DIFFERENTIAL FALL MIGRATION

By Jerome J. Barry

Many observers (see especially Murray, 1966, Tordoff and Mengel, 1956, and Leberman and Clench, 1969, 1970) have commented on the phenomenon known as differential fall migration (meaning differences in both the timing and location of migration between adult (AHY) and immature (HY) birds). This report deals with research undertaken to determine if different migration patterns (in location and timing) actually do exist between adult and immature birds and if these patterns are different at inland and coastal banding stations, and in fact if intermediate patterns exist at banding stations which are located between coastal and inland stations.

531 birds of 66 species were banded during the fall of 1969 and the fall of 1970 at three locations: Nashua River Area, Nashua, New Hampshire (herein referred to as Location A), Fort Dearborn, Rye, New Hampshire (herein referred to as Location B), and Star Island, Isle of Shoals, Rye, New Hampshire (herein referred to as Location C). Location A is located about 80 kilometers from the ocean, and I have used the data from this station as being indicative of an area which lies between most coastal stations and most inland stations. Nets were placed in this area in an abandoned field habitat, with moderate shrub growth, and immediately adjacent to the Nashua River. Location B is a coastal station in Rye, New Hampshire. Shrub growth is quite thick, with catbrier and poison ivy the dominant species.

The nets were set up in this thick growth, about 300 meters from the shoreline. This location provides exceptionally good cover for migrating birds, and attracts many species as they are making their way southward along the coast. Location C is an island lying about 11 kilometers off of the coast of New Hampshire. The characteristic growth at this location is bayberry, which never exceeds about 1 meter in height.

Data from Island Beach, New Jersey (Murray, 1966) and Powdermill Nature Reserve (Leberman and Clench, 1969, 1970) banding stations was used for means of comparison. The Island Beach station is located on an island just off of the coast of New Jersey, with a habitat similar to that of Location B (Murray, 1966). The Powdermill Nature Reserve is located near Rector, Pennsylvania, in the western part of the state. Therefore, Island Beach would be considered a coastal station and Powdermill an inland station.

Up to seven mist nets (all 12 meter, 1 1/4 inch mesh) were used. All birds were measured and aged by skull ossification, which was accomplished by wetting the feathers of the crown with isopropyl alcohol and then observing the degree of ossification on the exposed skull under a bright light.

I agree with Tordoff and Mengel (1956) on the aspect of sample size, in that the data presented in this report will only show trends in migra-

tion patterns, and should not be considered as absolute truths in reference to the timing and location of migration of adult and immature birds.

RESULTS

Differential Migration - Timing

Murray (1966) used three terms in describing differences in the timing of migration between adults and immatures. These terms describe appropriately differences in the timing of migration. They are: non-overlapping asynchronous- a migration pattern in which either all adults precede all the immatures or vice versa; overlapping asynchronous- a migration pattern in which the timings of migration of adults and immatures overlap, but the ratio of adults to immatures shifts; synchronous- a migration pattern in which the times of migration of adults and immatures coincide.

Figure 1 shows the percentage of adult birds present over successive ten-day periods in the fall at locations A and B. Both patterns show a similar shape, but when the percentage of adults is at its peak at location A, it is at its lowest point at Location B and vice versa. It also shows in a general way that the percentage of adults present(at both locations) is greater at the end of the migration period than at the beginning. This would indicate that if all species are considered together, they will show an overlapping asynchronous pattern, with immatures averaging earlier migration dates than adults.

Tordoff and Mengel(1956) reported overlapping asynchronous (with adults peaking before immatures) migration patterns in the following species: Lincoln's Sparrow, Red-eyed Vireo, Nashville Warbler, Yellowthroat and Catbird, and overlapping asynchronous (with immatures peaking before adults) migration patterns in the Dickcissel and Mourning Warbler. Leberman and Clench (1969, 1970) reported overlapping asynchronous(with adults peaking before immatures in all cases) patterns in the Eastern Wood Pewee, Slate-colored Junco, Red-eyed Vireo and Northern Waterthrush, and definite synchronous patterns for fourteen species. Murray (1966) reported twenty-six species with a synchronous pattern, none with a non-overlapping asynchronous patterm, and only the Red-eyed Vireo(with adults peaking before immatures) showing an overlapping asynchronous pattern. Hussell, Davis and Montgomerie (1967) and Clench (1969) differ on their views on the migration of the Least Flycatcher through Eastern No. America, but both show an overlapping asynchronous pattern with adults peaking before immatures in this species.

