A capture technique for wintering and migrating steppe eagles in southwestern Saudi Arabia

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Abstract We describe a technique to capture steppe eagles (*Aquila nipalensis*) in Saudi Arabia and identify some improvements for their safety. Capture of steppe eagles by vehicle pursuit was successful in 92% of attempts ($n=52$). Speed of capture was related to capture sites ($P<0.05$), but not to relative mass of crop contents ($P>0.05$), total body mass ($P>0.05$), or prevailing weather conditions at capture sites ($P>0.05$). Although this technique of capture was very effective for steppe eagles, its efficient use is limited to open habitats.

Key words *Aquila nipalensis,* capture techniques, crop content, raptor, Saudi Arabia, steppe eagle

Commonly used capture methods such as baited snare traps, rocket nets, or exclosure traps (Bloom 1987) are not suitable for steppe eagles (*Aquila nipalensis*). Problems with available traps include potential serious injury to birds (snares), traps designed for solitary birds that are impracticable for many birds at a carcass (exclosure traps), and avoidance of rocket nets by steppe eagles. Likewise, oral drugs are difficult to apply in the appropriate dose, are tolerated poorly, and are potentially dangerous (Ebedes 1973, Day et al. 1980). Remote delivery of drugs by gun has been used to capture griffon vultures (*Gyps fulvus,* Revers and Bögel 1994) but cannot be used for wild steppe eagles, which are difficult to approach and much smaller in size. Although several of the above mentioned techniques are successful on other eagle species (e.g., Harmata 1984, Bloom 1987, Jackman et al. 1994), few authors have addressed the problem of recapturing "trap-shy" individuals with the same technique.

Although the diet of steppe eagles varies considerably throughout their range (Cramp and Simmons 1980), migrating and wintering birds in Saudi Arabia feed on slaughterhouse offal and rubbish dumps in the desert (Hollom et al. 1988). After observing that birds feeding at these dumps have difficulty gaining flight when chased by a vehicle, we attempted to catch birds by chasing them. Our objectives were to describe a technique to catch wintering and migrating steppe eagles in Saudi Arabia and identify factors to maximize the birds' safety.

Study area

We conducted our study at 2 rubbish dumps with animal waste located 35 km from the city of Taif (21°15′N / 40°21′E), in west-central Saudi Arabia, at a mean altitude of 1,400 m above sea level. Both sites were sandy desert crossed by dry watercourses (*wadis*). At site 1, the terrain was undulating with numerous acacia trees (*Acacia tortillis*) along the main *wadi*; at site 2, the terrain was flat and trees were scarce. Neither area had naturally occurring permanent surface water. Consequently, the region was sparsely vegetated with intensively grazed perennial grasses and forbs and tall acacia trees present only in the *wadis*. These rubbish dumps primarily contained carcasses of sheep and goats, were not enclosed, and refuse destruction was not practiced. Scavenging birds had direct access to these sites.

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Adult steppe eagle under pursuit near Taif, Saudi Arabia.

Methods

We captured wintering and migrating steppe eagles in southwestern Saudi Arabia as part of a 4-year study. The capture team was composed of a driver and an onboard observer, who captured birds. We excluded juvenile birds (<1 year old) from the experiment due to potential naivety. We randomly chose adult or subadult birds from groups of scavenging eagles. We conducted captures shortly before or after sunset (+/-15 minutes), when thermals were less active. We chased a flying bird with a 4-wheel-drive vehicle to intercept its flight path and catch the bird when it attempted to land.

We did not hide the vehicle before the chase. We began our approach 200 to 300 m from a randomly chosen roosting or feeding bird. We cut off its flight path 3 to 5 times, at which time the chased eagle would lie on the ground. We then threw a blanket on it and the observer handled the eagle, with gloved hands, by the wings and legs. We then hooded the bird and allowed it to recover prior to handling.

