J. Field Ornithol., 69(3):466–473

DIGITAL PLAYBACK AND IMPROVED TRAP DESIGN ENHANCES CAPTURE OF MIGRANT SORAS AND VIRGINIA RAILS

GREGORY D. KEARNS
Maryland National-Capital Park and Planning Commission
Patuxent River Park, 16000 Croom Airport Road
Upper Marlboro, Maryland 20772 USA

NINA B. KWARTIN[1]
Marine-Estuarine-Environmental Sciences Program
University of Maryland
College Park, Maryland 20742 USA

DAVID F. BRINKER
Maryland Department of Natural Resources
580 Taylor Avenue
Annapolis, Maryland 21401 USA

G. MICHAEL HARAMIS
U.S. Geological Survey
Patuxent Wildlife Research Center
11410 American Holly Drive
Laurel, Maryland 20708 USA

Abstract.—We used playback of rail vocalizations and improved trap design to enhance capture of fall migrant Soras (*Porzana carolina*) and Virginia Rails (*Rallus limicola*) in marshes bordering the tidal Patuxent River, Maryland. Custom-fabricated microchip message-repeating sound systems provided digitally recorded sound for long-life, high-quality playback. A single sound system accompanied each 30–45-m long drift fence trap line fitted with 1–3 cloverleaf traps. Ramped funnel entrances improved retention of captured rails and deterred raccoon (*Procyon lotor*) predation. Use of playback and improved trap design increased trap success by over an order of magnitude and resulted in capture and banding of 2315 Soras and 276 Virginia Rails during September and October 1993–1997. The Sora captures more than doubled the banding records for the species in North America. This capture success demonstrates the efficacy of banding large numbers of Soras and Virginia Rails on migration and winter concentration areas.

EL USO DE GRABACIONES DIGITALES Y LA MEJORA DE DISEÑO DE TRAMPAS MEJORA LA CAPTURA DE INDIVIDUOS MIGRATORIOS DE *PORZANA CAROLINA* Y *RALLUS LIMICOLA*

Sinopsis.—Utilizamos tanto grabaciones de vocalizaciones como cambios en el diseño de trampas para mejorar la captura de *Porzana carolina* y *Rallus limicola* migrando en otoño por las ciénagas que bordean las margenes del Río Patuxent en Maryland. Sistema de repetir mensajes de sonido a base de microprocesadores fabricados justo para este proyecto proveyeron sonidos grabados digitalmente capaces de repetirse por largos períodos sin perder su buena calidad. Un equipo de sonido acompañó cada 30–45 m de líneas de trampas de verja movible ajustados con 1–3 trampas en forma de trébol. Las entradas con rampas mejoraron la retención de aves capturadas e impidieron la depredación por individuos de *Procyon lotor.* El uso de grabaciones y el diseño mejorado de las trampas mejoró el éxito de las trampas por sobre un órden de magnitud y resultó en la captura y anillaje de 2315 individuos

---

[1] *Current address: 9908 Chase Hill Ct., Vienna, Virginia 22182 USA.*

de *Porzana carolina* y 276 individuos de *Rallus limicola* entre septiembre y octubre del 1993–1997. Las capturas de *Porzana carolina* pasaron del doble de las capturas para la especie en Norte América. Este éxito en la captura muestra la eficacia de anillar grandes números de *Porzana carolina* y de *Rallus limicola* en lugares donde se concentran durante la migración y el invierno.

