

Working Paper



Coastal Capital: Jamaica The Economic Value of Jamaica's Coral Reef-Related Fisheries

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Executive Summary

Coastal and marine ecosystems provide vitally important goods and services to Jamaica. Coral reefs provide critical habitat for Jamaica's artisanal and industrial fisheries and help to build Jamaica's beautiful white sand beaches, which attract tourists from around the world. Reefs also protect Jamaica's coastline—including coastal communities and tourist hotels—from the destructive force of tropical storms.

However, these benefits have been frequently overlooked or underappreciated in coastal investment and policy decisions. As a result, overfishing, poorly planned coastal development, sedimentation, and pollution have combined to threaten Jamaica's reefs. These local threats are compounded by the growing global threats from climate change, including warming seas and ocean acidification. This suite of threats, coupled with Jamaica's high reliance on coral reefs, highlights the urgent need for improved coastal and fisheries management to reduce local pressures on reefs and preserve the benefits coral reefs provide to Jamaica.¹

Economic valuation—which can be used to assign a monetary value to the goods and services provided by ecosystems—gives policy makers an important tool with which to set priorities and improve decision-making around natural resources. The *Coastal Capital: Jamaica* project assessed the economic contribution of Jamaica's coral reef-related fisheries; quantified the relationship between coral reef degradation, beach erosion, and potential losses of tourism revenue in Jamaica; and examined the role of coral reefs in reducing coastal flooding during storms. Fisheries, tourism, and shoreline protection are just three of the many culturally and economically important services provided by reef ecosystems in Jamaica. Even without a complete economic valuation of other ecosystem services, the country's coral reefs are clearly valuable. Investing in the maintenance and enhancement of these reef-related benefits—and preventing future losses—is thus an important investment in the sustainability of Jamaica's economy.

This paper focuses on the economic contribution of Jamaica's coral reef-related fisheries. Reef-related fisheries—defined as fisheries that involve the capture of fish that depend directly on coral reefs, mangroves, or reef-protected habitat such as seagrasses for at least a portion of their life cycle—are socially and economically important in Jamaica. Reef-related fisheries support between 15,000–20,000 active fishermen, most of whom are artisanal.^{2,3} Fisheries provide coastal communities an important “safety net” of food and employment in times of need. Jamaica's fisheries also provide a wide range of employment—including wholesale and retail vendors, processors, gear makers, boat builders, and ice suppliers—and contribute directly and indirectly to the livelihoods of more than 100,000 people island-wide, or nearly 5 percent of the population.^{4,5}

Unfortunately, Jamaica's coastal waters are among the most overfished in the Caribbean. Many artisanal fishermen have few alternative sources of income, creating a high level of dependence on Jamaica's nearshore fisheries. Use of fish pots or traps with small mesh sizes, mechanization, and subsidies to the fishing industry, along with a rapid increase in spear-fishing and compressor diving have all exacerbated the overexploitation of Jamaica's reef fisheries.

For a long time, the Pedro Bank—located 80 km offshore—had remained a healthier fishery thanks to lower pressure from land-based pollution and fishermen alike. With Jamaica's mainland fishing grounds degraded, fishing pressure is increasing on the Pedro Bank, and illegal poaching and inadequate enforcement threaten the ecological sustainability of this offshore fishery as well. Likewise, the conch fishery—Jamaica's most strictly regulated fishery—is threatened by poaching and underreporting of catches. A further threat to the country's fisheries has been the recent explosion in the population of the lionfish—an invasive carnivorous species—in Jamaican waters.

Despite these pressures, Jamaica's fisheries continue to provide valuable jobs and revenue for the country. From 2001 to 2005, gross revenue from the sale of reef-related fish averaged US\$33.1 million per year, including an estimated US\$24.2 million per year from domestic sales and an estimated US\$8.9 million per year from exports. We also estimate the value of the subsistence catch (consumed domestically and not sold on the market) at US\$1.2 million per year during that time period. Combined, Jamaica's reef-related fisheries were worth an estimated US\$34.3 million per year from 2001 to 2005, a value equivalent to 0.3 percent of Jamaica's annual GDP.

While official data show that overall national trends in fish catch volume and value have been relatively stable in recent years, many studies suggest that Jamaica's fisheries are in a state of decline. The quality and average size of fish landed have both been declining since the 1970s. Furthermore, fishermen now have to travel further out to sea to maintain a constant level of catch. In fact, due in large part to decreasing Jamaican fish stocks, the country now has to import from abroad most of the fish eaten on the island. These trends indicate that the current level of fishing effort is not ecologically sustainable and that, should this level of effort continue, yields will probably decline in the future—along with the economic value of Jamaica's reef-related fisheries.

Research also suggests that Jamaica's reef-related fisheries would provide even greater value if they were sustainably managed. A 2003 study found that overfishing off of Jamaica's north coast led to a 13 percent decline in total fish catch volume and a 17.3 percent decline in fish catch value between 1968 and 2001. Scaling this up to the national level suggests that Jamaica's failure to effectively manage its fisheries may have cost the country some US\$1.6 billion in lost revenues over the period from 1975 to 2000, not counting the Pedro Bank fishery.⁶

Recent positive steps taken by the Jamaican government—including the drafting of a National Fisheries Policy beginning in 2003,⁷ the establishment of the National Fisheries Advisory Board in 2008, the creation of new fish sanctuaries in 2009 and 2010, and initiatives to control the lionfish invasion—could all eventually help to restore fish stocks in Jamaica and thereby mitigate a key threat to the country's coral reefs. Passage of a new fisheries law based on the draft National Fisheries Policy—which seeks to encourage the sustainable development of the fisheries industry, combat overfishing, and aim for sustainable yields—is therefore essential. Adequate funding for implementation and enforcement of fisheries regulations—as well as the political will for effective law enforcement—will be critical if these initiatives are to improve the condition of Jamaica's fisheries.

Jamaica's fisheries are in a troubling state of decline, but their productivity can be restored, along with the associated economic benefits. Further investment in maintaining coastal habitat, protecting coral reefs, and managing fisheries sustainably to restore fish stocks is greatly needed. If Jamaica's fisheries were restored, they could make an even greater contribution toward the country's economy and to the well-being of its people. It is in the long-term economic interest of Jamaica to:

Promote sustainable fishing:

- *Improve fisheries management.* Enact legislation and regulations aimed at sustainable yields, and invest in improved monitoring, enforcement, research, and data collection.
- *Strengthen marine protected areas.* Develop long-term funding for integrated management efforts, including the expansion of protected area networks and fish sanctuaries.
- *Provide for alternative livelihoods for artisanal fishermen.* This will help to ease the intense pressure on Jamaica's reef fisheries.

Manage coastal development wisely:

- *Improve wastewater management.* Enhanced management of sewage and runoff from construction would improve coastal water quality, benefiting coral reefs, fish, and local people.
- *Protect mangroves.* Mangroves serve as important fish habitats, and also act as buffers, reducing agricultural runoff that reaches coral reefs. The government should seek to protect remaining mangroves from clearance for beach and coastal development.
- *Improve land-use planning and zoning.* Enforcement of the government's current setback regulations, and reassessment of outdated regulations, would establish a more adequate buffer zone between beaches and coastal infrastructure, protecting both coastal ecosystems and beachside hotels.

Reduce watershed-based sedimentation and pollution:

- *Promote improved agricultural techniques.* Improved soil conservation (using terracing) and reduced use of chemicals would reduce flows of sediment and pollutants to coastal waters.
- *Retain and restore vegetation.* Reforestation—using local species—would help reduce erosion, especially on steep slopes and in riparian areas.

Manage for climate change:

- *Reduce local pressures to increase resilience.* The growing threats of warming seas and ocean acidification, driven by greenhouse gas emissions, will compound the existing local pressures on Jamaica's reefs. This points to the urgent need for better coastal and fisheries management to reduce local pressures and help reefs survive the growing global threats stemming from climate change.

