45 Autumn Migrations of Peregrine Falcons at Assateague Island, Maryland/Virginia, 1970–1984

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Enderson (1969c) raised the possibility of using observations of migrating Peregrine Falcons to estimate population size: "[My purpose] . . . is to call attention to the possibility of developing population indices for Arctic-nesting peregrines by means of systematic counts at certain favorable points where migrants can be readily seen along shorelines in the United States." Newton (1979) corroborated the premise: "Counts over many years at concentration points have revealed long-term population trends . . ." Edelstam (1972), however, pointed out possible problems, particularly when year-to-year variation is high.

Studies during the nesting season across the Peregrine's vast range in North America (e.g., White and Cade 1977, Burnham and Mattox 1984) are quite expensive and logistically difficult to conduct. They sample only a tiny portion of the population, and are often not conducted annually. Migration counts, on the other hand, are usually much easier to implement, and draw their samples from a large area of the breeding range.

Hawk Mountain in eastern Pennsylvania (Nagy 1977) and Cedar Grove, along the western shore of Lake Michigan in Wisconsin (Mueller and Berger 1961), are well-known raptor lookouts that have provided migration data on Peregrines for many years; however, annual counts are generally so low that inferences about population trends are difficult to make (but see Mueller et al. Chapter 46).

Assateague Island, a barrier island off the east coast of Maryland and Virginia, has been known since 1938 as a major focal point for migrating Peregrines in autumn (Shor 1970b, Nye *in* Ward and Berry 1972). Falconers trapped Peregrines there until the island was declared a national seashore in 1969. Hunting regulations implemented in the summer of 1970 included a prohibition on taking raptors for personal

use. That year we initiated a standardized observation and banding study of Peregrines that has continued uninterrupted each autumn since.

Early falconers provided invaluable baselines through their detailed field notes and summaries of numbers of falcons sighted and captured in the early years (B. McDonald unpubl. ms., Nye *in* Ward and Berry 1972). The objectives of our study have been to describe the timing and magnitude of the autumn migration, to observe trends in the numbers of Peregrines over time, and to compare recent migration counts with those from historical accounts.

METHODS

We observed and captured Peregrine Falcons each autumn from 1970-84 at Assateague Island, which is 58 km long. Observation and trapping methods followed those of Ward and Berry (1972) and were consistent for all years. F. P. Ward, M. A. Yates and W. S. Seegar made 92% of all the observations. Annual studies began as early as 17 September and continued as late as 25 October. Two moving vehicles were operated simultaneously from at least the last week in September through the first two weeks in October. A "party" refers to one or more people in one vehicle driving along the beachfront and wash-over areas of the island.

Different marking techniques were used during the 15 years. From 1970-72, trapped birds were marked only with United States Fish and Wildlife Service (USFWS) aluminum bands. Green plastic tarsal bands were also attached from 1973-79 (Ward 1975). In 1980-81, the breast feathers of immature birds were dyed yellow with picric acid, and from 1982-84 every bird trapped was dyed. Falcons were marked with dye so that effort would not be expended retrapping those individuals seen subsequently. Even so, some birds were retrapped.

Since 1981, a resident territorial pair of Peregrines has been present on the Virginia portion of the island (Wash Flats), having been released by The Peregrine Fund, Inc. as part of the effort to reestablish Peregrine Falcons in the eastern United States (Cade and Temple 1977, Cade 1985a). These resident birds were sighted usually once daily, and their counts were removed from all analyses of migrants. Residents were identified by their association with the hack tower, or by territorial behavior, color band or other markings. Other Peregrines released by The Peregrine Fund were also captured as they passed along the island.

Immature birds are Peregrine Falcons in brown juvenile plumage that were hatched in the same calendar year as their capture. The USFWS Bird Banding Laboratory refers to these as hatching-year (HY) birds. Observed birds that completed at least one pre-basic molt

and were in a blue-gray plumage are called after-hatching-year (AHY). Peregrine Falcons trapped in the fall that were in their first basic plumage with some juvenile feathers remaining are second-year (SY) birds. Consequently, AHY birds may include SY birds, but an after-second-year (ASY) designation does not.

