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Source: Tropical Conservation Science, 1(1) : 18-33

Published By: SAGE Publishing

URL: <https://doi.org/10.1177/194008290800100102>

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Conservation Letter

Belize's Ecosystems: Threats and Challenges to Conservation in Belize

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Abstract

Belize, for its small size, is remarkably diverse ecologically and culturally. However, its forests and marine resources are under significant threat, mainly from high deforestation rates, improper solid waste management, rapid coastal development, increasing poverty, weak institutional and legal frameworks, and the recent discovery of sweet crude oil. Sustainable solutions to these challenges will require innovative, practical, and cost-effective strategies that involve all stakeholders and that seek to improve the socio-economic conditions of these stakeholders. Belize's network of protected areas must be managed transparently, utilizing best management practices and informed by applied scientific research, if the biodiversity they contain is to be maintained

Keywords: Belize, deforestation rates, protected areas, management practices, coastal development, conservation

Received: 16 January 2008, Accepted: 14 February 2008, Published: 3 March 2008

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Cite this paper as: Young, C. 2008. Belize's Ecosystems: Threats and Challenges to Conservation in Belize. *Tropical Conservation Science* 1(1):18-33. Available online: tropicalconservationscience.org

Introduction

Belize, located between 15°52' and 18°30' North Latitude and 87°28' and 89°14' West longitude, is the second smallest country in Central America, measuring 280 km from north to south and 110 km from east to west with a land area of 22,963 km² [1] (Fig. 1). Topographically, the country is divided into two physiographic regions: the northern lowlands consisting primarily of limestone and sandy soils and southern coastal plains and the Maya Mountains dominated by granite, quartzites, and shales formed during the Cretaceous and Permian [2]. The northern lowlands are dominated by lowland, semi-deciduous forests, and savannas with numerous freshwater rivers, lagoons, wetlands, and swamps, while coastal lagoons and mangroves along the coast. The southern plains and Maya Mountains are dominated by submontane and montane broad leaf forest interspersed with pine (*Pinus caribaea* var. *hondurensis*) savannas [2]. This varied topography, geology, and strong seasonality of rainfall accounted for 85 ecosystem types being recognized within the country [2], with lowland broadleaf forests, submontane, and montane broadleaf forests 51% and 10%, respectively.



Fig. 1. Map of Belize showing neighboring countries. Source: *Belize*. [Map/Still]. from Encyclopedia Britannica Junior, February 2008, : <http://junior.britannica.com/eb/art-62317>

With a population of only 300,000 inhabitants [3], Belize's population density of 10 individuals/km² is the lowest in the region [4]. For its size, Belize is ethnically diverse. Meztizos, Creoles and Garifuna are the three largest groups with 49%, 25% and 6%, respectively, while the Q'eqchi', Yucatec and Mopan Mayans collectively make up 11% [5]. Until recently, most of the country's population was rural; however, due to increased internal migration, the majority of the population now occurs within the coastal zone [5].

Overview of Conservation Issues in Belize

There are currently **six major environmental issues** impacting Belize's natural resources. While these issues are by no means exhaustive, they represent the most pressing issues. High deforestation rates, improper solid-waste management, rapid coastal development, increasing poverty, weak institutional and legal frameworks, and the recent discovery of sweet crude oil all pose significant threats to Belize's ecosystem. Additionally, there are a number of other issues that impact conservation as well as the ability to conserve natural resources; these include the continuing threat posed by climate change, lack of research infrastructure, lack of graduate research programs in the natural sciences, and lack of Belizean role models in the sciences to stimulate interest in pursuing career paths in the natural sciences. Unless Belize is able to adequately respond to these challenges in a timely manner, the environment that has been the mainstay of the Belizean economy will be severely impacted. This paper discusses my opinions on these issues in addition to a number of other factors directly relevant to conservation and sustainable development in Belize.

1. High Deforestation Rate

Belize, compared to the rest of Central America, boasted an extremely high forest cover until the 1960s when large-scale agriculture replaced forestry as the mainstay of the Belizean economy [6]. Over the last five decades, large-scale agriculture (citrus, bananas, sugar cane) and, more recently, large-scale aquaculture (shrimp and tilapia farming) have escalated at the expense of the forests. Coupled with rapid and increasing coastal development, illegal logging, and slash-and-burn agriculture, Belize is currently experiencing a deforestation rate that is twice that of Central America (2.3% vs. 1.2% annually). The riparian deforestation rate is even more acute at over 13% annually [7]. If current rates continue unabated, the forest cover will decrease to 58% by 2020 [8] and will be gone within the next 40 years.

