Wildlife Session

Characteristics of Fox Enclosures in Florida

Mark A. Cantrell[1] *Florida Game and Fresh Water Fish Commission, 4005 S. Main Street, Gainesville, FL 32601*

John B. Wooding, *Florida Game and Fresh Water Fish Commission, 4005 S. Main Street, Gainesville, FL 32601*

Abstract: We inspected 17 fox enclosures and interviewed 26 operators to collect information on enclosure characteristics and use in Florida. Size of enclosures (N = 26) ranged from 30 to 360 ha ($\bar{x}$ = 108 ha). Red fox (*Vulpes vulpes*), gray fox (*Urocyon cinereoargenteus*), and coyote (*Canis latrans*) stocks were obtained from states in the southeast and midwest. Operators (54%) preferred coyotes exclusively or in combination with foxes: coyotes were admitted to be present in ≥35% of enclosures visited. Owners reported enclosure costs to be $40/ha. Fox enclosures provided a convenient recreational opportunity for houndsmen in an increasingly urban landscape.

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The opportunity to chase foxes by trailing hounds in Florida has diminished due to increasing human population, changing land use, increased deer populations, and decreased amounts of suitable land available for running dogs. During the 1988–1989 season an estimated 1,683 sportsmen hunted fox in Florida (Fla. Game and Fresh Water Fish Comm. (GFC), unpubl. data). Recently, fox enclosures (areas enclosed by fox-proof fencing, where dogs are released to chase foxes) have become popular alternatives for fox hunters in Florida. Fox hunters enjoy pursuit of game in fox enclosures because there is no risk of dogs being hit while crossing roads or being stolen, lost, or shot for running on posted land. Fox enclosures are useful for training young hounds. Ease of gathering dogs after a chase is another motivation for their use.

Little is known of fox enclosure characteristics and operation because the enclosures are a recent phenomenon in Florida. The objectives of this study were to (1) determine the distribution and abundance of fox enclosures in Florida; (2) describe their structure, operation, and use.

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[1]Present address: Natural Resource Branch, AFZA-DE-DN, Fort Bragg, NC 28387.

Methods

The characteristics of fox enclosures and their use were determined through interviews, on-site inspections, and observations with enclosure owners/operators from 1 May to 30 June 1989. We obtained the names and addresses of fox enclosure operators from GFC records, information from law enforcement personnel, advertisements and dog registrations in fox hunting magazines, and from other enclosure operators. We attempted to contact all known owners/operators. During interviews and inspections, we collected data on enclosure design and construction, operation, and species and origin of foxes. We also asked for suggestions and comments regarding current regulations governing fox enclosures.

We classified commercial fox enclosures as those operated primarily for profit. Non-commercial enclosures were operated primarily for the enjoyment of the owner, but may have been supplemented by fees collected from other users (designated "semi-commercial") or operated strictly for personal use (designated "private").

T-tests were used to test for differences in enclosure size; effective degrees of freedom (edf) were reported for means with unequal variances (Steel and Torrie 1980). Density of canids and amount of food per animal were calculated from data provided by enclosure operators.

Results and Discussion

Abundance and Distribution

We found 43 fox enclosures in Florida, located from the northwestern Panhandle part of the state to mid-peninsula; an additional 4 were under construction. Concentrations of fox enclosures were in the northeast: along the Suwannee River in Lafayette, Hamilton, and Madison counties and the Sante Fe River in Columbia, Baker, and Bradford counties. This enclosure concentration may reflect land availability and fox hunter preference in these regions.

Characteristics and Operation

We interviewed (sampled) owners/operators of 26 of 39 operational fox enclosures. We were unable to schedule interviews with 13 operators; however, we felt that the enclosures we sampled were representative of those found in Florida. Sixteen interviews were conducted on-site at enclosures, 1 interview was by telephone and the enclosure inspected later, and 9 others were conducted off-site. (No interviews were conducted at the 4 sites under construction.) All fox enclosure operators were eager to talk about their operations; however, some were cautious while discussing certain topics. The illegal presence of coyotes, dog-related fox mortality, and costs/profits of enclosures were topics most often avoided by operators, but most operators eventually discussed these subjects during the interview.

