J. Field Ornithol. 74(2):187–192, 2003

Trapping White Ibises with rocket nets and mist nets in the Florida Everglades

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Received 30 April 2002; accepted 19 September 2002

ABSTRACT. We lured White Ibises (*Eudocimus albus*) to trap sites with decoy plastic flamingos and captured them with a rocket net or mist nets. Our ability to attract ibises to a site (and consequently our capture success) was affected by vegetation height and water depth but not by decoy numbers or their arrangement. Both the rocket net (37 ibises) and mist nets (97 ibises) caught birds. The number of birds captured per day was the same for both methods, but the rocket net trap captured more birds per set than did mist nets. Because mist nets were easy to reset we captured 1–2 birds per set multiple times in one day with mist nets. We preferred mist nets over rocket net traps because mist nets allowed for shorter bird processing times, greater ease of set up, and fewer safety considerations for transport and operation of the trap. Also, rocket nets required more equipment and expense. Although we discouraged other species from landing at a trap site, there was evidence that these techniques may also be useful for capturing other wading birds.

SINOPSIS. **Captura de cigueñas (*Eudocimus albus*) con redes de cohetes y redes de niebla en la Florida**

Atraimos cigueñas (*Eudocimus albus*) a lugares particulares utilizando señuelos de flamencos para atraparlas con redes de cohetes y con redes de niebla. Nuestra habilidad para atraer las aves a ciertas localidades fue afectada por la altura de la vegetación, la profundidad del agua, pero no así por el número de señuelos y el arreglo de estos. Se atraparon 37 individuos con red de cohetes y 97 con las de niebla. El número de aves atrapadas por dia fue similar para ambos tipos de redes. No obstante, la primera permitió más aves por conjunto de estas. Dado el caso de que las redes de niebla son más fáciles de rearreglar capturamos de 1–2 aves por conjunto de puesta. Preferimos utilizar las redes de niebla ya que estas permiten el procesar estas más rapidamente, son más fáciles de montar y necesitan menos consideraciones de cuidado para transportarlas y operarlas. Por otro lado las redes de cohetes requieren más equipo y experiencia. Aunque virtualmente evitamos a otras especies, la técnica de captura parece ser adecuada para otras especies vadeadoras.

Key words: capture, ciconiiformes, colonial waterbird, decoy, wetland

Most efforts to capture long-legged wading birds have involved trapping at the nest (Frederick 1986; Jewell and Bancroft 1991; DeSanto et al. 1997). Although nest sites are often a dry and reliable place to find adult birds, trapping on the nest and repeated visits to wading bird colonies may have adverse effects on nesting success (Jewell and Bancroft 1991) and consequently may bias reproductive and population studies. Additionally, nest-trapping techniques limit researchers to capturing only incubating or brooding birds. Thus, studies of non-breeding birds, flighted juveniles, or breeding birds in other stages are limited.

Capturing wading birds away from their nests can be difficult because it is hard to predict where a bird will be and when it will be there. In the past, rocket nets have been used to capture large wading birds such as Great Blue Herons (*Ardea herodias*; Parris 1977) and Wood Storks (*Mycteria americana*; L. Bryan, pers. comm.) at foraging sites. Mist nets have been used at foraging (Rojas et al. 1999) and watering (Bateman 1970) sites near colonies to capture Scarlet Ibises (*Eudocimus ruber*), White Ibises (*Eudocimus albus*), and Cattle Egrets (*Bubulcus ibis*; Bateman 1970; Rojas et al. 1999). Aside from the Wood Stork study, neither of these techniques have been consistently successful because it is difficult to repeatedly attract birds to a specific site (Bateman 1970) and birds often become wary of nets that are repeatedly set at the same site (Bateman 1970; Parris 1977).

We developed a reliable, portable, and safe method of capturing White Ibises away from nests using a rocket net or mist nets. In this paper, we describe the lure arrangement and environmental variables that affected trap success,

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and compare the safety, efficiency, expense, and ease of use of rocket nets and mist nets.

