Juvenile Habitat for Nassau Grouper and Spiny Lobster is Enhanced by Discarded Queen Conch Shells

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ABSTRACT

In the Turks & Caicos Islands (TCI), queen conch shells are discarded as a waste product of the conch fishery and appear to act as important shelters for fishes and invertebrates in sea grass areas. This study investigated whether adding conch shells to seagrass increases the densities of Nassau grouper (*Epinephelus striatus*) and spiny lobster (*Panulirus argus*), both commercially important species in the TCI. In February 2008, four plots were prepared in the seagrass beds running parallel to Long Beach on the east coast of South Caicos, TCI. These conch plots were >300m away from each other, and each plot consisted of 4 permanent 20 m long transects running perpendicular to shore. Each transect was delineated with 20 conch shells with the aperture facing upwards. At approximately monthly intervals from late April to early July, the number of fishes and lobsters were recorded along these permanent transects and along control transects performed in the seagrass areas between conch plots. Compared to control areas, conch plots had higher densities of young-of-the-year *E. striatus*, juvenile *P. argus*, and all fishes combined. Respectively, mean densities were > 37, > 150 and > 22 times greater in conch plots. Thus, the strategic deployment of conch shells over wider areas may be of benefit to fisheries by enhancing stocks of Nassau grouper and spiny lobster.

KEY WORDS: Nassau grouper, spiny lobster, conch

Las Conchas del Caracol Reina Aumentan el Habitat de Juveniles de Mero de Nassau y Langosta Espinosa

En las islas de Turks & Caicos (TCI), las conchas del caracol reina son desechadas como un producto de desperdicio de la industria pesquera de caracol y parecen actuar como refugio importante para peces e invertebrados en las áreas de hierba marina. Este estudio investigó si agregar conchas de caracol a la hierba harina aumenta o no las densidades de los meros de Nassau (*Epinephelus striatus*) y de las langostas espinosas, ambas especies comercialmente importante en TCI. En Febrero del 2008, cuatro parcelas en la hierba marina fueron preparadas en forma paralela a Long Beach en la costa Este de South Caicos, TCI. Estas parcelas de caracol estaban > 300 m de distancia entre ellas, y cada zona consistía en 4 transectos permanentes, de 20 m de largo, perpendiculares a la costa. Cada transecto fue delineado con 20 conchas de caracol, con sus aperturas hacia arriba. Con intervalos aproximadamente mensuales, desde finales de Abril hasta principios de Julio, el número de peces y langostas fueron registrados a lo largo de estos transectos permanentes y de los transectos de control realizados en las áreas de hierba marina entre las zonas de caracol. Comparadas con las áreas de control, las zonas de caracol tenían mayores densidades de *E. striatus* menores de un año, *P. argus* juveniles, y todos los peces combinados. En las zonas de caracol, las densidades promedio fueron > 37, > 150 y > 22 veces mayores, respectivamente. Así, el despliegue estratégico de conchas de caracol en áreas mayores, podría beneficiar las pesquerías, aumentando el stock de mero de Nassau y de la langosta espinosa.

PALABRAS CLAVES: Mero de Nassau, langosta espinosa, conchas de caracol

Habitats pour les Mérous et les Langoustes Blanches Juvéniles Augmentés par les Coquilles Vides de Lambis

Dans les Îles Turks et Caicos (ITC), les coquilles de lambis vides sont jetées en tant que déchets des pêcheries de lambis et semblent agir en tant qu'important abris pour les poissons et les invertébrés dans les zones d'herbier. Cette étude à pour but d'étudier si l'ajout des coquilles vides de lambis aux herbiers, augmente la densité de mérous (*Epinephelus striatus*) et de langoustes blanches (*Panulirus argus*), touts deux commercialement importantes dans les ITC. En février 2008, quatre parcelles ont été préparées dans les herbiers parallèle à Long Beach sur la côte est de South Caicos, ICT. Ces parcelles à lambis étaient à > 300 m l'unes de l'autres et chacunes comprenaient 4 transects permanents de 20 m de long perpendiculaire à la côte. Chaque transect était délimité par 20 coquilles avec l'ouverture vers le haut. A environ un mois d'intervalle de la fin avril jusqu'au début du mois de juillet, le nombre de poissons et de langoustes ont été noté le long de ces transects permanents et le long de transects formés par la zone d'herbier entre chaque parcelle. Comparé aux zones contrôles, les parcelles de lambis avaient une densité plus grandes de jeunes de l'année *E. striatus*, juvéniles *P. argus* et tous poissons confondus. Respectivement, la densité moyenne était de > 37, > 150 et > 22 times greater plus grande dans les parcelles à lambis. Donc, le déploiement stratégique des coquilles vide de lambis sur de plus grandes aires peut être bénéfique aux pêcheries en augmentant les stocks de mérous et de langoustes blanches.

