Human–Wildlife Conflicts 1(1):24–26, Spring 2007

Using predator exclosures to protect ground nests from red fox

Ben C. West, Jack H. Berryman Institute, Department of Wildland Resources, Utah State University, Logan, UT 84322-5230, USA[1] *benw@cfr.msstate.edu*

Terry A. Messmer, Jack H. Berryman Institute, Department of Wildland Resources, Utah State University, Logan, UT 84322-5230, USA

Dominic C. Bachman, Jack H. Berryman Institute, Department of Wildland Resources, Utah State University, Logan, UT 84322-5230, USA

Abstract: Nest predation often is cited as a primary cause for low recruitment and subsequent population decline of many ground-nesting bird species. In response, managers and researchers have developed a myriad of techniques to reduce rates of predation on ground nests. Fences to exclude predators from nesting areas have reportedly been a successful, albeit expensive, strategy to reduce predation rates. Although many studies have evaluated the use of exclusionary fences as a management tool, nearly all of these studies have evaluated the impact of fences in terms of nest success rather than by actual fence penetration by predators. Many authors, for example, assumed that particular fence designs would repel meso-predators like red fox. During a study to assess fences as a management tool to manage predation on duck nests, we documented that red foxes routinely penetrated fences that were designed based on recommendations in the literature. Our observations call into question many fence design recommendations, particularly in areas with red fox populations. More research is needed to assess the ability of various fence designs to repel specific predators.

Key words: ducks, nesting, predation, predator management, red fox, *Vulpes vulpes*

Several avian populations have declined in recent decades (Messmer and Rohwer 1996, Nelson 2001). In many bird populations, low recruitment rates appear to be an important limiting factor for overall population size (Cowardin et al. 1985, Helmers and Gratto-Trevor 1996). Nest depredation is often the primary cause of low recruitment rates in ground-nesting birds (Cowardin et al. 1985, Helmers and Gratto-Trevor 1996, Martin et al. 1996). More importantly, the overall impact of nest depredation appears to have increased during the past several decades (Beauchamp et al. 1996, Nelson 2001). The ultimate cause for this trend is in debate, but the range expansion and population growth of medium-sized mammalian predators (primarily red fox [*Vulpes vulpes*] and raccoon [*Procyon lotor*]) appear to be important factors (Sargeant et al. 1993, Greenwood and Sovada 1996).

Many techniques have been developed to reduce the risk of depredation of ground nests (Greenwood and Sovada 1996, Jiménez et al. 2001). Fences designed to exclude or deter predators are considered a cost-effective strategy to manage nest depredation (Lokemoen 1984, Jiménez et al. 2001). Although fences have been used most often to protect duck nests from mammalian predators (Sargeant et al. 1974, Lokemoen et al. 1982, Arnold et al. 1988, Greenwood et al. 1990, Gatti et al. 1992, Lokemoen and Woodward 1993, Pietz and Krapu 1994, LaGrange et al. 1995, Cowardin et al. 1998), they also have been used to protect the nests of pectoral sandpipers (*Calidris melanotos*; Estelle et al. 1996), piping plovers (*Charadrius melodus*; Rimmer and Deblinger 1990, Mayer and Ryan 1991, Melvin et al. 1992), sandwich terns (*Sterna sandvicensis*; Forster 1975, Patterson 1977), least terns (*Sterna antillarum*; Minsky 1980, Koenen et al. 1996), snowy plovers (*Charadrius alexandrinus*; Koenen et al. 1996), and common eiders (*Somateria mollissima*; Patterson 1977).

Fences may be designed to protect individual nests, nesting colonies, peninsulas, or blocks of nesting habitat and may incorporate a physical deterrent only (e.g., wire mesh), electrically charged wires only, or a combination of the two. Many designs incorporate either buried mesh or an electrically charged trip wire to prevent predators from digging under the fence (Rondeau and Piehl 1989). Additionally, predators typically are discouraged from climbing by an electrically charged wire(s) placed at the top of or offset from the fence. Despite these precautions, some predators, particularly red foxes, may gain access to a protected area by jumping the fence (Patterson 1977, Gatti et al. 1992).

Patterson (1977) and Forster (1975) suggested

[1] Current address: Jack H. Berryman Institute, Box 9690, Mississippi State, MS 39762, USA

that an electrified fence 45 cm high usually deterred red foxes, but they also discovered that foxes occasionally jumped the fence. Gatti et al. (1992) reported that a 51-cm fence usually deterred red foxes from a duck breeding area, but they did note one instance where a fox penetrated the fence and depredated nests. Other researchers and managers have also constructed predator fences 0–122 cm high to protect ground nests (Minsky 1980, Greenwood et al. 1990, Rimmer and Deblinger 1990, Gatti et al. 1992, LaGrange et al. 1995, Estelle et al. 1996, Koenen et al. 1996). Correspondingly, technical publications have recommended fence designs approximately 122 cm in height to exclude foxes and other mammalian predators (Anonymous 1988, Rondeau and Piehl 1989).

