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HISTORICAL PATTERNS OF VAGRANCY BY BLUE-GRAY GNATCATCHERS IN NEW ENGLAND

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Abstract.—The pattern of occurrence of the Blue-gray Gnatcatcher (*Polioptila caerulea*) during its recent range expansion into New England is examined. Prior to widespread nesting in New England beginning in the 1970s the species was a rare vagrant in spring and autumn. Significant differences were observed between seasons in the frequency of occurrence of vagrants at coastal and inland sites from 1937 to 1960. Coastal reports predominated in both seasons but inland reports were more frequent in spring. It is proposed that spring vagrants overshot the breeding range on a broader front than autumn reverse migrants. Autumn vagrancy does not presage range expansion whereas an increase in spring vagrancy does.

PATRONES HISTÓRICOS DE MOVIMIENTOS ERRANTES DE INDIVIDUOS DE *POLIOPTILA CAERULEA* EN NEW ENGLAND

Sinopsis.—Se examina en este trabajo, los patrones de aparición de *Polioptila caerulea* en New England, durante su reciente extención territorial. Previo al inicio del 1970, cuando el ave comenzó a anidar en grandes números en New England, éste se consideraba como un raro errante durante la primavera y el verano. Entre el 1937 y 1960, se observaron diferencias significativas estacionales en la frecuencia de aparición de estos errantes en localidades de la costa del interior del estado. Los informes en la costa predominaron tanto en la primavera como en el verano, pero los informes de tierra adentro resultaron más frecuentes en la primavera. Se propone que los errantes primaverales excedieron en número y en forma más amplia a las posibles áreas reproductivas que los migrantes otoñales. Los movimientos errantes durante el otoño no presagian la extención territorial de una especie, contrario a los movimientos errantes durante el período primaveral.

Range shifts, particularly well documented historical range expansions, intrigue many biologists. Range expansions serve as natural experiments for examining community assembly rules and the nature and importance of dispersal in establishing the distribution of organisms (Hengeveld 1988). Birds are well suited to studies of dispersal as an agent of distributional change. There have been many well documented natural range extensions by birds over the last 200 years (e.g., Beddall 1963, Bull et al. 1985, Crosby 1972, Sharrock 1976). Several studies have examined range expansions by largely sedentary or nomadic bird species (Beddall 1963, Hurley and Franks 1976, Mundinger and Hope 1982, Stiles 1982). Few studies, however, address the influence of regular seasonal migration on vagrancy and subsequent range expansion. I examined the recent northeastward range extension by the Blue-gray Gnatcatcher (*Polioptila caerulea*) to investigate the influence of migratory behavior on range expansion.

Prior to 1947 the breeding range of the Blue-gray Gnatcatcher east of

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the Appalachians extended north to Philadelphia, Pennsylvania and Bridgeton, New Jersey (American Ornithologists' Union 1931). Before 1950 this species was strictly a rare vagrant in New England. Spring and autumn vagrants were recorded in about equal frequencies during the first half of the 20th century (Bagg and Eliot 1937, Forbush 1929). Vagrancy in New England increased from the late 1930s onward (Griscom and Snyder 1955). Over the last 40 yr this bird has expanded its range northward into southwestern Quebec, central Vermont and New Hampshire, and southwestern Maine (American Ornithologists' Union 1983). The species first bred in New England in 1947 (Saunders 1950), nonetheless it remained rare until the late 1960s. The expansion by the gnatcatcher into New England was erratic with occasional extreme extralimital breeding (e.g., at Shelburne, Vermont in 1954 [Nichols 1954]). Gnatcatchers did not become established at many modern breeding sites in New England until the 1970s. This study relates the pattern of gnatcatcher vagrancy during this increase to the species' eventual establishment as a breeding bird in the region.

I examined records of Blue-gray Gnatcatchers cited in two regional publications from 1937 to 1960 to determine the patterns of vagrancy in New England. I propose that spring and autumn patterns of vagrancy were fundamentally distinct and that vagrants originated from different age classes of gnatcatchers.

METHODS

All records of vagrant Blue-gray Gnatcatchers between 1937 an 1960 were compiled from thorough and carefully edited publications of the Boston Museum of Natural History and the Massachusetts Audubon Society, the Bulletin of New England Birdlife (BNEB) and Records of New England Birds (RNEB). The gnatcatcher's status as a rare but regular vagrant in New England during the survey period ensures that the majority of reports of the species by knowledgeable observers were recorded in these documents.

