Long-Term Band Encounters of Rehabilitated North American Eagles

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Abstract

Between 1973 and 2020, 122 Golden Eagles and 115 Bald Eagles submitted to veterinary medical rehabilitation were banded and released upon recovery in three western states. Adults of both species comprised the most commonly banded age class of rehabilitated (rehab) eagles. Bald Eagles admitted for toxins spent less time in rehabilitation than for those admitted for collision trauma. Encounter (band read for any reason) data from banded eagles provided by the Bird Banding Laboratory (BBL) were analyzed and fitted to appropriate functions in an attempt to describe underlying distributions inherent in the data. Up to March 2020, 28 (12.2%) rehab eagles had been encountered. Encounter rate was 7.4% for rehab Golden Eagles and 16.5% for rehab Bald Eagles, slightly different than those reported by BBL overall (8.0%, 12.2%, respectively). All Golden Eagles were recovered (encountered dead) but 26.3% of Bald Eagles were encountered alive. Days in rehabilitation were not different between species or between Bald Eagles encountered dead or alive. Sex ratio of encountered eagles was not different from ratio of banded eagles of either species. Median time between release and encounter for Golden Eagles was 1.75 yr and 1.42 yr for Bald Eagles. Median distance from banding to encounter site for Golden Eagles was 7.5 km and 115.7 km for Bald Eagles. Number of encounters per year was not related to number of rehab eagles banded that year or for any year previous. Encounters of live Bald Eagles > 30 yr old are discussed. Rehab Golden Eagles may have originated predominantly from western Canada and Alaska while Bald Eagles may have been a mix of a local, non-latitudinal migratory population and seasonal latitudinal migrants. Small sample sizes and lack of precise encounter data prevents utility of rehab eagle encounters to contribute to demographic vital rate estimates needed for effective management of either species. Banding rehab eagles may not justify the manpower investment by BBL required to manage data from banders that band rehab eagles exclusively. Falconry training may be warranted to increase survival potential of rehab Golden Eagles. If recent trends continue, increased rehabilitation effort focused on Golden Eagles may be warranted.

Key Words: Golden Eagle, Bald Eagle, rehabilitation, longevity, median ($\tilde{x}$).

Introduction

Leg banding has made an important contribution to the understanding of movements and longevity of birds (Wood 1945). Prior to the mid-1970s the Bird Banding Laboratory (BBL) did not encourage banding birds that were rehabilitated (i.e., held in captivity >24 hrs) and relatively few birds were banded annually. Since then, some raptor rehabilitation groups have focused primarily on auxiliary markers (e.g., radio/GPS/GSM transmitters, wing tags, colored leg bands) rather than just leg bands, especially on eagles, as more effective tools to evaluate success of rehabilitation efforts (e.g., Martell 1991) but others only band. Other than Lutmerding et al. (2012), we know of no other reports concerning long-term banding of rehabilitated (hereafter referred as "rehab" or "rehabbed") Golden Eagles (*Aquila chrysaetos*) and Bald Eagles (*Haliaeetus leucocephalus*) based exclusively on encounters of leg bands. Here, we report on encounters of rehab

eagles banded and released over 46 yr in the Rocky Mountain west.

Methods

Between May 1973 and March 2020, 634 Golden Eagles and 1002 Bald Eagles were banded under the authority of Federal Bird Banding Permit No. 20357 (A. Harmata) and sub-permits A-G and State Permits appropriate at the time. Of those, 237 were eagles submitted for veterinary care for a variety of reasons to individuals, informal groups, and the Montana Raptor Conservation Center, and were banded upon release (Table 1). Rehab eagles were released as early as August 1973 until October 2019. Eagles were released near Ft. Collins, Colorado (3 GOEA [1], 1 BAEA[2]), northwest Wyoming (1 GOEA, 3 BAEA), and across the state of Montana (118 GOEA, 111 BAEA). All eagles were banded with US Fish & Wildlife (USFWS now US Geological Survey) issued, pop-rivet metal leg bands. Age class at release was determined by methods consistent with Bloom and Clark (2001) for Golden Eagles and McCullough (1989) for Bald Eagles. Golden Eagles were sexed by methods described by Harmata and Montopoli (2013) and Bald Eagles sexed by methods modified from Bortolotti (1984). Nonadult age classes followed BBL classifications at banding and were Local or nestling (L), Hatch Year (HY), After Hatch Year (AHY), Second Year (SY), After Second Year (ASY), and Third Year (TY). Only After Third Year (ATY) did not follow BBL criteria. All ATY age class eagles were adults at least 5 yr of chronological age.

Records were scant for most eagles admitted to rehabilitation, especially between 1973 and 1995. However, reason for admittance could be determined or at least surmised for some. These reasons were condensed into three major categories: 1) collision-related injury, including head trauma, contusions, fractures, dislocations, etc.; 2) toxicity, mostly from lead (Pb) and other unknown substances and; 3) "other" which included an imprinted eagle ($N = 1$) and electric shock injuries ($N = 2$).