METHODS

Study area and trap site selection. In January–June 1999–2001, we captured White Ibises in Everglades Water Conservation Areas (WCAs) 1, 3A and 3B (Broward, Dade, and Palm Beach Cos., Florida). These areas are flat, seasonally inundated freshwater marshes dominated by extensive stands of sawgrass (*Cladium jamaicense*) and cattail (*Typha angustifolia*). We set traps at sites 1–3 km away from ibis roosts or colonies, and captured birds as they moved from these sites to foraging areas between sunrise and 10:00. Trapping in the early morning hours avoided heat stress to the birds, and birds responded best to the decoys in low light conditions.

Factors affecting trapping success. Ibises were lured to trap sites with white plastic flamingos (Crozier and Gawlik 2003) supported by 1-m long steel wire legs (Union Products, Leominster, MA; Cat. No. 77280 Snomingos). We placed 30–40 decoys in the trap site for at least one day before any trap attempt. We recorded number of days the decoys were at the site, decoy number, approximate area covered by decoys, water depth, vegetation height, time between trap set and first White Ibis arrival, additional bird species that landed with the decoys and their length of stay. We estimated the decoy area as the farthest distance between two decoys (length, mean = 6.1 m ± 1.7) multiplied by the distance between the two most distant decoys perpendicular to the length measurement (width, mean = 4.3 m ± 1.6). To estimate density, we divided the number of decoys by the area.

Trapping techniques. *Rocket net.* The rocket net was a 17.4 m × 12.9 m black, waterfowl-pigeon-dove net with 4.5 cm mesh (Wildlife Materials, Carbondale, IL). We initially deployed the net from a trapezoid wooden box (Wunz 1987; Eriksen et al. 1993; King et al. 1998) supported by three 10 × 45 × 5 cm wooden legs, but birds often escaped from the opening net or by running underneath the extended net where it was supported by marsh vegetation (Heath 2002). After four unsuccessful attempts, we flattened vegetation around the decoys, and placed the net on a supporting platform (Cox and Afton 1994) that allowed the net to be partially extended before it was fired (Fig. 1). The platform consisted of seven overlapping corrugated-plastic roofing panels (1 m × 3 m) placed on marsh vegetation. To prepare the net for deployment from the platform we folded it on to itself in 75-cm widths beginning at the net's anchored edge (Heath 2002). The vegetation density and surface area of the plastic sheets was enough to support the net and keep it above water.

Rockets were placed in three launchers constructed from 180-cm 3-angle steel fence post with two 15-cm steel pipes welded perpendicular to the post at 100 cm and 135 cm, respectively. The launchers were placed into the ground at varying depths, depending on the substrate, and angled slightly above horizontal (Fig. 1). An insulated firing wire was spliced in series for attachment of the rockets and wound once around each post to prevent it from being deployed with the net. We fired the charges with a 12-volt motorcycle battery connected to a toggle switch and a 35-m insulated copper electrical line (Wildlife Materials, Carbondale, IL). We fired the net from an airboat approximately 25 m away from the trap, and only after the bird (or birds) landed at the decoys and there were no birds circling in the area. Sometimes sparks from the rocket launchers ignited small, easily extinguished fires.

Mist nets. We placed two 3 m × 12 m, 5-panel mist nets with 100 mm mesh size (Avinet Inc.) in a V shape around plastic decoys (Fig. 1). The net's bottom edge was at least 30 cm above the water. The nets were supported by three aluminum poles (height 3.06 m). Each pole was anchored by two guy lines and concrete weights (8 kg), and inserted into a 1.5-m length of conduit placed into the muck for added support. If birds were not retrieved immediately after they contacted the net they would escape.

