DENALI'S MERLIN RESEARCH

Research on Denali merlins (Falco columbarius columbarius) has been conducted since 1983. In 1990 I began a 3 year study continuing data collection begun by earlier investigators, K. Laing (NPS), P. Schempf (USFWS), and K. Titus (Vir. Polytech Inst.). The present study is a NPS funded project and is part of a graduate masters study for the University of Alaska Fairbanks. This study has additionally been assisted by the USFWS Endangered Species Office, Fairbanks, Alaska.

The objectives of the present study include documenting the following: (1) the number of nesting merlin pairs along the major river drainages of primary access in northeastern Denali; (2) nest structure and nest site habitat use; (3) food habits; (4) reproductive performance statistics of all known occupied merlin territories; and (5) the levels of contaminants and eggshell thinning present in addled (nonviable) merlin eggs.

The graduate masters study is specifically investigating factors influencing merlin reproductive performance, with a goal of determining the present factor (or factors) of greatest influence. This graduate study is thoroughly investigating the effects of prey abundance on merlin reproductive performance, as well as other factors.

In 1990 and 1991, 17 and 21 breeding merlin pairs were found respectively. Expanded surveys in 1991 season found 5 previously unknown merlin territories. Additionally one new territory was established in a traditional area.

Since 1983 a total of 39 merlin nesting territories have been found on the north side of the Alaska Range between the Nenana River and the Wonder Lake area. Primary nesting habitats are open spruce stands along major river drainages in mountainous terrain and steep south facing tundra slopes covered with low shrubs. Merlins do not build their own nests. Nest sites selected have been primarily abandoned black-billed magpie (Pica pica) nests found in spruce stands. Eight known ground nest territories have been found since 1983 but occupancy of these sites has varied. Only 4 ground nest territories have been found occupied in any one year. All ground nests have been under shrub cover.

In 1991 a ground nest was found for the first time in the eastern portion of the study area and was positioned almost directly opposite what appeared to be a good condition unoccupied magpie nest. The unoccupied magpie nest was in a tall willow which may have made it less desirable. The male at this eastern ground site was banded, suggesting he was last year's territory owner at this site at which time nesting did occur in a tall willow unoccupied magpie nest. Thus this male's 1990 mate may have preferred to nest in a tall shrub willow magpie nest and his 1991 mate may have preferred to nest on the ground at the exact same spot. Eventually this first eastern ground nest failed after the young were banded, presumably due to mammalian predation. Also in 1991 the first ever cliff/canyon territory was found. This pair chose to nest in a natural pothole on a rock and earthen slope. It is believed males secure the nesting territory due to their earlier arrival back on the nesting grounds but that the actual nest site to be used is chosen by the female. These two cases illustrate the flexibility and individual variation in nest site choice among merlins when presented various nesting habitats such as exist in Denali.

Predation of ground nests may be significant factor why few merlin pairs select ground nest sites. Two of three ground nests found in 1991 failed due to predation but three ground nests found in 1990 all fledged young. Whether spring snow cover is a significant factor in ground territory use will be investigated in 1992.

Prey remains have been collected at nest sites each year. Collections have not yet been quantitatively analyzed but the most commonly observed species have been small passerine birds and a few shorebird species. Many different species from most of the major habitat types of northeastern Denali have been found in merlin prey remains. Thus the merlin can best be described as specializing in small avian prey but with a fairly generalist prey use within this group.

Young and adults have been banded at nest sites to assess territory occupancy rates and dispersal. Certain traditional nesting areas have been found to be used year after year but surprisingly by different merlin pairs each year. Investigations over the last four years have found that only 32% of male merlins return to their previous year's nest territory and only 7% of female merlins return to their previous nest territory. Quite contrary to what is believed to be the dominant strategy of most birds. Most birds return from year to year to the same general area where they have been successful at raising young. Denali merlins may not have a strong selective pressure to return to their same territory but only to an area with the same suitable nesting habitat. This lack of selection pressure may be due to merlins inability to build or repair their own nests, the quick deterioration of unoccupied magpie nests from year to year, unpredictable fluctuations in prey abundance, or prey levels of adequate abundance over vast areas of suitable merlin nesting and hunting range. Females particularly, may be either very random in nest site use, nesting over a very large area from year to year, or they may be experiencing a high rate of annual mortality.

Expanded surveys in 1991 found new merlin pairs but all merlins viewed were unbanded, leaving the question of where dispersing merlins are going or if they are experiencing mortality, unanswered. Radio telemetry would be needed to fully investigate the dispersal ecology/annual mortality of this species.

Contaminant analysis and eggshell thinning has been completed for addled eggs collected in 1990 and 1991. DDE the breakdown metabolite of DDT, which has been implicated in numerous avian contaminant studies for reducing reproductive performance, was specifically assessed. Results from the U.S. Fish and Wildlife Service contaminant analysis of Alaska raptor eggs, of which the Denali merlin eggs were part of, showed that merlin eggs had the highest contamination of DDE of all Alaska raptor species investigated, including the peregrine falcon (Falco peregrinus). Merlin eggs analyzed came from 8 clutches (total 10 eggs for contaminants, 11 eggs for thinning), 4 clutches for each year.

It should be noted here that researchers have indicated that DDE effect on productivity may not be strictly its effect on eggshell thinning but may affect productivity without the eggs actually breaking. It has been proposed that DDE can affect the formation of the eggshell resulting in a change in eggshell porosity and therefore altering egg viability. It is also been proposed that DDE can affect merlin behavior so as to influence overall productivity. It should also be noted

that the relationship between DDE and eggshell thinning, eggshell thinning and productivity, and DDE and productivity are not simple linear relationships but for different Falco species their exists varying threshold levels for each relationship (Fyfe et al. 1988).

