SHORT COMMUNICATIONS

Effects of Abundant Species on the Ability of Observers to Make Accurate Counts of Birds

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Bird numbers can be estimated using a variety of methods (Emlen 1971, Berthold 1976, Reynolds et al. 1980). The number of birds counted is frequently reported in relation to some measure of effort: e.g. per unit area, per count period, per observer day, or per km of trail. The numbers recorded are sometimes those of only a single species (Kepler and Kepler 1973, Mayfield 1973, Van Riper et al. 1978), but more frequently the numbers of all species encountered are recorded. In 16 of 18 articles in which estimated numbers of birds were reported in the 1973–1978 issues of *The Auk* and *The Condor,* observers recorded all birds encountered. In the other two studies, the numbers of only one species were estimated. The stated or implicit assumption in those studies reporting all species is that there is no loss of information with the added responsibility of keeping track of a larger number of species. The ability of a single person to record accurately all individuals and species has been challenged by Carney and Petrides (1957), Lack (1976), and Preston (1979). The question is: Are the data recorded by an observer who must record all species (generalist) less accurate that those recorded by an individual who has responsibility for recording only a subset of the community (specialist)?

We sought to answer this question in the subtropical rainforests of Hawaii, where species richness is low (number of species $\approx$ 15) but overall densities are high ($\approx$2,000 birds/km^2). We had four observers stand within 3 m of a central point and simultaneously but independently record birds through 8-min count periods during the first 4 h after first light on 11–12 May 1978 and on 15–16 May 1979. Of the four observers used in 1979, three had participated in this study in 1978. Observers varied their strategies from one count to the next, each observer having an equal number of turns at each strategy. Counts were all conducted in uniform habitat, and locations were changed regularly. The method of data collection and analysis is that of Ramsey and Scott (1979, 1981).

We considered four observer strategies, as follows.

Specialist 1: Record only the single most abundant species
Specialist 2: Record the three rarest species
Specialist 3: Record three of the more common species
Generalist: Record all species

In our study, the most abundant species was the Apapane (*Himatione s. sanguinea*); the three rarest were the Akiapolaau (*Hemignathus obscurus*), Hawaii Creeper (*Loxops maculata mana*), and Akepa (*Loxops c. coccinea*); the three more common species were the Hawaiian Thrush or Omao (*Phaeornis o. obscurus*), Iiwi (*Vestiaria c. coccinea*), and Red-billed Leiothrix (*Leiothrix lutea*).

For each of the seven species recorded by specialists, we tested the hypothesis that equal numbers would be recorded by generalists and specialists. The differences were significant for only the Apapane ($Z = 7.32$, $P < 0.001$) and the Hawaiian Thrush ($Z = 2.58$, $P < 0.002$). None of the other species had a Z value greater than 1.7 (Table 1), although the pattern of numbers is consistent. The test based on the three more common species combined, for example, has $Z = 2.9$, which is more significant than the value for the Hawaiian Thrush alone. The generalist recorded an average of 8.9 species (median 9, range 5–11) and 31.8 individuals (range 16–49) during each count period.

Table 2 compares effective radii (Ramsey and Scott 1979) for observers acting as specialist and generalist for the two most abundant species. In 6 of 8 cases and 5 of 8 cases the radius as specialist exceeded that as generalist for Apapane and Hawaiian Thrush, respectively. This suggests that the specialists are searching a larger area than are the generalists.

When paired observers were tested against each other (specialist vs. generalist), the number of Apapane recorded by the specialist was greater 38 out of 40 times ($Z = 5.69$), and similarly 25 out of 40 times ($Z = 1.58$) for the Hawaiian Thrush. These same comparisions using densities resulted in higher figures 26 out of 40 times for Apapane specialists and 21 out of 40 times for Hawaiian Thrush specialists.

The generally higher densities and larger effective radii of specialists suggest that they are recording more birds and searching a larger area than are the generalists (Table 2). Note that estimates of effective

TABLE 1. Observations of seven species recorded by specialists during the 40 8-min count periods. Species indicated by an asterisk are listed as endangered by the U.S. Fish and Wildlife Service (USFWS 1980).

