Comparison of video and traps for detecting reef fishes and quantifying species richness in the continental shelf waters of the southeast United States

Comparación de video y trampas para detectar peces de arrecife y cuantificar la riqueza de especies en las aguas de la plataforma continental del sureste de los Estados Unidos

Comparaison de vidéos et de pièges pour détecter les poissons de récif et quantifier la richesse spécifique dans les eaux du plateau continental du sud-est des États-Unis

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EXTENDED ABSTRACT

The management of many economically important reef-associated fish species is challenging due to difficulty sampling the rocky reef they inhabit and various life history characteristics leaving them vulnerable to exploitation (Coleman et al. 1999). commonly used sampling gears can be difficult to fish over rocky reef habitat and become snagged or damage the habitat. with the increase in underwater video sampling methods and the historical and still current use of traps for sampling, we compared chevron traps and underwater video for sampling temperate, rocky and coral reef habitats and reef fish communities. we used five years of comprehensive paired sampling data (n=7,034) collected over a large geographic area between north carolina and Florida along the southeast united states atlantic continental shelf, examining a large variety of fish species and families. to make comparisons, we examined frequency of occurrence of fishes caught in traps to those observed on video at both the family and species level and species richness between traps and videos.

Sampling includes chevron traps, shaped like an arrowhead when viewed from above, and using a paired sampling gear approach, underwater video cameras were attached to each trap to observe reef-associated fishes. each trap was baited with 24 menhaden (brevoortia spp.), had two high-definition cameras attached, one at the tip of the arrowhead and one at the base, and soaked for 90 minutes. a trap detection is characterized as at least one individual of that taxon was caught in that particular trap. fish detections from one camera at the base of the arrowhead, facing over the mouth of the trap were used in this study, evaluated from a continuous 20 minute segment of video starting 10 minutes after the trap landed on the sea floor. for a video detection, at least one individual from that taxon had to be observed during the 20 minute read segment. using presence-absence data for our analyses (whether a taxon was caught in a trap or observed on video) we compared frequency of occurrence of reef fishes at the family level. percent increase or decrease on video was then calculated using the frequency of occurrence for each family observed on video and caught in traps. statistical significance of potential differences between trap and video families frequency of occurrence was determined using a two-tailed exact binomial test. the second analysis at the species level was conducted in the same manner as the family level analysis focusing on 40 species due to their ecological or economic importance in the southeast atlantic ocean. the final relationship we examined was the number of fish species caught in traps to the number of fish species observed on video. a boxplot was used to illustrate this relationship showing the median number of species caught in traps at each number of species observed on video.

A total of 50 fish families were observed on video and 29 caught in chevron traps (fig. 1). the most commonly observed families on video were sparidae (n = 5,280; 75.1% of videos), serranidae (n = 5,279; 75.0%), carangidae (n = 4,807; 68.3%), labridae (n = 3,883; 55.2%), and lutjanidae (n = 3,863; 54.9%), whereas the most commonly caught families in traps were serranidae (n = 3,293; 48.6% of traps), haemulidae (n = 3,054; 43.4%), sparidae (n = 2,598; 36.9%), lutjanidae (n = 2,414; 34.3%), and balistidae (n = 1,949; 27.7%) (fig. 1). most fish families (40 out of 50; 80%) were observed significantly more frequently on video than they were caught in traps (two-tailed exact binomial tests: $p < 0.05$) (fig. 1). at the species level, 36 of the 40 species were observed on video more frequently that caught in traps and only 4 were observed less frequently on video than in traps (fig. 2). of those four only two species were caught significantly more often in traps than on video, black sea bass (*Centropristis striata*) and bank sea bass (*Centropristis ocyurus*) and 34 species were observed significantly more frequently on video ($p<0.05$) with twenty of the forty species more than 1000% more likely to be observed on the video than caught in a trap (fig. 2). eight species observed on video but never caught in the associated traps including goliath grouper (*Epinephelus itajara*), yellowtail snapper (*Ocyurus chrysurus*), sheepshead (*Archosargus probatocephalus*), queen triggerfish (*Balistes vetula*), and cobia (*Rachycentron canadum)*. the relationship between the number of species caught in traps and the number of species observed on video was asymptotic. at lower numbers the

relationship increased linearly for the number of species caught in traps but only at around 25-30% of the number of species observed on video, and beyond 10 species observed on video the corresponding number of species caught in trap increased very little. for example, if 10 species were observed on video the median number of species caught in the trap was 3 the median only increased to 4 when 30 species were observed on video.

