Fisheries Research 204 (2018) 16–25

Contents lists available at ScienceDirect

Fisheries Research

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

Habitat-specific performance of vertical line gear in the western Gulf of Mexico: A comparison between artificial and natural habitats using a paired video approach

Matthew K. Streich[a,*], Matthew J. Ajemian[b], Jennifer J. Wetz[a], Gregory W. Stunz[a]

[a] Harte Research Institute for Gulf of Mexico Studies, Texas A&M University–Corpus Christi, 6300 Ocean Drive, Unit 5869, Corpus Christi, TX, 78412, USA
[b] Florida Atlantic University, Harbor Branch Oceanographic Institute, 5600 US 1 North, Fort Pierce, FL, 34946, USA

ARTICLE INFO

Handled by Bent Herrmann

Keywords:
Vertical line
Gear efficiency
Selectivity
Red snapper
Relative abundance

ABSTRACT

Gear performance is often assumed to be constant over various conditions encountered during sampling; however, this assumption is rarely verified and has the potential to introduce bias. We used fishery-independent vertical line surveys to evaluate whether gear efficiency and selectivity is similar while assessing reef fish populations at oil and gas platforms, artificial reefs, and natural banks in the western Gulf of Mexico. We conducted 192 vertical line sets with cameras placed on a subset of these deployments to validate any differences in efficiency among habitat types. Red snapper (*Lutjanus campechanus*) accounted for 93% of the catch. No difference in red snapper CPUE among habitats was detected. When evaluating fish size, 8/0 and 11/0 hooks sampled significantly larger red snapper at natural banks than at artificial habitats. While CPUE was similar among all hooks at artificial habitats, CPUE at natural banks was lower for shallower hooks and increased towards the bottom hooks along the backbone. At all habitats, red snapper TL decreased from shallow to deep hook positions. Simultaneous camera deployments revealed other processes affecting efficiency such as bait removal and depredation. Vermilion snapper (*Rhomboplites aurorubens*) were effective at removing bait while avoiding capture. Perhaps related to this observation, Red snapper CPUE was negatively correlated with the vermilion snapper video index of abundance. Video confirmed gear saturation was prevalent (70% of deployments), occurring more frequently on artificial habitats. Furthermore, the time fished was effectively "shorter" at artificial habitats as the number of available baited hooks declined rapidly. These results point towards higher relative abundance at artificial habitats; however, the prevalence of saturation indicates vertical line CPUE may not always be proportional to true abundance, hindering our ability to detect differences at the scale examined in this study. Vertical line surveys should evaluate the prevalence of saturation as inferences regarding relative abundance may be compromised when this information is unknown.

1. Introduction

For many exploited fish populations, stock assessments and management commonly rely on fishery-dependent data. However, such data can often be biased by fisher behavior (e.g., targeting of specific portions of the population), management regulations, and gear selectivity (Hilborn and Walters, 1992). Fishery-independent sampling can control for some of these issues and efficiently provide indices of abundance and other biological data over a variety of spatial and temporal scales, which is critical for effective management (Yoccoz et al., 2001). However, fishery-independent methods may still suffer from the same inherent catchability and size selectivity biases because the gears used are often nearly identical to the gear used in the fishery (e.g., longlines, traps; Ellis and DeMartini, 1995; Harvey et al., 2012; Santana-Garcon et al., 2014). Thus, evaluations of gear performance that can help to identify survey biases are needed, and if possible, should be conducted under a range of environmental conditions and at various habitats that may be encountered during sampling.

Fishery-independent surveys commonly supply indices of abundance that are derived from catch per unit effort (CPUE). The usefulness of these indices relies on the assumption that changes in CPUE reflect proportional changes in actual abundance (Hilborn and Walters, 1992; Quinn and Deriso, 1999). Furthermore, this approach assumes that gear efficiency and selectivity remain constant across space, time, habitat types, and environmental conditions, which is often not the case nor verified (Hilborn and Walters, 1992; McAuley et al., 2007; Rozas and

* Corresponding author.
E-mail addresses: matthew.streich@tamucc.edu (M.K. Streich), majemian@fau.edu (M.J. Ajemian), jennifer.wetz@tamucc.edu (J.J. Wetz), greg.stunz@tamucc.edu (G.W. Stunz).

https://doi.org/10.1016/j.fishres.2018.01.018
Received 29 May 2017; Received in revised form 19 January 2018; Accepted 28 January 2018
0165-7836/

Minello, 1997). Certain gears such as longlines may be particularly prone to violating this assumption, because efficiency declines as the number of hooks remaining unoccupied and baited declines during the soak time (Somerton and Kikkawa, 1995). Identifying and accounting for such bias is crucial for estimating the relationship of the survey index with absolute population abundance; however, estimates of absolute population size are often unavailable or expensive to obtain. Nevertheless, with recent advances in remote monitoring (e.g., remote underwater video) and the use of paired gear comparisons, calibration and refinement of surveys designed to index abundance can be achieved (Bacheler et al., 2013a, 2014; Parker et al., 2016; Rodgveller et al., 2011).

