

Piscivore meets pisces: interactions between grey seals and fish on the Eastern Scotian Shelf and southern Gulf of St. Lawrence.

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Summary

Top-down effects of upper-trophic level predators play important roles in ecosystem structure and functioning. Nevertheless, interactions between pinnipeds and their prey remain poorly understood. This uncertainty has fueled debate on the impact of seal predation on fish stocks. We show that novel combination of acoustic (Vemco Mobile Transceiver, VMT) and GPS technology can be used to determine the spatio-temporal pattern of interactions between grey seals (*Halichoerus grypus*) and fish species in two marine ecosystems, the Eastern Scotian Shelf and southern Gulf of St. Lawrence, Canada. During four years of study, 16 of 64 adult grey seals recorded 1,117 detections from various fish species including 17 adult Atlantic cod (*Gadus morhua*), 7 Atlantic salmon (*Salmo salar*) and one American eel (*Anguilla rostrata*) implanted with coded acoustics tags. An examination of the spatio-temporal pattern of these interactions suggested that none involved predation. These preliminary results provide proof-of-concept that predators fitted with VMT and GPS tags can provide information on species locations in areas where fixed receiver arrays are not present and allow new insights into the nature of predator-prey interactions in otherwise inaccessible environments.

Introduction

Predator-prey interactions in the open ocean are poorly understood due to the difficulty of sampling free-ranging predators and their prey. Although advances in telemetry have contributed toward a greater understanding of the ecology of upper-trophic level predators (e.g., Breed et al. 2009), little remains known about how marine predators interact with their prey (Hayes et al. 2011). This limits our ability to address questions concerning the impact marine predators, such as seals, may have on fish populations of conservation or commercial interest, and their role in ecosystem structure and functioning (Bowen 1997). Recent advances in acoustic telemetry may help to reduce some of this uncertainty (Holland et al. 2009). The Vemco Mobile Transceiver is a 69 kHz coded transceiver that alternates between transmitting a coded acoustic signal and listening for transmissions from other Vemco 69 kHz coded acoustic transmitters. By attaching the VMT and a Fastloc™ GPS satellite transmitter to a marine predator such as a seal, and tagging fish species with Vemco transmitters, time-stamped, geo-referenced records of interactions between seals and fish can be collected over extended periods of time. In this study, we sought to determine whether the VMT combined with Fastloc™ GPS telemetry could be used to examine interactions between grey seals and several of their potential prey in two marine ecosystems off Eastern Canada.

Materials and Methods

Between 2009 and 2012, 72 adult grey seals were captured on Sable Island, NS, Canada. A GPS-satellite transmitter tag and VMT tag were deployed on each seal. The GPS tag was programmed to record a location every 15 minutes. The VMT was programmed to always receive, and transmit every 60 to 180 s. Individuals were recaptured during the subsequent breeding season (December to January of each year) to recover instruments. During the same period, six hundred and twenty-three adult Atlantic cod were tagged with a Vemco V13 acoustic transmitter in the southern Gulf of St. Lawrence and on the Eastern Scotian Shelf (Fig. 1). The V13 tags were programmed to transmit every 60 to 180 s. In addition, Atlantic salmon and American eel were tagged with Vemco acoustic transmitters through collaborations with other telemetry groups (Fig. 1). Bouts of detections with a

gap of < 10 min between detections constituted an encounter. Location, bottom depth and travel rate were assigned to each seal location and seal-fish interaction. Travel and foraging behaviours along each seal track were defined using a hidden Markov model (Patterson et al. 2009), where slow movement was assumed to be associated with foraging or resting behaviours.

Results and Discussion

Sixty-four of the 72 seals studied returned to Sable Island during the following breeding season and their telemetry tags recovered. Of these, 16 recorded 1,117 detections during 176 encounters with various fish species including Atlantic cod, Atlantic salmon, and American eel (Fig. 1). The majority of seal-fish encounters occurred on the Eastern Scotian Shelf (n = 156) (Fig. 1).

During encounters that involved Atlantic cod, Atlantic salmon and American eel, the seal moved relatively quickly, and encounters were brief. These likely involved a seal moving through an area used by a tagged fish. Encounters such as these provide information on the likelihood of predation. They also illustrate how top predators could be used to collect data on the spatial and temporal distribution of acoustically tagged prey (Hayes et al. 2011) and provide insight into competitive interactions and the role of upper-trophic predators in marine ecosystems (Bowen 1997).

Our findings demonstrate the value to the combined use of tracking technologies and mobile acoustic receivers to gain new understanding of inter-specific interactions in large inaccessible environments.

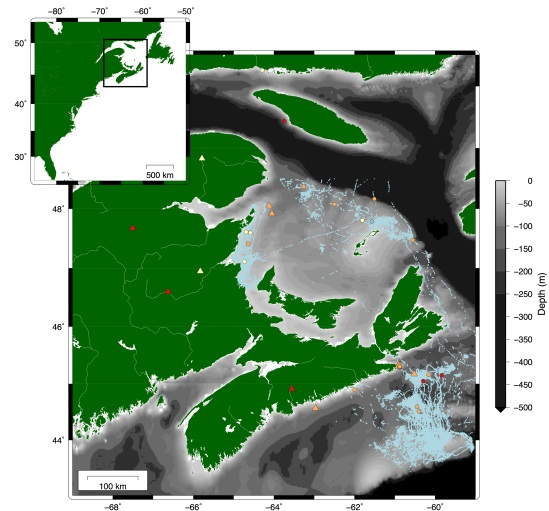


Figure 1 Distribution of fish deployments (Δ), grey seal-fish encounters (O) and movement tracks (light blue) for 16 grey seals on the Eastern Scotian Shelf and in the southern Gulf of St. Lawrence, 2010 to 2012. Atlantic cod: orange, Atlantic salmon smolts: red, Atlantic salmon kelts: pale yellow; American eel: light blue.

References

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