However, barriers and constraints to implementing these measures remain. There is currently little political will to tackle environmental issues in Jamaica, as the environment is perceived to be of lower importance than more commonly recognized economic issues such as job creation, GDP growth or the public debt. Levels of funding for coastal and fisheries management are likewise low, and as a result, enforcement of existing laws to protect coastal ecosystems and fisheries is weak, as is management capacity.

History demonstrates that conserving ecosystems begins with widespread awareness of the benefits they provide and the political will to act. To that end, *Coastal Capital: Jamaica* shows how Jamaica's coral reefs are integral to the national economy, through fisheries, tourism, and shoreline protection. Accordingly, development planners will want to take full account of the economic value of these reef-based ecosystem services when making decisions for Jamaica's future. As outlined above, policy and legislative reforms to promote sustainable fishing, manage coastal development and reduce land-based pollution would reduce key threats to Jamaica's coral reefs. It will also be necessary to explore opportunities for long-term financing for coastal conservation in Jamaica. Taken together, these measures could help to restore, increase, and sustain the economic benefits that coral reefs provide to Jamaica's people for many generations to come.

The Coastal Capital Project

This study is part of the World Resources Institute's (WRI) *Coastal Capital* project in the Caribbean. The project was launched in 2005 and aims to provide decision-makers with information and tools that link the health of coastal ecosystems with the attainment of economic and social goals. WRI and its local partners have conducted economic valuation studies of coral reefs and mangroves at national and subnational levels in five countries: Belize, the Dominican Republic, Jamaica, St. Lucia, and Trinidad and Tobago. We are using the results to identify and build support for policies that help to ensure healthy coastal ecosystems and sustainable economies.

Products from *Coastal Capital: Jamaica*, in addition to this paper, include a working paper on coral reefs, beach erosion, and impacts to tourism in Jamaica; a working paper by the Mona GeoInformatics Institute on shoreline protection and coastal inundation in Jamaica; an 8-page summary of the three Jamaica analyses for decision-makers; and a literature review and summary of 14 earlier coral reef economic valuation studies from Jamaica. These products, along with additional information about WRI's *Coastal Capital* series, are available online at <http://www.wri.org/coastal-capital>.

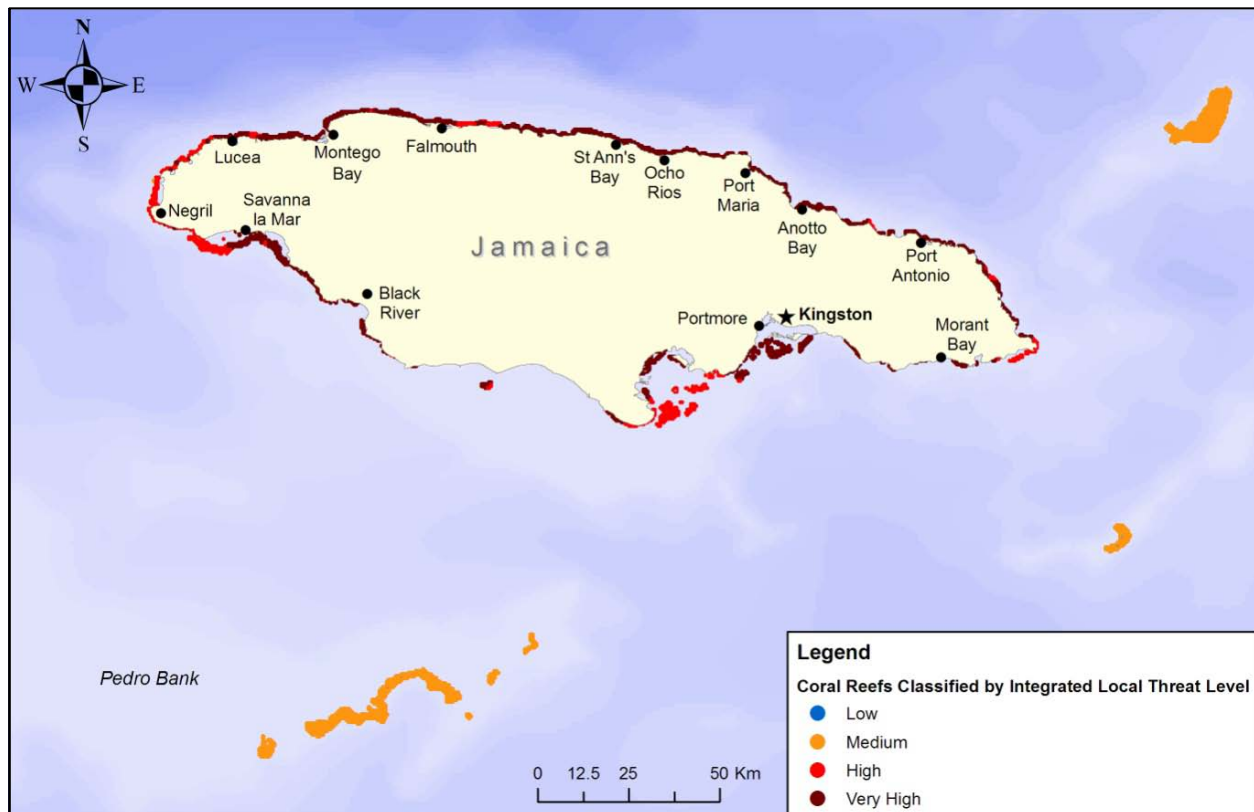
1. Introduction: Jamaica's Coastal Capital

Coastal and marine ecosystems provide vitally important goods and services to Jamaica. Coral reefs provide critical habitat for Jamaica's artisanal⁸ and industrial fisheries. Reefs also help to build and sustain Jamaica's beautiful white sand beaches, which attract "sun and sand" tourists from all over the world. Coral reefs also protect Jamaica's coastline from the destructive force of tropical storms, which protects the well-being of both coastal communities and the country's tourism industry.

Despite the importance of coral reefs to Jamaica's economy, these benefits have been frequently overlooked or undervalued in coastal investment and policy decisions. Consequently, Jamaica's reefs are among the world's most threatened (Map 1). Their continued degradation represents a significant threat to the socioeconomic well-being of the people of Jamaica.¹ Overfishing has nearly eliminated large predatory fish species, such as groupers and snappers. In recent decades, overfishing has also caused a massive decrease in herbivorous fish populations—such as parrotfish—resulting in an increase in algal cover at the expense of corals.^{9,10} The mass mortality of the long-spined sea urchin (*Diadema antillarum*)—a key coral grazer—due to disease outbreaks in the early 1980s further accelerated the shift from coral to algal cover.¹¹ Poorly planned coastal development has also taken its toll on Jamaica's reefs, as well as eutrophication and sedimentation resulting from land-based sources of pollution.¹⁰

The global threat of climate change has compounded more localized threats to Jamaica's reefs. In recent years, observations of coral bleaching and disease have been on the rise, as have the frequency and severity of hurricanes.¹⁰ Additional climate-related threats to reefs, such as ocean acidification, loom on the horizon.¹

Map 1. Jamaica's reefs are at risk from overfishing, coastal development, watershed-based pollution, and marine-based pollution.

