

Brief History of Bermudian Fisheries, and Catch Comparison between National Sources and FAO Records

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ABSTRACT

The purpose of this report is to present a brief overview of the Bermuda fisheries and to adjust the *Sea Around Us* Project (SAUP) catch database to recognize differences between more detailed national datasets and the aggregated data reported to FAO-FISHSTAT. These changes modify the species composition of Bermuda's fisheries catches starting in the mid-1970s, by disaggregating larger categories such as 'miscellaneous reef fish' into smaller taxonomic groupings. Catch records between 1950 and 1970 were adjusted for total catch.

INTRODUCTION

Bermuda, located in the western part of the central North Atlantic (32°17'N, 64°46'W, Figure 1), consists of more than 100 islands (total land area ~ 50 km²), forming the emergent top of a seamount. The remainder of this broad seamount consists of a geological platform of several hundred square kilometers of coral reefs with a lagoon-like area on the central platform. Bermuda is the most northerly location of reef building corals and coral-algal reefs in the western Atlantic Ocean. Bermuda, and offshore banks less than 200 m in depth, including Argus and the Challenger Banks, provide a total fisheries area of approximately 1,000 km² (Butler *et al.* 1993).

Fisheries

The fisheries of Bermuda are primarily for local consumption and may be classed as artisanal, although technologically advanced. Historically, fishers have accessed shallow inshore waters and have targeted mainly reef fishes, with serranids (groupers) dominating the catch. Traditionally, groupers were marketed to hotels and restaurants. As serranids became depleted in the late 1970s, and in line with correspondingly tightened regulations, efforts shifted first to deeper waters, primarily targeting two species of lutjanids, *Etelis oculatus* and *Pristipomoides macrophthalmus* (Luckhurst, 1996). As this fishery was rapidly depleted, fishing effort shifted more to pelagic species.

Throughout its history Bermuda has used various mechanisms to attempt to limit fishing effort, including gear restrictions, size and weight limits, temporal closures, restricted access to spawning sites and implementation of no-take zones. The earliest conservation measure to limit the effects of fishing pressure was for the protection of juvenile green turtles. This measure, introduced in 1620, is believed to be the first marine conservation/fisheries legislation in the New World. The most recent significant management measures were implemented in 1990 (Table 1) and there are new licensing and management measures pending. Thus, fisheries in Bermuda have been under some form of control for nearly 400 years, yet these restrictions seem to have had only limited success in protecting the resources. More effective enforcement in the past five years has helped to stabilize the fishery and consequent landings.

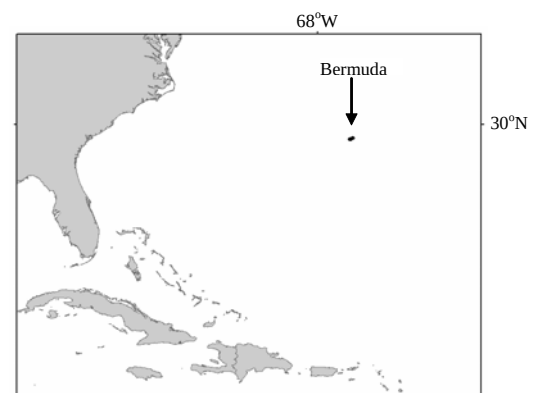


Figure 1: Location of Bermuda in the central North Atlantic Ocean.

Table 1: Time sequence for limiting fishing effort on particular stocks in Bermuda from 1620-1996 (Source: Smith-Vaniz *et al.* 1999).

