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# A Transect Method to Count Birds in Eucalypt Forest


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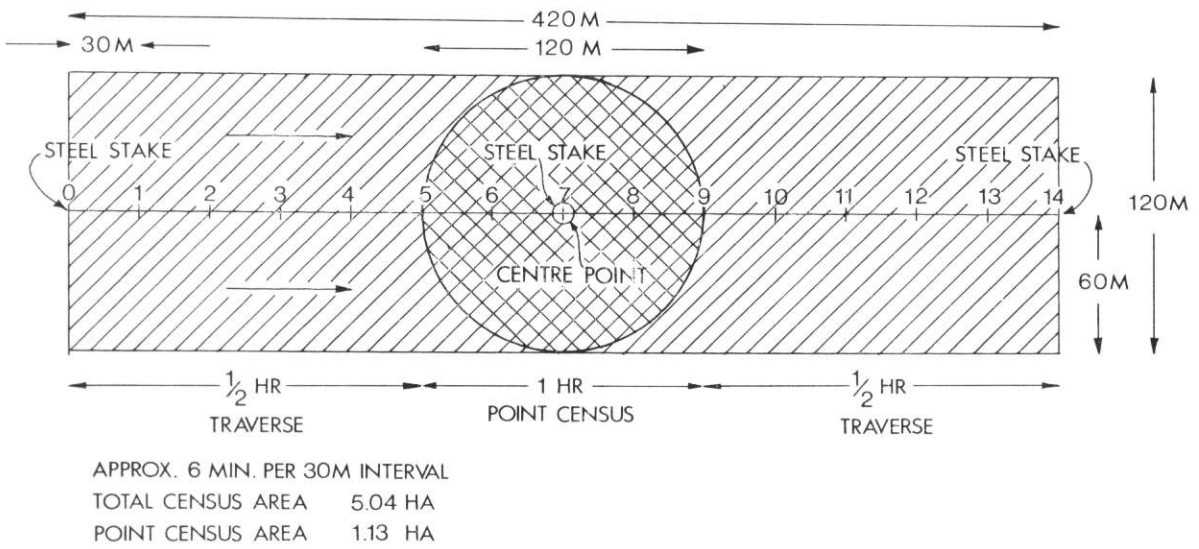
A transect method used to count forest birds in south-eastern Australia is described and its usefulness and limitations discussed. The method combines mapping along a transect 420 m long and 120 m wide, with a point count of 60 m radius. The transect requires two hours, one hour of which is spent on the point count. Four counts were necessary at each site with six counts required in an area with a richer avifauna. Steps were taken to reduce variation and bias due to weather conditions, time of day and differences between observers. The point count was included to allow comparisons with similar counts from areas of habitat too small for a full transect. The disadvantage was that the proportionally greater time spent on the point count biased the overall transect count towards birds recorded at the point. In common with other methods, the effectiveness of the census method was limited by the sporadic occurrence of many of the bird species in the area, and by the problems of the numbers of birds recorded varying with density of vegetation, season, species of birds and duration of the census. The procedure is time consuming but results in more information on bird disposition at each site and better species lists than do shorter counts of smaller areas. It has proved useful in providing a broad data base in surveys of large areas containing a variety of forest habitats and where knowledge of the avifauna is poor.


There are many ways to count forest birds. Among the most widely used procedures are transects, point counts, territory mapping and mist-net captures (see Ralph and Scott, 1981, for reviews of these and other procedures). Properly executed, all provide useful indices of abundance. The method used is selected to provide the data required to answer specific biological or environmental questions, balanced against the size of the area to be surveyed, the time available and the number of people involved (Dawson 1981 a, b; Shields and Recher in press).

During 1975 we initiated a survey of the forest avifauna in the Eden-Bombala area on the far south coast of New South Wales (Recher *et al.* 1980). Our objectives were to determine the distribution and relative abundance of birds in forest habitats and to assess the impact on the avifauna of the intensive logging associated with the Eden woodchip industry. To do this we required a census method that would provide a list of the bird species present at a particular site, together with a measure of the abundance of each species, and information on the distribution of the birds at the site. The method also had to be suitable for use in small forest stands and logged areas which were frequently less than 10 ha in size.

After several trials we adopted a procedure which combined mapping of bird distribution with counts of numbers along a transect of fixed width and length. The transect count incorporated a point count for comparison with similar point counts from areas too small for a complete transect. In this paper we describe the census procedure and discuss its effectiveness and its




• Figure 1. *A diagrammatic representation of the transect census method used at Eden and Kendall.*

limitations. Subsequent papers will compare the transect method with other census procedures (Shields and Recher in press) and discuss problems of observer variability (Kavanagh and Recher in press).