Average age of fox enclosures sampled was 4.0 years (range = 1–14 years). The 14-year old fox enclosure was operated intermittently until refurbishment 3 years ago. Thirteen (50%) of 26 enclosures had been in operation $\geq$3 years. Seven-

teen (64%) of 26 operators interviewed owned the property occupied by the enclosure, while 9 (35%) leased property.

Mean size of fox enclosures was 108 ha (range = 30–360 ha). Commercial fox enclosures ($\bar{x}$ = 134.8 ha, N = 16) were larger than those classified as non-commercial ($\bar{x}$ = 65.2 ha, N = 10; Student's t = 2.548, 17.1 edf, P = 0.02). Size of non-commercial enclosures classified as private ($\bar{x}$ = 70.9 ha, N = 3) was not different (Student's t = 1.26, 8 df, P = 0.24) from size of those classified as semi-commercial ($\bar{x}$ = 52.0 ha, N = 7).

Fences surrounding fox enclosures were constructed primarily of 5.08- × 10.16-cm mesh welded-wire (62%, N = 16) or 5.08- × 5.08-cm mesh chainlink fencing material (35%, N = 9). Height of fences averaged 1.7 m and ranged from 1.2 m to 2.1 m. Most (85%) were equipped with overhangs at an angle of 45° to 90° from vertical (Fig. 1). Overhangs ranged from 0.5 m to 0.9 m, averaging 0.6 m. Depth of fencing below ground level varied from 0.0 m to 0.9 m ($\bar{x}$ = 0.3 m). Fencing aprons were often connected to the base of the fence and placed flat along or just under the surface of the ground within the enclosure (Fig. 2). Electrically-charged wires were present at 24 (92%) of the fox enclosures sampled. Wires were placed at ground level N = 15, (57%), top of fence (N = 2, 9%), both ground and top (N = 8, 30%), and midway between ground and top of fence (N = 1, 4%).

Fence post spacing ranged from 2.4 m to 6.1 m, with a mean of 4.0 m. Post types included 10.16- × 10.16-cm treated wood, 5.08-cm diameter tubular steel, 2.54-cm steel-reinforcing bar (rebar), split-wood rails, salvaged railroad ties, and live trees.

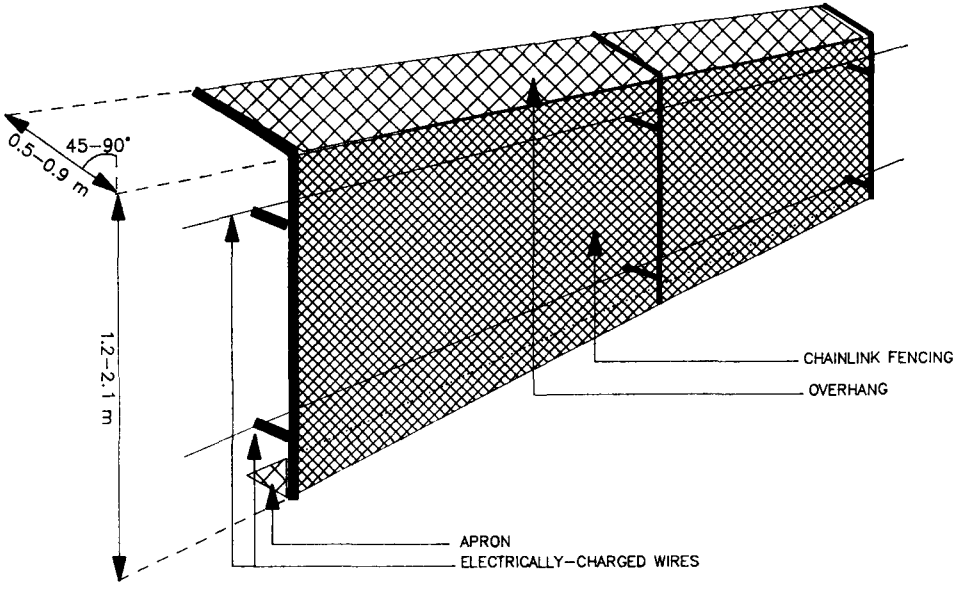

Figure 1. Typical fox enclosure fencing in Florida, 1989.

Construction costs were primarily for materials, while labor was usually provided by operators, friends, and family. Several operators offered a figure of $247/ha ($100 per acre) as a rule of thumb for estimating costs of construction and initial stocking. Prices paid for chainlink fence material were $2.56–$2.76 per meter. At the minimum reported rate, a square 40-ha (minimum legal size in Florida) enclosure would cost $6,511.76 for chain-link fencing, not including posts, gates, overhang material, electric fence, and construction labor.