Analyses. We categorized trapping attempts as either successful or unsuccessful (i.e., a successful attempt was one or more birds trapped) and used a multivariate analysis of variance (Manly 1994) to compare lure characteristics (decoy number, decoy density) and environmental conditions (water depth, vegetation height) between successful and unsuccessful sites. The data met test assumptions (e.g., normality). We combined results from mist net

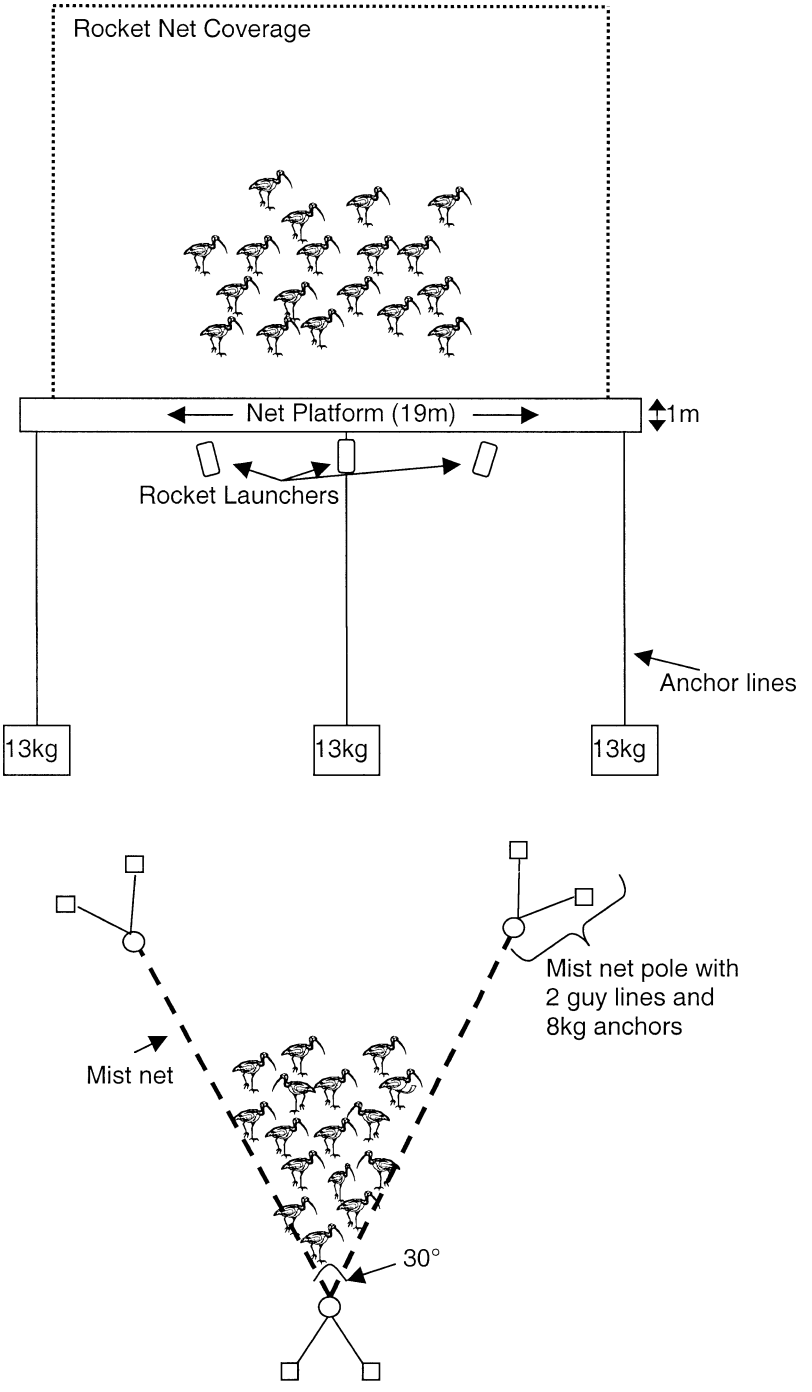

Fig. 1. Rocket net trap (top) including placement of platform, decoys, net, and anchor lines, and mist net (bottom) configuration with decoys and guy lines to anchors. These traps successfully captured White Ibises in the Florida Everglades.

Table 1. MANOVA table for variables that affected White Ibis trapping success in the Florida Everglades. Successful sites, $N = 16$; unsuccessful sites, $N = 17$. "*" indicates a significant effect ($\alpha = 0.05$).

