Island of hope for the threatened Nassau grouper

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In January 1971, a young biologist braved strong currents to dive on a massive spawning aggregation (gathering of reproductive adults) of Nassau grouper (family Epinephelidae) at Cat Cay in The Bahamas. The paper he published was the first-ever eye-witness account in the scientific literature describing a spectacular gathering of 30,000 to 100,000 large adult Nassau grouper (*Epinephelus striatus*) preparing to spawn (1). Historically, this grouper was among the most important fishery species in the tropical western Atlantic, with earlier accounts also documenting abundance during its reproductive season (2–6). In 2003, barely 30 y after Lavett-Smith's (1) account, the species was listed as threatened on the International Union for Conservation of Nature (IUCN) Red List. By 2016 it was included on the United States Endangered Species List and in 2017 was added to Annex III of the Specially Protected Areas and Wildlife (SPAW) protocol. All listings were unusual for a commercial reef fish and highlighted the growing crisis for this iconic species brought about by uncontrolled fishing on its spawning aggregations and a many-hundredfold decline in production from historic levels.

The Nassau grouper occurs in about 40 countries/overseas territories and reproduces only in its spawning aggregations. These have long been a focus of fishing because of their high predictability. Due to overfishing and despite multiple management attempts, more than 30 of at least 50 known aggregations across its range have disappeared, including the one at Cat Cay described by Lavett-Smith (7, 8). Fish numbers in most remaining exploited aggregations continue to decline or have failed to recover (9–11). Hence, the Waterhouse et al. (12) study is of much greater significance than is at first apparent. Far more than a profile of recovery of just one aggregation (possibly two) of one species in one country, the 15-y initiative that resulted in a threefold increase in numbers of Nassau grouper in Little Cayman demonstrates that recovery is possible and identifies a framework for action to save this threatened species.

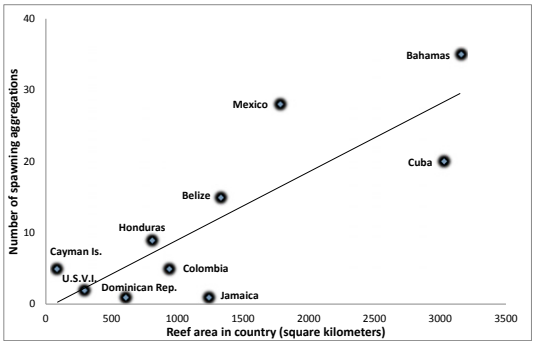

Fig. 1. Data from refs. 10, 11, 14, 15, 18, 19, and personal communications from Rodolfo Claro (Instituto de Oceanología de Cuba, Havana, Cuba) and Alfonso Aguilar-Perera (Universidad Autonoma de Yucatán, Mérida, Mexico). Coral reef areas data from refs. 20, 21, and personal communications from Brice Semmens (Scripps Institution of Oceanography, La Jolla, CA).

Many important reef fishes form spawning aggregations and, as for the Nassau grouper, are easily overexploited. With hundreds, thousands, or even tens of thousands of fish gathering briefly and predictably each year, these reproductive gatherings, once discovered, understandably, usually become "fishing seasons." At low levels of fishing pressure and with fish taken just for subsistence, aggregations persisted. But, as the small coastal fisheries of the region became increasingly commercialized and fishing technology improved, and with management weak or absent, aggregation fisheries soon began taking their toll. Starting in the late 1970s to 1980s, one by one Nassau grouper landings across the region plummeted (5, 13–15).

Nassau grouper spawning aggregation sites can be easy to target for fishing but difficult to protect and challenging to study. Most are located at the edges of coastal platforms, adjacent to the open ocean, limiting access for shore-based fishery officers with weak enforcement capability. Large catches of many tons of fish in a single day from a single site continued under heavy fishing but the underlying population

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declines were masked by "hyperstability" (whereby catch rates remain stable despite population declines). This "delusion of plenty," despite serious and ongoing declines, made it difficult to build a compelling case for management based on fishery catches, despite imminent collapse, and the declines continued. Many aggregations are also challenging to study underwater for they form briefly, often where currents are strong and at the depth limits of scuba divers. Just prior to spawning when fish counts are best made, the Nassau grouper can form large dynamic three-dimensional balls, the quantifying of which is akin to counting individuals in a large massed flock of birds. Given the short duration of annual aggregations and challenging field conditions, opportunities to make representative fish counts each year are extremely limited.

The Cayman Island aggregation site protection profiled by Waterhouse et al. (12), when considered in a wider context of multiple conservation and management efforts for this threatened species elsewhere, lays out a science-based blueprint for success. Clear and consistent management objectives, supported over a time span suited to this species (the Nassau grouper can live almost 3 decades, reach 1.2 m, and take 4 to 5 y to mature) (8), combined with measures introduced at the appropriate temporal and spatial scales to protect spawning fish, set the stage for recovery. Commitment by the Cayman Islands government, based on information collected through long-term collaborations between government staff and fishers, NGOs, and academics, focused on a common goal and ensured the introduction and support of suitable management measures. Fisher and community understanding, developed through multiple educational initiatives, encouraged compliance and supported enforcement. The development of innovative methods to document numbers of aggregated fish provided evidence of recovery, prompting ongoing protection.

Lessons learned from the Cayman Islands commitment are applicable in other countries where the Nassau grouper was once plentiful, most notably across the large shallow coastal platforms of The Bahamas, Belize, Mexico, Cuba, and Honduras (Fig. 1). Given the need to focus considerable efforts and funds to safeguard individual aggregations, in addition to other national-level measures and harmonized regional protection during the 4-mo spawning season, management should seek to protect at least 40% of remaining viable aggregations in each country. This fishery reference point, based on the "spawning potential ratio," is designed to safeguard a sufficient proportion of the unfished biomass of adult fish, taking account of the biology of the species, and was adopted by many fisheries authorities to safeguard reproductive capacity (16, 17). While some of the important range countries for the species already have seasonal and/or spatial closures and other management measures in place, illegal fishing and poor enforcement undermine these efforts and the need to strengthen government commitment to save the species and the benefits it supports is clear. A Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES) Appendix II listing to control international trade may also be warranted.

Nassau grouper spawning aggregations are dramatic wildlife spectacles and were once the largest such gatherings ever reported among large reef fishes, globally. Far more than just targets for fishing, they are important for producing the fish caught at other times and places by fishers who do not have access to aggregation sites. In some areas, they support dive tourism. Indeed, the nonextractive value can be 20 times that of removing the spawners (6). These fragile life-history events are savable, with the Little Cayman spawning aggregation now the largest one currently known for this species, and merit the attention and commitment needed to preserve them and to ensure the future of the Nassau grouper.

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