in shallow areas, yet can still capture sufficient light by taking on different growth forms in more submerged zones. These species are also relatively fast-growing species (S. C. Seiner, personal communication, 2001), and may out-compete other corals or marine organisms for substrate and light. Conversely, *S. siderea*, which

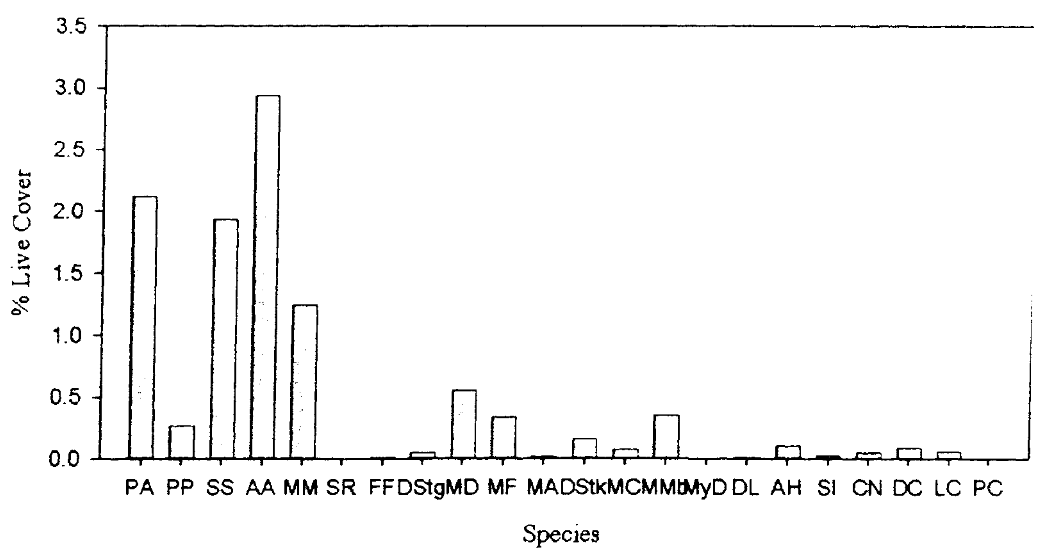

Figure 6.

was also a common species found at section B, is a slow-growing massive coral that forms large domes or boulders (colonies of up to 2–3 m in diameter). This species is most likely successful here because of its sturdiness and consequent longevity.

Deep Water Habitats

The species covering the most area within the deep surveys varied between sections. *S. siderea* was the most abundant within the deep portion of section A, covering a total area of 5.5%, while other scleractinians covered only minimal areas of 0.5% or less. The survey in section A was conducted along the seafloor, at 6–7 m depth, and consisted of sandy patches interspersed with coral-covered boulders. Because section A receives less wave action than section C, it is subjected to increased sedimentation because the area functions as a small circulating gyre. In addition, because of the increased nutrients circulating in the water column, macroalgae species, which compete with coral for light and space, were also the most abundant at section A, covering 6.2% of the area (Lehman, 2001). All of these factors may account for the low species diversity and low species evenness found here (Table 3). Again, as a sturdy massive species, *S. siderea* is more likely than other corals to withstand higher degrees of sedimentation or unstable substrate that exists in this sandy area. *A. agaricites* was the most abundant species found in the deeper portions of sections B and C. Colonies were also commonly found in shaded areas of the vertical rocky walls at these sections, and thus may be adapted to grow in minimal light conditions as well as in exposed shallow areas. *Madracis decactis* is another species adapted to low light areas of rocky walls, forming thinly encrusting small colonies. Colonies were also seen as tightly bunched lobes or knobs in more exposed areas of the walls. Both forms of this species composed approximately 1.5–2.0% of the area in both sections. *M. meandrites* was also prevalent in these sections. Again, this polymorphic species can form hemispherical heads or flattened plates and is adapted to a variety of conditions. Some are able to form in areas of coral rubble and sand and may not need to be firmly attached to the substrate (Humann, 1993). These characteristics are in accordance with the *M. meandrites* colonies found on the more unstable area of section B that contained an increased amount of dead coral (0.85%) and sand (11.95%) (Lehman, 2001). North D and South D were two submerged rocky pillars found in 15 m of water. *M. mirabilis* was the most abundant species found at North D, in which the flat top of the pillar, at approximately 10–11 m depth, was surveyed. This species was one of the few branching, nonmassive species found during this study, and was found here because these fragile colonies require deeper waters with less disturbance from wave energy (Humann, 1993). They are unable to grow outward on the rocky walls that were surveyed in other sections, and instead tend to form dense clumps of small branches. However, this species covered only a patch area of 2.5%, whereas the most abundant species at other sections covered 5.0–7.0% of the area. This is most likely due to the lack of substrate available at this section. Only five quadrat surveys were completed at North D. This also accounts for the lowest species diversity and the low species evenness observed here (Table 3). *M. meandrites* was the most abundant species at South D, in which both the vertical rocky wall (9–10 m) and the top of the pillar (5 m) were surveyed. *D. stokesii, M decactis,* and *P. astreoides* were also prevalent, yet each of these species covered less than 1.5% of the area within the section. This pillar was mainly composed of barrel and encrusting sponges, as well as bare rock (Lehman, 2001). It should also be noted that colonies of some species, such as *F. fragum* and *S. radians,* were found in high individual counts throughout a majority of the sections surveyed. Both of these species seem to tolerate high levels of surge and sedimentation. However, because colonies of these species reach a maximum size of only 5 cm and 30 cm, respectively (Humann, 1993), they did not compose more than 1.0% of the area within any of the quadrats during this study. Therefore, in terms of volume and cover, these species do not represent a major component of scleractinian community structure at Tarou Point.

