TECHNIQUES USEFUL FOR DETERMINING RAPTOR PREY-SPECIES ABUNDANCE*

by
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Abstract

A workshop was held by the Raptor Research Foundation on October 27 and 28, 1976, in Ithaca, New York, to develop standardized data collection and analytical methods for raptor studies. Applications of the methods will ensure compatibility and facilitate year-to-year and area-to-area comparisons valuable in environmental assessment and raptor population trend monitoring.

We have focused on one of the workshop topics, that of methods appropriate for measuring prey-species abundance. Emphasis is on techniques used in western grasslands. The selection and use of the particular techniques described in this paper will depend on the level of quantification desired, the habitat type, and the availability of research time and money. Long-term studies should include methods that will provide quantified data, i.e., density (number of individuals per unit area). Such data will enable calculation of prey exploitation rates and prey densities, parameters important to our understanding of raptor population dynamics.

Invertebrates

Sample Counts

Petrusewicz, K., and A. Macfadyen. 1970. Productivity of terrestrial animals, principles and methods. *IBP Handbook 13*. Blackwell Scientific Publications, Oxford. This technique is based on counts of all individuals of the species or group of species considered in a sample from a small but representative area. The size of the sample plot depends on the mobility and abundance of the species. Sample plots 1 m^2 work well for Coleoptera and Orthoptera. Data obtainable: density.

Catch-Mark-Recatch

See above reference. Capture, mark, and release a number of individuals at the same site. Later capture again using the same method in the same area and find the marked individuals. The population can then be determined by the Lincoln Index: $N = (b)a/a'$. This technique is useful for large, easily captured insects, particularly beetles. Data obtainable: relative density.

Quick Trap and Vacuum Sampler

1. Turnbull, A., and C. Nicholls. 1966. A "quick trap" for area sampling of arthropods in grassland communities. *J. Econ. Entomol.* 59:1100-1104. A trap that can be set down quickly over the sample area to contain the flying insects present is used. Material is removed by means of a D-Vac vacuum insect net. Berlese funnels are used to separate micro-invertebrates from the debris. Widely used in grassland studies. Data obtainable: density.

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2. Ahearn, G. A. 1971. Ecological factors affecting sampling of desert Tenebrionid beetles. *Amer. Midl. Natur.* 86:385-406. Discusses the influence of climatic conditions, activity, population size, surface illumination, trap density, and trap spacing on the use of the pitfall trapping technique in evaluating population size of ground-dwelling beetles. Data obtainable: relative abundance.

3. Greenslade, P. J. M. 1964. Pitfall trapping as a method for studying populations of Carabidae. *J. Anim. Ecol.* 33:301-310. Reviews pitfall trapping as a sampling method for Carabidae. Considers the effects of population size, locomotor activity, species' susceptibility to trapping, and habitat on the total catch. Data obtainable: relative abundance.

Malaise Trap

1. Mathews, R. W., and J. R. Matthews. 1971. The Malaise trap: its utility and potential for sampling insect populations. *Mich. Entomol.* 4:117-122. This method is based upon the observation that most flying insects that hit an obstacle respond by flying or crawling upward and thus into captivity. These traps are easy to use, can be placed in almost any habitat at any height, and are cheap to construct, or they can be purchased ready-made. Data obtainable: relative abundance.

2. Townes, H. 1972. A light-weight Malaise trap. *Entomol. News* 83:239-247.

Ocular Census Method

1. Bhatnager, K. E., and R. E. Pfadt. 1973. Growth, density, and biomass of grasshoppers in the shortgrass and mixed-grass association. *U.S. IBP Grassland Biome Tech. Rept. No. 225.* Colorado State Univ., Ft. Collins, CO. This method permits an estimate of the density of large-sized insects by traversing an area and counting the number of individuals in small sample areas (30.5 cm^2). A large number of sample points can be gathered in a short while, but the method applies only to large, easily recognized species (grasshoppers, beetles, etc.). Data obtainable: density.

