

Tracking Red Snapper Movements around an Oil Platform with an Automated Acoustic Telemetry system

MICHAEL MCDONOUGH* AND JAMES COWAN
Louisiana State University
Department of Oceanography and Coastal Sciences
Baton Rouge, LA 70803

ABSTRACT

Understanding the movement and behavior of red snapper (*Lutjanus campechanus*) around and among the many oil and gas platforms in the northern Gulf of Mexico (GOM) is crucial to the management of this important commercial and recreational species. What role oil and gas production platforms play in the attraction vs. production continuum for red snapper is unknown, but it is certain they have a role at some life history stage. We used the VRAP acoustic telemetry system to track 21 red snapper at a platform in the GOM (28E39.402 N, 090E14.126 W) for a period of two weeks (17-30 May 2006). Fish detections per hour generally decreased over the course of the study, and exhibited a strong periodicity. A Fourier transform analysis showed that red snapper had a 24-hour periodicity to their movements. These results appear to support the hypothesis that platforms function largely as attracting devices.

KEYWORDS: red snapper (*Lutjanus campechanus*), movement, oil platforms;

Rastreado los movimientos de pargo alrededor de una plataforma petrolífera con un sistema acústico automatizado de telemetría

Entendiendo la conducta y el movimiento del pargo rojo (*Lutjanus campechanus*), especialmente alrededor de y entre las plataformas de petróleo y gas en la parte norte del Golfo de México (GOM), es crucial para la administración de esta importante especie, del punto de vista comercial y recreativa. Qué papel juegan las plataformas de petróleo y gas en la atracción vs. la producción del pargorjo es desconocida, pero es cierto ellos tienen un papel en alguna de las etapas de vida. Utilizamos el sistema acústico de telemetría VRAP para rastrear 21 pargos rojos en una plataforma en el GOM (28E39.402 N, 090E14.126 W) por un período de dos semanas (17-30 el 2006 de mayo). Un análisis usando la transformación de Fourier mostró que el pargo rojo tuvo una periodicidad de 24 horas a sus movimientos. Estos resultados aparecen sostener la hipótesis que plataformas funcionan en gran parte atrayendo como dispositivos.

PALABRAS CLAVES: pargo (*Lutjanus campechanus*), movimiento, plataformas petroleras.

INTRODUCTION

Understanding the movement and behavior of red snapper (*Lutjanus campechanus*) around and among the many oil and gas platforms in the northern Gulf of Mexico (GOM) is crucial to the management of this important commercial and recreational species. It has long been known that artificial reefs such as oil platforms are good fishing localities. Several scientific studies have confirmed that platforms are common sites for fish aggregation (Seaman et al., 1989; Stanley, 1994; Love et al., 1999; 2000; Jennings et al. 2001) and that red snapper comprise a significant percentage of these communities (Stanley and Wilson, 1997; Nieland and Wilson, 2002; Wilson and Nieland, 2004). Platforms have also been implicated in the partial recovery of some fish stocks—reasons for this include increased food production and predator refugia around platforms. However, they may simply make red snapper more vulnerable to fishing. Current knowledge of how fish use platforms is scarce.

Estimates of abundance can only show that red snapper do associate with platforms, not why. Telemetry enables researchers to investigate site fidelity and observe temporal and spatial patterns in red snapper movement and

behavior. Site fidelity can serve as a proxy for the suitability of a platform to red snapper—if the platform does provide some benefit, the hypothesis is that red snapper would not risk predation and the energy costs involved with seeking new habitat. Investigating red snapper movement temporally can reveal if snapper exhibit any patterns, such as diel periodicity and diurnal/nocturnal or crepuscular movements. Temporal patterns often correspond to feeding behavior (Hobson, 1965; Helfman, 1986) and may give insight into whether platforms play some role in feeding by red snapper. Whether red snapper do or do not exhibit strong site fidelity to platforms, and do or do not gain nutrition directly from food webs dependent upon platforms also contributes to the resolution of the attraction vs. production debate (Bohnsack, 1989).