The nearly complete lack of information on the movements, survival, population trends, and harvest of Soras (*Porzana carolina*) (Melvin and Gibbs 1994, 1996) and Virginia Rails (*Rallus limicola*) (Conway and Eddleman 1994) underscores the need for development of methods to capture and band large numbers of these birds. Capturing rails is made particularly challenging by the elusiveness of the birds and the often impenetrable emergent marsh habitat they occupy. For example, in the exceptional fall migratory stopover habitat of the tidal Patuxent River, Maryland, wild rice (*Zizania aquatica*), bur-marigold (*Bidens laevis*), narrow-leaved cattail (*Typha angustifolia*), smartweeds (especially *Polygonum arifolium*), and spotted jewelweed (*Impatiens capensis*) commonly reach heights of 2 to 4 m, making trapping efforts labor intensive. Trap lines must be cleared through marsh vegetation, and walkways of wood pallets or other materials must often be used to service traps on soft marsh sediments. Our initial attempts at capturing rails using two-celled Seth Low traps (Low 1935, Stewart 1951) and attached 30–45 m length of drift fence met with limited success: 35 Sora and 2 Virginia Rail captures in five fall seasons of variable effort, 1987–1991.

In 1993, we experimented with tape playback of Sora and Virginia Rail calls to enhance capture success. Although Soras and Virginia Rails are vocal and respond to playback during the breeding season (Glahn 1974, Johnson and Dinsmore 1985), it was unknown if an audio broadcast would lure fall migrants to drift traps. A tape-loop recording of 40 s of Sora calls ("keek," "ker-wee," and "whinny"), followed by 20 s of Virginia Rail calls ("kiddick" and grunts), followed by a minute of silence, improved capture success markedly. However, tape cassette playback equipment was unable to cope with the heat and moisture of the marsh: tapes often broke, and the quality of sound reproduction decreased rapidly with continued use. Also, tape drives ran continuously and thus were a constant drain on power even when calls were not being broadcast. The units also lacked an automatic turn-on feature, requiring predawn visits to activate.

Because of the inadequacies of cassette players, we contracted fabrication of specially designed sound equipment with two local vendors: R. Dorfman, Dorfman Museum Figures, Inc., Ellicott City, Maryland and J. Kodak, Astrotronics, Inc., Lanham, Maryland (use of manufacturer's name does not imply government endorsement). The heart of the new units was the message repeater, a solid state microchip that could be digitally programmed with an audio message. Thus, rail calls could be recorded on solid state circuitry for long-term, high quality playback. We included two additional features in the design: a playback delay capability to adjust the off time between playings from 1–10 min, and a 24-h timing

FIGURE 1. Winter photo of trap line in tidal marsh showing walk-in traps with drift fencing running between the traps (top and bottom center), and sound system with solar panel and speaker (upper left). (inset) Digital playback equipment including amplifier, microchip message repeaters (near center) and timing units (upper right) in weather-proof housing.

circuit to provide programmable turn-on capability for the following day. All electronics, including amplifier and timing circuits, were packaged together in a weather-proof unit (Fig. 1). We used 15 watt, 8 ohm outdoor speakers and power was provided by a 12 vdc, 60 amp deep cycle wet cell battery charged by a 14 watt solar panel. Cost of each completed sound unit was about U.S. $700.

In our initial attempts to capture rails, we adopted Seth Low (Low 1935) cloverleaf traps, as modified by Stewart (1951, 1954) for use with Clapper Rails (*Rallus longirostris*) (see trap details in Meanley 1969:103). We fabricated the cloverleaf section of the trap from 61-cm high, 2.5-cm-mesh galvanized welded wire, except for the top which was 2.5-cm-mesh poultry wire. Following Stewart's design, we fashioned cloverleaf funnel entrances from 2.5-cm-mesh poultry wire and used a 1.3-cm-mesh hardware cloth ramp from which rails would enter and drop into the catch box. Each trap line consisted of one sound system, 1–3 traps, and 30–45 m of drift fence. Trap lines were always placed perpendicular to tidal creeks or main river shorelines and extended from the edge of vegetation 45–60 m into the marsh.

In using Stewart's trap, we noticed that many Soras would escape through the ground funnels and others were adept at climbing up the wall of the catch box and exiting the ramp. We also encountered difficulty with raccoons (*Procyon lotor*) that pushed through the flexible poultry wire funnels, lured by trapped rails and fish that were captured on high tides. To better contain trapped rails, as well as deter raccoons, we developed a ramped, tubular-funnel entrance that was made of more rigid 1.3-cm-mesh hardware cloth (Fig. 2). We elevated entrances about 7 cm in the cloverleaf section of the trap and about 15 cm in the catch box section. The funnel dimensions and elevation were critical in preventing rails from escaping. We also increased the effectiveness of our 2.5-cm-mesh poultry wire drift fencing by increasing its height from 45 cm to 60 cm, thus making it more difficult for the rails to climb over.

