The Nassau Grouper Spawning Aggregation at Caye Glory, Belize: a Brief History

A Case Study by The Nature Conservancy, Mesoamerican Reef Program

Prepared by
GUILLERMO ENRIQUE PAZ
&
ETHEL TRULY
GREEN REEF ENVIRONMENTAL INSTITUTE

FEBRUARY 15, 2007

© 2007 The Nature Conservancy

ACKNOWLEDGEMENTS

We wish to acknowledge and express our profound appreciation to the fishermen from Caye Caulker, Dangriga, Placencia and San Pedro, who so generously shared with us their time, their experience and their wisdom, all indispensable to the writing of this case study. They were Florencio Acosta, Joe Alamilla, Francisco Fashico Arceo, Omar Arceo, Bongos, Severo Castillo, Lincoln Eiley, Alan Forman, Ernesto Gómez, Florentino González, José González, Dimas Guerrero, Donaldo Guerrero, Efrain Guerrero, Orlando Guerrero, Arturo Lara, Alpheus Bucky Martin, Felipe Paz, Jaime Paz, Milo Paz, Tomaz Paz, Tony Rivero, Antonio Capulina Sanzores, Florencio Colas Sanzores, Earl Smith, Tony Vega, Carlton Young, Tom Young, Tom Young, Jr. Additional details about them are included in Appendix 1, they are quoted throughout the text and they are featured in the film created along with this case study.

We must also acknowledge and thank Marty O'Farrell, the videographer for the film created in combination with this case study; Doug Perrine/SeaPics.com, whose copyrighted pictures are included herein. We are also grateful to George Sedberry and Thom Grimshaw for their useful comments on earlier versions of this manuscript.

In addition, we want to thank the following organizations and individuals who contributed their time, their thoughts and, in some cases, their data. They include the management of Caribeña Producers' Cooperative, particularly for their generosity in permitting us access to their archives; the Fisheries Department, especially Isaias Majil, its Marine Protected Areas Coordinator, and Edgar Badillo, who participated in the monitoring; and the Belize National Spawning Aggregation Working Committee and its members.

This case study, the related film and the research behind both were made possible by the generous support of the American people through the Global Conservation Program of the United States Agency for International Development (USAID), through the Mesoamerican Reef Program of The Nature Conservancy (Belize), under the terms of Award No. LAG-A-00-99-00045-00. The contents of this case study and the related film and the opinions expressed therein are the sole responsibility of the authors and do not necessarily reflect the views of the Global Conservation Program, USAID, the United States Government or The Nature Conservancy. Likewise, neither the denominations used in this report nor the way in which the data in the report is presented imply, on behalf of the members of the Global Conservation Program or USAID, any judgment on the legal status of countries, territories, cities or zones, of their authorities or of the delimitation of their frontiers or boundaries.

The Nassau Grouper Spawning Aggregation at Caye Glory, Belize: a Brief History

ABSTRACT. This case study presents an historical perspective of the Nassau grouper spawning aggregation at Caye Glory, Belize, an aggregation exploited for over 80 years. Data were collected during interviews with key participants in the fishery and through literature and archival research to document the factors that have influenced the history of the Caye Glory spawning aggregation, to consider its current status and to identify implications from its history for the management of other spawning aggregation sites, particularly in the Mesoamerican Barrier Reef System. Despite the long known history of the Caye Glory aggregation, this study concludes that its demise is the result of the relatively recent success of Belize's fishing industry, coupled with the unwillingness or inability of the colonial and national governments to inaugurate effective and timely management of Belize's marine resources. The establishment of a strong export market for marine products, followed by the extraordinary financial and other achievements of Belize's fishermen's cooperatives, attracted more fishermen to the industry and provided them needed capital for new technology and fishing gears with which to more easily and effectively exploit the Caye Glory spawning aggregation. These same technologies also enabled greater exploitation of Nassau grouper throughout the reefs, during the entire year, by an ever increasing number of fishermen. Unsustainable fishing of Nassau grouper during spawning aggregations at Caye Glory and other sites, combined with the daily removal of Nassau grouper outside spawning aggregations, has led to the decline and near destruction of the Nassau grouper population in Belize.

Introduction

At one time, Caye Glory (sometimes also known as Emily) was the name of an island on the barrier reef of Belize, formerly the colony of British Honduras[1]. Although the tiny island disappeared entirely over forty years ago,[2] its name has persisted[3] as a reference to the site of spawning aggregations for several species, most notably the Nassau grouper (*Epinephelus striatus*). This paper's objectives are to examine the factors that have influenced the history of the Caye Glory spawning aggregation of Nassau grouper, to consider its current status and to identify implications from its history for the management of other spawning aggregation sites, particularly in the Mesoamerican Barrier Reef System.

Historically, Nassau grouper spawning aggregations at Caye Glory peaked around the full moon in December and/or January of each year (Carter et al. 1994, Heyman & Requena 2003) at the sharp bend point in the reef just east of the former caye, where the reef drops steeply into deep water (Heyman 2001). The site has been confirmed as a site of spawning aggregations for the following species in addition to Nassau grouper: Dog snapper (*Lutjanus jocu)*, red hind (*Epinephelus guttatus)*, black grouper (*Mycteroperca bonaci)*, yellowfin grouper (*Mycteroperca*

[1] The colony of British Honduras became the nation of Belize in 1981. "Belize" and "British Honduras" will be used interchangeably throughout, regardless of the period of reference. In addition, "cay" and "caye," correct but alternate spellings, will be used interchangeably or as used by cited authors.

[2] While in 1922 Caye Glory was noted to have coconut trees of 21 meters in height (Stoddart et al. 1982) and known to have been inhabited (Stoddart 1963), by 1960 the cay had been reduced by the hurricanes of 1931 and/or 1945 to "a mere strip of sand some thirty yards long, rising perhaps three feet above sea level, with only a mat of creepers and a single small coco-nut tree at one end for vegetation" (Carr & Thorpe 1961). The island disappeared altogether during Hurricane Hattie in 1961 (Stoddart 1963).

[3] Actually, its *names* have persisted. Some, particularly the fishermen of southern Belize, refer to it as Emily because of the shipwreck of a freighter named Emily at the site sometime before living memory, probably near the end of the nineteenth century. Among fishers from San Pedro and Caye Caulker, the site was traditionally known as "Los Fierros," meaning iron in Spanish, because of two iron pieces of the wrecked freighter that protruded from the water and provided a convenient "landmark."

venenosa), jolthead porgy (*Calamus bajonado), ocean triggerfish (Canthidermis sufflamen)* and permit (*Trachionatus fulcatus)* (Fisheries Department 2005, Carter et al. 1994, Heyman & Requena 2002, 2003).

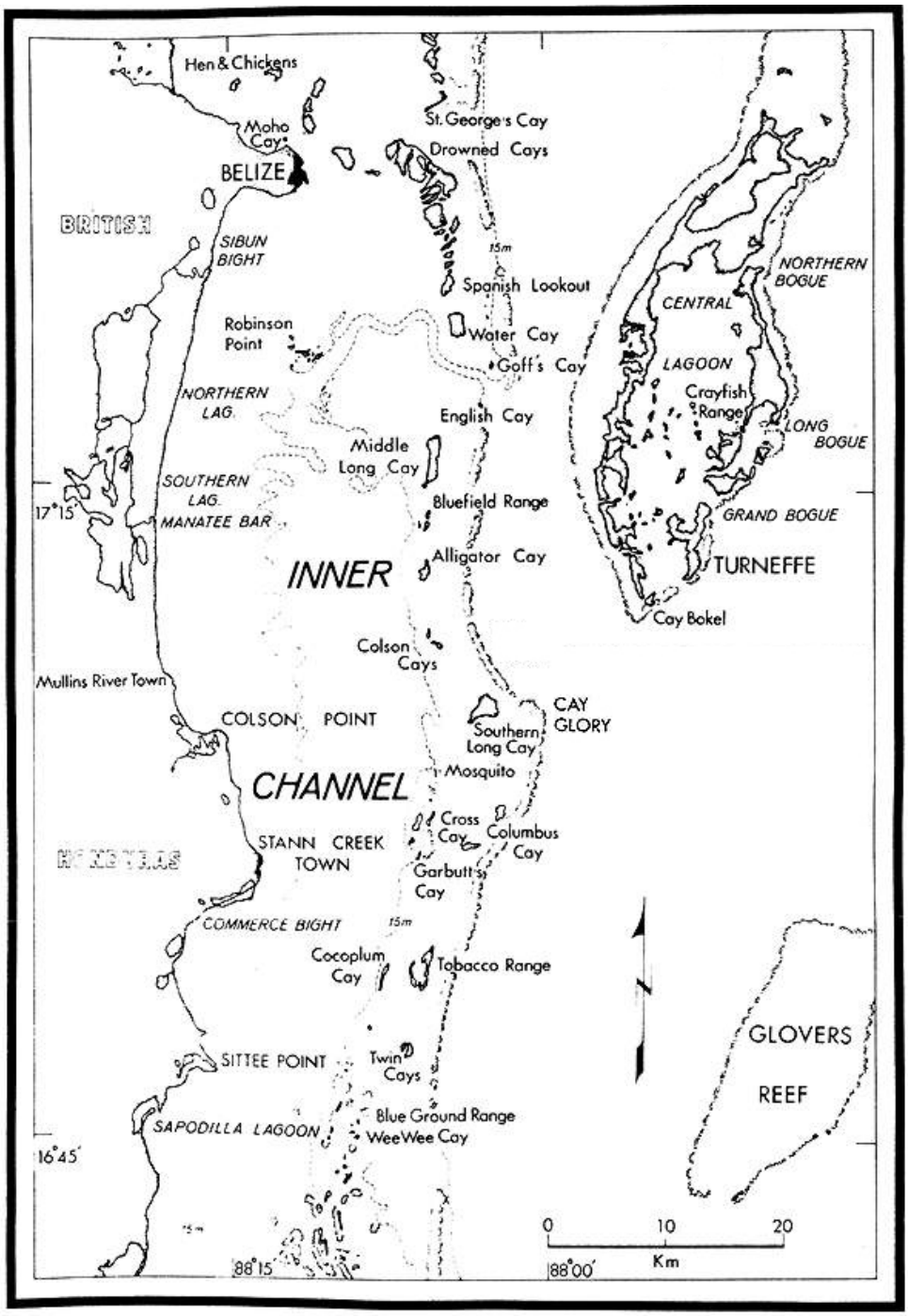


Figure 1: Geographical map of central Belize depicting spawning aggregation site at Caye Glory

Figure 2: Satellite image of the Caye Glory reef promentory showing location of the former island of Caye Glory, the grouper spawning site and shoal where local fishermen establish themselves temporary camps.

Data & Methods

Of the many stakeholders in Belize's fishing industry, this report focuses on the opinions and experiences of fishermen who have fished the Nassau grouper spawning aggregation at Caye Glory; Belize's fishermen's cooperatives; its Fisheries Department, and the Spawning Aggregation Working Group. Written sources upon which this report is based include the sparse literature relating directly to Caye Glory; publicly available statistics for the Nassau grouper population and the production and number of fishers at the national level; the few relevant and available records from Belizean fishing cooperatives; interviews with fishermen who have fished the Caye Glory spawning aggregation over many years, personnel from Belize's Fisheries Department and the Belize Spawning Aggregation Working Group; data from the scientific literature; archival records of the Belize National Archives; and the laws and regulations of Belize and the prior colony.

Interviews

Because of insufficient data to calculate changes in catch and catch per unit effort during the spawning aggregations of Nassau grouper at Caye Glory, we identified 211 fishermen from San Pedro, Sarteneja, Caye Caulker, Belize City, Placencia and Dangriga who had fished the Nassau grouper spawning aggregation at Caye Glory. Because of project constraints, we selected 29 fishermen[4] for lengthy interviews to test the meagre existing data; and, in 2006, the author interviewed them in San Pedro, Caye Caulker, Placencia and Belize City. Qualitative and semi-structured interviews were conducted in order to gather the most detailed accounts of change and identification of key past events possible. Interviewees were asked about their personal histories in the fishing industry; changes in catch size, gear, number of fishers, and numbers and types of boats; and their perception of the cause(s) for changes observed at Caye Glory.

[4] Their names and demographic information are provided in Appendix 1.

Only one fisherman interviewed was younger than 50 years old, and he was 48. Eighty per cent of the fishermen were 60 or over; 55% were over 70; and three were 90 years old. Two of the fishermen had 10 years experience in the fishing industry; all the rest had more than 20 years experience; and 60% had 40 or more years fishing experience. Seventy per cent of the fishermen had fished the Nassau grouper spawning aggregation at Caye Glory for between 5 and 50 years. The majority of those with fewer than 5 year's' experience in fishing the Caye Glory spawning aggregation were 55 or younger. Several also had significant experience brokering product from Caye Glory.

In addition the author met with various cooperative board members, non-governmental organization (NGO) representatives, officials of Belize's Fisheries Department and the Belize Spawning Aggregation Working Group. These interviewees were often selected on the basis of availability, and most interviews took place in the informant's work place.

The credibility of all interviewees and of their responses was gauged by their position, experience, and the quality of their observations and recommendations.

Data on Nassau Grouper Population and Landings and on the Number of Fishers

The history of the spawning aggregation of Nassau grouper at Caye Glory is of necessity concerned with the number of individual fish in the aggregation and the changes in that number over the more than 80 years of its exploitation. We report herein what few figures we have and detail the difficulties in obtaining reliable counts. We also provide the little production data we have for Nassau grouper during spawning aggregations at Caye Glory, but can go no further. Our conclusion is that we do not know how many Nassau grouper have participated in the spawning aggregations at Caye Glory over time or at any given time, but we are confident of a dramatic and definitive decline in those numbers.

We are equally confident of a dramatic and definitive decline in the Nassau grouper population at the national level, but are similarly unable to quantify or statistically substantiate that decline, although anecdotal evidence abounds. Locating reliable proxies for overall Nassau grouper population is likewise impossible. Nor is it a simple matter to even determine the catch —current or past— of Nassau grouper, all varieties of grouper or fin fish generally.

The colonial government collected almost no fisheries data until the 1950s and thereafter purported, with respect to scale fish, to account for exports only. The Colonial Reports, the *only* official source available through 1965, divided scale fish into two categories, fresh fish and fish variously described as dry, dried, salted or corned, with no indication of species, catch site or fishing technology used. In addition to their omission of fish sold locally, caught for personal consumption and illegally captured, the Colonial Reports are widely believed to underreport even exports. For example, the 1963 Colonial Report provides the official figure for salted fish exported to Puerto Barrios, Guatemala and Puerto Cortez, Honduras as 71,123 lbs. Yet in roughly the same period, Alan K. Craig reported that fishermen were capturing *Nassau grouper solely during the spawning aggregation at Caye Glory* at a rate of 200,000 lbs (90,719 kg) (Craig 1968). In 1961 C. P. Idyll observed in his *Recommendations for the Development and Control of the Fisheries of British Honduras*,

> At present the statistics of scale fish landings and exports are completely useless, through incompleteness and inaccuracy. The quantities declared as exported, for example, are said to be only a fraction of the true figures. This is because statistics are tied to export duties. This violates the first principle of statistical systems, associating production records with law enforcement and revenue production. Since the exporter pays in proportion to the quantities of fish

declared, and since checks on these quantities are difficult, the inevitable result is false declarations." (Idyll 1961 at 23).

Belize's fishing cooperatives — which must surely have recorded correct and complete figures as to the catch and payment of individual members! — published data no more helpful with respect to landings of Nassau grouper.[5] For example, the 1975 production figures for one cooperative included several undefined categories that theoretically could reflect Nassau grouper landings: fish fillet, whole fish, gutted fish, common fish and grouper fillet. In 1979, the only such categories were fish fillet, whole fish and common fish. In 1985, the categories were fish fillet, 2.50 fillet, 1.25 fillet, 2.25 fillet, whole fish and common fish. (Annual Reports of Caribeña Producers' Cooperative 1975, 1979, 1985). Moreover, the cooperatives received only a portion, possibly a small portion, of the Nassau grouper captured at Caye Glory during the spawning aggregation. The fishermen sold the rest directly to brokers in Puerto Barrios and Puerto Cortez or to the operators of a few large vessels from Guatemala that came to Belizean waters during the Nassau grouper spawning season specifically to purchase corned grouper. (Craig 1966, Fishermen Interviews[6]

Finally, reports from Belize's Fisheries Department are hardly more enlightening with respect to landings of Nassau grouper. Their production figures are divided into whole fish and fish fillet and apply to exports only. Again, we have no data concerning fish sold locally, caught for personal consumption, illegally captured or surreptitiously sold across the border to avoid export. The Fisheries Department acknowledges that since at least 1994, most of the finfish landed by independent fishermen and cooperative members is sold locally at the markets, hotels and to private individuals and therefore goes as unreported landings. (Belize Fisheries Department 2001, Villanueva 2004). Idyll's 1961 observations remain apt today, despite the proliferation of enhanced data collection technologies in the interim.

The numbers of fishers are estimates from various sources including Colonial Reports, British Honduras 1950-1965, the Table of Issued Licenses and other statistics gathered by the Fisheries Department and the literature. None of the estimates is believed to be accurate. In addition, the various numbers are not necessarily comparable, may or may not distinguish between full and part time fishermen, and may mix counts of individual fishermen with big producers and cooperatives. Estimates of the number and types of boats are based on figures from the same sources and likewise are not necessarily comparable, may or may not distinguish among types of boats and may mix counts of doreys with counts of larger vessels that routinely carry a number of doreys. In short, we offer what figures are available without vouching for their reliability or consistency.

Results and Discussion

The Glory Days at Caye Glory

Estimated Population in Aggregation

The Nassau grouper spawning aggregation at Caye Glory is commonly believed to have been known to fishermen of Belize as far back as the 1920s, but not earlier (Craig 1968). The fishermen interviewed for this report, however, believe otherwise. Many of them, including the oldest among them, began fishing as children with their fathers and grandfathers, who had tales to tell of fishing Caye Glory.

---

[5] We should also note that the archives of the cooperatives are generally incomplete and poorly maintained.
[6] For example, Tony Vega, Colas Sansorez, Felipe Paz, Ernesto Gómez, Donaldo Guerrero.

Figure 3: A hut at Caye Glory build on the shoals during the grouper spawning season.

Although the numbers that once typified the aggregation can never be known, the early literature provides an unambiguous albeit unquantified picture. In 1944 the spawning aggregation at Caye Glory was described as follows:

> The groupers congregate here in almost countless numbers in late December or early January; it is reported that they are so closely packed as to hide the white sand bottom (Thompson 1944 at p.10).

Similarly, in 1966 the Nassau grouper at Caye Glory were reported as "congregat[ing] in astonishing numbers" (Craig 1966 at p.82). Jacques Cousteau filmed many, many thousands of Nassau grouper at Caye Glory in the early 1970s and featured them in his television series *The Undersea World of Jacques Cousteau* (1968-1976).

The fishermen interviewed for this report confirm the massive size of the spawning aggregations at Caye Glory in years past, although they offer no more precision in numbers. Every single fisherman described it in the 1950s, 1960s and 1970s as "huge," "grand," or other words to like effect. As Carlton Young concisely stated, "That place used to have *grouper*." Similarly, José González commented "they were there by the thousands at the bottom." Others commented, Said, for example,

- In those days, we were just starting to use masks and I would jump in there. There were HUGE amounts, I tell you huge amounts, like sardines you would see them, but huge amounts.[7]
- We got the waterglass, and we spy and see them. There used to be hundreds, thousands. When they gathered to go up north, you would see them come together and see them travel by the millions, and that was every year. But fish, man, by the *millions*.[8]

[7] Orlando Guerrero
[8] Tom Young Sr.