Source	df	*SS*	*F*	MANOVA *P*
ANOVA: Water depth				
Trap success	1	111.385	4.74	0.0372*
Error	31	728.814		
ANOVA: Vegetation height				
Trap success	1	4514.214	4.75	0.0365*
Error	31	29294.801		
ANOVA: Number of decoys				
Trap success	1	0.018	0.00	0.9838
Error	31	1397.496		
ANOVA: Decoy density				
Trap success	1	0.522	0.66	0.4230
Error	31	24.546		

MANOVA: water depth, vegetation height, number of decoys, and decoy density

Source	Wilk's λ	*F*	Num df	Denom df	*P*
Trap success	0.75695631	2.2476	4	28	0.0893

and rocket net attempts because trapping success was not significantly affected by trap type (all interaction terms $P > 0.05$). To avoid problems of non-independent samples we only used the first trapping event at any one location for analysis. We used a *t*-test, or Wilcoxon Signed Rank test to examine differences between rocket net and mist net set characteristics. All descriptive statistics are reported as mean ± standard error. Statistical analyses were done with SAS software.

RESULTS

Factors affecting trap success. The decoys were successful in attracting seven wading bird species: White Ibises, Snowy Egrets (*Egretta thula*), Cattle Egrets, Glossy Ibises (*Plegadis falcinellus*), Great Egrets (*Ardea albus*), Tricolored Herons (*Egretta tricolor*), and juvenile Little Blue Herons (*Egretta caerulea*) for an average stay of 3.41 (±2.87) minutes. We vocally discouraged all birds that were not White Ibises from landing with the decoys when the mist nets were set.

We captured 134 White Ibises using either rocket or mist nets. Decoy number and density had no significant effect on trap success, but water depth and vegetation height did affect trap success (Table 1). White Ibises were more likely to be trapped in shallow water (water depth = 10.5 ± 0.67 cm, successful vs. 17.1 ± 1.85 cm, unsuccessful) with low vegetation height (vegetation height = 25.6 ± 5.14 cm, successful vs. 49.0 ± 9.18 cm, unsuccessful). Additionally, birds arrived more quickly to shallow water trap sites than deep ones ($r_s = 0.423$, $P = 0.0175$).

Trapping techniques. The maximum number of birds we captured with one rocket net set (or day) was 13. The maximum number of birds we caught with one mist net set was three and in one day of mist netting was five (four sets). On average we caught a similar number of birds per day using either method (1.78 ± 0.7 rocket net; 1.27 ± 0.1 mist nets; Wilcoxon 2-sample $S = 948.0$, $P > 0.8$).

Preparing rocket net traps took significantly more time than mist net traps (Table 2). Because mist nets were easy to reset, we were able to set many more mist net traps per day than rocket net traps (2.24 ± 0.1 vs. 1.52 ± 0.1, respectively). Rocket nets took almost 30 min to reset, and we were not able to reset the net at all if we were using the box technique because the wet net was too heavy to deploy properly from a completely folded arrangement.

Table 2. Comparison of preparation and clean-up times, and capture rates, of two trapping techniques used to capture White Ibises in the Florida Everglades (mean ± 1 SE). Costs represent 1998 prices for a whole set, including net and platform for rocket netting, and two nets and three poles for a mist net set.

Trap	No. days	No. sets	Set/day	Time to prep 1st set (min)[a]	Time to prep other sets (min)	Total clean time (min)	No. White Ibis trapped	White Ibis trapped/day[b]	Cost (US$)
Rocket net	19	29	1.52 ± 0.1	35 ± 2.0	27 ± 1.1	35 ± 3.4	34	1.78[c] ± 0.6	$2000
Mist net	78	174	2.24 ± 0.1	26 ± 1.0	8 ± 0.4	21 ± 0.8	97	1.25 ± 0.1	$500
Total	101	207	2.05 ± 0.1	28 ± 1.0	10 ± 0.7	24 ± 1.0	134	1.33 ± 0.1	

[a] For descriptions of time to prep first set, time to prep other sets, and total clean time, set text.
[b] ± 1 SD.
[c] Mean changes to 1.16 ± 0.25 when removing the day with 13 birds caught.