Year	Regulation
1620	Restrictions on turtles (shell size limit >18 inches, approximately 46 cm), and on using pilchards and fry for use in oil production (to ensure a supply of bait fishes).
1627	Limit on net length (18 m) for the taking of small fishes.
1677	Restriction against the taking of porgy (<i>Calamus calamus</i>) during spawning in April or May except for personal consumption.
1687	Legislation set limits on certain types of fishing gear.
1703	Further limiting of net length for hauling of fish to 5.5 m.
1791	Ban on setting fish pots.
1891	Mesh size limits, preventing the harvesting of oysters and scallops during summer months, new turtle size limit by weight (4.5 kg), minimum weight restrictions for rockfish (Serranidae or <i>Mycteroperca</i> spp.), hogfish (<i>Lachnolaimus maximus</i>), Nassau grouper (<i>Epinephelus striatus</i>) and porgies (<i>Calamus</i> spp., Sparidae) as well as size limits on mullets (<i>Mugil</i> spp.), yellow grunts (<i>Haemulon flavolineatum</i>), breems (<i>Diplodus bermudensis</i> (Sparidae) and chubs (Kyphosidae).
1911	Fish preserve in Harrington Sound (banned fish pots and nets except casting nets by special permit).
1912	Fisheries Act made provisions to enable: the restriction or prohibition of the taking of any species of fish, closing specified areas to fishing, designating minimum sizes, restricting the use of fish pots and nets, and prescribing the duties of the fisheries warden as well as provisions made for a fish hatchery to stock Harrington Sound.
1972	Fisheries Act and Regulations. Restrictions on fish pot use for commercial fishing only, while non-commercial fishers were allowed a maximum of two pots with an application, vessels and fishers to be licensed annually.
1973	Turtle fishery closed after 360 years of operation in local waters.
1974	Spawning sites of red-hind (<i>Epinephelus guttatus</i>) designated as seasonally protected areas.
1980	Moratorium on any new fish pots being licensed.
1982	Moratorium on issuance of new fishing vessel licenses (only transference).
1984	Fish pots limited to full-time fishers only (minimum of 100 days at sea).
1987-1990	Planned reduction in the number of fish pots (3200 to 1600).
1990	Fish pot fishery closed.
1995	Six species of grouper fully protected - no take, no possession
1996	Minimum sizes introduced for 3 grouper species and 2 snapper species, recreational bag limit - lane snapper, minimum sizes - bluefin tuna and swordfish

In 1962, the Government sponsored a freezing facility to store surplus fish caught in summer in order to market them in the winter when landings decreased (Smith-Vaniz *et al.* 1999). In order to meet the growing demand in a period with declining landings of groupers, fishers began to target other 'white meat' species such as snappers and other reef fishes including parrotfish (Scaridae). In the 1950s groupers comprised up to 90% by number of all reef fish caught in fish pots (Bardach 1958 in Smith-Vaniz *et al.* 1999), whereas by 1989 groupers accounted for only 19% of food fish catch (Luckhurst and Ward, 1996).

In response to the changing state of the reef fish communities, the Government initiated a marine protected areas (MPA) strategy beginning in the 1970s. Initially, two seasonally protected areas were declared based on the spawning aggregation sites of red hinds (Luckhurst, in press). Over the past 15 years, a total of 29 no-take MPAs have been created around the reef platform, based primarily on popular dive sites. A

moratorium was placed on the introduction of new fish pot licenses (the primary fishing gear at the time) in 1980, followed by a 1982 moratorium on the issuance of new fishing vessel licenses, although the transferring of licenses was allowed (Smith-Vaniz *et al.* 1999, Table 1).

A limited entry fish post fishery was established in 1986 but despite these regulations, reef fish populations continued to decline. The Government introduced a three-year plan (1987-1990) to reduce the number of fish pots by half, from 3,200 to 1,600. However in 1990, prior to the completion of the program, it was decided to ban the use of fish pots altogether. The fish pot ban was meant to help restore populations of reef fishes for non-consumptive uses (big and colorful reef fish are major tourist attractions). Interestingly, the first ban on fish pots was introduced in 1791, but did not meet with popular approval (Smith-Vaniz *et al.* 1999). The fish pot ban in 1990 displaced fishers who in turn targeted other fishes including deep-water snappers

(Lutjanidae, *Etelis oculatus* and *Pristopomoides macrophthalmus*) and pelagic species, such as wahoo (*Acanthocybium solandri*) and tunas (Scombridae). The deep-water snapper stocks were depleted rapidly within two years (Luckhurst, 1996). However, the two deep-water snapper species appear periodically in catches, primarily as a result of pulse fishing (Figure 2).

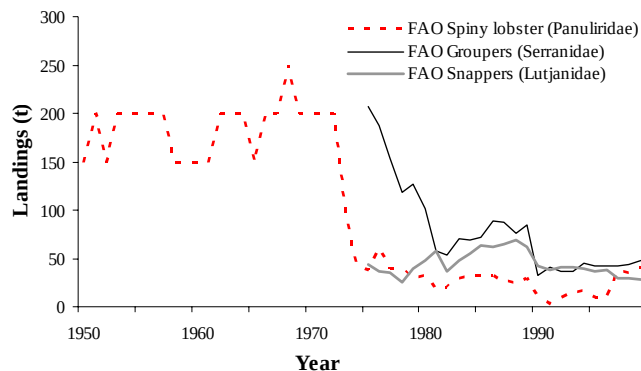


Figure 2: Landings of Spiny lobsters (1950-1999), Groupers and Snappers (1975-1999). Source: FAO-FISHSTAT.