The improved trap design with playback feature was used with increasing effort from 1993–1997. Traps were serviced twice a day, mid-morning and late afternoon. Under unusually high water or rainy weather conditions, trapping would be terminated early in the day. All playback recordings were run for 1 min with either a 1 or 2 min delay between playings. Typically sound systems were activated from dawn to late afternoon, or 6–10 h maximum use per day. Although sound systems were generally highly reliable, our most common problem was balancing power consumption with solar panel charging capability under variable sunlight conditions. An activated sound system drew about 250 ma and our solar panels provided 1000 ma charge capability under optimum light conditions. This charge capability was generally sufficient to sustain power supply under normal operating conditions, but frequent failures occurred under protracted cloudy conditions with poor solar panel charging performance. This necessitated removal and recharging of the batteries. Another frequent problem leading to system failure was poor electrical connections caused by a highly corrosive moisture and temperature environment in the marsh. Care should be given to provide weather protection and frequent inspection of all electrical connections to maintain reliable sound systems in the field.

Our improved methods resulted in markedly more captures of Soras and Virginia Rails than in our early trapping attempts (Table 1). A comparison of capture success based on trapping effort (Table 2) reveals that the improved trap design with audio lure increased the combined mean annual capture rate of Sora and Virginia Rails by a factor of 8.8, 10.6, or 13.6 based on the total number of traps (trap-days), length of drift fence (m drift fence-days), or number of trap lines (trap line-days), respectively. The close similarity in these capture rate ratios indicates that the trap line configurations (i.e., the length of fence used per trap on each trap line) were relatively consistent over the years. Our greatest trapping success occurred during the September peak trapping period in 1995, the year of our highest number of captures (753 Soras and 82 Virginia Rails). During this period our five best trap lines captured 621 Soras in 40 d, an average of 15.5 Soras/d or about 3/trap line/d. Our highest daily catch was 61 Soras. Most captures (64%) occurred in early morning; the remaining 36% occurred in late afternoon. Trap success was highly depen-

