Monitoring Fish Recruitment on a Fringing Reef in Virgin Islands National Park, St. John, US Virgin Islands

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ABSTRACT

Juvenile reef fish were surveyed monthly at Yawzi Point reef, St. John, US Virgin Islands, a fringing reef within Virgin Islands National Park, from July 1997 through October 1998. 58 species from 19 families were recorded.

Gobies (Gobiidae) were the most abundant of the 56,031 juveniles observed, particularly the locally abundant masked goby, *Coryphopterus personatus*, which was the most abundant species. Damselfishes (Pomacentridae) were the second most abundant family with *Chromis cyanea, Stegastes partitus, S. variabilis* and *S. planifrons* included in the ten numerically dominant species. Wrasses (Labridae), which included the second most abundant fish species observed (the bluehead wrasse, *Thalassoma bifasciatum*) were the third most abundant family followed by parrotfishes (Scaridae). Seven of the ten most abundant fish species demonstrated peaks in recruitment during summer months, the two exceptions being one parrotfish (*Sparisoma viride, S. aurofrenatum*) and one damselfish (*S. planifrons*). A significant difference in recruitment of three species was noted among subzones (edge vs. platform) on the fringing reef.

KEY WORDS: Recruitment, fish, monitoring

INTRODUCTION

Patterns of distribution and abundance of reef fish depend in part on recruitment of pelagic larval stages, on subsequent dispersal among habitats, and survival of new recruits. Local recruitment is highly variable over space and time and profoundly influences the population dynamics of the adult assemblage structure. This has fueled the debate as to whether the composition of an adult population is determined primarily by events occurring before, during or after settlement of juveniles into the reef environment (Doherty 1991).

Many different techniques (belt transect, quadrats) on natural and artificial reefs have been used to sample fish recruitment with the frequency of monitoring targeting the settlement characteristics of specific species, and the study objective (Victor 1991). As most mortality in reef fishes occurs shortly after settlement, infrequent recruitment surveys may underestimate the role of early post-settlement mortality (Levin 1998). There are very few multi-year data sets derived from year-round monthly or seasonal monitoring of recruitment in Caribbean reef sites. Seasonal patterns of recruitment have been studied extensively on the Great Barrier Reef (e.g. reviews by Doherty and Williams 1988; Doherty 1991). Fewer studies have considered seasonal patterns of fish recruitment in the Caribbean (Booth and Beretta 1994, Caselle and Warner 1996). When settlement of pelagic larvae is seasonally predictable, annual surveys of recruitment sampling are useful. However, when settlement is year-round, or seasonal, with variations both between species and within species, regular, perhaps monthly surveys may be necessary to quantify fluctuations in recruitment strength (Robertson 1998).

The aim of this study was to document recruitment variability at Yawzi Point reef in St. John, US Virgin Islands, within the boundaries of Virgin Islands National Park. The decision was to monitor juvenile fishes monthly at a single fringing reef site given the available resources. Annual surveys have been conducted at several sites, which will be included in future analyses. These data can be compared with information on fish assemblages at this reef and others around St. John, which will be valuable in management decisions in Virgin Islands National Park.

METHODS

The study site, Yawzi Point reef, is located between Little and Great Lameshur Bays on the southern shore of St. John. This fringing reef has a fairly level "platform", 7.6 m to 9.1 m in depth, which gently slopes to the seaward to the reef "edge", where the slope drops rapidly to depths of approximately 12 m to 13.7 m, terminating in a well-defined sand channel which separates the base of the reef from a seagrass bed. Live coral cover is approximately 12% on the reef platform (Rogers et al. 1997).

