

Tracking Potential Larval Dispersal Patterns from Nassau grouper Aggregation Sites: Evidence for Local Retention and the “Importance of Place”

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ABSTRACT

Nassau grouper spawn in large aggregations at specific locations 1-3 times each winter. The fate of the larvae between birth and the time they settle out is virtually unknown, yet the location of the aggregation site itself must be important in determining their fate. In order to investigate the “importance of place” for aggregation-spawning species, during the winter of 2008 we deployed Surface Velocity Profile drifters at the Nassau grouper spawning aggregation site on Little Cayman Island. A single drifter was deployed each night for five nights following the January full moon, then subsequently recovered after 12 hours to determine initial trajectory paths. On the 6th night, when peak spawning was observed, three drifters were deployed simultaneously and tracked for 35 days. The drifters released on the night of spawning showed substantial eddy formation near the aggregation site, in contrast to the largely linear paths taken on nights prior to spawning. This suggests an oceanographic-based “importance of place” for the aggregation site that may result in local recruitment. This would mean that local aggregations of fish are directly responsible for the long-term survival of local populations. We plan to continue our work in 2009. This work will give substantial credence to the need to protect specific locations because they are unique and critical to the long-term survival of the many species that aggregate there, including the important and endangered Nassau grouper.

KEY WORDS: Nassau grouper, spawning, dispersal, satellite drifters

El Seguimiento de Patrones Larvales Potenciales de la Dispersión de la Agregación del Mero de Nassau Localiza: ¿ Evidencia de la Retención Local?

La freza del mero de Nassau en agregaciones grandes en las localizaciones específicas 1-3 mide el tiempo de cada invierno. El sino de las larvas entre el nacimiento y el tiempo que deciden es virtualmente desconocido, con todo la localización del sitio de la agregación sí mismo debe ser importante en la determinación de su sino. Para investigar la “importancia del lugar” para la especie de agregación-freza, durante el invierno de 2008 desplegamos las traineras superficiales del perfil de la velocidad en el mero de Nassau que frezaba el sitio de la agregación en la pequeña isla del caimán. Una sola trainera fue desplegada cada noche por 5 noches que seguían la Luna Llena de enero, después recuperada después de 12 horas para determinar las trayectorias iniciales de la trayectoria. En la 6ta noche, cuando la freza del pico fue observada, tres traineras fueron desplegadas simultáneamente y seguidas por 35 días. En contraste con las trayectorias adquiridas noches antes de la freza, las traineras lanzadas en la freza del pico demostraron la formación substancial del remolino cerca del sitio de la agregación. Esto sugiere una “importancia oceanográfico-basada del lugar” para el sitio de la agregación que puede dar lugar al reclutamiento local. Esto significaría que las agregaciones locales de pescados son directamente responsables de la supervivencia de largo plazo de poblaciones locales. Planeamos continuar nuestro trabajo en 2009 en la pequeña isla del caimán, pero propondremos más importantemente el organizar de un lanzamiento multinacional, Del Caribe-ancho, coordinado de las traineras del SVP para evaluar patrones lavabo-anchos en transporte larval de sitios conocidos de la agregación. Esto dará crédito substancial a la necesidad de proteger localizaciones específicas porque son únicas y críticas a la supervivencia de largo plazo de las muchas especies que agregan allí.

PALABRAS CLAVES: Mero de Nassau, frezando, dispersión, basadas en los satellites

Le Cheminement des Modèles Larvaires Potentiels de Dispersión de L’agregation de Mérou de Nassau Situé: Évidence pour la Conservation Locale?

