Journal of Experimental Marine Biology and Ecology 483 (2016) 104–111

Contents lists available at ScienceDirect

Journal of Experimental Marine Biology and Ecology

journal homepage: www.elsevier.com/locate/jembe

Assessing the performance of a cost-effective video lander for estimating relative abundance and diversity of nearshore fish assemblages

Jessica L. Watson *, Brittany E. Huntington *

Oregon Department of Fish and Wildlife, Marine Resources Program, Newport, Oregon, United States

ARTICLE INFO

Article history:
Received 31 March 2016
Received in revised form 25 May 2016
Accepted 8 July 2016
Available online 17 July 2016

Keywords:
Rockfish
Underwater visual census
Marine reserves
GoPro®
Temperate

ABSTRACT

Rocky reefs in the temperate Northeast Pacific constitute a small portion of the nearshore seabed, yet are highly valued as productive habitat for local fisheries. Surveying these structurally complex, untrawlable habitats requires robust gear that can be deployed in rough sea states. Here, a cost-effective, compact video lander was evaluated for its ability to survey the diversity and abundance of nearshore (<40 m), rocky-reef-associated fish populations (e.g. Sebastes, Cottidae, Hexagrammidae). To determine the application and limitations of surveying complex rocky reefs with this new tool, this study sought to (1) determine the frequency of observation of known nearshore fish species, (2) evaluate the influence of baiting the lander on the observed fish assemblage, (3) identify the optimal deployment time to maximize observed species richness and abundance, and (4) evaluate species-specific behavioral responses to the lander characterized *a priori* as attractive, avoidance, or neutral. Seventy percent of lander deployments met established requirements of visibility, view, and habitat. Seventy-seven percent of observed fishes were identifiable to species. The method observed 15 species belonging to 5 families; 5 species were classified as common (observed in >20% of deployments), the remaining rare. Contrary to lander studies in other regions, bait was not found to improve species-specific identification, increase observed species richness or abundance (at the species or feeding guild level), or shorten deployment duration. A deployment time of 8 min on the benthos was determined as optimal for observing maximum species richness and abundance in the nearshore, doubling the previously described lander drop durations evaluated in deeper Oregon, U.S.A., waters. Species-specific behavioral responses to this compact lander were evaluated by viewing trends in species abundance (assessed within 30 s bins) over the deployment duration; no attractive or avoidance behaviors were observed. Results confirm that this simple, cost-effective video lander configuration is suitable for sampling the suite of fish species found in the nearshore, including rockfish species federally designated as "overfished" (*Sebastes pinniger* and *Sebastes ruberrimus*). Furthermore, this study illustrates the importance of evaluating the performance of survey tools in the specific environment in which the tool will be used to determine best-practices from long-term monitoring.

1. Introduction

Successful long-term monitoring strategies hinge on obtaining precise and accurate data on the diversity and abundance of focal populations. In the marine environment, this information can be challenging to obtain due to logistical and technical limitations of surveying underwater. The temperate reef systems in the nearshore Northeast Pacific (<40 m) are an important habitat for commercially and recreationally valuable fish species—including two federally designated overfished species (i.e. *Sebastes pinniger* and *Sebastes ruberrimus*). These structurally complex, untrawlable habitats present a challenge to survey. Yet, marine resource managers acknowledge the growing need for a comprehensive fishery-independent survey that can sample these reef-associated species considered at or below sustainable fishing thresholds (Yoklavich et al., 2007). Video-based techniques are advancing as a non-extractive, fishery-independent approach to monitor fish communities in these habitats. Mobile video camera systems have been designed to be towed behind boats (Knight et al., 2014; Lauth et al., 2004; Williams et al., 2010) and installed on remotely operated vehicles (Johnson et al., 2003). However, these mobile video approaches are frequently both logistically complex and expensive to execute, limiting the frequency of their use. Stationary video landers (i.e. underwater drop cameras) offer a logistically simple, inexpensive alternative that can be particularly useful to survey high-relief, rocky areas (Hannah and Blume, 2012; Langlois et al., 2010).

A growing number of studies have been conducted in recent years to assess the strengths and limitations of various designs of video landers to effectively survey fish communities (Watson et al., 2010; Holmes et

* Corresponding authors.
E-mail addresses: Jessica.l.watson@state.or.us (J.L. Watson), Brittany.e.huntington@state.or.us (B.E. Huntington).

http://dx.doi.org/10.1016/j.jembe.2016.07.007
0022-0981/

al., 2013; Hannah and Blume, 2012, 2014; Langlois et al., 2010). While this body of work continues to grow in subtropical and deeper temperate environments, evaluations of lander methods in shallow (<40 m), temperate habitats are more limited (but see Pita et al., 2014). Video lander configurations vary. Some configurations use external lights while others do not. Baited video landers have been shown to increase the diversity of species observed and be more cost-effective compared to underwater visual census approaches (Stobart et al., 2007; Langlois et al., 2010), while other studies have used unbaited landers to effectively capture fish and habitat data (Hannah and Blume, 2012; Easton et al., 2015; Pita et al., 2014). Optimal lander deployment (drop) durations reported in the literature vary widely, from 10 min or less (Hannah and Blume, 2012; Ellis and DeMartini, 1995) to up to 60 min (Colton and Swearer, 2010; Harvey et al., 2007; Langlois et al., 2010). Given this variation in lander configuration and deployment duration, it is essential when developing a robust lander survey approach to evaluate a given configuration's performance in the specific habitats of interest to refine protocols and test limitations of the sampling tool.