RESULTS

During the 15 years, 4702 Peregrine Falcons were observed and 1082 were captured as first encounters (Table 1). The capture efficiency for birds caught for the first time at Assateague Island was 23%, and nearly 6% of "new" birds were banded elsewhere or were banded at Assateague during a previous season. Recaptures, sightings of color-banded and color-marked birds, and sightings of the nonmigratory resident pair accounted for another 27% of our encounters. The total study effort comprised more than 6500 party-hours, ranging from a low of 221 party-hours in 1971 to a high of 725 party-hours in 1984.

Timing of Migration. — Ninety percent of the Peregrine Falcons counted at Assateague Island were observed between 21 September-18 October. Migrations by immature and adult birds were temporally similar (paired t-test, $n=15$ years, $P>0.05$, Figure 1). Mean capture date was 5 October for both immature and adult Peregrines.

Male Peregrine Falcons migrated before females (paired t-test, $n=15$ years, $P<0.05$), although there was substantial overlap and variation among years. Figure 2 is a composite for all years, indicating an overall trend not necessarily apparent in any single year.

Hourly observation and capture rates were rather constant throughout the day (Figure 3). The survey was not always conducted during the first and last hours of a day.

TABLE 1. Status of Peregrine Falcons observed at Assateague Island, 1970-84.

Status	*n*	%
First capture of unbanded bird	1018	21.7
First recovery of bird with band applied elsewhere or at Assateague in a previous season	64	1.4
Not captured	2324	49.4
Recaptured in the same season (some multiple)	331	7.0
Not captured but number read on color band (some multiple)	73	1.6
Not captured but color band observed	91	1.9
Not captured but yellow dye sighted	500	10.6
Not captured but identified as adult female resident	172	3.7
Not captured but identified as adult male resident	129	2.7
Total	4702	100.0

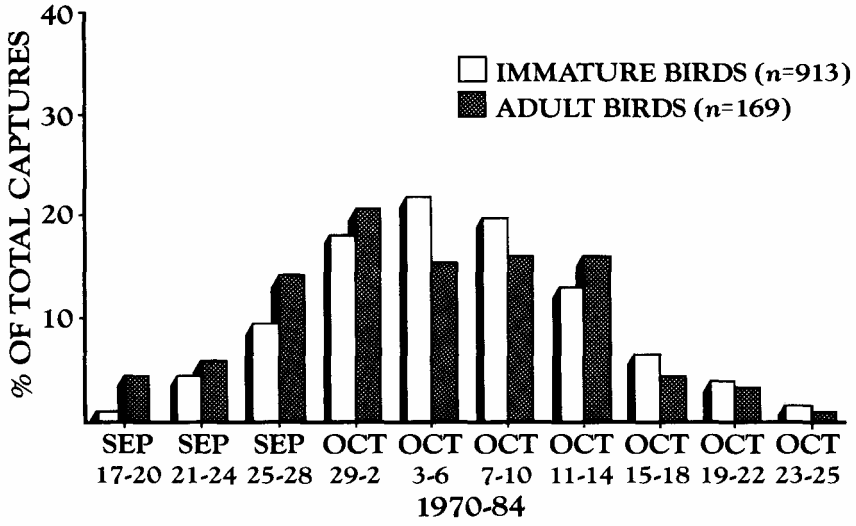

FIGURE 1. Dates that immature and adult Peregrines were captured at Assateague Island, 1970-84.

