A Common Redpoll Northern Winter Population in an Irruption Year

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ABSTRACT

*I banded 1991 Common Redpolls (*Acanthis flammea*) in Anchorage, Alaska, from March 1990 - April 1995, including during an irruption year (winter 1993 - 1994). My data set on arrival dates, age and sex composition, weights, and patterns of abundance within the Common Redpoll breeding range allowed me to formulate four tests of two hypotheses that have been put forth to explain irruptions: food shortage and high reproduction. During the irruption year, redpolls 1) arrived in Anchorage earlier than most years and they remained in the area longer than other years, 2) weighed less upon arrival than in one year with a comparable arrival time, but did not weigh consistently less or more than in other years, 3) showed no difference from overall expected ratios of adult males compared with all years (1990 - 1995) combined, and 4) showed no unique shifts in abundance or age/sex composition throughout the winter. My data generally support the food shortage hypothesis.*

INTRODUCTION

Hochachka et al. (1999) studied continental patterns of an irruption of Common Redpolls (*Acanthis flammea*, hereafter "redpoll") in the winter of 1993 -1994. They noted that irruptive migrations are difficult to study due to the unpredictability and large spatial scale over which movements occur. They point out that published studies are restricted to a fraction of the area involved, piece together anecdotal information, track movements of banded birds, or contain data from a narrow window. Hochachka et al. (1999) reviewed two plausible possible causes of irruptions in Common Redpolls and other species: shortages of alder or birch mast (seeds) in winter, or high population densities following summers of excellent reproduction/food abundance. Regional food shortage on the breeding grounds was found to be the best explanation for irruptions in another irruptive species, the Red-breasted Nuthatch (*Sitta canadensis*; Wilson and Brown 2017).

Hochachka et al. (1999) explored three questions using Project FeederWatch data: first, what is the pattern of arrival and departure of redpolls from different regions of the continent over the course of the irruption?, second, does a southward irruption result in abandonment of their more normal winter range?, and third, within a given region, do patterns of abundance change from non-irruptive years? They found that the normal winter range was not abandoned, that redpolls were more abundant in the southern part of their normal winter range in an irruption year versus a non-irruption year, and that there was no evidence that the majority of the population moved continuously throughout the irruption period. They concluded "that the irruptive migration of redpolls is more allied to conventional winter migration than to nomadism" (Hochachka et al. 1999: 195).

I banded 1991 Common Redpolls in Anchorage, Alaska, during the winters of 1989-1990 through 1994-1995. Anchorage is at the northern limits of the Common Redpoll's regular winter range. Although field guides indicate Anchorage is within the breeding range of Common Redpolls, very few "if any" actually breed in the lower elevations of Anchorage (pers. obs.) and may also include areas near tree line in the foothills of the Chugach Mountains. Because irruptions are likely to start in the northern part of a species range, data from Anchorage offer opportunities to address questions about Common Redpoll physical condition and abundance throughout the period of irruption, and "in particular" at the onset of an irruption. My data allow me to document Common Redpoll monthly abundance, population age and sex composition, and physical condition for three years before an irruption, during an irruption year, and for one year following an irruption. My data also allow me to evaluate the answers Hochachka et al. (1999) provided for their three questions. Weight and age/sex data from an additional 176 Common Redpolls I banded in Fairbanks, Alaska, in April 1992, are included in this study for additional comparative context.

I developed four tests to differentiate between the hypotheses of food shortages or successful breeding as the cause of redpoll irruptions. If food shortages is the cause of irruptions, then my data would show 1) redpolls arrived in Anchorage earlier in the irruption year than other years, 2) that weights at arrival would be less in the irruption year than in other years, 3) that sex/age composition of the population would not differ between years, and 4) that patterns of bi-weekly abundance would differ in the irruption year from other years.

Alternatively, if irruptions are based on highly-successful reproduction the previous summer, then my data would show 1) redpolls arrived in Anchorage at the same time in the irruption year as in other years, 2) that weights at arrival would be the same in the irruption year and in other years, 3) that the proportion of juveniles in the population would be greater in the irruption year than other years, and 4) that patterns of bi-weekly abundance would not differ in the irruption year from other years. Since the only segment of the population that can be definitively identified are adult males, a higher proportion of juveniles would be reflected in a lower proportion of adult males.