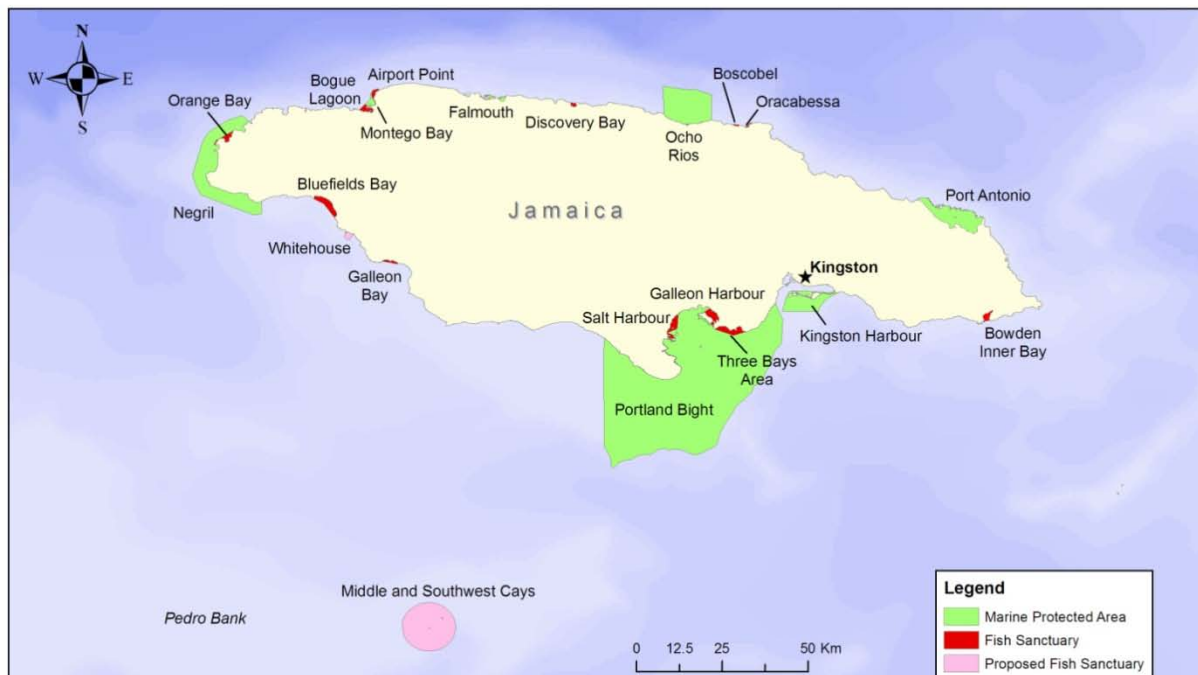


Source: See note 1.

This combination of threats has led to a dramatic decline in the health of Jamaica’s coral reefs in recent decades. Coral cover across Jamaica’s 763 km² of reefs declined from 50 percent in the 1970s to less than 5 percent by the 1990s.^{1,10,12} Although coral cover across Jamaica had rebounded to 13.7 percent by 2008—likely due to a resurgence in the *Diadema* sea urchin population—this is still much lower than the Caribbean average of 20 percent, and varies widely across monitoring sites.^{10,13} Furthermore, local human pressures on Jamaica’s reefs have continued to increase in recent years, and climate change is expected to compound local threats in coming decades,¹ indicating that the recent resurgence in Jamaica’s coral cover may be short-lived.

Recent reef conservation efforts—such as the establishment of marine protected areas (MPAs) and fish sanctuaries¹⁴—are positive steps, but large challenges remain. Beginning with the establishment of the Montego Bay Marine Park in 1991, Jamaica’s MPAs now cover more than 2,000 km².^{1,15,16} Jamaica’s MPAs have received varying levels of funding and enforcement, and protection remains an ongoing challenge due to sporadic and limited funding and inadequate management capacity. Still, the country’s MPAs have had some success. In 2008, densities for commercially important fish species and lobster were between 2 to 3.4 times more abundant inside MPAs than in unprotected areas, and a 2011 survey showed that fish diversity and coral cover were higher inside the Montego Bay and Negril MPAs than in unprotected areas.^{13,17} However, fish abundance countrywide remains extremely low.¹³ Jamaica’s fish sanctuaries, which now number eleven, cover approximately 50 km². The first sanctuary was established at Bogue Lagoon in Montego Bay in 1979, but most were only established in 2009 and 2010 (Map 2).

Map 2. Jamaica’s marine protected areas, including fish sanctuaries.



Source: See note 18.

Economic issues—such as unemployment, underemployment, inflation, and the public debt—rank high on the list of the government of Jamaica’s priorities.¹⁹ Economic valuation—which can be used to assign a monetary value to the goods and services provided by ecosystems—gives policy makers an important tool with which to set priorities and improve decision-making around natural resources. WRI’s *Coastal Capital: Jamaica* project assessed the economic contribution of Jamaica’s coral reef-related fisheries, and results are reported in this paper. In separate papers, the project also quantified the relationship between

coral reef degradation, beach erosion, and potential losses of tourism revenue in Jamaica, and also examined the function of coral reefs in protecting Jamaica's shoreline and coastal communities (Box 1). Fisheries, tourism, and shoreline protection are just three of the many culturally and economically valuable services provided by reef ecosystems in Jamaica. Even within this narrow scope, *Coastal Capital: Jamaica* finds that the country's coral reefs are clearly valuable. Investing in the maintenance and enhancement of these reef-related benefits—and preventing future losses—is thus an important investment in the sustainability of Jamaica's economy.

This paper examines recent trends in Jamaica's coral reef-related fisheries, using official government statistics of landings and sales, and provides an analysis of the current direct economic contribution of reef-related fisheries to the Jamaican national economy. We also supplement this figure with an estimate of the value of subsistence fishing in the country. We then complement our analysis of the direct economic contribution of Jamaica's reef fisheries with results of several previous fisheries studies conducted in Jamaica. These studies include assessments of employment and livelihood impacts, case studies of the conch industry and Pedro Bank fishery, and an estimate of the economic losses due to insufficient fisheries management and unsustainable fishing practices over a recent 25-year period.

Additionally, we examine fisheries laws in Jamaica, and review the country's draft National Fisheries Policy, whose provisions may become law in the near future and could greatly advance sustainable fisheries management in the country.⁷ Finally, we make the case for improved emphasis on protection of coastal ecosystems to sustain the economic benefits from Jamaica's fisheries into the future and enhance the other ecosystem services that Jamaica's reefs provide.

***Box 1. Jamaica's Coastal Capital:
Other economic values of Jamaica's coral reefs***

This paper is part of WRI's *Coastal Capital: Jamaica* project. Other findings include:

Beach tourism. Jamaica's tourism industry depends heavily on the country's beautiful coralline beaches. WRI focused on the three main beach tourist destinations—Negril, Montego Bay, and Ocho Rios—which are all impacted by coral reef degradation and associated beach erosion. We found that if reef degradation and beach erosion continue, the Jamaican tourism industry could lose up to US\$19 million per year, and the Jamaican economy could lose up to US\$23 million per year, due to reduced rates of tourist visitation.²⁰

Shoreline protection. Coral reefs also protect Jamaica's coastline from the destructive force of tropical storms. Reefs are crucial in protecting major hotels along the coast, as well as residential and industrial infrastructure. WRI assessed relative levels of protection afforded by Jamaica's reefs island-wide. We found that communities on the north coast of Jamaica—including Montego Bay and Ocho Rios—were highly protected by fringing coral reefs. Jamaica's south coast—dominated by shelf marginal and patch reef—is generally afforded the least amount of protection from its reefs.²¹

Past studies. WRI reviewed 14 previous economic valuation studies of Jamaica's coastal resources. The studies provide rationales for increased investment in the protection of Jamaica's coastal ecosystems, and many also explore sustainable ways to finance coastal and marine conservation. However, these studies have had limited success in influencing Jamaica's policy makers. In some cases, the studies were not made publicly available; in others, results were not effectively communicated to decision makers (WRI 2011).²²

The full beach tourism and shoreline protection analyses, as well as the full list of economic valuation studies, are available at www.wri.org/coastal-capital.