Vertebrates (Reptiles and Amphibians)

Transect Lines

Fitzgerald, G. J., and J. R. Rider. 1974. Seasonal activity of the toad *Bufo americanus* in southern Quebec as revealed by a sand-transect technique. *Can. J. Zool.* 52(1):1-5. A covered sand transect was used to collect data on toad movements. The transect was 225 m long and 46 cm wide. Tracks are recorded and then erased at least twice a day. This technique is useful to measure trends in reptile and amphibian populations. Data obtainable: trend data.

Drift Fence

Gibbons, J. W., and D. H. Bennett. 1974. *Determination of anuran terrestrial activity patterns by a drift fence method.* Copeia No. 1, pp. 236-243. Hardware cloth, 0.64-cm mesh and 61 cm high, was used for fencing. "The fence was placed in an 8-10-cm deep ditch, later filled with soil. Metal stakes alongside the fence added extra support. Metal buckets (diameter 35 cm; depth 41 cm) were placed at 20-m intervals in paired holes on opposite sides of the fence so the mouth of each can was at ground level flush with the fence." Amphibians were directed along the fencing and became entrapped in sunken buckets. This technique is widely used for amphibians. Data obtainable: relative abundance.

Mark-Recapture

Rose, F. L., and D. Armentrout. 1974. Population estimates of *Ambystoma tigrinum* inhabiting two playa lakes. *J. Anim. Ecol.* 43:671-679. Neotenic salamanders were collected with a 12.2 m x 1.8 m bag sein. Each animal was toe clipped, and its initial and subsequent dates of capture were determined. Population size was estimated by six different methods: Lincoln-Peterson (Southwood 1966); Bailey triple catch (Bailey 1952); Schnabel (Ricker 1958); Schumacher-Eschmeyer (1943); Jolly (Southwood 1966); and Leslie (1952). This technique was used on aquatic organisms, but the principles also apply to terrestrial organisms. Data obtainable: density.

Grid Trapping

1. Bellis, E. D. 1964. A summer six-lined racerunner (*Cnemidophorus sexlineatus*) population in South Carolina. *Herpetologica* 20(1):9-16. Wire-screen funnel traps (108 cm long; with a 15-cm diameter receiving cylinder at each end and a cone with a small opening at the apex with a 38-cm base resting on the ground) were used to capture lizards. Each cone was somewhat flattened where it contacted the ground, thus providing a broad receiver for the lizards. The cylinders were covered with vegetation to protect lizards from excessive sunlight. Traps were systematically moved about within quadrants to assure that all habitats were well trapped. Traps were not baited; their success depended on movements of lizards in normal activity. Lizards were individually marked by toe amputation and small blotches of poster paint on their dorsa. Data obtainable: density.
2. Rickard, W. H. 1968. Field observations on the altitudinal distribution of the side-blotched lizard. *Northwest Sci.* 42(4):161-164. Five can traps arranged in a line with 3-m spacing between were used to capture lizards and insects. Data obtainable: relative abundance; this method can also be used to determine density when coupled with a grid arrangement of traps, the mark-recapture technique, and assessment lines.

Birds

Line Transect Methods

1. Kendeigh, S. C. 1944. Measurement of bird populations. *Ecol. Monogr.* 14:67-106. A simple tally of individuals detected per unit of effort. Data obtainable: relative abundance and species diversity.
2. Rickard, W. H. 1964. Bird surveys in cottonwood-willow communities in winter. *Murrelet* 45(2):22-25. A simple tally of individuals detected while walking along an established path. Data obtainable: relative abundance and species diversity.
3. Jarvinen, O., and R. A. Vaisanen. 1974. Estimating relative densities of breeding birds by the line transect method. *Oikos* 26(3):316-322. This method considers transect belts of two different widths. "In the line transect censuses of breeding birds, all observations are registered. Observations made within 25 m of the transect, about 20% of total, constitute the 'main belt' records while 'survey belt' records refer to all observations. This study shows how observations outside the main belt can be utilized to estimate densities of different species." Data obtainable: relative abundance and species diversity.
4. Emlen, J. T. 1971. Population densities of birds derived from transect counts. *Auk* 88:323-342. Field transect counts are conducted in which all detections of birds, visual and aural, out of the limit of detectability are tallied. The count of each species is then multiplied by a conversion factor (coefficient of detectability) representative of the percent of the population that is normally detected by these procedures. This method is applicable for all seasons and is more efficient in terms of area covered per unit of effort than nest- or territory-count methods. Data obtainable: absolute density, which can be used for determining biomass and energy functions.