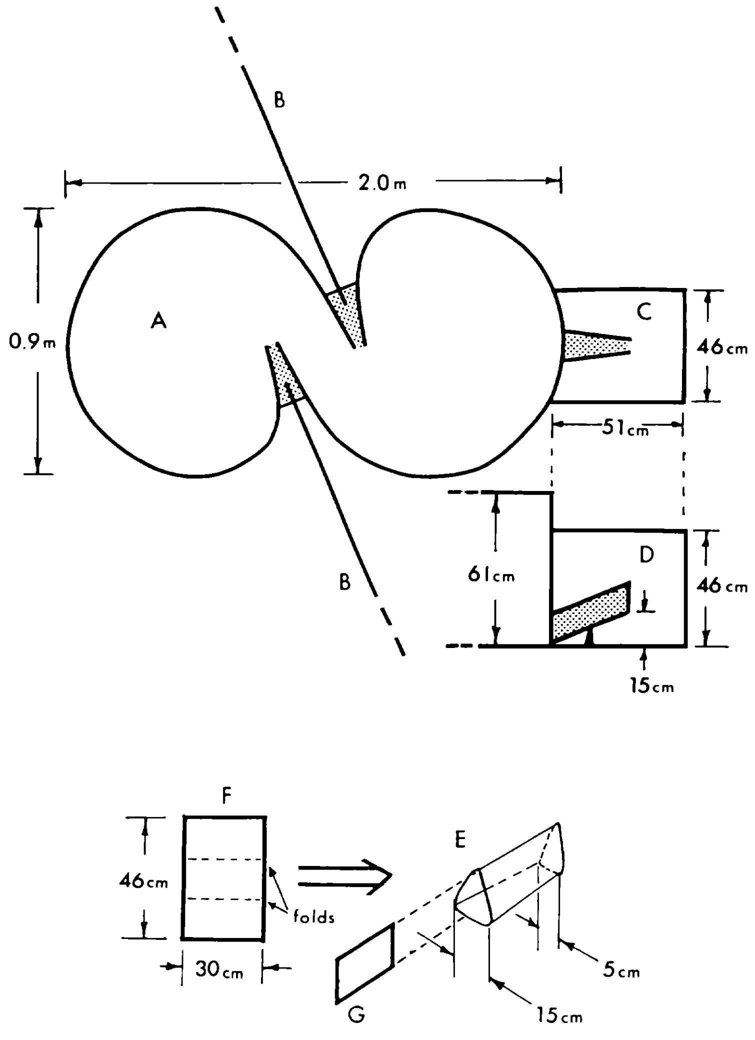

FIGURE 2. Top view of trap showing cloverleaf section (A), drift fence leads (B), funnels (stippled), and catch box (C). Side view of catch box (D) shows elevated funnel entrance. Funnels are elevated 15 cm in the catch box and 7 cm in the cloverleaf section. Funnels are a tapered triangular tube (E) formed from folding a rectangular piece of 1.3-cm-mesh hardware cloth (F). Baffle (G) is a hardware cloth panel inserted 13 cm into the center of each cloverleaf funnel to separate entrances on either side of the drift fence.

dent on water level in the marsh with the best captures occurring at low tides when the rails were more mobile on the marsh surface. The best trapping occurred when tide cycles produced two daily low tides, one in early AM and one in late PM.

TABLE 1. A summary of rail trapping effort and capture success at the Patuxent River Park study site, 1987–1997. Early trap design without audio playback (A) is compared with improved trap design with audio playback (B); no trapping was conducted in 1992.

Year	No. trap lines	Total traps/ total fence length	Trap days	Captures	
				Sora	Virginia Rail
A. Early Trap design without audio playback					
1987	2	2/30 m	35	2	0
1988	3	3/68 m	35	10	0
1989	1	3/46 m	70	6	2
1990	4	7/120 m	65	13	0
1991	2	5/99 m	70	4	0
Totals	12	20/363 m	275	35	2
B. Improved trap design with audio playback					
1993	6	13/213 m	70	74	34
1994	6	17/244 m	70	377	44
1995	9	21/305 m	70	754	82
1996	9	23/335 m	70	393	44
1997	11	24/450 m	70	717	72
Totals	41	98/1547 m	350	2315	276

Because Virginia Rails occurred at much lower density than Soras in the tidal marshes of the Patuxent River, our results with regard to improved capture rate are not as well substantiated for this species. Nonetheless, the indicated increased mean annual capture rate of Virginia Rails based on trap line-days for the two 5-yr trapping periods was 16.8, a figure comparable to 13.6 reported for Soras in Table 2. We conclude that our improved trap design with audio lure had a comparable effect in increasing captures of Virginia Rails as it did Soras.

During the 5-yr period 1993–1997, we tallied 48 trap mortalities for a loss rate of 1.6% of total captures. Most losses (22 or 46%) were due to mammalian predation, mostly raccoon and mink (*Mustela vison*), before funnel modifications were completed. Unexpected extreme high tides

TABLE 2. A comparison of capture success/effort for combined capture of fall migrant Sora and Virginia Rails using two trapping methods: A) early trap design without playback, and B) improved trap design with playback. Capture rates are based on three measures of effort: number of trap lines (trap line-days), number of traps (trap-days), and length of drift fence (m of drift fence-days) used during each 5-yr trapping period.