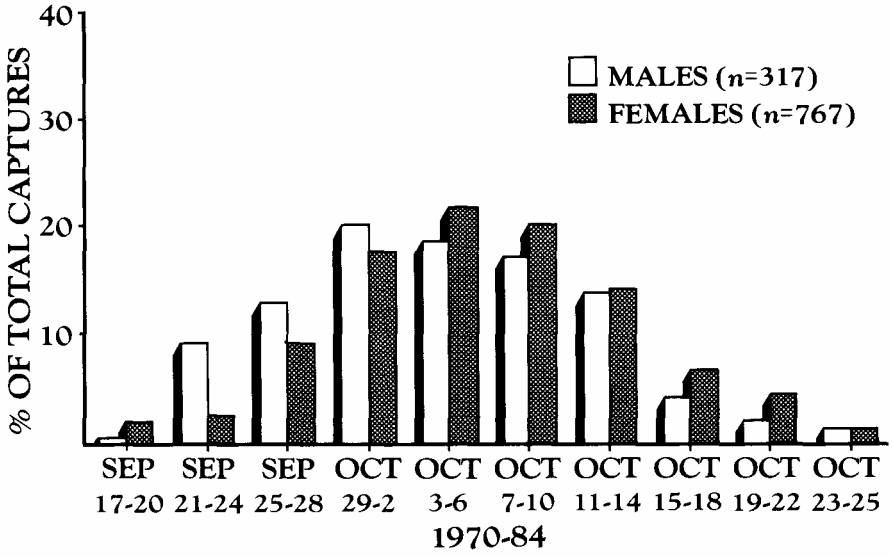

FIGURE 2. Dates that male and female Peregrines were captured at Assateague Island, 1970-84.

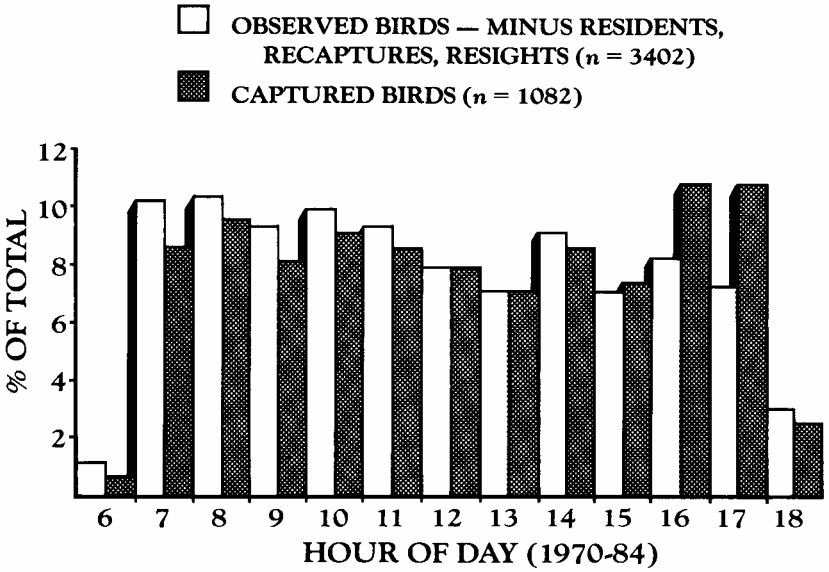

FIGURE 3. Hour of day in which Peregrines migrating through Assateague Island were observed and captured, 1970-84.

Trend in Numbers Observed and Trapped. — Numbers of Peregrine Falcons observed and trapped increased markedly near the end of the 15-year period. Numbers observed (minus resightings, recaptures and resident birds) averaged 76 birds per year from 1970-74, 222 birds per year from 1975-79 and 382 birds per year from 1980-84. When the data were standardized to the number of birds seen per 10 man-hours to account for more effort in recent years, the trend was similar (Figure 4). Less erratic observation and capture trends are evident for adult Peregrines (Figure 5), a group (unlike the HY cohort) not influenced by the annual vicissitudes of hatchability and survival in the nest.

After eliminating resightings, recaptures and resident birds, 85.1% of the Peregrines observed from 1970-84 were immature. There was considerable annual variation in the ratio of immatures to adults but no discernible trend (Table 2).