We recorded time between initial takeoff and final capture (capture time) with a stopwatch. We manually removed and weighed (g) crop contents as soon as the bird was caught to evaluate effect of body mass and crop fullness on speed of capture. We recorded body mass (+/-10g) before removal of the crop contents and then again before release. To assess whether speed of capture was dependent on weather conditions, we recorded ground temperature (°C), air temperature (°C), wind speed (m/s), and rainfall (mm) using a meteorological data logger (Grant 1250 series, Cosmark, Royston, United Kingdom). We measured wing length (cm), tail length (cm), beak length (cm), and gap (cm) of each bird and banded each with a National Commission for Wildlife Conservation and Development band (Riyadh, Saudi Arabia). All captured birds received a thorough medical check by a veterinarian and were evaluated for degree of cardiovascular stress. We recorded heart and respiratory rates (number/min) from direct cardiac auscultation and observation of thoracic movements, rectal temperature (°C) with a thermocouple probe (ATT-450, Omega, United States), and arterial pH on an automated blood gas analyzer (ABL 3, Acid-Base Analyzers, Radiometer, Denmark). We limited handling time to 20-30 minutes. Because of darkness after they were processed, birds could not be released the same day. Although stressful to the captured birds, we kept eagles in total isolation in a shaded aviary to document any immediate post-capture mortality. For these 2 reasons, we released birds at the pursuit site 18 to 22 hours after capture. We fitted 11 captured steppe eagles with satellite-monitored backpack transmitters to determine post-release survival.

We compared mean capture time between the 2 sites using the Student *t*-test. We also tested the hypothesis that capture time was not influenced by body mass, relative mass of crop contents, mean air temperature, mean ground temperature, difference between mean air and ground temperatures, and mean wind speed during the capture procedure using linear regression (*F*-tests). For these tests, we used Minitab for Windows (McKenzie et al. 1995). All tests were bilateral, and significant threshold was set as 0.05.

During captures and handling, we followed animal welfare guidelines of the National Commission for Wildlife Conservation and Development, Riyadh.

Results

We successfully captured 48 steppe eagles in 52 attempts (92%). We abandoned chases when birds

Adult steppe eagle lying on the ground at the end of a pursuit. The bird pants and is unable to escape. It is still alert.

Table 1. Capture time (sec), body mass (g), and relative mass of crop contents (%) of wintering steppe eagles captured in 2 different localities of southwestern Saudi Arabia, 1996 and 1997.

Locality Capture parameters	Mean	SD[c]	Range	CV[d]
Site 1[a]				
Capture time	509	131.7	360–840	25.8
Total body mass	3,287	324	2,780–3,900	9.8
Relative mass of crop contents	6.38	4.16	1.00–15.38	65.2
Site 2[b]				
Capture time	247.7	109.3	90–420	44.1
Total body mass	3,445	436.2	2,750–4,200	12.6
Relative mass of crop contents	4.32	3.53	0.71–16.12	81.7

[a] $n = 21$
[b] $n = 27$
[c] SD = Standard deviation
[d] Coefficient of variation = $100\bar{x}$ SD / $\bar{x}$

were not captured after 15 minutes (n=4) because we presumed that longer chase could be detrimental to them. We captured 15 birds between 23 February and 7 March 1996 and 33 between 25 December and 21 February 1997. None of the birds presented any symptoms of cardiovascular collapse or medical indications that the level of stress was life-threatening. No eagles died immediately (<12 hr) from capture and handling. During pursuit, flight distance was always less than 100 m. After a short, straight flight, eagles curved away from the vehicle and tried to escape in an upwind direction. The chasing distances varied, but never exceeded 3,000 m in a straight line from the roosting or feeding site to the capture location. Body masses were within the range described for the species (Cramp and Simmons 1980).