Figures 2 through 10 are histograms showing the timing of migration of nine species at Locations A and B. The White-throated Sparrow, Slate-colored Junco, Song Sparrow, Myrtle Warbler, Blackpoll Warbler and Yellowthroat all show synchronous migration patterns at Locations A and/or B. The Chipping Sparrow shows an overlapping asynchronous(with immatures peaking before adults) pattern at Location A. The Catbird shows a

synchronous pattern at Location A, but a non-overlapping asynchronous pattern at Location B. The Red-eyed Vireo similarly exhibits a non-overlapping asynchronous pattern at Location B. I feel that these non-overlapping asynchronous patterns are artificial, with sample size obviously accounting for this pattern's existence in the species mentioned.

Differential Migration - Location

Almost all migratory species in Eastern North America, with only a few notable exceptions (e.g. Tennessee Warbler and Yellowthroat), have a higher percentage of adults migrating southward by an inland route than a coastal one, and correspondingly a higher percentage of immatures migrating along a coastal route than an inland route.

Table 1 is a list of the total percentages of adults and immatures trapped at Locations A, B, Island Beach (Murray, 1966), and Powdermill (Leberman and Clench, 1969, 1970). This table shows quite clearly that there are more adults migrating along an inland route than a coastal route and more immatures migrating along the coast than inland. The intermediate (i.e. lying between an inland and coastal station) nature geographically of Location A shows, in fact, intermediate percentages of adults and immatures.

Table 2 shows differences in age-group migration patterns for certain selected taxonomic groups. Here again adults show a preference for inland routes and immatures a preference for coastal routes, with intermediate percentages for both at intermediate locations.

Table 3 is an analysis of age-group migration patterns by species. Almost every species supports the adult-inland, immature-coastal hypothesis. Intermediate percentages are once again evident for Location A; its intermediate position geographically between inland and coastal stations reflected repeatedly by intermediate percentages of adults and immatures for almost all species. The ambiguous position of the Tennessee Warbler, which had a lower percentage of adults at an inland station than a coastal station, cannot be explained. I feel the reversal in percentages for the Yellowthroat are indicative of a bias created by more concentrated breeding populations of Yellowthroats along the coast than inland.

THEORETICAL CONSIDERATIONS

The most important factor to consider when looking at the problem of the differential timing of migration is that of molt. Tordoff and Mengel (1956) commented on the relationship between molt and the time of migration. In those species where there is a synchronous pattern of migration, both adults and young must complete their molt at very nearly the same time, whether it is before they leave in late summer or fall or during migration itself, is relatively unimportant. The result is the same- a synchronous migration pattern. It should be mentioned here that

the differences that do exist in the timing of migration of any particular species are subtle ones, as a species with a non-overlapping asynchronous migration pattern has not yet been reported. Clench(1969) in her study on the Least Flycatcher stated that the adults leave the breeding grounds before completing their prebasic molt, while the immatures generally do not leave until they have completed their first prebasic molt. This would account for an overlapping asynchronous pattern in this species, and probably in the other species exhibiting this pattern as well.

A more complex problem is that of adults and immatures choosing (or being forced into) different routes for their migration. It is obvious that not all of the adults of any species follow an inland route, and not all of the immatures follow a coastal route. However, it has been shown fairly conclusively that at any given coastal location during the fall one will find a higher percentage of immatures in a sampling of the population than at an inland station, and conversely one will find a higher percentage of adults at an inland station than at a coastal one. The reasons for this will be different for each species, as Farner (1955) has pointed out.

Murray (1965) in his study of the Blackpoll Warbler found that this species is very prone to be drifted in a coastal direction by offshore winds. Offshore drift toward the coast hypothetically could account for a higher percentage of immatures at coastal locations. Unpublished data which I have shows immatures to be generally lighter than adults. These lighter immatures could be being blown coastally by strong westerly winds. However, this theory will have to be tested more extensively before it can be accepted.

Nisbet and Drury(1969) stated that a preponderance of immatures in a coastal sample is explained by a process of selection against individuals who are poor navigators. This may be true to some extent, but it certainly cannot account for the great disparity of percentages(of adults and immatures) at inland and coastal migratory pathways.