One clutch from each year contained more than one egg so interclutch variance in DDE concentration could be evaluated. Both clutches had levels of DDE consistent within the clutch, although shell thinning varied for the clutch with the lower DDE level. A high variance for eggshell thinning was found for the total sample analyzed, only three eggs from clutches with the highest DDE levels showed a very high level of thinning, the two highest DDE level eggs were cracked but not broken. It is thus believed that DDE levels present in this sample, except for three high DDE eggs, were below (4 clutches) or near (2 clutches) the threshold level where consistent thinning would occur. It is believed the threshold level for consistent thinning may be above 10 ppm DDE, although this conclusion may be in gross error due to the very small sample size it is based upon.

The arithmetic mean for the adjusted wet weight concentration of DDE in 8 eggs available for analysis was 10.6 ppm. The 1990-1991 merlin egg sample was heavily skewed by 3 high DDE content eggs, therefore the arithmetic mean is biased high. It is felt that the median or geometric mean better represent the true level of DDE represented in the sample, these levels are 5.88 ppm and 5.96 ppm respectively. Fyfe et al. (1976) stated that 6 ppm DDE should be considered a critical level above which merlin pair productivity was reduced. Fyfe et al. (1988) indicate that merlin productivity falls dramatically at a DDE level of 10 to 12 ppm wet weight. The level of DDE in the 1990-1991 Denali merlin egg sample is right at Fyfe et al. 1976 critical level for impacting productivity but the level was significantly less than Fyfe et al. 1988 critical level for severely inhibiting productivity.

The 1990-1991 merlin egg sample had a mean eggshell thickness 3.7% thinner than pre-DDT eggshell thickness for this subspecies of merlin. The Ratcliffe eggshell thickness index was 9.5% thinner than the pre-DDT value given for the species in total. Fyfe et al. (1988) report that the threshold level for DDE to affect thinning in merlin eggs at all is quite low, below 1 ppm DDE wet weight. Additionally Fyfe et al. (1988) report that merlin productivity is affected when the Ratcliffe thickness index is reduced to a level 15% thinner than the pre-DDT value and that productivity falls to 0 when the thickness index is reduced to a level 20% thinner than the pre-DDT value. The level of thinning, most accurately measured by the Ratcliffe index, in the 1990-1991 Denali merlin egg sample is significantly less than Fyfe et al. 1988 critical level for affecting productivity.

Schempf's (pers. comm.) analysis of addled and random viable eggs from Denali merlins, collected from 1984-1987, reports an arithmetic mean concentration of DDE in 30 eggs of 11.9 ppm adjusted wet weight. This sample (n=29) had a mean eggshell thickness 11.7% (calculated from mean eggshell thickness) thinner than pre-DDT eggshell thickness for this subspecies of merlin. The Ratcliffe eggshell thickness index was 16.8% thinner than the pre-DDT value given for the species in total. Thus the 1990-1991 merlin egg sample may (tentatively) indicate a reduction in DDE levels and eggshell thinning in the Denali merlin population. Still 3 out of 4 clutches in 1990 were above the Fyfe et al. (1976) critical level of 6 ppm DDE wet wt., and 1 clutch out of 4 was above this critical level in 1991.

Two out of 17 clutches laid in 1990 are believed to have failed due to high DDE levels. One clutch that never hatched had a mean DDE level of 9.0 ppm, with one egg 17.5% thinner than normal. The other clutch consisted of one egg which was broken and then the nesting attempt was abandoned. One clutch out of 21 laid in 1991 is believed to have failed due to high DDE levels. This failed clutch originally consisted of 4 eggs, a return visit in July found only 2 eggs which were subsequently analyzed for contaminants. These two eggs had a mean DDE level of 33.25 ppm, with a mean eggshell thinning index 34.4% thinner than normal. Diet of these specific pairs may indicate a possible use of contaminated prey species within their breeding range. Overall the DDE present within the population is believed to have been accumulated from prey on their wintering grounds in the neotropics, particularly from countries still using DDT based pesticides. Countries where high concentrations of DDE have been found in potential merlin prey species include countries of northern South America (Fyfe et al. 1990).

Other contaminants were not analyzed for this review but appeared low. Analysis of heavy metals present within the sample is still pending. Schempf found high levels of mercury in his 1987 analysis, which may be of continued concern for this population.
The DDE levels reported here for a collection of addled eggs made in 1990 and 1991, have dropped since the time of the larger sample contaminant analysis completed by Schempf in 1987. Presently I believe DDE is affecting productivity of particular highly contaminated pairs. A population DDE wide effect on nesting success is not believed to be operating, whether productivity is or has been depressed in this population is undetermined. Productivity is presently considered good in comparison to other merlin populations. Over the last 9 years of study, young produced (to banding age) per occupied territory has been very stable at close to 3 (mean=3.3, s.d.=.46). The population is not believed to be declining and may in fact be expanding.

This study is important for documenting the present distribution and numbers of nesting merlins in primary drainages and potential ground nesting areas in the northern portion of Denali National Park and Preserve. Additionally this study will increase our understanding of factors influencing merlin habitat use, as well as factors influencing their reproductive performance. Information gained from this study will be used in the development of a long term monitoring and management plan for this species so that a healthy merlin population continues to be a part of Denali's ecosystem.

Scott Wilbor

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