Many of the fishermen[9] also commented that the Nassau grouper were so numerous that each fisherman could get all he wanted or could handle.

Estimated Fishing Effort and Production during Spawning Aggregations at Caye Glory

While little published data exists specifically to indicate the numbers of fishermen and their landings during "runs" or Nassau grouper spawning aggregations at Caye Glory, Ernest Thompson recounted the following in 1944:

> The run is apparently timed by the phase of the moon… and exists at its height for only about 4 days. During these few days *every available fishing boat in the Colony operates* here and fish are caught at *an astounding rate* (Thompson 1944 at p.10, emphasis added).

Intense fishing during spawning aggregations at Caye Glory continued in subsequent decades. By 1968 Alan K. Craig, who suspected that overfishing was already underway, reported:

> The importance of the Cay Glory fishery can be judged from the fact that in recent years as many as three hundred boats [out of an estimated 500 total boats of all types, including those not seaworthy] have appeared during the grouper run. Before overfishing began a decade ago, it was not uncommon for an experienced crew of three men to catch and salt between one hundred and one hundred fifty dozen fish. The total catch from all boats has never been accurately determined, but an estimate of *one hundred short tons* [90,719 kg] is probably realistic. (Craig 1968 at 252, emphasis added).

Again, the fishermen interviewed for this report confirm these early descriptions. Although they often could not pinpoint the dates of the catches they described and had differing recollections of catch size (and perhaps differing typical catch sizes), they paint an unmistakable picture of bounty. Comments include, but are by no means limited to, the following:

- People fishing Cay Glory from north, west and south, people from Corozal, San Pedro, Cay Caulker and from south. We used to get more than 200 people fishing at Cay Glory.[10]
- Sometimes we would fish between 5 to 10 dozens of groupers a day among four of us.[11]
- The grouper bank of Cay Glory was the greatest fishing bank. There used to be hundreds of dories fishing there and everyone used to catch fish.[12]
- One year, Gaby and I went to Cay Glory with the *Exitar* two days before the new moon and were back in San Pedro before the full moon. The grouper were biting and we ran out of 4 sacks of salt and then we filled the live-well and sailed back to San Pedro. On that trip, we brought more than 30 dozen of salted fish and about 200 live groupers..[13]

---

[9] For example, Arturo Tuli Lara, Florentino González, José González.
[10] Tom Young Sr.
[11] Ernesto Gómez
[12] Arturo Tuli Lara
[13] Tomas Paz

- We would fish about 2,000 groupers among 6 or 7 of us. We would take up to 7,000 to 8,000 pounds of salted fish to Puerto Barrios in the fishing boat *la Helen*.[14]
- We used to make about 2 -3 trips a day to the fishing bank. … There were days that we used to fish up to 30, 40 dozens among 4 of us. Not every day did they used to bite a lot, but when they used to bite then we would take advantage and in 3 – 4 days, we would fish about 100 dozens.[15]
- There was a *lot* of grouper. … We fished about 140 to 170 dozens groupers among 9 of us. We stopped fishing because we filled the pen.[16]
- For a season, I got about 40,000 lbs of fish.[17]
- The grouper bank [at Cay Glory] was huge. There were approximately 50-70 dories fishing and everyone used to catch fish. … There were about 6 or 7 boats from San Pedro that used to go fish for grouper at Cay Glory. And each boat would bring approximately about 100 dozens of groupers. About 600 dozens of grouper total were brought to San Pedro every year.[18]
- We used to go fishing for 3 days and get 1,800 groupers, that's enough for corn[ing]. We would sell it for 14 cents a pound.[19]
- Me and mi uncle used to sell the grouper to Beto Pariente who take it to Puerto Barrios to sell. Every week we would carry a load of 5,000 pounds to Beto Pariente. … We use to make 3 to 4 trips for the day and catch about 60 to 75 groupers each trip when fish used to bite.[20]
- The grouper bank of Cay Glory was a huge fishing bank. There used to be hundreds of dories fishing there and everyone used to catch fish. Those days, you fish the amount that you want or what you calculate you can handle or work.[21]
- Everyday we would fish a minimum of 10 to 20 dozens. In a trip of a month, while camping there, we would catch up to 10,000 to 15,000 pounds of grouper.[22]
- Among 4 of us, when the fishing was good, we could catch up to 80 dozen grouper for the season. There were people that used to bring 300 to 400 dozens.[23]

---

[14] Donaldo Guerrero
[15] Florentino González
[16] Colas Sansorez
[17] Tony Vega
[18] José González
[19] Tom Young Sr
[20] Tom Young Jr
[21] Tuli Lara
[22] Orlando Guerrero
[23] Milo Paz

Figure 4: Fish corrals or holding pens built from mangrove stakes and chicken wire used for keeping the Nassau grouper alive.

Fishing at Caye Glory during the Nassau grouper spawning aggregation was hard work (Craig 1966, Carter 1988). The fishing was done in deep water on the outside of the reef. Fish were placed in the dories and "we had a guy there beating them with a stick."[24] Inside the reef, the fishermen built shacks or camps in which they ate, slept and corned, or salted and dried, their fish. The more prosperous fishermen also had pens, essentially wire cages in 3 or 4 feet of water, in which they kept fish alive and took them to market live. Those with no pens had to corn their fish at the end of each day in order to preserve them, while the others corned only the fish that did not survive to get into the pens. Descriptions of that hard work from the interviewed fishermen again reinforce the picture of bounty, as illustrated by the following comments:

- I made camp, big camp and I would take 30 sacs of salt and I store it on the camp. When we pile up the grouper in a platform … you think you never will finish. We had to open them up, corn them and then salt them. … One year I brought a … boy named Hanna, young and muscle-up. His job was to kill the groupers with a club. He started to kill them and was he happy killing them! After killing about 200, he started telling me that his shoulder was hurting him and he started complaining.[25]
- After the fish stopped biting, we then had to open and salt the groupers. We used to open and salt fish all day long up until 8 o'clock at night. Everything was full of grouper—the boat, the tendederos, the camp houses. There wasn't a single place that didn't have groupers. We had to sleep on top of the fish. We were so tired; we had supper and then went to sleep. We used a grouper for a pillow.[26]

The fish were hung to dry at Caye Glory, but often were hung longer after having been carried back to shore. As Tuli Lara recalled,

[24] Omar Arceo
[25] Tony Vega
[26] Tuli Lara

> When I used to go to school, those fences, those piers, the roofs of the houses, you only see the grouper hanging to dry. The park, everything they used to dry grouper.

The fishermen also salted the roe, although by a slightly different and easier process from that used for the rest of fish. The roe was sold or often used as "rent" for the fences, piers and roofs used to dry grouper.[27]

Figure 5: Fish-drying racks (tendedores) at Caye Glory.

In his *Report to the Government of British Honduras on Fisheries Management and Potential* in 1973, marine biologist R. H. Baird refers to "three known grouper banks…where grouper concentrate to spawn," one of which was Caye Glory. The report states "Three men have landed as much as 2000 lbs (907 kg) in a day." The report indicated the only limits on the size of the catch were boat capacity and technology, plus the inability of fishing cooperatives to freeze and store larger quantities at one time. (Baird 1973). His observation was confirmed by the fishermen interviewed for this report, as illustrated by the following comments:

- Those days, you fish the amount that you want or what you calculate you can work.[28]
- In those days, there were groupers. You could have fished what ever amount you wanted, until you got your amount and stopped fishing, or whatever you could work or whatever your boat could carry.[29]
- When they were biting, you fished the amount that you could work.[30]

Belize's Fishing Industry: the Wider Context

[27] Felipe Paz
[28] Arturo Tuli Lara
[29] José González
[30] Dimas Guerrero

The exploitation of the Nassau grouper spawning aggregation at Caye Glory must be considered in the wider context of Belize's fishing industry generally, including economic and cultural factors, and relevant legal developments during the period of decline.

Development of Belize's Fishing Industry

The fishing of Belize's coasts, cayes and barrier reef dates back at least to the country's early Mayan inhabitants (Carter 1990), but the development of a commercial fishing industry of any significance is very recent (See Sidebar 1). The primary marine product of value prior to the beginning of the twentieth century was the turtle, prized both for its shell and its meat. Belize's exports of shells and live turtles appear to have peaked around 1870 (Craig 1966 at p.42), but had, along with its turtle population, declined significantly by the end of the nineteenth century. The fading turtle industry had virtually ceased to exist by the early 1920s (Craig 1966).

At the beginning of the twentieth century, few individuals in Belize could earn a living from fishing, although some in the colony's traditional fishing communities (See Sidebar 2) fished to supplement their diet (Gordon 1981 at 68). Fishing "barely produced enough food to keep pace with the expanding population [, and only on] infrequent occasions … a surplus of fish was caught…" (Craig 1966 at p. 44). Most breadwinners worked for wages in the forestry industry or on a sugar or coconut plantation (Craig 1966, Gordon 1981). These occupations were characterized by physically taxing work, low pay and unpleasant or even harsh conditions; but they generally provided better incomes than fishing and sometimes also embroiled the workers in debt to their employers from which they could not extricate themselves (Gordon 1981).

By 1900 the main fishing gear throughout Belize were handlines with wire hooks, spear, seines and turtle nets (Gordon 1981 at 68, 71, 110-111; Craig 1966 at 43-44). Beach seines were used in the lagoons behind Ambergris Caye and on the beaches (Gordon 1981) and in the south (Craig 1966); however, "fishing equipment as expensive as the seine, was [at the turn of the century] (and still is [in the early 1960s]) out of keeping with the rather meagre inventory of simple tackle used by most fishermen in British Honduras" (Craig 1966 at 44). Few fishermen rose above subsistence level (Gordon 1981 at 68).

Moreover, at the beginning of the twentieth century, three major and interrelated obstacles prevented development of a substantial fishing industry in Belize, despite its abundant marine resources: the limitations of the fishing technology utilized, the paucity of effective preservation techniques and the absence of significant markets for surplus catch (Thompson 1944). Only when these impediments were removed could subsistence fishing for personal consumption begin to evolve into a true industry and attract larger numbers of full-time fishermen. Not coincidentally, the solutions giving rise to the fishing industry affected the fate of the Nassau grouper spawning aggregation at Caye Glory.

In 1900, the only sizable market for fish was at Belize City,[31] then the governmental and commercial centre of the colony and its most populous settlement. The few fishermen based there offloaded their catch directly into market stalls (Craig 1966) or kept the fish alive in the canal adjoining the market (Thompson re 1944). The other small markets, which existed primarily to provide foodstuffs to loggers, chicleros and agricultural wage earners, were located in Dangriga[32] in the south, Corozal in the north and up the Rio Hondo to the logging camps of northern Belize and southern Mexico (Gordon 1981, Thompson 1944). Fishermen not based in Belize City could serve the live market only with difficulty (Craig 1966, Gordon 1981, Thompson 1944); most fish was preserved through salting and sold as either "fresh corned" or "dry corned," the difference being that the former would remain good for about 24 hours and the latter much

[31] Belize City was known as Belize prior to the colony's independence.
[32] The town of Dangriga was formerly known as Stann Creek.

longer due to an additional 3-5 days of processing, primarily through drying in the sun (Thompson 1944, Craig 1968, Gordon 1981).

Figure 6: Dugout canoes or dories used to handline for grouper off the Caye Glory spawning site.

The first and most significant innovation to affect Caye Glory came in 1911 with the introduction of the smack, a sailing boat of Cuban design. Prior thereto, the most common fishing vessel in Belize had been the dorey,[33] a refined form of dugout canoe (Craig 1966) navigated by means of poles, making for a slow and exhausting journey; even after sails were added toward the end of the nineteenth century, poles continued to be essential when the wind was uncooperative (Gordon 1981). After the first smack was built to the specifications of a Caye Caulker resident who had spent several years in Cuba, its design was adopted quickly by other northern Mestizo fishermen and in the following decades by the less prosperous Creole and Garifuna fishermen at least as far south as Dangriga, although the dorey remained in widespread use until the latter part of the century and is still common in Toledo (Huitric 2005; Craig 1966 at 56).

The smack, far larger than the dorey, offered superior speed and stability and was designed for its sails to be quickly lowered and raised with relative ease and less likelihood of mechanical difficulty, especially at a critical moment (Craig 1966 at 56). It had the further advantage of local production for the fishermen of the north (Gordon 1981 at 112). However, it was the smack's "live well" that radically transformed fishing in Belize. The live well consisted of a hold into which seawater, entering through holes below the water line, circulated to keep the catch alive (Craig 1966 at 56). The only fish market of any size was then in Belize City, where live fish were favoured (Gordon 1981, Thompson 1944). Thus fishermen hoping to sell their catch there either had to head for market after only a short time in the fishing grounds in the hope of delivering reasonably fresh fish (Craig 1966 at 60) or to pole or sail a dorey while towing a

[33] Another prominent design was the botalón, believed to have been of Mexican origin. It was a sailing vessel somewhat more stable than the dorey and with a larger carrying capacity; however, it was "notorious for making little headway into the wind" and therefore did not always offer an advantage in speed. The botalón completely disappeared after the introduction of the smack (Craig 1966 at p.56).

second dorey with holes to permit the circulation of sea water (Gordon 1981 at 70). The smack's live well, however, made possible fishing trips of three or four days (Craig 1966 at 60), gave the smack larger carrying capacity and enabled fishermen from as far away as San Pedro to reach the market in Belize City in only one or two days (Gordon 1981 at 112).

More pertinently, Craig believed the smack to have made possible the discovery of the Nassau grouper spawning aggregation at Caye Glory and its initial exploitation, both probably occurring in the 1920s (Craig 1968 at 255-256). The fishermen interviewed for this report, however, believe fishing at Caye Glory began before the 1920s, although the smack may have rendered it the site accessible to many more fishermen. Their belief is based upon their having fished at Caye Glory as children with their fathers, who in turn had fished there with their fathers.

A modification produced the "dry smack," a smack without the live well but equipped with a hold into which water (or later ice) could be placed; the dry smack was often used at Caye Glory since the catch was commonly preserved through dry corning (Craig 1968, Thompson 1944). Subsequent developments in boat equipment rendered the Caye Glory site even more accessible to fishermen. Beginning in the 1950s when Belize's fishing grounds nearer to the fishermen's habitations had been depleted; more fishermen acquired not only smacks and dry smacks, but vessels with motors (Gordon 1981 at 125). By 1964 the vast majority of smacks, doreys and skiffs were "equipped with modern outboard engines from 5-75 h.p. … There [were] also a few large motor craft fitted with inboard engines used for transporting catches from the fishing grounds to the production centres" (Colonial Reports, British Honduras 1964-65, p.44). Thereafter, fishing at even greater distances from home and trips of increasing duration were enabled by even bigger boats and motors and improved ice and refrigeration capacity and then impelled by further declines in exploited fishing grounds (Huitric 2005; Gordon at 129).

Once the Nassau grouper spawning aggregation at Caye Glory was discovered, it annually attracted the large number of fishermen noted above. Despite the limited markets then available, the fishermen profited from their expeditions because of the sheer size of their catches and the timing of the spawning aggregation just before the beginning of the Lenten season, enabling them to ship bundles of corned fish inland and export some to Guatemala, Honduras and the US (Colonial Reports, British Honduras 1948-1965; Craig 1966, Thompson 1944). Nevertheless, neither the Nassau grouper spawning aggregation at Caye Glory nor the few other seasonal concentrations, such as the August aggregation of silk snapper at Long Cay, inspired a well-developed fin fishery. Rather, as late as 1966, Craig observed,

> Belizean fishermen continue to provide the local market with what may be termed 'daily subsistence fishing' without demonstrating any strong tendency to increase their efforts on a more elaborate commercial basis. (Craig at 75)

Lobster Industry

The first few decades of the twentieth century brought the beginning of Belize's spiny lobster industry. Belizeans had traditionally rejected lobster as "trash fish" (Gordon 1981) and had previously made no effort to exploit them (Craig 1966). In the early 1920s as the North American lobster industry was declining, an American named Stibbs and one Captain R. E. Foote, a Canadian, founded canneries to process lobster tails for export to the US market, thus revealing to Belizeans that this trash fish had value elsewhere in the world (Gordon 1981, Craig 1966, Thompson 1944). Their businesses would fail: marketing problems forced Stibbs' operation to close within a year, and Captain Foote's enterprise went down with the Depression of the 1930s after surviving a decade and a half that included three relocations of his facilities, the loss of one cannery to a hurricane and significant labour unrest (Gordon 1981, Craig 1966, Thompson 1944). Nevertheless, even before opening his cannery, Mr. Stibbs had introduced lobster fishermen from San Pedro to bully nets, used to catch lobster in shallower waters on the

reef until the late 1950s (Huitric 2005). At his Caye Caulker operation in the early 1930s, Captain Foote had introduced fishermen to the lobster pot, suitable for shallow, clear waters on sand patches in sea grass beds (Thompson 1944, Craig 1966). But he had also educated his work force on the concept of "reliable supply" and exposed them to the workings of the export market (Thompson 1944, Craig 1966, Gordon 1981).

From these tentative beginnings grew a successful lobster industry that has produced the country's most valuable marine export from roughly World War II to the present day. With the lobster fishery came the first freezer boat in 1934 (decades before widespread refrigeration in Belize) to purchase lobster tails directly from fishermen and transport them to the US (Gordon 1981). After World War II, buyers, usually from the US, sent more vessels with freezers, refrigeration and motors; picked up product in planes and a flying boat; and established processing and cold storage facilities in Belize City (Colonial Reports, British Honduras, 1948-1965; Gordon 1981), thus permitting full time, year-round lobster production (Huitric 2005). Fishermen began to prosper in the 1950s, moving the Fisheries Officer of British Honduras to comment in 1956 that many of the fishermen "now own their own homes and radios and also other amenities which were formerly beyond their reach" (Bradley 1956 at 6). The proceeds of lobstering provided fishermen with the capital necessary to improve their boats and gear, such as the first local powered fishing boat with an ice box in early 1952 with the purchase of a second one the same year and three more the year after (Bradley 1956). By 1965 Belize's fishing fleet included 400 smacks of 25 feet or more outfitted with sails and usually outboard engines; 400 to 600 dories and skiffs used as auxiliary crafts to the smacks, almost all with outboard engines from 5-75 hp.; and a few large motor craft fitted with inboard engines (Colonial Reports, British Honduras 1965). Advances in technology for processing frozen foods and using them in US homes, trends in US eating patterns favouring restaurant meals and seafood generally, and rising per capita income in the US strengthened the lobster market (Gordon 1981).

While Belize's small fin fishery long predated the development of lobster production, the latter stimulated the further development of the former, initially simply by attracting former wage earners from forestry and large-scale agriculture to fishing, particularly as the fortunes of those other industries slumped. Technology utilized in lobster fishing was adapted for scale fishing. For example, American Art Pinder had introduced masks and fins to San Pedro lobster fishermen in 1957, thus enabling divers to more efficiently target adult lobster on the reef where lobster pots and bully nets could not be used (Huitric 2005, Gordon 1981). However, the divers, especially in the northern cayes, also employed masks and fins in fishing for fin fish with their traditional Hawaiian slings and spears, thus expanding their ability to target Nassau grouper and other valuable commercial fish throughout the year and over all the reefs. In the 1960s came the spear gun, brought by two visitors from Florida to San Pedro; and within two years, spear guns were in widespread use. Groupers were particularly easy to shoot and were taken in ever increasing numbers, including for the sporting and eating pleasure of the tourists then discovering the cayes of Belize. SCUBA equipment arrived in the 1970s, permitting divers to fish at depths not previously available to them. As Carter has stated,

> No longer were these large fish [Nassau grouper] taken for a few weeks out of the year. Beginning in the 1970's, they were taken every day, every week of the year, from every possible habitat. … In a very short period of time fishes were removed from the reef of Belize with the same efficiency as the buffalo from the great plains of the United States. (Carter 2001 at 8).