Consistent with BBL terminology we considered a band encounter as determination of a band number regardless of condition of the bird (i.e., dead, captured and released, remotely read on live bird). A band recovery was an encounter only of a dead, banded eagle. We compiled banding and encounter data from BBL records and data were manipulated in Excel™ or Statistica 6.0 (Statsoft 2003) spreadsheets. Only eagles that were held in captivity for > 24 hr were included i.e., Banding Status Code 2 (Transported to a different 10-minute block), 4 (Hacked), 5 (Sick, Exhausted) or 7 (Rehab and Held) were included. Distance between release and encounter site was calculated for latitude-longitude (Lati-Long) coordinates if known but precise encounter coordinates of several encounters were unknown. Thus,

[1] Golden Eagle

[2] Bald Eagle

Table 1. Age classes of eagles rehabilitated, banded, and (encountered) in Colorado, Montana, and Wyoming, 1973-2019. See narrative for age class acronym.

	Age Class at Banding							
	L	HY	AHY	SY	ASY	TY	Adult	Total
Golden Eagle	2 (1)	31 (1)	5 (1)	21 (3)	11 (1)	8 (1)	44 (1)	122 (9)
Bald Eagle	4 (1)	16 (4)	7 (2)	8	12 (1)	14 (1)	54 (10)	115 (19)
Total	6 (2)	47 (5)	12 (3)	29 (3)	23 (2)	22 (2)	99 (11)	237 (28)

Lati-Long coordinates of the southeastern corner of the 10-minute block provided by BBL were used. Distance ($D_{(x)}$) was calculated by:

$D_{(x)}$ =ACOS(COS(RADIANS(90- *LatR*)) *COS(RADIANS(90- *LatE*)) +SIN (RADIANS(90- *LatR*)) *SIN(RADIANS(90- *LatE*)) *COS(RADIANS(LongR -*LongE*))*6371;

where:

LatR = latitude of release site, *LatE* = latitude of encounter/recovery site, *LongR* = Longitude of Release site, *LongE* = Longitude of encounter/recovery site.

Time or duration between banding and encounter was calculated by determining accrued number of days between dates and dividing by 365 (= yr). Some encounter dates were not known because Federal Wildlife Agents often failed to include encounter data when submitting dead eagles to the Federal Eagle Repository in Denver, Colorado. In such cases the band encounter creation date provided by BBL minus 6 months was used as encounter date.

Due to small sample sizes precluding rigorous, statistical evaluation, number of encounters of nonadult age classes (L – TY) were pooled and compared with Adult age class for proportional analysis of encounters. Nonadults were composed of at least 4 yearly age classes (<1, 1, 2, 3) while adults composed of many (4 – 30). Encounter distances(x) and time between release and encounter in $yr_{(x)}$ were compiled sequentially from shortest to longest, $log10_{(x)}$ transformed, and regressed with cumulative proportion of encounters (y). Results were fitted to appropriate functions (logarithmic, exponential, polynomial) and displayed in an attempt to describe distributions inherent in the data. Bearing ($B_{(x)}$) from release site to encounter site was calculated by:

$B_{(x)}$=DEGREES(ATAN2(COS(RADIANS(*LatR*))*SIN(RADIANS(*LatE*))-SIN(RADIANS(*LatR*))*COS(RADIANS(*LatE*))*COS(RADIANS(*LongE* - *LongR)*), SIN(RADIANS(*LongE* - *LongR*))*COS(RADIANS(*LatE*)), (see $D_{(x)}$ above for variable names).

We used nonparametric tests when applicable because distribution normality was seldom achieved, sample sizes were small, and medians ($\tilde{x}$) tended to reduce the effect of outliers. We accepted *P*-values of ≤ 0.05 as significant and indicative of difference but considered *P*-values of ≤ 0.10 as potentially indicating trend.

Results

Number of in days in captivity needed for rehabilitation of Golden Eagles ($\tilde{x}$= 39) was not different than Bald Eagles ($\tilde{x}$= 50) (*Mann-Whitney U* = 39.0, *P* = 0.19). Adults of both species comprised the most commonly banded age class of rehab eagles. Up to March 2020, 28 (12.2%) rehab eagles had been encountered; 9 Golden Eagles (Table 2) and 19 Bald Eagles (Table 3). Bald Eagles tended to be encountered over twice as often as Golden Eagles relative to number banded (*Fisher's Exact Test*, one-tailed, *P* = 0.039). Golden Eagles banded as SY were the most frequently encountered age class while Adult was the most frequently encountered age class of Bald Eagles. Proportion of non-adult (L – TY) Golden Eagles recovered was greater than Adults (two-proportion *z* test: *z* = 3.373, *P* < 0.01) but no proportional differences in encounters by age class banded was detected for Bald Eagles (*z* = 1.087, *P* = 0.277). All Golden Eagles were recovered dead while 26.3% (banded as 1 ASY, 1 TY, 3 Adult) of Bald Eagle encounters were live captured and released or band numbers on healthy birds read by observers. Sex ratio of encountered eagles was not different from ratio of banded eagles of either species (Pearson $x^2_{(4)}$ = 6.0, *P* = 0.20).

