

BREEDING CHRONOLOGY AND REPRODUCTIVE SUCCESS OF RICHARDSON'S MERLINS IN SOUTHEASTERN MONTANA

DALE M. BECKER AND CAROLYN HULL SIEG

ABSTRACT Breeding chronology and reproductive success of the Merlin (*Falco columbarius richardsonii*) were studied in southeastern Montana from 1978 - 1981. Breeding activity spanned 5 mo from the earliest observation of adults to the latest dispersal of adults and young from nesting areas. Clutch size, brood size and fledging success at active nests were similar ($P > 0.05$) among the 4 yrs. Mortality tended to be highest before the hatching stage. Breeding chronology and reproductive success were similar to results of studies in Canada.

The Merlin (*Falco columbarius*) is 1 of 6 species of falcons that occur in North America. Three subspecies of the Merlin in North America are recognized (Temple 1972). *F.c. richardsonii*, the subspecies of interest in this study, occurs in the prairie parklands of the Northern Great Plains.

Data pertaining to the ecology of *F.c. richardsonii* have been generated primarily from studies in the prairie provinces of Canada. The life history of Canadian Merlins, including breeding chronology and reproductive success, was documented by Fox (1964, 1971). In Alberta and Saskatchewan, Hodson (1976) reported that reproductive success at Merlin nests that fledged young was high, but net productivity was variable. An apparent increase in reproductive success over that reported by previous studies was discussed for Merlins in Saskatchewan by Oliphant and Thomson (1978).

Information on *F.c. richardsonii* in the United States is lacking, although local populations or scattered breeding pairs occur in several western states (Oliphant, this issue). This study was initiated to document the reproductive ecology of a population of *richardsonii* in Montana.

STUDY AREA AND METHODS

Breeding chronology and reproductive success were examined on a 39,448-ha study area in southeastern Montana. Sandstone buttes and hills ranging to 300 m above the adjacent prairies and farmlands are common on the study area. Maximum elevation is 1,282 m above sea level. Vegetation consists of approximately 27% forest cover and 67% grassland. The dominant forest species is ponderosa pine (*Pinus ponderosa*). Aspen (*Populus tremuloides*), box elder (*Acer negundo*), green ash (*Fraxinus pennsylvanica*), and a variety of shrubs grow in more mesic sites. Major grassland species are western wheatgrass (*Agropyron smithii*), blue grama (*Bouteloua gracilis*), prairie junegrass (*Koeleria cristata*), and needle-and-thread grass (*Stipa comata*).

The climate in southeastern Montana is characterized by frequent winds, hot summers, cold winters, and a semi-arid moisture regime. Annual precipitation averages 39 cm, of which 70% falls from May - September. Monthly mean temp during the Merlin breeding season range from -8°C in March to 33°C in July.

Breeding chronology and reproductive success were studied from March - September, 1978-1981. Breeding territories were located by traversing potential breeding habitat (i.e., ponderosa pine stands) during April and May. Nest sites were detected when adults were flushed or exhibited aerial and vocal defense behavior. When flushing was not observed but defensive adult Merlins were present, Black-billed Magpie (*Pica pica*) nests in the vicinity were examined.

Timing and duration of breeding activities were determined by observing Merlins from early spring through late autumn. Observations of courtship, hatching, growth of young, fledging, and dispersal were documented at all active nests. Number of eggs, young and fledglings were recorded during 3 visits to each nest: during incubation, shortly after hatching, and just prior to fledging. Precautions were taken to avoid disturbance of adults and young (Fyfe and Olendorff 1976).

Data collected during nest visits were used to calculate percentages of eggs hatched, young fledged, and eggs resulting in fledglings. Fledging success was calculated for active nests ("nests in which eggs have been laid") and successful nests ("occupied nests from which at least 1 young fledged during the breeding season under consideration") (Postupalsky 1974). Sex of nestlings was determined at approximately 2 weeks of age. Larger foot size and larger, less fully developed bodies (Fox 1964), along with greater tarsal diameter were generally reliable characteristics of females.

Student t-Tests were used to compare reproductive success among years. Paired t-Tests were used to compare average clutch size, brood size and number of fledglings/active nest within yrs. Clutch size, brood size and number of fledglings/active nest for the 4 yrs combined were compared using combination of probabilities from tests of significance (Fisher 1950). Unless otherwise noted, differences were considered significant at $\eta = 0.05$.

