Wildl. Soc. Bull. 22:121–125, 1994

USE OF A LONG-DISTANCE NIGHT VISION DEVICE FOR WILDLIFE STUDIES

JUNIOR O. KING,[1] ***U.S. Department of Agriculture, APHIS, ADC, Denver Wildlife Research Center, Mississippi Research Station, P.O. Drawer 6099, Mississippi State, MS 39762***

D. TOMMY KING, ***U.S. Department of Agriculture, APHIS, ADC, Denver Wildlife Research Center, Mississippi Research Station, P.O. Drawer 6099, Mississippi State, MS 39762***

Key words: night vision device, nocturnal observation, red-filtered light, wildlife

Development of night vision devices (NVD's) have made nocturnal studies of wildlife behavior more feasible now than was possible 45 years ago (Southern et al. 1946, Carpenter 1976, Beynon et al. 1981, Black and Collopy 1982, Brooks 1985, Hill and Clayton 1985, Waser 1985, Farnsworth and Cox 1988, Russell et al. 1991, McMahon and Evans 1992). Equipment used in past nocturnal studies ranged from vehicle headlights (Eltringham and Flux 1971) to complex infrared thermal imagery (Parker 1971, Coldberg 1977) costing >$500,000. We needed an NVD to study nocturnal food habits of great blue herons (see Table 1 for scientific names) (GBHE) at commercial channel catfish farms in the mid-delta region of Mississippi. Current systems proved inadequate or too expensive for our purposes. We describe a moderately priced NVD enhanced by a telephoto lens and a red-filtered light source.

EQUIPMENT DESCRIPTION AND METHODS

The pocketscope (Fig. 1A) is a third-generation light intensifier scope with a luminous gain of 20,000–30,000 times (Nite Optics Inc., Wilkes Barre, Pa.) (use of trade names for identification of materials does not constitute endorsement by the federal government). Third-generation scopes have an overall annual night light gain of 32% over second-generation scopes, and the photocathode tube has a 4 times longer life usage (C. Tott, B. E. Meyers and Co. Inc., Redmond, Wash., pers. commun., 1993). We attached a 1,280-mm F/5.6 catadioptric telephoto lens (B. E. Meyers and Co. Inc., Redmond, Wash.) to this pocketscope by means of an adapter also manufactured by B. E. Meyers and Co. Inc. The light source was a 400,000-candlepower spotlight connected to a 32-cm-long × 11.5-cm-wide section of PVC pipe using a rubber 10- × 15-cm pipe-boot coupling with hose clamps (Fig. 1K). We attached a standard red snap-on lens to the spotlight. An aluminum angle bracket (Fig. 1F) was then attached to the spotlight. The bracket enabled the light source to be attached to the telephoto lens with 2 No. 32 hose clamps. This allowed the observer to manipulate the NVD (enhanced light, telephoto lens, and pocketscope) with 1 hand while using the other to focus the lens and operate the pocketscope. We replaced the original on-off switch with a more heat-resistant one so that the spotlight would withstand long periods of operation.

The apparatus was suspended from the top of a vehicle door frame by a bracket attached

[1] Present address: U.S. Department of Agriculture, APHIS, Denver Wildlife Research Center, Olympia Research Station, 1835 Black Lane Boulevard SW, Olympia, WA 98512-5623.

Table 1. Species identified during nocturnal observations with night vision device in Humphreys County, Mississippi, 1991–1992.

Common name	Scientific name	Distance (m)
American white pelican	*Pelecanus erythrorhynchos*	1,700
Great blue heron	*Ardea herodias*	1,200
Black-crowned night heron	*Nycticorax nycticorax*	150
Canada goose	*Branta canadensis*	400[a]
Killdeer	*Charadrius vociferus*	200
Great-horned owl	*Bubo virginianus*	300[a]
Opossum	*Didelphis virginiana*	200[a]
Nine-banded armadillo	*Dasypus novemcinctus*	200
Coyote	*Canis latrans*	350[a]
Raccoon	*Procyon lotor*	1,200
Mink	*Mustela vison*	250
Striped skunk	*Mephitis mephitis*	350[a]
River otter	*Lutra canadensis*	400
White-tailed deer	*Odocoileus virginianus*	600[a]
Muskrat	*Ondatra zibethicus*	150
Nutria	*Myocastor coypus*	200[a]
Eastern cottontail	*Sylvilagus floridanus*	300
Channel catfish	*Ictalurus punctatus*	300

[a] Species were not observed beyond this distance. This does not imply maximum range for identification.

to a harness constructed from 2 nylon rifle slings (Fig. 1D) attached to the 1,280-mm lens. The harness allowed the device to hang in the open window so that it could be easily manipulated by the observer. This was necessary because the NVD (8.65 kg) was too heavy for a window mount. A heavy-duty tripod can be used when only stationary observations are required.

