INTRODUCTION

This report attempts to evaluate through simple correlations the ruffed grouse surveys that have recently been in use by the Wisconsin Department of Natural Resources (DNR). Wisconsin has maintained a consistency in annual hunting regulations despite fluctuations in ruffed grouse abundance, in the belief that in most of the range there is little depressant effect of hunting upon grouse populations. Information on populations and harvest provides a means of assessing such strategy.

Seven survey procedures have been in use for a sufficient period (at least 6 years) to permit evaluation. They include harvest estimates, roadside drumming transects, winter roost tallies, study area censuses, rural resident wildlife inquiry (spring and summer), and brood tallies. No attempt is made to estimate annual productivity, survival, or exploitation of ruffed grouse (hereinafter called "grouse") populations. The survey results are treated as simple population indexes applying to the year in which the survey was conducted. Extensive areas of the state in open farmland, particularly eastern and southern Wisconsin, do not support this bird, but no stratification within the regions below was attempted.

Survey data were compared in the northern forest, southern grouse range, and statewide (Fig. 1). The northern forest includes those counties predominantly within the northern deer range (Wisconsin Conservation Department 1962). These counties contain commercially valuable forest throughout, which averages greater than 70% of their land area. The study area census at Stone Lake and the grouse roost count provided data relevant only to the northern forest. The southern grouse range included the remainder of Wisconsin where grouse habitat varies from extensive forests to isolated woodlots, and from steep topography to extended glacial lake basins. The study area census at Sandhill provided data that was matched only with surveys in this southern grouse range.

PROCEDURES

Harvest Estimates

Harvest estimates have been derived from mail surveys since 1931 (except 1976-77) by the DNR Bureau of Wildlife Management. Only estimates since 1962 are used in this evaluation, as earlier estimates were based on a voluntary license stub return. Since 1962, a postseason one-page questionnaire has been mailed annually to a sample of small game licensees of the preceding year (Thompson 1951). The sample is weighted by county sales, and has numbered 10,000 licensees through 1971 and 20,000 since 1972. While not enforced, a statute is cited which requires reports when requested by the Department. The response rate has averaged about 45%. Follow-up mailings have not usually been made. Respondents report the number of ruffed grouse and other small game species bagged by county during the preceding season. In the absence of reasonably uniform or defined correction factors no adjustments were applied for response and nonresponse biases; hence the relation...
Ruffed grouse range in the “coulee country” of western and southwestern Wisconsin does not readily lend itself to closely prescribed sampling methods. Indexes may help integrate large area observations for trend estimation.

Northern Wisconsin range has fewer discontinuities, but much is remote and undergoes pattern change from wood utilization. Large scale index methods in effect provide larger sampling units, lessening these problems.

to true harvest cannot be stated. Reported kills in the northern counties were aggregated and projected to a total harvest for the northern forest. Harvest in the remainder of the state was calculated similarly. The statewide harvest was calculated by combining and projecting reports from all counties (DNR Wildlife Management Bureau).

Roadside Drumming Count

The roadside drumming count was developed in Minnesota by Petterborg et al. (1953) and modified for use in Wisconsin by Dorney et al. (1958). It was initiated in northern Wisconsin in 1961, but was temporarily discontinued from 1967 through 1961. The survey was reestablished in 1962 and coverage was extended to include the major statewide grouse range. General procedures, advantages and limitations of the roadside drumming survey were also described by Ammann and Ryel (1963) and Rogers (1981). Briefly, most Wisconsin counts are made on 15-mile road transects with drumming birds and number of drumming (drums) heard in 4 minutes recorded at 1 mile intervals. A single observer commences at least 1 hour before local sunrise in late April or early May. Usually two runs are made and the one having the higher number of drums is adopted. Individual bird tallies are distrusted due to the difficulty of distinguishing individual birds in forested areas.

Data from 1962 through 1980 are used in this analysis. Transects were distributed throughout the major
grouse range, but neither in a random nor systematic manner. Usually they were placed locally in the higher grade range. Each year 20-40 transects were run, averaging 34. In the northern forest, transects ranged from 12 to 21 in number and averaged 16/year. In the southern region, the number ranged from 12 to 19 and averaged 17. Counties were averaged to obtain 3 annual indexes: statewide, northern forest and southern (DNR Survey Reports: Thompson and Rusch series 1980 and earlier). The Minnesota drumming count data were reported by Chesness (1974) and Berg (Minn. DNR pers. comm.).