RESULTS

Breeding Chronology. - The earliest observation of an adult Merlin on the study area was 11 March 1978. Breeding activities spanned approximately 5 mo from the earliest observation of an adult until the latest dispersal of adults and young (Fig. 1).

Males were observed at breeding territories before females. Courtship began shortly after the arrival of the females in early April and continued until late-May (Fig. 1). Eggs were laid from mid-April through mid-June. Females usually incu-

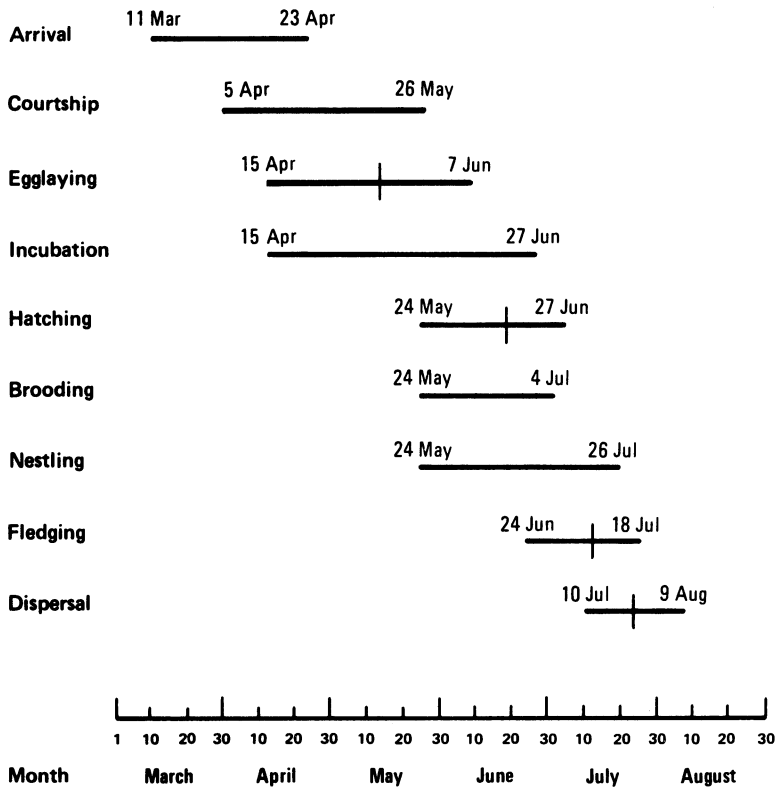


Figure 1. Nesting chronology of *F.c. richardsonii* in southeastern Montana. Horizontal lines indicate ranges of activity, vertical lines indicate means.

bated eggs, although males were occasionally observed on nests for short periods.

Earliest observed hatching occurred on 24 May 1980, and the latest on 27 June 1979. Nestlings were brooded 3 - 5 d, and remained in the nest 12 - 17 d before beginning to spend time on top of the nest canopy and/or in nearby branches. Young Merlins fledged from 26 - 33 ($\bar{x} = 29$) d after hatching. Fledging dates ranged from 24 June - 18 July. Fledglings remained in the vicinity of the nest from 7 - 19 ($\bar{x} = 13$) d after fledging. The latest dispersal of young and adults from a breeding territory occurred on 9 August 1979.

Reproductive Success. — Forty-eight active Merlin nests were located during the study, of which 43 (90%) were ultimately successful in producing fledglings. All nests were originally Black-billed Magpie nests located in ponderosa pine trees

on sideslopes of buttes.

The number of eggs laid per nest did not vary significantly from year to year during this study (Table 1). Brood sizes were also similar among years. Sex ratios of 157 nestlings indicated a slightly greater proportion of females (53%) than males (47%). Numbers of fledglings per active nest did not differ significantly among years, and for 4 yrs combined, was higher than the average number per successful nest (Table 2).

In 3 of the 4 yrs, and for the 4 yrs combined, significant mortality was observed from the time the eggs were laid until the Merlins fledged (Table 1). Average clutch size varied significantly from average brood size in 1978, 1979 and 1980, while clutch size was similar to brood size in 1981. Average number of fledglings per active nest was smaller than average brood size in 1979 ($P \leq 0.08$) and 1980. In 1978 and 1981, the number of fledglings per active nest did not differ significantly from

Table 1. Reproductive success for Richardson's Merlins in southeastern Montana, 1978 - 1981.