Le frai de mérou de Nassau dans de grandes agrégations aux endroits spécifiques 1-3 chronomètre chaque hiver. Le destin des larves entre la naissance et le moment où elles se précipitent est pratiquement inconnu, pourtant l’endroit de l’emplacement d’agrégation lui-même doit être important en déterminant leur destin. Afin d’étudier la « importance de l’endroit » pour des espèces de agrégation-frai, pendant l’hiver de 2008 nous avons déployé les pêcheurs extérieurs de profil de vitesse au mérou de Nassau engendrant l’emplacement d’agrégation sur la petite île de caïman. Un pêcheur simple a été déployé chaque nuit pendant 5 nuits suivant la pleine lune de janvier, puis récupéré après 12 heures pour déterminer les chemins initiaux de trajectoire. La 6ème nuit, quand on a observé le frai de crête, trois pêcheurs ont été déployés simultanément et dépistés pendant 35 jours. Contrairement aux chemins pris des nuits avant d’engendrer, les pêcheurs libérés au frai de crête ont montré la formation substantielle de remous près de l’emplacement d’agrégation. Ceci suggère une « importance océanographique-basée d’endroit » pour l’emplacement d’agrégation qui peut avoir comme conséquence le recrutement local.

Ceci signifierait que les agrégations locales des poissons sont directement responsables de la survie à long terme des populations locales. Nous prévoyons de continuer notre travail en 2009 sur la petite île de caïman, mais d'une manière primordiale nous proposerons d'organiser un dégagement multinational. Des Caraïbes-large, coordonné des pêcheurs de SVP pour évaluer les modèles bassin-larges dans le transport larvaire des emplacements connus d'agrégation. Ceci donnera la créance substantielle à la nécessité de protéger des endroits spécifiques parce qu'ils sont uniques et critiques à la survie à long terme des nombreuses espèces qui agrègent là.

MOTS CLÉS: Mérou de Nassau, engendrant, dispersion, pêcheurs satellites

BACKGROUND

Nassau grouper aren't just icons of the Caribbean—they are a social and ecological cornerstone of the region's coral reefs. Reports from the 19th century describe Nassau grouper as an abundant species on Caribbean reefs and a critically-important component of commercial fisheries. By the 1990s, the number of Nassau grouper had dropped so significantly that they became the first Caribbean reef fish to be listed as endangered by the International Union for the Conservation of Nature (IUCN). In Bermuda and the United States, harvest of Nassau grouper has been completely prohibited for more than two decades in an attempt to recover the species; unfortunately without any sign of recovery. As stocks continue to dwindle throughout the Caribbean and southeast Atlantic, managers are in desperate need of a new approach for the conservation of this critically important species. With our work in the Cayman Islands we have provided both the scientific basis to justify Nassau spawning aggregation protections and the data to demonstrate that they can work if governments make swift and decisive decisions to protect this important natural resource.

Five years ago, in response to what they identified as a critical conservation need, the Cayman Islands government protected all known Nassau grouper spawning sites in the Cayman Islands. This watershed event was motivated by the 2001 discovery and subsequent fishing-induced rapid depletion of a large (~7000 fish) spawning aggregation on the west end of Little Cayman Island. The government's rapid legislative response, driven in part by the results of a potent collaboration between the Cayman Islands Department of Environment (CIDOE) and the Reef Environmental Education Foundation (REEF), protected the last functional Nassau grouper aggregation left in the Cayman Islands, before all the fish were taken. The west-end site is now home to one of the largest fully-protected spawning aggregations left in the entire Caribbean, and works to preserve this endangered, economically and ecologically important reef fish. It should be noted, however, that the Cayman Islands spawning site protections were established under a 'sunset' provision, and their effectiveness must be demonstrated in the years leading up to 2011 or they will be revoked. The 8-year ban on fishing Cayman aggrega-

tions was enacted with the understanding that any extension to this ban would be contingent on a comprehensive assessment of the status of the Cayman Island's Nassau grouper spawning population. For our work this entails describing the spatial ecology of adult Nassau grouper and, more specifically aggregation site usage as a function of demography, as well as understanding the reproductive output from this aggregation. Integrating both adult and offspring components will be important to the comprehensive assessment of the fishing ban protections and the decision making process for management of reserves of the Cayman Islands and elsewhere.