MOTS CLÉS: Mérou, langouste, blanche lambis

INTRODUCTION

There are three main fisheries in the Turks and Caicos Islands (TCI), spiny lobster (*Panulirus argus*), queen conch (*Strombus gigas*). and reef fishes. The conch fishery appears to be sustainable at present, and is largely managed by a yearly export quota. However, the lobster fishery, which is presently the economically most important to the TCI, is displaying worrying signs through declines in landings over the past years. Accordingly, the TCI government has been promoting expansion into the reef fish fishery. However, few data are available for this fishery, and historically low levels of exploitation explain the lack of regulations beyond banning some gears and prohibition of harvest in some marine protected areas.

For the past five years, the queen conch export quota has ranged from 1.6 to 1.8 million pounds of unclean conch meat. Every year, this quota has been met, and this equates to roughly one million queen conch individuals harvested annually (a very low estimate). Each shell is a waste product usually disposed of at sea or around islands before boats return to land their catch. Shells are predominantly placed in large piles (middens) in specific areas. Middens are usually formed in areas away from good conch fishing grounds because of the widespread belief that the shells scare away live conch (Gisele Magnusson, NOAA Unpubl. data). In the TCI, the practice of creating middens has been encouraged because they act as artificial patch reefs creating shelter for fishes and invertebrates (Wilson *et al.* 2005). As a result, proportionately few shells are discarded in seagrass areas where live conch are found, and few are discarded outside of middens. However, solitary shells in seagrass appear to serve as more important shelter for juvenile Nassau grouper (*Epinephelus striatus*) and juvenile spiny lobster (*Panulirus argus*). During observations around South Caicos, TCI, all Nassau grouper < 12 cm TL were found in (or in close proximity to) seagrass habitat and 44% of these were found using conch shells as microhabitat (Claydon and Kroetz 2007). Whilst this study only attempted to characterize the habitat use of early juvenile groupers, many of the conch shells not inhabited by Nassau grouper were inhabited by spiny lobster and almost all of the conch shells used by either species were solitary (J.A.B.C. Pers. observation).

A number of studies have used discarded queen conch shells to provide (micro)habitat for fishes (Colin *et al.* 1997, Shulman 1984, 1985, Wilson *et al.* 2005). The present study explores the potential of enhancing the quality of juvenile habitat for Nassau grouper and spiny lobster through the strategic deployment of conch shells into areas of seagrass. An experimental approach was used to investigate whether densities of Nassau grouper and spiny lobster would be enhanced compared to control areas and whether conch shells would remain in place following deployment. Because Nassau grouper are regionally endangered (Cornish and Eklund 2008), and spiny lobster appear to be overfished, a strategy that provides shelter for the most vulnerable post settlement stages of these species may reduce mortality and lead to increased densities of adults in adjacent habitats.

MATERIALS AND METHODS

Study Area

The Study was conducted in the seagrass beds adjacent to Long Beach on the east coast of South Caicos, Turks and Caicos Islands (see Figure 1). This stretch of contiguous seagrass is roughly 2 km long and is mainly comprised of dense turtle (*Thalassia testudinum*) and manatee (*Syringodium filiforme*) grass. The seagrass is at depths ranging from 1 to 4 m.

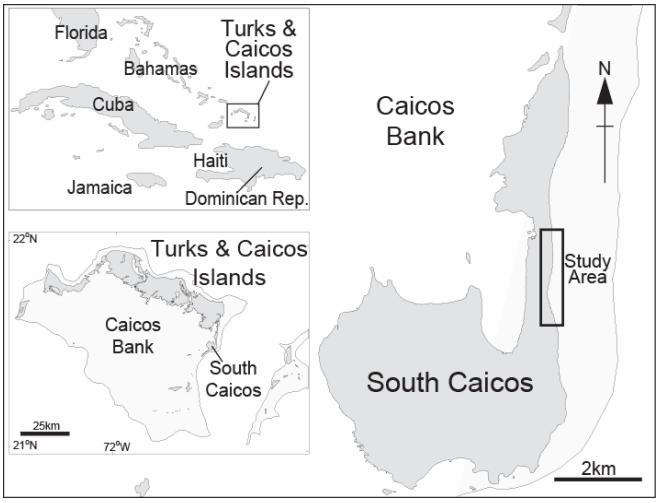

Figure 1. Study area at Long Beach on east coast of South Caicos, Turks and Caicos Islands.