Number of days Bald Eagles spent in rehabilitation was not different whether encountered dead or alive (*Mann-Whitney U* = 29.5, *P* = 0.96) although rehabilitation time tended to be less for live encounters ($\bar{x}$ 9 days). For banded Golden Eagles subsequently encountered after release, collision trauma comprised 62.5% of known injuries (*N* = 8) requiring a $\tilde{x}$ of 30 d (range 21-81) in captivity. One additional Golden Eagle electrocution injury required 39 d

Table 2. Recovery (all dead) statistics for 9 rehabilitated Gold Eagles banded and released, 1979-2020.

Band #	Age[1]	Sex	State Banded	Injury	Days Captive	Date Release	Years Out	Encounter[2]	
								Distance (km)	Direction Degrees
62947438	HY	F	Montana	Pelvis	30	8/12/2013	0.25	0.10	307.6
70908619	TY	U	Montana	Head Trauma	23	1/18/2019	0.25	7.58	286.6
62922749	ASY	F	Montana	Head Trauma	21	1/16/1999	2.92	284.47	300.9
62932043	SY	M	Montana	-[3]	-	2/2/1995	20.08	3019.45	300.2
62944031	SY	F	Montana	Pb[4]	64	4/12/2002	0.75	520.48	87.8
62905359	L	M	Colorado	Orphan	-	6/13/1979	0.58	0.10	270.0
67900454	SY	M	Montana	Electro	39	4/27/2007	1.75	7.41	359.4
67904274	Adult	M	Montana	Wing	34	1/25/2012	1.75	6.80	53.1
109800215	AHY	M	Montana	Wing	81	1/1/2010	4.25	60.78	180.6

[1] At Banding. Bird Banding Lab classification.
[2] From Release Site.
[3] No record.
[4] High lead concentration in blood.

of rehabilitation while Pb toxicity of another required 64 da of rehabilitation.

For banded Bald Eagles subsequently encountered after release, collision trauma comprised 60.0% of known injuries (N = 15) requiring a $\tilde{x}$ of 60 d (range 25-147) in captivity. Days in rehabilitation were considerably less for Bald Eagles treated for toxins including lead (Pb) than for known collision trauma ($\tilde{x}$ = 34 da, range 16-47) (*Mann-Whitney U* = 3.0, P = 0.052).

Time between release and encounter for Golden Eagles ($\tilde{x}$= 1.75 yr) and Bald Eagles ($\tilde{x}$= 1.42 yr) was not different (*Mann-Whitney U* = 74.5, P = 0.94). Half of rehab Golden Eagle encounters may be expected within 1.07 yr of release and 95% within 9.3 yr. Half of rehab Bald Eagle encounters may be expected within less than 1 yr of release and 95% within nearly 10.7 yr (Fig. 1).

Distance from banding to encounter site for Bald Eagles ($\tilde{x}$= 115.7 km) was farther (*Wald-Wolfowitz runs test, Z adj.* = -3.44, P < 0.01) than Golden Eagles ($\tilde{x}$= 7.5 km). Half of rehab Golden Eagle recoveries may be expected within 9 km and 95% within 1996 km (Fig. 2). Fifty percent of encounters of rehab Bald Eagles may be expected within 108 km and 95% within nearly 1077 km of the release site.

Number of encounters per year was not related to number of rehab eagles banded that year or for any year previous for either

Table 3. Encounter statistics for 19 rehabilitated Bald Eagles, 1976-2020.

Band #	Age[1]	Sex	State Banded	Injury	Days Captive	Release Date	Years Out	Encounter[2]		
								Distance (km)	Direction Degrees	Condition
62932069	Adult	F	Montana	-[3]	-	2/4/1991	0.50	109.13	260.7	Dead
62932097	Adult	M	Montana	-	-	3/25/1994	2.58	924.54	310.7	Dead
62922593	AHY	F	Montana	-	151	4/11/1997	0.17	1009.86	251.5	Dead
62922594	Adult	F	Montana	-	45	6/15/1997	0.33	22.59	145.1	Dead
62903448	HY	F	Montana	Wing	50	8/22/2001	1.25	31.66	234.3	Dead
62950142	L	U	Montana	Pelvis	25	7/12/2005	0.17	18.53	360.0	Dead
62950150	Adult	M	Montana	Toxin	16	6/17/2006	0.17	39.27	160.7	Dead
62933040	Adult	F	Montana	Pb[4]	47	4/29/2000	6.67	253.56	198.5	Alive
62900173	AHY	M	Colorado	Impact	86	2/25/1976	31.83	1416.23	65.7	Alive
67902215	Adult	F	Montana	Wing	85	8/14/2009	1.42	67.61	343.2	Dead
67903699	Adult	F	Montana	Wing	39	7/14/2010	0.75	9.07	253.8	Dead
109800256	HY	M	Montana	Imprint	16	9/1/2009	3.58	51.96	142.7	Dead
67903156	TY	F	Montana	Eye	50	11/25/2009	3.42	164.24	226.5	Dead
70902997	Adult	M	Montana	Pelvis	75	3/15/2014	1.75	280.28	86.6	Dead
109800224	HY	M	Montana	Wing	68	9/1/2014	0.33	115.74	80.9	Dead
67904293	HY	F	Montana	Wing	147	11/30/2012	5.33	41.28	44.1	Dead
62950459	Adult	M	Montana	Visual[5]	59	8/25/2015	2.92	201.03	244.2	Alive
78851934	ASY	M	Montana	Visual[5]	45	9/14/2018	0.08	1242.23	182.7	Alive
62932527	Adult	M	Wyoming	Impact[6]	34	5/18/2018	1.67	169.57	292.2	Alive

[1] Bird Banding Lab. Classification.
[2] From Release Site.
[3] No record.
[4] High lead concentration in blood.
[5] Band read by ornithologist.
[6] Blood Pb concentration also high.