Discussion

While the overall species richness at Tarou Point was relatively high, the results from the Shannon-Weaver diversity indices showed that species diversity within each section was relatively low (Table 3). This may be attributed to the lack of appropriate substrate in Dominica for coral growth. However, the maximum possible diversity calculated for this site was in the deeper portion of section B (H'max = 2.48), while the actual species diversity found here was 1.96. Sections North D and the deep portion of A represented the lowest H' = 1.33, 1.34). The deep portion of section B consisted of a vertical rocky wall, as well as a sandy area interspersed with a few coral-covered boulders located along the side of a submerged rocky ledge. Therefore, it is possible that the highest diversity was obtained here because a greater variety of habitats exist at this section, providing conditions for various species of coral to settle and grow, according to their species-specific requirements. The shallow portion of section C also exhibited high species diversity. Because this area is subjected to a high degree of wave action, especially when tropical storms occur, the high diversity may, in part, be attributed to the intermediate disturbance hypothesis (Connell, 1978; Karlson & Hurd 1993), in which small but frequent disturbances help maintain local species richness. An intermediate level of disturbance can therefore play a role in shaping coral community structure by keeping species interactions at low levels and preventing the elimination of inferior competitors. Conversely, the highest degree of species evenness resulted at the deeper portion of section C (see Table 3), while the deep section of A showed the lowest (J = .58). The high species evenness may be due to the fact that section C is a more nutrient-poor site with well-flushed sediments and increased water clarity (because of the high wave energy). These are optimal growth conditions for many species of scleractinians. Very few branching corals, such as *Acropora palmata* or *Acropora cervicornis*, were seen during this study. Although some branching species prefer high wave impact conditions (i.e., along the west coast of Dominica exposed to tropical storms) because they are fast growers and are capable of fragmentation and rebuilding, the level of wave energy, along with Dominica's characteristic shelf, would cause branching colonies to break, fall, and get washed away into deep waters. For example, a large *A. palmata* located at a site along the west coast of the island was toppled over by the force of Hurricane Lenny in November 1999. This colony fell into the sand of deeper waters and has never regrown (S. C. Steiner, personal communication, 2001). However, there is also evidence of a regional decline of *A. palmata* over the entire Caribbean (Lewis, 1984; S. C. Steiner, personal communication, 2001). It is possible that these events are linked to the absence of branching corals at Tarou Point. Because coral reef ecosystems are complex natural communities, there are several factors that can affect scleractinian community structure. Depth, along with light and substrate availability, are key abiotic factors controlling coral distribution and abundance (Cornell & Karlson, 2000; Huston, 1985). This is especially the case in Dominica, in which the narrow, deep shelf limits the amount of appropriate substrate available for coral growth, of which Tarou Point provided an accurate demonstration. Physical and environmental stresses such as sedimentation, turbidity, wind and wave action, eutrophication, and subtle temperature changes, may also contribute to local species richness and distribution patterns (Edmunds, Roberts, & Singer, 1990). Depending on the size of habitat and the resources available within that area, species interactions, both inter- and intraspecific, can also play a role (Cornell & Karlson, 2000). Connell (1978) concluded that species diversity is a nonlinear function of disturbance frequency, but that this response is dependent on coral growth rates (light levels and water clarity). This may have been the reason for the high species diversity in the shallow portion of section C, where the heavy wave action functioned to hush out excess sedimentation, providing clear, well-lit waters, and also acted as frequent disturbances to prevent any one species from becoming extremely dominant, which resulted in higher local species richness. All of these factors should be considered when discussing the local species richness and community structure of scleractinians.