The apparatus cost about $6,300 (1991 prices), including the $4,965 cost of the pocketscope.

RESULTS

This apparatus allowed observations and identification of a variety of wildlife species (Table 1). Several lenses were tested (50 mm, 135 mm, 300 mm) but were found to be inadequate for positive species identification beyond 100 m. This was caused in part by insufficient lens magnification or the lens F-number being too high. The 1,280-mm lens proved adequate since its low F-number allowed enough light gain for species identification. The 1,280-mm lens provided a focal range of 3–2,000 m, depending on light gain.

We tested an infrared long-range laser illuminator (B. E. Meyers and Co. Inc.) to facilitate light gain. The infrared light of the laser did illuminate insect wings, thus distorting view, and was more expensive than the red-filtered light ($2,075 vs. $45). The infrared laser is most effective during night observation periods when insects are not present. The red-filtered light produced the same effect as the infrared laser illuminator by penetrating shadowed areas created by moonlight and aiding in pocketscope light gain. Brooks (1985) described a similar method using filtered light in the infrared spectrum to increase viewing distance, but he was limited to <200 m (lens type not stated).

To quantify the capabilities of this system, we determined that the top line ("E") on a standard eye-chart was recognizable at distances up to 500 m using the red-filtered light and 300 m without the light. The chart was visible to the observer up to 1,200 m with the light and 1,000 m without the light. At 200 m with the light, line 4 could be read, but without the light only the "E" could be seen. These data were obtained during a first-quarter moon with full starlight and no overhead cover.