Detailed studies of Common Redpolls at their northern limits are mostly lacking for both breeding and non-breeding seasons (Knox and Lowther 2000). In fact, there appear to be only 7 known weights from Common Redpolls in Alaska (mean 13.6 g; Brooks 1968 in Knox and Lowther 2000).

METHODS

Common Redpolls were captured seasonally from 21 Mar 1990-5 Apr 1995 using one or two 12-m, 36-mm mesh mist nets arrayed around a feeding station. Age and sex were determined by combinations of plumage coloration, rectrix shape, and (rarely) wing length according to criteria in Pyle et al. (1987). Captured Common Redpolls were placed into 1 of 6 categories: adult males, adult females, juvenile males, juvenile females, juveniles of unknown sex, and unknown-aged birds of unknown sex (which consist of a mix of juveniles and adult females). An exception occurred in spring 1990 when all redpolls were classified as either adult males or unknowns. Adults are defined as birds >1 year old (i.e., birds that would be given an AHY age class if caught in December), and juveniles are birds <1 year old (i.e., birds that would be coded as HY if caught in December). In order to increase sample sizes, all juveniles and females were pooled together.

I included my late winter-spring 1990 data, even though most of the winter season was past when banding commenced, because March provided nearly half of my late-spring data. These numbers could help answer the question about population composition.

The study site was a heavily-wooded, sparsely-populated residential area on the Anchorage hillside, at an elevation of 110 m above mean sea level, at 61° 07' N, 149° 49' W. Dominant trees in the area included paper birch (*Betula papyrifera*), aspen (*Populus tremuloides*, *P. balsamifera*), and white spruce (*Picea glauca*). Dominant shrubs included willows (*Salix* spp.), red elderberry (*Sambucus racemosa*), and devil's-club (*Oplopanax horridum*). Dominant herbaceous vegetation was fireweed (*Epilobiuman gustifolium*) and bluejoint grass (*Calamagrostis canadensis*). Other residents and I in the neighborhood, provided supplemental food throughout the year, which potentially influenced weight and fat conditions. Forested habitats in Anchorage ranged from sea level (0 m mean sea level) 3.4 km west of my banding station) to treeline in the foothills of the Chugach Mountains at about 450 m msl (6.5 km east of my banding station). The foothills of the Chugach Mountains in Anchorage form part of a continuous arc of interface between mountains and lowlands extending from the Denali area (to the north) to the southern end of the Kenai Peninsula; this north-south interface likely funnels many south-bound migratory birds from interior

Alaska through Anchorage. Seasons in Anchorage vary considerably based on amount of daylight and snow cover. Birds in Anchorage experience short winter days from early November through January, with daylight occurring from about 1000 - 1530. Hours of daylight change quickly over a 2-month period centered around each equinox. Heavy snows and deep snowcover can occur from November through April, although temperatures are mild relative to Interior Alaska.

From 1990 - 1992, Common Redpolls were weighed with a 50-g Pesola scale to the nearest 1 g; beginning in 1993 they were measured with a more-precise Ohaus 300-g electronic scale to the nearest 0.1 g. Wing chord was measured to the nearest 1 mm. Capture times were recorded to the nearest 10-minute interval and standardized to Alaska Standard Time. When Common Redpolls were being captured in large batches (e.g., >30) or at rapid rates (23-41/hr), I frequently omitted weighing birds, and those that were weighed were usually birds of known age and sex. Because I determined in a previous study (North 2018) that there was no statistical difference in weights measured with the two scales for a smaller species (i.e., Red-breasted Nuthatch *Sitta Canadensis*), I pooled Pesola and Ohaus weight measures for the larger Common Redpoll.

