ON THE OCCURRENCE OF EASTERN WOOD WARBLERS IN WESTERN NORTH AMERICA

GEORGE T. AUSTIN

Department of Biological Sciences
University of Arizona
Tucson, Arizona 85721

The recent occurrence in western North America of wood warblers normally considered to be eastern migrants, especially in the fall, has been well documented by McCaskie and Banks (1964), Tenaza (1967), McCaskie (1970a, b), and others (see especially Audubon Field Notes). In light of the large number of records of these birds on the west coast, it is of interest to examine them from the standpoint of season and timing of occurrence and to contrast these with the usual migratory timing on the east coast. Comments are also made on the status of these species in the West.

Eastern warblers have been recorded in California since the 1800s but the reports are scattered. In the 1960s their occurrence appeared to be a regular feature of migration. To date, 29 species of typically eastern warblers have been recorded in the state (McCaskie et al. 1970). Ninety per cent of the records for California are for the period 1960–1969; of those prior to 1960, 64 per cent are for the period 1940–1959.

Several suggestions have been advanced as to the origins of these birds. These include development of a west coast migration route for species whose ranges extend beyond the 100th meridian (Gross, in Bent 1953; Mans and Peyton 1962; De Benedictis and Chase 1964; McCaskie and Banks 1964; McCaskie and Pugh 1964; McCaskie 1967, 1970b). Pulich and Phillips (1953) demonstrated a desert migratory route for the American Redstart. Root (1962) doubted a west coast route for this species. Other eastern warblers are considered vagrants (McCaskie and Banks 1964; McCaskie 1969), and weather patterns are thought to be responsible for their occurrence (Mans 1963; Chase and Paxton 1965; Paxton 1965; Bagg 1966, 1970; Snider 1968). Chase and Chandik (1966) thought that some species recorded in spring may be the return of the previous fall's "mis-migrants." It has also been suggested that the increase in records in recent years is a result of more observers, and thus more extensive field work, coupled with a greater awareness of the possibility of vagrants (De Benedictis and Chase 1964; Paxton 1965, 1966).

METHODS

Records were obtained from the literature, mainly Audubon Field Notes (through fall migration 1969), museum specimens, and unpublished notes of several people. The records were divided into spring (15 March–30 June) and fall (1 August–15 December) periods. Occurrences outside these periods were analyzed separately. An average date of occurrence of each species was calculated from records of all individuals for which a date was available. The median dates of occurrence, in most cases, did not differ more than ± 2 days from the mean date. Greater differences that did exist were for species with small sample sizes and did not change the basic patterns discussed herein. Since most of the records are from California, these data will be used as the basis for this report. California was divided into northern and southern regions corresponding with the middle and southern Pacific coast regions in Audubon Field Notes.

For comparison, migration timing of the various species on the east coast at similar latitudes was examined. Sources for these data include Audubon Field Notes, various state books (especially Stewart and Robbins 1958), Murray (1966) for fall, and Stevenson (1957) for spring. Age data for the West are based on museum specimens; those for the east coast are from Murray (1966).

Species involved are divided into four groups based on breeding range and are referred to by group number in following discussions. Group 1, breeding only east of 100° and generally south of Canada, includes the following warblers: Prothonotary (*Protonotaria citrea*), Worm-eating (*Helmitheros vermivorus*), Golden-winged (*Vermivora chrysoptera*), Blue-winged (*V. pinus*), Cerulean (*Dendroica cerulea*), Yellow-throated (*D. dominica*), Prairie (*D. discolor*), Louisiana Water-thrush (*Seiurus motacilla*), Kentucky (*Oporornis formosus*), and Hooded (*Wilsonia citrina*).

Group 2, those warblers breeding only east of 100° and north into Canada, includes: Parula (*Parula americana*), Black-throated Blue (*Dendroica caerulescens*), Blackburnian (*D. fusca*), Chestnut-sided (*D. pensylvanica*), Pine (*D. pinus*), and Canada (*Wilsonia canadensis*).

