# Preliminary Observation of Reproductive Failure in Nearshore Queen Conch (*Strombus gigas*) in the Florida Keys

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## ABSTRACT

In the Florida Keys, queen conch, *Strombus gigas*, occur nearshore in hard-bottom communities and offshore in seagrass meadows and rubble zones adjacent to the reef tract. Queen conch in nearshore aggregations have not been observed reproducing (mating or spawning) since our monitoring program began in 1987. However, reproduction has commonly been observed in offshore aggregations. Reciprocal transplants of conch with flared lips were made between pairs of nearshore and offshore sites, resulting in each site having both nearshore and offshore conch. Nearshore conch were not observed mating or spawning in their native nearshore region during this study. Nearshore conch transplanted offshore were not observed mating; however, three months after transplantation, nearshore conch were observed spawning at offshore sites. Offshore conch transplanted nearshore mated and spawned, but at reduced frequencies compared with conch that remained offshore. These preliminary results suggest that some component of the nearshore environment affects reproduction in conch and that transplanting nearshore conch to the offshore region restores the reproductive viability of transplanted conch.

KEY WORDS: Queen conch, reproduction, transplanting

## INTRODUCTION

Queen conch, *Strombus gigas*, occur within two distinct regions on the oceanside of the Florida Keys archipelago: nearshore and offshore. Conch within the two regions are isolated from one another by Hawk Channel, which runs parallel to the Florida Keys and lies between the island chain and the offshore reef tract (Berg and Glazer 1995). Hawk Channel consists of a fine-grained, soft-sediment substrate, which is unsuitable conch habitat and thus serves as a barrier to queen conch migration (Glazer and Berg 1994).

Since 1987, researchers monitoring queen conch stock abundance throughout the Florida Keys have not observed any reproductive activity among conch in nearshore aggregations; however, anecdotal reports indicated that conch in the nearshore region reproduced as recently as the mid-1980's (Brian LaPointe, personal communication 1998). Conversely, reproductive behavior has commonly been observed among conch in offshore aggregations (Glazer and Berg 1994). Glazer and Quintero (1998) conducted a histological examination of conch from these two regions and found that the gonads of offshore conch were viable and capable of undergoing gametogenesis, whereas the gonads of nearshore conch were nonfunctional. In the present study, we examined differences in reproductive behavior (i.e., mating and spawning frequency) between nearshore and offshore conch by transplanting nearshore conch to the offshore region and offshore conch to the nearshore region.

## METHODS

During March, April, and May 1999, we transplanted queen conch with flared lips from two nearshore to two offshore sites and vice versa, so that all four sites would have both nearshore and offshore conch. Nearshore sites were located at Tingler's Island (24° 41' N, 81° 05' W) and Duck Key (24° 45' N, 80° 55' W) in water 1-2m deep (Figure 1). Offshore sites were located at Alligator Reef (24° 51' N, 80° 37' W) and Pelican Shoal (24° 30' N, 81° 37' W) in water 5-11m deep (Figure 1). Reciprocal transplants of queen conch were made between Tingler's Island and Alligator Reef and between Duck Key and Pelican Shoal (Table 1). Fewer conch were collected and tagged from nearshore sites (Table 1) because aggregations were smaller there than at the offshore sites.

We used monel wire to secure a numbered, stainless-steel tag to each conch's shell spire. In addition, colored plastic tape was tied to the spires to facilitate recapture. From March 1999 through November 1999, each site was searched weekly except during periods of inclement weather. Divers using SCUBA surveyed offshore sites, while nearshore sites were surveyed by snorkeling. We quantified the mating activity of queen conch by counting the number of copulating pairs; spawning activity was quantified by counting the number of females laying egg-masses. For statistical purposes, data from the two nearshore sites were pooled and treated as the nearshore region; data from the two offshore sites were treated in the same fashion. Data were also pooled by season. Spring consisted of March, April and May; summer consisted of June, July, and August; fall consisted of September, October, and November.