Of the 1082 Peregrine Falcons captured, 55.6% were HY females and 28.7% were HY males. The proportion of immature birds captured (84.5%) was similar to the proportion of immature birds observed (Chi-square with Yates correction = 1.04, $df=1$, $P>0.25$). Of the 169 AHY birds captured, 73 (43.2%) were second-year females, 71 (42%) were ASY females and 18 (10.7%) were AHY females (i.e., discrimination between an SY versus older birds was in doubt). Only seven (4.1%) adult males were captured.

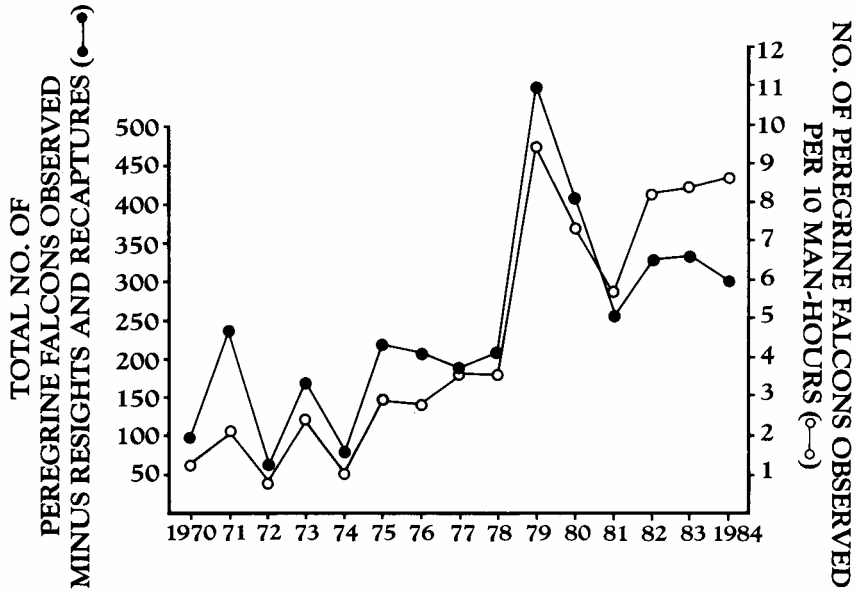

FIGURE 4. Total numbers of Peregrine Falcons observed and captured at Assateague Island, 1970-84.

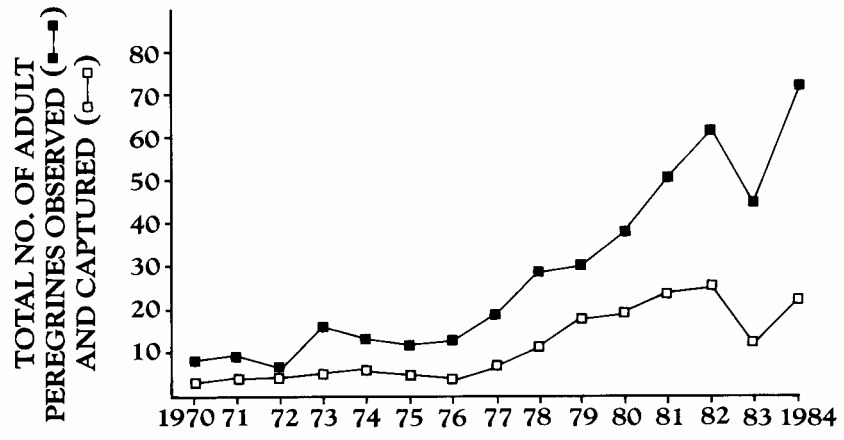

FIGURE 5. Numbers of adult Peregrines observed and captured at Assateague Island, 1970-84.

TABLE 2. Number of Peregrine Falcons observed according to age at Assateague Island, 1970-84, with historical data since 1939[a].