Available records of fishing effort concentrated on the number of fishers estimated to be employed, the size of vessels and the h.p. of motors for the time period 1950-1962. For the time period 1963-1970 the records of the fleet concentrated on the number of registered fish pot fishers and on the number of fish pots used (Table 2). With the advent of the Fisheries Act, 1972, a statistical monitoring system was established to collect more detailed information on the catch and effort from the commercial fishery. Mandatory reporting by licensed fishers provided more detailed information on the species taken as well as fishing effort. The principal measure of fishing effort for the Bermuda commercial fishing fleet starting in 1975 is hours at sea. The effort measure for fixed gear is number of trap hauls. Since the fish pot ban in 1990, this measure continues to be collected for the spiny lobster fishery where licensed fishers use a Government standard trap (Luckhurst, 2001).

Tourism and Resident Population

Bermuda, a British Crown colony, was claimed and permanently colonized in 1612. In 1700 the population for the island was

estimated to be 4,000 inhabitants (Smith-Vaniz *et al.* 1999) and by 2000 the population had grown to 63,022 (www.os-connect.com/pop, Figure 3).

The major factor driving local fisheries is the number of tourists who visit the island, as the growth in the tourism industry significantly increased demand for local fish. Tourism started to expand rapidly after 1950, as reflected by the growth in visitor days per year. Visitor days per year was over 440,000 in 1950, peaked in 1980 at over 3,175,000 and then started to decline so that by 1995 visitor days per year were 1,675,000 (Figure 3). After 1970, these numbers reflect only visitors who arrived by air and not by cruise ship. It is assumed that cruise passengers would have a lower impact on Bermudian fishery resources since a large proportion of cruise passengers would be eating aboard and most cruise ships would not take on provisions in Bermuda. From the 1950s to the 1970s the average stay by visitors was 6 days and 7 nights (Anon. 1950-1970), and it was here assumed that this average stay for visitors was also applicable in later years for those arriving by air. The percentage of visitors who arrived by air in 1995 (i.e., 67%, Archer 1995) was also assumed to be the same percentage as that in 1993.

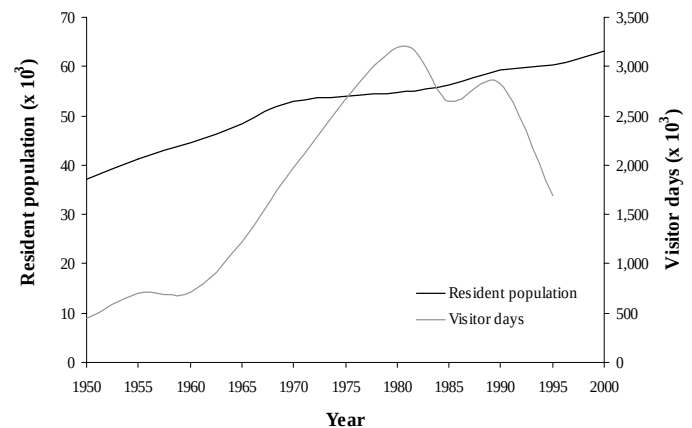
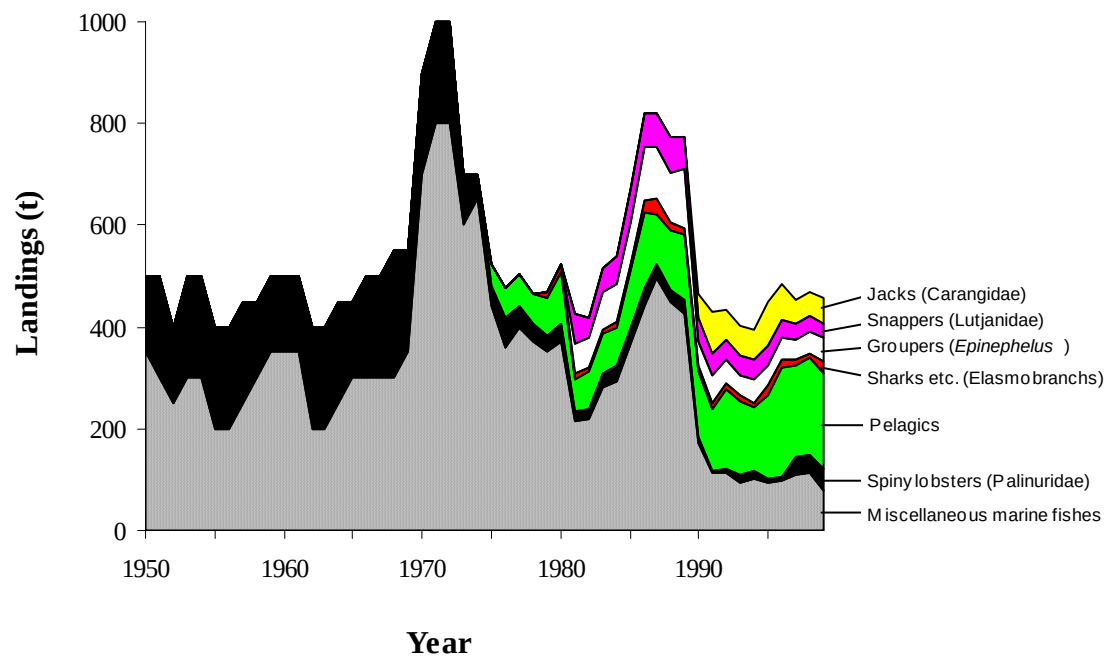