My rationale for using reports between 1937 and 1960 was dictated by the publication dates of BNEB and RNEB, and by changes in the status of the gnatcatcher in New England during the 1960s. The BNEB was published from 1937 to 1944 and the RNEB was published from 1945 to 1968. The publication of RNEB was intermittent after 1960 with a hiatus between 1961 and 1963, rendering more than 2 yr unavailable for analysis. The interpretation of autumn records also became difficult because of the increase in breeding records from Connecticut and the start of nesting in other New England states. I established three periods for analysis of the geographic dispersion of spring and autumn vagrants: 1937–1946, 1947–1953, and 1954–1960. This arrangement separates the initial decade of low-level vagrancy from the first year with a spring incursion (1947). The final two periods were established as equivalent periods of 7 yr each.

In order to satisfy the assumption of independence of events for tabular

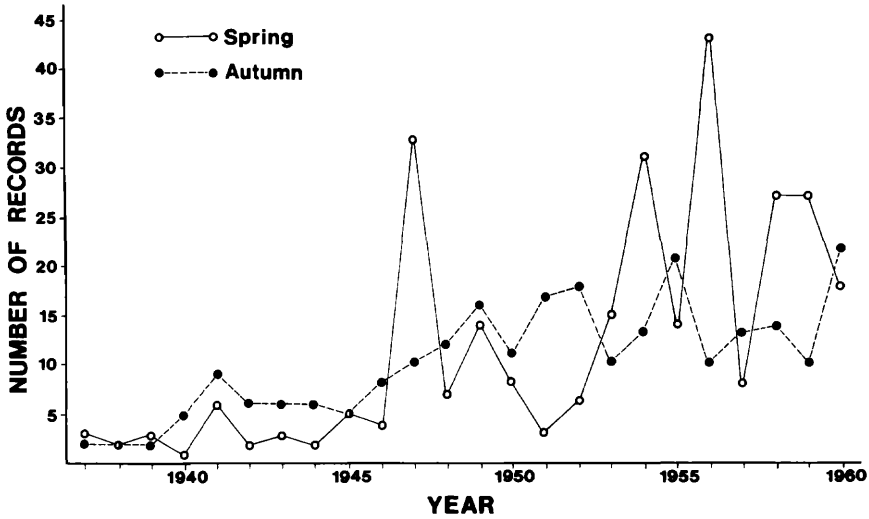

FIGURE 1. Reports of vagrant Blue-gray Gnatcatchers in New England by season, 1937–1960.

Chi-squared analysis I adopted several conventions to define a record. I considered reports of multiple individuals on the same date at one location as a single record because such birds may have arrived together. If on subsequent days additional individuals were reported these were considered new records. When reports covered a period of 2–3 wk I considered the first and last reports records of the same individual(s). Gaps of more than 3 d in a series of reports caused me to list reports as separate records. If a report indicated that multiple birds were encountered more than 1.6 km apart I considered these multiple records. The dates for migration were arbitrarily cut off at 1 June for spring, and begun at 1 August for autumn.

I defined inland records as reports from locations 17 km or more from littoral waters. I used tabular Chi-squared analysis to examine the interaction between season and locality. Statistical analysis was done with Systat V. 4.0 (Wilkinson 1988).

RESULTS

The number of vagrant Blue-gray Gnatcatchers was initially low (<10 birds/yr) in the late 1930s but rose over the next two decades (Fig. 1). Numerical increases by autumn vagrants were initially greater than those shown by spring vagrants and remained steadier with less dramatic fluctuation. From 1947 to 1960 the number of spring vagrants fluctuated widely, and particularly large flights occurred in 1947, 1954 and 1956. Peak autumn and spring totals of vagrants did not coincide within years or between adjacent years.

Differences in the numbers of inland and coastal records between spring and autumn were highly significant for the 533 records of gnatcatchers from 1937 to 1960 (Pearson's $\chi^2 = 79.28$, $P < 0.001$), and these differences were also significant for 1937–1946 ($\chi^2 = 11.93$, $P = 0.001$), 1947–1953 ($\chi^2 = 32.01$, $P < 0.001$) and 1954–1960 ($\chi^2 = 34.29$, $P < 0.001$) (Fig. 2a–c). Inland vagrants were frequent in spring, constituting approximately 37% of reports from 1947–1960. Inland reports were relatively more frequent in two of the three largest spring incursions, 1947 and 1956 (Fig. 2d, f). Only 5% of autumn records were from inland localities. Most autumn coastal reports were from peninsulae and headlands in Barnstable and Plymouth counties in Massachusetts. Coastal barrier islands and peninsulae in Essex County, Massachusetts, had more frequent reports during the latter 1950s (e.g., Plum Island, Marblehead Neck, Rockport).

The majority of spring gnatcatcher reports occurred in May (Table 1). Autumn reports were most frequent in September, with most August reports from the 20th and later (Table 1). Twenty-five percent of reports occurred on dates from October to December. There were two December observations, 16 Dec. 1943 at New London, Connecticut, and 6–13 Dec. 1950 at Marblehead, Massachusetts.