Group 3, those breeding west to the Rocky Mountains, includes: Black-and-White (*Mniotilta varia*), Magnolia (*Dendroica magnolia*), Cape May (*D. tigrina*), Black-throated Green (*D. virens*), Bay-breasted (*D. castanea*), Palm (*D. palmarum*), Ovenbird (*Seiurus aurocapillus*), Mourning (*O. philadelphia*), and Connecticut (*Oporornis agilis*).

Group 4 includes those breeding west of the Rocky Mountains: Tennessee (*Vermivora peregrina*), Black-

TABLE 1. Mean date and range of occurrence of eastern warblers in California in fall.

Group no.	Species	California						Range of occurrence
		Northern		Southern		Total		
		mean date	(n)	mean date	(n)	mean date	(n)	
3	Black-and-White	28 Sept.	(36)	4 Oct.	(62)	1 Oct.	(98)	15 Aug.–4 Dec.
1	Prothonotary	17 Oct.	(2)	11 Oct.	(3)	13 Oct.	(5)	30 Aug.–3 Dec.
1	Worm-eating	20 Nov.	(2)	18 Sept.	(1)	30 Oct.	(3)	18 Sept.–16 Dec.
1	Golden-winged	—		15 Nov.	(2)	15 Nov.	(2)	23 Oct.–8 Dec.
1	Blue-winged	13 Sept.	(1)	21 Sept.	(3)	19 Sept.	(4)	13 Sept.–26 Sept.
4	Tennessee	26 Sept.	(37)	5 Oct.	(75)	2 Oct.	(112)	1 Sept.–27 Nov.
2	Parula	2 Oct.	(5)	3 Oct.	(3)	2 Oct.	(8)	21 Aug.–13 Nov.
3	Magnolia	1 Oct.	(14)	6 Oct.	(23)	4 Oct.	(37)	23 Aug.–10 Nov.
3	Cape May	5 Oct.	(5)	24 Oct.	(2)	10 Oct.	(7)	15 Sept.–23 Nov.
2	Black-throated Blue	13 Oct.	(16)	19 Oct.	(30)	17 Oct.	(46)	10 Sept.–23 Nov.
3	Black-throated Green	4 Oct.	(1)	26 Oct.	(18)	25 Oct.	(19)	18 Sept.–8 Dec.
1	Cerulean	—		14 Oct.	(2)	14 Oct.	(2)	1 Oct.–26 Oct.
2	Blackburnian	3 Oct.	(7)	30 Sept.	(10)	1 Oct.	(17)	5 Sept.–28 Oct.
1	Yellow-throated	21 Sept.	(1)	15 Oct.	(1)	3 Oct.	(2)	21 Sept.–15 Oct.
2	Chestnut-sided	22 Sept.	(18)	4 Oct.	(14)	27 Sept.	(32)	20 Aug.–10 Nov.
3	Bay-breasted	30 Sept.	(2)	13 Oct.	(8)	10 Oct.	(10)	27 Sept.–23 Nov.
4	Blackpoll	27 Sept.	(57)	5 Oct.	(119)	2 Oct.	(176)	1 Aug.–16 Nov.
2	Pine	—		8 Nov.	(3)	8 Nov.	(3)	22 Oct.–6 Dec.
1	Prairie	1 Oct.	(7)	2 Oct.	(19)	2 Oct.	(26)	3 Sept.–4 Nov.
3	Palm	17 Oct.	(45)	24 Oct.	(60)	22 Oct.	(105)	10 Sept.–1 Dec.
3	Ovenbird	23 Sept.	(11)	9 Oct.	(10)	30 Sept.	(21)	12 Aug.–30 Oct.
4	Northern Waterthrush	30 Sept.	(25)	7 Sept.	(30)	17 Sept.	(55)	13 Aug.–26 Nov.
1	Louisiana Waterthrush	—		17 Aug.	(1)	17 Aug.	(1)	17 Aug.
3	Connecticut	24 Sept.	(3)	27 Sept.	(1)	25 Sept.	(4)	13 Sept.–3 Oct.
3	Mourning	—		3 Oct.	(1)	3 Oct.	(1)	3 Oct.
1	Hooded	29 Sept.	(1)	15 Oct.	(3)	11 Oct.	(4)	25 Aug.–24 Nov.
2	Canada	10 Oct.	(1)	18 Oct.	(10)	17 Oct.	(11)	24 Sept.–21 Nov.
4	American Redstart	21 Sept.	(60)	24 Sept.	(172)	23 Sept.	(232)	6 Aug.–13 Dec.

poll (*Dendroica striata*), Northern Waterthrush (*Seiurus noveboracensis*), and American Redstart (*Setophaga ruticilla*).