At the beginning of this process, the Grouper Moon Project, a cooperative research and monitoring program between CIDOE and REEF, provided the aggregation monitoring and fisheries statistics and analysis that motivated the legislative decision. Following the enactment of the new law, the Grouper Moon Project focused on efforts aimed at demonstrating the efficacy of the aggregation-site no-take legislation and in documenting recovery of the aggregation. Since 2002, Grouper Moon researchers have:

- i) Carried out a multi-year electronic tagging project on Little Cayman island that tracks the movements of adult grouper as they migrate to and from the aggregation site,
- ii) Developed and currently maintain a fisheries-independent monitoring program that tracks spawning frequency, changes in observed abundance on the aggregation site, and shifts in the size distribution of spawning adults, and
- iii) The subject of this talk, have recently started tracking potential larval dispersal patterns from the spawning aggregation. This dispersal work is designed to evaluate local larval retention and identify why multiple species aggregate in a specific location each winter full moon (up to 22 other species of fish use this exact same location to spawn during the winter full moon) –what we call “the importance of place”.

All of this work is performed with the overall goal of establishing the role that spawning aggregations play in the population dynamics of Nassau grouper and that protecting the Nassau grouper spawning aggregations in the Cayman Islands can lead to protection and recovery of this species.

RESEARCH

Our tracking of adults has demonstrated the surprisingly insular influence of the spawning site; all fish attending the west end Little Cayman spawning site are from the Island of Little Cayman. Additionally, our research shows that all reproductive aged fish from the island attend the aggregation each year. Put simply, the tracking research clearly demonstrates that the sum total of Nassau grouper spawning stock on Little Cayman is

concentrated into a tiny piece of ocean each winter, making them extremely vulnerable to exploitation during this time. This has in fact been the downfall of Nassau throughout their entire range.

Now that we understand the spatial ecology of adults at the spawning aggregation site, we are working to identify the connectivity of the system with regard to larval output and local recruitment. There is evidence that even within open ocean systems there can be a substantial amount of local larval retention. This means that local adults may be crucial to the long-term sustainability of local populations, counter to the sometimes proposed concept that larvae are transported in from other locations and therefore local adults are not important for local recruitment. In spite of the importance of this recruitment work, this concept has not been tested within the Cayman Islands, nor has it to our knowledge been tested anywhere specifically for grouper aggregations.

In late January 2008, we released a single Pacific Gyre Surface Velocity Profile (SVP) drifter at the west end of Little Cayman Island, directly over the aggregation site, on each of the six nights prior to Nassau grouper spawning, and recovered it on each of the following mornings. We then released three drifters on the night we observed peak spawning, allowed these drifters to move freely with the currents, and tracked them for a subsequent 30 days. For the six nights prior to spawning, the SVP drifter would move in a more or less linear or slightly curvilinear manner for the 12 hours it was at liberty. Following the night of spawning, however, instead of a linear path, all three drifters entered an eddy loop and spun in a counter-clockwise direction for almost three days as they moved slowly southeast of the island. Formation of eddies near the edge of the continental shelf has been postulated as the means by which larvae are retained near the areas where they are spawned. By the end of the 30 days at large, the drifters had made a large excursion south towards the Jamaican shelf, turned around when they encountered the Nicaraguan rise, and returned to the same latitude as that of their release off the east end of Cayman Brac.

Overall, these results indicate:

- i) The fish spawned on a night when oceanographic current conditions were substantially different than they were on the six nights previous to spawning,
- ii) There is a substantial chance for local larval retention based on the eddy formation during the first few days that larvae were in the water column, and
- iii) There appear to be biophysical barriers that limit dispersal of Nassau larvae from one location to another.

Taken together, protection of local spawning aggregations is likely very important for local recruitment, and aggregation sites likely have unique oceanographic features

that lend an “importance of place” to those locations. These locations therefore should be afforded special protections to act as conservation sites for all the species that spawn there.