YEAR	SAMPLE SIZE	CLUTCH SIZE ($\bar{x} \pm SE$) ¹	BROOD SIZE ($\bar{x} \pm SE$)	FLEDGLINGS/ ACTIVE NEST ($\bar{x} \pm SE$)	EGGS HATCHED (%)	YOUNG FLEDGED (%)	EGGS FLEDGED (%)
1978	8	4.1 \pm 0.2 ^a	3.3 \pm 0.4 ^b	3.0 \pm 0.6 ^b	79	92	73
1979	18	4.3 \pm 0.2 ^a	3.6 \pm 0.4 ^b	3.3 \pm 0.4 ^{c*}	84	92	78
1980	15	4.5 \pm 0.2 ^a	3.5 \pm 0.4 ^b	3.3 \pm 0.4 ^c	79	94	75
1981	7	4.3 \pm 0.4 ^a	4.3 \pm 0.4 ^a	3.3 \pm 0.9 ^a	100	77	77
Combined data	48	4.3 \pm 0.8 ^a	3.6 \pm 1.4 ^b	3.3 \pm 1.6 ^c	84	90	76

¹Mean \pm standard error

a,b,c Means within rows (clutch size, brood size, fledglings per active nest) with the same superscript are not significantly different ($P > 0.05$)

*In 1979, fledglings/active nest was smaller than brood size at $\alpha \leq 0.08$.

average brood size. For the 4 yrs combined, clutch size, brood size and number of fledglings per active nest were different.

DISCUSSION

Breeding Chronology. — The presence of male Merlins in early March when the study area was first visited indicated that some males may have arrived earlier, or possibly over-wintered in the area. Male *F.c. richardsonii* in Saskatchewan arrived at breeding sites as early as late February or early March, up to a month before females (Fox 1964).

The chronology of Merlin breeding activities in southeastern Montana was similar to breeding

chronology of captive *F.c. richardsonii* in Alberta (Campbell and Nelson 1975) and wild Merlins in Saskatchewan (Fox 1964; Oliphant 1974) and Alberta (Hodson 1976). However, some breeding activities began earlier in the spring in Montana than in Canada. As an example, the peak egg-laying date in Saskatchewan was 20 May (Fox 1964), while Merlins in Montana had generally completed laying by this date.

Reproductive Success. — Reproductive success remained relatively consistent throughout the study, as evidenced by the low year-to-year variability of clutch size, brood size and number of fledglings per active nest. Average clutch size,

Table 2. Reproductive success of Richardson's Merlins in various areas in the Northern Great Plains of the United States and Canada (sample sizes in parentheses).

STUDY	LOCATION	\bar{x} CLUTCH SIZE	\bar{x} BROOD SIZE	\bar{x} FLEDGLINGS/ SUCCESSFUL NEST
Fox 1964	Saskatchewan	4.5(10)	2.7(10)	---
Fox 1971	Great Plains (forested)	4.1(9)	4.0(16)	---
Fox 1971	Great Plains (prairie)	4.5(10)	2.7(17)	2.8(6)
Hodson 1976	Alberta and Saskatchewan	4.6(156)	3.5(107)	3.2(108)
Oliphant and Thompson 1978	Saskatchewan	---	---	4.0(47)
Fox and Donald 1980	Alberta	4.1(10)	3.7(10)	---
Fox and Donald 1980	Alberta	3.4(10)	1.9(10)	---
This study	Montana	4.3(48)	3.6(48)	3.7(43)

brood size and number of fledglings per successful nest for the 4 yrs combined are similar to results reported by Fox (1964, 1971); Fox (1964, 1971); Hodson 1976; Fox and Donald (1980); and Oliphant and Thompson (1978) (Table 2). Average clutch and brood sizes for our study are towards the upper range of reported values, and although fledging data from other studies are limited, the average number of fledglings in this study is generally higher.

Percentages of eggs which hatched and resulted in fledglings in southeastern Montana are within the range of reported values. The hatching success rate of the Merlin in Montana is higher than the 60% and 58% hatching rates reported by Fox (1964) and Hodson (1976), respectively. In Alberta, 85% of the young Merlins fledged (Hodson 1976), while 96% fledged in Saskatchewan (Fox 1964). The percentage of nestlings which fledged during this study is within this range.