Nevertheless, the spear gun, so effective at removing groupers and other fish from Belize's seas, was not commonly used in fishing spawning aggregations (Wade 2001, Arceo 2001).

Ironically, even the most significant technological development specific to scale fishing originated as an effort to develop an alternative to lobster, then believed to be fished to capacity (Bradley 1956) at a time when Nassau grouper were caught primarily with hand lines or sometimes spearing. In 1954 marine biologist Dr. C. F. Hickling introduced fish pots, essentially traps made of wire on a wooden frame. The first pots, imported from Jamaica, proved unsuccessful because large grouper consistently broke them. However, the following year a local variation of the fish pot proved impervious to the groupers' assaults and quickly achieved catches as high as 63 lbs. in a single day (Bradley 1956). Thus, scale fishing became a far simpler, cheaper and more profitable enterprise than in the past. These traps, easy to handle and operable from any type of fishing boat, enabled fishermen to "fish" 24 hours a day, 7 days a week, with a greatly reduced expenditure of time and effort. A fish pot can even continue its deadly work when its line is cut or its owner loses its location, when the trapped fish serve as bait for still more fish.

Thus, the improvements that accompanied the rise of Belize's lobster industry benefited its scale fishery. When they reached their lobster export quotas, usually by early December, that greater number of better-equipped fishermen with established export contacts was ready and available for the Nassau grouper spawning aggregation at Caye Glory (Des and Meyer 1965). Similarly, those exporters, having already invested in the assets necessary to procure, process, preserve and transport lobster and previously built relationships with their own buyers in the US, were ready to adapt. Salting was no longer the only means of preserving a catch, and the fishermen and exporters were positioned to supply the market for scale fish. The 1965 Colonial Report asserts that scale fish "is being exported in increasing volume either as whole fresh frozen, fish fillet or as dried (salted)."

Fishing Cooperatives

Most significant to growth of the fin fishery, however, was the production and marketing infrastructure—cooperatives of fishermen—spawned by the lobster industry. The "labour troubles" experienced by Captain Foote in his early lobster exporting business stemmed from dissatisfaction of the fishermen with the price Foote paid them. (Thompson 1944, Gordon 1981, Craig 1966). Thompson, reporting in the colonial era, attributed the problem to the "psychological attitude" of the workers, which he explained in part as follows:

> …although the fishermen are at first eager to supply the cannery, very soon they become convinced that they are being exploited and that the business concern is reaping huge profits from their labours, they get an exalted idea of the value of their produce, and this idea is entrenched because of the very high prices which small quantities of fresh lobsters have brought on luxury markets from time to time… (Thompson 1944 at 9).

Buyers who followed Foote in purchasing lobster for export encountered the same dissatisfaction from the fishermen with whom they dealt. Gordon, unburdened by a colonial perspective (but oppressed with a Marxist one), presented the issue somewhat differently forty years later:

> By the late 1950's it was becoming evident to Belizean lobster fishermen, and in particular the fishermen of Cay Caulker who had been in the industry the longest and were the most involved in it and therefore the most aware of what was going on, that the proceeds of the industry were not being distributed with equity. A lot of lobster was being taken out of Belize and sold in the US at high prices. They recognized that the buyers were getting rich off the trade but that the fishermen were not. (Gordon 1981 at 132).

Gordon then recounts the intense and courageous struggle of the fishermen of Caye Caulker to establish the first fishermen's cooperative in Belize. Belize already had a strong credit union movement and several other types of cooperatives, including 16 agricultural producers' cooperatives, as well as a Department of Cooperatives and Credit Unions in the colonial government that regularly provided training in cooperative formation. The colony's Fisheries Officer had lamented in his report of 1956 that because "there is no co-operative or any such society the fishermen are not able to get together to export their fish." (Bradley 1956 at 9). Nevertheless, the fishermen encountered strong resistance to their attempt to organize and their application for an export quota was rejected. Only in 1960 after a boycott during the lobster season of the only two lobster purchasing companies then operating in Belize —a risky proposition with a live product, in this case forced by the maneuverings of the sole owner of those two companies—did they receive an export quota and registration as the Northern Fishermen's Cooperative Society (Gordon 1981). That first cooperative was followed by the formation of others, most notably the Caribeña Producers' Cooperative in San Pedro, National Fishermen Producers' Cooperative Society in Belize City and Placencia Producers' Cooperative Society in Placencia, all of which continue in business today (Huitric 2005).

Together, the cooperatives profoundly changed Belize's fishing industry. The Caye Caulker fishermen almost immediately achieved a slight increase in the price they received for their lobster, although this appears to have been largely the result of the cooperative's prompting the *only* competition for the purchase of their lobster (Gordon 1981). However, neither Northern Fishermen nor the later cooperatives could "reap huge profits from their labours" or achieve an "equitable distribution of the proceeds of the industry" until they actually entered the more lucrative parts of the industry—processing and exporting—formerly operated by their "exploiters." To do so, of course, they had to build processing plants and other facilities, hire workers, arrange for sales agents in the US and pay for shipment of their product; and they were aided greatly by the government's decision in 1965 to give export quotas *only* to cooperatives, thus eliminating their foreign competition. Once fully established, they indeed participated in the gains from a rising export market.

The income of members of the fishermen's cooperatives rose dramatically. A member of Caribeña Producers' Cooperative in San Pedro, for example, each year received not only a competitive price for his catch, but also a share of the profit attributable to the sale of that catch in the export market, a distribution of the coop's net profit in the form of a dividend on his shares, a contribution to the pension fund and a rebate corresponding to the value of his produce for the year relative to that of other members (Gordon 1981). The other cooperatives had similar payment systems. Huitric summarized the financial impact as follows

> Fishers' incomes jumped by over 1000% in less than 5 years after the establishment of the cooperatives. In the 1980s, the average salary of a lobster fisher was five times greater than the average per capita income and twice the salary of civil servants. (Huitric 2005 at 21, citations omitted).

The success of the cooperatives and the spectacular increases in the incomes of their members had the predictable effect of attracting yet more to join the industry. (See Table 1.) A would-be fisherman needed little capital and ordinarily encountered minimal barriers to entry.[34] However, to move beyond the status of a basic fisherman, who typically worked as a member of a crew paid through a share of the catch, he required considerably more capital. Significantly, Caribeña and the other cooperatives provided their members with access to and favourable

[34] Although anyone had the legal right to fish Belize's waters, tradition often restricted access to some fishing grounds to the inhabitants of particular local villages, and locations for traps to particular individuals. Some of these traditions, which had the effect of excluding newcomers, persist today (Gordon 1981, Huitric 2005).

financing for all manner of equipment, plus the products routinely required by a commercial fisherman: boats, including those of a type and size suitable for long-distance fishing, sail cloth, outboard motors, gasoline, traps, sodium and ice, hooks, line, cords for making or repairing nets, *etc*.[35] (Gordon 1981). Better yet, the cooperatives often failed to enforce loan terms, allowing members to escape debts to their fellow coop members and artificially increasing the profit from their fishing efforts. Today all the cooperatives experience problems resulting from loan abuse (Huitric 2005). Finally, the cooperatives contributed to the increase in fishermen and their landings, both as institutions serving their members and as institutions perpetuating themselves. For example, Caribeña offered educational opportunities for its members to increase their technical skills, efficiency and profitability (Gordon 1981). In the 1980s when lobster production stabilized, cooperatives began competing among themselves by offering incentives to attract fishermen to join or to sell their landings to them (Huitric 2005). The cooperatives have sought to expand the industry, first into ever more distant fishing grounds as resources in exploited areas diminished and then into related fields such as aquaculture. They have also lobbied for conservation measures such as a closed season on conch, as well as for more industry-favourable price ceilings for marine products sold domestically (Gordon 1981).

Exports of Scale Fish

Almost since the discovery of the Nassau grouper spawning aggregation at Caye Glory, fishers corned their Caye Glory catch and exported much of it to Guatemala and Honduras, as well as some across the Mexican border. They benefited from the timing of the spawning aggregation just before the beginning of the Lenten season, when both domestic and foreign demand for fish also drove up the price (Colonial Reports, British Honduras 1954, 1963). How much was exported is not clear since, as previously noted, the export duty on fish imposed in 1948 rendered many foreign sales "unofficial" and uncounted. Several of the interviewed fishermen recounted their foreign sales of Nassau grouper caught during spawning aggregations at Caye Glory, including one who also acted as a broker:

- We would take up to 7,000 to 8,000 pounds of salted fish to Puerto Barrios in the fishing boat *la Helen*.[36]
- For a season, I got about 40,000 lbs of fish. I kept them live in a pen. I used to sell them in Chetumal [Mexico]. It took me about a month to clear all the fish.[37]
- In Puerto Barrios the pound of fish used to sell for 60 cents quetzals. One time that the sale was bad, we had to go the Guatemala City to sell it.[38]
- In the 50's and 60's, I used to buy grouper to take to sell in Guatemala during the Lent season. Every year during the grouper season, I would buy and store between 175,000 to 200,000 pounds of salted fish. I would make up to 7 trips to Puerto Barrios, Guatemala in my sailing boat to sell all that fish during the 7 weeks of the Lenten season. I used to load up my boat, the *Elsa P*, with 30,000 pounds of salted grouper. I travelled to Puerto Barrios for about 15 years.[39]

The colonial government unintentionally encouraged scale fish exports by imposing controls on the retail price of fresh and salted fish sold in British Honduras, then primarily in the market in Belize City, to serve the nutritional needs of the local population while protecting them from rising export prices. But as even the Colonial Report of 1952 observed, "The prices [for

[35] Loans could also be obtained for personal use, such as purchase of a home.
[36] Donaldo Guerrero
[37] Tony Vega
[38] Ernesto Gómez
[39] Felipe Paz

fresh and salted fish] paid by the export trade tend to be higher." Numerous fishermen interviewed for this report confirmed the price differential.[40] Not surprisingly, the domestic market was consistently underserved (Baird 1973).

Through other measures, the colonial government also intentionally encouraged the export of scale fish. Its initial concern was development of the colony's economy and employment of its people in the face of a scale fish resource believed to be grossly underexploited. Opined Thompson in 1944:

> While better methods of handling, processing and distribution could increase the local consumption of marine produce, this could provide a market for only a very moderate expansion of the present production. If expansion to the full potential of the Colony is to be an economic success, a considerable export trade to foreign markets would have to be established. (Thompson at 27).

Successive surveys of the fisheries of British Honduras at the behest of the colonial government agreed the scale fish population was underexploited, and a strong export market the best and quickest solution. Most also identified snapper and grouper as the scale fish most attractive for export to the United States, neighbouring countries and other Caribbean countries. (See the history of surveys in Idyll 1961). The government adopted several administrative measures furthering these goals, such as permitting the duty free import of engines purchased for the propulsion of fishing craft and providing loans for fishery improvement projects through the Industrial Development Corporation (Allsop 1967).

The government was concerned not only about developing the scale fish industry, but also about protecting the more valuable spiny lobster fishery against overexploitation and protecting the industry as a whole through diversification. This concern resulted in Dr. Hickling's experiments with fish traps noted above, as well as attempts to improve the techniques for salting grouper (Bradley 1956). The government even made sporadic attempts to tie export quotas for lobster to the sale of equal or other significant quantities of scale fish, either domestically or in the export market (Idyll 1961, Allsop 1967, Gordon 1981).

The lobster industry spawned the first fishermen's cooperative in Caye Caulker in 1960. Although the members of the second cooperative to begin operations, the Caribeña Producers' Cooperative in San Pedro,[41] were lobster fishermen with the same interests as those of Caye Caulker, they had another interest as well. The fishermen of San Pedro were then Belize's major users of the heart weir (Gordon 1981), with which they caught many lobster but also many scale fish (Thompson 1944, *cf.* Craig 1966). Because the live fish markets then available to them were glutted through most of the year, Caribeña's founders hoped a cooperative could develop an export market for scale fish (Gordon 1981).

Caribeña began handling scale fish (and conch) very quickly after commencing business in 1963. Its timing was good: the operation of new freezing plants permitted the export of greater quantities of fish than previously, to new markets and in a form more pleasing to the foreign palate than corned, the resulting being increased prices and ultimately motivation for other cooperatives to follow suit (Allsop 1967). The Colonial Report of 1965 described exports of scale fish as increasing to a "well established market in the USA," and by 1981 Gordon was able to describe Caribeña's achievement over the intervening years as follows:

---

[40] For example, Tony Vegas observed "The most I got was about 20 cents a pound in Puerto Barrios, but here you get 5 cents a pound at the Belize market."

[41] The Placencia Producers' Cooperative Society was second to register, but did not begin operations until 1967 (Gordon 1981).

> …the cooperative's production of marine products has increased especially in scale fish production. Here the cooperative has found markets for this product enabling fishermen to duly exploit the scale fish resource. (Gordon at 151)

We should note that "scale fish" include many species besides grouper. However, as predicted by the earlier analysts of the colony's fisheries, the scale fish most highly prized by the export (and domestic) markets were snapper and grouper. As Caribeña developed its export trade in scale fish, "red snapper and grouper fillets … by the 1970's were being exported to the US in large quantities." (Gordon 1981 at 219). Likewise, "groupers" include varieties other than the Nassau grouper. However, the Nassau grouper was the favored variety. As cited by Carter and Marrow in 1991, in "Belize, from 1972-1984, groupers, primarily *E. striatus*, constituted the second most commonly caught and most valuable family of marine fishes." (Carter and Marrow 1991). In the mid- to late-1980s, "the Nassau grouper alone represented over 60% of the total finfish catch" (Jacobs 1998). As late as 1994, groupers comprised more than 30% (17,410 kg) of the total finfish exported from Belize, of which 65% (11,233 kg) consisted of Nassau grouper (Gibson et al. 2006, citing J. Bradley, Northern Fishermen Co-operative; Paz & Grimshaw 2001).

Most cooperatives, however, were not particularly interested in scale fish as long as the price for lobster tails remained high (Dres and Meyer 1965). In addition, the cooperatives had difficulty coping with "periodic gluts" of scale fish (Snyder 1976). Only when export quotas for lobster were filled did cooperatives and fishermen turn their attention to scale fish (Colonial Reports, British Honduras 1952 to 1965), and that usually occurred about the time of the Nassau grouper spawning aggregation at Caye Glory (Dres and Meyer 1965). Nevertheless, exports and production of scale fish climbed for a while. (See Table 2 and Chart 1).

Although the scale fish industry never rivalled lobster in price or importance to Belize's economy, both government and private efforts to develop the fishery focused on the development of an export market beyond Puerto Barrios and Puerto Cortez; and the intended and unintended effects of those efforts, and of the labours of individual fishermen, aimed directly at the Nassau grouper. At the centre of the "target" was the spawning aggregation at Caye Glory.

History of Management and Legislation

- Purpose

From 1942 to at least 1976, the surveys of the fisheries of British Honduras sponsored by either the government or United Nations Development Programme focused on identifying potential for the fisheries' development from their underexploited state, but simultaneously dwelt on the need for their conservation.[42] The earliest reports, particularly that of Dr. Hickling in 1949, resulted in the appointment of a Fishery Officer in 1950 and the establishment of a management plan variously known as the "Fishery Policy" or "Fisheries Scheme" (Allsop 1967). The Colonial Report of 1950 described the Policy as being

> aimed at the *conservation* of existing stocks of fish to prevent *depletion through overfishing*; improving present methods of fishing and curing of fish and the *expansion of the export trade*; the *enforcement* of legislation controlling fishing within the Colony; to improve the equipment and status of fishermen …; the *compilation of accurate data* on catches, costs and profits and the number of vessels and men engaged in or employed in connection with the industry. (Colonial Report of 1950 at 52, emphasis added).

The *aims* of the Fisheries Scheme survive today, but its results were limited and its life short. It was abandoned in 1956, apparently with the departure from office of the Fishery Officer

[42] See, for example, Thompson 1944, Idyll 1961, Dres and Meyer 1965, Allsop 1967, Baird 1973, Snyder 1976.

(Idyll 1961, Allsop 1967). No further effort at planned fisheries management was undertaken until the creation of the Fishery Development Advisory Board in 1962 (Allsop 1967). However, during the Fisheries Scheme's existence, a system of licensing fishermen and boats was inaugurated. Conservation measures affecting scale fish, adopted for the protection of young game fish for tourism purposes, were the prohibition of beach seining in certain areas and seine mesh size controls. Measures adopted between 1949 and 1951 to ensure sustained lobster yields included export quotas, minimum size controls and a season from July to March only. (Allsop 1967, Colonial Reports, British Honduras 1948-1965).

- Data Collection

Virtually every one of the assorted surveys of British Honduras' fisheries builds a strong case for the necessity of data collection as an essential precursor to intelligent management and exploitation of marine resources. The "compilation of accurate data" was a prominent aspect of the Fisheries Scheme. However, in 1961 Idyll summarized the colony's sad history of data collection with respect to both the lobster and scale fish fisheries in words worthy of quotation at length:

> To determine the balance point, where exploitation is neither too heavy nor too light, it is necessary to have accurate records of total catch, catch by area, … size … and the amount of fishing effort. Then the classic tests of overfishing can be applied: steadily declining total catch, declining catch per unit of fishing effort (which is more precise than total catch, since it takes into account vagaries of markets, weather, etc.) and declining average size of [individuals caught].
>
> The collection of such statistics has been urged upon the Government by all scientists who have successively advised the Colony [names omitted]. It is regretted that, while a statistical system was begun under the Fisheries Scheme, it was not continued and the records which were collected have been destroyed.[43]
>
> Meanwhile, to insure that the current unfortunate position should not be perpetuated, whereby decisions [regarding fisheries management] must be made nearly in the dark, the Government should provide for the proper collection of data to allow rational management of this valuable resource. … The information will be as important in preventing the imposition of unnecessary restrictions on the fisheries as in designing regulations. (Idyll 1967 at 7-10).

However, the near darkness surrounding Idyll has not been lifted. Subsequent colonial surveys continue to lament the failure of the government to compile statistics and fairly beg that data collection begin immediately. Similar pleas appear in numerous more recent documents suggesting fishery management strategies.[44] The absence of such statistics – of early warnings of distress – can indeed be fatal to a species. As J. Gascoigne observed in a report on, *inter alia*, the health of the Nassau grouper population of the Bahamas,

> Animal populations are naturally variable and difficult to study, and even in the best circumstances (a small, easily defined area, lots of data and lots of funds) it is extremely difficult to "prove" that a population is in decline. Given … huge area and limited resources …, the only proof of overexploitation of a marine

[43] The Colonial Reports of 1956 through 1963 are identical in their descriptions and "counts" of boats, fishermen and markets for marine products, evidencing an absence of data collection in these areas. In the combined Report for 1964-1965, the number of fishermen is 250% higher than in the previous Report.

[44] See, for example, Carter and Marrow's 1991 Preliminary Fishery Management Plan for the Nassau Grouper (Epinephelus Striatus) Fishery and Jacobs' 1998 *Belize: Assessment and Analysis of the Fisheries Sector and Marine and Coastal Areas, Consultant's Report, National Biodiversity Strategy and Action Plan.*

> species that is likely is when the population reaches complete collapse. (Gascoigne 2002)

Thus, while action based on inadequate and unreliable data involves considerable risk and often unnecessary hardship to fishermen (and always hardship to politicians), inaction because of inadequate and unreliable data may involve even greater risk to the marine resource and ultimately greater hardship to fishermen. Only the politicians, long out of office when the harvest comes, are spared.