DISCUSSION

The dramatic increase in the numbers of vagrant Blue-gray Gnatcatchers in the 1940s and 1950s implied a corresponding increase in the total gnatcatcher population. Some readers may suspect that the increases documented here represent an increasing population of better trained observers and their anticipation of finding gnatcatchers conditioned by prior experience. This objection is valid and I cannot rule out some observational bias, however two factors reduce this difficulty. First, gnatcatchers were regular vagrants in the northeast from at least the 1920s onward (Griscom 1923), therefore bird watchers should have been aware of gnatcatchers throughout the period of 1937–1960. Second, the spring 1947 flight was unprecedented and had no parallel until 7 yr later. One presumes observers would have been sensitized to gnatcatchers after such a major flight. On the other hand numbers from 1957–1960, after the 1954 and 1956 flights, probably were greater due to observer awareness.

Increases may also represent an increase of migratory Blue-gray Gnatcatchers from newly established nesting populations rather than true vagrants. I contend that the vast majority of birds reported from 1937–1960 were vagrants for two reasons. 1) There were less than 15 documented instances of breeding by gnatcatchers in New England before 1970 (Ellison 1991). If a substantial regular nesting population existed it should have been better documented. 2) The pattern of predominantly coastal vagrancy in autumn persisted through 1960 (Fig. 2c). If regular migrants were present at some point there should have been an increase of inland reports in autumn. Inland occurrence during August and early September is now routine in New England (Ellison, pers. obs.).

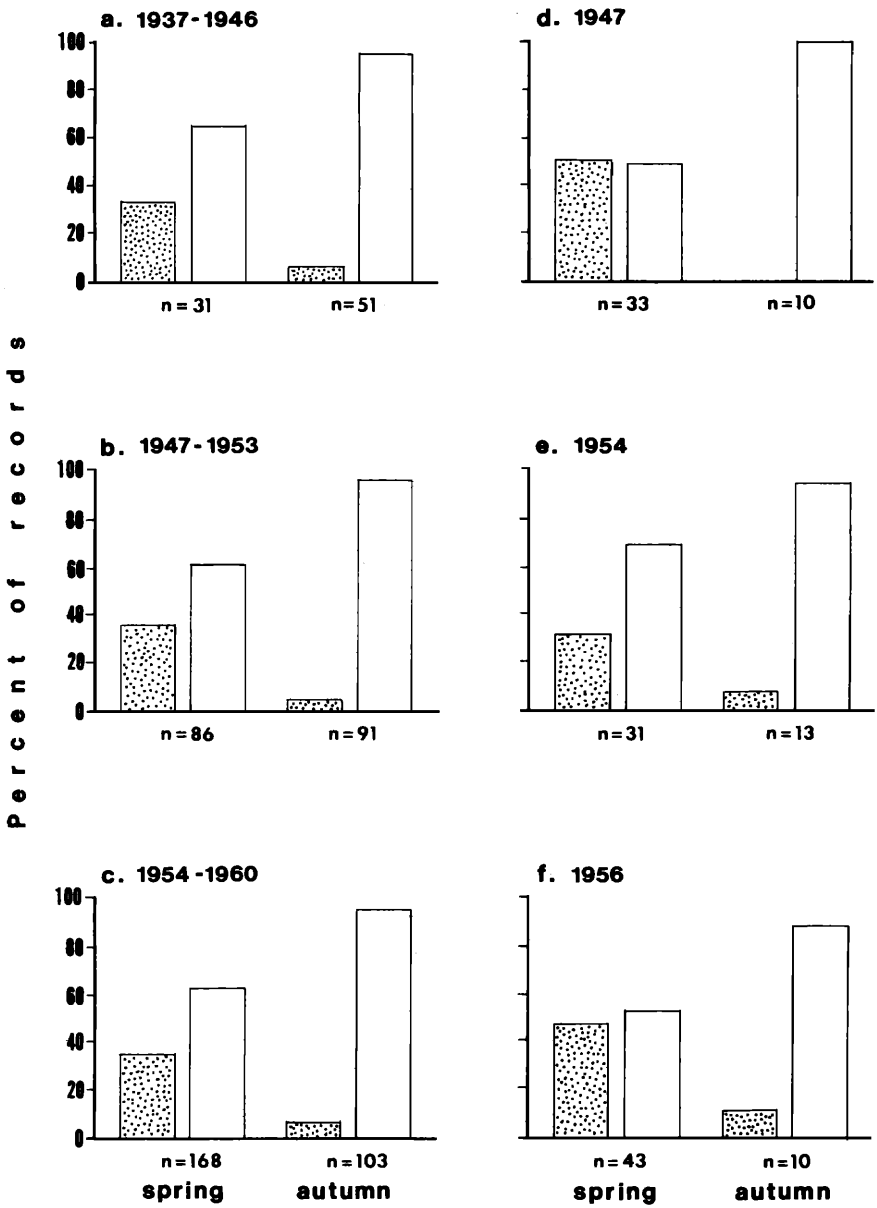

FIGURE 2. Distribution of vagrant Blue-gray Gnatcatchers in New England by location and season for three periods 1937–1960 (a–c) and selected years of high Spring vagrancy (d–f). Inland = stippled bars, Coastal = open bars.