Hamilton (1962) and Murray (1966) both commented that, based on orientational studies conducted experimentally, the orientational cues used by birds during fall migration are terrestrial ones. This, I feel, is perhaps the major reason for differential migration by location of adults and immatures. I cannot vision a better terrestrial cue than the Eastern shoreline of the United States itself. For an immature bird, which has never migrated, the coastline would be a rather simple landmark to follow southward during the course of their migration. There are also selective advantages for following inland and coastal routes by adults and immatures respectively. Adults traveling inland would be less prone to be effected from adverse weather conditions, while immatures travelling along the coast besides having an easy landmark to follow southward would also not have to compete (for food, shelter, socially) with the more experienced adults.

The problems involved in the study of migration are indeed complex. Until every theory can be tested on a vast scale these problems will remain at best in the theoretical stage. As suggested by Tordoff and Mengel (1956) sex classes should also be taken into consideration when working with the problem of differential fall migration. However, until more reliable sexing criteria are acquired for a great many more species, this will be a difficult undertaking.

I gratefully acknowledge Dr. Arthur C. Borror and Mr. and Mrs. Leon Phinney for their assistance in all phases of this research.

figure 1 % AHY FOR ALL SPECIES BY 10 DAY PERIODS

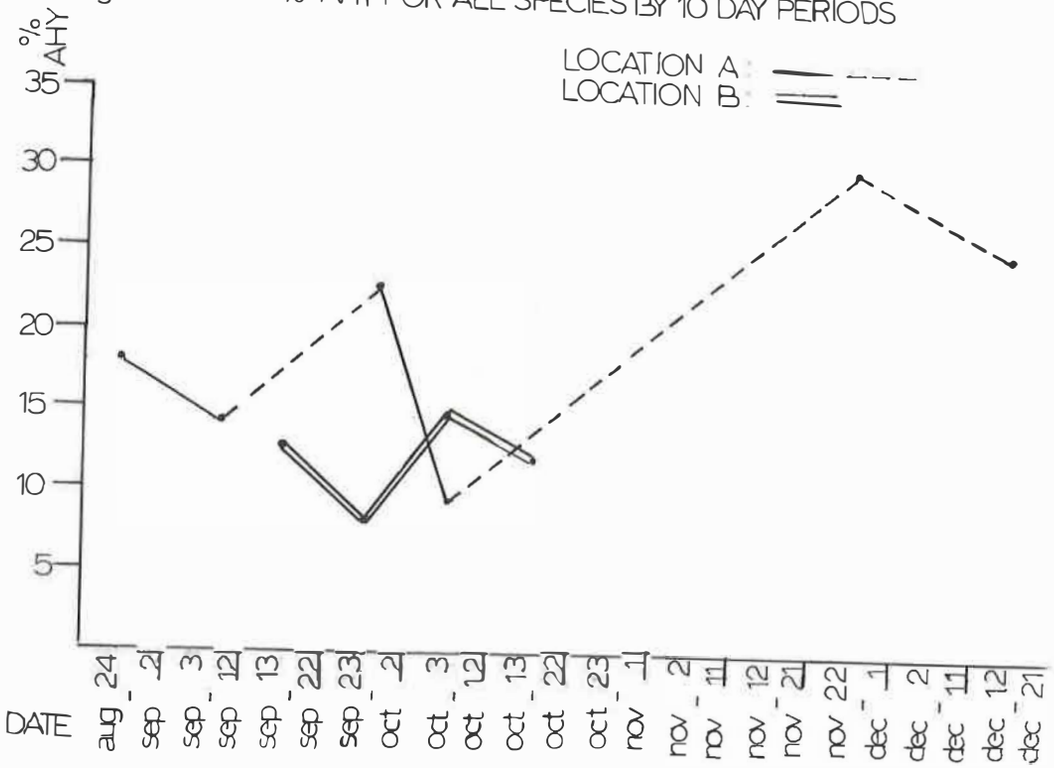


figure 2 WHITE-THROATED SPARROW