- Management and legislation directly or indirectly affecting Caye Glory

As had other analysts before him, Idyll found the colony's scale fish resources generally not in danger of overexploitation in 1961; nevertheless, he noted, "they cannot stand unlimited fishing." He recommended measures to prevent overfishing, "most easily done before overexploitation occurs." (Idyll 1961 at 10). In particular, Idyll urged compilation of a record of the numbers of grouper caught and recommended that the "men who salt groupers during the winter run" be permitted to fish by license only, a condition of the license being accurate reporting of their production (not tied to export duty). (Idyll 1961 at 23)

By 1968 Alan K. Craig suspected that overfishing at Caye Glory was already underway. He prophesied the demise of the spawning aggregation at that site:

> Exploitation of the Cay Glory grouper resource will continue to attract an ever-growing number of fishermen who are ignorant of fish population dynamics…This intense fishing activity concentrated on a population confined to a relatively restricted area can only result in overfishing, if indeed this has not already taken place. In any event it is certain there will be deleterious effects if fishing is not maintained at an efficient level. The inevitable consequences of uncontrolled exploitation of natural resources in British Honduras make a dismal, repetitious picture. Logwood, turtle, manatee, mahogany, cacao, sponge, chicle, pine, spiny lobster, and conch have all been subjected to indiscriminate harvesting to the point where they have failed commercially or show evidence of alarming declines. We may safely predict the same fate for the grouper fishery at Cay Glory…. (Craig, 1968 at 263)

Craig recommended the expansion of fishing efforts to new and undiscovered spawning sites to relieve the fishing pressure at Cay Glory. (Craig 1968). Other spawning aggregations were indeed discovered, such as the one at Rocky Point near Ambergris Caye in 1977. The Rocky Point aggregation was fished intensively during two spawning seasons and disappeared.

In the late 1970s and early 1980s, Belize generated a plethora of laws to protect its resources, including the Ancient Monuments and Antiquities Ordinance (1971), Fisheries Act of 1980, Wildlife Protection Act (1981), National Parks System Act (1981), and Land Utilization Ordinance (1981). Most, other than the Fisheries Act, focused on terrestrial areas and species, but nevertheless sometimes directly or indirectly affected marine natural resource use or conservation (Perkins 1983), laying the foundation for confusion, conflict and turf disputes among government agencies (Jacobs 1998).

The Fisheries Act of 1980 provided some protection to scale fish generally and to Caye Glory in particular by prohibiting fishing with traps, weirs or nets in any area within one hundred yards of the Barrier Reef or in the vicinity of Buttonwood Cay, Cay Glory and Maugre Cay. In addition, it banned the use of SCUBA equipment in fishing scale fish (except with permission from the Fisheries Administrator); barred the use of beach seines, traps and stop nets within a specified distance east of the Barrier reef or from any inhabited locality in Belize; established

mesh size limits for nets, traps and seines; and prohibited closing off a waterway, as with a heart weir.

Thus, the Fisheries Act banned several practices decimating the grouper population. However, despite the specific mention of Cay Glory, the effect of the Act's provisions on the Nassau grouper spawning aggregation at that site was, at best, indirect. Fishing during the spawning aggregation of Nassau grouper at Caye Glory, as well as the number of fishermen and number of boats involved, remained unlimited. Spears and handlines, even in 1980 the most commonly used gear during the aggregation, were unaffected. Spear guns were not prohibited. Heavy exploitation of the Nassau grouper spawning aggregation at Caye Glory continued, and both the size of the aggregation and the average size of the grouper caught during the run declined (Carter 2001). In fact, the fishing cooperatives noted "a definite downward trend in all products but lobster," including "scale fish which appears to be rapidly diminishing" (Vasquez 1982).

Nevertheless, neither the Fisheries Act of 1980 nor prior laws and regulations were necessarily honoured or enforced. In 1982 at a meeting of fishermen's cooperatives and government officials concerning issues facing the fishing industry, every single cooperative mentioned illegal fishing and the absence of effective law enforcement as a major problem for the industry, or even *the* major problem. Official statements of the cooperatives and the findings of the seminar cite violations of fishing laws and regulations by foreigners and Belizeans alike. The foreigners included those with fraudulent boat and fishing licenses; Guatemalans known to place large gill nets in Belize's southern waters and leave them overnight, a practice which caused much waste as well as large catches; Hondurans in big trawlers with 12 or more dories and teams of skin divers working in the cayes; Mexicans around San Pedro who "set miles of nets day and night"; and pirate groups which had known, established camps on several cayes and appeared to have protection from high in the government. Belizean nationals were also known to "scoff and laugh at our laws." They noted, "The benefits of illegal fishing (no taxes, no seasons, no size limits, no restrictions whatsoever) with its usually low penalties if and when caught and convicted far outweigh the benefits that accrue to loyal Belizean fishermen." The cooperatives even reported instances of Belizean fishermen armed with spear guns preventing fisheries officers from inspecting their boats.

Concerned that their industry was being killed by illegal fishing of increasing proportions and dismayed at the insufficient government response, the cooperatives voted to place a boat and crew at the disposal of the authorities to assist in searching and apprehending those violating fishing laws and to provide information concerning the whereabouts and activities of those violators. They also voted to approach the Minister of Fisheries concerning an exchange of information on cooperative membership, fishing licenses issued, names and locations of officials authorized to issue licenses, *etc*. They discussed, but ultimately did not approve, a proposal that cooperative managing committee members be appointed fisheries officers and compensated for arrests made. Clearly, they felt the industry seriously threatened by the lack of law enforcement they observed and sought immediate action. (Vasquez 1982).

The cooperatives' efforts to spur greater law enforcement efforts failed. However, continuing concern over, *inter alia*, the dwindling population of Nassau grouper and other scale fish produced more legislative and regulatory action, including the following enactments:

- 1982, a ban on fish traps or fish pots at all spawning banks (SI 17);
- 1983, a Fisheries Act amendment giving the new nation's Minister of Agriculture and Fisheries the authority to designate any area in Belize waters a marine reserve and to prohibit entry into the reserve;

- 1983, Half-Moon Cay Natural Monument established (SI 30 of 1982)
- 1987, Hol Chan Marine Reserve established (SI 57)
- Use of poison, explosives, and nets were prohibited generally on the reef, and the use of spear guns was prohibited in marine reserves.

Calls for better legislative protection of marine resources and more effective law enforcement continued, both from the fishing industry and from scientists such as Judith S. Perkins and Jacque Carter. Perkins noted, in addition to inadequate law enforcement, deficiencies in Belize's legislative framework for natural resource utilization as applied to marine resources and the inadequate funding and staffing of the wildlife reserves and the then sole marine reserve (Perkins 1983). Carter repeatedly and publicly warned of the dangers of fishing Nassau grouper spawning aggregations. (Carter 1988, 1989, 1990). In their 1991 *Preliminary Fishery Management Plan for the Nassau Grouper (Epinephelus Striatus) Fishery for the Government of Belize*, Carter and G. J. Marrow warned of continuing declines in the Nassau grouper population and collapse of the commercial fishery without protection of spawning aggregations and their sites, commonly the sites of spawning aggregations for many species. They advocated additional marine reserves and additional traditional fishery management techniques such as size limits (12 inches), permanent limited entry (one-time, non-transferable permits to fish at Cay Glory, Northern Two Cay and Mauger Cay). They further urged that the "under-staffed Fisheries Department [be] supplemented in order that they may enforce these laws effectively." Finally, they suggested the Fisheries Department establish a new staff position specifically for the collection and analysis of long-term fishery statistics, the same statistics suggested repeatedly by others. (Carter and Pryor 1991).

Additional legislation followed:

- 1993, Glover's Reef Marine Reserve established. Fishing of Nassau grouper at Glover's Reef closed from December to March (Seasonal Closure Zone), but closure not enforced. Spear fishing banned in the conservation zones of Marine Protected Areas. (SI 38).
- 1996, three additional marine reserves established: Bacalar Chico, Sapodilla Caye and Southwater Caye Marine Reserve. Bacalar Chico also included a Seasonal Closure Zone for the protection of the Nassau grouper spawning aggregation (SI 88, SI 117 and SI 118).
- 1998, Caye Caulker Marine Reserve established (SI 35).
- 2000, Port Honduras Marine Reserve and Gladden Split/Silk Caye Marine Reserve established (SI 9 and SI 95).

By 1998, Belize had at least twenty-two separate acts which could directly impact biological resources within coastal and marine areas and many regulations thereunder, as well as covenants pursuant to international pacts and treaties (Jacobs 1998). More did not mean better, however. As Jacobs noted,

> The lack of properly defined roles of individual institutions results in legislative overlaps in which several institutions might have the legal mandate to address a particular management need. This causes confusion and usually result in "turf protection" and poor inter-ministerial coordination, with the end result being ineffective implementation of laws and regulations. The physical infrastructure and operational framework of most institutions are inadequate to meet programmed objectives usually resulting in poor enforcement activities. Probably in all cases institutions are under-staffed and under-budgeted and compliance

> with most regulations is very much voluntary by stakeholders, since institutions are unable to meet their enforcement responsibilities. … The Fisheries Department, which is responsible for managing the third highest foreign exchange earner, is seriously under-budgeted with a technical staff of only seven people, five of which hold a University Degree. The enforcement section of the Fisheries Department has an acceptable size staff, but is practically dormant most of the time due to the lack of necessary infrastructure and funding for enforcement activities. (Jacobs 1998 at 7-8).

Jacobs concluded that marine reserves offered the best management mechanism then in use in Belize, even though he found the management and operational structures of protected areas to be inadequate and expressed concern for protection of the fish migrating in and out of the reserves. He also noted that Belize lacked effective fiscal disincentives for expanding the industry (the cost of a boat or fishing license did not even cover the cost of the paper on which it was written!) or for fishing illegally (fines for violations were too low). Moreover, the government offered fiscal incentives for actions that could harm the country's marine resources, such as for development in coastal areas, but offered none for actions benefiting conservation. Jacobs called for additional species-specific regulation, in particular for the Nassau grouper. Finally, he made a plea for data collection, stating "Permanent fisheries statistical and biological data collection is indispensable for long-term management needs." (Jacobs 1998)

In January of 2001 Green Reef Environmental Institute, in collaboration with the Belize Fisheries Department and several local and international NGOs, conducted the first national survey of spawning aggregation sites in Belize and organized a national workshop in July 2001 entitled "Working Towards Sustainable Management of Nassau Groupers in Belize." The workshop produced specific recommendations to protect Nassau grouper, among them total closure to all activities of an area between 3 to 4 square miles for each known spawning site and, for sites already part of an established protected area, designation zoned as either a wilderness zone or conservation 1 zone. These efforts also resulted in the formation of the Belize Spawning Aggregation Working Group and a consortium of non-governmental organizations that lobbied the government for legislation specifically for the protection of the Nassau grouper. (Gibson et al. 2006).

As a direct consequence, in 2003 two Statutory Instruments were enacted specifically for the protection of Nassau grouper in Belize. The first declared 11 sites, including "Emily or Caye Glory,"[45] as marine reserves closed to fishing all year round (SI 161). Those sites that were wholly or partially located in marine reserves, but not included in any seasonal closure or conservation zone, could be used only by traditional fishermen recommended by the respective co-managers of the reserve and with special license granted by the Fisheries Administrator. The second Statutory Instrument established a four-month closed season for Nassau grouper, extending from December to March (SI 162 as technically corrected). Fishermen at Maugre Caye and Northern Two Cayes, however, would be allowed to fish during the spawning season, but only under special license granted by the Fisheries Administrator, a condition of which was that all catch would be verified by a Fisheries Officer.

In 2007 Belize has no general ban on spear fishing, fishing with spear guns, or fishing Nassau grouper outside the December to March period. When and where fishing is permitted, Belize has no limits on the number of fishermen, boats or anchors or on the numbers of fish

[45] The full list is Rocky Point, Ambergris Caye; Dog Flea Caye and Caye Bokel, Turneffe Islands Atoll; Sandbore and South Point, Lighthouse Reef Atoll; Emily or Caye Glory; Northern Glover's, Glover's Reef Atoll; Gladden Spit; and Rise and Fall Bank, Nicholas Caye and Seal Caye, Sapodilla Cayes.

caught. The Fisheries Department continues to be underfunded and understaffed, and the funds available for investing in its personnel's professional training are woefully inadequate. Not coincidentally, data collection remains at a negligible level. More ominously, illegal fishing continues to be prevalent. As Enric Sala, one of the researchers at Glover's Reef Marine Research Station, recently told a local Belizean television station,

> Legal fishing is a problem, but the clearly illegal fishing is as big a problem … and we see fishing gear on the Nassau spawning site that's *closed* … if you have people fishing, poaching, and coming in illegally, the really only good way is to put somebody there to stop that. (http://www.channel5belize.com)

In Belize, the widespread lack of respect for legal obligations, lack of compliance with legal requirements and failure to enforce the law — including but not limited to laws and regulations governing its marine resources — do not portend well for the Nassau grouper, the fishermen of Belize or the nation as a whole. Debates over the niceties of legislative proposals and management options could well be irrelevant.

Continued Exploitation, Decline and Abandonment of Cay Glory

The many separate decisions of individual fishermen to make the investment and endure the hardships traditionally necessary to catch Nassau grouper during their spawning aggregations at Caye Glory seem closely correlated with their expected catch and its value—in other words, quite rational. When the Nassau grouper were "countless" and landings were "at an astounding rate," "every available boat" was at Caye Glory. The paucity of fishermen who have bothered to go there in recent years evidences a general anticipation of a dearth of Nassau grouper in the spawning aggregation, if any, (Sala and Ballesteros 2000) and low or no projected return on their investment.

A spawning aggregation is obviously attractive to anyone deriving some or all of his income from fishing since large numbers of fish can be caught with relative ease. The even greater lure of the Nassau grouper spawning aggregations at Caye Glory was explained by Craig in 1968:

> [T]o the fisherman of limited circumstances [the spawning aggregation at Caye Glory] is an annual chance to 'strike it rich' since his share of a good catch may amount to more than he would normally earn in *six months of routine work.* (Craig 1968 at 252, emphasis added)

Few abstract arguments will ever be as compelling as such an enormous financial incentive. The fishermen interviewed for this report substantiate Craig's characterizations. The amounts they mention are difficult to analyze because they cover an extended period that includes high inflation and the fishermen could not pinpoint the corresponding to a given price. But clearly while the market price rose and fell, the bounty of Caye Glory provided a rewarding enterprise.

The Nassau grouper spawning aggregation at Caye Glory attracted more and more fishermen and they caught more and more Nassau grouper. A scant bit of data from Caribeña suggests that Caye Glory may have been a major supplier of Nassau grouper for the export market in the 1960s and 1970s. Table 4 is based on Caribbean's reported production of "Grouper Fillets" for each month during calendar years 1973 through 1978, although the 1973 production data reports Grouper Fillets for December only and the 1978 production data for Grouper Fillets stops in March. The reported data was rearranged on a 12-month basis running from July to June of each year using all months for which data was reported. The production in December, January and February of each period was then calculated as a percentage of the total production for the

12-month period. We cannot be certain that all Grouper Fillets were Nassau grouper, and clearly Nassau grouper came from sites other than Caye Glory (although it was the leading spawning aggregation site at the time). Nevertheless, we are looking at the records of only one cooperative, while much of the Nassau grouper fished from the spawning aggregation at Caye Glory was going to Puerto Barrios or elsewhere rather than to Caribeña and other cooperatives. The Table suggests that spawning aggregations certainly, and Cay Glory likely, were feeding the export market with much of what they had to offer.

Some objected to the numbers of fishermen and stopped fishing at Caye Glory.[46] In the 1970s and early 1980s, as the price of lobster continued to rise, some of the fishermen from the northern cayes began to drop out of the Caye Glory fishery. (Carter 2001). As José González reported,

> The more prosperous fishermen then instead of going fishing for grouper would go fishing for lobster. This was when the lobster industry started. Then they used to make more money fishing for lobster than fishing for grouper and the grouper fishery was abandoned. Then the fisheries at Cay Glory starting staying behind.

As the northern fishermen less often travelled to Caye Glory, Carter reported other changes:

> Meanwhile the Carib and the Creole fishermen at Caye Glory saw smaller and fewer fish arrive. Several of the "old heads" (older fishermen), frustrated by the lower catches, left Caye Glory for the more promising banks at Glovers, Turneffe and Northern Two Caye. (Carter 2001)

Fishermen interviewed for this report confirmed Carter's observation. Tuli Lara, for example, stated, "When we heard of other fishing grounds, we stopped going to Cay Glory because the fish at Cay Glory were now small." Those who continued fishing Caye Glory were generally fishermen with vessels which could not practically make the trip to the newly discovered, but more distant spawning aggregations.

The estimated numbers of Nassau grouper at the Caye Glory aggregation site have declined steadily in recent decades, and a complete collapse of the spawning aggregation may have occurred. The modest published data specifically regarding the number of fishermen and their landings of Nassau grouper during spawning aggregations at Caye Glory is summarized in Table 5.

The annual fishing rites at Caye Glory continued until the spawning aggregation dwindled sufficiently that Nassau grouper could no longer be exported because of low and irregular availability, rendering the effort of fishing at Caye Glory not worthwhile for the many fishermen and boats once in attendance. In recent years, especially after the "no show" of Nassau grouper in the 1997-1998 spawning season (Jacobs 1998), few fishermen have bothered to attempt catching Nassau grouper during the spawning aggregation at Caye Glory (Sala and Ballesteros 2000).

Nevertheless, for a *few* fishermen, even a small catch could be profitable, even in recent years. For example, the economic value of the 2000 - 2001 Nassau Grouper catch in Belize, although largely derived from the domestic market and tiny relative to prior years, was estimated to have an average value of approximately US $210 per fishermen; or US $40 per fisherman-day for the 38 fishermen involved, approximately four times minimum wage in Belize (Paz &

[46] Such as Cola Sansorez.

Grimshaw 2001). Thus fishermen continue to have an economic incentive to catch Nassau Grouper in Belize, even though its reduced population cannot support a large number of fishermen.

Current Status of Cay Glory as the Site of a Nassau Grouper Spawning Aggregation

Whether the Caye Glory spawning aggregation of Nassau grouper has collapsed entirely is open to debate. Without question, the number of individuals aggregating there for spawning has dwindled, from the "countless numbers" of the 1940s to the "hard to find" of today. However, in considering the apparent demise of the Nassau grouper spawning aggregation at Caye Glory, we should note the difficulty in determining the numbers of grouper present at any given time, as well as in determining whether an aggregation is truly a spawning aggregation. Visual observation is considered the most important technique for estimating the number and size of fish within an aggregation (subject to developments in GPS technology). However, the technique is highly subject to inaccuracy; and training in underwater visual census is necessary, even for experienced divers (Sadovy Colin & Domeier 2005; Heyman et al. 2004). Moreover, a visual census can be influenced or distorted by a host of variables, beginning with basic visibility, the constant motion of the fish being counted and the risk of counting the same fish twice or more. Many aggregation sites, including Caye Glory, are multi-species aggregation sites; thus, the gathering Nassau grouper are likely to be mixed with other species, including other groupers, all of them incessantly moving. Despite recent efforts at standardizing visual survey methods, particularly in the collection of data providing ecological context, difficulties in comparing results from study to study abound. Variations in such factors as time of day for counts, timing of counts in relation to the moon phase, between-diver differences in fish counts and frequency of counts, as well as environmental conditions like substrate complexity, water temperature, the number and nature of boats nearby, and current speed and directions, may well produce wildly different count results, *all* of them possibly unrelated to actual fish abundance. Even minor variations in the timing of observations can dramatically alter the data obtained (Johannes 1996).