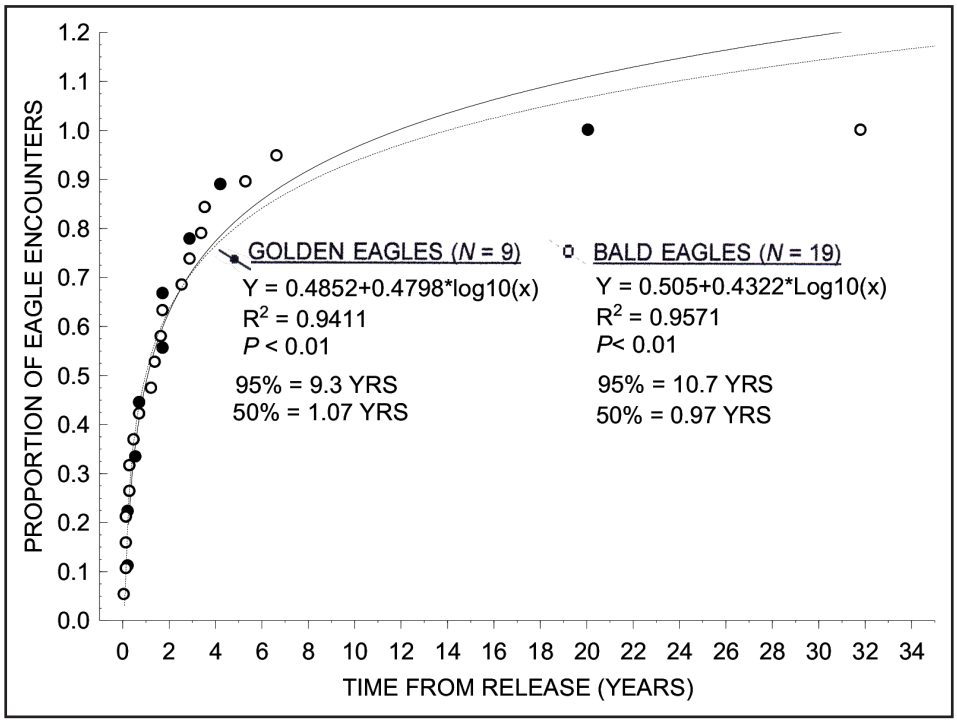

Figure 1. Time between release and encounter of banded, rehabilitated Golden and Bald Eagles.

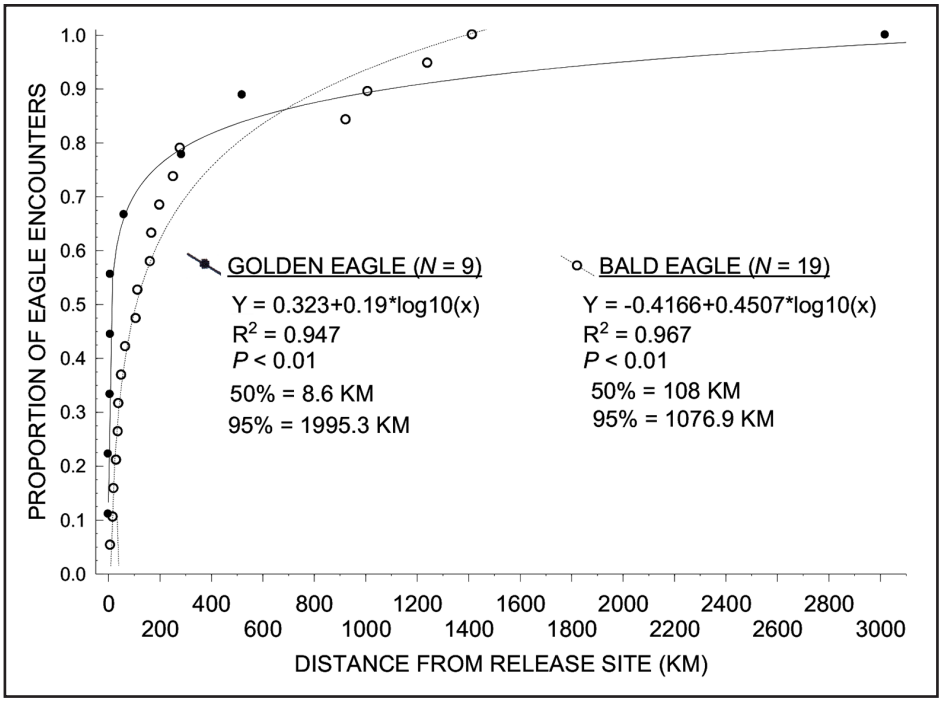

Figure 2. Distance between release and encounter of banded, rehabilitated Golden and Bald Eagles.

species (Figs. 3 & 4) ($r < 0.397$, $P > 0.66$). Distance of encounter from release site was strongly correlated with time since release for Golden Eagles ($r = 0.96$, $P < 0.01$) but slightly less so for Bald Eagles ($r = 0.53$, $P = 0.02$). Compass quadrant (NE/NW/SE/SW) of encounter from release site was not different for Golden Eagle recoveries or Bald Eagle encounters (Figs. 5 & 6) ($x^2(1) < 0.22$, $P > 0.63$).