Increasing incursions by illegal Guatemalan immigrants into Belize forests and protected areas for farming, hunting, and harvesting non-timber forest products have become acute in recent years and have contributed to the already high deforestation rate. In October 2007, an additional 13,000 acres of forests were illegally cleared in one of Belize's largest and most remote protected area (Lenny Gentle, personal communication, 2007). This issue of illegal incursions is a sensitive one because it is compounded by the long-standing territorial claim over Belize by Guatemala. Recently, efforts by the Organization of American States (OAS) to foster bilateral negotiations to settle the territorial dispute between the two countries failed to find an amicable solution; OAS has since recommended that Belize take the territorial dispute to the World Court [9]. This issue is compounded by the general sentiments among Guatemalan peasants that Belize is "theirs." Besides the illegal clearing of forests for farmland, these illegal immigrants also engage in illegal hunting, harvesting of non-timber forest products (e.g., *Chamedorea* palms), and the looting of cultural artifacts from within the Chiquibul Forest Reserve (Lenny Gentle, personal communication, 2007). The magnitude of these impacts is still to be ascertained. Any efforts or solutions to this problem must involve both governments as well as grassroots organizations and people (Fig. 2).

Outdated government policies also aid the deforestation rate in the country. Leased lands that are forested must be "developed" by the owners or their leases can be revoked. As a result, there is an enormous incentive for landowners to clear the land in an effort to meet the requirements of "development." Inevitably, forested lands are converted to alternative land uses; however, a significant number of properties just lie idle after they have been cleared because the landowners lack the capital to meaningfully engage in alternative land use. Simple amendments to the existing land-tenure legislation can have a significant impact on the deforestation rate and the subsequent fragmentation of Belize's forests.



Fig. 2. (a) View of Doyle's Delight, the highest point in Belize, (b) Slash-and-burn agriculture in Chiquibul Rainforest Reserve, (c) Black howler monkey eating cashew (*Anacardium occidentale*) at Community Baboon Sanctuary, (d) Creole drummer. Photos by Shannon Kenney

2. Soil and Liquid-Waste Management Issues

Belize produces ca. 200,000 tons/year of solid waste from household and commercial establishments, equivalent to between two and three pounds/day for each Belizean [10]. While the amount of solid waste being generated per capita is low for the region, the inability to properly dispose the wastes pose another serious environmental threat to Belize that is already causing health issues and land and water pollution, including pollution of Belize's Barrier Reef System—a World Heritage Site and the longest barrier reef in the Western Hemisphere, extending approximately 280 km along its Caribbean coast and covering approximately 1,400 km. The incapability of the country to properly dispose of solid waste is evident by the overflowing landfills readily observed from the nation's highways. Currently, none of the landfills in the country are properly sealed to prevent the leaching of pollutants into ground water. The large amount of industrial waste generated by large-scale industries (citrus, sugar, bananas, tilapia, and shrimp farms) also ends up in the country's landfills, which further compounds the

problem. Solid wastes in landfills are frequently burned, a practice that is environmentally harmful with serious health implications.

Likewise, the country is also unable to adequately deal with its liquid waste. As a result, inadequate liquid-waste management is contributing to natural-resource degradation in addition to raising health implications. Considering that the majority of Belize's population and industrial activity (e.g., shrimp and tilapia farming) occurs in the coastal zone, the inability to properly treat sewage waste poses a continuing and serious threat to the marine ecosystem and the Barrier Reef System. At present, only three population centers have sewage waste-treatment facilities (Belize City, Belmopan [capital], and San Pedro); even in these municipalities, the majority of the residents are not connected to the system but instead rely on septic systems. The rural population relies on pit latrines and septic systems, with the latter becoming more prevalent. Though the majority of the country's residents have access to potable water, a significant number (e.g., the Belize River Valley area) lack access to potable water; these residents rely on river, well, and pond water to meet their needs, which leads to a high incidence of gastrointestinal maladies among rural populations.

The liquid-waste issue is further exacerbated by the large number of cruise tourists who visit the country annually. Since 2004, when the country took a noticeable shift from embracing ecotourism to preferring large-scale mass tourism, over 800,000 visitors now visit our shores annually, with all expectations that a million visitors will soon visit annually [11]. This number of visitors represents a tripling of the Belizean population of 300,000 people. Not surprisingly, the country lacks the appropriate infrastructure (e.g., solid-waste and liquid-waste facilities) and an enforcement mechanism (e.g., monitoring) to deal with such a large number of visitors. Incidentally, the majority of cruise-ship passengers visit attractions within two hours of Belize City, most of which lack any sewage or solid-waste infrastructure to manage the waste left by tourists. In many instances, solid waste ends up in landfills where it is burned, while the liquid waste leaches into the environment.

3. Rising Poverty Rates

The rising incidence of poverty in environmentally fragile areas is also threatening Belize's ecosystems. Currently 33% and 10% of Belize's 300,000 people are below the poverty line or indigent, respectively [12]. Consequently, these people are forced to rely on subsistence agriculture where they slash and burn the forests; often they squat on and farm public lands. Additionally, the economic incentive obtained from harvesting forest products (e.g., medicinal plants or wood carving, bush meat, or cultural artifacts) leads to the overharvesting of many species (e.g., parrots, turtles) and illegal sale of artifacts on the black market. The majority of these poor people are located in areas with high forest cover and biodiversity. Thus, these areas are experiencing some of the highest deforestation rates. Poverty exacerbates environmental degradation because disadvantaged populations have more urgent concerns than implementing conservation practices. Any attempt to conserve the natural environment in these ecologically sensitive areas must include innovative solutions to improve the socio-economic conditions of the communities that buffer these areas.