Experimental Plots

This seagrass area was divided into four different sites of 300 x 30 m wide. In February 2008, a plot consisting of four permanent 20 m long transects running perpendicular to shore was prepared in each of these four sites. Each transect was delineated with 20 conch shells placed with the aperture facing upwards. Ten of the shells in each transect were secured to the substratum with a steel bar stake to which they were attached using a plastic zip tie looped through holes drilled in the shells. The remaining ten shells in each transect were placed loosely on the seagrass bed. The distribution of plots within each site was such that all plots were over 300 m away from one another.

Data Collection

At approximately monthly intervals from late April to early September, data were collected along the permanent transects in plots and along transects within control areas between plots. All data were collected using 20 m long x 1m wide transects. The number of conch shells and their orientation (aperture facing up or down), the number of

spiny lobsters, the number of Nassau groupers and their estimated sizes, and the numbers of all other fishes were recorded along transects. At each site, transects were conducted in control areas at distances of 50, 100, and 150 m away from the plot. Transects at increasing distance were conducted in order to investigate whether attraction was occurring. Attraction would be manifested most strongly in areas closer to the conch plots and therefore reduced densities would be found more in the 50 m transects compared to the 150 m transects. Within the control areas, a pattern of increasing density with increasing distance away from the conch plots would be indicative of attraction occurring.

RESULTS

Conch Shells

Prior to Hurricanes Hannah and Ike in September, all but one of the 320 conch shells that were deployed remained in place with aperture facing upwards. The shell that disappeared was a loose shell rather than one secured with a stake. Prior to September, densities of conch shells were more than 40 times higher in conch plots than in control areas. Following the hurricanes, densities of shells also remained higher but this was reduced to five times higher in conch plots versus controls.

Conch Plots versus Controls

The densities of Nassau grouper, spiny lobster and other fishes were greater in manipulated versus control areas during all months of study (see Figure 2). Within conch plots, there was a consistent rise in density of lobster and fishes (other than Nassau grouper) over the first four months of observation. Following the hurricanes, these densities reduced, but still remained over five times higher than those in control areas. With data pooled from all months prior to the hurricanes, the density of Nassau grouper is >37 times higher in conch plots than in controls, and >150 times and >22 times the density for lobster and other reef fishes respectively.

Attraction

For Nassau grouper, lobster, and other fishes there was no discernable pattern of attraction from control areas to conch plots: within control areas, densities were not found to be higher with increasing distance from conch plots. Densities within control areas remained consistently low.

DISCUSSION

The present study shows that deploying solitary conch shells in areas of seagrass enhances the densities of young of year Nassau grouper and juvenile spiny lobster around South Caicos, TCI. Densities of other fishes were also increased compared to control areas. The conch shells remained in place except when subjected to hurricane conditions. Therefore the study appears to show that such deployment of conch shells has the potential to be an effective fisheries tool. However, the effect of this strategy on the adult, marketable sizes of grouper and lobster is unknown.

The increases in density of Nassau grouper and lobster did not appear to be attributable to attraction from control areas. This suggests that increased densities were attributable to increased survival of in areas with higher availability of shelter provided by the conch shells. However, such enhanced survival was not explicitly demonstrated, and attraction could have occurred on scales beyond the detection of the present study.

Harvesting of queen conch has had a profound influence on the marine environments around the TCI and those around many other islands in the region where this species has been heavily exploited. Most of this influence is readily evident with conch middens piled high in shallow water. However, a more subtle consequence of conch fishing may also have altered the marine environments in these areas. Natural mortality of conch would largely result in empty conch shells in seagrass areas. These shells are likely to be solitary. Fishing greatly reduces this natural mortality and thus may greatly reduce the number of available solitary conch shells in seagrass areas. Therefore, the deployment of conch shells in seagrass that was trialed in the present study may actually help to restore the system to a state approaching that which would have been evident prior to heavy exploitation. Such a system richer in empty conch shells is likely to have had greater carrying capacity for juvenile lobster, Nassau grouper, and other fishes.

A number of additional experiments need to be conducted before encouraging the widespread deployment of conch in seagrass areas. Firstly, it is necessary to investigate whether the results of the present study scale up: the density of conch shells was enhanced in an area of only approximately 500 m^2 (20 m x 25 m) of seagrass bed. For this strategy to be meaningful in a fisheries context, it would be necessary to deploy conch shells over greater areas but it is unknown whether densities of the Nassau grouper and lobster will increase to the same degree as the present study. Other factors are also unknown: what is the optimum density of conch shells? Is there an optimal time of year to deploy conch shells? Are there areas of seagrass where the strategy will work better than others? Do these factors differ between Nassau grouper and lobster?