METHODS

We collected red snapper aboard a charter fishing vessel on 15 and 16 May 2006. Collections were performed at a complex of petroleum production platforms known as 'the Circle,' because they form a rough circle around the salt dome from which they extract oil. The Circle (28° 39.402N, 090 14.126 W) is located about 50 km off the

Louisiana coast in the northern GOM (Figure 1); all platforms are owned by Chevron-Texaco. Although we caught fish at several platforms, we released all fish at platform 134-S. Platform 134-S stands at the northern end of the Circle in 37 m of water. All platforms in the Circle are within 4.5 km of 134-S (Figure 2).

We collected 20 red snapper with hook and line for use during the study. Each fish was checked for visible signs of catastrophic decompression—bulging eyes, external hemorrhaging, everted stomachs, etc. (Rummer and Bennett, 2005)—and those that had none were placed into a pre-surgery holding tank, after which their air bladder was vented. When fish were able to swim upright on their own, they were determined to be ready for transmitter implantation. Fish were brought to level four anesthesia in a 325 mg l⁻¹ solution of MS-222. A small incision was made just dorsal to the ventral midline, between the pelvic fins and the anus, with a sterile, disposable scalpel. We then implanted an ultrasonic transmitter (Vemco, Ltd.), inserted a Floy® anchor tag (for visual identification in case of recapture) into the incision, and closed the incision with two catgut sutures and an acrylic adhesive (Krazy Glue®). Fish were then transferred to a post-surgery recovery tank and held until able to swim upright. Upon release, we monitored fish for ability to orient to the bottom and swim down (Patterson et al., 2001) for likelihood of survival.

Fish unable to swim down were re-collected, so that the transmitter could be re-used.

Prior to releasing the fish, we deployed the VEMCO radio-acoustic positioning (VRAP) system around 134-S to track the fish for two weeks (17-30 May 2006). VRAP is composed of three receivers that detect and record transmitters with independent hydrophones. Each transmitter has a unique code and emits at a random interval, so that VRAP can identify and track multiple individuals. Random intervals minimize simultaneous transmissions from multiple transmitters—VRAP cannot record more than one transmission at a time. All transmitters had battery lives that exceeded the length of the study, which was designed to study short-term movement and fidelity. A base station initializes the receivers for recording and uploads these data at user-defined intervals. If all three receivers have recorded a transmission, the base station is able to calculate a position for that fish. The base station will also record ‘unresolved tags’—tags detected by two or fewer receivers. This feature allows VRAP to detect fish presence, even when it can’t calculate position.

For this paper, we performed analyses on detections—positions plus unresolved tags—as a measure of fish presence. To analyze temporal patterns, we plotted total fish detected in an hour for the length of the study. Fish were considered ‘remaining’ until they were no longer detected.