4. Rapid Coastal Development

Rapid and uncontrollable coastal development for residential and commercial purposes is an escalating threat to Belize's coastal zone. A recent study estimated that 75-80% of all coastal land in Belize has been purchased by foreigners who will develop the land into condos, resorts, or residential properties [13], usually at the expense of the mangroves and littoral forests. Although Murray et al. [14] reported that 98% percent of Belize's original mangrove remained throughout the country, the situation is rapidly changing; two years later, in 1992, the mangrove

deforestation rate averaged a 0.7% reduction nationally due to increased urban expansion and tourism development. Near population centers, the annual rate of destruction of mangroves is 3.6% per year [15]. The situation is exacerbated by the fact that a majority of the aquaculture industry, primarily shrimp and tilapia farming, are located within the coastal zone [16] and pose a direct threat to coastal ecosystems. Instituting land rent for properties owned by foreigners [13], in addition to creating an effective land zoning policy and enforcement of environmental regulations, will control this rapid development.

5. Ineffective Institutional and Legal Frameworks

Belize currently suffers from ineffective institutional and legal frameworks that inhibit enforcement of environmental regulations. The enforcement agencies lack financial resources and personnel to enforce regulations. Likewise, the agencies that are in charge of safeguarding Belize's natural resources also lack the personnel, capacity, and financial resources to sustainably manage these resources. Many of the policies and laws are outdated and need revision. The recent completion of the National Protected Areas and Systems Plan to guide the management of protected areas in Belize is a step in the right direction. If implemented, the Policy and System Plan will remedy many of the institutional and legal issues, including the removal of "ministerial discretion," a loophole that gave ministers discretionary powers to de-reserve protected areas without the need for public consultations [17]. Discretionary powers of ministers extend beyond the designation/de-reservation of reserves; in many instances ministers approved projects that the Department of Environment rejected [17]. Some of the most pressing issues that currently challenge Belize institutions include illegal harvesting of flora and fauna, illegal hunting, illegal logging, looting of the extensive cave system, and the increase in the introduction of invasive species. The lack of coordination and cooperation among governmental ministries involved in conservation continues to plague any efforts to improve these inadequacies.

6. Oil Discovery in Belize

In 2002, sweet crude was discovered in western Belize. With millions of barrels of oil in proven reserves and the expectations of millions more to be discovered, the number of prospectors has increased substantially. Oil exploration licenses have already been issued to 17 oil companies for a significant portion of Belize's land and sea, except for the Maya Mountains in south-central Belize [18]. Furthermore, when the geology and petroleum map is compared to the protected areas map, the majority of these potential oil reserves occur within protected areas. Consequently, the oil industry, initially greeted with much enthusiasm within the country, now poses a new threat to Belize's ecosystems. With the current price of oil, there will be tremendous pressure and temptation by the government to make the necessary legal amendments to the protected-areas policy to allow oil exploration and production at the expense of further destruction of forests and potential pollution of watersheds and the marine environment via oil spills. The fact that the government can use "ministerial discretion" to de-reserve protected areas does not bode well for the status of Belize's system of protected areas. The lack of experience of our institutions in adequately mitigating oil-related risks behooves the development of appropriate safeguards to protect Belize's ecosystem. The earmarking of a small percentage of oil revenues for conservation and capacity building of personnel can have a tremendous impact on conservation efforts in Belize. In fact, these kinds of partnerships can be mutually beneficial for all stakeholders involved.

Belize and Climate Change

Any discussion of environmental issues affecting Belize would be incomplete if it did not include the significant threats posed by climate change. Climate change was excluded from the six most pressing issues because I believe that in the short term the environmental issues such as high deforestation rates, inability to properly manage solid and liquid waste, rising poverty rates, and escalating coastal development are more pressing concerns than climate change in Belize. The rate of change of all these issues is alarming and if nothing is done, they have the potential to significantly impact Belize's environment in the very near future. However, in the medium term, climate change poses a serious and significant threat to Belize. The majority of Belize's population lives in the coastal zone; consequently, rising sea levels, as a result of climate change, can have severe impacts on coastal populations, including the largest population centers that are near sea level. Rising sea levels and sea temperatures also negatively impact the Barrier Reef system that supports a thriving fisheries and tourism industry in Belize. Increasing sea temperatures have already led to massive coral bleaching within the Belize reef system, which has caused the highest reduction in live coral cover in the region since 1998 [19]. Coupled with disease (e.g., white band) and natural disturbances (e.g., hurricanes), climate change has led to an 80% reduction in live coral cover on portions of the reef over the last 20 years. Belize now boasts a coral cover of 13-15%, which is less than the 20% average for the Caribbean [20]. Considering the economic contribution of Belize's barrier reef to its economy (US \$150 million/year) [20], continued negative impacts can and will have devastating impacts on the Belizean economy.

Belize lies within the hurricane belt and most of the eastern portion of the country is slightly above sea level [20]. The constant threat of hurricanes, expected to increase in both frequency and intensity due to climate change, remains a real threat to Belize's coastal populations, coral reefs, and protected areas. With the weakening, and in some cases the destruction, of the reef system, the ability of the reef to buffer the tidal impacts from hurricanes will be substantially reduced, thereby increasing the economic costs from the destruction of property and from coastal erosion. Coastal erosion is already a major issue throughout the country's coastline [16]. Rising sea levels and increasing storm activity as a result of climate change will only exacerbate the erosion.