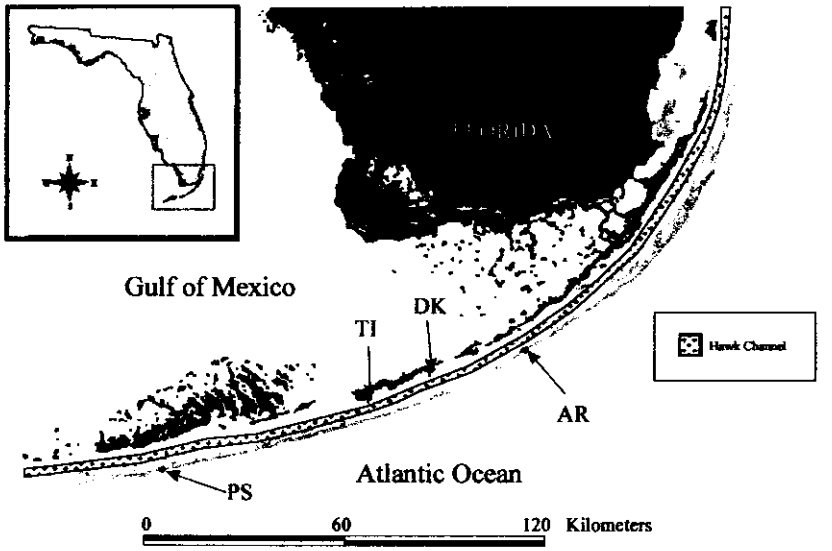


**Figure 1.** Sites in the Florida Keys where the queen conch transplant study was conducted. The nearshore region is landward of Hawk Channel; the offshore region is southeast of Hawk Channel. Nearshore sites included Tingler's Island (TI) and Duck Key (DK). Offshore sites included Pelican Shoal (PS) and Alligator Reef (AR).

**Table 1.** Number of queen conch collected and tagged at each site for the reciprocal transplant study in the Florida Keys. The number of conch released at the site of initial capture, the number transplanted, and the transplant location are also given. Letters in parentheses indicate whether the location was in the offshore (o) or nearshore (n) region.

| Source Location | # Collected & Tagged at Source Location | # Released at Source Location | # Transplanted | Transplant Location |
|---|---|---|---|---|
| Alligator Reef (o) | 201 | 101 | 100 | Tingler's (n) |
| Tingler's (n) | 44 | 21 | 23 | Alligator Reef (o) |
| Pelican Shoal (o) | 199 | 99 | 100 | Duck Key (n) |
| Duck Key (n) | 132 | 59 | 73 | Pelican Shoal (o) |

## PRELIMINARY RESULTS

**Mating**

Differences in mating frequencies were observed between the native nearshore conch and the native offshore conch. Nearshore conch were not observed mating at either their native nearshore sites or at the offshore sites where they were transplanted, whereas offshore conch were observed mating at both their native offshore sites and at the nearshore sites to which they had been transplanted (Table 2). Mating frequency of offshore conch was highest during the spring and decreased during subsequent seasons at both nearshore and offshore sites (Table 2). The mating frequency of offshore conch transplanted to the nearshore region decreased from 11.8% in the spring to 0.0% in the fall, whereas the mating frequency of offshore conch that remained offshore decreased from 5.3% in the spring to 0.9% in the fall (Table 2). All mating occurred between native offshore conch with the exception of two offshore females that were transplanted nearshore, who were observed mating with untagged nearshore males.

**Spawning**

We also observed differences in the frequency with which nearshore and offshore conch spawned. Nearshore conch were not observed spawning at their native nearshore sites; however, nearshore females transplanted to the offshore region spawned during the summer and fall with frequencies of 12.5% and 18.5%, respectively (Table 2). Native offshore females were observed spawning at offshore and nearshore sites; however, females transplanted nearshore spawned far less frequently than females that remained offshore. The spawning frequency of offshore female conch decreased over time at their native offshore sites from 46.2% in the spring to 5.3% in the fall. Spawning frequency of offshore females transplanted to the nearshore region also decreased over time: from 8.9% in the spring to 0.0% in the fall.

## DISCUSSION

Residence by queen conch in the nearshore region had a severe detrimental impact upon their reproductive behavior as neither mating nor spawning were observed in native nearshore conch. The fact that neither mating nor spawning was observed among native nearshore conch residing in the nearshore region in this study or in our ongoing monitoring program, coupled with the histological deficits reported by Glazer and Quintero (1998), suggests that conch native to the nearshore region are incapable of reproducing while residing nearshore. In addition, offshore conch transplanted to the nearshore region were observed spawning less frequently than offshore females that remained offshore. In fact, after six months, the reproductive behavior of offshore conch transplanted nearshore ceased entirely. Conch that remained offshore were observed mating and spawning throughout the entire study.