2. Coral Reef-Related Fisheries in Jamaica: Status and Trends

“If one tracks the data on our marine resources over time, [one] will have no choice but to conclude that we are losing our fish stock at a faster rate than the species’ capacity to replenish itself.”²³

- Dr. Christopher Tufton, Jamaica’s former Minister of Agriculture and Fisheries, December 2010

“I go further, I work longer, I work harder, and the catch is just the same... I used to go out in the morning and come back at 1:00, and have a lot of fish, sell some for money, and save some...now I spend the whole day sometimes until 6:00...because [there are] no fish, no lobster, they are dying out...”²⁴

- Jamaican fishermen, November 2008

Coral reef-related fisheries—defined as fisheries that involve the capture of fish that depend directly on coral reefs, mangroves, or reef-protected habitat such as seagrasses for at least a portion of their life cycle—are socially and economically important in Jamaica.²⁵ Reef-related fisheries support between 15,000–20,000 fishermen—including approximately 5,000 part-time fishermen—most of whom are artisanal.^{2,3,26} Jamaica’s fisheries also provide a wide range of employment—including wholesale and retail vendors, processors, gear makers, boat builders, and ice suppliers—and contribute directly and indirectly to the livelihoods of more than 100,000 people island-wide, or nearly 5 percent of the population.^{4,27} In 2005, reef-related fish sales earned more than US\$30 million in gross revenues.^{2,28}

Unfortunately, Jamaica’s nearshore waters are among the most overfished in the Caribbean and, according to many experts, have been overfished for decades.^{4,9,29-31} Many artisanal fishermen have few alternative means of earning a living, creating a high degree of pressure on Jamaica’s reef fish stocks.⁷

Map 3. Jamaica’s marine fisheries depend on coral reefs, but both reefs and reef fisheries are under high levels of threat from overfishing.



Sources: See notes 1, 31.

Consequently, all of Jamaica's reefs are now threatened by overfishing (Map 3, Box 2).¹ Catch composition has shifted radically over the years, with smaller fish, juvenile fish, and "trash" fish (lower-value species such as parrotfish, squirrelfish, or goatfish) now filling nets and fish pots that used to bring in larger and higher-value species.^{6,32,33} Use of fish pots or traps with small mesh sizes, mechanization of the fishing industry, subsidies for boats and fuel, along with a rapid increase in spear-fishing and compressor diving have all exacerbated the overexploitation of Jamaica's reef fisheries.^{9,34}

Box 2. The ecological implications of overfishing on coral reefs¹

Coastal communities depend on reef fisheries for food and livelihoods. If well-managed, fisheries can be a sustainable resource. However, population growth, more efficient fishing methods, and increased domestic and international demand for seafood have increased pressure on the world's reefs and significantly impacted fish stocks worldwide.

Removal of fish species from the reef food web can have cascading effects across the ecosystem. Fishermen often target large predators first, and as their numbers decline, begin to target smaller, herbivorous fish. As herbivores—who graze algae on a reef as they grow—disappear, algal growth can overtake coral growth on the reef. Overfished reefs may be less resilient to human and natural stressors, such as pollution, disease, and storms.

As a result of the depletion of high-value species such as snappers and groupers, parrotfish are now the primary species consumed in the country. However, parrotfish—which are one of the key herbivores on Jamaica's reefs and contribute to controlling the spread of marine algae—have also suffered a massive decline in population.³⁵ Parrotfish are important not only for maintaining ecological balance on the reef, but also for producing sand for Jamaica's beaches. Parrotfish break off coral with their strong jaws, and the coral passes through their digestive tract and becomes sand. A parrotfish can produce up to 90kg of sand per year.³⁶

The Pedro Bank, located 80 km to the southwest of the island of Jamaica, is characterized by relatively difficult living and fishing conditions. For a long time, the Pedro Bank had remained a

healthier fishery thanks to lower pressure from land-based pollution and fishermen alike (Box 3). Today, however, with Jamaica's mainland fishing grounds already degraded, fishing pressure is increasing on the Pedro Bank, and illegal poaching and inadequate enforcement threaten the sustainability of this offshore fishery as well.²⁹ Likewise, the conch fishery—Jamaica's most strictly regulated fishery—is nonetheless threatened by poaching and underreporting of catches, problems that can only be solved with greater enforcement and political will (Box 4).

A further threat to the country's reef-related fisheries has been the recent arrival of the lionfish—an invasive carnivorous species—in Jamaican waters. A native of the Indo-Pacific region, the lionfish has very few natural predators, has a voracious appetite for small fishes (thus competing with native predators such as snappers and groupers), and is capable of invading multiple coastal habitats, including reefs and mangroves.³⁷ The lionfish population has greatly expanded across the Atlantic and Caribbean region since the 1990s, and this invasion has been a serious problem in Jamaica since 2009.³⁸ With Jamaica's reefs already overfished, and under other human pressures as well, an unchecked lionfish invasion could cause irreversible changes to the ecosystem—and thus poses a grave threat to the country's reef-related fisheries.³⁹

The need for improved fisheries management is great in Jamaica. However, the Fisheries Division—the government entity responsible for managing Jamaica's fish resources—is severely handicapped by limited capacity and funding. The Fisheries Division suffers from many years of neglect, which has led to a limited presence and effectiveness in the field.⁴⁰ It is meant to be undergoing a restructuring—from a regulatory division of the Ministry of Agriculture and Fisheries to an executive agency—to ensure increased effectiveness and "promote transparency, accountability, and efficiency and involvement of all stakeholders in the management of the sector."⁴¹ Unfortunately, this process has stalled. This has created

further frustration within the Fisheries Division, and among its partners invested in fisheries management efforts.

Despite these challenges, the government has taken steps to improve fisheries management in recent years. In May 2008, the government founded the National Fisheries Advisory Board, comprised of stakeholder representatives from the commercial fishing industry, sport fishermen, artisanal fishermen, and marine ecologists.⁴² The board was created to monitor fisheries activities and issues and to advise the Minister of Agriculture and Fisheries (and the Fisheries Division) on possible corrective actions.

Another recent positive development has been the expansion of the country's fish sanctuaries. In September 2009, the government expanded the number of fish sanctuaries in the country from two to eleven.²³ The government established a co-management framework⁴³ for the new fish sanctuaries, and in December 2010 the Ministry of Agriculture and Fisheries signed a Memorandum of Understanding with seven NGOs and CBOs to monitor the sanctuaries. Under the agreement, the government committed US\$265,000 to the local organizations for monitoring and patrolling.²³ Although it is too early to assess the effectiveness of the new fish sanctuaries, studies have shown that increases in fish stocks can occur within one to three years after the establishment of effective no-take zones.⁴⁴ However, adequate funding and enforcement will be critical to the success of the new fish sanctuaries.

The National Environment and Planning Agency (NEPA) and the Ministry of Agriculture and Fisheries are both currently working to address the lionfish threat. NEPA's initiative includes monitoring locations of lionfish, determining what other fish species are the primary prey, developing trapping mechanisms, and implementing a public awareness and training program to teach people how to safely handle the lionfish from sea to plate.⁴⁵ The Ministry of Agriculture and Fisheries is likewise promoting the consumption of lionfish to control its population and is developing a more thorough lionfish management plan with NGOs, the University of the West Indies, and the private sector.^{46,47} However, the Jamaican public still remains skeptical of the lionfish as a food source.⁴⁸

Finally, the Jamaican government has spent years producing a draft National Fisheries Policy in consultation with many stakeholder groups.⁷ The policy, the first of its kind among Caribbean Community (CARICOM) member states, seeks to overhaul existing fisheries laws, moving from a system based on maximizing short-term fisheries production to a system based on economic development through sustainable fisheries management. If the provisions of the draft policy become law, it has the potential to greatly improve fisheries management across the country. However, as with the new fish sanctuaries, adequate funding and enforcement will be a crucial determinant of its success.