	Year															
Age	39-47[b]	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84
Adult	40	8	9	7	16	13	12	13	19	29	30	38	51	62	45	72
Immature	126	44	93	21	96	35	114	84	134	122	380	275	176	281	269	295
Unknown	309	11	4	11	8	6	19	41	24	28	61	56	55	66	105	65
Total	475	63	106	39	120	54	145	138	177	179	471	369	282	409	419	432
Percent Immature	76	85	91	75	86	73	91	87	88	81	93	88	78	82	86	80

[a] Excludes known resightings, recaptures and resident birds.
[b] Nye (1969) taken from Ward and Berry (1972); numbers are totals for all years from 1939-47.

Of 422 Peregrines recaptured or resighted and identified as individuals (e.g., by reading the number on a colored and numbered tarsal band), 217 (51.4%) were recaptured or resighted on the same day. Some Peregrines were recaptured up to 19 days after their initial capture in Assateague Island (Table 3). Seventy-nine percent of the recaptures or resightings other than on the same day were 1-3 days later.

Comparisons with Historical Data. — Our Peregrine Falcon observations from Assateague Island were compared with those by A. Nye for the period 1939-44. B. McDonald (unpubl. ms.) also provided data on observations of Peregrines on Assateague Island and nearby Virginia barrier islands from 1956-69. Data were converted to the number of Peregrines seen per party per day for the period of 25 September-16 October (Ward and Berry 1972). Nye saw an average of 11.7 Peregrines per day during the peak of migration, and McDonald saw an average of 4.3. Our average from 1970-78 was 3.6. By 1979-84, the numbers observed increased dramatically to an average of 11.8 per party per day (Figure 6). There was a positive correlation between the mean number observed per party per day over time for the 15-year study ($r=0.82$, $n=15$ years, $P<0.001$); i.e., in each successive year more Peregrines were observed.

TABLE 3. Number of recaptures or identified resightings of Peregrine Falcons within the same season at Assateague Island, 1970-84. Recaptures on the same day and observations of resident adults are excluded.

Day after initial capture	Frequency (n = 205)	Percent
1	96	46.8
2	40	19.5
3	26	12.7
4	13	6.3
5	5	2.4
6	4	1.8
7	1	0.5
8	3	1.5
9	3	1.5
10	2	1.0
11	2	1.0
12	1	0.5
13	2	1.0
14	2	1.0
15	1	0.5
16	2	1.0
17	1	0.5
18	0	0.0
19	1	0.5

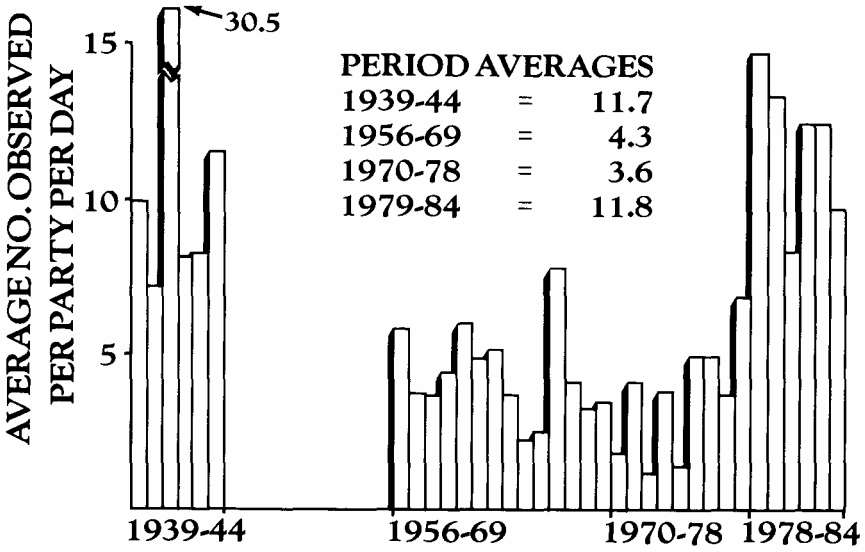

FIGURE 6. Numbers of Peregrine Falcons migrating each year on Maryland/Virginia barrier islands, 25 September-16 October.