RESULTS

The major occurrence of migrant eastern warblers in California is in fall. I have 1350 records of 28 species (table 1). When compared with peak migration periods on the east coast, a number of interesting patterns emerge, as summarized in table 2. Species of group 4 are not only individually more abundant than are those of other groups but their occurrence in California more closely approximates the timing of their migration on the east coast. About half of the California occurrences are on either side of the mean of the east coast peak. Species of group 3 occur, on the average, two weeks later than their eastern peak mean and those strictly eastern in their breeding range (groups 1 and 2) occur three to five weeks later. Ninety per cent of the California records of the latter groups are after the eastern midpoint.

Eastern warblers are less common in spring. I know of 330 records of 21 species. Dates of occurrence and comparison with east coast migration are presented in tables 3 and 4. The trends noted for fall migration are present but are less clear cut. In general, spring occurrences are later in relation to the east coast peak than are fall occurrences.

The lack of birds-of-the-year among June specimens ($n = 33$) indicates that June oc-

TABLE 2. Timing of occurrence in fall of eastern warblers in California in relation to eastern migration as a function of breeding range.

Group no.	No. species	No. records[a]	$\bar{x}$ no. records per species	Relation to eastern midpoint	
				$\bar{x}$ no. days after	$\bar{x}$ % records after
1	9	50	5.6	35.7	92.0
2	6	120	20.0	21.9	88.3
3	9	384	46.2	15.5	76.5
4	4	796	199.0	4.8	54.6

[a] Includes undated records.

TABLE 3. Mean date and range of occurrence of eastern warblers in California in spring (sample size of dated records in parenthesis).

Group no.	Species	California						Range of occurrence
		Northern		Southern		Total		
		mean date	(n)	mean date	(n)	mean date	(n)	
3	Black-and-White	18 May	(19)	6 May	(26)	11 May	(45)	19 March–30 June
1	Prothonotary	—		17 May	(3)	17 May	(3)	6 May–25 May
1	Blue-winged	—		16 June	(1)	16 June	(1)	16 June
4	Tennessee	5 June	(12)	3 May	(12)	20 May	(24)	21 March–22 June
2	Parula	31 May	(11)	19 May	(13)	25 May	(24)	22 March–23 June
3	Magnolia	12 June	(12)	24 May	(5)	6 June	(17)	8 May–26 June
2	Black-throated Blue	—		4 May	(2)	4 May	(2)	17 April–21 May
3	Black-throated Green	28 May	(7)	5 June	(1)	29 May	(8)	5 May–22 June
2	Blackburnian	31 May	(1)	—		31 May	(1)	31 May
2	Chestnut-sided	18 June	(4)	5 June	(1)	15 June	(5)	5 June–21 June
3	Bay-breasted	11 June	(2)	11 June	(1)	11 June	(3)	3 June–18 June
4	Blackpoll	6 June	(11)	21 June	(1)	7 June	(12)	15 May–22 June
3	Palm	20 May	(9)	18 April	(3)	12 May	(12)	8 April–7 June
3	Ovenbird	13 June	(14)	24 May	(13)	3 June	(27)	13 May–24 June
4	Northern Waterthrush	22 May	(6)	11 May	(22)	14 May	(28)	8 April–30 June
1	Kentucky	2 June	(1)	4 June	(1)	3 June	(2)	2 June–4 June
3	Connecticut	15 June	(5)	4 June	(1)	13 June	(6)	28 May–22 June
3	Mourning	—		12 June	(1)	12 June	(1)	12 June
1	Hooded	13 May	(2)	16 June	(1)	24 May	(3)	4 May–16 June
2	Canada	5 June	(1)	2 June	(2)	3 June	(3)	21 May–13 June
4	American Redstart	13 June	(22)	24 May	(52)	30 May	(74)	19 April–30 June

currences are not southward fall movements. However, one of three July specimens, one August specimen, and 15 of 20 September specimens are immatures.