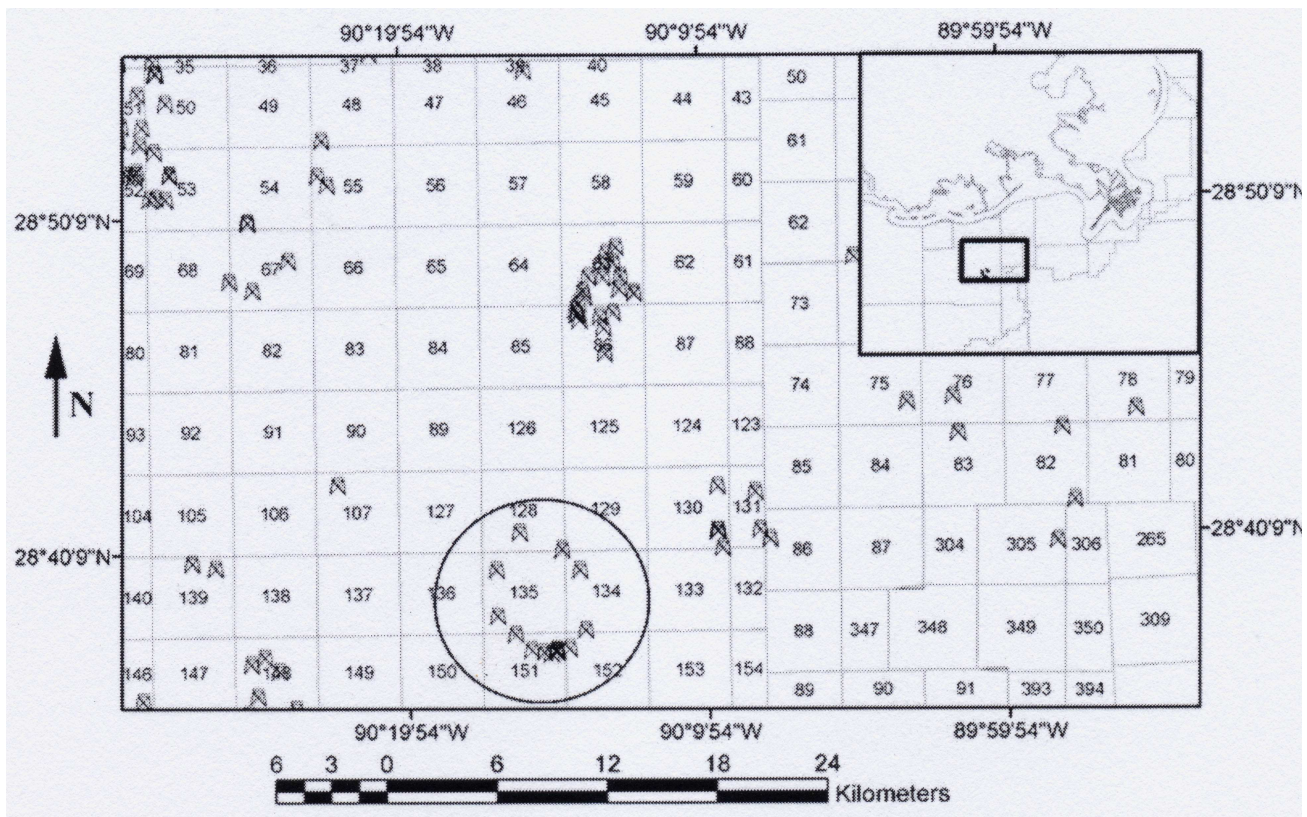


Figure 1. Map of study site: ‘The Circle’ is shown in reference to the Louisiana coast

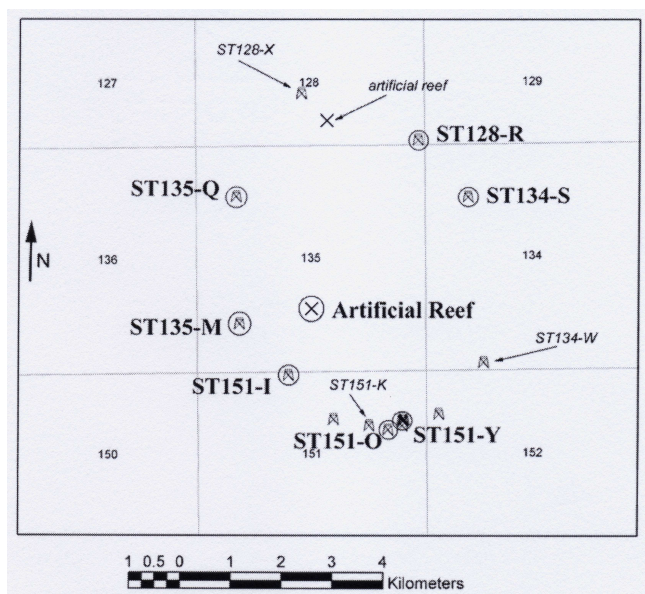


Figure 2. Map of study site showing the position of platform ST 134-S within 'the Circle.'

We also ran a Fourier transform analysis on the number of fish detected per hour to determine if there was any periodicity in the data (PROC SPECTRA, SAS INST.).