While spawning aggregations have historically been at risk of overexploitation because of their occurrence at predictable times and places, they can paradoxically be difficult to locate, certainly for purposes of scientific measurement. Nassau grouper may congregate several times a year at a site, but at different times in relation to the moon (Starr et al. 2007). The grouper may be disturbed and therefore may disperse prior to being counted. Nassau grouper spawning aggregations are typically spread over substantial areas along the bottom in relatively deep water. Additionally, they have been documented to aggregate at one depth and spawn at another, although many reports are silent on this point (Jacobs 1996). Most significantly, Nassau and other grouper varieties have been noted to have nearby but shifting aggregation sites, to move among sites during different years and to vary the spatial distribution of individuals somewhat over time at aggregation sites (Johannes 1996). Thus, divers at one spot or depth may miss a genuine spawning aggregation entirely.

When the numbers in a spawning aggregation have been reliably documented for a given site for several years, the question then becomes whether variations in the numbers over time are "natural" or the product of some interference (Sala 2001). Considerable variation in peak spawning aggregation size from month to month and year to year occurs. For example, monitoring of spawning aggregations of three grouper species (not including the Nassau grouper) in Palau documented variations of as much as 61% from year to year, the significance of which R. E. Johannes described as follows:

> There is considerable intermonthly and interannual variation in peak spawning aggregation size that is evidently independent of fishing pressure, management measures or recruitment. This background variability makes it difficult to detect

> changes in aggregation size due to changes in fishing pressure quickly enough to adjust management measures effectively in response. (Johannes 1996 at iv).

The Nassau grouper spawning aggregation at Caye Glory has not been so reliably documented over any period of time to prove its demise. However, as J. Gascoigne observed in a report on, *inter alia*, the health of the Nassau grouper population of the Bahamas,

> Animal populations are naturally variable and difficult to study, and even in the best circumstances (a small, easily defined area, lots of data and lots of funds) it is extremely difficult to "prove" that a population is in decline. Given … huge area and limited resources …, the only proof of overexploitation of a marine species that is likely is when the population reaches complete collapse. (Gascoigne 2002).

Notwithstanding all the difficulties and imprecision noted above, the difference in the number of Nassau grouper observed in the spawning aggregation at Caye Glory from the 1940s to date is so dramatic that we do not hesitate to say the downward trend is definitive. While the evidence is best characterized as anecdotal, it is overwhelming. The only real issue is whether the spawning aggregation has collapsed altogether and, if so, could now be ever so tentatively returning.

Monitoring teams from the Belize Fisheries Department counted the following maximum numbers of Nassau grouper on a single day in the January spawning periods of 2003, 2004 and 2005 respectively:[47]:

1,000

1,000

350.

These quantities, while negligible in historic terms, are larger than any documented for Caye Glory since 1989. We should note that visibility was relatively poor throughout the 2005 survey.[48]

In reporting its 2004 and 2005 surveys of Caye Glory and three other historic spawning aggregations sites, the Belize Fisheries Department commented that the

> increasing trend in abundance of Nassau groupers at Caye Glory is a result of many criteria. One of the criteria could be the new strategies adopted by the Belize Fisheries Department in 2002 to close the area and protect the aggregating species. (Belize Fisheries Department 2005 at 35).

We should note another possible contributing factor to any increasing trend in abundance: that prior to the formal closure of Cay Glory in 2002, most fishing of the Nassau grouper spawning aggregation had ceased at that site because the anticipated catches did not justify the effort (Sala and Ballesteros 2000). As put by one of the fishermen interviewed, "Today the

---

[47] We cite the numbers as reported by The Belize Spawning Aggregation Working Group, Information Circular No. 3, September 2005 because the Fisheries Department reported only on its 2004 and 2005 surveys (and then only on a cumulative basis).

[48] Fisheries Dept., raw survey data sheets.

fisherman does not come [to Caye Glory]; that means that the fish are not there. Whether they closed it or not, they still can't fish."

But did the Fisheries monitoring teams establish an "increasing trend in abundance"? We noted above the difficulties of population counts in surveys of spawning aggregations, particularly given that Nassau and other grouper varieties have been noted to have nearby but shifting aggregation sites, to move among sites during different years and to vary the spatial distribution of individuals somewhat over time at aggregation sites (Johannes 1996). Indeed, at least two spawning aggregation sites have been observed *at Caye Glory*, the first being the larger and primary site located directly in front of the shoal where fishermen traditionally set their fishing shacks, and another being somewhat south of that site.

The Fisheries Department team sent to monitor the Nassau grouper spawning aggregation at Caye Glory in 2003 were accompanied by fishermen who had fished the spawning aggregation (I. Majil, pers. comm.). They first monitored the primary site, but did not encounter an aggregation. According to Edgar Badillo and Isaias Majil, Belize's Marine Protected Areas Coordinator, they then moved 1½ kilometers north, where they found the reported gathering of approximately 1000 Nassau grouper (I. Majil, E. Badillo, pers. comm.). In January of 2006, the monitoring team, without the assistance of a fisherman, failed to find any aggregation, but feel they may have simply missed it (I. Majil, pers. comm.).

One fisherman interviewed for this report remarked, "The fish move to another place, maybe a mile south and when it is time to spawn, they spawn there."[49] Tomas Paz, another of the interviewed fishermen, recounted an experience similar to that of the Fisheries Department team:

> I remember one time when I went with my father fishing at Caye Glory. It was really windy that day and … [I and] my father and another person stayed in the sailing boat moored inside the reef. We got bored as we were missing all the excitement; so we decided to take the sailing boat outside the reef and go fishing. We reached the bank where all the dories and dug out canoes were fishing, and we dropped anchor. Our anchor did not catch and we started drifting south. We drifted about 1 km and when the anchor finally caught we stayed put and began to fish were we were. The fish were biting and we were landing them. When we noticed, we were surrounded by the fishermen and the doreys. The groupers were at the primary site but they were not biting that day there. There are two banks in Cay Glory.

Because we cannot eliminate the possibility that surveys of recent years have missed an aggregation in the vicinity of the traditional Caye Glory site or undercounted one, we cannot conclude the existence of an "increasing trend in abundance," particularly when the "increase" is so small as to be within the rather wide margin of error associated with visual counts of spawning aggregations.

Did the Fisheries monitoring teams observe a spawning aggregation at Cay Glory in 2004 or 2005? As the Fisheries Department itself noted in its Report, determination of a spawning aggregation at Caye Glory would require direct evidence of spawning through observation or the study of gonads from specimens obtained from the aggregation (Belize Fisheries Department 2005 at 35, Heyman et al. 2004; Colin et al. 2003; www.scrfa.org). While the Fisheries teams did not see actual spawning, the Department suggested in its Report that spawning may have occurred at or after dark when observation was impossible (Report at 35) and when spawning is most likely to occur (Heyman et al. 2004). No testing of samples was performed.

---

[49] José González

When direct evidence of a spawning aggregation is not available, indirect evidence is considered, including density increases, spawning-specific colour changes and behaviours, swollen abdomens and increases in the gonadosomatic index. A combination of indirect observations increases the likelihood that the aggregation is actually a spawning aggregation (Heyman et al. 2004). The Report contains the following statement of potential indirect evidence of a spawning aggregation:

> It was observed that most of the multi-species diplaced [sic] courtship, fighting and colour change when aggregating at the four sites. At the same time a few species displayed resting behaviour, while others were observed to be Gravid as in the Nassau groupers (Report at 33).

Whether the *Nassau grouper at Caye Glory* were observed to have displayed courtship behaviour and colour change or to have been gravid are not clear, either from the report or the raw survey data of the divers, nor are the dates and years of observation stated.

The only potential indirect evidence of a spawning aggregation discussed by the Fisheries Department in its Report is the increased numbers of Nassau grouper over the reported numbers during most recent spawning seasons and over the numbers at Cay Glory during the non-reproductive times monitored by the Department. However, *even if* their counts were accurate, and *if* the numbers were sufficient for spawning to occur, the data remains insufficient even as a basis for speculation.

Causes of the Decline of the Nassau Grouper Spawning Aggregation at Caye Glory

Three explanations have been suggested for the decline of the Nassau grouper spawning aggregation at Caye Glory. Each will be considered separately for purposes of discussion, but they are clearly interrelated and their separation somewhat arbitrary. They are as follows

1. Change of location of the aggregation;
2. Disturbances and adverse changes in the physical attributes of Caye Glory, particularly from changes in fishing practices; and
3. The effect of overfishing, particularly on a selective basis.

➢ **Change of location of the aggregation**

Many fishermen, including some of those interviewed for this report, maintain that Belize's Nassau grouper population is not declining, but is capricious in its movements and simply relocates its aggregation site from year to year. Thus, they believe the demise of Caye Glory's spawning aggregation is the result of movement of the aggregation to another site or to a deeper level. For example, the fishermen offered the following:

- There used to be lots of grouper and there still are. What happened is that the grouper moved from the site. It was not that the grouper was finished, it changed site.[50]
- What I think is that the grouper changed site, maybe they went deeper.[51]

[50] Tuli Lara
[51] Florentino González

- That fish would come up from the deep. … In my opinion, the groupers change places.[52]
- …[F]ish know the season and come and go. You could catch an amount of grouper here today, next week there are none there. And next year you come and they're there again.[53]
- The [Nassau grouper] is from the gulf, it is neither from the reefs nor from the shallows. This fish travels from the gulf of Quita Sueños which is about 600 miles from here.[54]

Other Belizean fishermen agree. In the 2001-2002 spawning season, Paz and Grimshaw interviewed fishermen at Dog Flea Caye who reported that the Nassau grouper spawning aggregation there had moved south from Mauger Caye (approximately 4 miles) in recent years. Meanwhile, the spawning aggregation they observed grouper at Sandbore Caye peaked at 4,000 to 6,000 Nassau grouper; but three fishermen who had lived on Sandbore Caye for 27 years tending the lighthouse there claimed populations of 20,000 to 30,000 Nassau grouper had aggregated at the site in the mid-1980's and that the fishing effort during the spawning aggregation had not changed in the interim.[55]

Another example cited by the fishermen interviewed for this report was that of Rocky Point just off Ambergris Caye. A Nassau grouper spawning aggregation was discovered there in 1977, but disappeared after two seasons of fishing.[56] Fishermen interpreted its disappearance as a change of site. For example,

> That grouper that were in Rocky Point, you couldn't see the bottom where the school of grouper was. Maybe it was about 20 feet thick spread across the bottom. You couldn't see the bottom from all the grouper there. It was something of millions, and millions and millions, and suddenly it all disappeared. The grouper bank was just fished for two years and the fishermen could not have fished them out. Then it is obvious that the grouper moved.[57]

The scientific literature also contains some support for the fishermen's claim of site change. Johannes, for example, found grouper to have nearby but shifting aggregation sites, to move among sites during different years, to vary the spatial distribution of individuals and to vary in peak spawning aggregation size "evidently independent of fishing pressure, management measures or recruitment." (Johannes 1996).

Whatever the truth with respect to Caye Glory, attempts to prohibit fishing at Caye Glory and/or during Nassau grouper spawning aggregations failed in Belize prior to 2002 because of the political influence of the fishermen holding this view or otherwise opposing closure of the fishery. Thus, the impact of this belief has been profound.

---

[52] José González
[53] Tom Young, Sr.
[54] Francisco Arceo
[55] It is possible that the "fishing effort" measured in number of fishermen remained constant, but other factors, such as boat type, changed.
[56] Another fisherman familiar with the Rocky Point site claimed that the "thousands and thousands and thousands of grouper" were caught primarily by tour guides the first year. The second year "there was some fishing, but the biggest attraction was from the big numbers of tourists, who were taking video cameras and under-water cameras out there. … I do believe that they moved to some areas probably not far away, but up to now we have not found where they are." Comments of Manual Heredia, fisherman of San Pedro, in Proceedings of the First National Workshop on the Status of Nassau Groupers in Belize: Working Towards Sustainable Management, 2001.
[57] José González

- **Disturbances and adverse changes in the physical attributes of Caye Glory, particularly from changes in fishing practices**

Although the significance of *details* of spawning aggregation sites is not thoroughly understood (Claydon 2004), that many sites are multi-species and utilised for many generations "suggest that suitable aggregation sites may be uncommon and therefore critical to protect from disturbances such as pollution and physical mutilation" (Paz and Grimshaw 2001). Indeed, the site may be the "most critical factor" to a Nassau grouper spawning aggregation (Carter 1989, 1990).

Most of the fishermen interviewed, including those who believe that the Nassau grouper spawning aggregation of Caye Glory changed its location, believe that the aggregation left because of disturbances and adverse changes in the physical attributes of Caye Glory during the spawning season. One purely natural source of disturbance was mentioned: hurricanes, which "damaged the environment many times … [and] … broke off all what harbours them, things that cause them to stay there."[58] Damage from hurricanes is undisputed, but does not explain population declines in the last couple of decades not achieved by the many hurricanes of prior decades.

Other disturbances mentioned many times by the fishermen interviewed for this report were not natural. One fisherman mentioned environmental issues from development and said:

> Not only in Belize, but in other countries also, the mangroves getting damaged and the seabeds are being dredged. These areas are also important for us to protect because this is where the small fishes live.[59]

The aggregation disturbance mentioned most often was the number of fishermen themselves, a number which became greater as motors made Caye Glory more accessible to more fishermen, particularly in the 1970s and 1980s. In addition to fishermen, the motors brought noise and fishing lines. Comments included the following:

- It could be that when they starting using motors, that caused [the aggregation] to move. [60]
- It was not feasible to go to Cay Glory to spend a week there because there was too many people going there. That was what ruined the site. The fish got scared by too many fishing lines, too much iron [i.e., too many anchors] that they used to throw.[61]
- I believe that so many boats, dories that used to go there and all the fishing lines ran the fish from there. … All of that can affect the fishing ground.[62]
- In my opinion, the groupers change places. What causes it is all the noise from the motors. In the old days, the grouper did not move because no one had an engine. You used to get to the grouper bank with paddles, there were no motors and whoever had a boat used sail. That's why the fish did not used to get scared, but when all the motor-powered skiffs started going, the noise starting chasing them.[63]

---

[58] Tony Vega
[59] Omar Arceo
[60] Tuli Lara
[61] Colas Sansorez
[62] Florentino González
[63] José González

In addition, prior to the days of motors at Caye Glory, it was common for fishermen in several doreys to tie themselves together and thus use only one anchor among them, thereby disturbing the environment and grouper less.

The change in fishing gear was another factor identified by the fishermen as causing or contributing to the demise of the Caye Glory spawning aggregation of Nassau grouper. Initially, almost all the fishing at Caye Glory was by handline and hooks (Thompson 1944, Craig 1968) with some spearing with Hawaiian slings or spears. One fisherman commented that fishing gear should have been limited to hand lines,

> There is a saying that goes: fishing with hook and line can never deplete the fish. … When Jacque Cousteau came to Belize, he made a study on the groupers of Cay Glory. He made the same recommendation in his report that the grouper of Cay Glory can NEVER be fished out only fishing with hook and line. NEVER can they be fished out fishing only with hook and line.[64]

There were, however advantages to spearing, which became more common once masks and fins were used. As two fisherman recalled,

> The fishing at the bank was tremendous during spawning and we speared them everywhere we saw them.[65]
>
> Later on, when I was about 15 years old [around 1961], my brother and I would dive down and spear them. It was faster; the fish weren't biting and you were seeing the fish.[66] …

Another gear mentioned as destructive to the spawning aggregation was the seine and because of the quantity of Nassau grouper that could be caught. Use of the seine at Caye Glory was apparently rare and was limited to the 1970s and early 1980s when Guatemalans and Hondurans were occasionally spotted slipping in at night around Caye Glory. One fisherman reported,

> Those people come from way across [the border]. They come fishing; they give nothing to the country. … Sometimes in one seine a thousand pounds they would catch, and it wasn't one seine they got, but five and six seines."[67]

Another fisherman commented on the catch of a fish trap at a spawning aggregation as follows:

> And throughout my experience one thing I never liked is what used to happen at the grouper bank. I used to free dive the grouper bank and I used to find huge fishing traps being lowered down on the bank with a lot of small lobsters as bait. Within an hour they used to pull 80 to 100 grouper in the traps. That's what I never used to like.[68]

However, the fishermen interviewed felt the greater destructiveness of the fish pot or trap resulted from the irritation or injury it caused to the scales or fins of the Nassau grouper caught in it, whether alive or dead. The fishermen have observed that Nassau grouper tend to flee an area once it has been "contaminated" by an injury to other Nassau grouper, possibly because of a scent released into the water. Comments included the following:

---

[64] José González
[65] Dimas Guerrero
[66] Orlando Guerrero
[67] Bucky Martin
[68] Omar Arceo

- Yes, that fish pot affected a lot of things… That's what killed the place.[69]
- What scared the bloody fish from there were the same fishermen, when they put wire traps down below. You would see the fish get in there and the trap get stuck and the fishermen cut off the buoy and leave the bloody trap there; and the fish then died there, and that's what kind of scared them. From then, then the fish started to leave.[70]
- The grouper fishery of Cay Glory decreased because they set fish pots there. After they moved to Turneffe to fish, because we were the only ones fishing the Mauger Cay bank, it had large fish. There they started making the fish pots. But because the guy in charge was related to them, one was his nephew and the other was his uncle, he never said anything. But from the very beginning I told the lighthouse keeper: That [fish pot] is going to be the poison of this place, once you start setting traps. Then they started setting traps in Cay Glory. They messed up Cay Glory and they messed up Mauger Cay. But that fish pot caused it.[71]

Another fisherman, with many years experience in spearing grouper and training from his father, avoided contaminating the water. He commented,

> But then you have to be careful how to spear them. You can't spear a fish and damage the flesh. You have to be able to shoot the fish in a dead shot.[72]

Once boats were equipped with freezers and the cooperatives were purchasing fillets, some fishermen began to fillet their catch at the site. They caused further contamination when a few "threw the head in the fishing ground," again causing the Nassau grouper to abandon the spawning site.[73] The interviewed fishermen explained that their longstanding practice of disposing of fish guts in the water had no such effect since contamination is caused solely by external irritation to Nassau grouper.