Fish recruits (recently settled post-larval juveniles) were counted along 50 x 2 m strip transects (Fowler et al. 1992). Transects were conducted within the two subzones, platform and edge. Four censuses were conducted in each subzone per month, all on the same day, however additional censuses were conducted in July 1997, 1998 (8 Edge, 10 platform; 8 edge, 8 platform, respectively), and February 1998 (6 edge and platform). Each diver recorded the species and size (see below) of each small juvenile encountered along the transect. Each transect was conducted within 25 - 30 minutes. For most species, juveniles less than or equal to 3 cm total length (TL) were counted. However, fishes of some species settle at larger size. Therefore, selected species were recorded at larger sizes. Groupers (Serranidae) and snappers (Lutjanidae) were recorded at sizes less than or equal to 10 cm TL. Hamlets (*Hypoplecterus* spp.), butterflyfishes

(Chaetodontidae), angelfishes (Pomacanthidae), and surgeonfishes (Acanthuridae) recruits were recorded at sizes up to 5 cm. Small reef fishes, such as blennies and gobies (particularly the locally abundant masked goby, *Coryphopterus personatus*, reach adult size at 3 cm or less. For these species, recruits were defined as individuals 1 cm or less in size.

Student T-test were used to evaluate juvenile abundance for the edge versus platform data comparison.

RESULTS

A total of 56,031 juveniles of 58 species were counted during the study. Gobies (Gobiidae) were the most abundant juveniles observed during the study period. Pomacentridae was the second most abundant family with 12.4% of the total, followed by Labridae (9.0%), Scaridae (8.9%), Haemulidae (3.1%); Table 1. These families comprised 97.8% of all juveniles observed (91.7% excluding gobies); Table 1.

In four of the five most abundant families, late spring-summer peaks in recruitment were followed by rapid declines, although some variation was present among families. Pomacentrids peaked in June 1998 with 189 fish per transect (100 m^2), and declined to less than 20 fish per transect during later summer-fall months (Figure 1). This decrease during late summer-fall was also observed in 1997. Labridae abundance was driven by the bluehead wrasse (*Thalassoma bifasciatum*). This family peaked in June 1998 and remained relatively high until August 1998 when it began a decline until October. Labrids showed no recruitment pulse in 1997, but no data are available before July 1997. Scarids showed peak abundance in July 1997 and declined steadily through the year until May 1998. Generally, a pulse of scarids occurred June –September. Haemulids were driven by the abundance of tomtates (*Haemulon aurolineatum*) with pulses in August 1997 and August-September 1998, and low levels from December through May. Acanthurids were the exception in showing no strong recruitment peak, but rather similar numbers of recruits in all seasons. Larger recruitment pulses were observed for most families in summer 1998 than in 1997, with the exception of scarids, which had greater peaks in 1997.

Of the 58 species observed, the masked goby was overwhelmingly the dominant recruit during the period (36,036 of 56,031 fish observed [64%]; Table 1. Excluding gobies, five species accounted for 61.5% of the number of recruits observed. This included a wrasse (*T. bifasciatum* – 21.5%), a planktivorous damselfish (*Chromis cyanea* – 13.6%), a parrotfish (*Scarus croicensis* – 10.1%), a benthic damselfish (*Stegastes partitus* – 8.6%), and a grunt (*H. aurolineatum* – 7.7%).

Table 1. Abundance and percentage of total fish recruits observed for six numerically dominant families on Yawzi Point reef, St. John, US Virgin Islands, during July 1997 – October 1998. Adjusted percentages were calculated using the total number of recruits observed excluding *Coryphopterus personatus*, which dominated abundance (62.4%).

Family	Total Recruits	Percent of Total	Percentage of
Gobiidae	36036	64.3	na
Pomacentridae	6930	12.4	33.9
		9.0	24.7
Scaridae	4965	8.9	24.3
Haemulidae	1790	3.2	8.8
Acanthuridae	562	1.0	2.7
Species	**Total Recruits**	**Percent of Total**	**Percentage of**
Coryphopterus personatus	34959	62.4	na
Thalassoma bifasciatum	4393	7.8	21.5
Chromis cyanea	2789	5.0	13.6
Scarus croicensis	2067	3.7	10.1
Stegastes partitus	1753	3.1	8.6
Haemulon aurolineatum	1580	2.8	7.7
Sparisoma aurofrenatum	1112	2.0	5.4
Stegastes variabilis	946	1.7	4.6
Stegastes planifrons	936	1.7	4.6
Scarus taeniopterus	891	1.6	4.4
Sparisoma viride	812	1.4	4.0