In conclusion, fisheries stock assessments and management have diminished the utility of fishery-dependent data due to increased regulations and fishery-independent survey data is increasing in importance for these processes. no single sampling gear is able to perfectly sample the temperate reef habitats and fish community and determining the best fishery-independent sampling gears has become paramount for successful fisheries management (Murphy & Jenkins 2010). we found that video is a beneficial gear for sampling reef fishes on temperate rocky and coral reefs and when paired with traditional sampling gears like chevron traps allows us to leverage the strengths of each gear. to make inferences about patterns in reef fish biodiversity, video appears to be more useful than traps (Harvey et al 2012), however, traps have some distinct advantages with some species having a higher frequency of occurrence in traps than on video (Wells et al. 2008). using a paired gear approach allows for more comprehen-

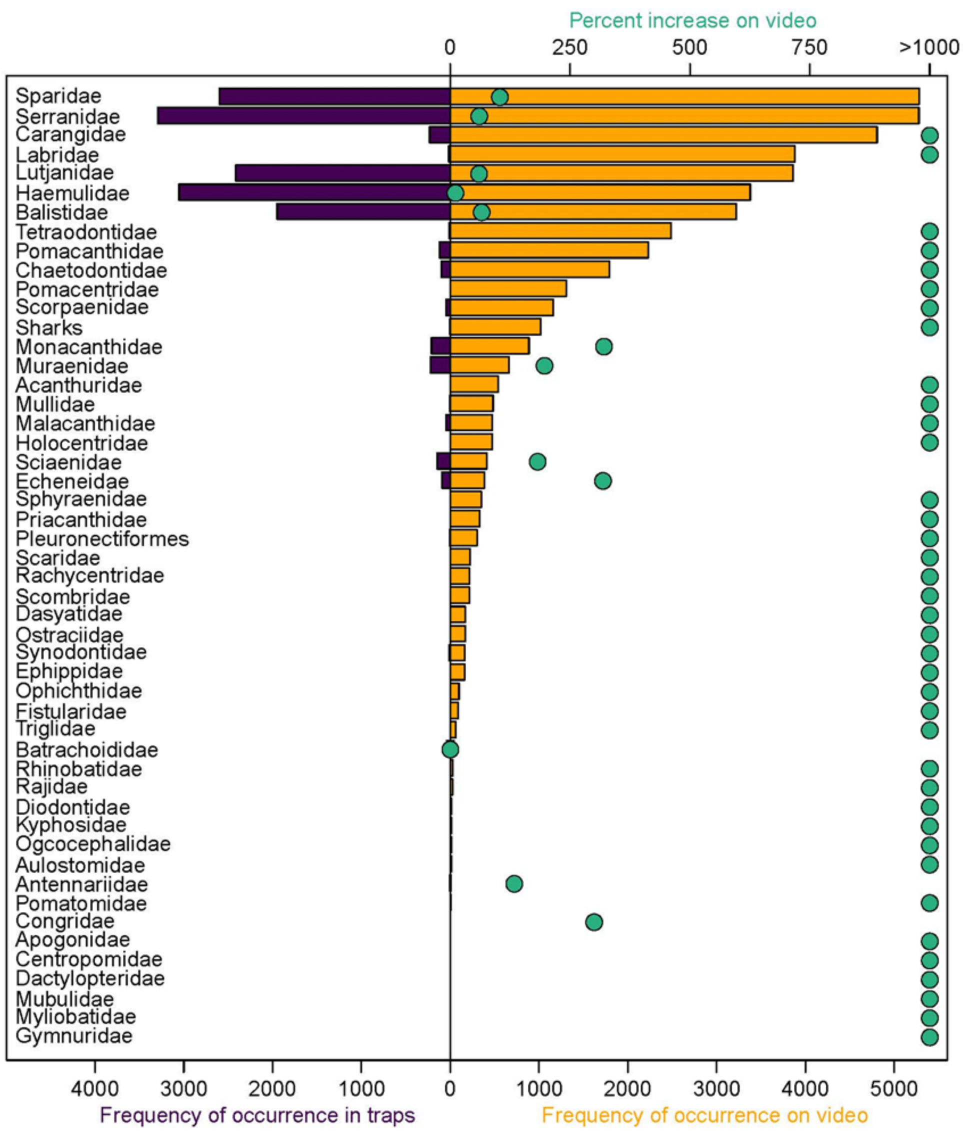

Figure 1. Frequency of occurrence of fish families from paired video (right of zero, orange bars) and trap (left of zero, purple bars) sampling on the southeast united states atlantic continental shelf in 2015–2019. the green points (top axis) shows the percent increase in frequency of occurrence on video compared to traps for all fish families. note that sharks from all families were grouped into a single "sharks" category, and all pleuronectiformes were grouped at the order level due to identification issues for flatfishes across various families.

sive data and the estimation of relative abundance and species richness with more certainty and the collection of biological samples to inform stock assessment models and management.

