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The Analysis of Habitat Utilization Using Broad-scale Survey Data

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Abstract

Problems associated with the use of extensive survey data to broadly define the habitat preferences of uncommon species are discussed. A robust habitat utilization index (HUI) is derived which circumvents problems associated with both differential trapping effort and distribution of individuals between habitats.

Introduction

Effective reservations of land are needed often to encourage the survival of rare or endangered species. Decisions on land reservation may be required urgently before adequate data are available on the specific habitat preferences of the species in question.

Here I discuss some of the problems involved in the analysis of broad-scale survey data to derive tentative answers to questions for which the survey was not designed. Specifically, how to derive, from broad-scale biological surveys, a measure of habitat preference for a species which is uncommon.

The Problem

By their nature regional survey data are broadly based and do not focus on single species problems. In consequence they have little resolution of the habitat or population characteristics of a single species, especially if that species is rare. They are irregular in timing with respect to season, and data from different years and areas may need to be pooled to boost the sample size of uncommon species. In addition the only quantitative data available are expressed as catch per unit effort.

Raw data from surveys can be pooled and used simply only if trapping effort is constant between habitats, the populations are stable, their proportional distribution between habitats is constant and there is no seasonal variation in trap proneness between habitats. No real surveys or populations obey these constraints.

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The Index

To overcome the variation in trapping effort, the catch for a species in each habitat is scaled as catch per unit effort.

$$PH_{ij} = IH_{ij}/EH_{ij},$$

where IH_{ij} is the number of individuals of a species trapped in habitat i of survey area j and EH_{ij} is the trapping effort (e.g. trap nights) in habitat i of survey area j.

The survey data to be pooled may come from different areas and may be sampled in different seasons or years. In addition, different numbers and types of habitat may be included in the various survey areas. Hence we derive another scaling factor, namely the catch per unit effort in all i habitats of survey area j.

$$PE_j = IE_j/EE_j,$$

where IE_j is the number of individuals of the species trapped in all i habitats of survey area j and EE_j is the trapping effort in all habitats of survey area j.

The relative importance of habitat i in survey area j is then PH_{ij}/PE_j which is summed for all survey areas and corrected for the number of survey areas considered giving the dimensionless Habitat Utilization Index

$$HUI_i = \left[\sum_{j=1}^{n} PH_{ij} \cdot \frac{1}{PE_j}\right] \cdot \frac{1}{n}$$

The absolute importance of habitat i in all survey areas is simply

$$\left[\sum_{j=1}^{n} PH_{ij}\right] \cdot \frac{1}{n}$$

I want to examine the robustness of the index to changes in trapping effort between reserves (survey areas) and habitats, and to changes in the distribution of individuals between habitats. Figure 1 and Table 1 include analysis of Kitchener's (1981) index AI, to be discussed later.

Consider a matrix with i rows and j columns (Table 1). Each cell contains two values: the number of individuals of the species trapped in habitat i of reserve j and the trapping effort in habitat i of reserve j. From this matrix the index HUI_i can be calculated for each habitat i. Establish a series of such matrices in which the proportional trap success stays constant between reserves but the trapping effort is increased by a constant factor α in successive reserves. In addition, the proportional distribution of individuals trapped per unit effort (β) varies between habitats. Figure 1 shows that the index HUI does not vary with changes in α and β when the real distribution of individuals is held constant.

Table 1 Matrix of 3 habitats in each of 3 reserves to illustrate discussion in the text. Each cell shows numbers trapped (e.g. $X_{1,1} = 5$) and the total trapping effort (e.g. $X_{1,1} = 100$) for each habitat (i) in each reserve (j). The calculated values of AI and HUI are given for each habitat to the right of the matrix.

		Reserve†				
	i \ j	1	2	3	HUI	AI
	1	5/100	17.5/350	61.25/1225	2.33	5.97
habitat†	2	5/200	17.5/700	61.25/2450	1.17	2.99
	3	5/400	17.5/1400	61.25/4900	0.58	1.49
		15/500	52.5/2450	183.75/8575		

† $\alpha = 3.5$ and for habitats 1 to 3, β is successively 0.05, 0.025 and 0.0125.