	Generalist	Percentage of birds observed by specialists	Specialist	Z
Apapane	531	66.7	798	7.324
Hawaiian Thrush	170	75.4	221	2.579
Iiwi	110	81.8	136	1.658
Red-billed Leiothrix	131	92.3	141	0.606
Akepa*	20	75.4	26	0.885
Hawaii Creeper*	17	122.2	14	−0.539
Akiapolaau*	4	100.0	4	0.000

radii compensate somewhat for differences between specialists and generalists, as illustrated by the contrast not being as great for densities as it is for raw numbers.

Specialists recorded larger numbers of Apapane and Hawaiian Thrush than did generalists. In the theory of variable area surveys, when two observers or two observer strategies result in different raw counts of birds, there is also a difference in the patterns of detection distances. Thus, estimates of effective areas surveyed differ in compensation, so that both, in theory, have the same density estimates. The only advantage to larger counts representing more area is smaller variability in the density estimate. The evidence suggests that the theory is operative here; i.e. one reason a specialist counts more birds is that he is surveying a larger area.

The evidence is not, however, conclusive. Several other explanations are possible. Generalists, for example, lacking the time to sort out numbers and positions of an abundant species, may purposely enter conservative numbers or may simply become confused with the large number of birds and be unable to sort out individuals. Specialists may overcount as a result of boredom. We feel that many of the increased numbers of birds recorded, however, may be those missed by generalists (see Lack 1976 and Mayfield 1981). Some of these may be at greater distances than would normally be recorded, but undoubtedly a significant percentage are found closer and some perhaps within the distance for which perfect detectability is assumed.

That generalists are at least comparable to specialists when recording the rarest species (Akiapolaau, Hawaii Creeper, Akepa) may reflect the importance placed on these species during the training periods. Alternatively, observers may simply try harder to record individuals of an unusual species than they do

TABLE 2. Comparison of generalists and specialists for birds recorded, area surveyed, and density for Apapane and Hawaiian Thrush.

	Birds recorded		Area surveyed		Density	
Observer	Gen.	Spec.	Gen.	Spec.	Gen.	Spec.
Apapane						
A	110	204	34.1	32.6	3.23	6.25
B	124	202	15.7	26.3	7.93	7.69
C	155	202	35.9	42.4	4.32	4.77
D	82	77	18.7	24.5	4.39	3.14
E	59	98	3.4	4.8	17.48	20.62
Total	530	783	107.8	130.6	4.90	6.00[a]
Hawaiian Thrush						
A	43	56	55.0	104.3	0.78	0.74
B	40	45	31.0	34.9	1.30	1.29
C	51	70	44.2	60.5	1.16	1.16
D	20	23	33.1	40.8	0.61	0.56
E	16	27	13.6	12.5	1.17	2.18
Total	170	221	176.9	253.0	0.96	0.87

[a] $P < 0.001$.

another individual of an already frequently recorded species. The failure of either specialists or generalists to dominate when only one observer recorded a rare species suggests that being a specialist or generalist does not affect an observer's tendency to record rare species, nor his judgment in making identifications.

Based on our findings, we feel that estimates of common birds when four or more individuals of a species are likely to be recorded in a count period should be made by dividing responsibilities between observers, with each responsible for a selected number of species whose numbers are comparable. Division by guild, taxonomic group, or similarly behaving species might be reasonable ways to make these divisions. When making up lists of species for observers, their strengths and weaknesses in identifying species should be considered. We suspect that this division of labor would also work in the tropics, where it is difficult to find observers familiar with all species in an area. Division of effort may also reduce the number of species that are overlooked by observers. This will be particularly important in species-rich areas.

This division of labor should result in more accurate estimates of densities of the more common species. It has been suggested that these species are those for which we need the most reliable estimates of abundance. Our data suggest that it is the rarest species that are recorded most accurately. This may be because observers are more motivated to record them accurately, or it may simply be that all observers react attentively to novel stimuli, and calls, songs, behavior, and appearance of rare species tend to be novel.

