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RADIO TELEMETRY IN THE STUDY OF RAPTOR HABITAT SELECTION

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Studies of raptor habitat selection using only visual observation must encounter the problem of differential visibility and penetrability among habitat types. The chief virtue of radio telemetry in habitat studies is elimination of bias of detectability differences since a radio-tagged bird is equally detectable in all habitats. Telemetry also permits night observations which are generally impossible with other techniques.

In each of three studies I will discuss, basic techniques are the same: tag as many birds as feasible in order to approach a good sample size (see comments in Pollock's summary), use a study area large enough to accommodate the movements of all tagged birds and determine position as closely as possible, generally once or twice/d if possible. A powerful transmitter is invaluable in such studies, particularly if study animals are not predictable in their locations. Habitat must be mapped, or a previously completed map must be obtained. To explain observed preferences, raptor activity in favored habitat(s) is observed visually and aided by telemetry.

There are two basic means of acquiring habitat data. Frequent surveys designed to locate all individuals provide information for all birds under similar conditions. Following individuals for set periods can give more detailed information but introduces variability caused by different conditions during the observation periods. Both methods are useful, and in most cases, study design will suggest one over the other.

The standard method used to determine habitat preference is to calculate amount of time or number of occurrences of birds in each habitat type compared to availability of each habitat type. Habitat availability is measured by calculating total area of each type in the study area. Along a river or other linear habitat, total linear distance can be used rather than area. A Chi-square test or rank correlation test can be used to determine if raptors use habitat types in a different proportion to actual areas available (i.e., if raptor presence is distributed nonrandomly among habitat types). Several recent publications concerning the methodological and statistical problems of availability/preference data are listed at the end of this summary.

Overlays are often used to assign habitat or other values after a location has been made. Location is plotted on the habitat map and habitat type assigned to that observation. In large heterogeneous study areas it is safer to assign a habitat type at time of observation to avoid the possibility of mismapping or slight inaccuracies in assessing location of the bird. Remember that edge is often a meaningful habitat type. When testing for nonrandom use of habitat one must be aware of possible seasonal shifts. Lumping data from different seasons or years may obscure seasonal or yearly preferences. References addressing the problem of accurate location of signals, and effects of habitat on triangulation accuracy are listed following this summary.

Habitat preferences can be demonstrated fairly readily using techniques outlined above. Often habitat preference studies function as pilot studies suggesting what further research is appropriate to determine cause of preference. Prey availability, prey preference, availability of special features (nest sites, necessary microhabitat features) or other factors may need to be measured.

The common result of data collection to explain habitat preference is a welter of data from many variables potentially capable of explaining observed preferences. Multivariate data analyses may not always be necessary. Simple nonparametric correlation and Chi-square analyses often reveal major relationships more cheaply and quickly. Univariate and bivariate tests should always precede and may render more complicated analyses unnecessary. Sound management guidelines and simple relationships are generally more useful than long equations for many variables of which only one or two are significant. The following three examples demonstrate the study of habitat selection using radio telemetry.

Migrating Peregrine Falcons (*Falco peregrinus*) were studied at Padre Island, Texas, on two consecutive winters. Habitat types had been mapped previously and were easily identified from a plane. Twenty-seven female falcons were located 2×/d

(weather permitting). Preferred habitat was different in each year; thus, the pooled sample showed no selection. Yearly rainfall differences accounted for change in habitat preference; prey availability seemed to be the factor most responsible (Hunt et al. 1980b, 1981).

Wintering Bald Eagles (*Haliaeetus leucocephalus*) were studied on the Skagit River in Washington to determine the impact of planned dam construction. Food availability seemed to explain most habitat preference. Studies of salmon (*Salmo* sp.) availability and eagle feeding habits showed the area was at carrying capacity for Bald Eagles, and dam placement would reduce the local population as eagles emigrated into other areas. Possible alternate use areas were determined by following eagles during a period when a flood rendered the previously used area undesirable (Hunt et al. 1980a; Hunt and Johnson 1981).

Bald Eagles were also studied on the Pit River in northern California. Seven subadults showed definite seasonal movement patterns between the Pit River and a large lake to the north. To study use of the Pit River itself, 33 individuals (juveniles, subadults and nesting adults) were tracked from ground and air. River habitat was mapped in 0.1 km sections. Values for prey availability, public use and other variables were assigned to each section. Eagles showed a definite preference for pools (as opposed to riffles, runs and pocket water). Further studies to determine what microhabitat variables affected eagle use of pools were conducted from blinds located near pools. In another part of the study distribution of Bald Eagles along the river proved to be related to prey biomass and prey-size variability along the river (BioSystems Analysis, Inc. and U. Cal. Davis 1985).

