Post-release survival and home range of mesopredators in a National Marine Sanctuary using acoustic telemetry.

Supervivencia posterior a la liberación y área de distribución de los mesodepredadores en un Santuario Marino Nacional utilizando telemetría acústica.

Survie après la remise à l'eau et domaine vital des mésoprédateurs dans un sanctuaire marin national à l'aide de la télémétrie acoustique.

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EXTENDED ABSTRACT

The effectiveness of marine protected areas is frequently compromised by a lack of critical information concerning habitat use of key species. An important tool in evaluating fish movement ecology is acoustic telemetry, where ensuring the optimal survival of tagged fish is critical to collecting robust data. In this study, acoustic telemetry was used to evaluate post -release survival of two native mesopredators, *Cephalopholis cruentata* (graysby) and *Lutjanus griseus* (gray snapper), tagged internally at-surface and at-depth, as well as asses habitat use and overlap within a National Marine Sanctuary.

Along the continental shelf edge in the northwestern Gulf of Mexico, Flower Garden Banks National Marine Sanctuary protects a series of special habitats under the National Marine Sanctuaries Act (16 U.S.C. 1431). This includes East Flower Garden Bank (EFGB) the northern most coral reef in North America and some of the healthiest coral habitat in the western hemisphere (Johnston et al. 2022). EFGB is a high rugosity complex coral reef primarily composed of *Orbicella* spp. that extends from 17–50 m deep. However, there is current limited understanding of spatiotemporal habitat use of key meso-predators across the sanctuary. An improved understanding of species' habitat use will play a pivotal role in shaping management decisions and preserving ecosystem services.

Cephalopholis cruentata and *L. griseus* were tagged between June – September 2022, on EFGB and monitored by a 20 VR2Tx receiver array. Receivers were installed at 150 m distance from one another and secured at either 2 m or 5 m above the reef to ensure line-of-sight was maintained between receivers. The receiver array encompassed a detection area of approximately 27 hectares of high complexity coral reef. At-surface tagged *C. cruentata* (N=6) and *L. griseus* (N=4) were collected from the surface with hook-and-line, vented, and released immediately post-surgery using a SeaQualizer descend-er or released at-depth by divers. *Cephalopholis cruentata* (N=4) and *L. griseus* (N=3) tagged at-depth were collected and maintained at-depth by scuba divers using hand lines or nets, administered anesthesia (MS-222) prior to surgery, and released immediately post-surgery. Both species were tagged internally with V9-4L or V8-4L transmitters following the same surgical procedures. For all individuals, the tag-to-body relationship never exceeded 2% of fish total weight, estimated by size and allometric weight conversion.

Cephalopholis cruentata tagged at-depth were detected for an average of 95% of the potential detection period, whereas *C. cruentata* tagged at-surface were detected for an average of 6% of the potential detection period. At-depth and at-surface tagged *L. griseus* were detected for an average of 72% and 100% of the potential detection period, respectively. Kernel utilization distribution (KUD) of hourly center of activity for each species revealed that *C. cruentata* (n=2) average home range (95% KUD) was 0.007 ha (± 0.003 SD) and average core range (50% KUD) was <0.001 ha (± <0.001 SD). Overlap was not determined due to the limited sample size. *Lutjanus griseus* (n=7) average home range was 13.3 ha (± 4.8 SD) and average core range was 2.1 ha (± 1.0 SD). The average degree of overlap of *L. griseus* home range was 58.1% (± 22.1 STD).

While surgically placing acoustic tags at-depth is more logistically complex than tagging at-surface due to diver-based limitations, the additional effort of at-depth tagged dramatically improved long-term survival of *C. cruentata*. The life-history of *C. cruentata* may contribute to their sensitivity to barotrauma as the species does not naturally make significant vertical movements through the water column, primarily inhabiting rocky reefs and hiding within or nearby structure. Conversely, *L. griseus* did not exhibit distinct differences in post-release survival between at-surface or at-depth tagging methods. The species is known to naturally make regular vertical movements through the water column. The study demonstrates that species-specific life-history, particularly tendencies to make natural vertical movements, should be considered in tagging studies to improve post-release survival of target species.