DISCUSSION

The results of this study indicate that:

(1) Populations of northern Peregrine Falcons from which Assateague Island draws its sample of autumn migrants decreased substantially from 1956-78 relative to pre-DDT data from the same environs.

(2) Observations of Peregrines from 1979-84 were nearly identical to data from a pre-DDT survey conducted from 1939-44.

(3) Many migrants (about 20%), particularly immature birds, remain on Assateague for a day or more; about 20% of those stay for more than four days.

(4) More than 6% of Peregrines captured for the first time during a season had been banded elsewhere or at Assateague during a previous season (see Yates et al. Chapter 44).

(5) When carried out in a systematic manner, longterm counts of Peregrines at key migration foci do reveal longterm population trends.

Our counts increased substantially during the course of this study, agreeing with the summary by Cade (1982) that Peregrine populations breeding in the American arctic increased in the late 1970s. The low counts we had in the early 1970s also agree with surveys on arctic breeding grounds (Cade and Fyfe 1970); even in 1975 numbers were still considered to be very low (Fyfe et al. 1976a). Interestingly, the

trends in our data (Figures 4 and 5) were similar to those presented by Wikman (1985) for Finland, and Speer (1985) for the Federal Republic of Germany for *F. p. peregrinus*. A population recovery in Britain appears to have taken place a few years earlier (Ratcliffe 1980).

By 1979, many of our daily counts during peak migration were similar to historical accounts (1939-44) for peak days. As an example, on 3 October 1979, 61 Peregrine Falcons were observed, 17 by Ward and 44 by Yates. Another example was 1 October 1980, when 75 were observed, 36 by Ward and 39 by Yates.

Unlike many raptors, immature and adult Peregrine Falcons were not temporally separated during fall migration at Assateague Island (Figure 1). Rosenfield and Evans (1980) found that immature Sharp-shinned Hawks peak in their migration a few weeks before adults. Weir et al. (1980) found that female Northern Saw-whet Owls migrated earlier than males in some years. Hunt et al. (1975) reported that adult Peregrine Falcons arrived first during autumn migration along the Texas coast (Chi-square analysis for 20 years pooled, which does not allow for year-to-year variation). They found adult females migrating prior to immature males, followed by immature females. Immature and adult Peregrines migrate by Assateague Island at the same time; however, they generally feed on different prey (Ward and Laybourne 1985).

With many Peregrine Falcons being resighted and recaptured in a season at Assateague, it is difficult to determine the actual number of Peregrines that pass by the island each fall. Because all birds were not captured, we do not know how many individuals were resighted several times, thus inflating counts. However, the field methods remained standardized for 15 years, and data indicate a strong upward trend.

The timing of autumn migration at Assateague Island and Padre Island, Texas is similar (Hunt et al. 1975). This indicates that observers at these concentration points were not counting the same birds, but that both locations are key concentration areas for Peregrine Falcons in autumn. Banding results also indicate little seasonal interchange between these two areas (Yates et al. Chapter 44). Indeed, Assateague Island and Padre Island are the two known major concentration areas for migrant Peregrine Falcons in North America, and data accrued for more years at these two locations will augment tremendously our ability to infer population status based on migration statistics.

ACKNOWLEDGEMENTS

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Timely computer programming advice was provided by L. Moyer, L. McAllister and particularly D. Jacobs.

Editors' Note: According to information from M. Yates, the number of Peregrines observed and trapped at Assateague Island continued to increase in 1985 and 1986. The team counted 483 falcons and trapped 147 in 1985. The numbers nearly doubled in 1986 to 830 observed and 230 trapped. The number of observed adults reached an all-time high of 109 in 1986 (compare with Figure 5).

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