In addition to the records within the dates prescribed for spring and fall, there are more than 100 other records for California. Four species have wintered in recent years (Black-and-White and Palm Warblers, Northern Waterthrush, American Redstart). Five other species are thought to have wintered at least once (Tennessee, Parula, Chestnut-sided and Blackpoll Warblers, Ovenbird). In addition, there are several July records which may be either late spring or early fall transients. The Parula Warbler bred once (Williams et al. 1958).

DISCUSSION

FALL

On the basis of timing of occurrence, a number of tentative generalizations can be made. The species of group 4 occur in greatest numbers in California at about the time they are migrating in eastern North America at similar latitudes. These occurrences are distributed rather evenly on either side of the midpoint of their migration period in the east (table 2). The four species of group 4 are among the six most abundant eastern warblers in California in the fall and account for 59 per cent of the records. For all except the Northern Waterthrush, the mean date of occurrence is earlier in northern than in southern California (table 1). These data alone suggest a regular migratory movement through California.

All four species breed in northwestern British Columbia and/or parts of Alaska (Webster 1950; AOU 1957). West coast specimens of the Blackpoll Warbler have been assigned to the Alaskan race *D. s. lurida* by McCaskie and Banks (1964). Root (1962) suggested the southeastern Alaskan population of the American Redstart as the likely transient in California. The paucity of fall records (eight) of these species for Oregon suggests

TABLE 4. Timing of occurrence in spring of eastern warblers in California as a function of breeding range.

Group no.	No. species	No. records[a]	$\bar{x}$ no. records/species[a]	Relation to eastern midpoint	
				$\bar{x}$ no. days after	$\bar{x}$ % records after
1	4	9	2.3	24.4	88.9
2	5	35	7.0	24.7	91.4
3	8	130	16.3	21.4	80.2
4	4	156	39.0	13.6	76.8

[a] Includes undated records.

TABLE 5. Number of records and mean date of occurrence of warblers possibly using the desert flightline (dates in parentheses indicate mean date for coastal southern California).

Species	No. records (spring)	$\bar{x}$ date	No records (fall)	$\bar{x}$ date
Black-and-White Warbler	20	12 May (6 May)	7	25 Sept. (4 Oct.)
Northern Waterthrush	20	10 May (14 May)	25	3 Sept. (15 Sept.)
American Redstart	53	24 May (22 May)	106	11 Sept. (2 Oct.)

an overwater flightline, possibly with the Farallon Islands-Point Reyes area as the first landfall (nearly 100 records in the falls of 1968 and 1969 alone). McCaskie (1970b) pointed out that there is only one coastal record of the American Redstart north of Point Reyes; there are but three fall records of the other three species in the same area.

The Northern Waterthrush and American Redstart winter in western México (Small 1954; AOU 1957; Miller et al. 1957). Both are thus likely to pass through California regularly as suggested for the former by Mans and Peyton (1962). The latter species winters commonly in California (McCaskie 1970b). The Tennessee Warbler has been recorded in Sonora (Miller et al. 1957).

The number of fall records of at least two species of group 3 (Black-and-White and Palm Warblers) indicate that they are also regular transients. Grinnell and Miller (1944) suggested the regular occurrence of the former. Both species winter in the state, and the Black-and-White Warbler winters in western México (Small 1954; AOU 1957). The Ovenbird may also fall into this category; it is reported as a sparse transient and winter resident in western México (Miller et al. 1957) and was common in coastal Nayarit in April 1968 (E. L. Smith, pers. comm.). Thus, there is evidently frequent crossing of the Rocky Mountains by species that breed and are generally believed to migrate east of this range. Wherever the route, it is evident that significant numbers somewhere cross the Rockies and move southwestward toward the coast. It also appears that the Rocky Mountains are used more for migration by several species than formerly supposed; there are a number of records of eastern warblers from the very few stations gathering data (see Audubon Field Notes).