Box 3. The Pedro Bank—Jamaica’s most productive remaining fishing ground

The most productive remaining fishing ground in Jamaica is the Pedro Bank, an 8,040 km² “submarine plateau” off Jamaica’s southwest coast. The Pedro Bank supplies over 90 percent of the country’s conch exports and a significant portion of its domestic fish products.⁴⁹ It is also one of the main harvesting grounds for queen conch in the Caribbean.⁵⁰ A socioeconomic study (Espeut 2006) estimated that approximately 500 residents were living in the Pedro Cays in the heavy hurricane year of 2005, and noted that anecdotal evidence suggests as many as 1,000–2,000 people have lived on the Pedro Cays at one time.²⁹ In addition to fishermen based on the cays, many mainland fishermen target the Pedro Bank as well.

In Espeut’s study, the average landed catch per boat/day on Northeast Cay was 40 kg (worth approx. US\$117), and on Middle Cay was 108 kg (worth approx. US\$390), which translates to an annual gross income of roughly US\$3,417–\$12,074 per fisherman. Espeut estimates, conservatively, that the total direct contribution to GDP from fishermen living on the Pedro Cays would equal roughly US\$2.7 million per year. Moreover, this may be a dramatic underestimate due to underreporting of lobster catches, no reporting of conch, and the low population on the Cays at the time of the survey.²⁹ To produce a more accurate picture of the current contribution of the Pedro Bank fishery to the Jamaican economy, Espeut suggests that the study should be repeated in a more representative year and before hurricane season, adapted to improve lobster and conch catch records, and expanded to include mainland fishermen using the area. Fisheries Division estimates concur that the real value of the Pedro Bank fishery may be much higher. They suggest that the value of the legal Pedro Bank fishery could be upwards of US\$26.4 million per year, with approximately US\$8.8 million from conch, US\$4.4 million from lobster and US\$13.2 million from finfish.⁵⁰

It is also important to note that the Pedro Bank serves as a vital support system or safety net to many communities along Jamaica’s South Coast. In addition to direct catch earnings, Pedro Bank fishing activities generate related jobs—such as boat and gear repairs and maintenance, as well as fish processing and sales—that assist the families of fishermen and the extended community.

Espeut notes that even with the fishery in decline, fishermen living on the Pedro Cays are still earning more than they could at a minimum wage job on the mainland (US\$2,632/year). The study also found that very few of the men living and fishing on the Cays had the training or literacy to move into alternative fields. Therefore, an effort to improve education and promote economically competitive alternatives will be critical to shifting people away from relying on an over-fished resource and into more sustainable livelihoods.²⁹

Box 4. Jamaica’s conch fishery—lucrative but threatened

Jamaica’s conch fishery is the largest industrial fishery in the country and also the most heavily regulated. Jamaica is held to a strict quota of conch exports by international agreements restricting conch exports as a result of its threatened species status (CITES, Appendix 2). The conch fishery remains one of the healthiest and most lucrative fisheries in the country, but a number of worrying signs point toward overexploitation of the resource.

The most recent estimated maximum sustainable yield for conch from the Pedro Bank is 800–900 MT per year, based on a stock assessment conducted in 2002. However, recorded harvests by licensed fishermen between 1993 and 1999 ranged from 1,400–2,000 MT per year.⁵¹ In response, the Fisheries Division began a management scheme in 1995 that included issuing a limited number of conch fishing licenses, setting a yearly quota for conch, and prohibiting the processing or sale of conch during closed season. This has successfully reduced recorded harvests to less than 700 MT per year—below the maximum sustainable yield—for every year since 2003.⁵²

However, Jamaica’s conch fishery remains severely threatened by unreported and illegal catch, which also has the effect of reducing the quota for legal fishermen. The Fisheries Division, estimating that 300–400 MT could be lost to foreign poachers each year, was forced to set its yearly quota to only 502 MT in 2003. This low quota effectively allocated nearly half of the potential sustainable yield to poachers—an illegal catch worth over US\$3 million.⁴ Some experts estimate that illegal catch could still equal or exceed legal catch levels each year.⁵³ Due to the continued weak levels of law enforcement, the conch industry is also threatened by overfishing from licensed fishermen, as well as heavy poaching from foreign vessels.⁵¹

3. Economic Contribution of Reef-Related Fisheries

In spite of the pressures outlined above, Jamaica’s reef-related fisheries continue to provide valuable jobs and revenues for the country. Here we highlight data on the volume and value of marine fish caught in Jamaica, exploring historical trends and recent statistics to get a picture of their importance to Jamaica’s economy.

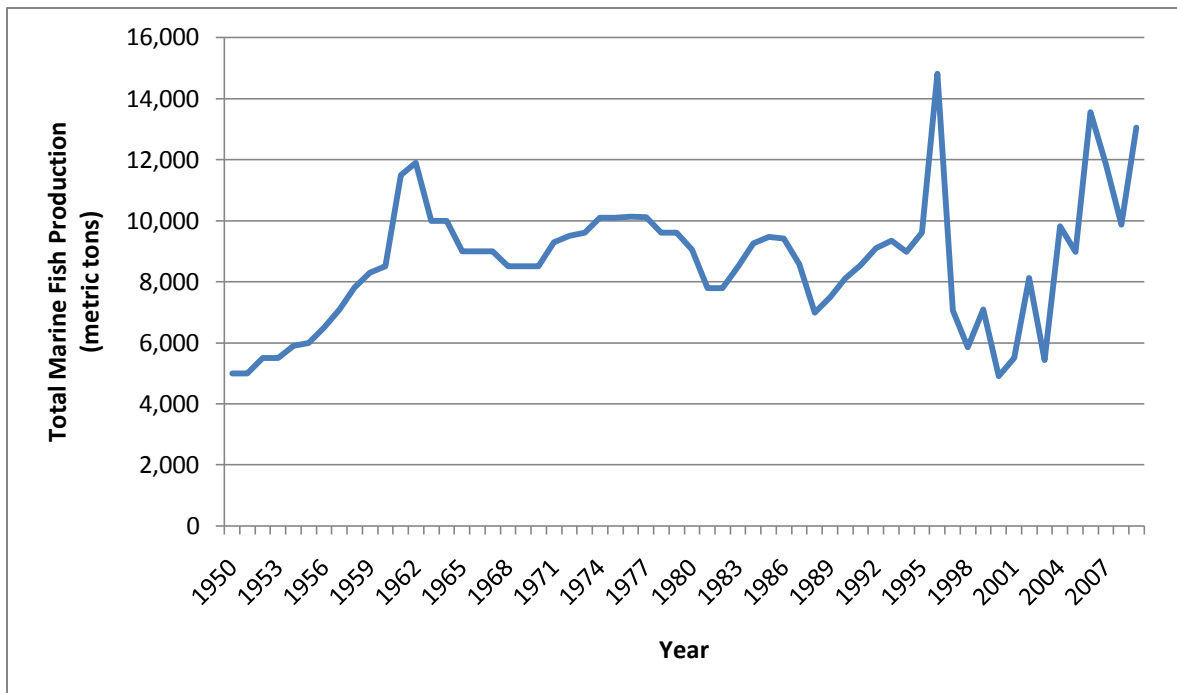
Fish Production

Nearly all commercially valuable fish currently caught in Jamaica are reef-related.⁵³ Coastal habitats, such as mangroves and seagrass beds, also provide critical habitat during different stages of the life-cycle for many valuable fish species. However, the consensus—among researchers, government officials, and others—is that Jamaica’s nearshore waters are heavily overfished.

Fish catch grew from roughly 5,000 metric tons (MT) per year in 1950 to a peak of nearly 12,000 MT per year in the early 1960s following mechanization of the fleet and government-subsidized expansion of the fishing grounds.⁹ The catch level then dropped through the 1960s to roughly 8,000 MT, and ranged between 5,000–10,000 MT per year from the early 1970s to 2005, save for a very high catch year in 1996 (Figure 2).