Mortality tended to be highest prior to hatching for Montana, as evidenced by the significant loss of eggs before the nestling stage. However, post-hatching mortality was common during each year, and for the 4 yrs combined, resulted in a significant loss of Merlins before they fledged. Causes of mortality in this study were not specifically identified, but could be attributed to predation of eggs and nestlings and inclement weather around hatching time. Cold, rainy weather in Alberta during the hatching stage resulted in severe losses of active nests (Hodson 1976). Human disturbance did not appear to be a major cause of nest failures. Precautions were taken by study personnel to minimize disturbance of breeding Merlins and nestlings, and the isolation of most nests made harassment from other human activities unlikely.

Results of this study indicate that the sequence and duration of Merlin breeding activities in southeastern Montana were similar to the breeding chronology reported in Canada, although breeding activities appeared to begin earlier in the spring. Reproductive success rates in southeastern Montana were generally higher and consistent among years when compared to other studies. Mortality was highest before hatching, followed by the period between hatching and fledging. Although human disturbance from research activities did not appear to be a cause of mortality, extensive human activities, such as energy development and mineral exploration, and development of more extensive

agricultural practices may disrupt breeding activities. Data provided by this study will be useful in monitoring the status of this Merlin population in light of future land development activities.

ACKNOWLEDGMENTS

Research in 1978 and 1979 was funded by the USDA Forest Service, Custer National Forest. Research in 1980 and 1981 was funded by the USDA Forest Service, Rocky Mountain Forest and Range Experiment Station in Rapid City, South Dakota. We thank George T. Allen, Daniel W. Carney, Richard LeVesque and Stephen L. Mackey for assistance in data collection in the field. Gene Hoff provided housing for field personnel during the study. Critical comments on an earlier draft of the manuscript were provided by I.J. Ball, Richard L. Hutto, B. Riley McClelland, Christopher Servheen and Daniel W. Uresk.

LITERATURE CITED

- CAMPBELL, J.A. AND R.W. NELSON. 1975. Captive breeding and behavior of Richardson's Merlins, 1974. *J. N. Am. Falconer's Assoc.* 14: 24-3 1.
- FISHER, R.A. 1950. Statistical methods for research workers. Hafner Pub. Co. New York, N.Y. 354 pp.
- FOX, G.A. 1964. Notes on the western race of the Pigeon Hawk. *Blue Jay* 12:140-147
- _____. 1971. Recent changes in the reproductive success of the Pigeon Hawk. *J. Wildl. Manage.* 35:122-128
- FOX, G.A. AND T. DONALD. 1980. Organochlorine pollutants, nest-defense behavior and reproductive success in Merlins. *Condor* 82: 8 1-84.
- FYFE, R.W. AND R.R. OLENDORFF. 1976. Minimizing the dangers of nesting studies to raptors and other sensitive species. Can Wild. Serv. Occas. Paper No. 23. Can. Wild. Serv., Ottawa, Ont. 7pp.
- HODSON, K.A. 1976. The ecology of Richardson's Merlins on the Canadian prairies. M.S. Thesis. Univ. of British Columbia, Vancouver, B.C. 83 pp.
- OLIPHANT, L.W. 1974. Merlins: the Saskatoon falcons. *Blue Jay* 32:140-147.
- OLIPHANT, L.W. AND W.J.P. THOMPSON. 1978. Recent breeding success of Richardson's Merlins in Saskatchewan. *Raptor Res.* 12:35-39.
- POSTUPALSKY, S. 1974. Raptor reproductive success: some problems with methods, criteria and terminology. Pages 21-32 in Hamerstrom, F.N., Jr., B.E. Harrell and R.R. Olenclorff (eds.). Management of raptors. Raptor Res. Rep. No. 3.
- TEMPLE, S.A. 1972. Systematics and evolution of the North American Merlins. *Auk*. 89:325-338.

USFWS, Montana Cooperative Wildl. Rsh. Unit, Univ. of Montana, Missoula, MT 59812. Address of second author: USDA Forest Service, Rocky Mtn. Forest and Range Exp. Sta., South Dakota Sch. of Mines and Tech., Rapid City, SD 57701.