Because climate change can also impact the distribution and intensity of rainfall patterns, Belize's agricultural industry will also be affected. Agriculture is Belize's largest economic contributor to GDP; thus, any significant impact to this industry would be equally devastating. Increased sea levels are expected to increase salinization and salt water intrusions in addition to inundating agricultural land [16]. Though tropical ecosystems may be resilient and have the ability to bounce back after these types of intermediate disturbances, the concomitant anthropogenic impacts may decrease the resiliency of these ecosystems to the detriment of the ecosystems and economy of Belize.

The Challenges for Belizean Scientists

Belizean scientists, like many scientists from small developing countries, face a number of challenges that are difficult, but not impossible, to overcome. Foremost among these is the absence of a culture of conducting research as well as the research infrastructure to support in-country scholarship. Indeed, most of the research conducted and published on Belize has been conducted by foreigners. None of the educational institutions in Belize are research institutions per se; they are primarily teaching institutions. Consequently, active research labs maintained by faculty conducting research are absent from Belizean tertiary institutions.

Secondly, because research in the natural sciences by Belizean scientists is still in its infancy and because there are no educational institutions with active research programs in-country, it is

extremely difficult for Belizean scientists to compete internationally to obtain grant money to conduct natural science research in Belize. Most of the funding for research comes from a handful of local and international NGOs currently conducting work in Belize (e.g., Wildlife Conservation Society, World Wildlife Fund, Protected Areas Conservation Trust). Even so, most of this funding is now being diverted to the marine realm (Bruce Miller, personal communication, 2007). Those scientists interested in terrestrial ecosystems find it particularly difficult to secure funding, even for applied conservation-oriented research. One solution to reduce this shortfall is for Belizean scientists to forge collaborative research opportunities with scientists from research-oriented institutions in the US or elsewhere. Such programs have the potential to be a win-win situation for all parties involved.

Thirdly, because the tertiary institutions are primarily teaching institutions, faculty normally has a very high course load every semester. It is not uncommon for some faculty to teach as many as five courses every semester (Roy Young, personal communication, 2007). As a result, faculty members have very little time to engage in research. In many ways, the administration of our tertiary institutions fails to appreciate the importance of research, particularly because research has never been a priority for these institutions or in the country. The “publish or perish” mentality is absent in Belize, to the detriment of the applied research so badly needed within the country.

Finally, there is very little investment in research by the government of Belize. Compared to other countries in the region (e.g., Costa Rica), the Belizean government’s investment in natural science research or in infrastructure is miniscule, despite the economic contribution of the protected areas network to the Belize economy. Recently, there has been an increase in the number of research stations as the number of non-governmental organizations (NGOs) increases in the country. Most, if not all, of the researchers at these research stations are non-Belizeans. Even though some of these research stations offer Belizean rates, the reduced rates are usually still prohibitive for many aspiring non-funded Belizean scientists to afford.

How Can More Belizeans Become Scientists?

Having strong, creative teacher education programs in the sciences for primary- and secondary-level teachers is a necessary first step to excite students in pursuing careers as scientists. However, teachers themselves need training and capacity building to bolster and improve their knowledge in the natural sciences. More scholarship opportunities for Belizeans to pursue careers in the natural sciences will make it feasible for Belizeans to pursue such careers and thus produce a cadre of trained professionals to teach our children. Once the number of scientists increases, younger generations will have role models they can emulate. Most Belizeans, like minorities in the United States, tend to choose career options in business, medicine, law, and education with very few pursuing careers in the natural sciences. While this is partly historical, the lack of role models is also a significant factor.

Currently, Belize offers no graduate degree program in the natural sciences. As a result, the cost of pursuing advance training in the sciences is prohibitive, because Belizeans must leave Belize to find graduate programs in Central America, the Caribbean, the US, or elsewhere. Tertiary-level institutions in Belize must begin to offer quality and accredited degree programs in the natural sciences with research being a priority. Although the pool of trained Belizean scientists in this area is small, it is growing and the in-country capacity certainly exists to make a start. Sister partnerships with local and international institutions can temporarily fill human resource gaps that are sure to exist when such programs are in their infancy.

Based on my experience teaching in Belize, Belizean students are enthusiastic about becoming involved in conservation. However, this enthusiasm is not directly translated into these students’ pursuing careers in conservation due to the reasons mentioned above (few role models, historical predisposition to other fields, and lack of graduate programs). Another factor is the

perception that the salary in the conservation field is uncompetitive. Students need to be convinced that careers in conservation are extremely rewarding notwithstanding the large number of challenges. Being engaged in conservation will introduce students to the current realities and complexities surrounding conservation and force them to examine the inter-relationships that exist between the realities of the Belizean landscape: high poverty, high unemployment, limited personnel, high deforestation rates, paper parks, etc., and conservation. The issues that led us to the point where we must now conserve are multifaceted; as such the solutions must be innovative and equally comprehensive. As young Belizean scientists, they can meaningfully participate in this dialogue and contribute to finding solutions to the challenges that Belize is currently facing and will continue to face in the future. As the impact on Belize's environment becomes more pronounced, we will also need more trained natural scientists who can contribute to finding a balance between conservation and development.