Grouse Roost Tally

The number of winter grouse roosts, as described by Dorney (1968), occurring on 1/50-acre plots was tallied from 1965 through 1978 in conjunction with annual deer pellet surveys conducted only in northern Wisconsin (Thompson 1955). Roost data were evaluated since 1962 because that was the first year with comparable data from other grouse surveys. Annually, an average of 15 northern deer management units were sampled from 1962 through 1965. Beginning in 1966, 35 northern units were systematically scheduled on a 3-year rotation (ca. 12/year) until aban-
donment of these surveys. Grouse roosts/acre were calculated from these surveys to compare the populations in the northern forest.

Study Area Censuses

A minimum estimate of the drumming grouse population was determined annually on each of two study areas since 1968: the Stone Lake Experimental Area (4,202 acres) in Oneida County (Moulton 1975) and a part (2,400 acres) of the Sandhill Wildlife Area in Wood County (Kubi-siak 1980) (Fig. 1). These areas are searched at least twice each spring to locate drumming grouse. Only grouse positively identified as established on activity centers are tallied and used in subsequent analyses. The acreage searched each year remains constant, so the number of male grouse can be used as an index for direct comparison with annual indexes from each of the broader surveys.

Wildlife Inquiry — Spring and Summer

Since 1962, questionnaires have been mailed to Wisconsin rural residents by the Technical Services Section requesting whether ruffed grouse and other small game species were seen by the respondent on their “farms”. Questionnaires were mailed in May through 1975 (Spring Inquiry) and also in August through 1980 (Summer Inquiry), except 1976. Spring Inquiry results give the percentage of respondents seeing ruffed grouse between the
previous October and May, and the Summer Inquiry reflects the percentage observing grouse between the previous May and August. Mailings have ranged from 1,800 to 3,900 with approximately a 90% reply rate. This high rate is maintained by purging mailing lists of cooperators missing two consecutive returns. These surveys have been described in DNR Survey Reports (Thompson and Rusch series 1980 and earlier).

**10-Week Brood Tally**

Brood survey information has been reported as being a valuable index to grouse abundance. In Michigan, Ammann and Ryel (1963) found brood data to be significantly correlated with roadside drumming data. They concluded that a tally of broods seen, especially in relation to an estimate of observer effort, was a good index to grouse abundance.

Detailed brood observations of ruffed grouse were reported by DNR field personnel from 1961 to 1969. However, use of a comprehensive form over a long observation period seemingly discouraged reporting by many field personnel, so a 10-week summer reporting period system was tried in an attempt to achieve greater compliance. This requires reporters to state only the total number of ruffed grouse and pheasant broods seen in each county, and the observers' estimates of percentage of working hours spent in the field. An announcement letter is given to each field employee in early June with a simple record form at the bottom. Broods seen during working hours of the 10-week period between mid-June and late August are to be counted. Broods seen outside of working hours and during special brood surveys are not to be tallied. At the end of the period, a letter with the same tally form is distributed to employees which calls for immediate submitting of the tally. Each report consists of an individual employee record. If a brood is seen while the observer is in the company of other employees, only one person is to report it. This system yields greater participation and a larger number of broods than the earlier formal brood reporting. This system has been used since 1970 and the indexes derived are total number of broods seen and number of broods seen/observer, but only the latter is reported here. (DNR Survey Reports: Thompson and Rusch series, 1980 and earlier).

**SURVEY COMPARISONS**

Data from surveys are listed in the Appendix, and include some earlier years which were not used in the comparisons but which provide a longer historical record. Plots of the separate surveys for comparable series of years are presented in Figures 2-4 for the three regions studied: northern forest, southern range, and combined statewide. Missing years are marked “NA” (not available) or “Terminated” if the survey has been discontinued.

Simple correlations ($r$) were calculated for matching years for the various surveys. These values, number of years used, and significance level for these pairs are given in Table 1. All the appropriate correlations were calculated, but $r$ values are given only when they have less than a probability ($P$) of 0.20 for chance occurrence. Otherwise, only the number of years used is given.

Diagrams capsulating the significant relationships are given in Figure 5, with lines connecting the correlated surveys. In these diagrams, the study area censuses were not included in order to preserve simplicity. The roost tally surveys were made only in the northern forest range.

Surveys still being conducted as of 1980 are underlined.

**Northern Forest Range**

Most surveys in the northern forest range consistently reflected changes in grouse abundance. Major trends were shown by the data from most of the 7 surveys (Figs. 2-4). The only major inconsistencies seemed to occur in comparisons involving the spring and summer wildlife inquiries. The population low in 1966 was reflected by each