Studies evaluating the strengths and limitations of a video lander approach for a given area or fish community are especially valuable to inform long-term monitoring strategies for a given region (Pita et al., 2014; Stobart et al., 2007). Video landers show promise to comprise a key component of the long-term strategy for monitoring nearshore waters and the newly established marine protected areas in California and Oregon, U.S.A. (Langlois et al., 2012, 2006). As such, they have recently been the subject of methodical studies in this region (Hannah and Blume, 2012, 2014). However, we know of only one study using a video lander in shallow (<40 m) nearshore waters in Oregon (Easton et al., 2015). While Easton et al. (2015) used a lander to explore fish–habitat associations in this environment, their study did not evaluate the strengths and limitations of the tool. In the nearshore Northeast Pacific, favorable sea states (including visibility) are limited and the landers themselves are often expensive and bulky to withstand deployment into complex rocky habitats. The size and weight of these lander configurations also often require the additional expense of contracting larger vessels for deployment. Specific fish species common to shallow littoral habitats in the Northeast Pacific may exhibit varied responses to a video lander; introducing uncertainty in detectability that may influence the tool's ability to provide unbiased data. Additionally, the poor-visibility in the nearshore Northeast Pacific may limit the ability to confidently identify fish to species.

Here, a lightweight, cost-effective video lander was designed to be readily deployed off smaller vessels as an alternative to previously used larger lander configurations to sample the diversity and abundance of nearshore fish communities (e.g. Sebastes, Cottidae, Hexagrammidae) in Oregon's nearshore system of marine reserves. Diversity and abundance estimates of these nearshore reef fish assemblages are important metrics when monitoring Oregon's marine reserves. As such, optimizing the collection of these metrics should be considered when assessing this new lander configuration. Specifically, video landers generate relative conservative abundance estimates of the fish inhabiting a given reef. However, the limitation of these relative abundances estimates is that they may underestimate true abundance (Conn, 2011). Thus, it is important when using this newly configured lander to try to limit underestimates of abundance to verify that the highest abundance possible is observed during the drop duration. The Oregon Department of Fish and Wildlife (ODFW), the management agency tasked with monitoring reserve performance, recognized the need to assess the application and limitations of this new lander design within Oregon's nearshore waters to sample the target fish community prior to establishing long-term marine reserve monitoring with this tool. The objectives of this assessment were fourfold: (1) to determine the frequency of observation of nearshore fish species; (2) to determine whether baiting the lander would improve ability to resolve species-specific identification, increase estimates of species richness, increase estimates of abundance, or reduce drop duration needed to observe maximum richness or abundance; (3) to identify the optimal drop duration to maximize richness and abundance in this environment; and (4) to evaluate the *a priori* behavioral responses of species to this lander that could bias data. Evaluating the performance of this cost-effective, compact video lander prior to establishing a long-term monitoring program is essential to inform marine resource managers about the strengths and limitations of this sampling approach to survey the fish community of interest in this environment.

2. Material and methods

2.1. Lander design

The objective of lander configuration presented here was to reduce the size and weight such that it could be readily deployed off smaller vessels frequently owned by management agencies, ameliorating the expense of contracting larger vessels. Additionally, reducing the cost of the lander itself enables replicate landers to be affordably constructed and used simultaneously to maximize sampling during rare weather and visibility windows. Given the shallow depths of Oregon's nearshore rocky reefs and marine reserves, ambient light was deemed sufficient, eliminating the need (and cost) of external lights. To maximize data collection during favorable sea states, the newly configured lander needed to be remote (i.e. without live-feed umbilical to the vessel) to allow multiple lander deployments at a given time from a single vessel. Lastly, the lander needed to be designed to be both rugged and stable for encountering rocky reef habitats in an upright orientation.

The lander frames were constructed of 25 mm ID aluminum pipe in a tripod design with lead leg weights and topped with two 3 mm thick aluminum plates 20 cm in diameter (Fig. 1). Weights were attached to the base of the legs to maintain a low center of gravity to reduce potential for tipping. At the top of the lander was a stainless steel eye bolt for buoy line attachment (Fig. 1). This streamlined tripod configuration was designed to reduce the chance of the lander frame becoming stuck in rocky habitat but strong enough to be able to withstand contact with rocky substrates with limited damage. Three GoPro® Hero 3+ Black Edition HD cameras with magenta filters were mounted 42 cm from the base of the lander (comparable Hannah and Blume, 2012) with 120° separation (Fig. 1). Three cameras maximized the likelihood of obtaining unobstructed video footage on at least one camera. Footage from a single camera per drop was used for analysis. These cameras were chosen based on cost, relatively high image quality in low light conditions, and small size. High-definition video was collected at 1080 × 1920 progressive format at 48 frames per second in the low-

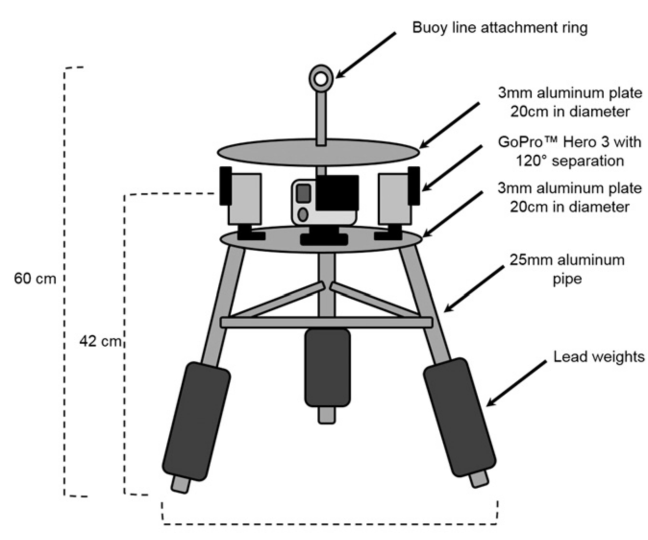

Fig. 1. Schematic of the lander design showing the various components.