Implications for Conservation

1. How Can Conservation Efforts in Belize be Improved?

International and local NGOs have a large role to play in assisting conservation efforts in Belize (Appendix 1). However, their role must be limited to technical transfer of expertise and capacity building among the local NGOs, government departments, and local stakeholders to allow them to effectively and efficiently manage Belize's protected areas and natural resources. The agenda of international NGOs must become less esoteric and more responsive to the socio-economic, political, and environmental challenges currently facing the country. Rather than each NGO having its own mandate and conservation priorities, they must improve coordination and collaboration and pool their financial and other expertise to achieve the most urgent conservation objectives.

Secondly, both national and international scientists must do more to engage the public and especially students in becoming excited about nature and conservation in order for us to build a cadre of trained Belizean scientists. Internship opportunities both locally and abroad will expose these students to new horizons and introduce them to field of conservation. Bioblitz-type activities with adequate media coverage and student involvement can showcase the work and importance of biodiversity to the public. Belizeans must also begin to demand that the government invest more money in natural science research and infrastructure in addition to ensuring that public agencies (e.g., forestry department) have the capacity, personnel, and financial resources to adequately manage Belize's natural resources.

Though much research is conducted in Belize in a variety of disciplines and taxa, very rarely is the research easily available and accessible to students, scientists, conservation stakeholders, and policy makers. Subscribing to academic journals is prohibitive for most institutions and small organizations in Belize. Consequently, the findings from research done in Belize are rarely utilized in the management and decision-making of protected areas or in educating students or persuading politicians. Recently, the Ministry of Natural Resources launched the Clearing House Mechanism (CHM) website (<http://www.chm.org.bz/>) as part of the commitment to the Convention of Biological Diversity. This site should serve as a repository for research papers on Belize. Biodiversity and Environmental Resource and Data Systems of Belize (BERDS) is another excellent repository of Belizean-based research (<http://www.biodiversity.bz>). Though the CHM and BERDS are welcomed and timely, a niche exists for NGOs to serve as intermediaries between scientists and the public, including conservation managers and stakeholders, to essentially translate the scientific findings into lay language so as to allow comprehension and incorporation, where appropriate, into management of Belize's resources.

Lastly, lack of funding for in-country research remains a serious impediment to aspiring Belizean scientists. Funding, utilizing a number of fundraising approaches as well as the expertise of the conservation community, must be identified and earmarked for applied natural science-based research that can provide scientific arguments for factoring into policy development and decision making. In the meantime, individual donations to worthy Belizean organizations actively engaged in conservation will continue to go a long way in protecting Belize's natural resources.

2. The Best Way to Manage Belize's Natural Resources

Considering these realities, what is the best way to manage Belize's natural resources? There is no "best" way to manage the forest resources in Belize, because these forest resources face a number of different threats based on their designation (e.g., forest reserve vs. wildlife sanctuary), location, access, management capacity, and financial resources. What is apparent is that forest resources in Belize need to be managed in a more holistic and transparent manner using best practices (e.g., co-management) and best-management guidelines and criteria, and that local people must be empowered and receive economic benefits from conservation. Management decisions should be based on clear scientific criteria where appropriate rather than on an ad hoc, piecemeal basis. The protected areas network must be viewed as a network and its management must be integrated. Governmental ministries with mandates to protect Belize's natural resources (National Institute of Culture, Ministry of Tourism, and Ministry of Natural Resources and the Environment) must begin to coordinate, cooperate, and pool their energies and expertise for the benefit of the system as a whole.

Empowering local communities and local people, where appropriate, to become stewards and co-managers of forest resources is also paramount. Educating local people on the importance and necessity of conservation is prudent; however, education alone will never be sufficient. By empowering them to become stewards of their environment, local people will become an integral part of the decision-making process as it relates to conservation and development. The experience and successes of the Community Baboon Sanctuary and the Toledo Institute for Development and Environment (TIDE), among other initiatives in Belize, demonstrate that co-management of forest resources is a viable and sustainable strategy for managing natural resources for the long term. Co-management of Belize's natural resources, in which local people partner with governments to protect natural resources, is a viable strategy in Belize; however, the experience in Belize has had mixed results [21] largely because the government viewed co-management agreements as a means to absolve them of any management and financial responsibility in co-managed areas. If co-management is going to work, the management capacity of the co-managers must also be increased to make management effective. Sustainable strategies to ensure financial sustainability after initial grants funds are expended must be identified in advance to prevent closure of the protected areas and subsequent loss of employment of those community members directly involved in the project.

These experiences also demonstrate that conservation must be profitable to local people. In other words, the economic benefits derived from conservation must benefit local people and aid in improving their socio-economic conditions. Recognizing that deteriorating or poor socio-economic conditions are drivers of environmental degradation, any successful conservation initiative involving local people must first be cognizant of these factors and attempt to empower people by providing them with the necessary skills, know-how, and financial resources required to improve their conditions. Unless the socio-economic conditions are improved, conservation will never be a priority in the lives of poor local people. In many instances, cultural lifestyles of local people may conflict with conservation objectives; in these cases, amicable solutions must be found that provide viable livelihood alternatives to those individuals and/or communities. Once conservation initiatives can replace the opportunity costs forgone by local people in adopting conservation objectives, a sustainable relationship can be fostered. In the end, local people must obtain economic benefits from conservation.