KEYWORDS: Biodiversity, BRUVS, Detection, Camera, Paired gears

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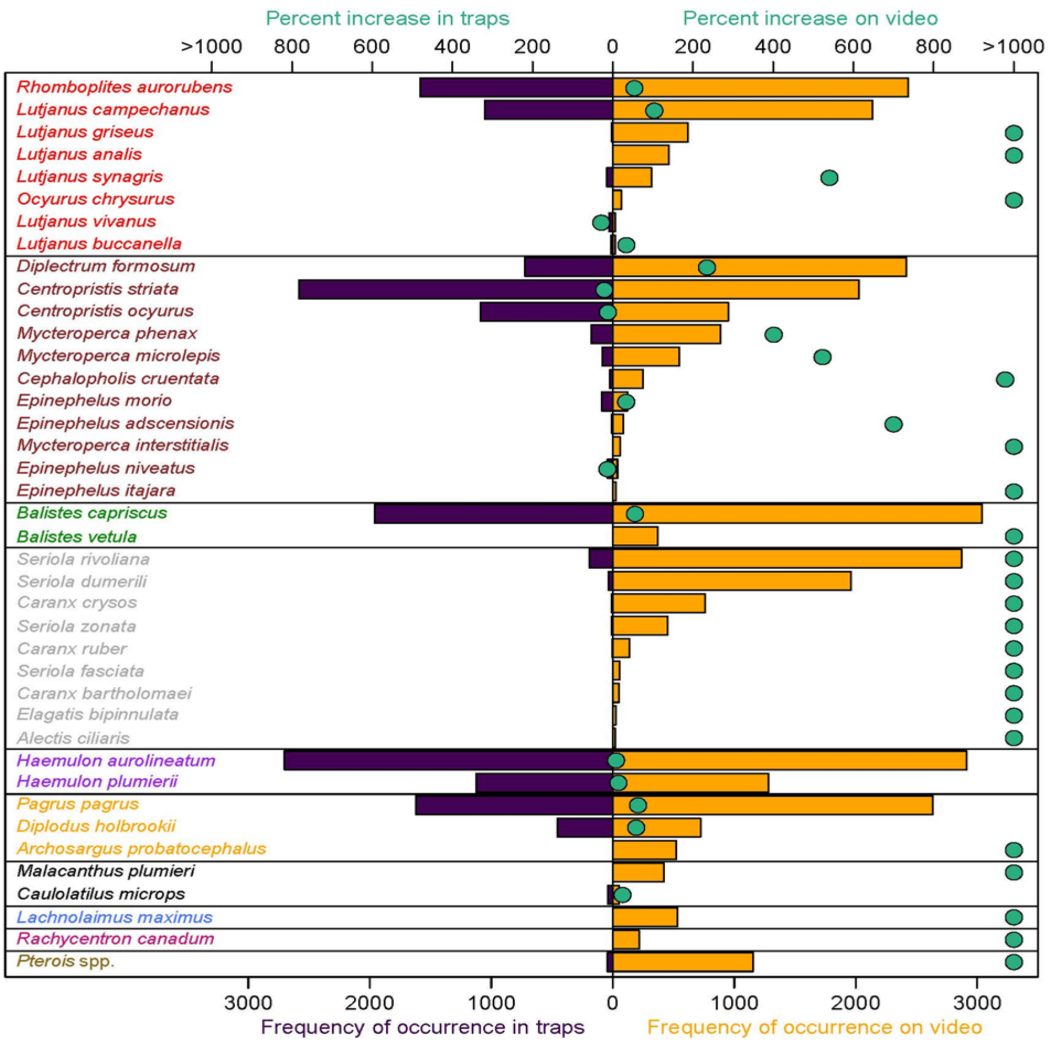

Figure 1. Frequency of occurrence of priority fish species (scientific names color coded by fish families) from paired video (right of zero, orange bars) and trap (left of zero, purple bars) sampling on the southeast united states atlantic continental shelf in 2015–2019. the green points (top axis) show the percent increase in frequency of occurrence on video compared to traps (right of zero) or vice versa (left of zero) for all species. note one exception of two Indo-pacific lionfish species grouped into a single species grouping of Pterois spp, as a result of the species being nearly morphologically identical.