The quality of construction and maintenance of fox enclosures was judged to be high. Apparently, the price of foxes discourages poor workmanship or maintenance of fences. Condition of fox enclosure fencing was subjectively classified as excellent (55%), good (36%), and fair (9%). Operators inspected fences by driving a perimeter road (median = 30 times/month, range = 2–90 times/month). Some operators (42%) lived adjacent to or within their enclosures, which increased their awareness of maintenance needs. Electric-fence voltages were checked daily. Other maintenance consisted of checking for digging beneath fences, removing fallen limbs, and repairing water damage. Enclosures with periodically wet areas and peat bogs experienced rusting of non-galvanized fencing. One operator dipped rolls of welded-wire fencing in tar before stretching it through wet areas. Three operators reported that flooding creeks washed out portions of their enclosures ≥ 1 time; repairs were made in the rain before any foxes escaped.

Key components of fencing which appeared to contribute to security were the placement of an electrically-charged wire and the use of an apron and an overhang which prevented escape by digging under or climbing over the fence. Although chainlink fencing appeared strongest, fences constructed of 5.08- × 10.16-cm mesh welded wire were probably sufficiently resistant to escape when combined with electric fencing and a daily maintenance schedule.

Fox enclosures contained cypress ponds, field or pastures, pine flatwoods, oak hammock, planted pine, and scrub. Planted pine was found within 58% of enclosures, comprising from 3%–100% of the total area ($\bar{x}$ = 68%). Cypress ponds were found in 46% of the enclosures, making up 1%–47% of the total area ($\bar{x}$ = 14%). Pine flatwoods comprised 25%–100% of the total area ($\bar{x}$ = 80%) of 42% of the fox enclosures surveyed. Fields, oak hammocks, and scrub habitat comprised 19%, 15%, and 11%, respectively, of fox enclosures surveyed. Scrub habitat was a major component (range = 70%–100%; $\bar{x}$ = 89%) of the 3 fox enclosures in which it was found. Oak hammocks and fields comprised 27% and 11%, respectively, of the enclosures in which they were found.

Habitat types within fox enclosures probably were reflective of available land types. However, open land was preferred by operators because it facilitated fast, "hot" chases. The high occurrence of pine monoculture probably reflects its initial openness, convenient dual use for timber production, and prevalence in Florida.

Escape structures for chased foxes were provided in 81% of the fox enclosures surveyed. Commercial fox enclosures provided escape cover as often as non-commercial enclosures. All fox enclosures had natural escape cover, including gopher tortoise (*Gopherus polyphemus*) burrows (69%), fox dens (46%), or trees and/or

thick vegetative understories (100%). Brush pines (50%) were the most frequently provided escape cover in fox enclosures. Barrels (55-gal) with narrow entrances were supplied in 35% of fox enclosures, metal culverts in 31%, and metal and PVC pipes (15.24–20.32 cm diameter) in 31%. Three enclosures (12%) had adjacent, fenced escape enclosures of 2–6 ha, accessible to foxes through dog-proof grating.

The operation of "hunts" within fox enclosures was varied. Dogs were released into enclosures from 1 to 7 nights per week. Some enclosures were rented to individuals or groups on a nightly basis, some were open to the public, while others were more selective of clientele. Nights of the week on which fox enclosures reportedly operated most were Saturday (91%) and Friday (78%). Nights most often operated during the week were Monday (43%) and Wednesday (35%). Several operators stated that alternate-night running allowed foxes to rest.

Fees charged were usually on a per-dog basis and were \$3 or \$5/dog. A minimum fee was charged for nights that an enclosure was rented to an individual or group (usually \$5/dog with a 10 dog minimum). Disparity in fees charged per dog was apparent between western Panhandle enclosures (\$3) and those enclosures east of Tallahassee (\$5). One west Florida operator attributed this disparity to competition with enclosures in south Alabama and Louisiana. Several enclosures were reserved by one or several individuals for a particular night each week. One operator indicated that his fox-hunting enclosure was reserved on Friday and Saturday nights through 1991, and week nights were scheduled 3 months in advance. One operator indicated that his enclosure was utilized almost exclusively for toughening of deer hounds during July and August.