Additionally, the benefits from conservation to local people can be enhanced substantially if women are involved more in conservation. When women obtain economic benefits, these benefits will trickle down to the family, thereby increasing the number of individuals benefiting. Too often women are excluded from meaningfully participating in conservation initiatives, usually to the detriment of the project. The Community Baboon Sanctuary Women's Conservation Group is a role model and a testament that women are capable conservation managers who deserve to be included in the decision-making process.

Because the lack of financial resources continues to be one of the biggest impediments to effective management of Belize's natural resources, the government needs to allocate the necessary financial resources to allow better management and enforcement of Belize's forest regulations in addition to improving the human capacity to better manage the protected-areas network of Belize. Setting aside a percentage of the oil revenues for conservation will ameliorate the paucity of funding for conservation significantly. International and local NGOs also have a role to play by contributing their expertise and financial resources to improve the protected-areas system as a whole. Often, the goals of conservation NGOs are too esoteric to make their contributions truly meaningful at the level of the entire system.

Lastly, forest resources must be seen as more than just the trees. Their contribution and importance in providing ecosystem services must be recognized, appreciated, and factored into the decision-making process. Unfortunately, the contribution of Belize's protected areas to its economy is as yet unknown [22]; the economic evaluation must be completed and given priority so that it can be used as leverage against competing land-use alternatives that are bound to arise. Similarly, the sustainable harvesting and marketing of non-timber forest products (NTFPs) can provide convincing economic arguments to continue protecting forest resources in addition to alleviating the poverty of people near forests.

Considering the above-mentioned issues affecting Belize, a multi-sectoral approach that seeks to find a sustainable balance between development and conservation must be identified, adopted, and implemented if Belize is to conserve its unique ecosystems and the biodiversity they contain. With a population growth rate of 2.7% year and a fertility rate of 4.2 children per woman, the Belizean population will double to 600,000 in only 25 years [5]. Coupled with an already very high deforestation rate, increasing incidence of poverty, and increased demand for forest and marine products, Belize's ecosystems will face tremendous pressures. According to the Food and Agricultural Organization [23], pressures on Belize's forest are expected to increase by 20% in the next two decades. Currently, illegal logging poses a serious but insidious threat to Belize's forests because of the subsequent fragmentation of large tracks of forests that result after logging. The fact that approximately 60% of all the lumber in Belize is harvested illegally exacerbates this issue [23]. This, of course, cannot continue. Besides the removal of trees, logging roads provide access to farmers who are often replaced by cattle ranchers, thereby increasing deforestation in the classic fishbone pattern. While the issue of illegal logging appears to be an easy one to solve—just increase the monitoring of sawmills and increase the penalty for those caught logging illegally—in reality, the issue is compounded by the lack of human resources and operational budget for the Forestry Department. The Department's staff of only 38 employees, including 21 rangers [8] is woefully insufficient to adequately enforce the environmental regulations in ca. 248,000 hectares for which they are responsible. Any effort to reduce illegal logging and the subsequent fragmentation of Belize's forest must involve strengthening the capacity of the department to carry out its responsibilities, including improved monitoring and enforcement.

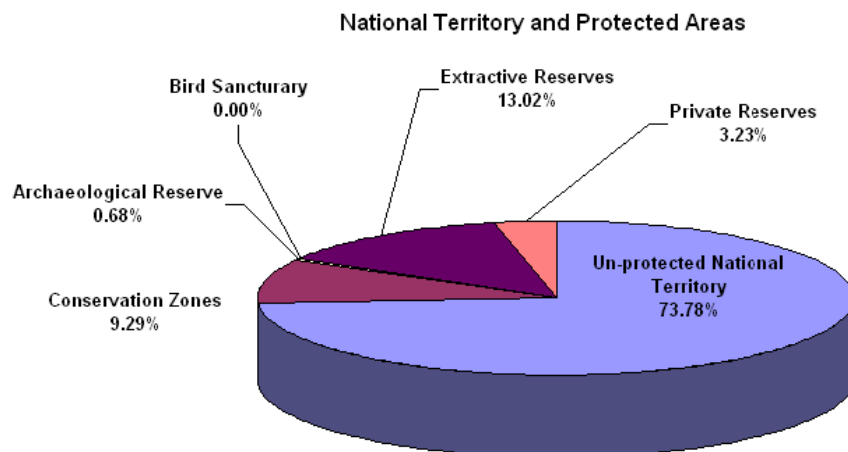


Fig. 3. National Territory and Protected Areas of Belize. Source: see [22] in references.

