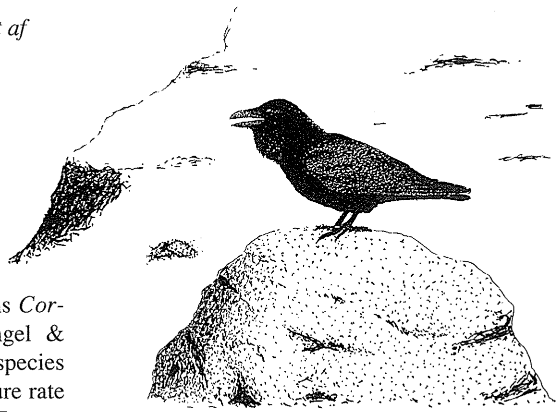
Capturing Common Ravens *Corvus Corax* in Greenland

MARCO RESTANI, RICHARD E. YATES, and JOHN M. MARZLUFF

(Med et dansk resumé: Ny metode til fangst af Ravne Corvus corax *afprøvet i Grønland)*



Introduction

Researchers have trapped Common Ravens *Corvus corax* using various techniques (Engel & Young 1989, Bub 1991), but in general the species has proven difficult to capture. Mean capture rate of 11 previous studies was <2 ravens/day. Factors reported to affect success included trap and bait type, a history of persecution, non-target interference of traps, and seasonal abundance of natural food. Wildlife managers also require an efficient method to capture ravens because human-raven conflicts are common and, in many areas, appear to be increasing (Salomonsen 1967, Larsen & Dietrich 1970, Knight & Call 1980, Skarphédinsson et al. 1990, Engel & Young 1992). Not only have ravens become pests at municipal landfills, feed lots, and airports, but some have depredated the nests and/or young of threatened and endangered species (e.g., Desert Tortoise *Xerobates agassizii*, U. S. Dep. Inter. 1989; Least Tern *Sterna antillarum*, Linz et al. 1992; Marbled Murrelet *Brachyramphus marmoratus*, Nelson & Hamer 1995).

In 1992 we initiated a study of Common Raven migration and foraging ecology in West Greenland which required that a large number of ravens be captured and ringed. Herein we describe in detail a safe and simple trapping technique which yielded very high success (5.5 ravens/day) during the short arctic summer. Also reported are daily and hourly capture rates, information unavailable in the literature, to assist further biologists and managers contemplating work on this species. Only one other published study has reported capture effort and success during the breeding season (Engel & Young 1989: 0.1 ravens/day), and none has occurred in the Arctic. Baseline morphological data of ravens trapped in Greenland are also included for comparative purposes.

Study area and methods

The study area was located in West Greenland, inland of Søndre Strømfjord (67°00'N, 50°42'W). See Burnham & Mattox (1984) and Feilberg et al. (1984) for detailed descriptions of study area topography and vegetation. Raven trapping occurred at the Kangerlussuaq (pop. 250) municipal landfill (elev. 30 m, 1.0 ha). The landfill was not staffed and refuse was unloaded near or over a steep erosional embankment from 0730-1700 hours, Monday through Saturday. Most refuse was ignited after dumping and every three weeks nonflammable materials were bulldozed into the ravine and covered with sand.

We captured ravens using a box trap (3.1 × 3.1 × 1.9 m) fitted with a manually operated, swinging door (Fig. 1). The three sides and roof of the trap were sections of chain-link fence wired together at the tubular frame ends. The door (3.4 × 1.6 m), a lighter piece of fence, was wired to the cross arm of the roof so it overlapped each side by 0.15 m. The sides and back wall were buried 0.3 m in sand to add structural strength. The door was propped open with a 2 m wooden stick (2 × 2.5 cm) which rested on a circular metal plate (diameter 0.3 m). A trigger cord tied to the bottom of the support stick was lightly buried with sand and strung approximately 12 m to a plywood blind (2 × 1 × 1.5 m). We erected the trap as close (<20 m) to the dumping area as possible while still keeping out of the way of landfill operations.