Home range estimates for *C. cruentata* were limited to two individuals due to the small-scale movements of the species. The majority of detections for each individual were restricted to one receiver, preventing KUD analysis and therefore, home range estimates. A greater resolution movement study is needed to fully assess habitat use and examine spatial overlap for *C. cruentata.* However, *L. griseus* made much larger scale movements across the reef and this study presents the first home and core range area estimates for the species. While there was variability in the home range size between individuals, moderate to large spatial overlap was observed. *Lutjanus griseus* exhibit distinct temporal behaviors: hunting and feeding during crepuscular periods and resting in schools during the daytime. Further examination of this data is needed to elucidate

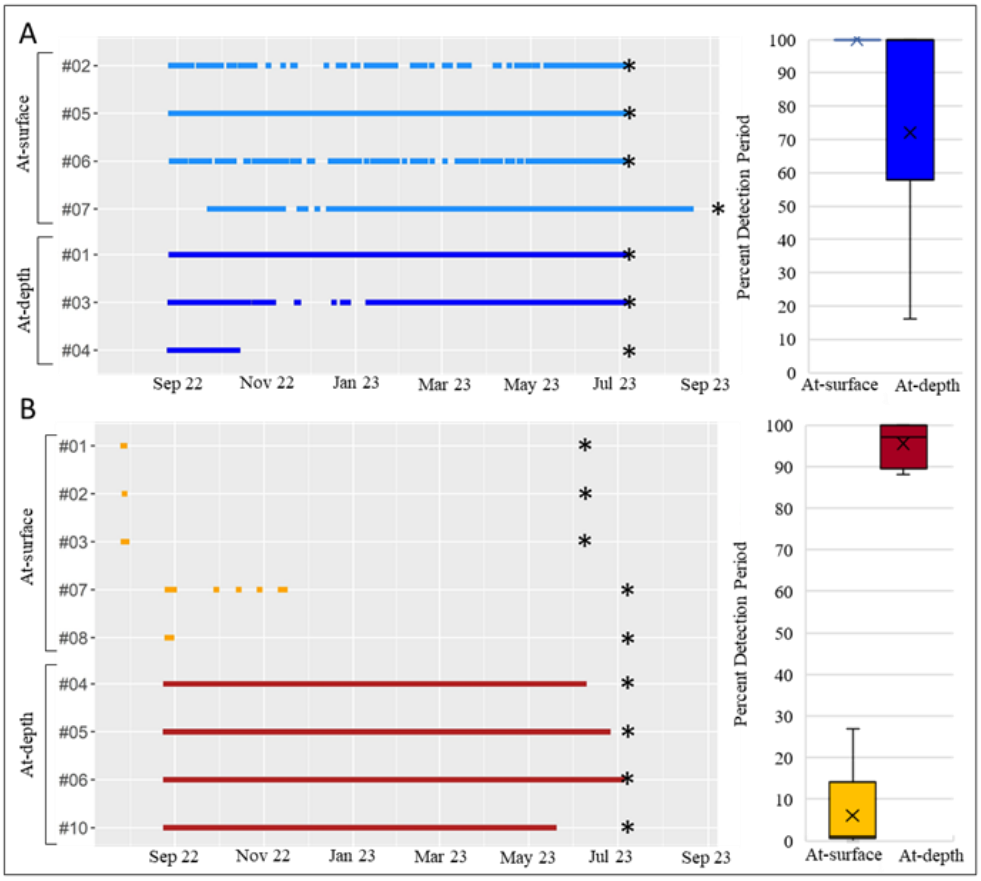

Figure 1. Tag detection periods for **A** *Lutjanus griseus* and **B** *Cephalopholis cruentata*. Black stars indicate the end of the estimated tag life for each individual. Box plots show the percent of the potential detection period that tags remained in the array for each tagging method, where x represents the mean.

temporal overlap of habitat use and characterize if overlap is positive (predation reduction from schooling) or negative (resource competition).