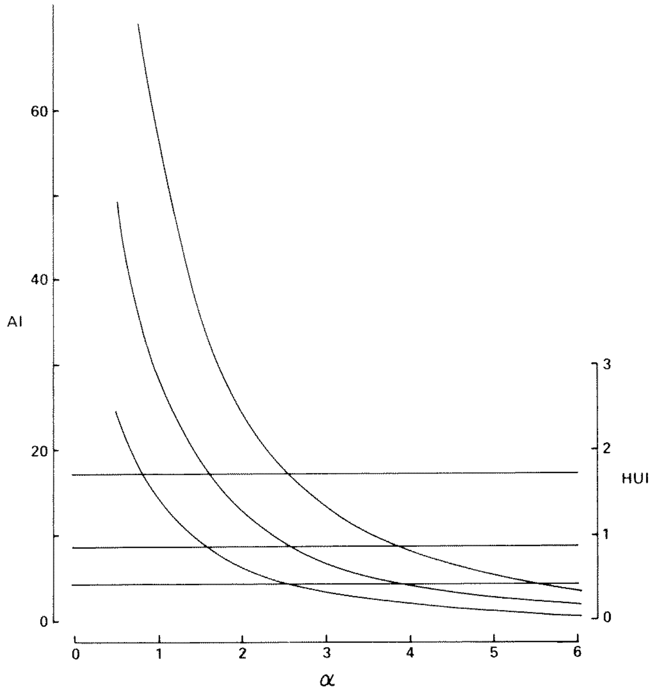

Figure 1 Graph showing the manner in which the indices AI and HUI vary with changes in trapping effort between habitats and the proportion of individuals caught per unit effort. The three straight lines represent HUI (right ordinate) as α (see text) varies from 0 to 6 for, from top to bottom, β values of 0.05, 0.025 and 0.0125. The three curves show the variation in AI (left ordinate) as α and β vary over the same range and sequence as for HUI.

Discussion

Kitchener (1981) analysed the habitat requirements for *Phascogale calura* (Gould), a species considered rare and endangered, using data available for a number of extensive surveys conducted over many years on nature reserves in the Wheat Belt of Western Australia. Such surveys usually provide the only data available on habitat preferences of widespread but uncommon species on which to base decisions about conservation. Kitchener (1981) derived an index to permit the pooling of survey data to delineate the habitat preference of *P. calura*. This index has been used subsequently to examine the habitat preferences of *Ningaui timealeyi* (Archer) (Dunlop and Sawle 1982).

The general case of Kitchener's (1981) abundance index is

$$AI = \sum_{i=1}^{n} \frac{P_i}{T_i},$$

where P is the proportion caught in a given habitat of all individuals in reserve (survey area) i, T is the total trapping effort (e.g. trap nights) in a given habitat in all reserves and n is the number of survey areas (reserves). The index is scaled in some way (Kitchener used AI x 10 while Dunlop and Sawle used AI x 10^2).

The index AI is shown, alongside HUI, in Table 1 and Figure 1 for varying values of α and β. An ideal index should show no change in value for a given β as the value of α is changed. While HUI shows no change, the index AI is extremely sensitive to changes in α (Figure 1) which are much smaller than the variation in α considered by Kitchener (1981) and Dunlop and Sawle (1982).

HUI permits one to pool survey data, where the trapping effort varies between habitats and reserves, and obtain an unbiased estimator of the habitat preference within the limitations of the data base. Interpretation of the index will depend on the spatial and temporal resolution of the survey data and the degree of synchrony of different surveys. Care in planning of surveys will eleviate some of the difficulties of interpretation. As uncommon species are rarely amenable to intensive work, these surveys may provide the only information on which to base preliminary decisions on conservation and in planning species-specific work.

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References

Dunlop, J.N. and Sawle, M. (1982). The habitat and life history of the Pilbara ningaui *Ningaui timealeyi*. *Rec. West. Aust. Mus.* 10 (1): 47-52.

Kitchener, D.J. (1981). Breeding, diet and habitat preference of *Phascogale calura* (Gould, 1844) (Marsupialia: Dasyuridae) in southern Wheat Belt, Western Australia. *Rec. West. Aust. Mus.* 9 (2): 173-186.

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