Management Implications

Numerous international conferences concerning coastal zone management for SIDS have occurred in the past decade, such as the 1992 Rio Earth Summit, which established Agenda 21 and the Rio Declaration Principles and emphasized the need for sustainable development and natural resource conservation (Earth Summit, 2002), and the Global Conference on the Sustainable Development of SIDS, held in Barbados in 1994, which served to implement Agenda 21 and highlight the economic and ecological vulnerabilities of SIDS. The Barbados Programme of Action was adopted at this conference, which formulated actions and policies to support sustainable development for SIDS (UNEP, 1994). However, despite international efforts, the state of economic fragility in Dominica, and in SIDS in general, is often incapable of supporting the actions suggested by these conferences, and the funding expected is not always delivered. For instance, funding for the implementation of Agenda 21 has decreased instead of increasing as promised (Earth Summit, 2002). Globalization, a prominent issue facing SIDS, has added to these economic problems and is challenging Dominica's traditional dependence on agriculture and agricultural export as its primary economy, leading to the decline of the banana industry on the island. The declining focus on agriculture has led to shifts in employment availability and thus to increased coastal migration, as younger generations who do not want to associate with agricultural work head to the coasts in search of better employment opportunities, which they generally do not find. Some resort to other options, such as spearfishing, which has recently introduced new fishing pressures in Dominica (S. C. Steiner, personal communication, 2002).

As the problems associated with unsustainable resource use and globalization continue, SIDS are forced to look for economic alternatives, which often include tourism and development expansion projects. Dominica supports only a small industry of ecotourism, due to the lack of white sandy beaches, large airports, hotel chains, and casinos. However, the severity of the economic situation is forcing the government to depend more on tourism as its primary industry. There are currently three to four main cruise lines that visit Dominica, with about four ships coming in steadily on a weekly basis for the past 15 years. Yet until 10 years ago, no formalized tour guide system had even been established (C. Allan, personal communication, 2001). Approximately 200,000 travelers arrived by cruise ships in 1996, a 42% increase since 1995 (Bly, 1997, p. 1). Currently, Dominica receives approximately 250,000 cruise and 75,000 stay-over visitors annually (Christian, 2001, p. 3). Dominica opened its first U.S. tourism office in December 1996, and 13,500 American visitors were recorded that year, a 25% increase from 1995.

Waste management and sedimentation have been the main pollution issues affecting the coastal zone in Dominica, as the laws regarding waste management exist on paper, yet are not properly monitored or enforced. The increased visitation levels due to tourism have already contributed to increased coastal pressures and environmental degradation by pollution, inappropriate development, resource misuse, and improper waste management (McLawrence, 2001; Raymond, 2001). Because of Dominica's topography, most development or construction results in deforestation, landslides, agricultural run-off, and increased pollution and sedimentation directly into Dominica's waters. In addition, the products from the maintenance and operation of these infrastructures, along with the input of chemicals from factories, photoshops, and hospitals introduce high nutrient and toxin concentrations into the seas, increasing the biological oxygen demand of marine organisms and potentially suffocating organisms such as sponges and coral.

Past and present efforts to encourage coastal management and environmental conservation include beach cleanups (i.e., through Caribbean Development Bank/UNESCO projects) and beautification projects (i.e., replanting trees after hurricanes). The National Development Corporation, which is responsible for promoting Dominica as a suitable investment location and tourism destination, has also discussed initiatives to establish a Centre of Nature Excellence and a Centre for Ecotourism Research and Training on the island to help ensure sustainable development and ecotourism (McLawrence, 2001). The 2001 Commission on Sustainable Development for Intersectoral Action (CSI) workshop in Dominica outlined several projects that have recently begun and are aimed at increasing awareness and local voice in coastal management. For example, LINKS (Local and Indigenous Systems in a Global Society) emphasizes the importance of "traditional" knowledge and the empowerment of local and indigenous communities in sustainable development. The SIVs Project (Small Islands Voice Project) aims to overcome the isolation of small islands by strengthening local, regional, and inter-regional awareness, communication, and capacities (Cambers, 2001). However, in order to prevent further degradation and promote sustainable tourism and development, closer cooperation and communication, as well as full participation, among stakeholders, is necessary. Increased mobilization of funding should also be emphasized. The traditional top-down planning and decision-making process that persists on small islands limits local voice from contributing to management decisions. The majority of civil society is not provided with accurate or sufficient information on the choices being made. It was suggested at the CSI workshop that local administration on the island needs to emphasize equal participation, education, cultural sensitivity, and the sharing of research and information resources, locally and regionally, in order to increase local capacities, expertise, and self-reliance. It was also suggested that UNESCO increase its level of assistance with education, research, and promotion of Dominica's interests on a global level (Burton-James, 2001). In addition, the varied interests and expectations among fishermen, tourism and recreational sectors, government officials, nongovernmental organizations, and local communities will call for a greater focus on conflict management as the pressures on Dominica's coastal zone increase. It is important that development and conservation efforts are not conducted independently of other sectors of the national economy. In order to achieve long-term success and sustainability of efforts and resources, increased collaboration, coordinated education and training programs are necessary, as well as short- and long-term planning and monitoring strategies. Tarou Point provides a prime example of this. Little has been studied regarding the short- and long-term implications of the impacts of excessive intrusion on coastal soils due to construction. However, heavy construction over the past few years at Tarou Point has increased sedimentation and resulted in extremely turbid waters at this site, making attempts to monitor the marine environment here extremely difficult (S. C. Steiner, personal communication, 2002). It is imperative that those involved recognize that coastal zone management is a dynamic and integrated process that will require constant monitoring and reviewing in order to adapt to the ongoing changes in environmental, economic, and social conditions on the island.