TABLE 1. Summary of the number of Blue-gray Gnatcatcher records in New England from 1937–1960 by month of occurrence.

Month	*n*	% all records	% within season
Spring			
April	76	14.3	26.7
May	209	39.2	73.3
Total	285	53.5	100.0
Autumn			
August	71	13.3	28.6
September	115	21.6	46.4
October	47	8.8	18.9
November	13	2.4	5.2
December	2	0.3	0.8
Total	248	46.4	100.0

The first sign of an increase occurred in the early 1940s and was most pronounced in autumn. Numbers of autumnal vagrants increased more smoothly than those of spring vagrants, which showed marked fluctuation. These differences likely reflect differences in the sources of spring and autumn vagrants. Vagrants in autumn were probably reversed migrants, that are usually disoriented immatures (Baird and Nisbet 1960, DeSante 1983, Ralph 1978). Therefore, autumn vagrancy should more faithfully reflect a steady population increase than that of spring. Spring vagrants were birds that overshot the northern edge of the breeding range in periods of good weather for spring migration (see Gauthreaux and LeGrand 1975, McLaren 1981), and should have represented a broader demographic cross-section of the population. Large incursions in April and May are thus associated with favorable weather displacing large numbers of northbound migrants, whereas fall vagrancy is a more subtle interaction between disorientation and weather, hence the larger fluctuations of spring.

The contrast between spring and autumn in the distribution of vagrants also reflects differences in the nature of spring versus autumn migration. Spring migrants probably move along a broad front in order to disperse into a wide geographic region. The nature of reversed migration in autumn may have led to the collection of dispersing young along such leading lines as the Atlantic coast. Persistent southwest winds may have encouraged the dispersing immatures northward along the coast into New England and the Maritime Provinces of Canada. Elkins (1983) has described a similar phenomenon for central European and Mediterranean sylviine warblers in Scotland.

Overshooting spring migrant songbirds often re-determine their course and return southward (Elkins 1983). A few birds may choose to remain north of the known breeding limit and attempt to breed (Sealy 1980; Ellison, pers. obs.). Some spring migrant passerines possess viable sperm during migration (Quay 1989). Therefore, it is plausible that gnatcatchers

may have arrived north of the nesting range in breeding condition, heightening the prospect of extralimital breeding in years of major incursions.

Autumn vagrants were more geographically limited and often occurred on dates outside of normal migration in the historic breeding range (see Weston 1949 for characteristic dates). The latest and farthest displaced birds appeared to be doomed by their persistent reversed migration (see also DeSante and Ainley 1980). An example of this phenomenon of persistent reversal was the late autumn influx of gnatcatchers in 1984 in New England and Maritime Canada, which resulted in many late December and a few January records as far north as Newfoundland (Forster 1985, Heil 1985). Earlier autumnal reversed migrants might re-determine their migratory heading (Ralph 1978), but their return northward in spring seems unlikely. The first breeding of gnatcatchers at the outer coastal locations frequented during autumn reversal (e.g., eastern Long Island, Martha's Vineyard) occurred long after nesting inland and at mainland coastal sites in New England and New York State (Bull 1974, Whiting and Pesch 1983).

The pattern described above suggests a model for range expansion for the Blue-gray Gnatcatcher. Warming winter climate in the southeastern United States from the 1930s to the mid-1950s (Karl et al. 1989) coincided with the increase in number of vagrants in the northeast (Ellison 1991). These warm winters may have caused increased survival by overwintering gnatcatchers. This in turn may have led to the increase in vagrancy in New England during this period. Autumn vagrancy increased steadily but was limited to young reversed migrants along the coast. Favorable spring weather conditions caused major incursions in 1947, 1954 and 1956 in northeastern North America (Ellison 1991, Gunn and Crocker 1951). These incursions brought sufficient numbers of birds northward to allow some pairs to breed in new sites. In 1947 this led to the breeding establishment of the Blue-gray Gnatcatcher in northern New Jersey (Bull 1964). Subsequent incursions encouraged breeding in Connecticut and further prospecting in other New England states. Many authors were intrigued by the combination of autumn vagrancy with spring vagrancy by gnatcatchers (Bagg and Eliot 1937, Griscom 1949). These authors erroneously supposed that these records implied breeding somewhere north of New England because the phenomenon of reversed autumn migration was not known. This study indicates that the mechanism of vagrancy must be taken into account when interpreting the significance of changes in the numerical and distributional status of vagrant birds.

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