Mammals

Mark-Recapture Technique

1. Jolly, G. M. 1965. Explicit estimates from capture-recapture data with low death rates and immigration—Stochastic Model. *Biometrika* 52:315-337. A model is presented which gives an estimate of the total population for each trapping period. Data obtainable: total population estimate, movements, and biomass estimates.

2. Smith, M. H., et al. 1971. Determining density for small mammal populations using a grid and assessment lines. *Acta Theriologica* 16(8):105-125. A 16-x-16 grid was used to obtain density estimates. Eight assessment lines were used to evaluate the area of effect around the grid. Data obtainable: total population, biomass.

3. Kaufman, D. W., et al. 1971. Use of assessment lines to estimate density of small mammals. *Acta Theriologica* 16(9):127-147. Uses an octagon census line plus primary and secondary assessment lines. Linear regression equations were fitted to accumulative captures over distance for primary and secondary assessment lines to determine the area of effect around the octagon census lines and a selected portion of the primary assessment lines. Data obtainable: density.

4. Smith, H. D., C. D. Jorgensen, and H. D. Tolley. 1972. Estimation of small mammal using recapture methods: Partitioning of estimator variables. *Acta Theriologica* 17(5):57-66. A model using a grid design surrounded by a dense line of traps to detect movement of animals into and out of the grid. Useful where permanent and semipermanent grids are established in populations that cannot be disturbed by removal or killing. Data obtainable: density.

Area Estimate

Flinders, J. T., and R. M. Hansen. 1973. Abundance and dispersion of Leporids within a shortgrass ecosystem. *J. Mammalogy* 54(1):287-291. Modified belt or strip method using a line transect which was developed for grasslands. The number of Leporids sighted within the transect area divided by the transect area yielded a measurement of population density. Data obtainable: density for hares and rabbits, coyotes, raccoons, skunks, badgers, and other medium-sized night-active mammals; movements.

Mound and Earth Plug Census

Reid, V. H., R. M. Hanson, and A. L. Ward. 1966. Counting mounds and earth plugs to census mountain gophers. *J. Wildlife Manage.* 30:327-334. Count mounds and earth plugs which can be related to intensive trap out of study area. Data obtainable: density.

Other Useful References

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BARBED WIRE IMPALES ANOTHER GREAT HORNED OWL

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At 0900 on 24 May 1976, accompanied by K. Quackenbush, I found an adult Great Horned Owl (*Bubo virginianus*) impaled by both wings on the top wire of a five-strand, barbed-wire fence (fig. 1). The fence was on semiarid rangeland, predominantly mesquite (*Prosopis glandulesa*) and retama (*Parkinsonia aculeata*), near a small water tank, approximately 20 km NNE of Laredo, Texas.

The bird was alert and active when found. A set of barbs was entangled in the skin of each wing. Closer examination showed that the bird had injured its right eye, probably on a barb, during its attempt to get free. A small patch of skin was lost on each wing when the barbs were removed, but no bleeding occurred.

Because the owl was active and did not appear seriously injured, we released it, whereupon it hopped along the ground for 18 m, perched briefly on a small tree, and then flew 90 m to a mesquite tree. We did not observe it further.

The owl was apparently flying with wings extended when it hit the barbed wire with enough force that it made two complete turns around the wire and became firmly entangled on the barbs.