Effectiveness of removals of the invasive lionfish: how many dives are needed to deplete a reef?

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ABSTRACT

Introduced Indo-Pacific red lionfish (*Pterois volitans/miles*) have spread throughout the greater Caribbean and are associated with a number of negative impacts on reef ecosystems. Human interventions, in the form of culling activities, are becoming common to reduce their numbers and mitigate the negative effects associated with the invasion. However, marine managers must often decide how to best allocate limited resources. Previous work has identified the population size thresholds needed to limit the negative impacts of lionfish. Here we develop a framework that allows managers to predict the removal effort required to achieve specific targets (represented as the percent of lionfish remaining on the reef). We found an important trade-off between time spent removing and achieving an increasingly smaller lionfish density. The model used in our suggested framework requires relatively little data to parameterize, allowing its use with already existing data, permitting managers to tailor their culling strategy to maximize efficiency and rate of success.

Subjects Ecology, Marine Biology
Keywords Invasive species, Lionfish, Caribbean, Removal efficiency, *Pterois volitans*, Management prioritization

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INTRODUCTION

Indo-Pacific red lionfish (*Pterois volitans/miles*) were introduced to South Florida in the 1980's and have since spread throughout the greater Caribbean showing exponential population growth throughout the invaded range (*Betancur-R et al., 2011*), with populations in the invaded range reaching greater densities than those of their native range (*Kulbicki et al., 2012*). These population booms have resulted in reduced abundance of native species (*Morris & Akins, 2009*; *Barbour et al., 2010*; *Côté & Maljkovic, 2010*), decreases in recruitment (*Albins & Hixon, 2008*), and possible shifts in benthic community composition (*Lesser & Slattery, 2011*; *Albins & Hixon, 2013*; *Layman, Jud & Nichols, 2014*). Human intervention, in the form of culling, has become common to mitigate lionfish's negative effects (*Morris, 2012*).

Total eradication of lionfish across the invaded range is unlikely due to their high abundance, wide-spread distribution and the high resilience of the species (*Morris, Shertzer*