SPRING

During spring, similar patterns occur but they are far less apparent. Although the timing of the Tennessee Warbler and Northern Waterthrush is similar to that in the east, the other two species of group 4 occur much later, which caused Root (1962) to doubt a west coast migration route for the American Redstart. However, the number of spring records for California appears to support the suggestion of a west coast route for that species (Gross, in Bent 1953).

Gross (in Bent 1953) reported early redstart arrival dates as 20 May in British Columbia and 9 June in Alaska. Munro and Cowan (1947) reported breeding underway in mid-June. Thus, although the California occurrences of the American Redstart in spring are late (by east coast standards), most individuals could be part of the western breeding population. Although sample size for the Blackpoll Warbler is small, they also could be considered breeding birds. Early arrival dates are 22 May (British Columbia) and 20 May (Alaska) and three egg dates for Alaska are from 10 to 21 June (Gross, in Bent 1953).

As for species of group 3, the Black-and-White Warbler is the most common in California. As noted above, it winters in western México and can be considered a regular migrant. Timing of the occurrences of this and at least three other species (Magnolia and Palm Warblers and Ovenbird) is such that they could arrive on the breeding grounds in time to breed. Again, as in fall, there are several species whose occurrence in the West is hard to explain. Although the suggestion of Chase and Chandik (1966) that spring birds are the return of fall mis-migrants may have merit (see beyond), this simply shifts the lack of knowledge to the fall season.

DESERT FLIGHTLINE

Pulich and Phillips (1953) indicated a desert flightline for the American Redstart. There are now over 100 records in fall and 50 in spring for the area included (desert areas of southern Nevada, southeastern California, and southwestern Arizona), substantiating this region as an important inland pathway for this species. It appears that two other species (Black-and-White Warbler and Northern Waterthrush) also utilize this route, as indicated by the number of records in this limited and relatively unworked area (table 5).

TABLE 6. Proportion of various eastern warblers in four western areas (as per cent of total recorded).

Breeding range	New Mexico	Arizona	Southern California	Northern California
Spring				
East of 100°	27.5	23.5	14.0	13.8
To Rocky Mts.	25.0	20.6	32.2	48.0
West of Rocky Mts.	47.5	55.9	53.8	38.2
Fall				
East of 100°	28.2	16.3	14.7	10.3
To Rocky Mts.	28.2	28.8	28.0	33.9
West of Rocky Mts.	43.5	54.8	57.3	55.8

Of particular interest is the timing of the fall redstart movement in relation to that in southern coastal California. The desert movement is three weeks earlier. Are the southern breeding populations (Utah, Oregon) using the desert flyway, and northern coastal populations the coastal route? A similar pattern of early occurrence is shown by the Black-and-White Warbler and Northern Waterthrush. Timing of spring migration is similar in both localities.

OTHER WESTERN OCCURRENCES

All species of warblers recorded in California have been reported in other western states. In addition, the Swainson's Warbler (*Limnothlypis swainsonii*) has been reported in Colorado (Bent 1953; Baumgartner 1964, 1965). However, the relative abundance of the various species varies with season and location. Relative abundances are used for comparisons since there is no way to quantify intensity of field work. Strictly eastern species are relatively more common in New Mexico and become progressively less common through Arizona, southern California, and northern California in both spring and fall (table 6), suggesting that they come from the east along this route. This supports the route suggested by Bagg (1970, and see below).

The Black-throated Blue Warbler and Northern Waterthrush are more common inland than on the coast. Parula and Magnolia Warblers, Ovenbird, and American Redstart are about equally common inland and on the coast. Tennessee, Blackpoll, and Palm Warblers are nearly exclusively coastal (fig. 1). Species of groups 1, 2, and 3 are generally more common in spring than fall. Black-and-White, Parula, and Magnolia Warblers, Ovenbird, and Northern Waterthrush are relatively more common in spring. Palm and Blackpoll Warblers are more common in fall.

Timing of migration in other western states is similar to that in California but averages 5–9 days earlier in fall and 6–13 days earlier in spring.