KEYWORDS: Acoustic monitoring, Marine protected area, Space use, Mesopredator

LITERATURE CITED

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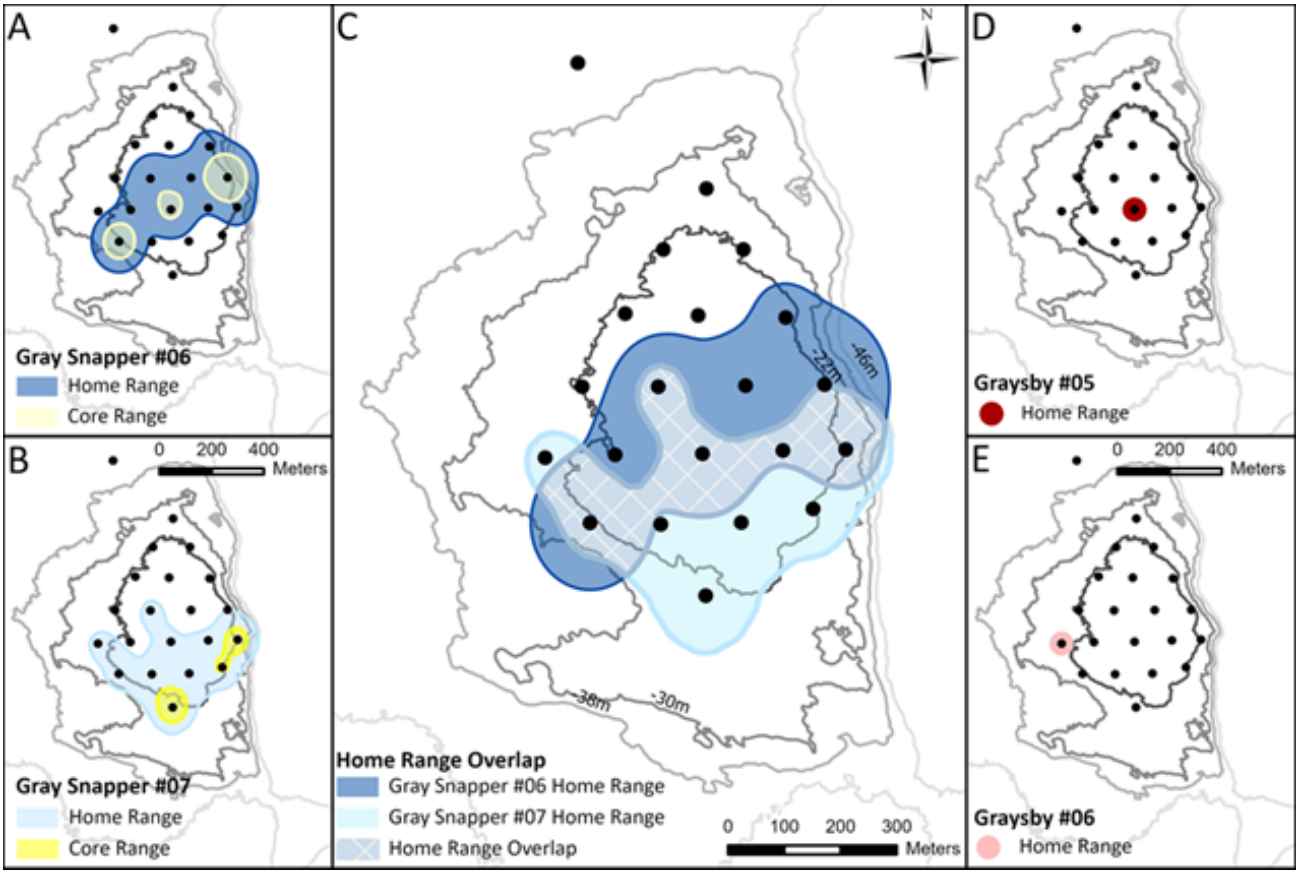

Figure 2. Home and core range maps for **A** *Lutjanus griseus* #06 and **B** *Lutjanus griseus* #07 and **C** the overlap in home range between the two *Lutjanus griseus*. Home range for **D** *Cephalopholis cruentata* #05 and **E** *Cephalopholis cruentata* #06. Black dots represent acoustic receiver locations and gray lines represent bathymetric contours.