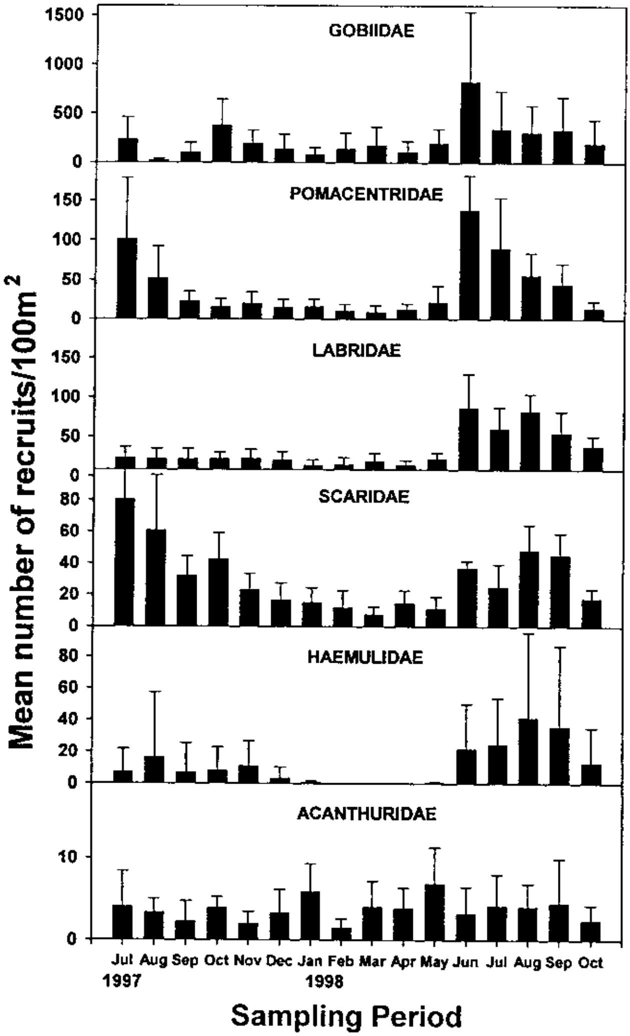

Figure 1. Recruitment patterns of the six numerically dominant families of observed fish recruits to Yawzi Point reef, St. John, U.S. Virgin Islands, during July 1997 - Oct. 1998. Bars represent the mean number of recruits observed per 100 m^2 census (n = 8, except July 1997 n = 18, Feb. 1998 n = 12, July 1998 n = 16) per month. Errors bars are one standard deviation of the mean.

Although recruitment patterns of most species showed pulses during both summer periods, many differences were apparent among species. The second most abundant species (*T. bifasciatum*) had a large pulse in 1988 and none for the months sampled in 1997 (Figure 2). The two most abundant damselfishes (*C. cyanea* and *S. partitus*) showed large recruitment pulses in both summers, whereas, *Stegastes variabilis* showed a single pulse in 1988 (like *T. bifasciatum*) and *S. planifrons* was less abundant with more even recruitment (Figure 3). The parrotfishes showed similar recruitment patterns within genera. The two scarus species (*S. croicensis* and *S. taeniopterus*) showed large peaks during the summer periods, whereas, the *Sparisoma* species (*S. aurofrenatum* and *S. viride*) were less abundant with more consistent recruitment (Figure 4).

Four species within three families of the ten numerically dominant species revealed a significant greater abundance on the reef edge when compared to the reef platform (t-test: $t < 0.05$): the bluehead wrasse (Labridae), the tomtate (Haemulidae), the cocoa and the threespot damselfish (Pomacenthidae).

DISCUSSION

Our results indicate that although recruitment varied on a temporal scale, recruitment pulses were generally observed in the summer to early fall. April and June recruitment pulses were reported for all species observed on artificial reefs off St. Thomas (Beets 1997). Luckhurst and Luckhurst (1977) reported on sixteen species within Serranidae, Grammidae, Apogonidae, Sciaenidae, Pomacentridae, Gobiidae, and Canthigasteridae in the Netherlands Antilles and reported biannual pulses in settlement, primarily in the spring and fall; and recruits were present throughout the year for seven of the sixteen species. In Barbados, Tupper and Hunt (1994) found that recruitment for all species observed occurred predominantly from May to November.