REFERENCES

BIOSYSTEMS ANALYSIS, INC. AND UNIVERSITY OF CALIFORNIA AT DAVIS, DEPARTMENT OF WILDLIFE AND FISHERIES BIOLOGY. 1985. The Pit 3, 4, and 5 Project Bald Eagle and Fish Study, Final Report. Prepared for Pacific Gas and Electric Co., Department of Engineering Research.

HUNT, W. G. AND B. S. JOHNSON. 1981. Impacts of a proposed Copper Creek dam on Bald Eagles: second winter study. BioSystems Analysis, Inc. Environmental Report for Seattle City Light, City of Seattle, Washington.

———, ———, J. B. BULGER AND C. G. THELANDER. 1980a. Impacts of a proposed Copper Creek dam on Bald Eagles. BioSystems Analysis, Inc. Environmental Report for Seattle City Light, City of Seattle, Washington.

HUNT, W. G., F. P. WARD AND B. S. JOHNSON. 1981. Peregrine Falcon migration: continuing studies. Report to Department of Defense.

HUNT, W. G., F. P. WARD, C. M. ANDERSON AND G. P. VOSE. 1980b. A study of the spring passage of Peregrine Falcons at Padre Island, Texas, using radio telemetry. Report prepared for the U. S. Fish and wildlife Service and the National Park Service.

Published results of the studies are in preparation.

Sources of Error in Triangulation:

GARROTT, R. C., G. C. WHITE, R. M. BARTMANN AND D. L. WEYBRIGHT. 1986. Reflected signal bias in biotelemetry triangulation systems. *J. Wildl. Manage* 50:747–752.

HUPP, J. W. AND R. T. RATTI. 1983. A test of radio telemetry: triangulation accuracy in heterogeneous environments. *Proc. Int. Wildl. Biotelem. Conf.* 4:31–46.

LENTH, R. V. 1981. On finding the source of a signal. *Technometrics* 23:149–154.

SPRINGER, J. T. 1979. Some sources of bias and sampling error in radio triangulation. *J. Wildl. Manage.* 43:926–935.

WHITE, G. C. AND R. A. GARROTT. 1986. Effects of biotelemetry triangulation error on detecting habitat selection. *J. Wildl. Manage.* 50:509–513.

Preference/Availability:

ALLDREDGE, J. R. AND J. T. RATTI. 1986. Comparison of some statistical techniques for analysis of resource selection. *J. Wildl. Manage.* 50:157–165.

CHESSON, J. 1983. The estimation and analysis of preference and its relationship to foraging models. *Ecology* 64:1297–1304.

HEISEY, D. M. 1985. Analyzing selection experiments with log-linear models. *Ecology* 66:1744–1748.

JOHNSON, D. H. 1980. The comparison of usage and availability measurements for evaluation of resource preference. *Ecology* 61:65–71.

NEU, C. W., C. R. BYERS AND J. M. PEEK. 1974. A technique for analysis of utilization-availability data *J. Wildl. Manage.* 38:541–545.

Other Habitat Studies:

CARSON, R. G. AND J. M. PEEK. 1987. Mule deer habitat selection patterns in northcentral Washington. *J. Wildl. Manage.* 51:46–51.

LITVAITIS, J. A., J. A. SHERBURNE AND J. A. BISSONETTE. 1986. Bobcat habitat use and home range size in relation to prey density. *J. Wildl. Manage.* 50:110–117

MILLER, M. L. AND B. W. MENZEL. 1986. Movements, homing and home range of muskellunge *Esox musquinongy,* in West Okoboji Lake, Iowa. *Environ. Biol. Fishes* 16:243–255.

RYDER, T. J. AND L. L. IRWIN. 1987. Winter habitat relations of pronghorns in southcentral Wyoming. *J. Wildl. Manage.* 51:79–85.

TRIVELPIECE, W. Z., J. L. BENGTSON, S. G. TRIVELPIECE AND N. J. VOLKMANN. 1986. Foraging behavior of gentoo and chinstrap penguins as determined by new radiotelemetry techniques. *Auk* 103:777–781.

WALTON, R. AND B. J. TROWBRIDGE. 1983. The use of radio tracking in studying the foraging behavior of the Indian Flying Fox (*Pteropus giganteus*). *J. Zool.* 201: 575–579.

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