Fig. 1. Top: The trap used to capture Common Ravens at a landfill in West Greenland, 1993-1995. The photo was taken from inside the blind. Bottom: A raven approached and entered the trap minutes after the construction vehicle departed the area.
For oven den benyttede fælde fotograferet fra skjulet, og for neden en Ravn på vej ind i fælden.

The trap was baited each trapping day with 2-3 bags of garbage. Most was spread evenly inside the trap from the back wall up to within 1 m of the front door. Some garbage was strewn in front of the trap, but the area in the path of the swinging door was kept clean. Ravens appeared to favor high caloric foods (e.g., butter, pastries, meat, cheese), so these items were concentrated in the rear of the trap. We attempted to have the trap baited and a trapper hidden in the blind by 0600 hours, after which an observer departed the landfill in a vehicle, parking 750 m from the site. When all ravens feeding in the trap were at least 1 m from the entrance, preferably with their heads down or facing the rear, the trapper triggered the door by pulling forcefully on the cord. If ravens or non-target species (arctic fox *Alopex lagopus*, Glaucous Gull *Larus hyperboreus*) fed under the open door, we did not pull the trigger cord regardless of how many ravens were in the trap.

We fitted ravens with a Danish Zoological Museum aluminum lock-on ring on the right leg and a pop-rivet, alpha-numeric color ring on the left leg; the latter permitted identification of individual ravens from a distance. Ravens were assigned into rough age groups based on interior mouth color: all black (adults), mostly black (subadults), all pink (juveniles) (Kerttu 1973). Mouth color changes from pink to black with both increasing age and dominance status, which prevents accurately aging ravens older than juveniles (Heinrich & Marzluff 1992). However, we inferred age from mouth color and body plumage coloration and molt (Heinrich 1994) to permit comparisons to literature published before 1992. Each raven was weighed to the nearest 25 g and, in 1995, we also measured the unflattened right wing chord (mm). Ravens were ringed and measured inside the trap and released at the landfill within 20 minutes of capture.

Both observer and trapper counted the number of ravens at the landfill opportunistically during most trapping days ($\bar{x}$ = 2.1 counts/day, SE = 0.1, range 0 - 5). The trapper also recorded sightings of previously ringed ravens, noting the alphanumeric codes and time and date of observations. Each day the maximum number of ravens counted at the landfill at one time, by either observer or trapper, was designated the daily population index. We calculated daily capture success for 10-day periods by dividing the number of ravens caught by number of trapping days (1993-1995). Simple linear regression was used to determine if daily capture success correlated with the daily population index. We similarly calculated hourly capture success (2-hour blocks) and conducted the same test for a relationship between counts and success.

Tab. 1. Number (%) and age class of Common Ravens captured and ringed at a landfill in West Greenland, 1993-1995. Age inferred from mouth color and plumage coloration and molt (see Methods).
Antal (pct) af forskellige aldersklasser af Ravne fanget og ringmærket ved Kangerlussuaq, 1993-95. Alderen er bestemt vha. mundfarve og dragt- og fældningskarakterer.

		Age Class		
Year	Total	Adult	Subadult	Juvenile
1993	147	117 (80)	25 (17)	5 (3)
1994	138	107 (78)	22 (16)	9 (6)
1995	74	29 (39)	31 (42)	14 (19)
Total	359	253 (70)	78 (22)	28 (8)

Results

We captured and ringed 359 ravens from 1993 to 1995 (Tab. 1). More adult ravens and fewer subadults and juveniles were captured during 1993-94 than in 1995 (X^2_4 = 46.16, P < 0.01). Number of trapping days varied each year (9 June – 18 July 1993 [n = 14]; 16 June – 7 August 1994 [n = 29]; 25 June – 9 August 1995 [n = 22]), but capture effort (hours/day) was similar (1993: $\bar{x}$ = 5.1 [SE = 0.9]; 1994: $\bar{x}$ = 5.4 [0.5]; 1995: $\bar{x}$ = 4.0 [0.3]; $F_{2,62}$ = 2.13, P = 0.13). Although capture success (ravens/day) declined from 1993 (10.5) to 1994 (4.8) and 1995 (3.4) ($F_{2,62}$ = 6.49, P < 0.01), overall success was high for the 3-year study ($\bar{x}$ = 5.5 ravens/day [SE = 0.8], range 0 - 26, n = 65). Mean number of ravens captured per attempt was 3.7 (SE = 0.3, range 0 - 12, n = 95), and we averaged 1.5 (SE = 0.2, range 0 - 6, n = 95) attempts per day.

