Modeling the behaviors of nesting Roseate and Common Terns using nanotag signal strength

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Background and Objective

Nesting behaviors of seabirds are typically quantified during observation periods of several hours, but continuous 24-hour measurements are difficult to obtain. Here we present the use of continuously collected telemetry data to describe and predict the nesting behaviors of Common Terns (Sterna hirundo) and Roseate Terns (Sterna dougallii) on Great Gull Island, Long Island Sound, New York. Digital VHF transmitters, known as nanotags, were attached to nesting adults and monitored by a fixed antenna and receiver erected on the island. Observed nesting behaviors of tagged terns were compared to the simultaneous variation in signal strength recorded by the receiver to develop a model that predicts nesting behavior from telemetry data. This study was a part of a larger project aimed at tracking coastal birds using a network of receivers in the Northeast. Ultimately the results may be used in siting offshore wind energy facilities to minimize harm to birds.

Methods

During June 2015, we captured 31 Common Terns, and 30 Roseate Terns, at their nests on Great Gull Island. A nanotag was attached to the back of each bird using sutures and epoxy, and the individual was then returned to the nest. VHF signals from tagged birds were monitored by a receiving station in the nesting colony, which consisted of four receiving antennas attached to a single mast and receiver. Ten tagged birds were observed during two-hour intervals, and all nesting behaviors were recorded. Behaviors were then compared to the signal strength and variation that was simultaneously recorded by the four antennas at the receiving station. We then developed a model that predicted tern behavior from signal strength variation using an optimization procedure. For our analysis, behavioral categories included sitting, flying, flushing, or out of range.

Results

Calibration of Model:

Behavioral observations made during 14 two-hour stints, for 10 tagged terns, were used to calibrate our model. After optimizing the fit of signal strength data to observed nesting behaviors, we were able to correctly classify tern behavior in 87% of the cases.

Predicting Activity Patterns of Unobserved Birds:

After calibrating our model, we predicted likely nesting behaviors of unobserved tagged birds. Below plots indicate the predicted behaviors of a Common and Roseate Tern over a 24-hour period.

Additional Information from Regional Receivers:

By supplementing our data, with information collected by the regional network of receivers, we can enrich our understanding of tern behavior when they depart Great Gull Island. Below, we show data demonstrating that Bird 366 was detected by a receiver at Napatree Point, RI, located 23 km from the nesting colony.

Discussion

Overall, our model correctly classified the behaviors of nesting terns 87% of the time, demonstrating the potential for using variation in telemetry signal strength to continuously monitor bird behavior. However, there was much variation between nests where model accuracy was relatively low (46% correct classification), apparently due to rocks or hills blocking transmission of the signal to the receiver. This constraint should be considered by others wishing to use this technique in other systems. In the future, we hope to use our model to describe nesting behavior of terns throughout the nesting season, and to supplement our colony data with tracking information from the network of receiving stations in the Northeast. This broader data set will help us better understand the behavior of terns during the breeding season, and their potential interaction with proposed offshore wind farms.

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