In the U.S. Gulf of Mexico (GOM), recent stock assessments for red snapper (*Lutjanus campechanus*) have recommended additional fishery-independent sampling to elucidate regional and sub-regional (e.g., habitat) differences in red snapper demographics (SEDAR, 2013). Accordingly, a vertical line survey was recently developed to characterize the spatial and temporal distribution of commercially and recreationally important reef fish species (Gregalis et al., 2012; SEAMAP, 2013). One particular goal of the survey includes generating an index of abundance for red snapper at both unstructured and structured (i.e., natural hard bottom and artificial structure) habitat types while also providing fishery-independent biological data on size structure, age, growth, and reproduction (Gregalis et al., 2012; SEAMAP, 2013). While this gear is efficient in obtaining such data from patchy reef habitats, there are nuances with selectivity than can influence assessments. For example, Gregalis et al. (2012) evaluated the performance of vertical lines to sample reef fish at artificial (e.g., military tanks and reef pyramids) and unstructured habitats (i.e., bare substrate) off the coast of Alabama. They showed that peak catch rates occurred with five minute soak times and demonstrated the species selectivity of vertical lines by using a remotely operated vehicle (ROV) survey prior to the vertical line soak. Vertical line hook size selectivity has also been estimated for red snapper and vermilion snapper (*Rhomboplites aurorubens*) at natural habitats in the GOM (Campbell et al., 2014). While these two studies have provided important information on the performance and selectivity of vertical lines, vertical line gear performance among habitat types remains underdeveloped. This is particularly important given that the survey spans natural and artificial habitats – two habitats that can have dramatically different physical characteristics (e.g., vertical relief, habitat area). If vertical lines fish habitats differently, data generated from the survey (i.e., CPUE index of abundance; size structure) may not be comparable across habitats. For example, because the gear fishes vertically in the water column, the efficiency or size selectivity of shallower hooks may be different at natural habitats given their greater distance from the structure.

The goal of this study was to evaluate the performance of vertical lines, following Southeast Area Monitoring and Assessment Program (SEAMAP) specifications, to survey red snapper at three 'reef' habitats commonly found over the western GOM shelf. While other studies using vertical line gear have uncovered important data concerning red snapper population dynamics, our aim with this work was to provide information necessary for calibrating vertical line estimates of relative abundance. Given the previous work of Gregalis et al. (2012) and Campbell et al. (2014), we were specifically interested in testing the effects of hook size and hook position on the red snapper vertical line index of abundance (i.e., CPUE) and size among habitat types. Finally, we used simultaneous camera deployments to 1) compare an alternative video-based index of abundance with the vertical line index of abundance, and 2) evaluate other factors such as depredation and gear saturation that may alter vertical line efficiency between habitats.

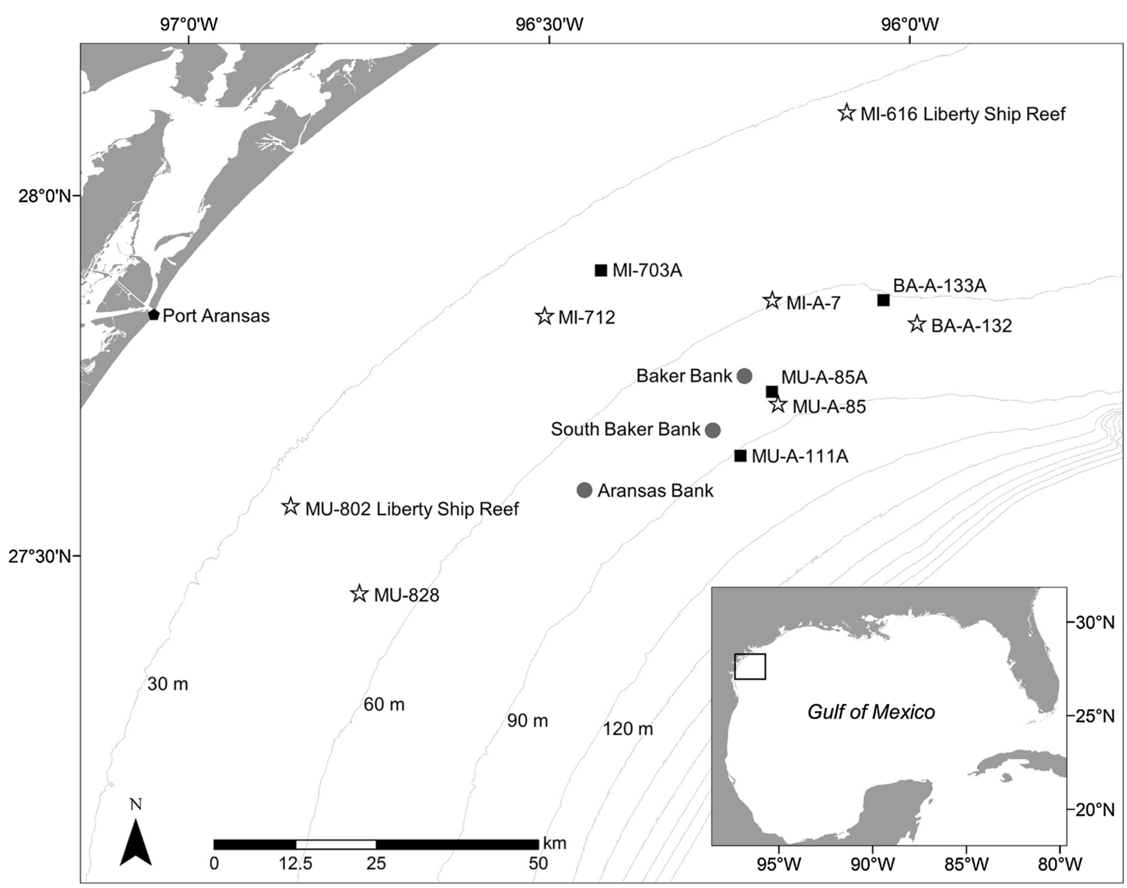

Fig. 1. Locations of artificial reefs (stars), standing platforms (black squares), and natural banks (gray circles) surveyed with vertical longlines from 2012 to 2015 in the western Gulf of Mexico. Gray contour lines indicate relevant bathymetry (30 m isobaths). Inset map displays study area relative to the Gulf of Mexico.