AGE OF VAGRANTS

Patterns of age distribution may give some insight into the occurrence of vagrants in the West (table 7). Immatures may comprise up to 90 per cent of fall Palm Warbler and American Redstart migrants (Chase and De Benedictis 1965). The proportion of immature warblers is nearly as high as on the east coast (Murray 1966). Other studies reported the percentage of immatures as 90–95 in coastal locations in the East (Robbins et al. 1959; Baird and Nisbet 1960; Drury and Keith 1962; Nisbet et al. 1963) while inland localities may have less than 40 per cent immatures (Robbins et al. 1959; Nisbet et al. 1960). This was attributed to wind drift (Baird and Nisbet 1960).

Several data suggest that immatures have at least an ability to migrate in a particular direction (standard direction) for a particular distance while adult navigation and orientation appear to be more refined (Matthews 1968). Newmann and Lancaster (1960) felt that more vagrants were recorded in fall because immatures lack experience and are unable to reorient if displaced. The data of Perdek (1958) on the Starling (*Sturnus vulgaris*) and Schwartz (1963) on the Northern Waterthrush support this. Thus a bird-of-the-year, after displacement, will continue to navigate in a particular direction. If it reaches an area

TABLE 7. Comparison of age data for eastern warblers in western United States and warblers at Island Beach, New Jersey, in fall.

Location	% adult	% immature	*n*	No. species
California	13.6	86.4	59	19
Other west	28.6	71.4	14	11
Total west	16.4	83.6	73	20
New Jersey[a]	8.5	91.5	4487	22

[a] From Murray (1966); all others from specimens.