Rocket net traps also took more time to clean up than mist nets (Table 2).

Ibises rarely escaped once they contacted the net (six of 103 escaped). We arrived to mist nets less than 2 min after ibises contacted the net. More often, ibises seemed to see and avoid the net. Of the 347 birds that approached the nets, 97 were captured (28%). Most birds (68%) were trapped on the outside of the 'V' set. Even with large mesh-size nets, ibises were rarely entangled in the nets. Instead, they were 'bagged' in a net panel hanging over a stiff trammel line. Thus, it was important to set appropriate distances between tiers in the mist nets and maintain tight trammel lines, creating enough "bag" for ibises to get caught. Once a bird was caught in the mist net no other birds would approach the area until the bird was removed.

Five captured ibises (three with a rocket net, two with mist nets) were entangled and struggled in surface water. These birds were too wet to fly after processing, but could fly after being isolated for approximately 45 min in a recovery box. To prevent birds from getting too wet, we attempted to trap in areas that had enough vegetation to support the rocket net, and we avoided trampling vegetation under mist nets. No birds sustained permanent injuries or died by either method.

DISCUSSION

Factors affecting trap success. We found that if environmental variables were favorable, birds responded to decoys regardless of how long the lures had been in place. We captured birds up to 17 d after the decoys had been set and repeatedly lured ibises to a site in a manner that the birds quickly attempted to land with the decoys regardless of trap equipment. Crozier and Gawlik (2003) recently reviewed the effectiveness of three decoy types in attracting birds to a particular location. They found that plastic flamingos and stuffed bag decoys were more successful than two-dimensional decoys made from plastic sheets (Crozier and Gawlik 2003). The decoys in our study may have been effective because they were realistic and/or three-dimensional compared to cloth decoys used in past lure and trapping studies (Bateman 1970). Decoy number and density had no effect on capture success. However, because our ultimate goal was to capture birds, both of these variables were constrained by the size area covered by the trapping techniques. Further research that investigates a greater range of decoy numbers or density might produce different results.

Ibises arrived sooner and were more likely to be captured at sites with low water levels and short vegetation. White Ibises might select shallow drying areas where prey items are concentrated (Gawlik 2002). Fast arrival and landing, which occurred most often in shallow areas, probably increased our trap success with mist nets because birds seemed less likely to see the mist nets if they did not circle the decoys before landing.

Trapping techniques. We found that using either capture technique was efficient and reliable. Mist nets were easier to use, cheaper, weighed less, took less time to set and clean up, and were safer than rocket nets (Heath 2002). We could capture more birds at one time with a rocket net, but because reset times were consistently lower for mist nets, the latter method

was better for multiple captures of a few birds in a given day. These methods may also be useful for capturing other species of wading birds as evidenced by the individuals from six other species of water birds that landed among the decoys (five of which were captured in mist nets).

No birds were injured or killed with these techniques, and results from radio-telemetry indicate that ibises we captured and handled did not abandon reproductive attempts after capture (Heath 2002). Other researchers who have used rocket nets reported drowning (Cox and Afton 1994) or collision with the net or rocket (King et al. 1998) as causes of injury or death. In addition, indirect factors such as large numbers of birds captured at one time with a rocket net may have adverse effects. Studies of ducks trapped by the hundreds show that prolonged entanglement in the net and handling times may cause muscle myopathy (Dabbert and Powell 1993) or decreased survival (Cox and Afton 1998).

ACKNOWLEDGMENTS

We thank P. Epanchin, E. Fenichel, P. Fontaine, S. Wright, M. Ruane, R. Hylton, and C. A. Lott for their help in designing and constructing successful traps. K. Bildstein's, C. A. Lott's, and an anonymous reviewer's suggestions improved the manuscript. Financial support was provided by the Army Corps of Engineers. This is Florida Agricultural Experiment Station Journal Series Number R-08984.

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