Notable Bald Eagle Encounters

Three encounters of live, banded Bald Eagles are noteworthy. One (629-32527, Table 3) was originally banded (and colorbanded) as L in a nest at the confluence of Butler Creek and the Snake River (43.402661 -110.823989) south of Jackson, Wyoming on 23 May 1989. He was encountered alive on 4 April 2018, 14.5 km north of Pinedale, Wyoming (83.6 km, 125.7^0 from natal nest), a victim of a vehicle impact and remanded to rehabilitation at Wind River Raptors, Lander, Wyoming. At just under 30 yr old, blood analysis indicated elevated levels of Pb and on X-ray, he had a 3-part ulnar fracture, all bones appeared very thin, and there were several skeletal breaks that had healed (Barnes, N., Wind River Raptors, pers. comm.). He was administered chelating therapy, healed quickly, and was released on 18 May 2018 near Lander, Wyoming. On 28 January 2020 he was again encountered alive at Hoback Junction, Wyoming (43.3243 -110.7282) having impacted a living room picture window, ending up inside the house. He was again remanded to rehabilitation, chelated for elevated blood Pb, and released near the Snake River, Wilson, Wyoming on 6 March 2020 at near 32 yr old.

The second encounter of note was 629-00173 (Table 3). After recovering in captivity from a minor impact injury to the phalangeal portion of the wing, the Colorado Division of Wildlife provided the eagle to a research project in the San Luis Valley of Colorado (Harmata 2002a) to serve as a lure bird. After a winter season of use, the SY Bald Eagle was released near Waverly,

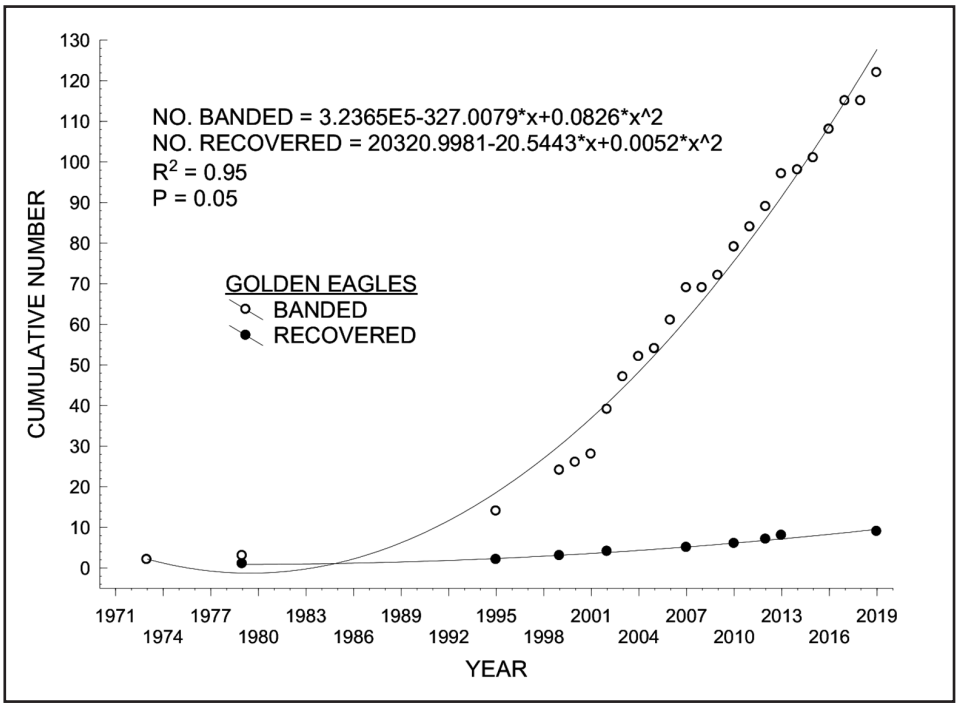

Figure 3. Relationship of cumulative number of recoveries to cumulative number banded per year for rehabilitated Golden Eagles.