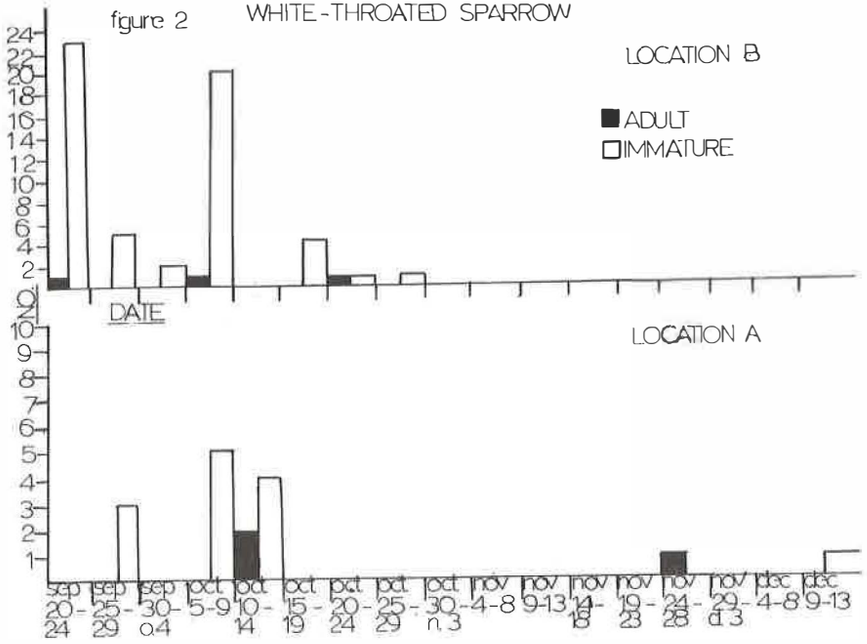


figure 3 CHIPPING SPARROW LOCATION A

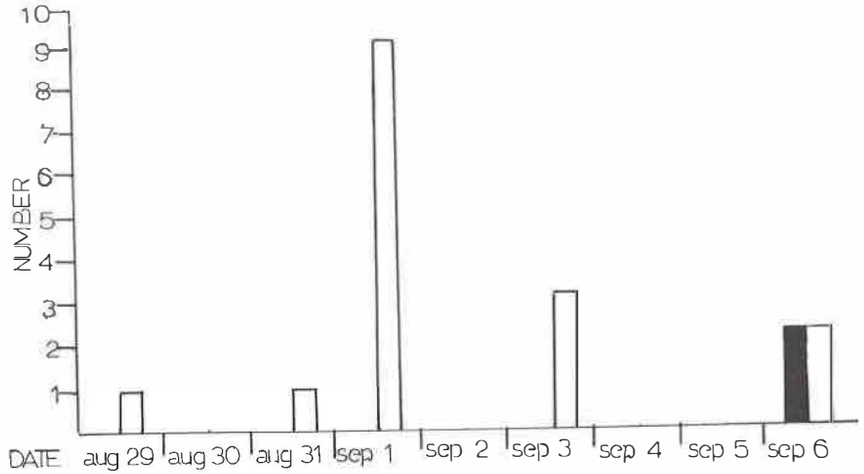


figure 4 SLATE-COLORED JUNCO LOCATION A

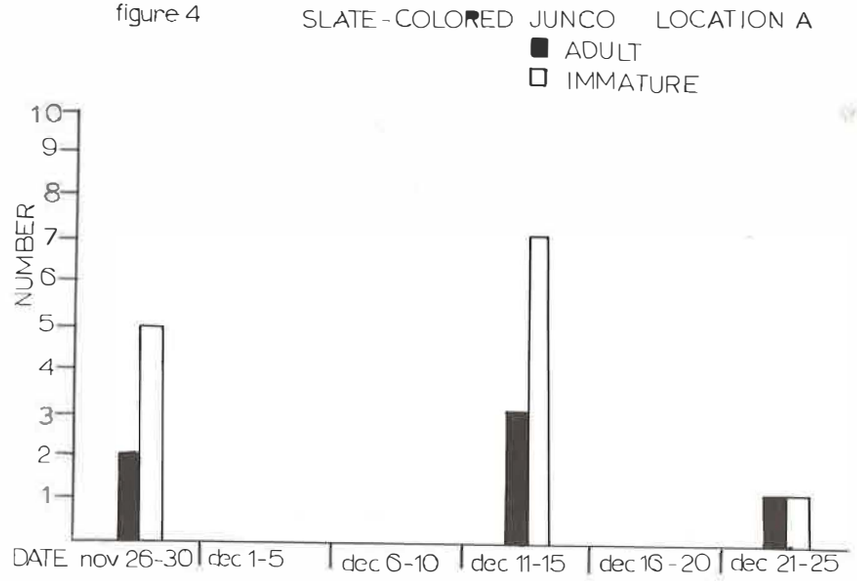


figure 5 SONG SPARROW

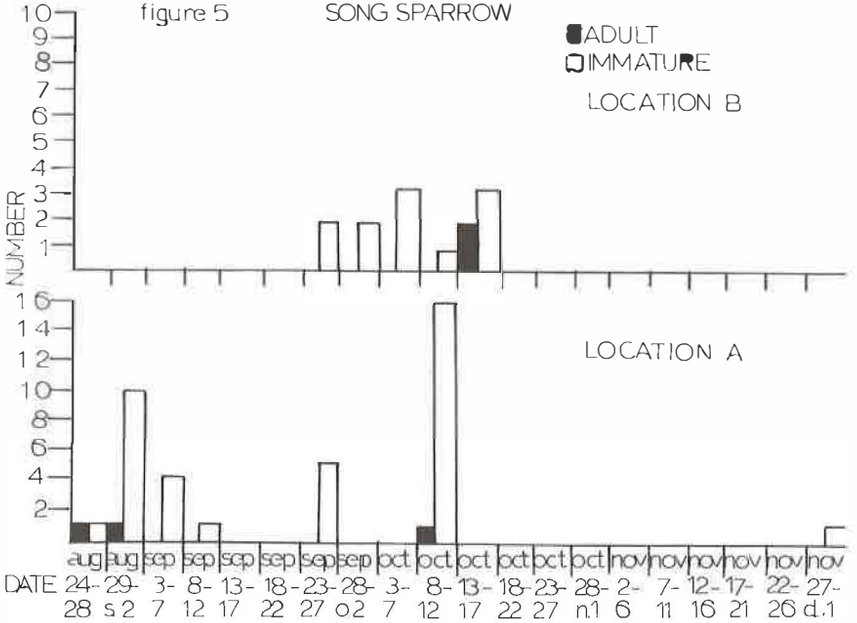


figure 6 RED-EYED VIREO LOCATION B

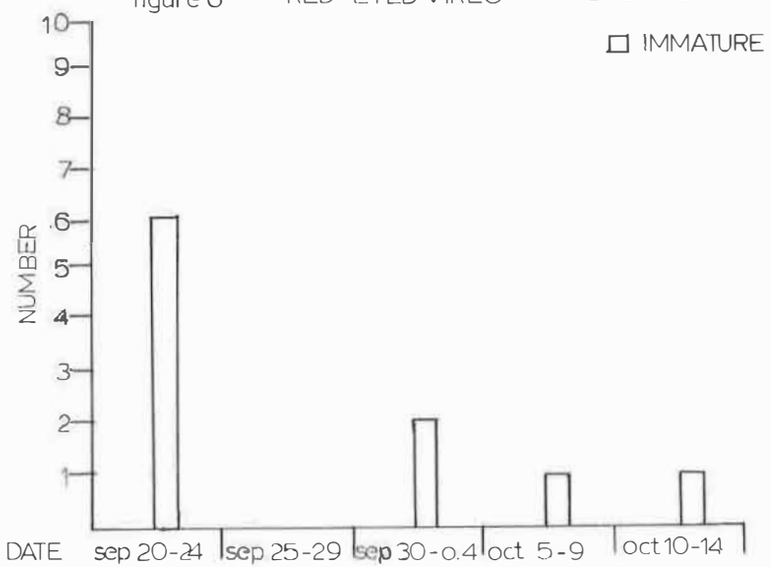


figure7 MYRTLE WARBLER LOCATION B

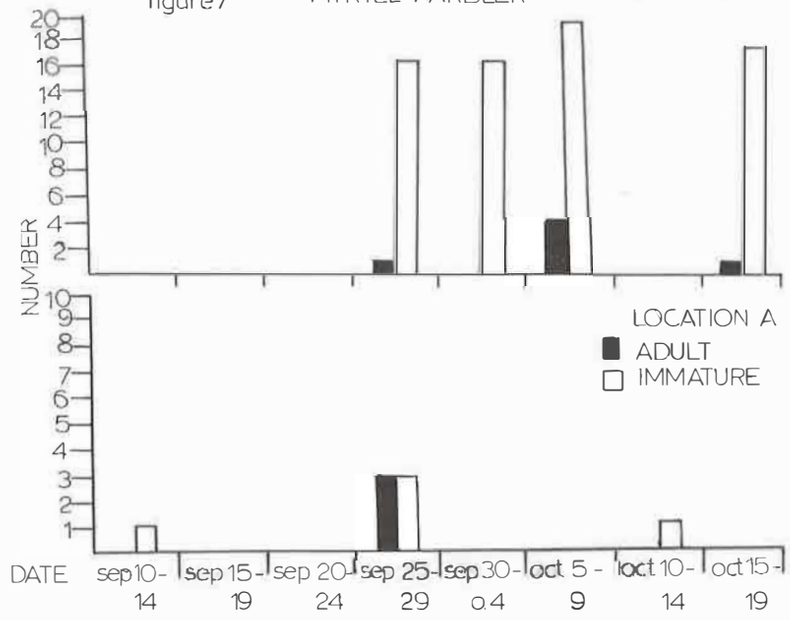


figure 8 BLACKPOLL WARBLER LOCATION B

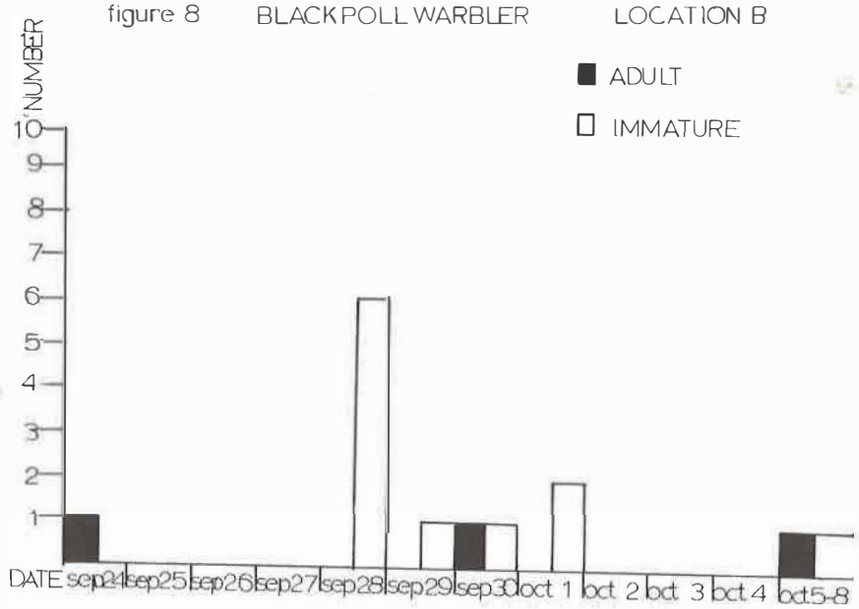
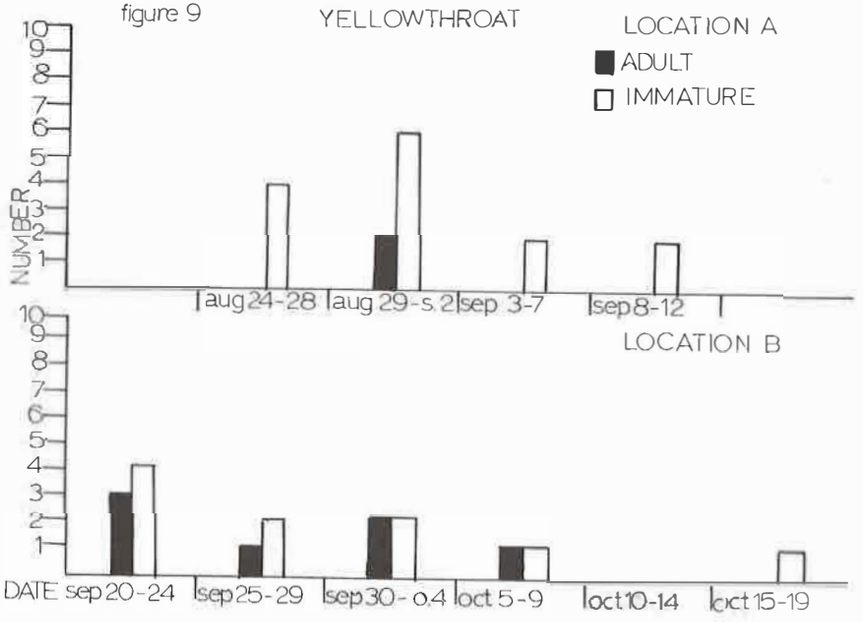