Figure 3: Resident population of Bermuda and the number of visitor days year⁻¹ for the time period 1950-2000. Visitor days year⁻¹ are included until 1995 only as more recent data was not available. Visitor days were calculated using an average of 6 days and 7 nights (6.5 days) per visitor for the 1950-1970 period, the same average was used in later years for passengers arriving by air only.

Table 2: Historical data on fishing fleet 1950-1970. (Source: Bermuda Reports for relevant years; n/a = not available).

Year	Number of fishers	Number/Size of boats	Registered fishers	Number of fish pots	Estimated Total Catch (tonnes)	
					Fish	Lobster
1950	100 full-time	50-60 boats/16 ft rowboat to 45 foot power boat	n/a	n/a	404	64
1951/52	100 full-time	n/a	n/a	n/a	399/ 386	64/64
1953/54	100 full-time	60 boats/16 ft rowboat to 50 ft power boat	n/a	n/a	431/454	68/64
1955/56	130 full-time	52/n/a	n/a	n/a	544/567	64/64
1957/58	130 full-time	53 boats/only 3 over 30 ft in length	n/a	n/a	572/637	64/61
1959/60	130 full-time	58 boats/average length of 28 ft	n/a	n/a	624 (1960)	n/a
1961/62	170 full-time and part-time	90 boats/ between 12 and 60 ft (50% between 20-29 ft with inboard motor average of 43 h.p.; 25% between 30-50 ft with motor average of 109h.p.)	n/a	n/a	612 (1962)	64 (1962)
1964	n/a	n/a	480 (100 of which are amateurs)	5400	n/a	n/a
1966	n/a	393	572 (58 of which are amateurs)	n/a	n/a	n/a
1967	100 full-time	n/a	530 (91 of which don't use fish pots)	6750	658	n/a
1968	100 full-time	n/a	535 (90 of which don't use fish pots)	6850	658	n/a
1969	100 full-time	n/a	556 (87 of which don't use fish pots)	7000	658	64
1970	100 full-time	n/a	556 (87 of which don't use fish pots)	7000	658	64

(a)



(b)