In Hawaii we have two observers make simultaneous observations in an area, each observer taking only one of the two most common species in the area along with all less common species. One observer stands 9.2 m in front of and the other 9.2 m behind a station. At the end of each count period, they briefly compare species lists and then move on to the next station. No interaction is allowed during the count period. Densities are later estimated using a modified Emlen technique (Ramsey and Scott 1979) for each observer and a weighted average of the two observers. Working in pairs increases the safety factor for observers in remote areas, increases observer attentiveness, reduces the number of species that are overlooked, and, finally, increases the accuracy of the density estimates for the more common species. The accuracy of distance estimates may also be increased (Scott et al. 1981).

In friendlier terrain and in projects that are smaller in scope, the same division of labor may be obtained by having a single observer divide his count period or run consecutive, short counts. Common species would be divided, whereas rarer species would be sought throughout.

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Responsiveness of Male Swamp Sparrows to Temporal Organization of Song

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In this paper, we investigate the ability of male Swamp Sparrows (*Melospiza georgiana*) to discriminate between their own species' songs and those of the congeneric Song Sparrow (*Melospiza melodia*) using the temporal pattern of syllable delivery as a cue. Male Swamp and Song sparrows often hold adjacent or overlapping territories in eastern North America, and thus it must be important to male Swamp Sparrows to distinguish between Song and Swamp sparrow songs in order to avoid wasting time and energy by responding to singing Song Sparrows. Although there are striking differences between the temporal organizations of the songs of these two species, Peters et al. (1980, Anim. Behav. 28: 393) were unable to show preferential responsiveness of male Swamp Sparrows toward their own species-typical temporal organization compared to two different Song Sparrow-like patterns.

The temporal pattern of natural Swamp Sparrow song is exceedingly simple: a single, multi-note syllable is repeated in a constant rate trill. Natural Song Sparrow temporal patterns are much more complex. Typically, there are two to seven phrases in a Song Sparrow song, each composed of different notes or syllables. Trills of repeated syllables usually alternate with groups of unrepeated notes, called note complexes. Trills are delivered at either constant or accelerated rates.

Peters et al. (1980) demonstrated that territorial male Swamp Sparrows respond to single-speaker playback of conspecific song by approaching the speaker. In a choice experiment, male Swamp Sparrows were presented with Swamp Sparrow song from one speaker and Song Sparrow song from a second speaker; subjects responded by approaching significantly closer to the speaker playing Swamp Sparrow song. Peters et al. (1980) went on to investigate the nature of the cues used by Swamp Sparrows to distinguish between Song Sparrow and Swamp Sparrow song. In one experiment, male Swamp Sparrows were given a choice between (1) a synthetic copy of natural Swamp Sparrow song (Swamp Synthetic), composed of a single Swamp Sparrow syllable repeated in a constant rate trill, and (2) a song composed of Swamp Sparrow syllables assembled in a two-part, Song Sparrow-like temporal pattern. The latter song was composed of one Swamp Sparrow syllable in an accelerated trill followed by a second syllable in a constant rate trill. Contrary to expectation, male Swamp Sparrows responded by approaching significantly closer to the song with the two-part, Song Sparrow-like pattern. In a second experiment, male Swamp Sparrows were given a choice between (1) Swamp Synthetic and (2) a song composed of a single Swamp Sparrow syllable in an accelerated trill. The subjects were equally responsive to both these songs.

Although some of the test songs used by Peters et al. (1980) had temporal features typical of Song Sparrow songs and lacking in Swamp Sparrow songs, none of the songs approached the complexity of natural Song Sparrow song. We hypothesized that Swamp Sparrow males would show preferential response toward Swamp Sparrow temporal patterns over Song Sparrow temporal patterns of natural complexity.

To test this hypothesis, we gave male Swamp Sparrows a choice between Swamp Synthetic song and a newly synthesized song, the Complex song (Fig. 1). The latter song was synthesized by entering natural Swamp Sparrow syllables into a computer and manipulating them into the desired temporal pattern (see