Another potentially significant change in fishing practice was in the fishermen's bait. The early fishers used dead conch, octopus or parrot fish as bait. Then some fishermen began using live bait, usually grunt. Once the fish became used to the live bait, others complained they would bite nothing else. When a few began using jack as bait, they attracted sharks. The interviewed fishermen reported that when some finally tried to use *grouper* for bait, the spawning aggregation at Caye Glory was over. Comments included the following:

- When we first went [to Caye Glory], we used to use pure conch for bait because conch was there by the millions. They never used to sell it like now. Then 10 years later, we had to catch live fish. We would go fishing for them live grunt and carry it for fishing.[74]
- The fish stopped biting. The fish became spoiled and only wanted live bait. They started using, fishing with jacks that attracted the sharks and chased away the fish.[75]
- I don't know if [so many boats and fishing lines] ran off the fish, or maybe they start using the same grouper for bait. All of that can affect the fishing ground.[76]

---

[69] Bucky Martin
[70] Tom Young Sr.
[71] Francisco Arceo
[72] Omar Arceo
[73] Colas Sansorez
[74] Tom Young Sr.
[75] Cola Sansorez

- That grouper moved from those places because they either fished it with the same grouper or they filleted it and threw the head in the fishing ground.[77]

➢ **Overfishing**

The scientific literature abounds with documentation of the vulnerability to overfishing of the Nassau grouper. (See Side Bar 3) Notwithstanding the possibility of shifting aggregations, failure to locate aggregations and the effects of changing fishing practices, the scientific community overwhelmingly ascribes the demise of the Nassau grouper spawning aggregation at Caye Glory, as well as of the Belizean and Caribbean grouper population generally, to overfishing. Such findings and opinions are too numerous to cite. A few of the fishermen interviewed for this report share that view and/or commented on the "waste" sometimes involved in the fishery. Their comments include the following:

- I believe that the fish at Cay Glory decreased a lot because they used to kill them a lot, it was a lot that was fished.[78]
- You catch what you can handle. If you can handle 100 grouper then you catch that amount, if you can't handle what you catch then don't catch any more. But those people are greedy and catch more than they can handle and then they have to throw away a lot of fish. So now that cripple the place.[79]
- When the fish has roe is when they bite the most, and that is when we fished them the most. We didn't know that we were killing the industry.[80].
- If they had taken care of the fishery at Cay Glory, in fact if they had taken care of all those grouper fishing grounds, it would never have come to this.[81]
- The night is coming, the dory is full of fish, they can't corn them. You know what they do? They cut open the fish belly, take out only the roe and dash away the fish, and tomorrow they go back again and fill [the dory] again. I always tell them boys, one of this days we'll come when we won't be able to get none.[82]
- When the Lent was over, whatever I didn't sell I left in the pen. I would leave about 200 groupers. I don't even bother to get them out because I had enough.[83]
- They should have given a little certain time. Suppose they would have given you this year to fish, next year you can't. At least they have more than one spot. They have Glover's Reef, they have Half Moon Cay. Suppose they said, we will give you this season to fish Emily, you will work this season here but next season you're not supposed to come here, you're going to Glover's Reef, now over to that site.[84]

At least one fisherman also commented on the deleterious effect on the spawning aggregation at Caye Glory of indiscriminate fishing of Nassau grouper elsewhere.[85]

---

[76] Florentino González
[77] Colas Sansorez
[78] Ernesto Gómez
[79] Bucky Martin
[80] Dimas Guerrero
[81] Colas Sansorez
[82] Bucky Martin
[83] Tony Vega
[84] Bucky Martin
[85] Dimas Guerrero

Fishermen's Attitudes Toward Closure of the Caye Glory Fishery and Seasonal Closure for Nassau Grouper

The fishermen interviewed for this report tended to oppose the closure of the Caye Glory fishery and of the Nassau grouper fishery during the spawning season. Two fisherman gave the closure unalloyed support, saying,

- They had already ruined the fishing ground of Cay Glory. They had to close it to see if the fishery would recover. I think what they are trying to do is a good idea, to see if the fish will come back in a few years.[86]
- If we want to protect this Nassau Grouper now … we should not fish them any more on the movement of the moon. … To see if we can increase the grouper population, we could give them a chance to expand, to spawn and whatever they need to do. [87]

Several questioned the wisdom or efficacy of the closure or had somewhat neutral observations:

- My opinion, now you can make more money with showing the fish that fishing it.[88]
- Actually, closing the grouper bank will not work as they think it will work. Well, if it was a place like a hatchery then the population would increase tremendously but not in the open sea.[89]
- Today the fisherman does not come, that means that the fish is not there. If they closed it or not, they still can't fish. Therefore, if they let the fishermen fish the site, the fishermen will try to find the fish.[90]
- The fish is from the gulf, it is neither from the reefs nor from the shallows. This fish travels from the gulf of Quita Sueños which is about 600 miles from here.[91]
- I think that's a bad style, closing up the banks, because fish know the season and come and go. You could catch an amount of grouper here today, next week there are none there. And next year you come and they're there again.[92]

Those fishermen who opposed the closure were motivated overwhelmingly by concern for the lost income of active fishermen and those who depend on them. Illustrative comments include the following:

- I think that they should still let the fishermen to continue to fish there. Stann Creek live from that.[93]
- I don't fish for grouper anymore and if I say close the grouper banks, I am not thinking good because there are people that still make a living from that.[94]
- I think closing the bank is something bad because that was for the poor people. I think the government did a bad thing to cut that down all of a sudden. They

[86] Ernesto Gómez
[87] Omar Arceo
[88] Milo Paz
[89] José González
[90] Tuli Lara
[91] Francisco Arceo
[92] Tom Young, Sr.
[93] Allan Forman
[94] Tuli Lara

> don't worry about the poor people. A lot of people used to live on that and now you can't even catch a fish round there again. It's closed; it's a marine reserve now.[95]

Conclusions and Recommendations

Lessons learned from Caye Glory

We propose the following lessons, stated simply and in general terms, from the history of the Nassau grouper spawning aggregation at Caye Glory:

- Even a seemingly unlimited resource can be destroyed.
- Once a resource is destroyed, most options for promoting its health are moot.
- Laws and regulations are meaningless if not enforced.
- Law enforcement requires the expenditure of capital, both monetary and political; the near certainty of unpopularity with one or more influential sectors of society; and courage.
- Compliance with laws and regulations involves aggravation ranging from inconvenience to significant penalty, financial loss and loss of freedom. Failure to comply should involve a greater degree of the same.
- Intelligent management of a marine resource is necessary if the resource is to be exploited over the long term by anyone.
- Systematically and accurately collecting, recording and maintaining appropriate data is essential for the intelligent management of a marine resource. Doing so is unexciting, expensive and burdensome to all affected and usually is accompanied with no short-term reward. Failing to do so may or may not be exciting, but will certainly be expensive and burdensome to all affected and will likely be accompanied by both short and long term pain.
- Data collection deferred is intelligent management denied.
- Intelligent management is difficult in the absence of scientific understanding of that which is being managed. However, developing scientific understanding is a slow process. In the interim, attempts at intelligent management necessarily involve risk and should be approached cautiously. Likewise, failure to attempt intelligent management necessarily involves at least as much risk and should be approached cautiously.
- People who depend for their immediate livelihoods on a resource tend to know a great deal about that resource. Their knowledge should be garnered and considered in the development of any scheme for managing that resource.
- People whose compliance is necessary for the success of a management scheme must have adequate incentives for compliance, adequate disincentives for non-compliance or both.
- People who depend for their immediate livelihoods on a resource are often not capable of evaluating management of that resource for the long term, especially when they perceive that that management threatens their livelihoods in the short term. While their advice and consent should be carefully, diplomatically and sympathetically sought, their approval and satisfaction cannot be prerequisites to appropriate action.

---

[95] Tom Young Jr

- People who depend for their immediate livelihoods on their popularity in the short term are generally not good stewards of resources which require management for the long term.
- Resources which require long term management for the benefit of multiple stakeholders are best handled by true professionals *somewhat* insulated from those who depend for their immediate livelihoods on their popularity.

Management Options for the Mesoamerican Barrier Reef System

Hand-line and spear fishing are very damaging to spawning aggregations. Traditional hand-line fishers can remove more than 10% of male and female fish from a spawning aggregation, and tag returns now show that year-round spear fishing can remove as many as 14% of the adults from a local population. Fisheries models developed with local data indicate that this level of fishing is unsustainable; and if continued, the population will disappear in the near future.

Nassau groupers are territorial and spend most of the year in their limited section of their parent reef. Recently conducted tagging studies indicate that only 3% of the Nassau groupers spawning at Glover's Reef actually leave the atoll after spawning. This information indicates that year-round fishing regulations can have direct impacts on the integrity of Nassau grouper spawning aggregations, and that they can help bring back local populations of Nassau grouper from the threat of extinction.

It follows from the preceding discussion that Nassau grouper management efforts should be designed to protect the breeding and survivorship of adult stocks. The following nine (9) key management options have been identified to slow or prevent further decline and extinction of fisheries similar to that at Caye Glory throughout in the Mesoamerican Barrier Reef System (MBRS). These may be summarized as follows:

1. ***Permanently close the Nassau grouper fishery throughout the MBRS region.*** This option will reduce Nassau grouper decline to the extent that the regulation is adhered to and enforced, but does not allow for future, sustainable capture of the species. General compliance would not be expected, particularly so long as it remains legal to land finfish catches as fillets.
2. ***Close the Nassau grouper fishery throughout the MBRS region for 5 years.*** This option will allow five years of un-interrupted breeding to replenish local stocks, but also affords the fishery to be reopened if managed sustainably. General compliance would be expected to be moderate.
3. ***Close the Nassau grouper fishery at known spawning sites (only).*** This option will protect breeding individuals at known sites, but offers no protection to population outside the breeding site and season. General compliance would be expected to be moderate.
4. ***Establish a closed season from December 1 to March 3.*** This option will protect breeding individuals anywhere in the MBRS during their breeding season, but general compliance would be expected to be poor.
5. ***Establish a minimum size limit of 20 inches.*** This option will protect juvenile fish from fishing mortality until they have had at least one opportunity to breed and is suited to populations in which juvenile mortality is high, and adult mortality is low. General compliance would be expected to be poor.

6. ***Establish a maximum size limit of 20 inches –*** This option will protect adult fish from fishing mortality, and is suited to populations where juvenile mortality is low, and adult mortality is high. General compliance would be expected to be poor.
7. ***Ban spear fishing throughout the MBRS region.*** This option will reduce fishing mortality on all sizes of Nassau grouper. General compliance would be expected to be poor.
8. ***Ban spear fishing in marine protected areas (only.*** This option will reduce fishing mortality on Nassau grouper residing within marine protected areas only. General compliance would be expected to be high.
9. ***Ban the landing of finfish catches as fillets.*** This option will allow finfish to be landed with head and fins intact for identification and will prevent the illegal sale of Nassau grouper as fillets. General compliance would be expected to be poor as the majority of the finfish landings are sold locally to hotels and restaurants who serve fish as fillets.

Options 3, 4 and 8 are already being implemented in Belize and a closed season is being implemented in Mexico.

Management Recommendations for the Mesoamerican Barrier Reef System

For recovery of the MBRS region's Nassau grouper stocks, we recommend harmonization of fisheries regulation for the 4 countries of the MBRS region in the following manner, as further discussed below.

1. Closure of the Nassau grouper fishery for a period of 5-years, followed by:
2. Closure of all known Nassau grouper spawning aggregation sites;
3. Seasonal closure of the Nassau grouper fishery from 1 December to 31 March;
4. Minimum catch limit of 20 inches outside protected areas and no-take sites; and
5. A permanent ban on the use of spear fishing for the taking of Nassau grouper in the MBRS region.

Consecutive closure of the fishery will immediately benefit Nassau grouper stocks. Of the three options (#1, 2, 3) presented, the five year moratorium offers both immediate impact and an opportunity for traditional fishers to return to the fishery once it has stabilized and can support sustainable extraction.

Permanent closure of the fishery will be likely to realize poor compliance. However, it is important to note that spawning aggregation sites should be specifically identified for the purpose of enforcement and therefore should receive dedicated protection as no-fishing zones. Therefore, we recommend a 5-year moratorium on fishery as the preferred option for management, and thereafter closure of known Nassau grouper spawning aggregation sites.

Seasonal closure of the fishery will benefit Nassau grouper stocks in both the short and long term with relatively low compliance cost (*i.e.*, added cost only for those sites not currently managed) and therefore is recommend.

Size limit regulations are difficult to establish because arguments for both upper *and* lower limits have been put forth. Without the impact of fishing, the Nassau grouper and other large, late-maturing species typically experience greater mortality as juveniles. When fishing

mortality is biased toward adults and compounds naturally biased adult mortality, upper size limits are likely be appropriate. But if fishing mortality is being selectively reduced on spawning adults and by gear restrictions, then a lower size limit may ensure a greater number of individuals have an opportunity to breed. Consequently, we recommend a lower size limit in conjunction with seasonal closures and gear restrictions, and a higher size limit in their absence.

Spear fishing restrictions can only promote the recovery of Nassau grouper and the wider the scope of their application; the faster will be the recovery of the MBRS region's native population. Consequently, we recommend a complete ban on the spear fishing of Nassau grouper in the MBRS region.

.***.

Literature Cited

Allsopp, W. H. L. 1967: *Fisheries Development in British Honduras (Belize): An Analysis of Plans and Achievements*. Food and Agriculture Organization of United Nations Development Programme. Rome, Italy. 17pp.

Auil, S.A. 1993: *An Analysis of the Belize Coral Reef Finfish Fishery*, Unpublished dissertation, University of the West Indies.

Baird, R.H. 1973: *Report to the Government of British Honduras on Fisheries Management and Potential*. United Nations Development Programme. Rome, Italy. Rep. FAO/UNDP (TA), (3202): 49 pp.

Belize Fisheries Department 2005: *Spawning Aggregation of Multi-Species at Caye Glory, Nicholas Caye, Rocky Point and Sandbore (Belize)*. Minister of Agriculture and Fisheries.

Belize Spawning Aggregation Working Group (SPAG Working Group) 2005: Information Circular No. 3, September 2005.

Bolden, S.K. 2000: *Long-distance movement of a Nassau grouper (Epinephelus striatus) to a spawning aggregation in the central Bahamas*. Fishery Bulletin 98(3), pp.642-645.

Burton, M.L., Brennan, K.J., Muñoz, R.C., Parker, R.O. Jr. 2003: *Preliminary evidence of increased spawning aggregations of mutton snapper (Lutjanus analis) at Riley's Hump two years after establishment of the Tortugas South Ecological Reserve*. Center for Coastal Fisheries and Habitat Research, National Marine Fisheries Service, NOAA.

Carr, D. and Thorpe, J. 1961: *From the Cam to the Cays, A Cambridge Expedition to British Honduras 1959-60*. Putnam and Company Limited, London, G.B.

Carter, J., 1988: *Grouper Mating Ritual on a Caribbean Reef.*. Underwater Naturalist, Vol. 17, No. 1, 1988, pp.8-11.

Carter, J., 1989: *Grouper Sex in Belize*. *Natural History*. October 1989, pp.61-68.

Carter, J., 1990: *A Delicate Balance*. Wildlife Conservation, Jan./Feb. 1990, pp. 58-67.

Carter, J. and Marrow, G.J. 1991: *Preliminary Fishery Management Plan for the Nassau Grouper (Epinephelus Striatus) Fishery*. Funded by Wildlife Conservation International.

Carter, J., Marrow, G.J. and Pryor, V. 1994: *Aspects of the Ecology and Reproduction of Nassau Grouper, Epinephelus Striatus, Off the Coast of Belize, Central America*. Proceedings of the 43rd Gulf and Caribbean Fisheries Institute, pp. 65-111.

Carter, J., 2001: *Historical Overview of Nassau Grouper Aggregations in Belize*. Proceedings of the First National Workshop on the Status of Nassau Groupers in Belize: Working Towards Sustainable Management, at Belize City, 30 July 2001, Green Reef Environmental Institute. 4-10.

Claydon, John 2004: *Spawning Aggregations Of Coral Reef Fishes: Characteristics, Hypotheses, Threats And Management. Oceanography and Marine Biology: An Annual Review* 2004, R. N. Gibson, R. J. A. Atkinson, and J. D. M. Gordon, Eds., p.265-302

Coastal Zone Management Authority and Institute (2003): *State of the Coast Report 2001-2002 (Belize)*. p.67

Coleman, F.C.; Koenig, C.C.; Huntsman, G. R.; Musick, J.A.; Eklund, A.M.; McGovern, J.C.; Chapman, R.W.; Sedberry, G.R..; and Grimes, C.B. 2000: *Long-lived Reef Fishes: The Grouper-Snapper Complex*. American Fisheries Society Policy Statement. www.fisheries.org

Colin, P.L. 1992: *Reproduction of the Nassau Grouper, Epinephelus Striatus (Pisces: Serranidae),and its Relationship to Environmental Conditions.* Environ Biol Fish 34:357-377.

Colin, P.L., Shapiro, D.Y., Weiler, D. 1987: *Aspects of the Reproduction of Two Species of Groupers, Epinephelus Guttatus and Epinephelus Striatus in the West Indies*. Bull Mar Sci 40(2):220-230.

Cornish, A. 2004. *Development and Summary of Global Spawning Aggregation Database*. Society for the Conservation of Reef Fish Spawning Aggregations (SCRFA), www.scrfa.org. pp. 4-7.

Cornish, A. S. 2005. *Development and Summary of Global Spawning Aggregation Database*. Society for the Conservation of Reef Fish Spawning Aggregations (SCRFA). www.scrfa.org. p 16.

Craig, A.K. 1966: *Geography of Fishing in British Honduras and Adjacent Coastal Waters*. Louisiana State University Press, Coastal Studies Series Number Fourteen.

Craig, A.K. 1968: *The Grouper Fishery at Cay Glory, British Honduras*. Annu. Assoc. Am.Geog. 59: 252-263.

Dahlgren, C. 2001: *Studying Nassau Grouper Spawning Aggregations: the Key to Rebuilding and Conserving this Important Fishery Resource*. The National Undersea Research Center for the Caribbean, Marine Research Center, Lee Stocking Island, Bahamas. www.cmrc.org.

Domeier, M.L., Colin, P.L. 1997: *Tropical Reef Fish Spawning Aggregations: Defined and Reviewed.* Bull Mar Sci 60:698-726.

Dres, John K. W. and Meyer, Jacob 1965: *Report to the Government of British Honduras on Various Aspects of the Lobster and Scale Fishery in Coastal Waters*. Food and Agriculture Organization of the United Nations. Report No. 2100. Rome, Italy

Gascoigne, J. 2002: *Nassau Grouper and Queen Conch in the Bahamas: Status and Management Options*. Prepared for The Bahamas Reef Environment Educational Foundation.

Gibson, J., Pott, R.F., Paz , G., Majil, I. and Requena, N. 2006: *Experiences of the Belize Spawning Aggregation Working Group.*

Gordon, E.T. 1981: *Phases of development and underdevelopment in a Caribbean fishing village: San Pedro, Belize.* Doctoral dissertation, Stanford University, Stanford, California.

Heyman, W.; Azueta, J.; Lara, O.; Majil, I.; Neal, D.; Luckhurst, B.; Paz, M.; Morrison, I.; Rhodes, K.L.; Kjerve, B.; Wade, B.; & Requena, N., 2004: *Spawning Aggregation Monitoring Protocol for the Meso-American Reef and the Wider Caribbean*. Version 2.0. Meso-American Barrier Reef Systems Project.

Heyman, W.D. & Requena, N. 2003: *Fish Spawning Aggregation Sites in the Mesoamerican Barrier Reef Systems Region: Recommendations for monitoring and management.* Mesoamerican Barrier Reef System Project, The Nature Conservancy, Punta Gorda, Belize.

Heyman, W.D. & Requena, N. 2002: *Status of Multi-Species Spawning Aggregations in Belize.* The Nature Conservancy.

Heyman, W.D. 2001: *Spawning Aggregations in Belize: A Report Generated for the Workshop "Towards a Sustainable Management of Nassau Groupers in Belize*." Proceedings of the First National Workshop on the Status of Nassau Groupers in Belize: Working Towards Sustainable Management, at Belize City, 30 July 2001, Green Reef Environmental Institute. 4-10.

Heyman, W. and Graham, R. (eds.) 2000: *The Voice of the Fishermen of Southern Belize*. Toledo Institute for Development and Environment, Punta Gorda, Belize. 44pp

Hilborn R. & Walters C.J. 1992: *Quantitative Fisheries Stock Assessment: Choice, Dynamics and Uncertainty*. Chapman and Hall, New York, USA.

Huitric, M. 2005: *Lobster and Conch Fisheries of Belize: a History of Sequential Exploitation.* Ecology and Society 10(1):21.

