A Comparison of the Feeding Ecology of the Invasive Lionfish in Bonaire, Klein Bonaire, and Curacao

Una Comparación de la Ecología Alimentaria del Pez León Invasor en Bonaire, Klein Bonaire y Curacao

Comparaison de L'écologie de L'alimentation de la Poisson Lion Invasive à Bonaire, Klein Bonaire et Curacao

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ABSTRACT

Widely regarded as a generalist predator with a voracious appetite, lionfish are principally piscivorous but have been known to feed on invertebrates. Prey species in the Atlantic region are naïve to lionfish predation strategies, resulting in lionfish having higher predation efficiencies than either local predators or lionfish in their native range. Lionfish management is considered a regional issue across the Atlantic and Caribbean region, but if lionfish feeding ecology varies between regions (especially amongst islands within the invaded regions), the consequent ecological impacts are likely to vary, and control or eradication strategies will need to be tailored to each regional area. To determine the magnitude of ecological impacts of lionfish, and to assess for local-scale variation in feeding ecology, a total of 11,161 lionfish ranging between 21 to 455 mm TL were collected and analysed between October 2009 and November 2013. Lionfish were sampled from Bonaire (6,288), Klein Bonaire (2,743) and Curacao (2,130). Stomach contents were identified and feeding ecology analysed to assess whether lionfish exhibited density-dependent feeding and whether trait-based selection was occurring whereby factors such as prey colour, shape, or behaviour affected dietary preferences. Finally, lionfish feeding ecology from the southern edge of the invaded rage was compared to that reported previously from the United States and Bahamas to determine whether feeding ecology and preferences differed geographically and over the invasion timeline.

KEY WORDS: Marine, invasive, diet, control, Caribbean

INTRODUCTION

The red lionfish (*Pterois volitans)* is a generalist predator with a voracious appetite (Morris and Akins 2009, Green et al. 2012, Benkwitt 2013, Cote et al. 2013) employing a diverse range of feeding strategies making them well suited for feeding on benthic and cryptic prey and occupying higher levels of the food chain (Hare and Whitfield 2003, Bervoets 2009). Prey species in the Atlantic region are regarded as being naïve to lionfish's predation strategies, resulting in lionfish having higher predation efficiencies (Albins and Hixon 2008). This study conducted extensive stomach content analysis at the onset of invasion in Bonaire and Curacao and compares the realized diet and inferred feeding ecology to previous studies in home range and in Bahamas. The overall aims of this study were to:

i) Examine the dietary preferences and habits of lionfish around Bonaire, Klein Bonaire and Curacao,
ii) Compare lionfish diet composition over a four-year time scale in Bonaire, and
iii) Compare lionfish feeding ecology in Bonaire, Klein Bonaire and Curacao to Morris and Akins' (2009) study in Bahamas and other case studies presented in scientific literature.

METHODS

Between October 26th, 2009 and November 24th, 2013 a total of 11,161 lionfish were collected in Bonaire, Klein Bonaire, and Curacao during the hours of 07:30 to 23:00. Trained volunteers collected all specimens using scuba gear at the dive sites surrounding Bonaire, Klein Bonaire, and Curacao. These sites consisted of high profile coral reefs and patch reefs, ranging in depth from 0.3 to 91.5 m. Collections were achieved using hand nets, pole spears, or the use of the Eradicating Lionfish Tool (ELF Tool). ELF Tool and caught specimens were stored in containment devices such as dry bags or the Zookeeper™. Upon capture of specimens, data was collected on the date, time, location, and depth of capture, and lionfish were measured (Standard Length, Total Length, Wet Weight). Specimens were also visually examined for the presence of supra-ocular tentacles and external parasites, and their gonads visually examined to determine sex and maturity. Finally, the stomach was severed and contents examined and identified to the lowest possible taxon, counted, measured to the nearest mm, and volumetric analysis conducted to calculate indices of dietary importance.