CONCLUSION

On the limited scale of the present study The addition of discarded queen conch shells into seagrass habitat proved effective in increasing the densities of early juvenile Nassau grouper, juvenile spiny lobster and reef fishes in general (also predominantly juveniles). Increasing the carrying capacity of seagrass for these taxa may have important implication for fisheries. Further investigation into this strategy as a means to enhance the quality of areas of seagrass as nursery habitats is warranted.

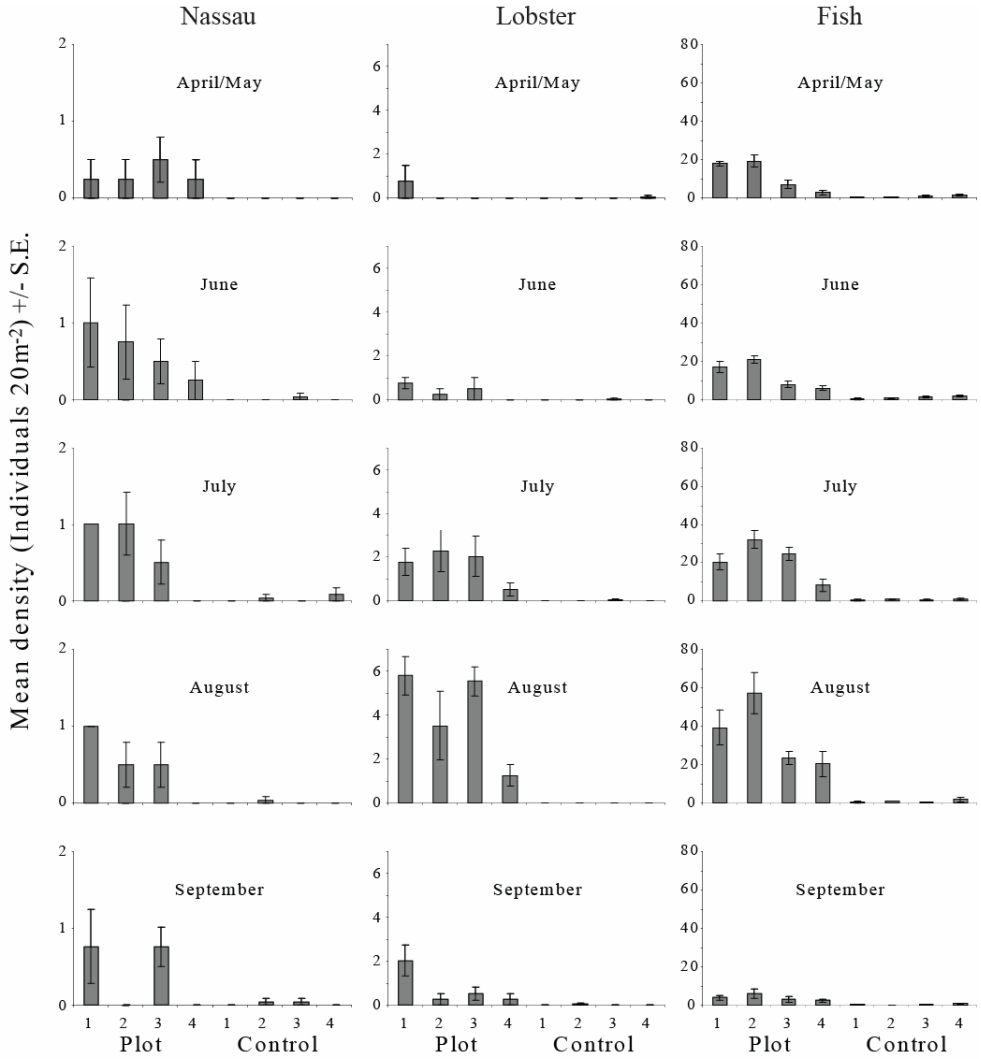

Figure 2. Mean density of Nassau grouper (*Epinephelus striatus*), spiny lobster (*Panulirus argus*) and other fishes in sites 1,2,3, and 4, within areas enhanced by conch shells(= *Plot*) and those without added conch shells (= *Control*) over successive months from late April to mid September. The data for September were collecting following two hurricanes (Hannah and Ike). Error bars represent standard error.

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