

Decadal Changes in Reef Fish Recruitment at Turneffe Atoll, Belize: Before and After Lionfish Invasion

Cambios Decenales en el Reclutamiento de Peces de Arrecife en el Atolón Turneffe, Belice: Antes y Después de la Invasión del Pez León

Décennales Changements dans le Recrutement des Poissons de Récif À Atoll Turneffe, Belize: Avant et Après L'invasion de la Poisson-lion

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ABSTRACT

Invasive lionfish have been shown to have many deleterious effects on native reef fish populations in the western Atlantic, reducing recruitment by up to 80% and prey fish biomass by 65%. Few studies have been able to compare baseline fish recruit communities on natural reefs before and after the invasion. With historical data going back over a decade, we look at the differences in community structure before and after the lionfish invasion at seven sites around Turneffe Atoll, Belize. Significant differences in the abundance of some species were found across survey years, with 2002-2004 typically having similar abundances and 2013 being most different from the others. A nonmetric multidimensional scaling analysis was used to compare overall community structure. We found differences in the structure of recruit communities across this decadal time scale; with some species being more frequently observed post invasion while others were more common prior to the invasion. It is currently unclear if the lionfish invasion (ca. 2008) is the primary factor for the observed shift in community structure at Turneffe Atoll or if other factors are the primary driver (e.g. Hurricanes, coastal development, bleaching events etc.). Future manipulative studies need to be performed to determine the primary causes of the shifts in fish communities that are currently being observed at Turneffe Atoll.

KEY WORDS: Lionfish impacts, recruitment, coral reefs, community structure, invasive species

INTRODUCTION

Biological invasions are defined as the arrival, survival, and successful reproduction of a species in a habitat where it previously did not exist (Elton 1958). It has been estimated that invasive species cost the US economy more than \$120 billion annually (Pimentel et al. 2005) with at least 42% of all threatened and endangered species at risk due to invasive species (Pimentel et al. 2005). With rates of species invasions rapidly increasing globally (Ruiz et al. 1997, Cohen and Carlton 1998, Mack et al. 2000, Semmens et al. 2004, Côté and Green 2012), it is becoming more important to understand how these invasions are shaping the invaded communities.

The invasion of the western Atlantic and Caribbean by two species of lionfish (*Pterois volitans/miles*) represents the first case of a marine fish becoming a major invasive threat to a local ecosystem (Albins and Hixon 2011) and is recognized as a global environmental problem (Sutherland et al. 2010). Lionfish are voracious predators in their invaded range consuming a wide variety of both economically and ecologically important species such as: grouper, snapper and parrotfish (Morris and Akins 2009, Côté et al. 2013). Lionfish have been shown to reduce recruitment of native species by up to 80% on artificial reefs and overall native fish biomass by 65% (Albins and Hixon 2008, Green et al. 2012). The consumption of the ecologically important herbivorous parrotfish has been suggested as the trigger of a trophic cascade in a mesophotic reef in the Bahamas, leading to overgrowth of corals by competitively dominant algae (Albins and Hixon 2011, Lesser and Slattery 2011).

Despite the growing awareness of the impact of lionfish on native fish species, few studies have looked at the how lionfish are changing the structure of native communities on natural reefs. Here we use surveys of recruitment over a decadal scale, spanning the lionfish invasion, to investigate the possible effects of lionfish predation on natural reef fish communities. Given that lionfish are known to drastically reduce native fish recruitment (Albins and Hixon 2008) we hypothesize that the community structure of native fish species has changed since the lionfish invasion.

METHODS

This study was conducted at seven sites around Turneffe Atoll in Belize (TA) spaced approximately 10 km apart around the circumference (Figure 1). The sites were censused for recruitment of 16 species of common species of reef fishes (Table 1) on a bi-weekly basis during the summer months (between May and September) of 2002 through 2004. One identical survey was performed in July/August 2013. Only individuals ≤ 2.5 cm total length were recorded as newly recruited juveniles. At each site recruitment was censused using 16 1 x 30 m transects, eight of which were located at a deep