There are few published reports of predator exclosures being constructed at heights ≥122 cm. Although Patterson (1977) and Forster (1975) specifically evaluated the ability of red foxes to penetrate electric fences and generally supported the contention that relatively short fences are effective, their conclusions are based on indirect observations; little published research has documented how red foxes penetrate exclosures.

Our experience

As part of a larger study to evaluate the impacts of nest depredation on local duck populations, we constructed 4 16-ha predator exclosures on Bear River Migratory Bird Refuge (BRMBR) in northern Utah during the spring of 1999 (West 2002). The fences were similar to designs suggested by Rondeau and Piehl (1989) and others. The fences incorporated both wire mesh and electrified wires to deter predators. The wire mesh extended 114 cm above the ground with additional electrified wires to discourage climbing and digging.

On the morning of May 22, 2001, during the last spring of the nesting study, we observed an adult red fox inside one of the predator exclosures. When the fox detected our presence, it ran to the edge of the exclosure and leaped over the fence with apparent ease. We immediately inspected the fence and found no evidence that the fox gained access to the area by digging underneath the exclosure. We later located an active fox den within 200 m of the exclosure. Subsequent spotlight observations yielded red fox sightings within the exclosure on multiple occasions throughout the 2001 nesting season.

Our nesting data also support the observation that foxes routinely penetrated our exclosures. During 1999–2001, we located and marked 39 duck nests within the 4 exclosures using a standard chain drag (West 2002). Of these nests, 8 were successful, and the remaining 31 were depredated. Among the depredated nests, 14 were found with no eggshell remnants remaining at the nest, evidence consistent with depredation by foxes and some avian predators (Sargeant et al. 1998). Although common ravens (*Corvus corax*) occur in the area and have been known to carry away eggs, we suspect that red foxes were responsible for some of the instances of nest loss where no eggshell remnants were found in the nest.

Conclusions

Our observations imply that in areas where red foxes occur, fences of ≤122 cm may not be sufficient to deter them, and the minimum fence height required to deter red foxes is unknown. Moreover, researchers have documented captive red foxes escaping 2-m-high chain link fence enclosures that were topped with electrified wires (M. R. Conover, Utah State University, personal communication). Given the high cost required to construct predator exclosures, more complete information about the ability of foxes to jump or scale fences would be particularly valuable. We suggest that future research focus on the behavior of foxes encountering fences of different heights and materials.

Acknowledgments

Funding for this project was provided by the U.S. Fish and Wildlife Service's Bear River Migratory Bird Refuge, the National Fish and Wildlife Foundation, and the Jack H. Berryman Institute. V. Hirschboeck, K. Lindsey, C. Hendricks, T. Littrell, K. Fleming, and R. Greer provided valuable field assistance during the course of this research. We thank V. Hirschboeck for reviewing an earlier draft of this manuscript.

Literature cited

Anonymous. 1988. Fences. Bureau of Land Management, Vegetative Rehabilitation and Equipment Workshop, Missoula, Montana, USA.

Arnold, P. M., R. J. Greenwood, B. G. McGuire, C. R. Luna, and R. F. Johnson. 1988. Evaluation of electric fence exclosures to improve waterfowl nest success in the Arrowwood wetland management district. Pages 131–132 *in* M. A. Johnson, editor. Proceedings of the Mallard Symposium. Bismarck, North Dakota, USA.

Beauchamp, W. D., R. R. Koford, T. D. Nudds, R. G. Clark, and D. H. Johnson. 1996. Long-term declines in nest success of prairie ducks. Journal of Wildlife Management 60:247–257.

Cowardin, L. M., D. S. Gilmer, and C. W. Shaiffer. 1985. Mallard recruitment in the agricultural environment of North Dakota. Wildlife Monographs 92.

Cowardin, L. M., P. J. Pietz, J. T. Lokemoen, H. T. Sklebar, and G. A. Sargeant. 1998. Response of nesting ducks to predator exclosures and water conditions during drought. Journal of Wildlife Management 62:152–163.

Estelle, V. B., T. J. Mabee, and A. H. Farmer. 1996. Effectiveness of predator exclosures for pectoral sandpiper nests in Alaska. Journal of Field Ornithology 67:447–452.

Forster, J. A. 1975. Electric fencing to protect sandwich terns against foxes. Biological Conservation 7:85.

Gatti, R. C., J. O. Evrard, and W. J. Vander Zouwen. 1992. Electric fences for duck and pheasant production in Wisconsin. Wisconsin Department of Natural Resources. Technical Bulletin 176, Madison, Wisconsin, USA.

Greenwood, R. J., P. M. Arnold, and M. G. McGuire. 1990. Protecting duck nests from mammalian predators with fences, traps, and a toxicant. Wildlife Society Bulletin 18:75–82.