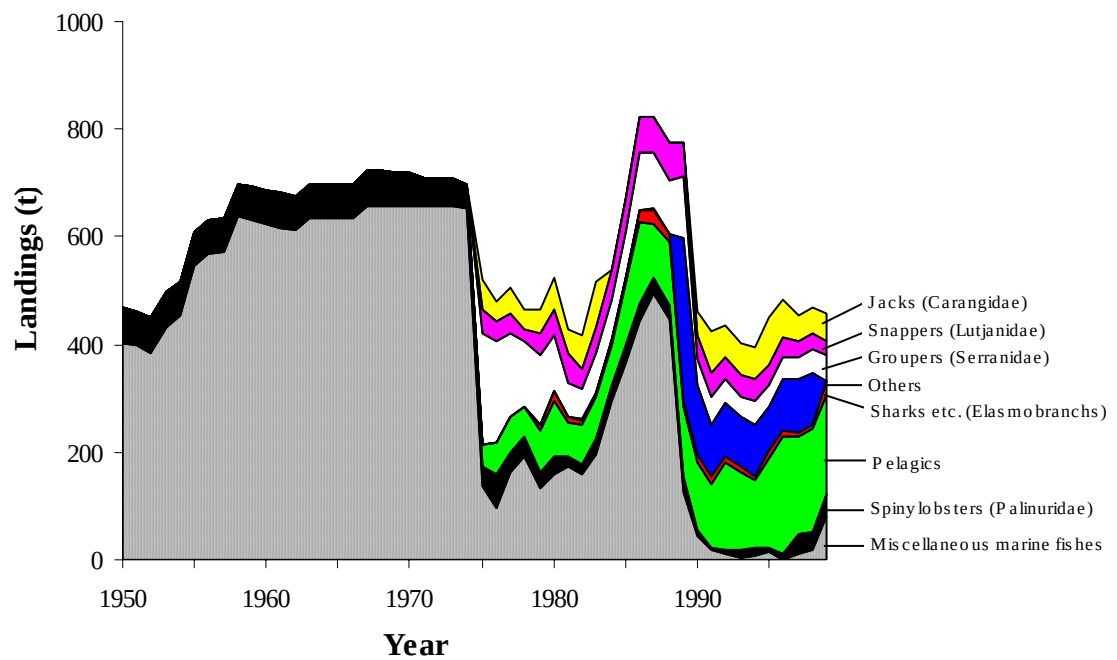


Figure 4: Bermudian landings as based on (a) the FAO FISHSTAT database and (b) the SAUP database (adjusted FAO data).

Fisheries Catches and Database Adjustments

The average annual landings ($\pm$ SE) as reported by FAO for the time period 1950-1999 were 537 tonnes ($\pm$ 22). Two peaks in landings of 1,000 tonnes and approximately 800 tonnes are reported for the early 1970s and late 1980s, respectively (Figure 4a). While some groups, such as the lutjanids (other than the two deep-water snappers previously mentioned), display little sign of decline in catches in the FAO database, others, such as groupers (Serranidae) and spiny lobsters (*Panulirus argus*), have had landings decline drastically from historical levels (Figure 2).

Prior to 1975, FAO-FISHSTAT landings for Bermuda were reported in only two groups, 'marine fishes nei' (miscellaneous marine fishes) and Caribbean spiny lobster (*Panulirus argus*, Figure 4a). In 1975, FAO landings started to include 'large pelagics' (tunas, wahoo & marlins) and in 1979 'Elasmobranchs' were added. Since 1981, both Groupers (reported as *Epinephelus* only) and Snappers (reported as Lutjanidae) became listed, and Carangidae were first reported in 1990 (Figure 4a).

Landings in the *Sea Around Us* Project database were modified from the FAO-

FISHSTAT landings data to reflect adjustments and changes in taxonomic groupings reported by the British Colonial Office's Bermuda Reports published between 1950 and 1970 (Anon. 1950-1970), the Western Central Atlantic Fishery Commission (WECAFC 1985), Luckhurst (1996) and Anon. (1999). Landings were updated for the period 1950 to 1998.

Data from Luckhurst (1996) and WECAFC (1985) overlapped for both the reporting period and taxonomic breakdowns. The former source reports on landings from 1975-1992 and the latter reports on periods from 1975-1983. Additional data supplied by Anon. (1999) was for the period 1989-1998. Data taken from the Bermuda Reports adjusts the landings reported for the time period 1950-1970 (Anon. 1950-1970). The estimated landings in the Bermuda Reports differ from those reported by FAO, as the estimated landings for spiny lobsters are considerably lower while those for miscellaneous marine fishes are considerably higher. These reported values change the trajectory of these two groups. The landings for spiny lobsters do not show the significant decline in catches, and the miscellaneous marine fishes make up a larger proportion of total catches (Figure 5).