Natural obstructions such as fog, atmospher-

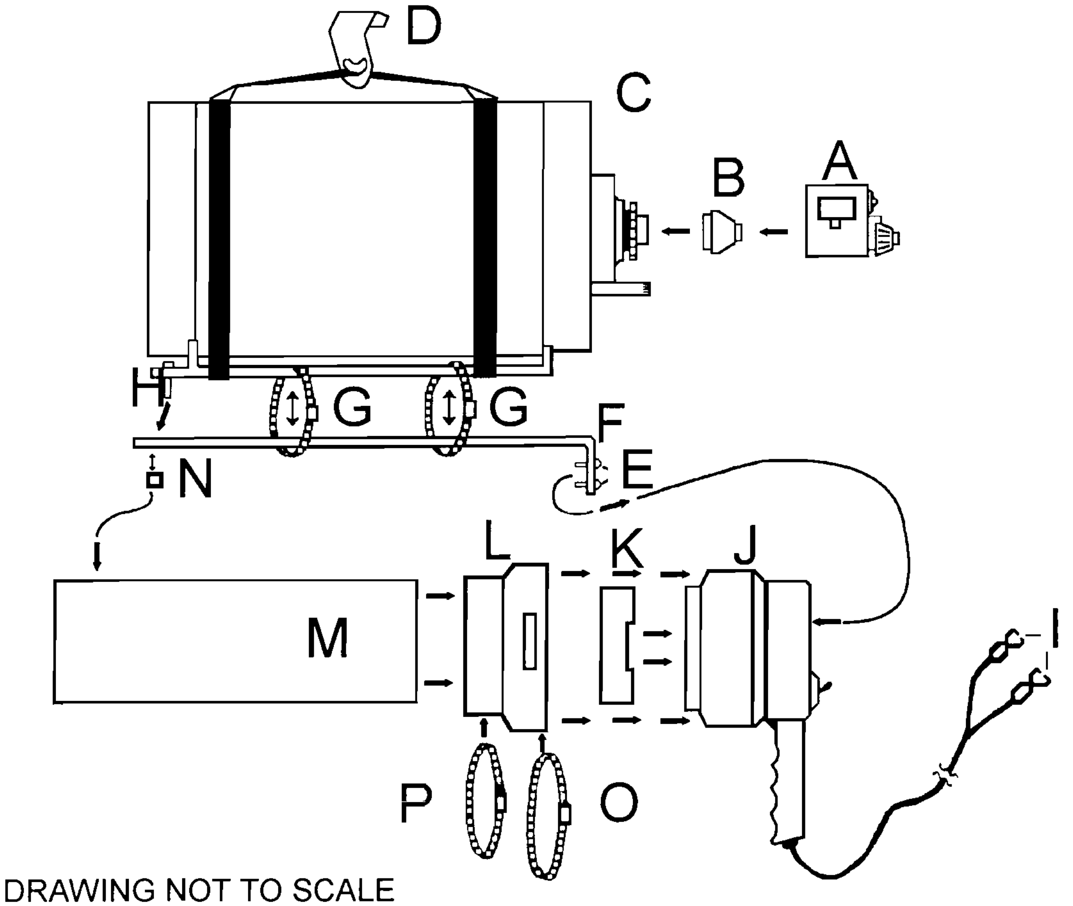

Fig. 1. Drawing of night vision device (NVD, 1,280-mm lens, light enhancer). Item description and specifications: A = night vision device (pocketscope, type Generation III, model F4975, spectrum response near infrared, resolution 30 lp/mm, luminous gain 20,000–30,000 times); B = adapter C-mount/1,280 lens; C = lens 1,280 mm F/5.6; D = hanger assembly, hanger bracket and 2 standard nylon rifle slings; E = bolt assembly (3 each), ¼ × ¾ inch bolt, nut, lock washer; F = bracket 50.8 × 5.1 × 0.3 cm; G = 2 hose clamps No. 32; H = bolt assembly ¼ × 1½ inch bolt, nut, lock washer; I = battery clamps, 50 amp; J = spotlight 400,000-cp; K = standard red q-beam snap-on lens; L = rubber pipe coupling, 10.2 × 15.2 cm; M = 10.2-cm PVC pipe, schedule 40, 32 cm long; N = rubber bushing 10 cm wide × 2.8 cm long; O = hose clamp No. 96; P = hose clamp No. 80.

ic dust, and moisture that absorb light in the infrared spectrum will greatly decrease observation distance. Dark, overcast nights, no moonlight, or a heavy canopy also will decrease light gain and thus decrease observation distance. To assess this we used the eye-chart on a night with no moon, full starlight, and 50% overhead canopy. The "E" could be read up to 400 m with the light and could not be seen at 100 m without the light. The chart was visible past 500 m with the light and 200 m without the light. With a quarter-moon, we experienced a ≥20% increase in observation distance.

Wildlife viewed in the NVD appeared in various shades of green which allowed the observer to discern light and dark color patterns, thus making species identification possible. Prey taken by GBHE's could be discerned as catfish or other species such as shad (*Dorosoma* spp.), sunfish (*Lepomis* spp.), and mosquitofish (*Gambusia affinis*) at distances across the length of 1 pond (about 300 m). Identifications were made under conditions ranging from dark overcast nights to bright moonlight. The maximum viewing range is approximately 2,000 m under ideal conditions (clear sky, full moon, no atmospheric dust or moisture).

DISCUSSION

The night viewing range of this apparatus without the red-filtered light and under ideal conditions well exceeded the effective viewing range of 300 m mentioned by McMahon and Evans (1992) who used a Javelin Model 325 infrared scope (Apollo Lasers, Javelin Division, Los Angeles, Calif.) (lens type not stated) to observe American white pelicans (AWPE). This range extension was facilitated by using a 1,280-mm lens and red-filtered light, greatly enhancing the visibility of objects seen through the NVD.

Red-filtered light is highly reflective from the eyes of birds and mammals (Southern et al. 1946) so that the eyeshine of these animals can be seen even if the scope is not entirely in focus. Red-filtered light seemed to disturb herons and other animals less than did white unfiltered light. The use of white light, such as vehicle headlights, made the animals leave the area or alter their behavior in all instances. Fall (1974) stated that red-filtered light had a calming effect on disturbed captive Norway rats (*Rattus norvegicus*). Clark (1980) used red-filtered light as an aid to walk to observation points and keep wildlife disturbance to a minimum.