Because of the perceived strong influence of rapidly-changing photoperiod on food intake and metabolism (e.g., Seibert 1949, Krebs et al. 1995, Swanson et al. 2014), I pooled capture data into 2-week periods beginning with the winter solstice (day 1 = 22 Dec). This resulted in eight winter periods ending 12 Apr (= day 112), and four spring periods from 13 Apr – 8 Jun (= days 123 - 168). (In Anchorage, winter conditions typically persist going into period 8 and are over by the end of period 9 [pers. obs.] See Table 4 for equivalences of period with dates and days from 21 Dec.). The four spring periods were subsequently combined to increase sample sizes for weight analysis. Mass samples included weights from recaptured birds either once during the initial 2-week capture period if birds were not weighed during initial capture (n = 6), or once during subsequent 2-week periods (n = 65). I used statistical functions in Excel (AVERAGE, STDEV.P, INTERCEPT, SLOPE, and RSQ) to calculate means, standard deviations (SD), and regression lines to characterize weights

RESULTS

From 21 Mar 1990 – 5 Apr 1995 I banded 1981 (n = 1960 winter, 21 spring) Common Redpolls (Table 2). Few recaptures were obtained during the winters of 1989 - 1990 through 1993 - 1994, but recapture events were very common in the winter of 1994 - 1995 (Table 1). Only one recapture event occurred between two winter seasons. Adult male Common Redpoll 1930-75805 was banded 5 Mar 1994 (mass = 14.6 g at 1530, wing = 75 mm) and recaptured 7 Jan 1995 (mass = 16.2 g at 1440, wing = 77 mm).

Arrival Times. **–** Winter arrival times varied considerably year to year as shown in Table 2. The earliest arrivals occurred just after the winter solstice during the irruption year of 1993 - 1994. Common Redpolls also arrived at essentially this time the following year as well. Durations that wintering Common Redpolls were present ranged from <2 months in 1992 - 1993 to 6 months in 1993 - 1994. Approximate winter monthly banding rates of newly captured individuals based on total number banded divided by the number of months Common Redpolls were present through 12 Apr (e.g., for 1993 - 1994, 520 captures/3.75 months = 138) are included in Table 2. Years with later arrival dates had lower monthly banding rates than years with early arrival dates (Table 2). This suggests that when populations arrive later that they move in smaller overall numbers.

Mass. – Weights were obtained from a subset of 1816 Common Redpolls at initial winter (n = 1795) and spring (n = 21) captures (Table 3). When weight data are combined across years into bi-weekly periods, they show a steady progression of weight decrease throughout the winter (Table 3). The exception was period 4 (days 43-56, 2 Feb - 15 Feb), which coincides with the onset of rapid daylight increase. A regression analysis of the results in Table 4 and derived a y-intercept of 15.82 g, a slope of -0.26917 g/period (periodic rate of weight loss), a Pearson correlation coefficient of -0.9146, and an $R^2 = 0.84$ (indicating a strong correlation between average weight and seasonal periodicity). The only periods where the mean ± the standard error overlapped were periods 2 (15-28; 5 Jan - 18 Jan) and 3 (29 - 42; 19 Jan - 1 Feb), and 3 and 5 (57-70; 16 Feb - 1 Mar), meaning all the others were statistically significantly different from one another.

Arrival weights during the irruption year (1993 - 1994) were less than the following year, when redpolls arrived in Anchorage at essentially the same time in late December (Table 4). Weights also declined substantially between periods 1 and 2 in the irruption year, but not the following year. Weights during period 2 of the irruption year were intermediate between the following year and a previous year (1990 - 1991) when redpolls arrived in early January. During periods 4 - 6, weights during the irruption year were intermediate between other years. Weights during period 8, were higher than other years during period 8. Overall, weights seemed more steady seasonally during the irruption year than other years (Table 4).

A subset of the 43 Common Redpolls I captured during period 8 in Fairbanks in 1992 had a mean weight of 14.1 g ± 1.4 SD, which was 0.35 g more than their southern counterparts at the time: these weights were collected primarily before noon.

Age/Sex Composition. – The overall population was dominated by juveniles and adult females. Adult males compromised from 9 - 42% of the population (Table 5). Overall, adult males comprised 25.90% of the population across all years, and 25.67% of the population during the irruption year (essentially no difference; $X^2 = 0.0020$, 1 df, $P > 0.95$). The proportion of adult males in the population did start out high during the irruption year and showed a general decline as the winter season progressed (Table 6), suggesting either an influx of juveniles or an exodus of adults. The proportion of adult males in the population was the most consistent throughout the season in the year following the irruption.

In period 8 (days 99 - 112) in 1991 - 1992, adult males comprised 50% of the population (n = 12) in Anchorage. (In period 7, with a larger sample size of 72, they comprised 43% of the population). In Fairbanks during this same time period (8), they comprised 15% of the population (n = 176), suggesting more young birds remained farther north than adult males. This, taken with the decreasing proportion of adult males as the winter progressed in the irruption year suggests the possibility that juveniles from the north may have been moving south as winter progressed.