Daily capture success correlated with number of ravens counted at the landfill only in 1994 (1993: r^2 = 0.20, P = 0.31, n = 7; 1994: r^2 = 0.21, P = 0.02, n = 25; 1995: r^2 = 0.26, P = 0.12, n = 21). Raven numbers decreased during the study (1993: $\bar{x}$ = 83.7 [SE = 46.2], n = 7; 1994: $\bar{x}$ = 68.1 [7.6], n = 29; 1995: $\bar{x}$ = 41.8 [5.1], n = 22; $F_{2,55}$ = 2.42, P = 0.10), and this decline was significant from 1994 to 1995, years with a good sample of counts (t_{48} = 2.54, P = 0.01). The daily population index was a relatively poor predictor of capture success (r^2 = 0.50, P = 0.11, n = 6) (Fig. 2), and success varied during the summer season (r^2 = 0.12, P = 0.50, n = 6). Hourly capture success correlated with number of ravens counted at the landfill (r^2 = 0.51, P = 0.05, n = 8) (Fig. 3), but not with time of day (r^2 = 0.01, P = 0.92, n = 8).

Following capture and ringing, adult ravens took longer ($\bar{x}$ = 9.5 days [SE = 1.6], n = 63) to return to feed at the landfill than subadults ($\bar{x}$ = 3.7 [1.6], n = 23) and juveniles ($\bar{x}$ = 2.1 [1.2], n = 14) ($F_{2,97}$ = 4.18, P = 0.02). However, adults were just as likely to be reobserved as subadults and juveniles (X^2_2 = 3.98, P = 0.14); expected values for each age class were calculated from the total number of ravens ringed. Many (n = 78) ringed ravens were also observed feeding at the landfill 1-2 years post-capture. Over the course of the 3-year study, we retrapped 40 ravens the same year they were ringed. Adults (n = 19) were less likely to be retrapped than subadults (n = 5) and juveniles (n = 6) (X^2_2 = 5.25, P = 0.07); expected values calculated from total number ringed. An additional 10

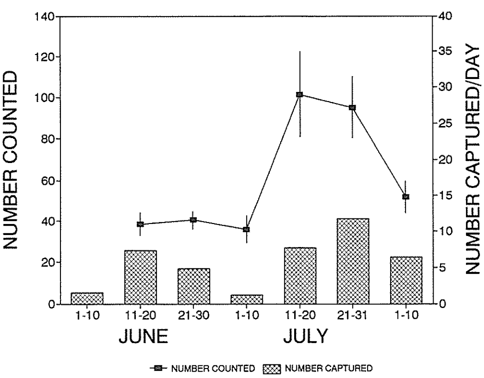


Fig. 2. Mean daily number (±1 SE) of Common Ravens counted and captured at a landfill in West Greenland, 1993-1995.
Antallet af Ravne fanget (søjler) hhv. talt i området (kurve) pr dag (gennemsnit over tidagesperioder i årene 1993-95).

ravens were retrapped at the landfill 1-2 years post-ringing.

Juvenile ravens weighed less ($\bar{x}$ = 1317 g [SE = 33.5], n = 25) than subadults ($\bar{x}$ = 1520 [15.9], n = 77), which weighed less than adults ($\bar{x}$ = 1607 [9.4], n = 248) ($F_{2,247}$ = 48.75, P < 0.01). Adults ($\bar{x}$ = 429.8 mm [SE = 3.7], n = 29) and juveniles ($\bar{x}$ = 429.2 [3.1], n = 11) had longer wing chords than subadults ($\bar{x}$ = 405.1 [4.4], n = 30) ($F_{2,67}$ = 12.08, P < 0.01).