With the exception of AWPE's, the only disturbance we noted using this type of red-filtered light was that the animals being observed stopped momentarily, looked toward the light source, and then resumed their activity (resting, foraging, browsing). This momentary disturbance lasted $\leq$15 seconds in the most extreme case and lasted $\leq$5 seconds in $\geq$95% of all observations at $\leq$1,200 m. Observations of $>$1 minute with constant use of the red-filtered light indicated no change in behavior activity. Raccoons and GBHE's did not stop foraging when exposed to red-filtered light. Observations of GBHE's that were resting on levees for several minutes were observed entering catfish ponds to forage while we were using the filtered light, thus indicating no behavioral alterations. However, during our observations of the AWPE's, we noted that the bird rafts remained calm until the red-filtered light was turned on, then the birds moved away from it. When the light source was turned off the pelicans calmed down and re-formed rafts.

Observer eye strain, also described by Hill and Clayton (1985), became apparent with uninterrupted periods of viewing over 30 minutes. Limiting viewing sessions to 30 minutes seemed to reduce this problem but did not eliminate it. This problem may be resolved by the use of a 15.3-cm biocular viewing lens, allowing both eyes to view objects through the scope. This accessory is not available for our pocketscope, but is available for a similar type of pocketscope produced by B. E. Meyers and Co. Inc.

Acknowledgments.—Deep appreciation is given to B. E. Meyers for technical assistance and adapters. Gratitude is expressed to A. R. Stickley, Jr. and D. F. Mott for editing comments and to R. Flynt for aiding in data collection and drawing assistance.

LITERATURE CITED

Beynon, J. L., D. L. Hutchins, A. J. Rubino, A. L. Lawrence, and B. R. Chapman. 1981. Nocturnal activity of birds on shrimp mariculture ponds. J. World Mariculture Soc. 12:63–70.

Black, B. B., and M. W. Collopy. 1982. Nocturnal activity of great blue herons in a north Florida salt marsh. J. Field Ornithol. 53:403–406.

Brooks, R. P. 1985. Methodologies for behavioral studies of nocturnal mammals. Pages 1–14 *in* R. P. Brooks, ed. Nocturnal mammals: techniques for study. School of For. Resour. Res. Pap. 48, Pennsylvania State Univ., University Park.

CARPENTER, L. H. 1976. A night-viewing device to monitor activities of wildlife. Colo. Div. Wildl. Game Inf. Leafl. 103, Denver. 2pp.

CLARK, N. C. 1980. Nocturnal birding. Bird Observer East. Mass. 8:241–245.

ELTRINGHAM, S. K., AND J. E. C. FLUX. 1971. Night counts of hares and other animals in East Africa. East Afr. Wildl. J. 9:67–72.

FALL, M. W. 1974. The use of red light for handling wild rats. Lab. Anim. Sci. 24:686–687.

FARNSWORTH, P. B., AND P. A. COX. 1988. A laser illuminator designed for pollination studies with a night vision device. Biotropica 20:334–335.

GOLDBERG, P. S. 1977. Infrared imagery scanning systems for censusing big game. M.S. Thesis, Utah State Univ., Logan. 68pp.

HILL, S. B., AND D. H. CLAYTON. 1985. Wildlife after dark: a review of nocturnal observation techniques. James Ford Bell Museum of Nat. Hist. Occas. Pap. 17, Univ. Minnesota, Minneapolis. 23pp.

MCMAHON, B. F., AND R. M. EVANS. 1992. Nocturnal foraging in the American white pelican. Condor 94:101–109.

PARKER, H. D. 1971. Infrared "eyes" for game management. Colo. Outdoors 20(6):35–38.

RUSSELL, R. W., P. DUNNE, C. SUTTON, AND P. KERLINGER. 1991. A visual study of migrating owls at Cape May Point, New Jersey. Condor 93:55–61.

SOUTHERN, H. N., J. S. WATSON, AND D. CHITTY. 1946. Watching nocturnal animals by infrared radiation. J. Anim. Ecol. 15:198–202.

WASER, P. M. 1985. Observing nocturnal mammals: an exercise in masochism? Pages 15–18 *in* R. P. Brooks, ed. Nocturnal mammals: techniques for study. School of For. Resour. Res. Pap. 48. Pennsylvania State Univ., University Park.

Received 22 September 1992.
Accepted 27 September 1993.
Associate Editor: Swihart.