Presently, 26.2% of Belize's national territory [24] is under some form of protection (Fig. 3,4); however, terrestrially 36% of land is protected in a vast network of protected areas [24] that includes private, public, and community-based conservation initiatives (Fig. 3). On the surface, it appears that Belize is doing an excellent job in protecting its natural resources. However, upon closer inspection, only 13% of the protected areas in Belize are reserved strictly for the conservation of biodiversity; the majority of the protected areas are extractive reserves that allow the removal of flora, timber, and fauna [17]. The situation is worsened by the fact that some of these parks are "paper parks" with no visible on-the-ground management or no management plan. Many parks that do have an on-the-ground presence lack the management capacity or the financial resources necessary to effectively manage the park. Unless these protected areas are managed in an integrated manner and utilize best-management practices in collaboration with all their stakeholders, most of these parks will lose the very species they were set up to conserve.

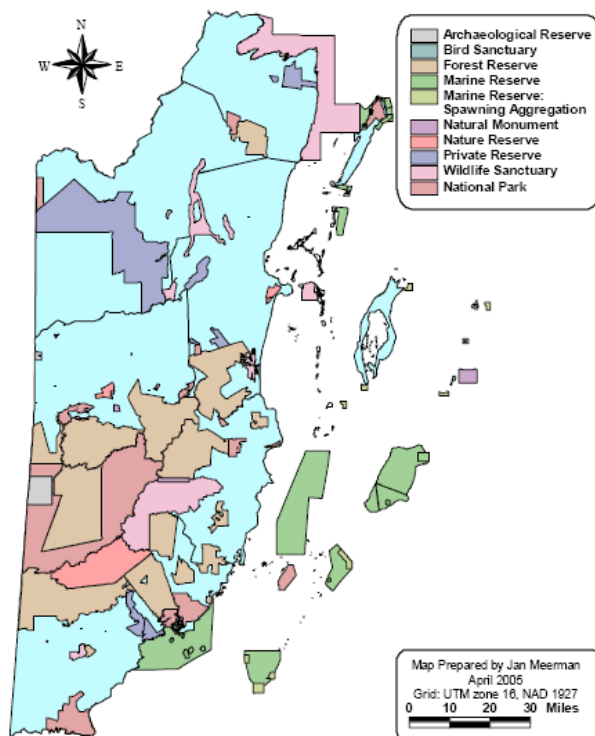


Fig. 4. National protected areas Map of Belize. Source: see [22] in references.

3. The way forward

Belize, despite its small size, is remarkably diverse both ecologically and culturally. However, the challenges outlined above pose serious threats to Belize's ecosystems. Because of the realities of globalization, these challenges will become more pronounced unless we find creative, practical, and cost-efficient solutions to overcome them. Recommendations below (Fig. 5) are an attempt to stimulate discussion of how to address these conservation issues in Belize. It is obvious that any successful strategy must incorporate and must be based on best-management practices that are guided by applied research. A number of key components must first be put in place to ensure a sustainable and concerted response.