Within our ten most abundant species, we found year-round recruitment of *T. bifasciatum, S. partitus, S. variabilis*, and *S. planifons*. *Thalassoma bifasciatum* has been found to recruit throughout the year in St. Croix, US Virgin Islands, with pulses in June, August and November. Additionally, significant spatial variation in settlement was observed between different shores (north vs. south) of St. Croix (Caselle and Warner 1996). In Barbados, *T. bifasciatum* has been found to recruit seasonally from spring until fall (Hunt von Herbing and Hunte 1994).

During a 3.5 year study of four damselfish (genus Stegastes) in Puerto Rico, settlement pulses were recorded in September for *S. variabilis, S. leucostictus*, and *S. partitus*. *Stegastes planifrons* demonstrated a pulse during October - September (McGehee 1995). Year-round recruitment was reported in damselfish in the Netherlands Antilles, with a pulse reported for *S. partitus* during September and April, and in *S. plaifirons* during September - October

(Luckhurst and Luckhurst 1977). *Chromis cyanea* was reported to settle in May and June, with the largest pulse from August to November (Luckhurst and Luckhurst 1977). We observed the largest number during the summer (July 1998, June 1997).

The tomtate (*H. aurolineatum*) was the most dominant grunt observed with pulses in August of both years. Very low levels of settlement were observed from December through May. Beets (1997) also found this the most abundant grunt recruit, but pulses on artificial reefs southeast of St. Thomas occurred in April to June. During a 2.25 year study in St. Croix, Shulman and Ogden (1987) reported settlement pulses for grunts occurred from May through November, with low level of settlement from December through February.

Whether the differences in pulses we are observing is reflective of reproductive efforts, water temperature, currents, weather patterns, lunar, geographical or other effect is open to speculation. In that we are monitoring for seasonal variations, we have not attempted to observe lunar effects, thought many fish correlate settlement with lunar periods e.g. *S. partitus* (see: Robertson et. al. 1988), *T. bifasciatum* (see: Caselle and Warner 1996) and grunts (see: Shulman and Ogden 1987). Several years of data from monthly surveys are required to reveal patterns on recruitment of reef fishes because of the temporal and geographic variation within the same species (Robertson 1989). The data we have presented should provide valuable information to our growing knowledge of recruitment patterns in the Caribbean.

Juvenile recruitment patterns have strong effects on the abundances and distributions of adult reef fishes, and on the structure of their assemblages (Robertson 1998). A study of fish assemblages around St. John, US Virgin Islands (Beets 1993) listed the fourteen most abundant species present at Yawzi Point reef. Our recruitment data revealed an identical ranking with the four most abundant species of the adult and large juveniles (*C. personatus, T. bifasciatum, C. cyanea* and *S. croicensis*). Interestingly, only the princess parrotfish (*Scarus taeniopterus*) was not ranked in numerical abundance in the previous analysis (Beets 1993). It is very important to note that recruitment was variable between the two fringing reef subzones, platform and edge, sampled during this study. Not all reefs have identical structure and topography, and it is important to document these recruitment differences. Differential recruitment among zones and subzones will have profound effect on adult abundance.