Trapping method	Years	Mean annual capture rate ± SD		
		Rails/ trap line-days	Rails/ trap-days	Rails/m drift fence-days
A	1987–1991	0.063 ± 0.04 A[a]	0.040 ± 0.03 A	0.002 ± 0.001 A
B	1993–1997	0.860 ± 0.41 B	0.356 ± 0.17 B	0.023 ± 0.011 B
Ratio of capture rates B/A		13.6	8.8	10.6

[a] Column means with different letters are significantly different ($P < 0.01$; t-test, df = 4).

accounted for 16 drownings (33% of losses), while the remaining 10 losses (21%) were of a miscellaneous nature: trap trauma, heat exhaustion, and unknown causes. We emphasize that servicing traps promptly and covering catch boxes with burlap or marsh vegetation as provision for shade and security, reduces stress and exposure-related mortality. The most common injury we encountered was abrasion at the base of the bill from probing the wire sides of the catch box. This was remedied by constructing catch boxes from 1.3-cm-mesh vinyl-coated wire. Other injuries that occurred were a few broken upper mandibles and broken toes; these injuries were rare and anomalous.

Our traps also were effective in capturing a variety of other small marsh birds, especially Swamp Sparrows (*Melospiza georgiana*) and Song Sparrows (*M. melodia*). They also caught about 3 Least Bitterns (*Ixobrychus exilis*) each year.

Our 2315 Sora bandings have more than doubled the North American banding records for the species (M. Gustafson, Bird Banding Laboratory, pers. comm.) and demonstrate that our improved trap design with audio lure can facilitate capture of large numbers of Soras as well as Virginia Rails on migratory and winter concentration areas. Our audio broadcast seemed to be particularly attractive to migrants arriving in the marsh during predawn hours and continuing into the early morning daylight hours, a time when communicating may be most critical for individuals to keep in contact as members of a flock. Although the cost of solid-state message repeater units may be prohibitive for certain banding programs, we highly recommend the use of these devices and suggest that the long-term benefits of playback quality, reliability, and field use with automatic turn-on feature, far outweigh the initial expense.

ACKNOWLEDGMENTS

Logistic support and funding were provided by the Maryland National-Capital Park and Planning Commission, the Maryland Ornithological Society, the Chesapeake Bay Trust, the Maryland Chapter of Quail Unlimited, the U.S. Fish and Wildlife Service, and the Jug Bay Wetlands Sanctuary. We thank B. Meanley for his invaluable advice and encouragement. S. Barker, E. Springborn, T. Lorenzo, and E. Goldstein for field assistance, and M. C. Perry and S. M. Melvin for helpful review of the manuscript.

LITERATURE CITED

CONWAY, C. J., AND W. R. EDDLEMAN. 1994. Virginia Rail. Pp. 193–206, *in* T. C. Tacha and C. E. Braun, eds. Migratory shore and upland game bird management in North America. Int. Assoc. Fish and Wildl. Agencies, Wash., D.C.

GLAHN, J. F. 1974. Study of breeding rails with recorded calls in north-central Colorado. Wilson Bull. 86:206–214.

JOHNSON, R. R., AND J. J. DINSMORE. 1985. Brood-rearing and postbreeding habitat use by Virginia Rails and Soras. Wilson Bull. 97:551–554.

LOW, S. 1935. Methods of trapping shore birds. Bird-Banding 6:16–22.

MEANLEY, B. 1969. Natural history of the King Rail. N. Am. Fauna No. 67. Bur. Sport Fish. and Wildl. 108 pp.

MELVIN, S. M., AND J. P. GIBBS. 1994. Sora. Pp. 209–217, *in* T. C. Tacha and C. E. Braun, eds. Migratory shore and upland game bird management in North America. Int. Assoc. Fish and Wildl. Agencies, Wash., D.C.

———, AND ———. 1996. Sora (*Porzana carolina*). No. 250 *in* A. Poole and F. Gill, eds. The birds of North America. Academy of Natural Sciences, Philadelphia and American Ornithologist's Union, Washington, D.C. 20 pp.

STEWART, R. E. 1951. Clapper Rail populations of the middle Atlantic states. N. Am. Wildl. Conf. 17:421–430.

———. 1954. Migratory movements of the northern Clapper Rail. Bird-Banding 25:1–5.

Received 8 Apr. 1997; accepted 15 Aug. 1997.