Greenwood, R. J., and M. A. Sovada. 1996. Prairie duck population management. Transactions of the North American Wildlife and Natural Resources Conference 61:31–42.

Helmers, D. L., and C. L. Gratto-Trevor. 1996. Effects of predation on migratory shorebird recruitment. Transactions of the North American Wildlife and Natural Resources Conference 61:50–61.

Jiménez, J. E., M. R. Conover, and T. A. Messmer. 2001. Exclusionary methods to reduce predation on ground-nesting birds and their nests. Berryman Institute Publication 20, Utah State University, Logan, Utah, USA.

Koenen, M. T., R. B. Utych, and D. M. Leslie, Jr. 1996. Methods used to improve least tern and snowy plover nesting success on alkaline flats. Journal of Field Ornithology 67:281–291.

LaGrange, T. G., J. L. Hansen, R. D. Andrews, A. W. Hancock, and J. M. Kienzler. 1995. Electric fence predator exclosure to enhance duck nesting: a long-term case study in Iowa. Wildlife Society Bulletin 23:261–266.

Lokemoen, J. T. 1984. Examining economic efficiency of management practices that enhance waterfowl production. Transactions of the North American Wildlife and Natural Resources Conference 49:584–607.

Lokemoen, J. T., H. A. Doty, D. E. Sharp, and J. E. Neaville. 1982. Electric fences to reduce mammalian predation on waterfowl nests. Wildlife Society Bulletin 10:318–323.

Lokemoen, J. T., and R. O. Woodward. 1993. An assessment of predator barriers and predator control to enhance duck nest success in peninsulas. Wildlife Society Bulletin 21:275–282.

Martin, T. E., I. J. Ball, and J. Tewksbury. 1996. Environmental perturbations and rates of nest predation in birds. Transactions of the North American Wildlife and Natural Resources Conference 61:43–49.

Mayer, P. M., and M. R. Ryan. 1991. Electric fences reduce mammalian predation on piping plover nests and chicks. Wildlife Society Bulletin 19:59–63.

Melvin, S. M., L. H. MacIvor, and C. R. Griffin. 1992. Predator exclosures: a technique to reduce predation at piping plover nests. Wildlife Society Bulletin 20:143–148.

Messmer, T. A., and F. C. Rohwer. 1996. Issues and problems in predation management to enhance avian recruitment. Transactions of the North American Wildlife and Natural Resources Conference 61:25–30.

Minsky, D. 1980. Preventing fox predation at a least tern colony with an electric fence. Journal of Field Ornithology 51:17–18.

Nelson, H. K. 2001. Impact of predation on avian recruitment: an introduction. Wildlife Society Bulletin 29–2-5.

Patterson, I. J. 1977. The control of fox movement by electric fencing. Biological Conservation 11:267–278.

Pietz, P. J., and G. L. Krapu. 1994. Effects of predator exclosure design on duck brood movements. Wildlife Society Bulletin 22:26–33.

Rimmer, D. W., and R. D. Deblinger. 1990. Use of predator exclosures to protect piping plover nests. Journal of Field Ornithology 61:217–223.

Rondeau, A. J., and J. L. Piehl. 1989. Construction and operation of electric fences for predator management: a mid-continent waterfowl management project. U.S. Fish and Wildlife Service, Fort Snelling, Minnesota, USA.

Sargeant, A. B., R. J. Greenwood, M. A. Sovada, and T. L. Shaffer. 1993. Distribution and abundance of predators that affect duck production—Prairie Pothole Region. United States Fish and Wildlife Service, Resource Publication 194.

Sargeant, A. B., A. D. Kruse, and A. D. Afton. 1974. Use of small fences to protect ground bird nests from mammalian predators. Prairie Naturalist 6:60–63.

Sargeant, A. B., M. A. Sovada, and R. J. Greenwood. 1998. Interpreting evidence of depredation of duck nests in the Prairie Pothole Region. U.S. Geological Survey, Northern Prairie Wildlife Research Center, Jamestown, North Dakota and Ducks Unlimited, Inc., Memphis, Tennessee, USA.

West, B. C. 2002. The influence of predator exclosures and livestock grazing on duck production at Bear River Migratory Bird Refuge, Utah. Dissertation, Utah State University, Logan, Utah, USA.

Ben C. West currently serves as the national outreach coordinator for the Jack H. Berryman Institute at Mississippi State and Utah State universities. He holds faculty appointments of associate professor at MSU and adjunct assistant professor at Utah State University. Ben's educational background includes a B.S. in natural resources management from the University of Tennessee-Martin, an M.S. in wildlife science from Virginia Tech, and a Ph.D. in wildlife science at USU. Ben's professional interests include wildlife damage management, communication, and conflict resolution in the natural resources arena. Ben currently serves as president for the Mississippi chapter of The Wildlife Society.