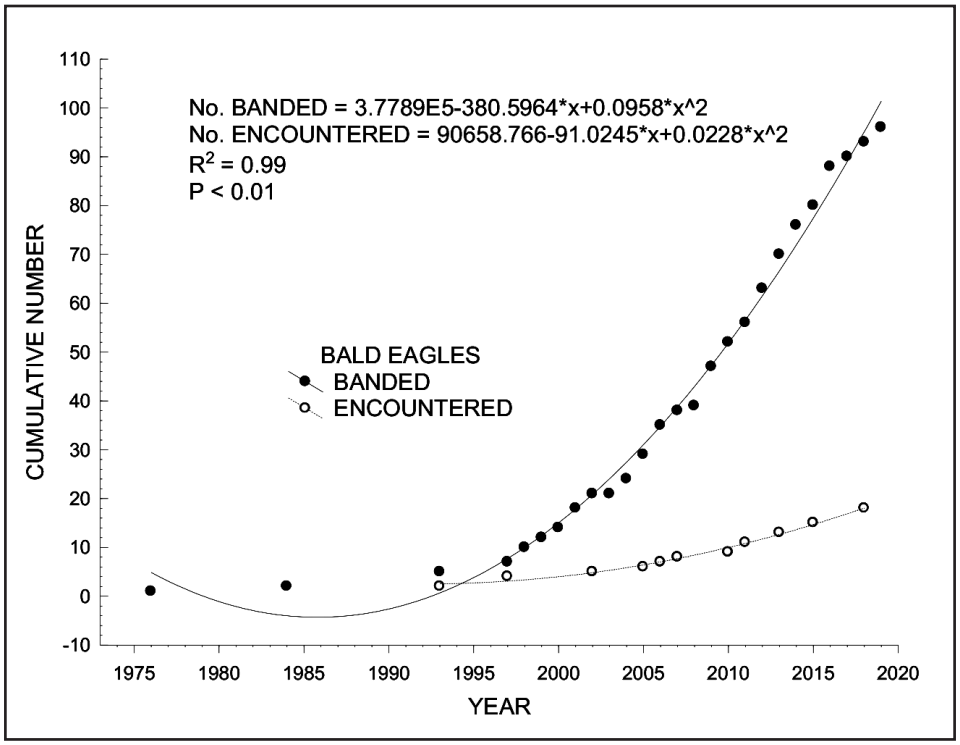

Figure 4. Relationship of cumulative number of recoveries to cumulative number banded per year for rehabilitated Bald Eagles.

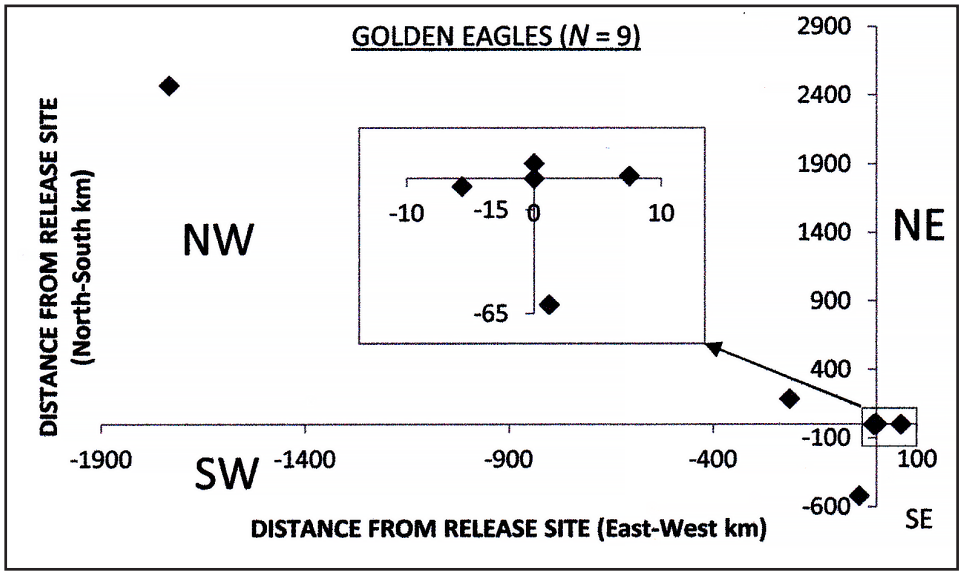

Figure 5. Directional dispersion and x- y- distance (km) of Golden Eagle recoveries from release sites.