Capture time was significantly longer at site 1 than at site 2 (t_{46}=7.50, P<0.001, Table 1). There was no significant effect of any of the climatic variables ($F_{1,46}$>0.52, P>0.470) or body mass ($F_{1,46}$= 2.3, P=0.140) on capture time. The difference in relative mass of crop contents between the 2 sites was not significant (t_{46}=1.85, P=0.080), and there was no significant effect of relative mass of crop contents ($F_{1,46}$=3.94, P=0.052) on capture time. For these reasons, the difference between sites could not be explained by the confounding effect of relative mass of crop contents in the 2 sites. Mean tracking period for the 11 radiotagged eagles was 175.6 days (range=44-364, SD=103.6 days). All satellite-tracked birds were alive until the last relocation, and this was assumed to correspond to minimum survival time. We recaptured 3 of the 48 banded birds (6.2%) using the same technique 12.5, 14, and 24.5 months later at the same site.

Discussion

During pursuit, it was important to drive as closely as possible to the steppe eagle, forcing it to make erratic flight maneuvers, which we could easily match. Eagles quit trying to escape when pushed to accomplish these exhausting maneuvers. After the eagle landed, it was crucial to quickly secure the bird, as birds would fly or run several dozen meters farther if missed. Once the eagle was running, pursuit by the observer was necessary but never lasted more than 30 seconds.

Capture rate was very high (92%) and demonstrated efficiency of the method. Although the 4 abandoned chases may have slightly biased the data, we found the level of disturbance caused by the prolonged chase unacceptable and abandoned the pursuit.

Difference in speed of capture between the 2 sites can be explained by differences in the terrain and density of trees. The trees limited the speed at which eagles could be chased, and undulating terrain allowed the birds to increase their speed when flying downhill. The very flat ground and lack of trees at site 2 allowed the capture team to stay close to the bird during the chase, to limit the bird's ability to maneuver, and to restrain it quickly once it had landed.

Although climatic variables did not significantly affect capture time, it has been suggested that chase duration is decreased when rainfall occurs shortly before or during chasing procedure as birds' plumage is overloaded with water (X. Eichaker, personal communication). As no rainfall occurred during or prior to the study, we could not test this hypothesis.

Capture of raptors by chasing may be considered stressful, and a study done on the golden eagle (*Aquila chrysaetos*) using helicopter and net-gun has stressed this point (O'Hara 1986). As the stress levels associated with other raptor capture techniques have never been evaluated, it is difficult to make comparisons. However, birds captured more quickly appeared clinically to suffer less exertional stress. Studies conducted on mallards (*Anas platyrhynchos*) and wild turkeys (*Meleagris gallopavo*) have demonstrated that amount of muscle damage and physiological stress inflicted during a capture attempt was related to the degree of struggling and exertion (Spraker et al. 1987, Bollinger et al. 1989, Dabbert and Powell, 1993). We suggest that eagles captured more quickly revealed less exertional stress and less muscular damage. Mean capture time in our study was less than 10 minutes and was comparable to helicopter pursuit of golden eagles (Ellis 1975). We observed no mortality during the 18-22 hours following capture, and 11 steppe eagles captured using this technique and fitted with satellite transmitters demonstrated a survival of at least 175 days following capture. Finally, 3 birds were recaptured, using the same method, more than one year after the study. Although we do not know survival of birds that were not captured with this technique, our data suggest that capture stress did not jeopardize post-release survival of the birds.

We tried to minimize degree of harassment we caused to the birds; further studies will have to critically quantify degree of physiological stress induced by similar techniques of capture.

Although this technique was very effective in catching wintering and migrating steppe eagles, its efficient use is limited to open desert and steppe habitats relatively free of obstructions. This technique does permit capture and recapture of selected individuals and may be useful for other large carrion-feeding raptors.

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Steppe eagle capture was a cooperative operation involving several National Wildlife Research Center staff members. Top row, left to right: Frédéric Lacroix, Michael Allen, Jean-Yves Cardona, Patrick Paillat; bottom row: Stéphane Hémon, Daniel Lenain, and Eric Bedin.

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