	Days from 21 Dec											
Years	1-14	15-28	29-42	43-56	57-70	71-84	85-98	99-112	113-126	127-140	141-154	155-168
1989-1990							(115)	43	4		3	2
1990-1991		25	7	44	108		4					
1991-1992				2	3	24	77	(12)		(5)	4	
1992-1993				17	21	33	46	15				
1993-1994	23	86	124	46	30	157	0	51	1		2	
1994-1995	63	41	54	131	182	325	34	(27)				

Table 1. Bi-weekly new captures of Common Redpolls in winter in Anchorage, AK, 1990 - 1995. Numbers in parentheses indicate periods where banding opportunities covered only part of the period. Shaded boxes indicate periods when no banding effort occurred.

Winter	First Capt.	Last Capt.	Winter banded	Spring banded	Monthly Winter Rate	Recaptures
1989-1990	unknown	2-Jun	158	9	211	2
1990-1991	5-Jan	16-Mar	188	0	75	8
1991-1992	8-Feb	23-May	118	9	67	3
1992-1993	14-Feb	4-Apr	132	0	75	1
1993-1994	23-Dec	21-May	517	3	138	10
1994-1995	24-Dec	unk (>9 Apr)	857	na	245	134

Table 2. Dates of first and last captures, total winter and spring captures, and winter capture rate of Common Repolls in Anchorage, Alaska, 1990-1995.

Days from 21 Dec	Mass (g)	SD	SE	n
1-14	15.63	1.23	0.17	53
15-28	14.91	1.33	0.11	155
29-42	14.73	1.52	0.11	187
43-56	15.02	1.56	0.15	210
57-70	14.70	1.28	0.07	352
71-84	14.38	1.09	0.05	493
85-98	14.25	1.26	0.08	264
99-112	13.82	1.20	0.10	151
113-	12.81	1.08	0.23	22

Table 3. Seasonal mean Common Redpoll weight, all birds (n = 1838 new captures, and 71 recaptures) and years combined, Anchorage, AK 1990 - 1995.

Period	Dates	Days from 21 Dec	1989-1990	1990-1991	1991-1992	1992-1993	1993-1994	1994-1995
1	22 Dec – 4 Jan	1-14	No banding				15.4 ± 1.2; 23	15.8 ± 1.3; 30
2	5 Jan - 18 Jan	15-28	No banding	14.4 ± 1.3; 25			14.6 ± 1.1; 87	15.7 ± 1.3; 43
3	19 Jan – 1 Feb	29-42	No banding	16.9; 7			14.6 ± 1.5; 126	14.8 ± 1.5; 54
4	2 Feb - 15 Feb	43-56	No banding	14.4 ± 1.1; 46	13.5; 2	15.1 ± 1.4; 17	14.6 ± 1.4; 46	15.5 ± 1.7; 99
5	16 Feb – 1 Mar	57-70	No banding	14.1 ± 1.2; 111	13.7; 3	14.3 ± 1.0; 21	14.3 ± 0.9; 31	15.2 ± 1.3; 186
6	2 Mar - 15 Mar	71-84	No banding		13.7 ± 0.7; 24	13.8 ± 1.0; 33	14.4 ± 1.2; 131	14.5 ± 1.0; 305
7	16 Mar - 29 Mar	85-98	15.1 ± 1.3; 114	13.2; 4	14.0 ± 1.1; 78	14.2 ± 1.2; 33		14.9 ± 1.2; 35
8	30 Mar – 12 Apr	99-112	13.6 ± 1.2; 43		13.8 ± 1.3; 13	13.1 ± 0.9; 15	14.0 ± 1.3; 52	13.6 ± 1.1; 28
9	13 Apr - 26 Apr	113-126	11.75; 4		No banding		14.5; 1	No banding
10	27 Apr - 10 May	127-140			13.4; 5			No banding
11	11 May - 24 May	141-154	13; 3		12.7; 4		12.4; 2	No banding
12	25 May - 2 Jun	155-168	12.8; 3					No banding

Table 4. Mean masses of Common Redpolls during bi-weekly winter capture periods in Anchorage, AK, 1990 - 1995. Data show "mean ± SD; sample size," or "mean; sample size" for small sizes where standard deviations not calculated.