RESULTS

All implanted red snapper were able to swim down and are believed to have survived surgery. The VRAP system was able to detect 15 of the 20 individuals. Figure 3 reveals that fish detections per hour generally decreased over the course of the study, and exhibited a strong periodicity. The data indicate that five fish left immediately (before being tracked by VRAP); another two left after two days, and another two after eight days. Ten stayed near the platform for at least twelve days, but only five remained at the end of the study. One fish was detected only once during the two weeks of tracking. A periodogram from the Fourier analysis reveals a strong peak at 24 hours (Figure 4).

DISCUSSION

Our study is one of a few to apply a real-time telemetry system to the movement and behavior of red snapper. Population estimates that have shown that red snapper congregate near oil platforms in large numbers (Stanley, 1997; Nieland and Wilson, 2002; Wilson and Nieland, 2004); and site fidelity studies on a variety of artificial reef types and sizes have reported widely varying results, from <25% to >60% (Beaumariage, 1969; Fable, 1980; Szedlmayer and Shipp, 1994; Szedlmayer, 1997; Patterson et al., 2001; Patterson et al., 2003; Szedlmayer and Schroepfer, 2005). However, some tag-and-release studies show the one-way, long-term movements of red snapper that are at large for

Fish detections vs. time (Total)

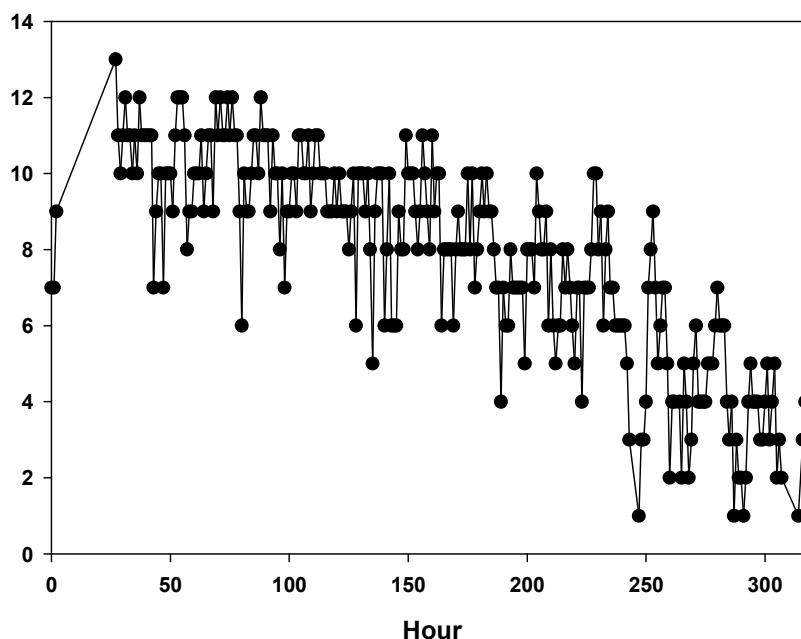


Figure 3. Chart of the number of fish detected per hour of the study. On the y-axis is the number of fish detected in an hour; on the x-axis is the hour of the study, from hour 0 to the end.

many days post tagging (Szedlmayer and Shipp, 1994; Patterson et al., 2001), and no one has been able to ascertain what red snapper are doing when they associate with artificial reefs. These above cited results, sometimes conflicting, have contributed to the confusion over whether artificial reefs attract or produce fish, because of the role that site fidelity plays in some of the conceptual models defining the argument (e.g., Bohnsack, 1989; Lindberg et al., 1990; Strelcheck et al., 2005).

The number of fish detected each hour decreased and increased at regular intervals; the Fourier periodogram indicates a diel pattern. It is likely that this periodicity represents feeding behavior; many diurnal and nocturnal fish school during their inactive phase and disperse to forage during their active phase (Hobson, 1965; Helfman, 1986). These facts could explain our regular decreases in fish detections—the red snapper may be schooling near the platform, but foraging away from the platform. This would be consistent with several diet studies that suggest the red snapper, and other reef-associated species, feed on non reef-associated prey items (Sedberry and Cuellar, 1993; Lindquist et al., 1994; McCawley, in press).