In the late 1990s, exports of reef-related fish increased, due to the establishment of an industrial conch and lobster fishery and the subsequent growth in lobster and conch exports.⁵⁴ By 2007, there were more than 17,000 registered fishermen (mostly artisanal), and approximately 4,000 registered fishing boats, operating across 187 fishing beaches (designated landing sites).^{3,55}

Figure 1. Total marine fish production in Jamaica (metric tons), 1950–2009.



Sources: See notes 3, 51, 52, 56, 57. *Note:* increases observed after 2006 may be due to improved data collection methods rather than actual increases in landings.

Capture fisheries production averaged 7,566 MT from 2001 to 2005 (Table 1), similar to levels seen since the 1970s. Preliminary data from the Fisheries Division show that from 2006 to 2009, total marine fishery production in Jamaica increased to an average of 12,081 MT per year—higher than the peak levels observed in the 1960s. However, according to the Fisheries Division, the increase in catch volume for 2006 onward may be due to improved data collection methods and not due to actual increases in landings.⁵⁵

The apparent relative stability in fish catch since the 1970s is misleading, though, as fishermen have been forced to expand into ever farther waters to maintain this level of catch.²⁹ This need to expand into farther waters—as well as the dramatic shift in catch since the 1970s toward smaller fish, juvenile fish, and “trash” species noted in the section above—indicate that the current level of fishing effort is not ecologically sustainable.

Table 1. Jamaica: Volume of marine fish catches in metric tons, 2000–09

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Finfish	4,586	4,349	7,000	4,595	8,811	7,158	12,330	11,048	9,475	12,544
Conch	-	946	946	504	550	640	650	640	400	400
Lobster	288	167	130	295	451	300	98	150	-	-
Shrimp	37	39	38	37	-	875	476	-	-	111
Total	4,911	5,501	8,114	5,431	9,812	8,973	13,554	11,838	9,875	13,055

Sources: See notes 3, 52. Note: data are preliminary estimates.

Fish Sales

Using data from the Fisheries Division and the Statistical Institute of Jamaica (STATIN), the ECOST project (2007)⁵⁸ pulled together official estimates of total sales (domestic and export).

Gross revenues from recorded sales averaged US\$33.1 million from 2001–05, or approximately 0.3 percent of Jamaica’s GDP (Table 2). The same study estimated that when value added is taken into account, fisheries contributed approximately 3 percent of Jamaica’s GDP, or nearly US\$300 million per year during that period.²

Table 2. Jamaica: Value of marine fish catches in US\$ millions, 1996–2005

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Finfish	46.6	20.8	15.6	23.5	17.1	16.3	26.2	17.2	32.9	26.6
Conch	10.5	13.4	12.5	10.0	-	6.9	6.9	3.7	4.0	4.7
Lobster	7.2	2.4	1.5	3.0	4.7	8.5	3.2	2.7	1.2	2.7
Shrimp	1.4	0.5	0.1	0.4	0.3	0.3	0.3	0.3	0.3	0.3
Total	65.8	37.2	29.7	36.5	22.1	32.0	36.6	23.9	38.5	34.3

Source: See notes 2, 28 (STATIN 2007 in ECOST 2007).

According to experts at the Fisheries Division and the University of the West Indies, approximately 95 percent of conch is exported to the United States and the European Union (by way of Martinique), and 40 percent of lobster caught in Jamaica is exported to the United States. For both species, most of the

remainder is sold to hotels and restaurants within the country. The majority of wild-caught marine shrimp is sold on the local market. Approximately 90 percent of finfish landed in Jamaica are sold whole to middlemen or vendors at landing sites.² In Table 3 below, we use these estimates to disaggregate the official data on gross revenues, in order to get a rough estimate of the revenue from domestic sales and exports in each category of fish.

Annual gross revenue from domestic fish sales from 2001 to 2005 is estimated at US\$24.2 million, and revenue from exports is estimated at US\$8.9 million. Export revenues also include the value added from processing and packaging fish products; we include this as an additional benefit to the national economy stemming from the fisheries industry.

Table 3. Jamaica: Average annual revenues from reef-related fisheries, 2001–05

	Avg. annual Catch (MT)	% sold domestically	Gross revenues (local sales, US\$ millions)	% exported	Gross revenues (exports, US\$ millions)	Avg. sale price (US\$/kg)	Total gross revenues (US\$ millions)
Finfish	6,383	90	\$21.4	10	\$2.4	\$3.73	\$23.8
Conch	717	5	\$0.3	95	\$5.0	\$7.35	\$5.3
Lobster	269	60	\$2.2	40	\$1.5	\$13.71	\$3.7
Shrimp	198	100	\$0.3	0	-	\$1.55	\$0.3
Total Value	7,566	NA	\$24.2	NA	\$8.9	NA	\$33.1

Sources: Author’s calculations, see also notes 2, 3, 28 (STATIN 2007 in ECOST 2007). Figures may not total correctly due to rounding.

Subsistence Fishing

Fisheries often provide an important safety net for the poor and serve as an important food source for many coastal communities at all income levels. In fishing households, some portion of the catch brought in by fishermen often goes toward household consumption. This catch frequently consists of the lower-value or “trash fish” that cannot be sold elsewhere. The catch still has a value in that it provides a source of food and protein, and replaces household spending on these items. In Jamaica, experts suggest that 10 percent of total finfish catch goes toward subsistence use.⁵⁹ This portion of catch tends to fall outside of officially recorded estimates, so its value would be in addition to the catch numbers recorded above. To estimate a ballpark value for subsistence catch, we assign a 50 percent lower sale price, to account for the lower quality of the fish (US\$1.86/kg). Using these calculations, and the average annual finfish catch of 6,383 MT from 2001 to 2005, we estimate that subsistence catch in Jamaica is worth US\$1.2 million per year.

Limitations

The analysis above shows that during the period 2001 to 2005, Jamaica’s reef-related fisheries contributed an estimated US\$34 million to the country’s economy per year. However, this figure understates the value of Jamaica’s reef fisheries; poaching (both by domestic and foreign vessels) and underreporting of catch causes the official catch and sales numbers to be artificially low. For example, the Ministry of Agriculture and Fisheries estimates that foreign poaching of lobsters deprived Jamaica of more than US\$130 million over the five-year period ending in 2010.⁶⁰ This US\$34 million annual figure, therefore, is a conservative estimate of the current contribution of Jamaica’s reef fisheries to the national economy.

It is also important to note that this assessment provides a “snapshot” of reef-related fisheries revenues at the current level of extraction. Although the recent overall trends in fish catch volume and value have remained more or less stable, many studies cited above demonstrate the declining quality and size of reef fish landed, as well as the additional effort being expended to maintain the current level of catch. Coral reef fish surveys have indicated a substantial decline in fish biodiversity, biomass, and abundance over time.^{10,11,13,30,35,61} Despite the official data, which do not yet reveal a significant decline in fish catch, these other signs indicate that the current level of fishing effort is not sustainable. Should this level of effort continue, yields will probably decline at some point in the future—along with fishing revenues. On the other hand, improvement in fisheries management could help to restore fish stocks and increase revenue from Jamaica’s reef-related fisheries.

There are also limitations in the quality of the data used in this paper. We noted above that the catch volume data are preliminary and that the Fisheries Division is currently working to revise them. Additionally, no official sales data were yet available for years after 2005. It was also impossible to disaggregate data on finfish catch and value by individual species, which would have provided a clearer picture of the shift in species caught over time. Better and more frequent collection of catch volume and sales data will be essential to monitor and inform the sustainable management of Jamaica’s fisheries.