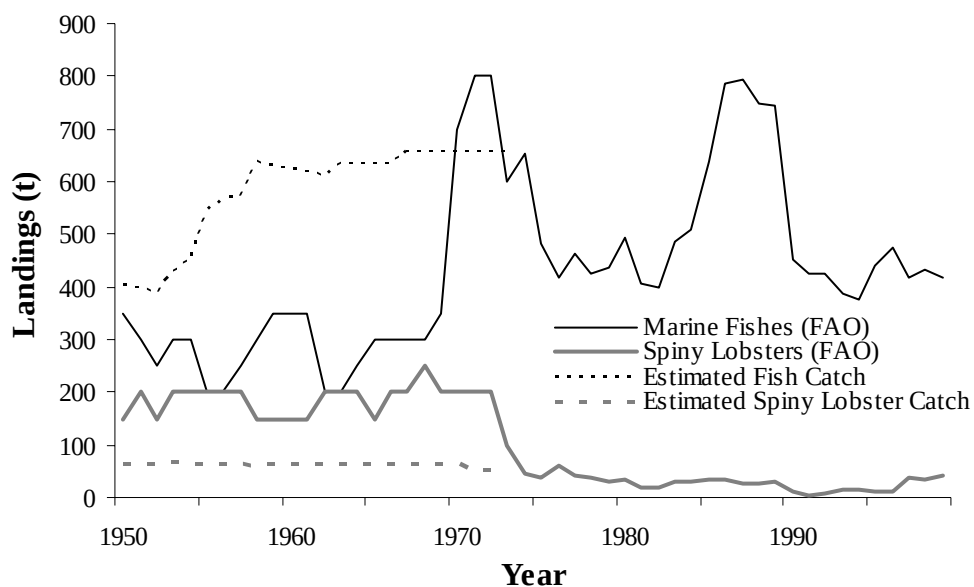


Figure 5: Landings of spiny lobsters and marine fishes for the period 1950-1998. Dashed lines represent the estimated catches as per the Bermuda Reports (Anon. 1950-1970).

For the period 1984-1998 the new data improve the species breakdown within the Lutjanidae and *Epinephelus* groups, by assigning landings, where possible, to the species level. For other years the data decrease the component of 'miscellaneous marine fishes' by reassigning these landings into lower taxonomic groupings at the family, genus or species level. In the case of the Lutjanidae, the FAO landings were separated into genus and species levels with a remaining component at the family level (Lutjanidae). FAO-FISHSTAT landings for groupers (Serranidae) were adjusted to reflect genus and species groups. However, for 1990-1992 the remaining amounts were assigned to the family level (Serranidae) to reflect proper taxonomic groupings (Figure 4b).

In summary, adjusted fisheries catches for Bermudian waters have shown a decline from the 1970s and 1985 peaks in landings. However, more recent years show an increase in landings mainly driven by increasing landings of pelagics (Figure 4b). A marked shift in target species composition driven by management action in response to observed depletions has occurred throughout the 1980s and 1990s. The present study has contributed to improved taxonomic accounting of catches and some corrections of historic catches by Bermudian fishers.

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REFERENCES

- Anon. 1950-1970. The Bermuda Report. London, H.M. Stationery Office. Numerous Volumes.
- Anon. 1999. Annual Report 1999, Department of Agriculture and Fisheries, Bermuda Government, 61 pp.
- Archer, B. 1995. The Importance of Tourism for the Economy of Bermuda. *Annals of Tourism Research* 22(4): 918-930.
- Butler, J.N., Burnett-Herkes, J., Barnes, J.A., Ward, J. 1993. The Bermuda Fisheries: A Tragedy of the Commons Averted? *Environment* 35(1): 7-15, 25-33.
- Luckhurst, B.E. 1996. Trends in Commercial Fishery Landings of Groupers and Snappers in Bermuda from 1975 to 1992 and Associated Fishery Management Issues, pp. 277-288. In: F. Arreguin-Sanchez, J.L.

- Munro, M.C. Balgos and D. Pauly (eds.) Biology, Fisheries and Culture of Tropical Groupers and Snappers. ICLARM Conf. Proc. 48.
- Luckhurst, B.E. 2001. National Report of Bermuda, pp. 175 -178. In: FAO / Western Central Atlantic Fishery Commission. Report on the FAO/ DANIDA/ CFRAMP/WECAFC Regional Workshop on the Assessment of the Caribbean Spiny Lobster (*Panulirus argus*). FAO Fisheries Report No. 619. Rome, FAO.
- Luckhurst, B.E. in press. Current status of conservation and management of reef fish spawning aggregations in the greater Caribbean. *Proc. Gulf Caribb. Fish. Inst.* 55.
- Luckhurst, B.E. and Ward, J.A. 1996. Analysis of trends in Bermuda's fishery statistical database from 1975 to 1990 with reference to fishery management measures implemented during this period. *Proc. Gulf Caribb. Fish. Inst.* 44: 306 - 324.
- Smith-Vaniz, W., Collette, B.B., and Luckhurst, B.E. 1999. Fisheries of Bermuda: History, Zoogeography, Annotated Checklist and Identification Keys. American Society of Ichthyologists and Herpetologists Special Publication 4: 424 pp.
- WECAFC 1985. National Reports and Selected Papers Presented at the Fourth Session of the Working Party on Assessment of Marine Fishery Resources. Paipa, Department of Boyaca, Colombia, 29 October-November, 1984. FAO Fish. Rep. (327) Suppl.: 290 pp.