RESULTS AND DISCUSSION

A total of 11,161 lionfish ranging between 21 to 455 mm TL were collected and analysed between October 26, 2009 and November 24, 2013 where a total of 10,945 prey items (7,383 fish and 3562 invertebrate) belonging to 29 families (11 invertebrate, 18 fish) were documented in their stomach contents. Lionfish across all study sites possessed a predominantly fish only diet (Bonaire: 45%, Klein Bonaire: 43%, and Curacao: 46%) (Figure 1). Stomach composition fluctuated through-out the day (Figure 1). Comparison of the overall ranking of families within Bonaire, Klein Bonaire, and Curacao revealed that the top eight families were similar in composition but different in ranking. Across all three dietary importance indices,

the top four teleost families in lionfish diets in Bonaire, Klein Bonaire, and Curacao are Pomacentridae, Gobiidae, Labridae, Apogonidae, and Grammatidae (Table 1). Interestingly lionfish in this study did not appear to be as gluttonous/voracious as initially suggested by other studies in the Caribbean (Albins and Hixon 2008, Albins and Lyons 2012, O'Farrell et al. 2014) and do not appear to be removing large quantities of ecological and economically important species.

CONCLUSION

Lionfish within Bonaire, Klein Bonaire and Curacao possessed a generalist, but predominantly fish-only diet. However, contrary to scientific literature, lionfish within this study did not appear to be as gluttonous/voracious as they did not remove large quantities of ecological or economically important species, but instead acted as a typical predator, a niche generally lacking within the Caribbean. Further research is required to assess the impacts of the invasive lionfish based on its feeding ecology within the Caribbean region.

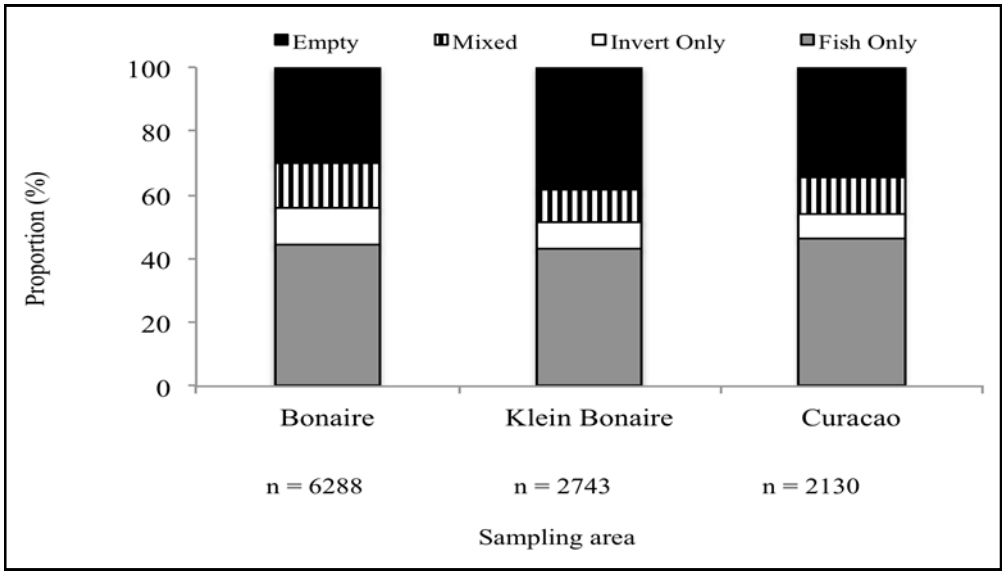

Figure 1. Diet composition of lionfish in Bonaire, KleinBonaire, and Curacao

Table 1. Rankings of the top 10 fish families in Bonaire, Curacao, Klein Bonaire, and Bahamas based on the Index of Relative Importance (IRI)

Rank	Bonaire [n = 1,883]	Curacao [n = 1,282]	Klein Bonaire [n = 1,493]	Bahamas (2009) [n = 1,069]
1	Pomacentridae	Pomacentridae	Pomacentridae	Gobiidae
2	Labridae	Gobiidae	Gobiidae	Labridae
3	Grammatidae	Labridae	Apogonidae	Grammatidae
4	Apogonidae	Apogonidae	Labridae	Apogonidae
5	Gobiidae	Serranidae	Serranidae	Pomacentridae
6	Serranidae	Scaridae	Scaridae	Serranidae
7	Blenniidae	Grammatidae	Grammatidae	Blenniidae
8	Scaridae	Blenniidae	Blenniidae	Antherinidae
9	Lutjanidae	Acanthuridae	Holocentridae	Mullidae

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