BEHAVIOUR OF DEEP-SEA SHARKS INFERRED FROM IN SITU ACOUSTIC TRACKING IN THE CRETAN SEA, EASTERN MEDITERRANEAN.

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EXTENDED ABSTRACT ONLY – DO NOT CITE

Introduction and Methods

Ultrasonic telemetry has proved a useful tool for studying behavioural aspects of shallow-water shark species, both pelagic and inshore (Nelson, 1990). However, the difficulties associated with working at great depths have limited the use of this technique in studying deeper-dwelling species. In previous experiments deep-water sharks have been captured on long-lines, brought slowly to the surface and depth-sensing transmitters manually attached (Yano and Tanaka, 1986; Carey and Clark, 1995). This technique clearly involves stress to the sharks and necessitates the constant presence of a surface vessel. These limitations can be avoided using the AUDOS (Aberdeen University Deep Ocean Submersible), an autonomous underwater vehicle with a baited camera and an Acoustic Telemetry and Transponder Interrogation System (ATTIS). The bait attracts fish, which swallow code activated transponders (CATs) embedded in small detachable food parcels. Using AUDOS, Bagley et al. (1994) tracked 3 Portuguese dogfish, *Centroscymnus coelolepis*, at 1500 and 1650m m in the Northeast Atlantic, all of which departed from the range of the hydrophone within 30 – 285 min post ingestion, swimming at a speeds of 0.07 – 0.14 ms^{-1}. However in this region sharks are not numerically dominant scavengers. Transponders may be taken by the morid *Antimora rostrata* or not ingested at all if the bait parcels are dismembered by the small eel *Synaphobranchus kaupi*. Previous baited camera deployments in the Cretan Sea, Eastern Mediterranean have

attracted a scavenger assemblage made up almost exclusively of elasmobranchs. The aim of this study was to attempt *in situ* tracking of these species to gain information on their swimming speeds and space utilisation patterns. Five deployments of the AUDOS vehicle were made at 1500, 1750, 1822, 2220 and 2490m, each lasting between 20-24h. At every station, 4 CATs were deployed either in small bait packages attached by cotton thread to the reference scale, or hidden within the main bait (10 – 20kg of tuna).

Results

Four species of shark were photographed; the sixgill shark, *Hexanchus griseus* and the velvetbelly lantern shark, *Etmopterus spinax* were observed at every station; the blackmouth catshark *Galeus melastomus* between 1500 and 1822 m and a fourth, unidentified species at 1822 m only. *E. spinax* was attracted in the highest numbers, with up to 9 individuals photographed at any one time. Both *H. griseus* and *G. melastomus* were usually observed singly, with 2 individuals being photographed on some occasions.

Transponders were ingested during two of the three deployments where ATTIS was available. Three sharks were tracked at 1503 m (Figure 1). The first shark to take a transponder was not photographed. Both *E. spinax* and *G. melastomus* were observed at the bait around this time, and both species were also photographed 19 hours after the start, when the tagged shark returned. The second transponder was taken 4 hours after the bait arrived on the sea floor and was identified as *G. melastomus*. Once this individual departed out of range of the hydrophone, it did not return, despite bait still being present. The third transponder was ingested after 19 hours. This coincided with a single *H. griseus* attacking and consuming the tuna. This individual remained in the vicinity until the experiment was terminated just under 3 hours later.

At 1750m none of the small bait bags were ingested, but a sixgill shark attacked and consumed part of the main bait along with the transponder sewn inside 5h after its arrival on the sea floor. This shark remained within range of the hydrophone for over 12 hours, repeatedly circling and attacking the bait, departing once it had all been consumed (Figure 2).

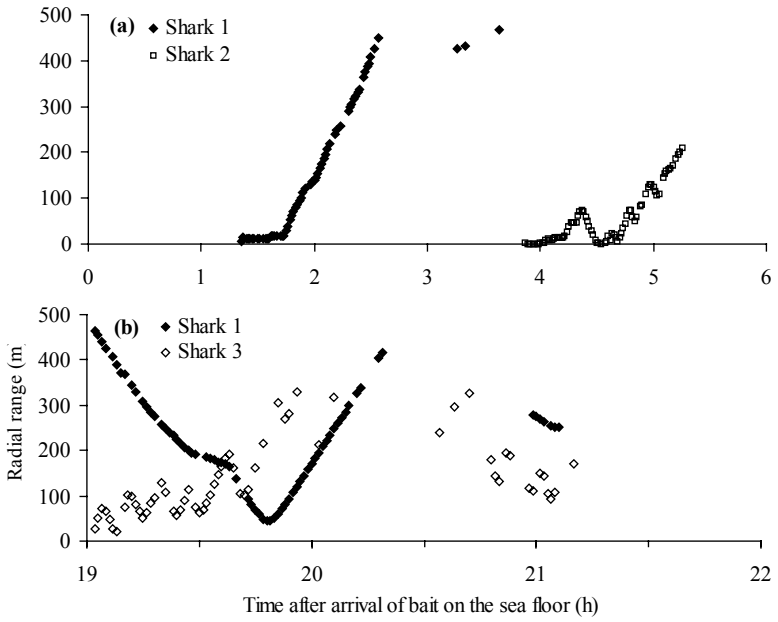

Figure 1. Movements of three sharks attracted to bait at 1503m in the Cretan Sea indicated by radial range from hydrophone

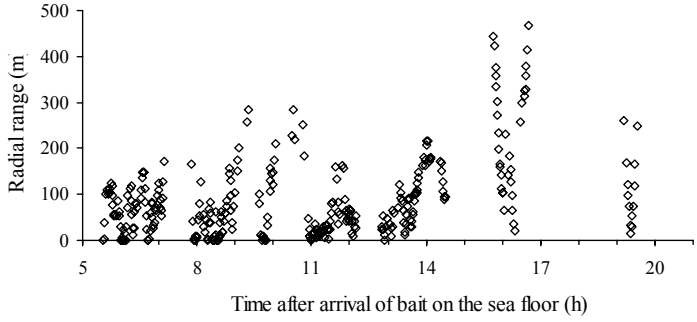

Figure 2 Movement of shark 4 at 1750m indicated by radial range from hydrophone

Discussion

The telemetered movements obtained in this study provide *in situ* information on approximate swimming speeds and behaviour patterns of *G. melastomus* and *H. griseus*. Given the limited food availability in the deep-sea environment, deep-sea sharks are expected to be nomadic foragers, as is the case for the ubiquitous deep-sea grenadier, *Coryphaenoides armatus* (Priede et al., 1991). However, one of the sharks tracked in this study behaved unusually, moving out of range, but then returning 15h later. Assuming a constant radial velocity of $0.16ms^{-1}$, calculated from its track when in range of the hydrophone, this shark could have covered a distance of 8.64km during this time. Translated into the area within a circular path returning to the same point, this equates to 4.66 km^2. Could this be evidence of a home range for this species?

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