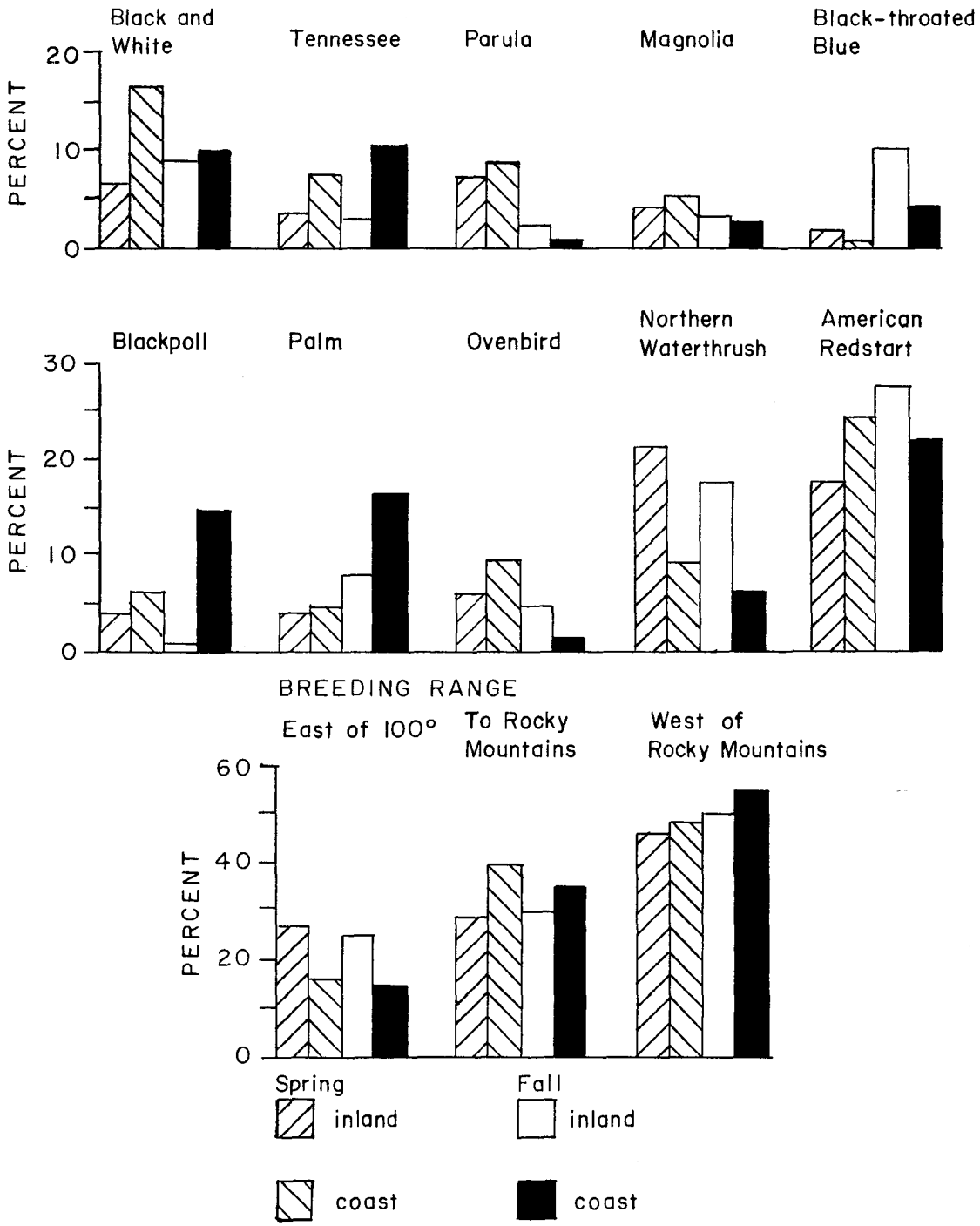

FIGURE 1. Relative abundance of eastern warblers in western United States (as per cent of total records for season and location).

where it can winter successfully, it will also migrate in spring in the now inappropriate standard direction northward and turn up again out of its usual range. Thus the suggestion of Chase and Chandik (1966) may carry weight in some cases. Lateral drift, followed by navigation in the standard direction in connection with a leading line (see Mueller and Berger 1967a) such as the Pacific coast may account for many of the western occurrences of eastern birds. In time, this may develop into a regular route of migration as appears to be developing for several species which formerly migrated eastward before turning south.

INFLUENCE OF WEATHER

Several authors have noted the occurrence of vagrants following weather disturbances from the east (see citations in introduction), although Small (1963) said that weather did not appear to effect the arrival of vagrants. De Benedictis (1967) thought it premature to correlate vagrants with weather. Part of the problem is that most weather patterns move from west to east. However, Bagg (1970) noted that airflows developed over Texas and moved to the west over southwestern states along the Mexican border. After two of these, a number of vagrants appeared on the Pacific coast. If these are a regular fall occurrence, downwind movement would provide the lateral displacement needed for the above argument. Of interest are recoveries of fall migrant hawks banded in Wisconsin which demonstrated a southwesterly drift in southern United States (Mueller and Berger 1967b).

I agree with others that the increase in records in recent years is mainly a function of an increase in intensity of fieldwork. However, the occurrence of the Blackpoll Warbler appears to be a very recent phenomenon. The first California record is for spring 1955. Then, since 1961, this species has been found in numbers which on certain days exceed those of some of the common western species on the coast. It seems impossible that a species this common could have been missed in 100 years of California ornithology.

The above data point to significant gaps in our knowledge. Long-term studies are needed in many areas to document the presence or absence of the various species. Such areas as the Great Basin and the west coast of México are particularly important. Eventually intensive banding programs such as are being carried out in the Point Reyes-Farallon Islands area and in the San Diego area should provide some answers. More such programs are needed. Additional studies of small areas such as conducted by McCaskie and Banks (1964) are needed. Collecting programs should be initiated to detect whether eastern races of widespread species occur (i.e., Nashville Warbler, *Vermivora ruficapilla;* Yellowthroat, *Geothlypis trichas*; Yellow-breasted Chat, *Icteria virens*; Wilson's Warbler, *Wilsonia pusilla*).

SUMMARY

The timing of occurrence of eastern wood warblers in California and other western states was examined. Species which breed west of the Rocky Mountains occur at about the same time that they migrate in eastern North America. It is suggested that these regularly use the west coast as a migratory route. Species which breed only east of the Rockies occur more than three weeks after the migratory peak in the East. Some of these may be regular transients; others appear to be vagrants which are concentrated by the Pacific coast. Three species apparently use the desert flightline. Most vagrants in fall are immatures. These may move westward on airflows from the east across the southwestern states.

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