figure 9 YELLOWTHROAT LOCATION A



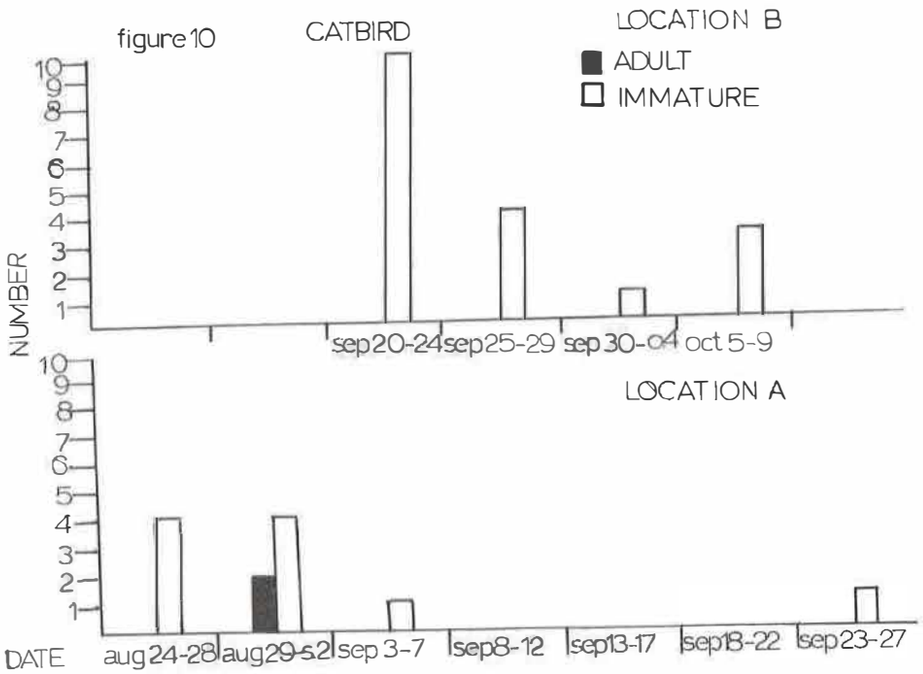


TABLE 1. TOTAL % AHY AND HY-ALL SPECIES

LOCATION	% AHY	% HY
Island Beach*	9.2 (N=816)	90.8 (N=8062)
Location B	10.9 (N=32)	89.1 (N=261)
Location A	16.9 (N=32)	83.1 (N=157)
Powdermill**	31.3 (N=2785)	68.7 (N=6405)

* Murray, 1966.
** Leberman and Clench, 1969, 1970.

TABLE 2 PERCENT ADULT BY TAXONOMIC GROUP FOR EACH LOCATION

GROUP	LOC.C	ISLAND BCH*	LOC.B	LOC.A	POWDERMILL**
Vireonidae		10.1	0		36.4
Turdidae		7.3	16.7		
Fringillidae		4.6	8.0	14.4	37.5
Parulidae	2.5	8.6	12.4	22.5	23.1
Dendroica		7.9	8.9	38.5	21.4
Non-Dendroica Warblers		10.1	22.2	14.8	25.0

* Murray, 1966.
** Leberman and Clench, 1969, 1970.

TABLE 3 PERCENT ADULT BY SPECIES(TOTAL N FOR EACH SPECIES OF AHY+HY= 10 OR MORE)

SPECIES	LOC.C	ISLAND BCH*	LOC.B	LOC.A	POWDERMILL**
White-cr. Sparrow		4.4			32.4
Field Sparrow		2.9			28.0
White-thr. Sparrow		5.0	5.1	18.8	46.9
Chipping Sparrow		2.5		11.1	
Slate-col. Junco		2.1		31.6	
Song Sparrow			18.8	7.7	
Lincoln's Sparrow		5.1			18.8
Swamp Sparrow		6.8			30.5
Red-eyed Vireo		10.1	0		37.6
Philadelphia Vireo		6.7			16.2
Nashville Warbler		0			48.3
Tennessee Warbler		30.5			13.5
Myrtle Warbler	0	8.2	8.1		26.7
Magnolia Warbler		9.2			25.4
Blackpoll Warbler		9.6	21.4		24.3
Black-thr. Grn. W		2.2			8.9
Palm Warbler		0.8			4.0
Ovenbird		7.7			17.4
No. Waterthrush		13.1			25.6
Connecticut Warb.		2.6			46.2
Yellowthroat			41.8	12.5	22.2
Catbird			0	16.7	12.6

* Murray, 1966
** Leberman and Clench, 1969, 1970.

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