4. What Else is at Stake?

The economic contribution of reef-related fisheries in Jamaica—while significant—does not tell the whole story. Overfishing, the most pervasive human pressure on Jamaica’s coral reefs, threatens to compromise the reefs’ ability to provide other essential ecosystem services to Jamaica’s people, including tourism and shoreline protection (Box 1).¹

Furthermore, a continued decline in Jamaica’s reef fisheries would have negative social implications, both on livelihoods and food security. A recent study also shows that the Jamaican economy has already incurred high losses from the degradation of its reef fisheries in recent decades.⁶ We examine each of these issues in greater detail below.

Employment and Livelihoods

In Jamaica, where unemployment reached 12.9 percent in 2011,⁶² fishing is an important, long-standing source of employment, as well as a traditional source of food and livelihood. While certain other sectors in the Jamaican economy—such as the mining industry—generate more revenue, they also require higher inputs of capital and technology, provide fewer jobs to Jamaicans, and have relatively few linkages to other sectors of the economy.⁶³ Fisheries, on the other hand, serve as a social safety net for the poorest, providing an “employer of last resort” in times of need, and providing seasonal employment when other sectors are less busy.^{3,4} Jamaica’s fisheries also provide a wide range of other employment opportunities, contributing directly and indirectly to the livelihoods of more than 100,000 people across the country.⁵ It is especially important to draw attention to these benefits of reef-related fisheries because they are not directly accounted for in the revenue statistics above. Nevertheless, social and human impacts at the local level stand at the heart of concerns about declines in marine fisheries in Jamaica and across the Caribbean.

A recent assessment of the Jamaican fishing industry estimated that there are 15,000–20,000 active fishermen in the country.² In some coastal communities—such as the western resort town of Negril—more than three-quarters of households derive their livelihoods from artisanal fishing.⁶⁴ Most of those

who fish in Jamaica are men, but many women are involved in the processing and sale of fish. As of 2000, there were six processing plants in the country, processing high value fish (primarily conch and lobster) for export and sale.⁶⁵ Many other people make a living cleaning or selling fish informally at landing sites. A 2007 study found between 8,000 and 10,000 vendors and middlemen selling fish island-wide; the majority of these vendors are women, many of whom are related to the fishermen bringing in the catch.² Other experts suggest that the number of vendors may be even higher, with a ratio of three vendors to each fisherman.^{5,66}

Fish Consumption and Food Security

Fish and fishery products are important to the Jamaican diet. The UN Food and Agriculture Organization⁶⁷ estimates that Jamaicans consume over 30 kg of fish per capita per year, although local estimates are somewhat lower, in the range of 11–20 kg per capita per year.^{2,7} Fish consumption accounts for 8–9 percent of total protein consumed by Jamaicans, as compared to the world average of 6 percent.⁶⁸ Fish is also a vital source of protein that is available year round, even when other protein sources are not.⁴

However, despite local fisheries' economic and social importance, they do not fulfill the consumption needs of Jamaica's own populace—the majority of the fish eaten on the island is imported from abroad.⁶⁹ Therefore, a collapse in Jamaica's fisheries would have a negative impact on food security in the country, especially among the rural poor living in coastal areas, who are most reliant on local fisheries as a subsistence food source.⁴ It also makes economic sense to restore local fish stocks in order to reduce the country's expenditures on imported fish.

Economic Costs of the Decline of Jamaica's Marine Fisheries

Only a small amount of research has been done to estimate the economic losses that could be attributed to past degradation of Jamaican fisheries over time. Sary et al. (2003)⁶ examine the change in value of fish catch over time for a few specific landing sites on the north coast of the island, comparing catch and effort data from 1968 and 2001. Over the course of approximately 30 years, total catch fell 13 percent by weight and 17 percent by value (using 2001 prices). Noting that the low availability of larger fish in the later time period has inflated prices for what would have been "trash" fish 25 years earlier, the authors estimate a total decline in value of around 20 percent. They conclude that Jamaica's failure to effectively manage fishing grounds over an area of 12km² cost the country more than US\$8 million between 1975–2000. Using estimates of shelf area and productivity for the north and south coasts of Jamaica, the authors scale this up to a rough estimate of US\$1.6 billion in lost revenues for the country as a whole (not including Pedro Bank) over the 25-year period.⁶ This averages out to an estimated US\$64 million in lost revenues annually during that period (nearly twice the yearly annual revenue from reef-related fisheries seen in Table 3 above). This result suggests that under sustainable management, Jamaica's reef-related fisheries could provide significantly more revenue to the country than at present.

5. Conclusions and Policy Recommendations

Jamaica's Fishing Industry Act of 1975 and Fishing Industry Regulations of 1976 are the two main pieces of legislation that regulate the country's fisheries. However, weak enforcement, as well as policy decisions to maximize short-term production above ecologically sustainable levels, have led to ongoing overfishing and degradation of fish habitat. The observed conditions and threats described in this report are likely to seriously undermine the long-term productivity of Jamaica's fisheries. Although the country's marine fisheries continue to support many jobs and livelihoods, a continuation of current

negative trends is likely to put these jobs and livelihoods at risk. The newly designated fish sanctuaries represent an important first step for better management, but greater action is necessary.

Since 2003, the government has worked to draft a new National Fisheries Policy in order to overhaul the existing, outdated legal framework. The draft policy seeks to rectify the problems discussed above, promote sustainable development of Jamaica's fishing industry (with optimal levels of production), and enhance food security.⁷ The draft policy has been through extensive review by civil society and other fisheries stakeholders, and its provisions should become law within the next two years.

Below we highlight some of the many positive aspects of the draft fisheries policy and make several recommendations for improvements. We also recommend investments in overall coastal ecosystem protection that would serve to not only strengthen the capacity of Jamaica's coral reefs to sustain the country's fisheries, but also provide other essential ecosystem services, such as beach tourism and shoreline protection.

The draft National Fisheries Policy⁷ includes important provisions to:

- *Establish more stringent regulations.* The draft policy seeks to reduce fishing effort in nearshore fisheries to allow fish stocks to recover. All major fishing areas will be required to have fisheries management plans defining specific restrictions and regulations, including quotas, gear and species restrictions, and minimum catch sizes. The policy will also establish new fish sanctuaries. Additionally, the policy will seek to reduce the number of artisanal fishermen operating in nearshore fisheries by providing for alternative livelihoods.
- *Finance greater enforcement of existing and new laws.* Historically, enforcement of Jamaica's fisheries laws and regulations has been weak. The draft policy seeks to address the funding problem by instituting license and registration fees for fisheries activities to partly finance the cost of enforcement. The government will also seek financing for boats, equipment, improved facilities, and staff training, which should ensure that the newly established fish sanctuaries do not become "paper parks."
- *Collaborate with fishermen and regional partners to reduce foreign poaching.* Foreign poaching—especially of conch and lobster—is a major problem in Jamaica, but government capacity for monitoring, control, and surveillance on the high seas is limited. The government has already begun to encourage Jamaican fishermen operating offshore to be "chief guardians" of the country's fisheries and to report instances of poaching to national authorities. The policy also speaks to the need for regional efforts to deter illegal fishing throughout the greater Caribbean region.^{60,70}
- *Move toward a framework for co-management* with coastal communities, fishing cooperatives, NGOs, and other stakeholders. The push for co-management has already begun with the new fish sanctuaries declared in 2009 and 2010. The draft policy emphasizes the value of building partnerships between the government and fisheries stakeholders to involve stakeholders in decision-making and fisheries management. Successful projects, such as the Caribbean Coastal Area Management Foundation (C-CAM) in Old Harbour Bay,² could serve as models. However, adequate funding, as well as a favorable enabling environment with clear devolution of rights and authorities to local community-based management organizations, will be essential for co-management to be effective.
- *Invest in improved research and data collection, storage, and dissemination.* We noted above that the lack of reliable data on fish catch volume and value makes it difficult to monitor Jamaica's fishing sector. The draft policy would improve data collection, thereby allowing the government to evaluate the effectiveness of the new management measures. Improvements in data collection, monitoring, and analysis could also increase the understanding of the roles of illegal fishing,

underreporting of catches, and legal but ill-advised overfishing of certain species, as part of the government's overall efforts to address overfishing and to improve fisheries management. As above, adequate levels of funding will be necessary to support these activities.