## Census Method

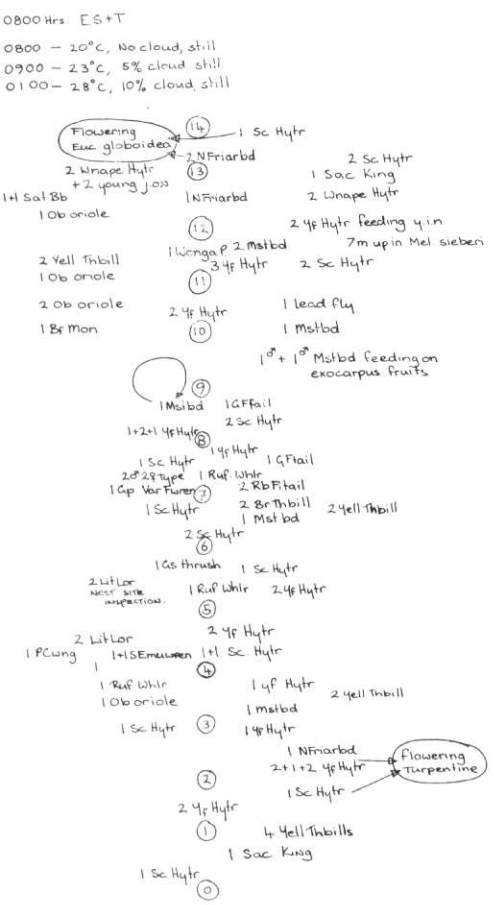
Each transect was a strip 420 m long and 120 m wide having an area of 5.04 ha (Figure 1). We marked the transect along the centre line at 30 m intervals to assist in regulating the rate of movement of the observer, mapping of bird records and gauging the distance to birds. The point count was made from the centre point of the transect and was restricted to a 60 m radius, which circumscribed an area of 1.13 ha.

Since our objective was to compare bird communities in different habitats, each transect was located within an area of uniform habitat. The length of the transect was determined largely by the topography of the Eden area. Specifically, ridges averaged 500 m in length and there was invariably a change in forest-type between ridge and gully. The width of the transect was based on work near Sydney and at Myall Lakes which had indicated that most birds could be detected at distances of up to 60 m in eucalypt forest (Recher, 1969, 1975).

Weather permitting, each transect was censused on four or more consecutive days. Each census was for two hours and was divided into three portions. For the first 30 minutes the observer moved at a steady rate along the centre line of the transect between points 0 and 5. The next hour was devoted to a point count from the centre of the transect, point 7. The final 30 minutes was spent moving at a steady rate between points 9 and 14 (Figure 1).

Bird activity, and hence detectability, varies with weather conditions (O'Connor and Hicks 1980, Robbins 1981) and with time of day (Shields 1977, Grue *et al.* 1981). It is necessary to control as many of these variables as possible if the results are to be at all meaningful (Dawson 1981a). We restricted counts to the early morning, from 30 minutes before sunrise to four hours after sunrise. The four counts per transect consisted of two at dawn and two later in the morning. Counts were completed only when the weather was fine, without rain and with little wind. As several observers were involved in the survey, the four counts per transect were divided equally amount them. This was done to minimise the effects on counts of differences between observers (Enemar 1962. Robbins 1978, Cyr 1981, Kavanagh and Recher in press).

All birds seen or heard on the transect within 60 m of the observer were recorded. Most birds were first detected by sound and an ability to identify calls was essential. Birds seen flying over-




• Figure 2. *The mapping procedures used to record observations during counts is illustrated by this count at a site at Kendall in November 1977.*

head were noted, but not included in the count unless hunting (e.g. raptors) or foraging in the air space over the transect (e.g. swifts). The position of each bird when first detected was marked on a map of the transect (Figure 2). In addition to providing information on the disposition of birds within the transect area, the map also helped in keeping track of individuals during the census to avoid repeat counts.