Fish in this study also exhibited low site fidelity, particularly considering the brevity of the study. Only five of twenty implanted red snapper remained after 14 days. These results concur with those of Peabody (in review) which reported much lower site fidelity, <1%, than previous studies of red snapper site fidelity to artificial reefs (Szedlmayer and Shipp, 1994; Szedlmayer, 1997). It is worth noting that the structures in the above cited studies

were smaller by several orders of magnitude than oil platforms. The number of snapper inhabiting oil platforms (Stanley and Wilson, 1997; Nieland and Wilson, 2002; Wilson and Nieland, 2004) would create rather large foraging haloes (Lindberg et al., 1990; and Bortone et al., 1998), forcing red snapper to make long searches for available prey. We hypothesize that once they move such distances, returning is not desirable due to energy costs and predation risk.

One issue that must be addressed is the ability of VRAP to detect transmitters. Our receivers are contained within moored buoys that do move with the tides, and we are operating around an oil platform, which does provide underwater obstruction to transmissions. Our assumption is that these obstructions would be consistent throughout the day, however, and would not affect the diel pattern and the site fidelity we observe. Another component of ability to detect is detection radius. All telemetry systems are limited by the acoustic noise of the site at which they are deployed. Platform 134-S is an active production platform surrounded by other active production platforms—the study area is quite noisy acoustically, and our detection radius (150 m) consequently suffered.

This fact necessitates a discussion of how detection radius affects site fidelity estimates. Szedlmayer (1997) reports fidelity as those fish that remained within the maximum detection radius of the receiver, which was 1.6 km. Szedlmayer and Shipp (1994), a mark and recapture study, considered movement less than 2 km to be an exhibition of site fidelity. Movements this far would have put red snap-

Fish Presence Data

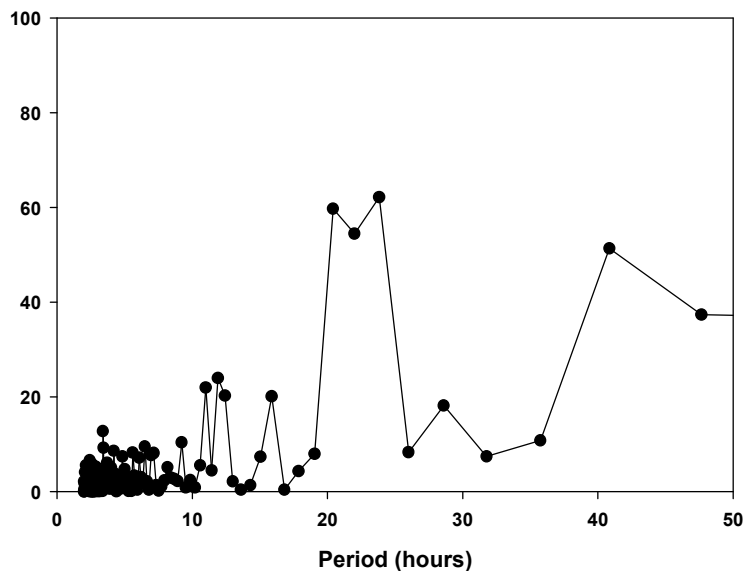


Figure 4. Periodogram from a Fourier transform analysis run on the number of fish detected per hour. The y-axis shows the power of the period. The x-axis is time (hr).

per not only beyond our detection radius, but also at other platforms. At question is how far a fish can move and still be considered site 'faithful.' We must define site fidelity in a way that is biologically meaningful.

Bohnsack (1989) suggests the use of models as one means of clarifying the attraction-production issue. Patterson et al. (2003) modeled decline in recaptures at tagging sites to estimate site fidelity. They reported more conservative (24.8-26.5% per year) site fidelity estimates for the same types and sizes of artificial reefs as the above cited studies.

Our results indicate that red snapper do not rely upon oil platforms for food, and they exhibited low site fidelity. Both of these behaviors are associated with the attraction end of the spectrum (Bohnsack, 1989). That would suggest that use of oil platforms as a tool for managing red snapper is a concept that needs to be rethought.

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