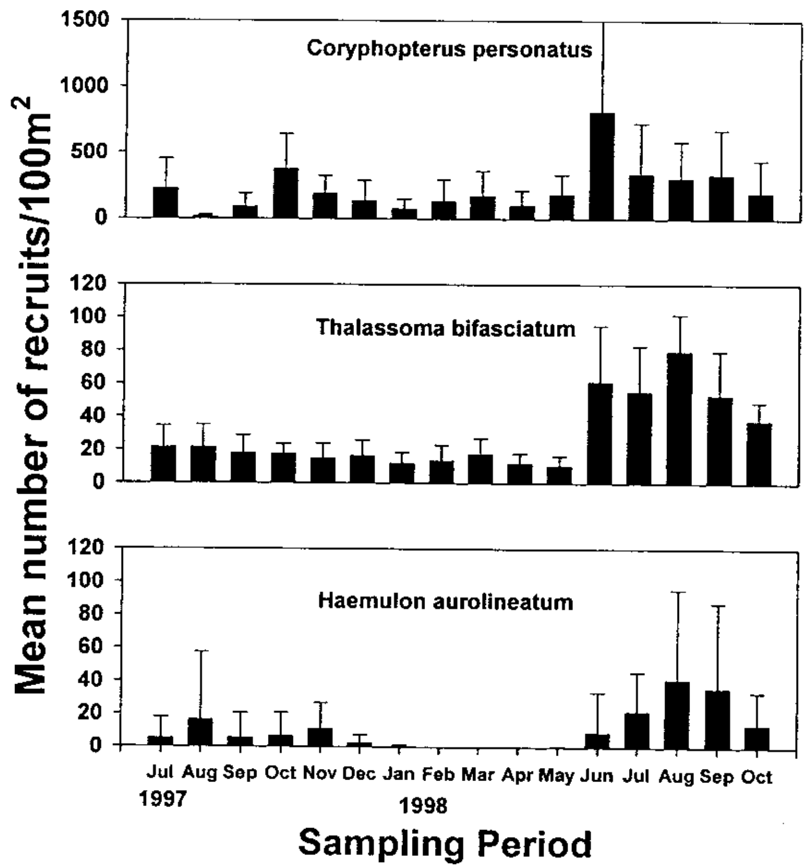

Figure 2. Recruitment patterns of three numerically dominant species of observed fish recruits to Yawzi Point reef, St. John, U.S. Virgin Islands, during July 1997 - Oct. 1998. Bars represent the mean number of recruits observed per 100 m^2 census (n = 8, except July1997 n = 18, Feb. 1998 n = 12, July 1998 n = 16) per month. Errors bars are one standard deviation of the mean.
Note: Different scale in top graph.