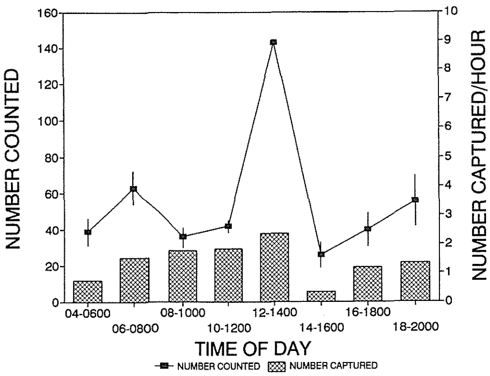


Fig. 3. Mean hourly number (±1 SE) of Common Ravens counted and captured at a landfill in West Greenland, 1993-1995. Error bar for 12-1400 removed for clarity. *Antallet af Ravne fanget (søjler) hhv. talt i området (kurve) pr time (gennemsnit over totimersperioder for hele sæsonen i alle årene 1993-95).*

Discussion

We had much higher capture success (5.5 ravens/day) than reported in the literature (review by Engel & Young 1989:5) and attributed this to several factors. First, many ravens fed at the landfill and increasing counts during July suggested an influx of trap-naive individuals, presumably dispersing juveniles and nonterritorial adults. Second, baiting ravens with small rather than large, cacheable pieces of garbage forced them to feed inside the trap; this attracted other hungry ravens through local enhancement. The careful distribution of bait also concentrated ravens either deep within the trap or away from the swinging front door. Third, use of a manually operated door prevented non-target species from fouling the trap, a problem common to other methods (e.g., leghold traps). In fact, we encouraged foxes and gulls to feed in or near the trap because they often attracted ravens. Last, ravens displayed little wariness to unnatural objects (e.g., furniture, metal barrels) dumped at the landfill and quickly habituated to the trap and blind, which were deliberately placed near the unloading area (Fig. 1).

Two behavioral responses of ravens to capture merit discussion. Adult ravens appeared to be more sensitive to handling than the younger age classes. Although each age group revisited the landfill with equal probability following ringing, it took longer for adults to return to the site and fewer were retrapped. Some local ravens also became trap wary. Between mid-June and early July the number of ravens counted at the landfill remained constant, yet we experienced a steady decline in capture success (Fig. 2). Not until raven numbers increased in mid-July did success improve. In general, however, despite being handled, ravens continued to frequent the trap site – 40 were retrapped at the landfill the year they were ringed and over 100 were reobserved.

Some researchers have speculated that ravens avoided traps (Engel & Young 1989) and feeding on the ground (Kilham 1985) because of past and ongoing persecution. Ravens in Greenland are heavily persecuted (Salomonsen 1967) and local bounties continued until the end of 1995. We have received 28 recoveries – 93% killed by shooting – and shooting occurred at the landfill during this study, yet capture success remained high. Shooting also accounted for most recoveries in Nova Scotia where Coldwell (1972) caught a mean 4.2 ravens/day. Therefore, a combination of factors (e.g., trap and bait type, availability of alternative food) likely reduced trap success in other studies and future emphasis on the effect of persecution is unwarranted.

Availability of natural food and breeding season events indirectly lowered capture success by reducing the number of local ravens. Few ravens fed at the landfill in June at the height of the breeding season, but numbers doubled in mid-July and capture data revealed that some of this increase was due to juvenile immigration (Restani et al., unpubl.). Both counts and capture success dropped from peaks in mid-July after the hunting season opened on 1 August. Large groups (>50) of ravens then fed on the widely dispersed remains of hunter-killed muskoxen *Ovibos moschatus* and caribou *Rangifer tarandus*. Finally, during a single winter before our study began, managers of the nearby airport caught and killed over 300 ravens at the landfill (T. Jensen, pers. comm.). Taken together, if these seasonal events in West Greenland are typical, then capture success at arctic landfills should be highest in late summer and winter (limited alternative food, many ravens), and lowest in late spring and early autumn.