Dominica may be behind as a major tourism destination in the Caribbean because of its inability to develop the desirable infrastructure, but it has made progress in its natural resource development and protection. Since the 1950s, Dominica has designated over 40,000 acres as national parks and reserves and has recently had its first national park, Morne Trois Pitons, designated as a World Heritage Site by UNESCO (Kinas, 2002). However, the majority of the preserved areas on the island are terrestrial; minimal efforts have been made to research, monitor, and protect the marine environments on the island. The only action recorded thus far to protect marine resources in Dominica is the Scotts Head/Soufriere Marine Reserve (SSMR), located on the southwest coast of the island. The SSMR was established in 1998 in response to increasing competition for marine resources between the traditional fisheries and the recent onset of diving and tourism. The main goal of the SSMR has been the reduction of user conflicts through the allocation of use-specific zones. LAMA, the Local Area Management Authority, which consists of various local stakeholders, is responsible for the overall management and enforcement of SSMR. Education, marine resource conservation, preservation of traditional fishing culture, and economic development are the primary objectives of the reserve. The greatest obstacles to accomplishing these goals remain the same; lack of financial and human resources, and insufficient enforcement and implementation of management policies originally established on paper. Tarou Point is just one example of an area on the island that contains valuable marine resources. As such, this site needs to be monitored on a regular basis to determine phase changes in community structure and the causes of these changes. Factors such as coral cover and distribution, algal growth, and reef fish community structure can all be useful measuring tools of coastal degradation by acting as indicators for the extent of pollution, nutrient concentrations, sedimentation rates, and other natural or anthropogenic impacts occurring on the island. Regular monitoring of the marine environments throughout Dominica, through the use of these tools, are pertinent to achieving successful, integrated management and avoiding further degradation of important coastal and marine resources.

Conclusion

The intention of this research was to study an area of Dominica that is of concern because of high-pressure artesanal fishing and its growth as a popular diving destination. A very limited amount of research has been performed on the marine environment in Dominica, and no quantitative studies on the coral communities at Tarou Point had been conducted previously. Because each survey was conducted only once, statistical analyses were not calculated for this study. It would be extremely beneficial to repeat these surveys at Tarou Point in the near future. Determining what factors shape local scleractinian community structure is difficult not only because of the high degree of polymorphism and species-specific responses of these organisms, but also because research methods and concepts such as "substrate heterogeneity" or "high levels of disturbance" are not universally defined. The results of this study were presented to representatives of the Ministry of Agriculture and Environment, Government of Dominica, and other pertinent environmental organizations on the island with hopes of providing a database by which to facilitate further monitoring. However, it is unclear whether these organizations have progressed with any further monitoring of this site. The Institute for Tropical Marine Ecology (ITME), which is currently the main organization involved with monitoring the marine environment around Dominica, is in the process of generating an initial database that is both accessible and user-friendly (S. C. Steiner, personal communication, 2002) The main objective behind this project is to provide decision makers on the island with accessible information that defines and quantifies the marine resources in Dominica *before* decisions regarding the use and management of natural systems are made. However, as previous coastal management cases in SIDS have shown, the success of such a project will depend directly on the level of technical capacity, training, funding, and the abilities and willingness of the people and government of Dominica to commit to continuous monitoring and management. Therefore, it is hoped that this study will also serve as a model to raise public awareness and emphasize the importance of monitoring marine and coastal resources throughout the island in order to prevent further degradation.

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