Idyll, C. P. 1961: *Recommendations for the Development and Control of the Fisheries of British Honduras.* The Marine Laboratory, Institute of Marine Science of the University of Miami.

Jacobs, N.D. 1998*: Belize: Assessment and Analysis of the Fisheries Sector and Marine and Coastal Areas, Consultant's Report, National Biodiversity Strategy and Action Plan.*

Jacobs, N.D. 1996: *Biological Aspects of the Nassau Grouper (Epinephelus striatus) with Reference to Advances in its Culture*. Masters Thesis. Centro de Investigación y de Estudios Avanzados del Instituto Politécnico Nacional, UNIDAD MERIDA, Recursos del Mar, Yucatan Mexico.

Johannes, R.E.; Squire, L.; Graham, T.; Sadovy, Y.; and Renguul, H. 1999: *Spawning Aggregations of Groupers (Serranidae) in Palau*. Marine Conservation Research Series Publ. No. 1, The Nature Conservancy. 144pp.

Paz, G. & Grimshaw, T. 2001: *Status Report on Nassau Grouper Aggregations in Belize, Central America*. Proceedings of the First National Workshop on the Status of Nassau Groupers in Belize: Working Towards Sustainable Management, at Belize City, 30 July 2001, Green Reef Environmental Institute pp.27-36

Perkins, J.S. 1983: *The Belize Barrier Reef Ecosystem: an Assessment of its Resources, Conservation Status and Management*. The New York Zoological Society. pp.268.

Sadovy, Y. 2005: *Troubled Times for Trysting Trio: Three Aggregating Groupers in the Live Reef Food-Fish Trade*. SPC Live Reef Fish Information Bulletin #14 – October 2005.

Sadovy, Y., Colin, P., and Domeier, M.. 2005: *Monitoring and Managing Spawning Aggregations: Methods And Challenges*. SPC Live Reef Fish Information Bulletin #14, pp.25 29.

Sadovy, Y. and Domeier, M. 2005: *Are Aggregation-Fisheries Sustainable? Reef Fish Fisheries as a Case Study.* Coral Reefs 24:254-262.

Sadovy, Y. and Domeier, M. 2005: *Perplexing Problems of Sexual Patterns in the Fish Genus Paralabrax (Serranidae, Serraninae).* J. Zool., Lond. (2005) 267, 121–133 C_ 2005.

Sadovy, Y. and Eklund, A-M. 1999: *Synopsis of biological data on the Nassau grouper, Epinephelus striatus (Bloch, 1792), and the jewfish, E itajara (Lichtenstein, 1822).* NOAA Tech Rep NMFS 146:1-65. *Fishery Bulletin*, FAO Fisheries Synopsis 157. US Department of Commerce, Seattle WA.

Sala, E. 2001: *Status of the Grouper Spawning Aggregation on Glover's Reef, Belize, July 2000 – June 2001, Scientific Report to the BelizeFisheries Department..*

Sala, E. 2002: *Conservation of Grouper Spawning Aggregations in Belize, Annual Report FY02 to WCS, July 2002*

Sala, E., Aburto-Oropeza, O., Paredes, G., and Thompson, G. (2003): *Spawning Aggregations and Reproductive Behaviour of Reef Fishes in the Gulf of California*. Bulletin of Marine Science 72(1): 103-121.

Sala, E., Ballesteros, E. 2000: *Conservation Status and Dynamics of the Glover's Reef, Belize, Grouper Spawning Aggregation, December 1999 – January 2000, Scientific Report to the Wildlife conservation Society's Glover's Reef marine Research Station, Belize, Central American*, Scripps Institution of Oceanography, La Jolla, CA.

Sala, E., Ballesteros, E., & Starr, R.M. 2001: *Rapid Decline of Nassau Grouper Spawning Aggregations in Belize: Fishery Management and Conservation Needs.* Conservation, October 2001. Fisheries, 26:23-31.

Sale, Peter F.; Cowen, Robert K.; Danilowicz, Bret S.; Jones, Geoffrey P.; Kritzer, Jacob P.; Lindeman, Kenyon C.; Planes, Serge; Polunin, Nicholas V.C.; Russ, Garry R.; Sadovy, Yvonne J. and Steneck, Robert S. 2005: *Critical Science Gaps Impede Use of No-Take Fishery Reserves.* Opinion TRENDS in Ecology and Evolution, Vol.20 No.2:75.

Snyder, Donald G. 1976: *Processing, Product Development and Marketing of Belizean Fishery Products*. Food and Agriculture Organization of the United Nations. Rome, Italy

Starr, R. M; Sala, E.; Ballesteros, E.; Zabala, M. 2007: *Running Head: Spatial dynamics of the Nassau Grouper (Epinephelus Striatus) in a Caribbean Atoll.* In Press, Marine Ecology Progress Series.

Stoddart, D.R. 1963: *Effects of Hurricane Hattie on the British Houduras Reefs and Cays, October 30-31, 1961*. Atoll Research Bulletin No. 95, pp. 1-142 at p.52.

Stoddart, D.R.., Fosberg, F.R. and Spellman, D.L. 1982: *Cays of the Belize Barrier Reef and Lagoon.* Atoll Research Bulletin No. 256, p.1-156 at p.16.

Thompson, E. 1944: *The Fisheries of British Honduras.* Development and Welfare in the West Indies. Bulletin No. 21.

Vasquez, H. P. 1982: *Proceedings of Seminar Sponsored by the Belize Fishermen Cooperative Association Ltd. in Collaboration with the Cooperative and Credit Union Department of the Ministry of Cooperatives*. Belize Fishermen Cooperative Association Ltd. 33pp.

Villanueva, J. 2004: *Fisheries Statistical Report 2004*. Belize Fisheries Department, Ministry of Agriculture & Fisheries. July 2005

Wade, B. 2000: *Nassau Grouper Aggregations in Belize*. Unpublished document.

Wade, B. 2001: *Management and Conservation of Belize's Reef Fisheries: Fisheries Department's Perspective*. Proceedings of the First National Workshop on the Status of Nassau Groupers in Belize: Working Towards Sustainable Management, at Belize City, 30 July 2001, Green Reef Environmental Institute. 39-40.

APPENDIXES

Appendix 1: Table of fishermen interviewed

Fishermen Interviewed	Age	Yrs. Fished	Yrs fished at Caye Glory	Village or Town
Tony Vega	90	60	25	Caye Caulker
Tom Young Sr	78	55	20	Caye Caulker
Tom Young Jr	58	43	6	Caye Caulker
Earl Smith	55	30	4	Caye Caulker
Bongos	62	20	2	Caye Caulker
Felipe Paz	90	10	12	San Pedro
Tomaz Paz	73	45	25	San Pedro
Florentino Gonzalez Sr.	77	40	20	San Pedro
Jaime Paz	65	40	15	San Pedro
Donaldo Guerrero	62	40	20	San Pedro
Francisco Fashico Arceo	78	66	6	San Pedro
Florencio Colas Sanzores	70	51	6	San Pedro
Antonio Capulina Sanzores	62	40	6	San Pedro
Arturo Lara	77	40	20	San Pedro
Florencio Acosta	79	50	20	San Pedro
Tony Rivero	51	20	3	San Pedro
Dimas Guerrero	57	10	5	San Pedro
Orlando Guerrero	61	30	10	San Pedro
Jose Gonzalez	72	22	12	San Pedro
Milo Paz	61	20	10	San Pedro
Efrain Guerrero Sr.	90	30	5	San Pedro
Alan Forman	78	25	2	San Pedro
Joe Alamilla	52	20	0	San Pedro
Ernesto Gomez	78	50	2	San Pedro
Severo Castillo	83	50	5	San Pedro
Omar Arceo	48	25	0	San Pedro
Alpheus Bucky Martin	76	62	50	Placencia/Dangriga
Lincoln Eiley	65	45	1	Placencia
Carlton Young Sr.	72	50	1	Placencia

Sidebar 1

Belize's Historic Fishing Communities

Historically, Belize has had three distinct fishing communities, each with its own fishing techniques, favored gear and traditions (Craig 1966, *cf.* Huitric 2005). In addition, each had its own traditional fishing grounds and respected the traditional fishing areas of the other groups. However, it should be noted the three fishing communities *shared* the Nassau grouper spawning aggregation at Caye Glory (Craig 1966).

Creole: Belize's oldest maritime community was comprised of creoles, a mixture of European settlers and slaves brought primarily from Africa via Jamaica (Gordon 1981 at p.22) in the eighteenth century. These fishermen historically lived in and around Belize City, the government and financial center of the British Honduras, where they constituted a small and less prosperous portion of the population. They had the convenience of being able to anchor their boats in Haulover Creek and transfer their catch directly to market stalls (Craig 1966) or to pens or wells in the canal adjacent to the market, where the fish were kept alive. Thompson commented on the arrangement as follows:

> As this canal also operates as part of the city sewage system, the propriety of this method of handling the fish might be doubted; however the fish appeared to be in excellent condition and no bad effects due to sewage were reported. Fish bought are gutted into this canal, where the refuse in instantly disposed of by hordes of cat fish which act as very effective scavengers. (Thompson 1944 at 7).

Creole fishermen also lived on St. George's Cay and in the southern coastal village of Placencia. Hand lines and seines were their most common fishing gear (Craig 1966).

Northern: From the mid-nineteenth century, the largest group of fishermen in Belize hailed from the village of San Pedro on Ambergris Caye and of Caye Caulker on the tiny island of the same name, both having been settled by Mestizo and Mayan refugees from the Caste Wars (1848 through 1872) in the Yucatan and neighboring areas of Mexico. Culturally and ethnically similar fishermen also lived in Sarteneja and Corozal, villages on the mainland across the Bay of Chetumal from the northern cayes, but constituted only a small portion of the primarily farming population. Although the village of San Pedro had acquired its name for the patron saint of fishermen at least by 1851, a fact implying the significance of fishing to its populace (Gordon at p.68), most villagers also grew corn, sugar and other foodstuffs as well, some of which they sold to the workers in Corozal's sugar industry and in the market in Belize City. Acknowledged early on to be the best fishermen in Belize, they turned away from fishing when employment in logwood, mahogany, chicle and coconut was more profitable, albeit with unpleasant and even harsh conditions; some were forced to continue in those occupations beyond their desire because of debts to their employers, incurred through the advance system prevalent on plantations and in forestry enterprises (Gordon 1981). When the coconut industry fell on hard times, many left the cayes to seek employment elsewhere or fell back on fishing. Acknowledged early on to be the best fishermen in Belize, they were the first to have sailing smacks and were known to take far better care of their boats and fishing gear than the other groups (Craig 1968)[96]. The lobster industry had its most true foundation with Captain Foote's lobster cannery on Caye Caulker, where he also introduced the lobster pot used heavily there. The fishermen of San Pedro quickly followed into the lobster fishery, although they used the heart weir and the tramp, a local variation of the weir fashioned by a San Pedrano based on a design he saw in the newspaper (Gordon 1981; *cf.* Craig 1966) and skin diving, enhanced by the introduction of fins and masks in

[96] One possible reason for the special care of their boats is the infestation of shipworm in their usual waters (Craig 1968 at 256-257).

1957 (Craig 1966, Gordon 1981). Thus, the northern fishermen were most successful when the lobster industry began in earnest, and many plowed their proceeds back into their boats and fishing gear. The northern fishermen comprised the majority of fishermen during the Nassau grouper spawning aggregation at Caye Glory when Craig observed them in the 1960s, but they were also the first group to begin dropping out of the Caye Glory fishery when the size of the Nassau grouper caught during the spawning aggregation declined and other spawning aggregations were discovered. Those who continued fishing Caye Glory were the ones with vessels which could not practically make the trip to the newly discovered, but more distant spawning aggregations.

Garifuna: Finally, Belize's southern fishing community was comprised primarily of Garifuna or Black Caribs, the descendants of African slaves who had survived the shipwreck of a slave ship near St. Vincent and of Carib Indians who had previously migrated from the Amazon and conquered many of the islands in the sea which bears their name. After fierce fighting, the British finally succeeding in displacing the Garifuna from St. Vincent and other settlements to the island of Roatan, from which some migrated to Honduras, Guatemala and Belize at the beginning of the nineteenth century. Those in Belize were initially employed primarily in the mahogany industry, but moved into fishing as the mahogany industry faded. Garifuna fishermen predominated along the southern coast from Stann Creek (Dangriga) south to the Guatemalan border, with large settlements in Seine Bight and Punta Gorda, as well representation in the primarily creole settlement of Placencia.

The Garifuna were known for the high quality of their doreys, a design they may have brought with them, and by the 1840s were supplying doreys to the whole of the colony. The Colonial Report of 1954 described the dories as

> shapely craft, usually painted white above water and red or green below, rigged with jib and mainsail; they are fast and in the skilled hands of the local fishermen surprisingly seaworthy. (Colonial Report of 1954 at 60).

Although the dorey was later replaced by the smack as the major fishing vessel in Belize, it remained in widespread use (ultimately with outboard engines) until the latter part of the twentieth century and is still common in the southern part of the country (Huitric 2005; Craig 1966 at 56). In particular, doreys were used as satellites from smacks and other larger vessels, and it was from dories that most of the fishing at Caye Glory took place. (Craig 1968)

Sidebar 2

Economy of Belize Prior to Major Exploitation of Caye Glory

Until the middle of the twentieth century, Belize's economy was dominated by the forestry industry (Gordon 1981) and certain large-scale agriculture and processing, all of which served an export market. Indeed, the genesis of British Honduras lay in its forestry resources, initially logwood for making dye in Europe (Gordon at 28). Mahogany subsequently became the prime forestry product as the logwood market waned, although logwood production made a resurgence in the 1880s. Mahogany production reached its zenith in the 1840s during the period of massive construction of railway coaches in Great Britain, but has remained an important export (Gordon at 29). In addition, from the early 1890s until the Depression of the 1930s, Belize had a lucrative export trade in chicle, the sap from sapodilla trees used in making chewing gum in the U.S. (Gordon at 77, etc.).

The first export product cultivated and processed in British Honduras was sugar prepared from sugar cane grown in the northern mainland and cayes. From the first shipment to Europe in 1857, export levels rapidly increased; however, the industry had collapsed by the mid-1890s because of sugar beet competition from Europe (Gordon at 73). In the latter half of the nineteenth century, Belize's small domestic market for coconuts, grown on the northern cayes and mainland, metamorphosed into a lucrative export industry once adequate transportation to the US market could be arranged (Gordon at pp. 92-93). The success of large coconut plantations increased greatly in the first two decades of the twentieth century, despite damage from hurricanes in 1916 and 1920, until the industry declined precipitously during the Depression of the 1930s and thereafter (Gordon at 106).

The fortunes of the major forestry and agricultural enterprises were determined not only by the fickleness of their respective markets and such factors as hurricanes and access to cost-effective transportation, but also by the degree of their success in securing labor. British Honduras possessed abundant natural assets, but scant human resources (Thompson 1944, Craig 1966). In the nineteenth and early twentieth centuries, most of the industries cited above "bound" their workers by advancing them funds for the tools or living accommodations necessary for their job performance and then permitting debt repayment from their wages. In addition, wages were frequently paid in the form of script redeemable only at the "company store," where goods were often overpriced to boot. These practices were profitable for the owners, but their true value lay in securing and retaining a labor supply.

Therefore, by the turn of the twentieth century, while small scale agriculture and fishing existed as alternative occupations in British Honduras, most breadwinners worked for wages in the forestry industry or on a sugar or coconut plantation. Farming and fishing were generally relegated to side activities, mostly for personal consumption or modest income augmentation. In addition, independent farming was traditionally an occupation of low status, partly because of its association with the Maya who occupied the lowest rung of the social ladder (Gordon 1981). Fishing did not bear the same stigma as independent farming, but the number of individuals dedicated to fishing for their livelihoods was quite low (Craig 1966).

The forestry and large-scale agricultural industries cited above declined at varying times and rates by the end of the nineteenth century and in the first three decades of the twentieth. The Depression of the 1930s eradicated what prosperity remained in those industries, and many or most of their workers were available for other pursuits. Quite a few sought work elsewhere —in Mexico, Panama, the United States— or turned to other occupations, such as fishing (Gordon 1981). Many of those who went elsewhere, however, returned when the lobster industry beckoned.

Side Bar 3

Vulnerability of Nassau Grouper to Overfishing

The scientific literature abounds with documentation of the vulnerability to overfishing of the Nassau grouper. Nassau grouper stocks are below sustainable levels and have even been eliminated from much of their historic range (Dahlgren 2001, Sadovy and Eklund 1999). Their vulnerability has been ascribed to the following life history traits, in addition to their desirability as seafood and therefore relatively high price:

- Slow growth and a high age at maturity
- Increasing reproductive rate with age
- Increasing number of eggs per reproductive event with age
- Change sex from female to male
- Reproductive failure at low density
- Long life and low adult mortality
- Reproduction through spawning aggregations. (Gascoigne 2002).

The Nassau grouper's long life span (it is not unusual to find groupers aged 15 or 20 years, or more), slow growth rate and late sexual maturation mean that populations are typically slow to replace themselves or to recover from overfishing (Gascoigne 2002; Sadovy 2001). Overfishing is reached at a low level of fishing mortality in a species with naturally low mortality (Coleman *et al.* 2000). Sex change from female to male late in life renders Nassau grouper vulnerable to *selective* fishing pressure since the fisherman's target is likely to be the larger individuals—who are also the older and male individuals—thus males are reduced disproportionately. Worse yet,

> populations with low natural mortality, long life and increased reproductive output with age tend to depend on older individuals for reproduction. As mortality increases, the probability of an individual's surviving to a given age declines exponentially, meaning that even small increases in fishing mortality have a large impact on life span because the number of older individuals declines much faster than the total population figure. Therefore the reproductive output declines faster than the overall population size. This is even worse if fishing targets older (larger) individuals specifically. [The combination of such factors renders it] easy to reach the situation where very few individuals even survive to reproduce. A population that contains a large proportion of immature individuals is not likely to be in good reproductive health. (Gascoigne 2002).

However, the greatest threat to the survival of the Nassau grouper stems from its reproduction through spawning aggregations, defined as a group of conspecific fish, gathered at a specific site and time, for the purpose of spawning, with fish densities or numbers significantly higher (at least three times) than those found during the non-reproductive period (Domeier and Colin 1997; *cf.* Claydon 2004). These aggregations, the only known reproductive opportunities for many species of reef fishes (Sadovy and Domeier 2003), may draw individuals from both a wide area and the immediate vicinity (Bolden 2000; Green Reef Environmental Institute 2002). For groupers, spawning generally occurs over only one to three days during two to four consecutive months. During each month, individuals congregate to build up in numbers to a peak, until spawning occurs often over several consecutive evenings. The fish usually disperse immediately after the spawning event. Thus, the total annual reproductive output for the

population of a region occurs in a tight window of time and space (Dahlgren 2001, Sadovy and Eklund 1999, Heyman and Requena 2003).

Some evidence exists to indicate that "social learning" plays a role in the development and repeated formation of a spawning aggregation, suggesting that location of spawning sites and/or routes thereto are passed from older and experienced individuals to the next generation (Starr et al. 2007, Sadovy and Domeier 2005, Coleman et al. 2000, Bolden 2000, *cf.* Carter 1989). Thus the reduction of older individuals might endanger the aggregation's future. In addition, since those older individuals tend to be male, their reduction below some critical threshold could cause a rapid decline of the population and disappearance of the spawning aggregation from its historic site (Carter et al. 1994). Moreover, if too few individuals congregate for spawning, no spawning will occur (Starr et al. 2007, Sala 2001). No evidence exists to indicate that a spawning aggregation, once collapsed, will recover (Starr et al. 2007), even if closed to fishing (Sadovy and Eklund 1999).