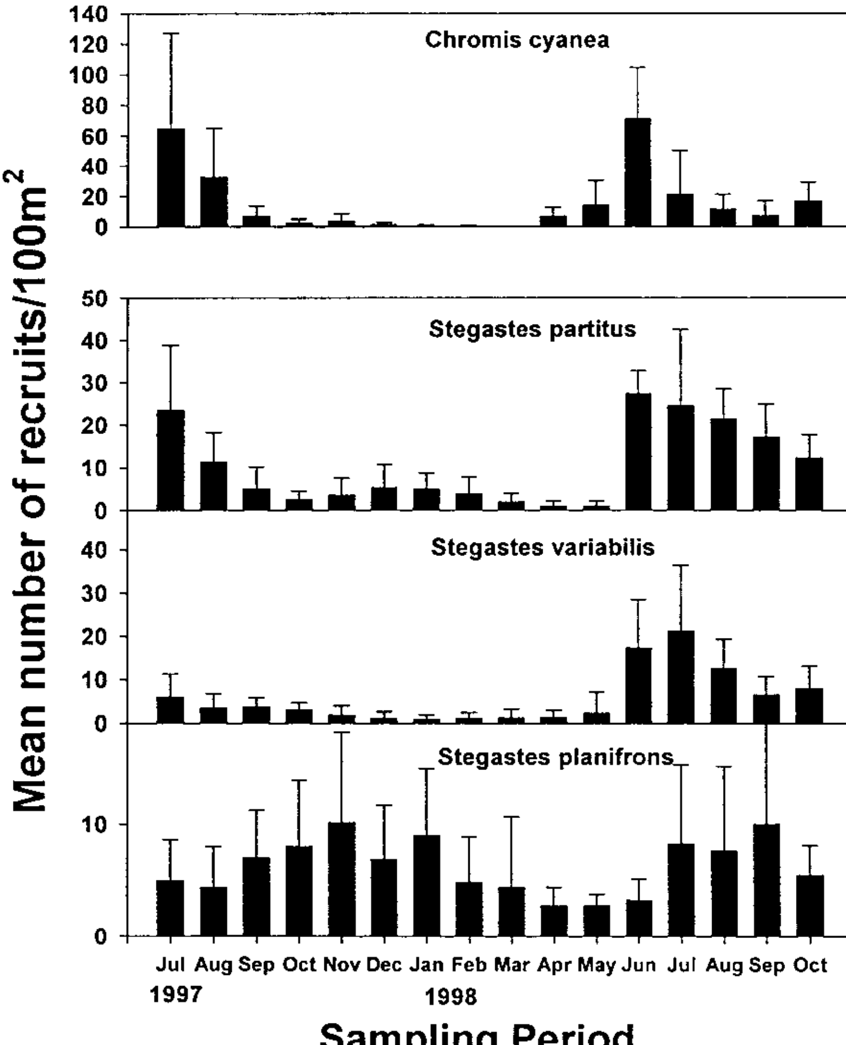

Figure 3. Recruitment patterns of damselfish recruits to Yawzi Point reef, St. John, U.S. Virgin Islands, during July 1997 - Oct. 1998. Bars represent the mean number of recruits observed per 100 m^2 census (n = 8, except July 1997 n = 18, Feb. 1998 n = 12, July 1998 n = 16) per month. Errors bars are one standard deviation of the mean.

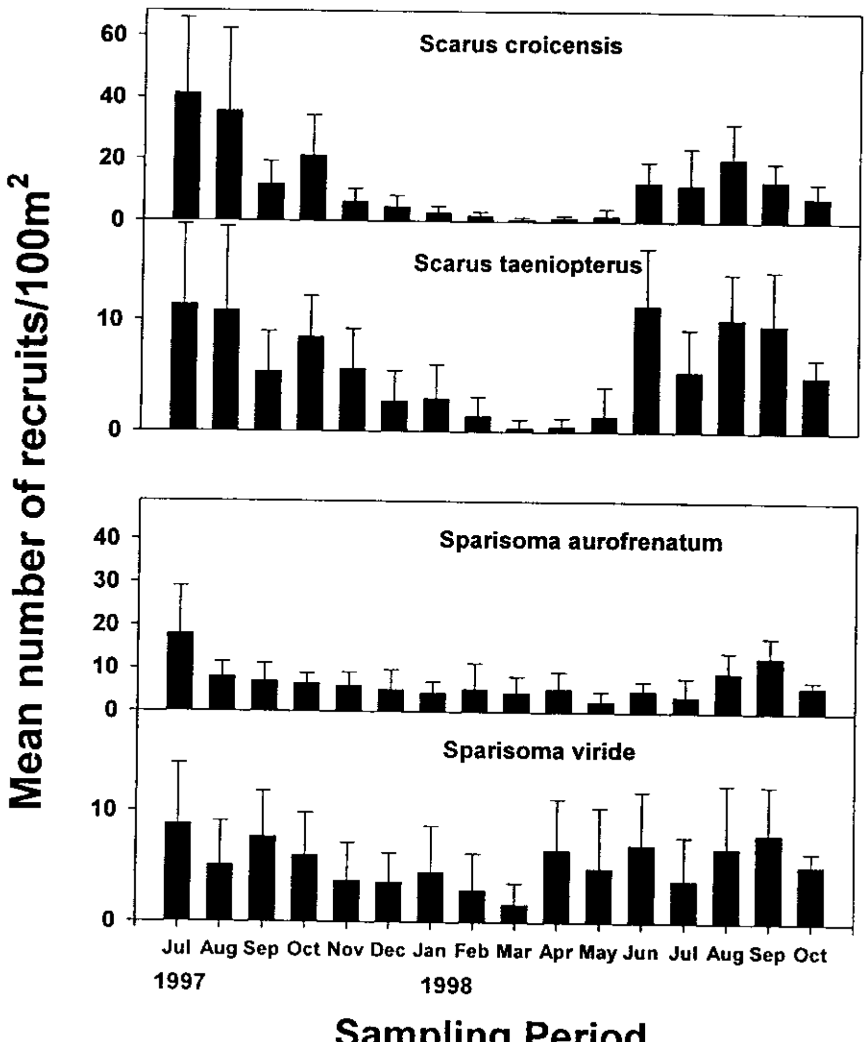

Figure 4. Recruitment patterns of parrotfish recruits to Yawzi Point reef, St. John, U.S. Virgin Islands, during July 1997 - Oct. 1998. Bars represent the mean number of recruits observed per 100 m^2 census (n = 8, except July 1997 n = 18, Feb. 1998 n = 12, July 1998 n = 16) per month. Errors bars are one standard deviation of the mean.

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