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Seasonal response of Wood Thrushes to taped-playback songs.—Broadcast vocalizations are a useful technique to detect various bird species (see review by Johnson et al. 1981), such as raptors (e.g., Lynch and Smith 1984, Kimmel and Yahner 1990, Morrell et al. 1991), marsh birds (e.g., Marion et al. 1981, Johnson and Dinsmore 1986, Kaufmann 1988), and songbirds (e.g., Falls 1981, Richards 1981). As part of a study focusing on nest-site selection and nesting success of Wood Thrushes (*Hylocichla mustelina*) in a forest managed for Ruffed Grouse (*Bonasa umbellus*) habitat in central Pennsylvania, we developed a survey protocol using taped-playback songs as a means of increasing the number of contacts of Wood Thrushes during the breeding season. Our objective in this study was to test the response of Wood Thrushes to taped-playback songs among three trials (I–III) during the 1992 and 1993 breeding seasons.

Study area and methods.—We conducted our study at the 1166-ha Barrens Grouse Habitat Management Area (HMA), State Game Lands 176, Centre County, Pennsylvania, from June–July in 1992 and 1993 (details of the Barrens Grouse HMA were given in Yahner 1993). The study area has been managed for Ruffed Grouse habitat since 1975 by the Pennsylvania Game Commission (PGC) using an even-aged system of forest clearcutting. The Barrens Grouse HMA consisted of a reference (control) and a treated (clearcut) sector of similar size. The PGC established four parallel transects on each of the two sectors to survey Ruffed Grouse populations at the Barrens Grouse HMA (Yahner 1984). Each transect was 3.2 km long and was oriented in an approximate N-S direction; distance between transects was 0.4 km.

We established 128 stations (N = 64/sector) at 200-m intervals along the eight transects. In both 1992 and 1993, each station was visited once per trial (early to mid-June, mid- to late June, and early to mid-July; trials I–III, respectively) between sunrise and 11:00 hr; the order of visits to transects was alternated between the two sectors. At each station, the observer recorded unsolicited contacts (sightings, call notes, songs) of Wood Thrushes during a 1-min equilibrium period (protocol modified from Morrell et al. 1991). A series of taped-playback songs (Cornell Laboratory of Ornithology, Cornell Univ.) of a Wood Thrush then was broadcasted, using a Johnny Stewart Bird and Animal Caller (Model MS512, Johnny Stewart, Waco, Texas). The series consisted of six songs, each separated by 10-sec pauses; the speaker was rotated to a different direction for each song. After the equilibrium and broadcast periods, the observer noted solicited contacts of Wood Thrushes during a 4-min post-broadcast period. Because of possible difficulty in an observer hearing Wood Thrushes during the playbacks, contacts noted only between the end of the pre-broadcast and before the post-broadcast period were not recorded. To minimize counting the same individual bird twice, contacts of birds recorded in the post-broadcast period included only

those believed to be of birds not seen or heard in the previous equilibrium period. When an unsolicited or solicited contact of a Wood Thrush was noted, period (equilibrium or post-broadcast), trial (I–III), and location of the bird were recorded.

The observed versus expected numbers of survey stations in which unsolicited contacts were noted in the 1-min equilibrium period were analyzed among the three trials (I–III) using *G*-tests for goodness-of-fit (Sokal and Rohlf 1981). Similarly, the observed versus expected number of survey stations in which solicited contacts were noted in the 4-min post-broadcast period were compared among the three trials. The expected number of stations per trial in both analyses was based on the sum of the observed number of stations in which contacts were recorded per trial divided by three trials. If the observed versus expected number of stations with contacts varied significantly ($P < 0.05$) among the three trials in either period, we used a posteriori *G*-tests for goodness-of-fit about the cell (trial) of interest (Sokal and Rohlf 1981).

Results.—Five-hundred eight contacts of Wood Thrushes were noted during the 1992 and 1993 breeding seasons combined. These included 247 (48.6%) unsolicited contacts at 91 stations in the equilibrium period and 261 (51.4%) solicited contacts at 99 stations in the post-broadcast period. The number of different Wood Thrushes seen or heard per visit to an individual station in both the equilibrium and the post-broadcast periods ranged from one to three. During the equilibrium period, one bird was recorded on 76.9%, two birds on 19.5%, and three birds on 3.6% of the total visits to the survey stations in which Wood Thrushes were noted. During the post-broadcast period, one additional bird was recorded on 73.0%, two additional birds on 20.9%, and three additional birds on 6.1% of the total visits to the stations in which thrushes were noted.