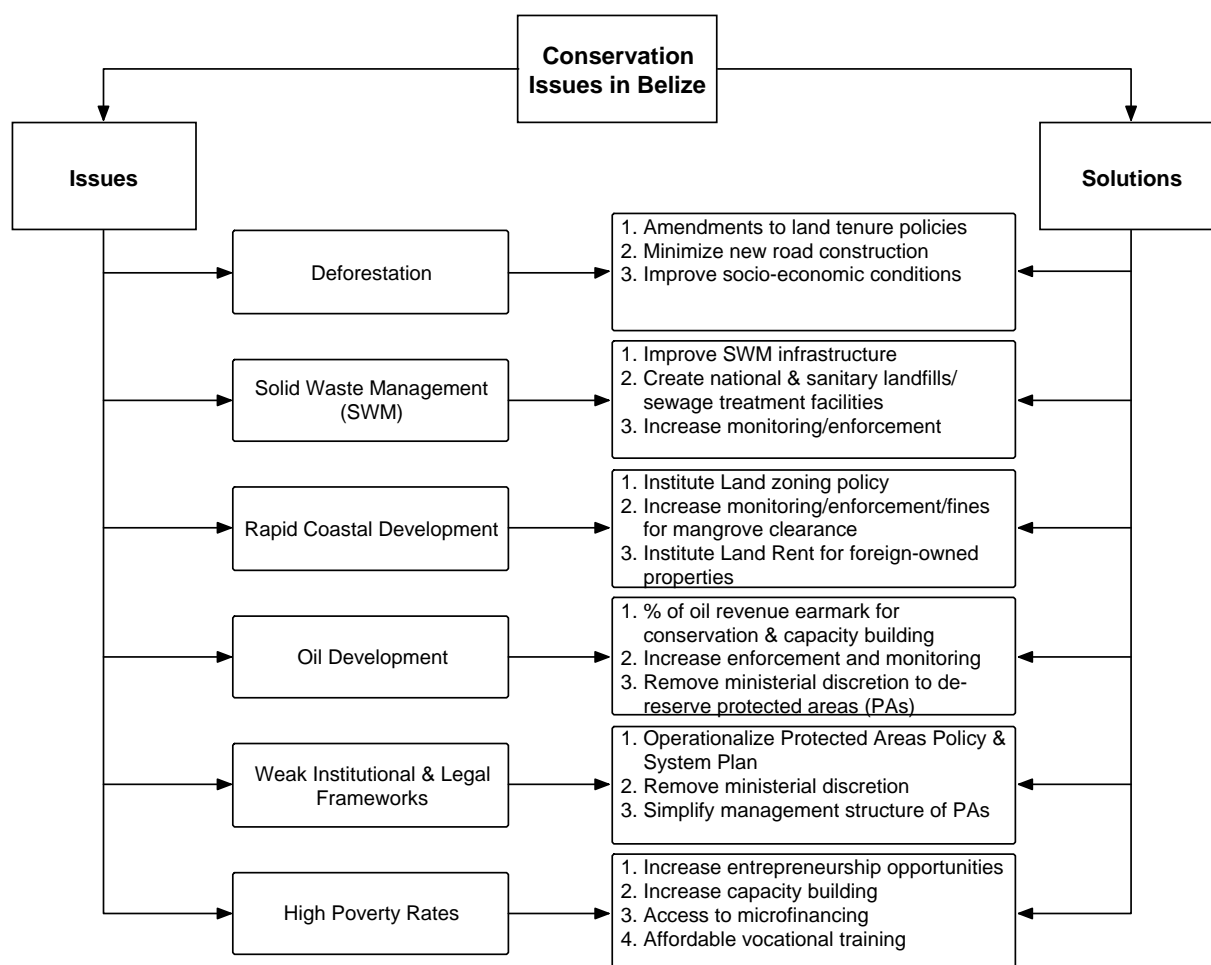


Fig. 5. Conservation issues in Belize with possible solutions

First, active research programs must be given priority at both public and private tertiary-level institutions. The government must earmark adequate funding for conservation-oriented research as well as research infrastructure to allow faculty to conduct research that can aid in the sustainable development of the country. Second, the National Protected Areas Policy and System Plan accepted by the Cabinet must be adopted and operationalized in order to make the protected areas network more simple, stronger, comprehensive, financially sustainable, and integrated. If made operational, the national protected-areas system plan contains the appropriate legislative amendments and mechanisms necessary to proceed [22]. Third, both local and international NGOs must begin to pool their research expertise and financial resources

to (i) identify, in collaboration with all stakeholders, applied research gaps and priority conservation areas in the country, (ii) conduct relevant and culturally appropriate capacity-building initiatives to empower community-based organizations to become active partners in conservation, (iii) develop means of disseminating the findings from applied research to the conservation community that will allow adoption in management where appropriate, and (iv) develop a unified culture of advocacy using scientific research against initiatives that threaten the environment.

Fourth, a percentage of the earnings from the substantial oil reserves in the country should be earmarked specifically for (i) conservation-oriented research, and (ii) increasing the number of skilled and qualified personnel in appropriate government ministries to allow them effectively to perform their mandates. Fifth, conservation must find ways to benefit local people economically. As such, non-traditional mechanisms must be identified and adopted to empower people to become stewards of their environment. Conservation will become an almost inevitable task if the areas we hope to conserve occur in a sea of poverty. Finally, biodiversity and ecosystem services must become key concepts among the conservation community. Identification of the economic contribution of biodiversity and ecosystem services to the Belize economy must be completed so that these can provide leverage and be used in cost-benefit analyses to influence decisions about our natural resources.

Acknowledgements

Special thanks Dr. Alejandro Estrada for suggesting that I write a paper that expanded on the interview conducted with Mongabay.com and to Rhett Butler for posing questions that resulted in the writing of this paper. Cynthia Naydani created the flow chart.

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Appendix 1. List of selected Local and International Non-Governmental Organizations active in Belize

NGOs	Contact Information
Belize Ecotourism Association	http://www.bzecotourism.org/
The Global Environment Facility Small Grants Programme (GEF-SGP)	http://www.gefsgp.org/
Healthy Reef	http://www.healthyreefs.org/
Protected Areas Conservation Trust (PACT)	http://www.pactbelize.org/
United Nations Development Program (UNDP)	http://www.undpbelize.org/
Belize Audubon Society	http://www.bas.org
Friends of Nature	www.friendsofnaturebelize.org/
Toledo Institute for Development and Environment (TIDE)	http://www.tidebelize.org/
Programme for Belize (PFB)	http://www.pfbelize.org/
Ya'axché Conservation Trust (YCT)	http:// www.yct.bz
World Wildlife Fund	http://www.wwfca.org
Wildlife Conservation Society	http://www.wcs.org/international/latinamerica/mesoamerica/belize
Wildlife Trust	www.wildlifetrust.org
Association of Protected Areas Management Organizations (APAMO)	apamo@pfbelize.org
Belize Foundation for Research and Environmental Education (BFREE)	http://bfreebelize.net
Conservation International	http://www.conservation.org
Fauna & Flora International	http://www.fauna-flora.org/goldenstream.php
Sarstoon-Temash Institute for Indigenous Management Society for the Promotion of Education and Research (SPEAR)	www.satiim.org.bz/ http://www.spear.org.bz/
Toledo Association for Sustainable Tourism and Empowerment (TASTE)	taste_scmr@btl.net
The Nature Conservancy (TNC)	http://www.nature.org/wherewework/centralamerica/belize/
Foundation for Wildlife Conservation, Inc.	www.zoosociety.org/runawaycreek