The draft National Fisheries Policy represents an enormous step toward improved management of Jamaica's fisheries. However, many challenges still remain. It remains to be seen how many of the policy's provisions will be integrated into the eventual legislation, and how effective the new regulations stemming from that legislation will be. Insufficient funding for the Fisheries Division's staffing and operations—as well as limited management, technical, and enforcement capacities—will likely remain key concerns. Co-management carries the risk of the government devolving all management and enforcement responsibility to small NGOs and CBOs with insufficient capacity. Therefore, leadership and support within the highest levels of the Jamaican government—as well as the environmental and business communities— in support of needed policies, legislation, regulations, and capacity building in the public sector and at the local level will be critical to the success of fisheries management in Jamaica.

Improved fisheries management should curb overfishing, a key driver of coral reef degradation in Jamaica. However, several important areas are not fully addressed in the policy. We believe fisheries management in Jamaica could also benefit from the following recommendations:

- *Monitor closely the impact of the new fish sanctuaries and scale up this approach* if it proves to be successful in Jamaica. Experience with similar “no-take zones” in other countries shows that after three to five years of successful protection, fish stocks can recover inside the protected area and fish can begin to “spill over” into adjacent areas where fishermen can catch them. However, many factors contribute to the success (or failure) of such protected areas. These factors include the active participation of local communities in protected area management, the level of enforcement, the size of the protected area, and the area's natural ability to protect fish habitat.⁷¹
- *Improve coordination between fish sanctuaries and other marine protected areas.* Improved coordination between the management structures of these protected areas would strengthen fisheries management and conservation, facilitate information exchange between the country's protected areas and fisheries stakeholders, and could unlock sources of future funding and support for the fish sanctuaries. For instance, a Global Environment Facility project to strengthen the operational and financial sustainability of Jamaica's protected areas system⁷² could also be an additional source of funds for fisheries enforcement.
- *Provide for alternative livelihoods for artisanal fishermen.* As noted above, one way in which the draft policy seeks to reduce fishing effort on Jamaica's reefs is to reduce the number of artisanal fishermen in nearshore fisheries and facilitate their transition to other forms of income.⁷ Aquaculture, tourism, and possibly even harvesting marine algae are all possible alternative sources of income. However, it is absolutely critical that the government allocate the necessary funds and training to facilitate the research and development of these alternative livelihoods. A failure to do so would have significant social and economic repercussions.
- *Promote a shift to sustainable fish consumption.* The Jamaican population is accustomed to eating reef fish, and as long as demand for these marine species remains high, it will be difficult to contain overfishing on Jamaica's reefs. The government recently initiated public education campaigns to promote consumption of the invasive lionfish, as well as locally produced tilapia (Jamaica's primary aquaculture species), in efforts to reduce demand for reef fish. However, the public remains wary about consuming lionfish and farmed fish, highlighting the need for continued public education.^{48,73}
- *Design and implement a plan of action to protect parrotfish* and parrotfish brood stock through a strategy of critical habitat protection, including no-take areas, catch size limits, and a moratorium on night-diving to fish. A national education and public relations campaign—aimed at the tourism

industry as well as the wider public—could create the support necessary for parrotfish conservation.

Overfishing is the most pervasive human pressure on Jamaica’s reefs. However, coastal development and runoff from the land are also major threats to the country’s reef ecosystems.¹ Therefore, the government and even private actors in the country should consider investing in protection of coral reefs, seagrass beds, and mangroves, the critical habitats for most commercial fish caught in Jamaica. Investment in coastal ecosystems would also provide important “co-benefits” by enhancing the other services that these ecosystems provide to Jamaica, such as tourism and shoreline protection. Looking forward to a sustainable future for the country’s reef-related fisheries—and for the other ecosystem services that Jamaica’s reefs provide—we argue that it is in Jamaica’s long-term economic interest to:

Manage coastal development wisely:

- *Improve wastewater management.* Enhanced management of sewage, as well as runoff from construction, would improve coastal water quality, benefiting coral reefs, fish, and local people.
- *Protect mangroves.* Mangroves serve as important fish habitats, and also act as buffers, preventing agricultural runoff from reaching coral reefs. The government should seek to protect the remaining mangroves from clearance for beach and coastal development.
- *Improve land-use planning and zoning.* Enforcement of the government’s current setback regulations, and reassessment of outdated regulations, would establish a more adequate buffer zone between beaches and coastal infrastructure, protecting both coastal ecosystems and beachside hotels.

Reduce watershed-based sedimentation and pollution:

- *Promote improved agricultural techniques.* Improved soil conservation (using terracing) and reduced use of chemicals would reduce flows of sediment and pollutants to coastal waters.
- *Retain and restore vegetation.* Reforestation—using local species—would help reduce erosion, especially on steep slopes and in riparian areas.

Look to the future:

- *Manage for climate change.* The growing threats of warming seas and ocean acidification, driven by greenhouse gas emissions, will compound the existing local pressures on Jamaica’s reefs. This points to the urgent need for better coastal and fisheries management to reduce local pressures and help reefs survive the growing global threats stemming from climate change.⁷⁴

Barriers and constraints to implementing these measures remain. There is currently little political will to tackle environmental issues in Jamaica, as the environment is perceived to be of lower importance than strictly economic issues such as job creation, GDP growth, or the public debt. Levels of funding for coastal and fisheries management are likewise low, and as a result, enforcement of existing laws to protect coastal ecosystems and fisheries is weak, as is management capacity.

History demonstrates that conserving ecosystems begins with widespread awareness of the benefits they provide to people and the political will to act. To that end, this study has shown that Jamaica’s coral reef-related fisheries are integral to the national economy, providing annual revenues of more than US\$30 million and livelihoods to nearly 5 percent of the population. The other *Coastal Capital: Jamaica* analyses (summarized in Box 1) show that coral reefs also provide Jamaica with important economic benefits from beach tourism and protect the country’s shoreline and coastal communities.

It is critical for development planners to take full account of the economic value of these reef-based ecosystem services when making decisions for Jamaica’s future. Passage of national fisheries legislation

and regulations based on the recommendations of the draft National Fisheries Policy would help ensure that Jamaica's fisheries continue to provide an important source of revenue and employment for the foreseeable future. Additional policy and legislative reforms to promote sustainable fishing, manage coastal development, and reduce land-based pollution as outlined above would further improve the health of Jamaica's coral reefs. Finally, it will be necessary to explore opportunities for long-term financing for coastal conservation in Jamaica, including market-based approaches such as payments for ecosystem services, MPA user fees, and charging polluters for damages. Taken together, these measures could help to restore, increase and sustain the economic benefits that coral reefs provide to Jamaica's people for many generations to come.

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26. Because not all fishermen who are registered rely on fishing as a primary source of income, it is difficult to determine an exact number of fishermen in Jamaica. As of 2007, there were more than 17,000 registered fishermen in the country (Murray 2008). However, other experts think that this number overstates the number of active fishermen, and that a better estimate is closer to 10,000 (Espeut 2011, pers. comm.)
27. Espeut (2011, pers. comm.) suggested that there are 10,000 fishermen, 30,000 vendors, and 30,000 in other closely related occupations (processors, gear makers, etc.)—a total of 70,000 people. Espeut further suggested a multiplier of 2 on top of this to capture others whose livelihoods are indirectly supported by fisheries, bringing the total people who are directly or indirectly supported by fisheries to 140,000. The ECOST study (2007) suggested that as many as 200,000 were indirectly supported by fisheries, due to large distributor networks in bigger towns. Therefore, we believe that 100,000 people is a conservative estimate.
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