In many areas, the majority of annual landings (up to 90%) of Nassau grouper, is, or once was, taken from spawning aggregations (Sadovy and Eklund 1999). Overall, an estimated one-third of known Nassau grouper spawning aggregations have either disappeared or decreased to negligible numbers (Sadovy and Eklund 1999, Heyman & Requena 2003). However, a global database compiled by the Society for the Conservation of Reef Fish Aggregations (SCRFA) shows that within exploited aggregations of known history over 60% show evidence of declines, almost 20% may have ceased to form, while the remaining 20% show stability or, in a few cases, may increase (http://www.SCRFA.org). Not coincidentally, Nassau grouper, once the most commonly landed species within the Caribbean and tropical western Atlantic, is in decline or collapse throughout the region (Claydon 2004), including in Belize (Paz and Grimshaw 2001). The Nassau grouper has been listed as an endangered species by the US federal government, red listed as an endangered species by the International Union for the Conservation of Nature, and classified as threatened by the American Fisheries Society (Sadovy and Domeier 2005 citing Musick et al. 2000).

While fishing a spawning aggregation can have a huge effect on the Nassau grouper population of a region and the ecology over a broad area (Claydon 2004), fishing outside the spawning aggregation—during other times of the year and/or at other locations—can reduce the size of the spawning aggregation itself (Sadovy and Domeier 2005). Most obviously, fishing near an aggregation site to catch fish moving toward the aggregation will deplete the aggregation (Aguilar-Perera and Aguilar-Dávila 1996). Highly efficient gear, such as fish pots and spear guns, can diminish a spawning aggregation by rapidly depleting the population that might otherwise join the aggregation. However, year-round fishing by hand line and spear can remove as much as 14% of the adults from a local population per year. Fisheries models developed with data gathered at Glover's Reef indicate that such a level of fishing is unsustainable, and if continued, will cause the Nassau grouper population to disappear in the near future. (Sala et al. 2001). Moreover, tag studies indicate that only 3% of the Nassau groupers spawning at Glover's Reef actually leave the atoll after spawning, a finding which could explain apparent inability of a Nassau grouper spawning aggregation to reform after its collapse. (Starr et al. 2007).

Table 1: Estimates of number of fishermen and boats

Year	# of Fisher	# of Boats & Type	Source
1944	340-400		Thompson 1944
1948		125 fishing dories and smacks between 15-35 ft. Two motor vessels equipped with deep-freeze refrigeration engage in catching & purchasing lobster	Colonial Report
1950	600 whole-time and part-time	150 boats & smacks ranging from 15-35ft.	Colonial Report
1952	400 full-time, of whom an estimated 225 were engaged in crawfishing from July-Mar, and scale fishing during the rest of the year.	200 boats ranging from dug-out dories 12 ft and up; motor boats 45 ft long; smacks widely used, typically with live-well 25 ft in length, 8 ft beam and 3 ft draught; and 4 motor-powered craft with ice compartments to take lobster to BC for export.	Colonial Report
1953	400 full-time & 200 part-time, of whom an estimated 250 were engaged in crawfishing from July-Mar, and scale fishing during the rest of the year.	same as preceding Colonial Report	Colonial Report
1954	same as preceding Colonial Report	400 fishing boats: open dug-out sailing dories rigged with jib and mainsail; decked sailing smacks (25ft) fitted with large, live wells; few motor craft, fitted with either outboard or inboard engines.	Colonial Report
1955	same as preceding Colonial Report	same as preceding Colonial Report	Colonial Report
1956	same as preceding Colonial Report	same as preceding Colonial Report	Colonial Report
1957	same as preceding Colonial Report	same as preceding Colonial Report	Colonial Report
1958	same as preceding Colonial Report	same as preceding Colonial Report	Colonial Report
1960	same as preceding Colonial Report	same as preceding Colonial Report	Colonial Report
1961	same as preceding Colonial Report	same as preceding Colonial Report	Colonial Report
1962	same as preceding Colonial Report	same as preceding Colonial Report	Colonial Report
1963	same as preceding Colonial Report	same as preceding Colonial Report	Colonial Report
1964-65	1000 full-time & 200 part-time employed in the local fishing industry, the majority of which is engaged in crayfishing during July-March.	400 large fishing smacks (25 ft length) outfitted with sails and usually outboard engines and 400-600 dories & skiffs which are used as auxiliary crafts to the smacks. Almost all dories and skiffs (12-20 ft) are equipped with modern outboard engines from 5-75 hp.; a few large motor crafts fitted with inboard	Colonial Report

		engines used for transporting catches	
1964	1,200		Colonial Report
1965	1,200		Colonial Report
1965	1,000	500 total boats of all types, including those not seaworthy	Craig 1966, 1968
1967	421 fishermen engaged in lobster fishing out of a total of some 500 sea going fishermen and another 100 or more lagoon and part-time operators		Allsop 1967
1973	There are approximately 500 full-time fishermen, of whom 475 are members of the fishermen's co-operatives.		Baird, 1973
1975	1,100		Gordon 1981
1976	about 500 full-time fishermen, nearly all of whom are members of fishermen's cooperatives		Snyder 1976
1982			Perkins 1983
1992-98			CSO 1999
1996	1676	794	Table of issued licenses
1998	1718	759	Table of issued licenses
1998	> 3000 fishermen & plant workers		Jacobs 1998
1999	2137	728	Table of issued licenses
2000	1872	750	Table of issued licenses
2001	1707	608	Table of issued licenses
2002	1947	617	Table of issued licenses
2003	2009	689	Table of issued licenses
2004	1731	621	Table of issued licenses
2005	Fisheries employ 2000–3000 fishers and 200 workers to process the catch		Huitric 2005 citing FAO 2001
2005	2061		Table of issued licenses
2006	2131	653	Table of issued licenses

Table 2: Estimates of scale fish production

Year	Fresh, Chilled, or Frozen Fish	Salted, Dried or Smoked Fish	Total
1960	103,479	24,855	128,334
1961	98,330	39,931	138,261
1962	140,164	34,557	174,721
1963	167,892	71,123	239,015
1964	64,600	31,900	96,500
1965	110,756	48,986	159,742
			Scale Fish
1965			159,300
1966			206,900
1967			305,416
1968			389,958
1969			239,502
1970			246,508
1971			210,132
1972			114,680
1973			105,650
1974			135,435
1975			210,692
1976			419,448
	Whole Fish	**Fish Fillet**	**Total**
1977	955,722	123,002	1,078,724
1978	822,835	70,937	893,772
1979	590,374	60,941	651,315
1980	723,482	57,267	780,749
1981	610,244	24,840	635,084
1982	802,673	40,009	842,682
1983	1,003,785	57,520	1,061,305
1984	533,910	67,386	601,296
1985	501,659	84,707	586,366
1986	713,133	99,522	812,655
1987	893,821	63,083	956,904
1988	809,422	52,763	862,185
1989	599,441	36,057	635,498
1990	537,436	56,586	594,022
1991	695,382	87,558	782,940
1992	526,912	86,191	613,103
1993	362,194	58,169	420,363
1994	199,255	60,499	259,754
1995	252,307	43,386	295,693
1996	145,510	53,782	199,292
1997	175,495	47,376	222,871
1998	193,757	50,408	244,165
1999	183,110	38,666	221,776
2000	109,575	28,205	137,780
2001	81,528	41,498	123,026
2002	135,026	48,294	183,320
2003	21,124	54,769	75,893
2004	20,616	38,226	58,842

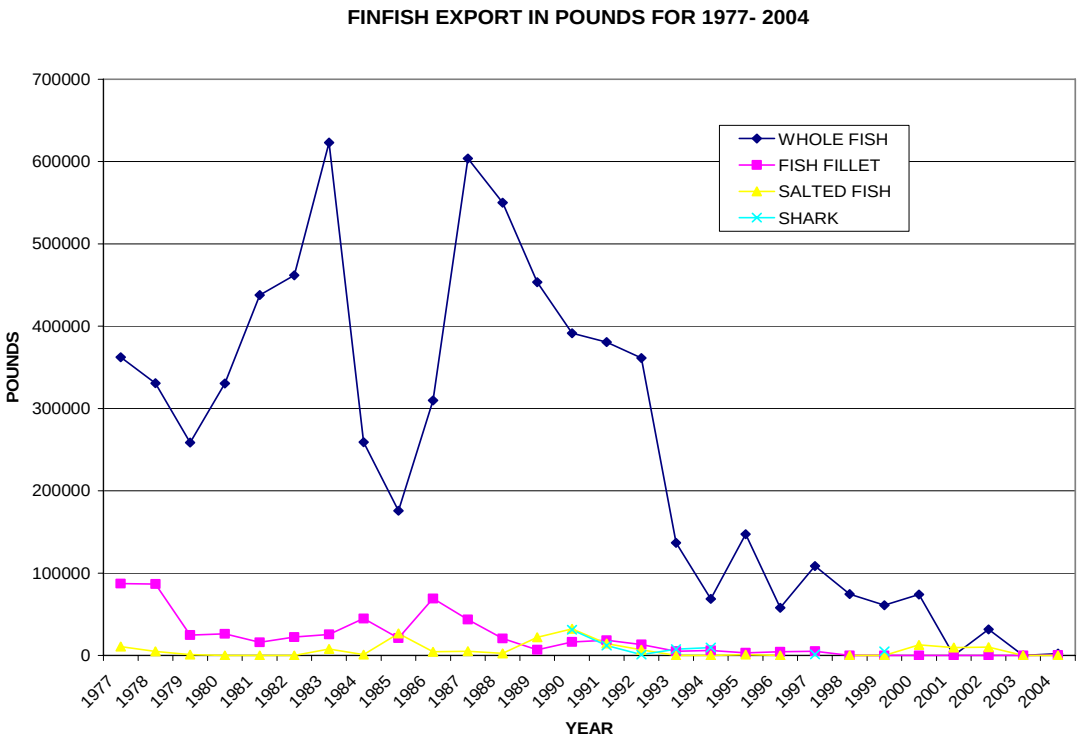
Table 3: Caribeña grouper fillet production in Lbs.

12 Months Ending June 30 Except as Noted	Lbs. Grouper Fillets	Lbs. Delivered in Dec, Jan, Feb	Percentage Delivered in Dec, Jan, Feb
Dec 1973 through June 1974	20,490	17,491	86%
July through June 1975	29,421	12,579	43%
July through June 1976	22,061	7,766	35%
July through June 1977	47,822	35,454	75%
July 1977 through March 1978	44,443	26,353	60%

Table 4: Estimates specific to Nassau Grouper spawning aggreations at Caye Glory

Year	Estimated Nassau Grouper in Aggregation	Estimated Catch during Aggregation	Estimated Fishermen &/or Boats	Source
1944	"countless numbers," unquantified	At any astounding rate	Every available boat	Thompson 1944
1964-65	"astonishing numbers," unquantified	100 short tons	300 boats	Craig 1966
1979		130,000 lbs.		Carter 1988
1984			Fewer than 20 long boats (dugouts)	Carter et al. 1994
1986		<30,000 lbs.	Fewer than 20 long boats (dugouts)	Carter et al. 1991, 1994
1988	15000	<27,000 lbs.		Carter 1988; Carter et al. 1991
1989	"Probably 5000 to 10,000"			Carter 1989
1996		>2000	15 fishermen in 5 longboats (dugouts)	Jacobs 1996
1999	3	< 200 total fish, only a few of whom were Nassau Grouper		Wade 1999
2000	no spawning aggregation		0	Sala & Ballesteros 2000
2001	21	18	5 fishermen from 2 boats boats with 10 fishermen	Paz and Grimshaw 2001
2002	10			Heyman & Requena 2002
2003	1000			SPAG Working Group citing Fisheries Dept.; original data of Fisheries Dept.
2004	1000			SPAG Working Group citing Fisheries Dept.; original data of Fisheries Dept.
2005	350			SPAG Working Group citing Fisheries Dept.; original data of Fisheries Dept.

Chart 1: Finfish export (1977 – 2004)



Source: Villanueva, J. 2004: *Fisheries Statistical Report 2004*. Belize Fisheries Department, Ministry of Agriculture & Fisheries. July 2005

Table 5: Caye Glory fishermen identified

San Pedro	Sarteneja	Caye Caulker	Belize City	Placencia	Dangriga	Hopkins
Acosta, Augusto "Cucho"						
Acosta, Don Víctor "Pitiflor"						
Acosta, Fidencio "Mus"						
Acosta, Florencio "Bosh"	Allen, Jacobo					
Acosta, Manuel "Flit"	Allen, Marcus					
Aguilar, Pedro "Don Pol"						
Alamilla, Adolfo "Palow"	Blanco, "Wado"					
Alamilla, Alfredito "Xkili"	Blanco,"Chemo"					
Alamilla, Alfredo "Fred"	Cansino, Alfonzo "Pancho"					
Alamilla, Anselmo "Senor Slack"	Cantun, Ilario "Cofre"					
Alamilla, Candido "Candich"	Cobb, Grimo					
Alamilla, Edilberto "Morongo"	Cruz, "Polo"					
Alamilla, Eduardo Sr.	Cruz, "Vaso"	Vega, Tony	Karl Cabral	Carlton Young	Alpheus "Buckey" Martin	
Alamilla, Edubijes "Fire ants, Fiance"						
Alamilla, Guadalupe "Pilin"	Cruz, Carlos "Calin"	Vega, Domingo	Rooster	Mr. Patt	Wooly Possium	
Alamilla, José "PoJoe"	Cruz, Luciano "Mex"	Reyes, Nacho	Jack Barrows	Godfrey Leslie	Wild Hog	
Alamilla, Juan "Juancito"	Cruz, Pedro Sr.	Young, Tom Sr.	Jack Cabral	Clarence Lopez		
Alamilla, Luis						
Alamilla, Luis "Abuelo"						
Alamilla, Luis Sr.	Don Piston	Young,Tom Jr.	Phillip Young	Lincohn Eiley		
Alamilla, Miguel "Paña"	Flores, Cresencio "Chencho"	Alamina, Ventura				
Alamilla, Octavio "Tabito" Sr.	Palmero, Luciano "Coqui"	Canto, Pablo				
Alamilla, Octavio "Tabo"						
Alejo, Carlos "Comadre"	Perez, Cuperto "Misha"					
Ancona, Edubijes "Fireants, Fiance"						
Ancona, Manuel	Blanco, "Titi"					

Ancona, Marcelino "Lino"
Aquilar, Jemiliano "Veves"
Arceo, Francisco "Fashico"
Ayuso, Adolfo "Werta"
Ayuso, Félix "Cabezas"
Ayuso, Félix "la mera"
Bardalez, Francisco "Pancho"
Bradley, Andrew
Bradley, Author "Ata"
Bradley, Roberto Sr.
Brown, Eduardo "Toto"
Cardenez, Carmelo "Pepe"
Cardenez, Fermin "Munci"
Cardenez, Guadalupe "Benji"
Cardenez, Marcial "Chalie"
Cardenez, Marcial Sr. "Chalie"
Carlos Alamilla "Poleo"
Castillo, Severo "Keb"
Chan, Alejo
Cocom, Carmen "King"
Cocom, Eluterio "King"
Dawson, Daniel "Borracho"
Dawson, Vincent "Chalecas"
Eiley, John
Forman, Allan
Gómez, Albino "Chinito"
Gómez, Ernesto "Tarzan"
Gómez, Meraldo "Meruch"
Gómez, Priciliano "Nanito"
Gómez, Romel "Millón"
González, Florentino
Perez, Nerio
Samos, Genaro "Yato"
Samos, Pablo
Samos, Reynerio "Churchil"
Santos, Sabino "Brada Sab"
Sosa, Efrain
Tepaz, Lorenzo "Lencho"
Tepaz, Silvero "Chunqui
Tepaz, Jose "Campol"
Verde, "Chino"
Verde, Emilio "Caransa"
Verde, Julian
Verde, Cristino "Tino"

"Yaach"
González, Gil
González, José
"Sabache"
González, Samuel
González, Secun
Graniel, Armando
"Gaman"
Graniel, Baldemar
"Calbo"
Graniel, Erlindo
"Once"
Graniel, Mario Graniel
Graniel, Pedro "Físico"
Graniel, Pedro "Pete"
Graniel, Rosendo
"Chendo"
Graniel, Rosendo
"Papi"
Graniel, Ruperto
"Pelon"
Guerrero, Abel
"Cheveral"
Guerrero, Adriano "El
Mudito"
Guerrero, Dimas Jr.
Guerrero, Dimas Sr.
Guerrero, Donaldo
"Duck"
Guerrero, Efrain
Guerrero, Lucilo "Don
Luz"
Guerrero, Ofel
Guerrero, Orlando
"Manco"
Guerrero, Ovidio
Guerrero, Pablo Sr.
Gutiérrez, Brualio
"Babo"
Gutiérrez, Elias
Gutierrez, Francisco
"Pancho Patas"
Henkis, Fedrick
Henkis, John
Henkis, Virgilio "Bill"
Heredia, Anastacio
Heredia, Leonél
"Chocolate"
Heredia, Manuel Sr.
Jorge Reina
Kumul, Amelio "Xmel"
Lara, Arturo "Tuli"
Manrique, Andres
"Catalan"
Marín, Bartolo
Marín, Mercedes

Marín, Pablito
Meciago
Mendez, Lorenzo
Muñoz, Gonzalo
"Chintina"
Muñoz, Reynaldo Jr.
Muñoz, Reynaldo Sr.
"Candeles"
Netan
Núñez, Alberto "Beto"
Sr.
Núñez, Albeto
"Chonita"
Núñez, Antonio
Nuñez, Apolonio
Nuñez, Cruz
Nuñez, Francisco
"Masca fiero" Pancho
Núñez, Francisco
"Payo"
Nuñez, Genarito
Nuñez, Genaro
Nuñez, Gualberto
"Wally"
Núñez, Guillermo
"Mito"
Núñez, Luis "Chato"
Núñez, Maximiliano
"Mach"
Núñez, Rafael "Raf"
Núñez, Ramon
"Muncho"
Nuñez, Rodolfo
Paz, Algemiro "Milo"
Paz, Felipe "Bufa"
Paz, Jaime "Sapo"
Paz, Seferino
"Bacalin" "Kankic"
Paz, Tatito Tomas
Paz, Tomas "Tampuy"
Pérez, Fernando
"Tintan"
Pérez, Francisco
"Gaby"
Pérez, Jairo "Galento"
Rivero, Antonio "Tony"
Rivero, Carlos
"Mojarita" Calin
Rivero, Cesario
Rivero, Eliezer "Rod"
Rivero, Miguel "Don
Mike"
Rodríguez, Anacleto
"Cleto" "Bug Jones"
Rosado, Inéz "Kiap"
Rosado, Valerio

Salazar Eiden
Salazar Marciano Sr.
Sansorez, Antonio "Capulina"
Sansorez, Emeterio "Met"
Sansorez, Florencio "Colas"
Silva, Justino
Staines, Enrique "Caga"
Tapia, Casirio "Don Cas"
Tapia, Felipe "Senor Tapun"
Tolosa, Aulalio "Lalo"
Tolosa, Manuel "Gaitas"
Tzul, Anastacio "Pigin"
Tzul, Jesus "Japón"
Valdez, Gonzalo "Chalo"
Valdez, Narciso "Chicho"
Valdez, Narciso Sr. "Churchil"
Valencia, Miguel "Beans"
Valencia, Miguel F.
Varela, Leoli
Varela, Ramón "Lalo"
Vera, Hipolito "Kasham"
Verde, Pancho
Victor "Viki"
Villanueva, Espiridion "Espiri"
Villanueva, Tulu