## Results

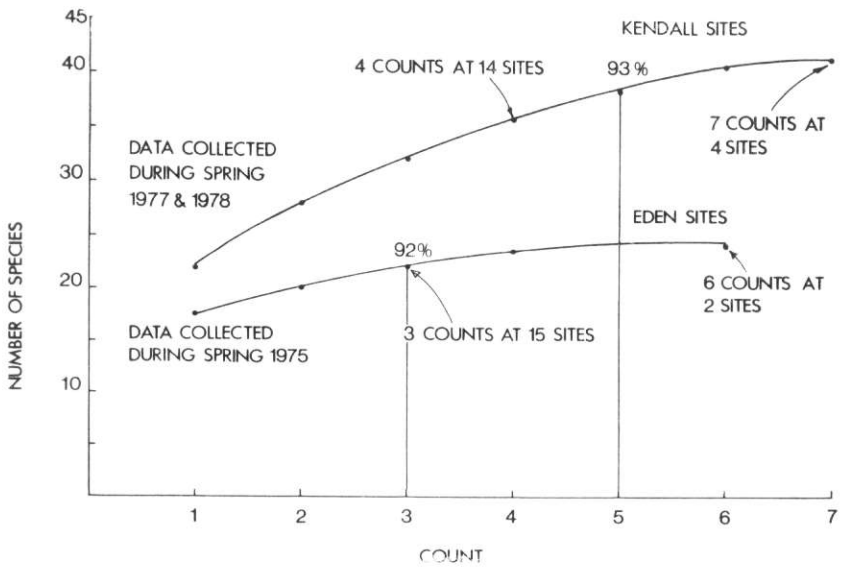
Census results were obtained from 30 transects in eucalypt forest in the Eden-Bombala area. These transects were censused either in spring 1975 or spring 1976. The census method was also used in spring 1978 on 14 transects in eucalypt forest on the north coast of New South Wales near Kendall. All transects were censused four times, with some transects at Eden censused up to six times and some transects at Kendall censused up to seven times.

At Eden the mean rate of addition of new species had fallen to one per census by the fifth census. At Kendall it was not until the seventh census that the rate dropped to one per census (Figure 3). This difference between the two areas arises from the richer avifauna in the northern forests (Milledge 1979). The number of cenusues per transect was therefore standardised for subsequent surveys at four for Eden and six for Kendall.

Two transects near Bombala were censused in five consecutive breeding seasons commencing in 1976, and two others in four consecutive breeding seasons commencing in 1977 (four counts per transect in each year). There were significant changes in the composition of the avifauna between years (Recher *et al.* 1980) and new species continued to be added each year to the species lists for each transect (Figure 4). The pattern was similar for the point counts, but fewer species were recorded. Over the years the species accumulation curves for point and transect counts remained parallel with no tendency for the number of species recorded on point counts to approach the number recorded on transect counts (Figure 4). This suggests that fewer species are recorded on point counts because a smaller area is censused rather than because less time is spent on the counts.

The number of species recorded at the 30 points at Eden-Bombala (four counts per point) was highly correlated with the numbers recorded in the corresponding transects ($r = 0.86$, $df = 28$, $p < 0.001$). On average 69 percent of species recorded on the transect were recorded during the point counts (range 50-85 percent). Similar results were obtained for the 14 points at Kendall: a mean of 73 percent of transect species were recorded during point counts (range 53-84 percent), with a high correlation between the two ($r = 0.79$, $df = 12$, $p < 0.001$).

For the 44 transects at Eden-Bombala and Kendall, the number of individuals recorded during point counts averaged 36 percent of the number recorded during transect counts (range 25-54 percent). This is at variance with the fact that the point count only sampled 22 percent of




• Figure 3. *Accumulation of bird species on successive two-hour transect counts in eucalypt forest during spring. Thirty transects were censused at Eden-Bombala and 14 at Kendall. In both areas only four transects were censused more than four times. More than 90% of the species ultimately recorded on a transect were registered after three counts at Eden and five counts at Kendall.*

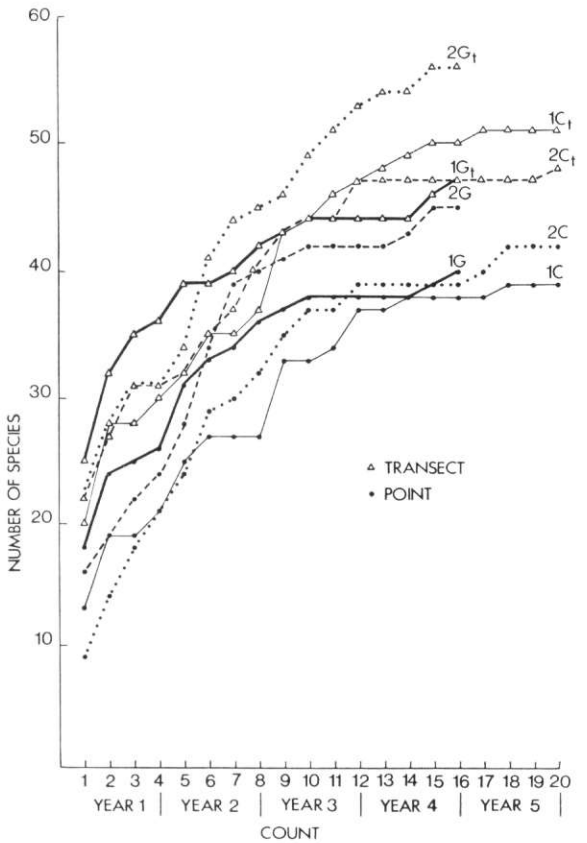
the total area of the transect. However, estimates of bird numbers are affected by the duration of the census since birds are continually moving into or through the census area. Thus the proportionally greater number of birds recorded in the point count is probably a result of the longer time spent there compared to other parts of the transect.