**Table 2.** Frequency of mating (both males and females) and spawning (females only) of native and transplanted queen conch, by season. "Native" refers to conch that were released at their initial capture site. "Transplant" in the Nearshore Region refers to conch that were moved nearshore from their original offshore location. "Transplant" in the Offshore Region refers to conch that were moved offshore from their original nearshore location. N represents the number of observations.

| | Nearshore Region | | | |
|---|---|---|---|---|
| | N | % Mating | N | % Spawning |
| Spring | | | | |
| Native | 37 | 0.0 | 6 | 0.0 |
| Transplant | 169 | 11.8 | 56 | 8.9 |
| Summer | | | | |
| Native | 106 | 0.0 | 34 | 0.0 |
| Transplant | 490 | 2.9 | 215 | 4.7 |
| Fall | | | | |
| Native | 20 | 0.0 | 9 | 0.0 |
| Transplant | 46 | 0.0 | 21 | 0.0 |

| | OffshoreRegion | | | |
|---|---|---|---|---|
| | N | % Mating | N | % Spawning |
| Spring | | | | |
| Native | 95 | 5.3 | 39 | 46.2 |
| Transplant | 19 | 0.0 | 10 | 0.0 |
| Summer | | | | |
| Native | 467 | 2.4 | 188 | 17.0 |
| Transplant | 83 | 0.0 | 40 | 12.5 |
| Fall | | | | |
| Native | 232 | 0.9 | 95 | 5.3 |
| Transplant | 51 | 0.0 | 27 | 18.5 |

There were two occasions when offshore females that were transplanted to the nearshore region mated with native, untagged nearshore males. This suggests that the males were always capable of reproduction and/or that the presence of reproductive offshore females stimulated mating behavior in nearshore males. Preliminary results from histological examinations suggest that some nearshore males may be reproductively viable (Nancy Brown-Peterson, unpublished data), and Reed (1995) reported that male conch demonstrated a preference for mating with spawning females. Either way, males appear less susceptible to whatever chronic effect nearshore conditions have on females.

Transplanting nearshore conch to the offshore region appeared to mitigate the deleterious effects that the nearshore environment had on conch reproductive behavior. Nearshore females transplanted to the offshore region were observed laying eggs throughout the summer and fall (Table 2). However, the peak spawning period of the transplanted nearshore conch was several months later than the peak spawning period of the native offshore conch. Nevertheless, there is reason to conclude that the timing of both groups' reproductive behavior may eventually become similar. Apparently, it takes at least three months after transplantation for the adverse effects of the nearshore environment to be mitigated, explaining the lag

in peak spawning for the transplanted nearshore conch. Had we conducted the transplanting earlier in the year (e.g., January instead of March), the out-of-phase spawning may have been prevented.

Nearshore female conch transplanted offshore were observed spawning, but not mating. We cannot confirm that these nearshore females mated after transplantation, but we suspect that mating must have occurred offshore because of the deficits in nearshore conch described above. The observed mating frequency was low (<12%); however, this is not unexpected because Randall (1964) reported similar mating frequencies for conch in the Virgin Islands. Therefore, we suspect that the lack of observations (Table 2) of nearshore conch mating in the offshore region may have been an artifact of the low probability of encountering that activity and of the low number of nearshore conch transplanted offshore.

The implications of this study have a direct bearing on our ongoing queen conch stock restoration program in the Florida Keys. We have been examining the efficacy of producing and releasing hatchery-reared conch in an effort to increase the queen conch spawning stock. The present study clearly demonstrates that the goal of increasing the reproductive population will not be realized if conch are released into nearshore sites. Transplanting large numbers of naturally recruiting nearshore conch to the offshore region may be more cost-effective than producing juvenile conch in a hatchery, especially if survival rates of transplanted conch are equivalent or greater than those of hatchery outplants. However, before a transplantation program can be implemented, we must 1) ascertain if reproductive output will truly be augmented, 2) determine if the larvae produced from nearshore transplants are as viable as larvae produced by native offshore conch, and 3) determine if larvae produced from transplanted conch are retained within the Florida Keys.

The goal of this study was to compare the reproductive behavior of nearshore and offshore conch in the Florida Keys; however, several new areas of research are now open for inquiry. A more detailed histological study will provide further information on reproductive condition. Efforts should also focus on identifying the anthropogenic and/or environmental factors that are affecting the reproductive viability of nearshore animals. Other areas in the Caribbean have shallow-water, nearshore aggregations of queen conch in which reproduction has never been observed, including Mexico (Alberto de Jesus Navarrete, personal communication, 2000) and the Turks and Caicos (Wesley Clerveaux, personal communication, 2000). Therefore, identifying the key elements involved in the reproductive failure of nearshore conch in the Florida Keys may prove to be important for the entire region.

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