Year	Adult Males	Non-Adult Males	Proportion Adult Males		Observed - Expected
			Observed	Expected	
1989-1990	45	122	0.27	0.26	0.01
1990-1991	17	172	0.09	0.26	-0.17
1991-1992	48	66	0.42	0.26	0.16
1992-1993	24	108	0.18	0.26	-0.08
1993-1994	134	388	0.26	0.26	0
1994-1995	245	612	0.29	0.26	0.03
Total	513	1468	0.26		

Table 5. Proportion of adult males in population.

	Days from 21 Dec											
Years	1-14	15-28	29-42	43-56	57-70	71-84	85-98	99-112	113-126	127-140	141-154	155-168
1989-1990							28	30	0		0	0
1990-1991		8	14	18	5		25			20	0	
1991-1992				50	33	71	43	50				
1992-1993				29	14	18	22	0	0		0	
1993-1994	48	33	28	22	37	18		18				
1994-1995	32	24	31	25	37	25	26	26				

Table 6. Percent of population comprised by adult male Common Redpolls in biweekly winter capture periods, Anchorage, AK, 1990 - 1995. Shaded blocks indicate periods where no banding effort occurred.

DISCUSSION

My banding data appears to support the food shortage hypothesis. If a food shortage drives irruptions, irruptive species should begin moving earlier than otherwise, and be in poorer condition as they begin to move. Common Redpolls arrived on the Anchorage winter grounds earlier during the irruption year than other winters other than the following winter. However, early winter "arrival" weights were not lower than in other years, nor were mid-winter or late-winter weights. Overall sex and age composition did not vary from other years, but biweekly abundance patterns appear to have varied from other years and redpolls were present in the winter range longer than other years, although there is no good statistical test for this. The apparent absence during one late winter two week period should not be taken to support the food shortage hypothesis as I outlined it, as weather conditions and personal schedules affect banding effort. The causes of the high rate of recaptures (see Table 2) in my last (non-irruption) year of banding are not apparent.

My data also support two of Hochachka et al.'s (1999) other three findings: 1) they found that the normal winter range was not abandoned, and I found that this was true for the northern part of the winter range as well; 2) they found that redpolls were more abundant in the southern part of their normal winter range in an irruption year versus a non-irruption year, and I found this was true for the northern part of their winter range as well; and 3) they found that there was no evidence that the majority of the population moved continuously throughout the irruption period, and neither did I, but my data are weak on this point. They concluded "that the irruptive migration of redpolls is more allied to conventional winter migration than to nomadism" (Hochachka et al. 1999: 195). The high reproduction hypothesis is generally not supported by my data. However, it is possible that high reproduction coincident with a subsequent food shortage work in tandem to influence irruption events.

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Ageing American Kestrels In-hand

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ABSTRACT

*Previously, we thought that we could correctly age female American Kestrels (*Falco sparverius*) by the width of the dark subterminal band (wide for adults and narrow for juveniles), but others have reported that juvenile female kestrels may have either narrow or wide subterminal bands. Pyle (2008) identifies differences in tail tip shape as a character to distinguish between juvenile and adult female kestrels (wide and blunt on adults, narrow and pointed on juveniles). We show, based on the tails of 169 known-age females, that tail tip shape serves to determine age, but with some caveats. Tail tip shape serves for ageing males based on 79 known-age males. Kestrels that had been aged by molt, recapture, plumage, and fault bars have served to verify the accuracy of tail tip shape in ageing. We found a few cases in which, for various reasons, this technique did not work. We will discuss these herein.*

INTRODUCTION

American Kestrels (*Falco sparverius*) have two age-related plumages, adult and juvenile. Parkes (1955) advocated that female American Kestrels could be aged by the width of the dark subterminal band (narrow and the same width as the other dark bands for juveniles, and much wider than the other dark bands for adults), but he urged caution, due to small sample size and exceptions. Smallwood (1989), in his ageing key, reported that if the dark subterminal band of females was more than 1.75 times the width of the other dark bands, age is indeterminant, and that juveniles had subterminal band less than 1.75 times the width of other dark bands. Many kestrel researchers have questioned whether this method works for all juvenile females. Liguori et al. (2020) show nestling females with