The efficiency of the one hour period for the point count was tested in a series of censuses in eucalypt forest at Pennant Hills near Sydney. Nine point counts were made at each of three points in spring 1979. The rate of species accumulation during each one hour count was measured by noting the number of species which had been recorded by the end of each 10 minute period during the hour. In general, half the total number of species recorded during a one hour point count were recorded in the first 10 minutes, two-thirds in the first 20 minutes, and three-quarters by the 30 minute mark.

## Discussion

Our censuses at Eden and Kendall revealed that many of the bird species of these forests are sporadic in occurrence over time and space, making it difficult to obtain a complete species list for a particular site. Given the 5 ha area and two hour duration of each census, it might have been expected that by the end of the second census the majority of the bird species using the site would have been recorded and that subsequent censuses would only add occasional new species. This was not so. Appreciable numbers of new species were recorded during the third and fourth censuses at both Eden and Kendall (Figure 3), and in the Kendall forests, with their richer avifauna, even after six censuses new species were still frequently recorded. When we take into account year to year variation in the avifauna at a site then the number of censuses required to obtain a complete species list is considerable. At Bombala, species were still being added to the transect lists in the fifth year of the censuses (Figure 4).

If our census method is to measure the absolute density of birds on the transect, then we require that all birds present are recorded, none are counted more than once, and no birds move in or out of the area during the census (Burnham *et al.* 1980). It is certain that these assumptions are violated. In order to obtain as much information as possible on as many species as possible, we censused large areas over long periods. By censusing large areas we decreased the probability of birds being missed, while the




● Figure 4. *Accumulation of bird species on successive breeding season counts on four transects near Bombala. The rate of accumulation is compared between the two-hour transect counts and the one-hour point counts.*

long census periods increased the probability of birds moving into the transect during the census. The latter effect is shown by the high numbers of birds recorded during point counts compared to the rest of the transect.

For many of the purposes for which birds are censused, however, a measure of absolute density is not necessary; a measure of the density of one population relative to that of another (relative density) is sufficient (Caughley 1977, Bull 1981). The number of birds recorded during a census may be unsatisfactory for estimating absolute density, but as long as the relationship between the two remains constant, then the numbers of birds recorded can be used as a measure of relative density for comparing different situations. In our case, the situations being compared were different types of forest, including logged and unlogged forest.

The assumption of a constant relationship between the number of birds recorded and their relative density breaks down in cases where the detectability of birds differs between the situations being compared. This is likely to happen when a habitat with open vegetation is compared to one with dense vegetation where birds will be more difficult to detect. Problems also arise in comparisons between seasons, when such factors as a reduced frequency of calling can affect the detectability of birds. The movement patterns of the birds may also change with the seasons and influence the numbers recorded. Detectability and movement patterns will also vary from species to species. Whenever comparisons are made using measures of relative density rather than absolute density, careful thought should be given to factors which may affect the relationship between the two.

One advantage of our census method was that it involved producing a map of bird sightings on the transect (Figure 2). In addition to providing information on the disposition of birds along the transect, these maps can be used to investigate how bird detectability declines with distance from the centre line of the transect, and whether this decline in detectability varies between habitats (Emlen 1971, 1977; Burnham *et al.* 1980; Franzreb 1981). It may also be possible to use the maps to estimate the absolute density of breeding birds using a territory mapping method, where the number of bird territories is determined from clusters of sightings over successive censuses (IBCC 1970; Svensson 1978; Oelke 1981).

A disadvantage of the census method was that the proportionally greater time spent on the point count meant that the overall transect counts were biased towards birds in the area of the point count, which comprised on average 36 percent of all bird sightings but only 22 percent of the total census area. To eliminate this bias it would be preferable to reduce the duration of the point count to 30 minutes and to increase the time spent in other parts of the transect accordingly. The species accumulation curve over the 60 minutes of a point count suggests that a 30 minute count would result in little loss of information, since on average three-quarters

of the species recorded over 60 minutes have been recorded by the 30 minute mark.

The procedures described in this paper are a compromise between detailed studies of a few plots and rapid surveys of many plots. They provide more information on bird distribution and a better species list per plot than rapid surveys, but less accurate estimates of density than are possible from more detailed studies. They were useful in providing a broad data base in surveys of large areas containing a variety of forest habitats and where knowledge of the avifauna was poor. The method proved to be successful in detecting differences in the avifauna of different forest habitats (Recher *et al.* 1980; Milledge 1979). In our work, we now ask more specific questions about the ecology of forest birds based on the information obtained during the early censuses.

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