The number of stations at which at least one unsolicited contact of a Wood Thrush was recorded during the equilibrium period varied from expected among the three trials in 1992 and 1993 combined ($G = 7.96$, df = 2, $P < 0.05$) (Fig. 1). In trial I, the number of stations characterized by contacts of Wood Thrushes (N = 46, 18.0%) combined was less than expected ($G = 7.51$, df = 1, $P < 0.01$). In trials II and III, however, the number of stations in which Wood Thrushes were noted (N = 76 of total, 29.7%, and N = 68, 26.6%, respectively) did not vary from expected (G's ≤ 3.67, df = 1, $P > 0.10$).

The number of stations in which at least one solicited contact of a Wood Thrush was recorded during the post-equilibrium period also differed from expected among the three trials in 1992 and 1993 combined ($G = 7.51$, df = 2, $P < 0.05$) (Fig. 1). The number of stations where one or more Wood Thrushes were noted did not differ from expected in both trials I (N = 77 of total, 30.1%) and II (N = 71, 27.7%) (G's ≤ 3.04, df = 1, $P > 0.10$). In contrast, the number of stations with solicited calls was lower than expected in trial III (N = 48, 18.8%) ($G = 7.27$, df = 1, $P < 0.01$).

Discussion.—Based on the results of our study, we believe that taped-playback songs are most useful as a means of soliciting Wood Thrushes early in the breeding season (e.g., trial I). A decline in response by Wood Thrushes to taped-playback songs later in the breeding season (e.g., only 41% of the total contacts in trial III were solicited vs. 63% in trial I) may be attributed to the nesting chronology. Although Wood Thrushes occasionally produce more than one brood (Harrison 1975), some pairs probably terminated breeding by mid- to late July, resulting in fewer solicited contacts than earlier in the breeding season.

Because unsolicited contacts comprised a lower percentage of the total contacts in trial I (37%) compared to either trial II (52%) or trial III (59%), we suspect that taped-playback songs helped elicit contacts of birds that otherwise would not sing or sang infrequently early in the breeding season (early June) without the use of taped-playback songs. Hence, use of taped-playback songs would increase the likelihood of detecting more Wood Thrushes than would otherwise be detected without the use of this technique. Furthermore, because singing

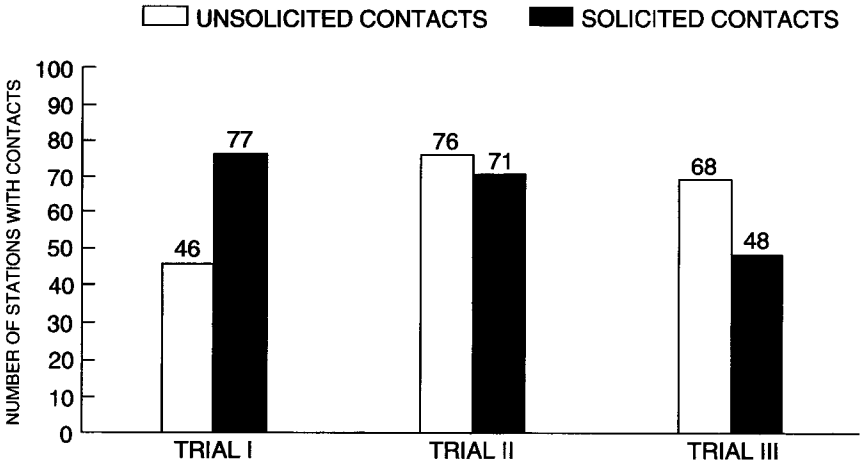

FIG. 1. The number of survey stations (N = 128) with unsolicited (1-min equilibrium period) contacts and solicited (4-min post-broadcast period) contacts of Wood Thrushes in early to mid-June, mid- to late June, and early to mid-July (trials I–III, respectively) during 1992 and 1993 combined at the Barrens Grouse Habitat Management Area, Centre County, Pennsylvania.

by Wood Thrushes tends to decline rapidly after sunrise (Robbins 1981), many of these birds probably would not be detected by an observer later in the morning without the use of taped-playback songs. We must caution, however, that there is a possibility that some birds responding to taped-playback songs were nonbreeding floaters in the population rather than breeding individuals.

In conclusion, we found that the use of taped-playback songs make transect surveys of breeding Wood Thrushes, as well as searches for active nests of thrushes (Yahner and Ross, unpubl. data), more efficient (labor or time), especially on relatively large study areas. An efficient protocol for surveying Wood Thrushes is important because breeding populations of Wood Thrushes have been given considerable attention in recent years (Hoover 1992, Roth and Johnson 1993, Bollinger and Linder 1994), in part because of regional declines in population numbers (Robbins et al. 1989, Askins et al. 1990, Robinson 1992). When surveying Wood Thrush populations, we recommend that taped-playback songs be used earlier (e.g., June) rather than later in the breeding season (e.g., July).

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