Each day ravens from a nearby communal roost first arrived at the landfill between 0400-0430 hours. They fed undisturbed until either the first capture attempt or until the first vehicle arrived, usually at 0900 hours. Human activity at the landfill kept ravens from feeding near the trap and decreased capture success. The timing of this disturbance was fairly predictable, so we concentrated trapping efforts in early morning, at mid-day, and after 1700 hours.

In summary, researchers and managers planning to capture Common Ravens in human-altered, arctic landscapes can expect good success during late summer (this study) and winter (Salomonsen 1967). Success during winter will be greater than that in summer, but trapping should occur when the likelihood of marking or controlling specific age groups, determined by study objectives, is highest. For example, we found juveniles easiest to capture in late summer, shortly after dispersal from natal areas, whereas other evidence suggested that adult ravens frequent landfills mostly during winter.

Acknowledgments

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Resumé

Ny metode til fangst af Ravne *Corvus corax* afprøvet i Grønland

Forskellige metoder har i tidens løb været anvendt for at fange Ravne *Corvus corax*, men oftest med ringe held (gennemsnitlig fangstrate i 11 tidligere studier var <2 Ravne/dag). Her beskrives en ny metode, benyttet i forbindelse med ringmærkning af Ravne på lossepladsen ved Kangerlussuaq (Søndre Strømfjord) flyveplads i Grønland (67°00'N, 50°42'W) i 1993-95, hvor vi opnåede en fangstrate på 5,5 Ravne/dag – den højeste, der hidtil er rapporteret.

Fælden er afbildet på Fig. 1. Svingdøren på forsiden udløstes manuelt via en snor fra et skjul ca 12 m fra fælden. Som lokkemad anvendtes affald spredt foran og inden i fælden, dog ikke i området lige foran og inden for svingdøren. I alt fangedes her 359 Ravne (Tab. 1). På trods af fangst- og mærkningsaktiviteterne blev Ravnene ved med at opsøge lossepladsen i stort tal, og mange af de mærkede fugle blev genset efter kortere eller længere tid. Adulte Ravne syntes dog at reagere stærkere på håndteringen end de yngre aldersklasser (vendte tilbage til stedet senere og genfangedes relativt sjældnere).

Fangstraten såvel som antallet af Ravne på lossepladsen toppede med.-ult. juli og faldt igen kort efter 1. august, hvor jagten på moskusokse og rensdyr startede, og Ravnene begyndte at fouragere på resterne af de nedlagte dyr spredt over store områder.

Faktorer, der bidrog til den høje fangstrate, var det store antal Ravne, der frekventerede lossepladsen; brugen af små stykker lokkemad, som fik Ravnene til at æde inde i fælden og derved tiltrække artsfæller, mens de formodentlig var fløjet bort med større stykker; den manuelle udløsning af fælden, så fangst af uønskede arter (polarræv *Alopex lagopus*, Gråmåge *Larus hyperboreus*) blev undgået; og stedets karakter, med mange unaturlige genstande ud over fælden (møbler, tønder m.v.). Forhold, der hæmmede fangsten, var tilstedeværelsen af anden føde end lokkemaden og menneskers besøg og arbejde på stedet. Forfølgelse, lokalt eller mere generelt, synes derimod ikke at påvirke fangst af Ravne, skønt dette ofte hævdes i litteraturen.

Kombineret med andre data, f.eks. om Ravnens årstidsbestemte vandringer, tyder vore resultater på, at fangst af Ravne ved arktiske opfyldningspladser i forsknings- eller forvaltningsøjemed vil have størst succes sent på sommeren og om vinteren.

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Marco Restani, Department of Biology, Utah State University, Logan, UT 84322-5305, USA

Richard E. Yates, P. O. Box 383, West Glacier, MT 59936, USA

John M. Marzluff, Sustainable Ecosystems Institute, 30 East Franklin, Suite 50, Meridian, ID 83642, USA

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