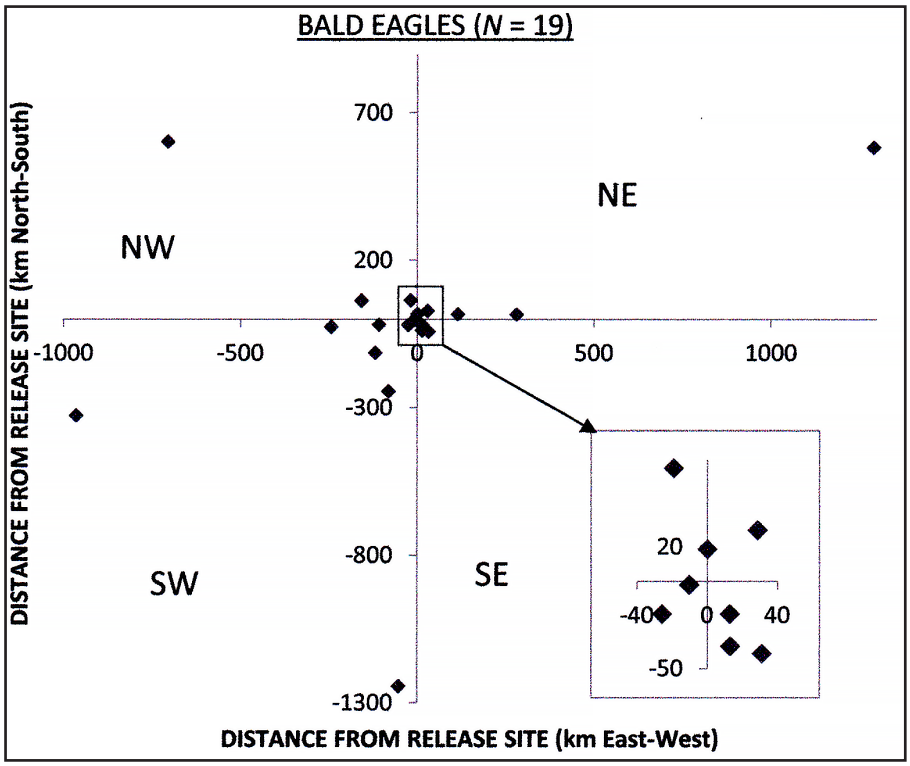

Figure 6. Directional dispersion and x- y- distance (km) of Bald Eagle encounters from release sites.

Colorado (40.7767 -105.0774) on 25 February 1976. She was encountered alive on Menominee Tribal Lands in northeastern Wisconsin in 2008 (date uncertain), 31 yrs later. The encounter was not reported to BBL by Tribal Authorities due to initial confusion over the band number and Sovereignty concerns but was released to the wild after a successful rehabilitation for Pb poisoning (Gibson, M., Raptor Education Group, Inc, Antigo, WI, pers. comm.).

A third encounter of a live eagle involved rehabilitation effort but is notable primarily because of longevity. A nestling Bald Eagle was banded (and colorbanded) along the Snake River near Hoback, Wyoming (43.2504 -110.7776) on 12 June 1982. On 12 March 2016 the eagle was found alive beneath a power pole (43.5094 -110.7564) suffering from severe electric burn damage on one wing. She was remanded to rehabilitation which was unsuccessful and she was euthanized at age 34, an age second only to a 38 yr old Bald Eagle banded and recovered in New York (https://www.pwrc.usgs.gov/BBL/longevity/Longevity_main.cfm).

Discussion

Encounter Rate

As of 2008, encounter rates reported by BBL for Golden Eagles and Bald Eagles were 8.3% and 14.0%, respectively, the highest of all raptors. Eliminating multiple encounters of the same eagle (i.e., unique), encounter rate of Golden Eagles reported by BBL (8.0%; Lutmerding et al. 2012) was still slightly greater than that reported here (7.4%). Unique encounter rate reported by BBL for Bald Eagles (12.2%) was less than rehab Bald Eagles reported here (16.5%). Lower rates for rehab Golden Eagles than those reported by BBL were possibly a function of age at banding. BBL rates are likely composed of a much higher proportion of younger, i.e., mostly L or nestling age classes at

banding (e.g., 43% L for Permit 20357) and younger age classes notoriously have less environmental awareness fostering reduced survival potential than older age classes (e.g., McIntyre et al. 2006). A higher proportion (73%) of rehab eagles were >1 yr old and despite getting into some difficulty that required treatment/captivity, likely had a higher post-release survival potential than young eagles banded as nestlings (L). A greater preponderance of rehab Bald Eagles (83%) were banded older than nestlings also, but higher encounter rate (16.5%) than rehab Golden Eagles may be a function of naturally associated habitat. Bald Eagles are associated with environments more commonly frequented by recreationists (marine, riparian, or lacustrine systems; Stalmaster 1987, Gerrard and Bortolotti 1988) and thus more likely to be encountered, while Golden Eagles are more often found in more remote, upland environments (Gordon 1955; Palmer 1988; Watson 1997) that most humans avoid.

Origins of Rehab Eagles

Golden Eagle recoveries were focused more closely to the release site, i.e., 50% within 9 km, while Bald Eagles traveled farther with 50% of encounters within 108 km (Fig.2). Median distance from banding and encounter site of rehab Golden Eagles ($\tilde{x}$ = 7.58 km) and Bald Eagles ($\tilde{x}$ = 112.44 km) was well within a single day's cruising distance for both species (Yates et al. 2001, Harmata 2002a) and therefore of little indication of origin.

Date of admission to rehabilitation may be more instructive as to origins of rehab eagles rather than movement distance or direction subsequent to release. Eighty-five percent (85%) of recorded admission dates (N = 7) of rehab Golden Eagles occurred within months when migrant eagles from northerly latitudes would be present in the Continental US (late autumn to early spring). In fact, the only admittance dates in summer were of L and HY age classes i.e., locally produced eagles. Wintering Golden Eagles in the western Continental US have been shown to originate from western Canada and Alaska (McIntyre 2006, Harmata 2015 App. Fig. 17) and in fact, bearing and distance of one outlying Golden Eagle recovery clearly indicates origin from an Alaskan population (Fig. 5).

