Considerations and Recommendations for Satellite Telemetry Studies of Sea Ducks

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Which cohorts to mark

To fully delineate the geographic limits of sea duck populations, the connectivity and site-fidelity patterns of all cohorts need to be described. Connectivity involves the movement patterns of individuals between specific breeding, molting, staging, and wintering areas. Site-fidelity is the consistency with which individuals return to the same breeding, molting, staging, and wintering sites year after year. Cohorts include 1) adult females, 2) adult males, and 3) subadults (including hatch year [HY] females and males), usually in that order of priority.

- Adult females are typically the highest priority cohort to mark, followed by adult males and then sub-adults. Because adult females are most limiting to population growth/regulation and most adult females tend to be paired and highly site faithful, this cohort defines the geographic limits of breeding populations more than any other group.

- Adult males and subadults provide different kinds of information, some of which is needed to fully define populations. Adult males undergo long-distance molt migrations to very specific, geographically restricted sites. These sites are important because they usually support large numbers of molting birds for an extended period (up to 30% of the annual cycle). The dispersal and ultimate pairing patterns (especially age and location of first pairing and first breeding) of subadults are important to understanding population structure; these aspects have rarely been addressed for sea ducks due to the high cost of PTTs.

- It is critical that the sex and age of each marked bird are determined accurately. For adults, sex and age can usually be determined from plumage characteristics. For subadults, sex needs to be determined via cloacal examination and age by measuring bursal depth.

Sample size considerations

The number of birds marked at a particular capture site depends on several factors, including: 1) the cohort(s) being considered, 2) the number/density of birds using the site, 3) expected post-release mortality rate due to surgery-related effects, weather, or predators, 4) past experience/success rate, and 5) available funds.

- For most studies, researchers should strive for a minimum of 20 functional PTTs per cohort per site. A functional PTT is defined as one that generates location data over at least one annual cycle (but preferably two cycles to describe site-fidelity). See Lindberg and Walker (2007).

- Due to high cost of PTTs, it may be necessary to deploy PTTs at a given capture site over several years to achieve adequate sample sizes. This approach also has the benefit of incorporating annual variation in timing of migration, survival, and weather effects.

- Much like a statistical power analysis, any existing PTT data from pilot studies should be analysed to assess variation in dispersal patterns. If variation is high, then more PTTs than usual will have to be deployed.

- Individuals to be marked should be healthy, representative specimens and (as practical as possible) selected randomly from the population.

Capture season/location

An important consideration in designing satellite telemetry studies is to define the population to which inferences will be made. In many cases, the intended inference will be to the entire population. Accordingly, markings should be made representatively at a particular life stage or event. For example, marking could occur at multiple sites throughout the breeding range or wintering range, or at "bottleneck" locations where all or most of the population occurs, such as spring staging areas. Marking on molting areas will typically target males, but if birds are marked at multiple molting sites throughout the range, it could be considered representative of the population.

- Capture season and location are species- and cohort-specific and also depend on the number and density of birds (affects ease of capture), logistics (remoteness), weather, and potential predators.

- Hatch Year birds (birds less than one year old) should ideally be captured on their natal areas, to anchor the initial position and to maximize the amount of location data generated during fall when post-fledging dispersal occurs.

PTT type and configuration

- Sea ducks require implants to minimize interference with diving/foraging behavior (Korschgen et al. 1996).

- Because PTTs are surgically implanted close to the bird's center of gravity, sea ducks should theoretically be able to carry a heavier transmitter that birds marked with externally mounted transmitters (recommended max 3% of body weight). This means using a lighter (e.g., 26g) implant in females and HY birds and a heavier (e.g., 38-42g) unit in males for most sea ducks. For larger body species (e.g., eiders, scoters) the larger units can be used in all cohorts.

- A nylon mesh is sometimes sewn around the PTT prior to sterilization to provide additional surface area for adhesions that will stabilize the PTT inside the body cavity.

Duty cycle

- There is an obvious trade-off between PTT longevity and data quantity/frequency. The duty cycle should have the shortest possible ON period and longest possible OFF period to extend the life-span of each PTT. This generates data on individual movement patterns across years which, in turn, are needed to describe inter-annual site fidelity to breeding, wintering and molting sites, as well as annual variation in timing of migration.

- The duty cycle must also provide at least one high quality location per ON period as well as a sufficient number of ON periods per season. These data are critical to understanding connectivity patterns and migration routes/timing and staging sites in detail. Researchers will need to determine the optimum duty cycle for their study (species, capture location, timing, study objectives, etc) to meet the above information needs.

- Within certain limits, MTI can modify the duty cycle to meet the needs of individual researchers by programming different ON and OFF periods, transmission repetition rates, etc.

- For captures done in areas where immediate mortalities may occur due to surgery-related effects or predators, the duty cycle should have a final, continuous ON cycle programmed if body core temperature suddenly drops to ambient (= death) to facilitate PTT retrieval. A special receiver (Yaesu VR-500) with Yagi antenna is needed to locate PTTs on the ground and these can be purchased from Microwave Telemetry Inc. (@ $500 USD per unit) or a more generic unit from Radio Shack (see Bates et al. 2003) that will allow you to recover PTTs from dead birds.

Literature Cited

Bates, K., K. Steenhof, and M. R. Fuller. 2003. Recommendations for finding PTTs on the ground without VHF telemetry. Procedings of the Argos Animal Tracking Symposium, 24-26 March 2003. Annapolis, Maryland. Available on CD from Service Argos, Inc., 1801 McCormick Drive Suite 10, Largo, MD 20774.

Korschgen, C. E., K. P. Kenow, A. Genron-Fitzpatrick, W. L. Green, and F. J.Dein. 1996. Implanting intra-abdominal radio transmitters with external whip antenna in ducks. J. Wildl. Manage. 60:132-137.

Lindberg, M. S. and J. Walker. 2007. Satellite telemetry in avian research and management: sample size considerations. Journal of Wildlife Management 71:1002-1009. http://www.bioone.org/doi/abs/10.2193/2005-696.