Rehab Bald Eagles ranged farther than rehab Golden Eagles (*c.f.*, Figs. 5 & 6). However, 79% of known admission dates (N = 14) of rehab Bald Eagles were within months when migrant eagles from boreal forests of Canada (see Gerrard and Bortolotti 1988, Harmata 2002a) would be absent in the Continental US (late spring to early autumn). As no difference was detected between species in time from release to encounter, Bald Eagles may have been predominantly from a local, non-latitudinal migratory population (Harmata et al. 1999). However, outliers (Fig.6) indicate there also were latitudinal migrants not nesting/summering within the vicinity of regional rehabilitation facilities.

Utility of Banding Rehab Eagles

Small sample sizes, lack of precise encounter data (date of demise, cause, exact location), and unknown age of Adult subjects prevents utility of rehab eagle encounters to contribute to demographic vital rate estimates needed for effective management of either species (USFWS 2016, Hunt et al. 2017). One aspect of demography to which banding may contribute is longevity. Few permanent electronic tracking devices and/or attachment methods (back pack harness) persist longer than a decade and generally inflict unacceptable damage or mortality (Lockhart and Kochert 1980, Withey et al. 2001, Reynolds et al. 2004, Steenhof et al. 2006, Baron et al. 2010). Leg bands endure for the life of an eagle and several > 30 yr old eagles have been encountered (see Notable Bald Eagle Encounters, above) However, considering number of eagles banded, those encounters are exceedingly rare.

Reduced survival potential of previously compromised, rehab eagles is almost intuitive. Most rehab Golden Eagles here were recovered within 9.3 yr

(95%, Fig. 1); somewhat less than expected longevity found by Harmata (2002b) at just over 11 yr and may hint at reduced survival of rehab Golden Eagles. Proportionately more nonadult age classes were recovered than Adults. McIntyre (2012) found 82% of known mortalities ($N = 11$) of wild non-adult Golden Eagles were from starvation, revealing a possibly additive but generally unrecognized role of natural mortality. Increased investment of time and training such as employing licensed falconers to intensively train nonadult Golden Eagles prior to release may help offset natural mortality (Mauch 1998). Although Adult rehab Golden Eagles may have an increased survival potential over nonadults without training, no recovered rehab Golden Eagle approached the documented longevity record of 60 yr (Sweden, Staav 1990). However, one was near published accounts of wild Golden Eagles of notable age (> 20 yr) (Harmata 2012, Harmata and Restani 2015). Such an encounter may hint at efficacy of rehabilitation efforts if encounter date matches actual age.

We know of no published reports of Golden Eagles breeding subsequent to rehabilitation but Martel et al. (1991) reported successful breeding of a rehabilitated Bald Eagle. Lack of measurable difference in proportion of encounters between age classes of Bald Eagles suggests falconry training to increase survival potential prior to release may not be as efficacious as for Golden Eagles. Bald Eagles taken from the wild are notably difficult to adequately train (compared to Golden Eagles) to take naturally associated prey (fish, waterfowl; AH pers. obs.) thus effort may be futile from an enhanced survival perspective.

Ninety-five percent of rehab Bald Eagles were encountered within 11 yrs (Fig. 1). Martell et al. (1991) reported on survival of 19 radio-tagged, rehab Bald Eagles. Longest survival was 3 yr but all remaining were < 1 yr. They reported no band recoveries but several were again remanded to rehabilitation. Median values of time between release and encounter reported here are likely representative of actual time rehab Golden Eagles (1.75 yr) and Bald Eagles (1.58 yr) survive in the wild post-release. Unfortunately, how representative these values are of actual survival is equivocal as many recovery reports to BBL usually do not include information on carcass age or cause of death.

Considering the extended time to develop adequate sample sizes of encountered eagles experienced during this study, banding rehab eagles may not justify the manpower investment by BBL required to manage data from banders that band rehab eagles exclusively, without auxiliary markers. Few eagles are banded annually and encounters rare. Best practice may be for rehab centers to employ established Master Bird Banding Permit holders familiar with banding codes, schedules, and reporting procedures to band rehab eagles and record and submit data.

Most (87.5%) Golden Eagles and virtually all Bald Eagles were originally admitted to rehabilitation due to conflicts with humans or their artifacts (e.g., vehicles, power lines, contaminants) and likely met their ultimate demise for similar reasons (Russell 2014). Although contaminants appear to be declining (Stauber et al. 2010) and electrocutions actively managed (APLIC 2006, 2014), a comparatively high rate of anthropogenic mortality continues to affect North American Eagles and is likely limiting populations west-wide (USFWS 2016).

Evidence is emerging of population and productivity declines of Golden Eagles in the western US (Millsap et al. 2013, Watson et al. 2020). However, Montana currently (ca. 2020) supports over 500 active Bald Eagle territories in the state, which far surpasses the estimated carrying capacity of 352 territories identified by the Montana Bald Eagle Working Group in 1994 (MBEWG 1994) and the population in Montana and surrounding States continues to expand (USFWS 2016). If trends continue, rehabilitation effort focused on primarily on Golden Eagles may be warranted.

Acknowledgements

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