The mean numbers of dogs released in fox enclosures ranged from 6 to 75, with a composite mean of 20.3 dogs. The minimum and maximum number of dogs ranged from 1 to 30 and 10 to 115, respectively. The median maximum number was 22.5 dogs. For all fox enclosures, the maximum number of dogs ranged from 1 dog/8.0 ha to 1 dog/1.3 ha. Commercial enclosures had the highest density of running hounds (1 dog/8.0–1.3 ha, $\bar{x}$ = 1 dog/3.2 ha), similar to semi-commercial enclosures (1 dog/4.8–2.8 ha, $\bar{x}$ = 1 dog/3.5 ha), yet only slightly greater than enclosures classified as private (1 dog/5.3–4.0 ha, $\bar{x}$ = 1 dog/4.7 ha).

Densities of gray foxes in fox enclosures were 3.2–55.6 animals/km^2 ($\bar{x}$ = 18.4 animals/km^2). Densities of red foxes in enclosures were 0.3–46.9 animals/km^2 ($\bar{x}$ = 16.2 animals/km^2). Coyote densities in enclosures were 1.3–46.9/km^2 ($\bar{x}$ = 11.1 animals/km^2). Total density of all canids stocked for chasing in fox enclosures ranged from 5 to 111 animals/km^2 ($\bar{x}$ = 19.6/km^2). Density of stocked animals was greatest in enclosures classified as private ($\bar{x}$ = 28.6/km^2 or 1/3.5 ha), whereas semi-commercial and commercial enclosures had similar, less-dense stocking rates ($\bar{x}$ = 19.6/km^2 and 18.5/km^2, respectively, or 1/5.1 ha and 1/5.4 ha, respectively).

Combined densities of all canid species in enclosures consistently exceed those of wild populations throughout their range. Mark-recapture and radio-telemetry data indicated densities of wild gray foxes in east Florida of 1 fox/km^2 (Progulske 1982). Density estimates of red foxes range from 1/41 km^2 in spring in Iowa (Scott and Selko 1939) to as high as 30/km^2 in an urban area of plentiful food resources in

Great Britain (Harris 1977). Coyotes recently have expanded their range into Florida (Brady and Campell 1983); although numbers appear to be increasing (Wooding and Hardisky 1990), no density estimates are available for Florida. The only density estimate of coyotes in the southeast was 0.35/km^2 in west Tennessee (Babb and Kennedy 1989). In other areas, estimates were 1/km^2 in south Texas (Andelt 1985) and up to 2.0/km^2 in small areas in Kansas (Gier 1975).

Studies of the interspecific spatial relationships of sympatric foxes and coyotes indicate that red foxes living among a low density of coyotes were not regularly harassed by coyotes (Voigt and Earle 1983, Sargeant et al. 1987). However, wild red fox territories tend to be non-overlapping and adjacent (Sargeant 1972) or along the periphery of coyote territories (Voigt and Earle 1983, Major and Sherburne 1987, Sargeant et al. 1987). Preston (1975) found that both wild and zoo-reared red foxes introduced into an enclosure with resident red foxes experienced continual non-physical harassment until locating unused dens. This indicates that the number of dens, or other necessary resources, may limit density.

In this study, using the estimated maximum densities of hounds and the estimated densities of foxes and coyotes within fox enclosures, the number of hounds per animal was 1.2 dogs/animal (range = 0.7–12.8 dogs/animal). Again, the differences in hunting pressure per night among the groups sampled was slight, but apparent: foxes and coyotes in enclosures classified as commercial experienced from 0.7–12.8 dogs/animal ($\bar{x}$ = 1.3 dogs/animal); semi-commercial, 0.7–1.7 dogs/animal ($\bar{x}$ = 1.2 dogs/fox); and private, 0.8–1.1 dogs/animal ($\bar{x}$ = 0.9 dogs/animal).

Dogs were allowed to run in enclosures for 3 to 23 hours, but averaged 5–6 hours. Dogs were usually released shortly after dark (2100–2200 hours). However, some operators claimed to release dogs at 0300–0400 hours when night-time temperatures were coolest. Chases of individual animals were estimated to last 5–45 minutes for gray foxes, 30–90 minutes for red foxes, and up to 5 hours for coyotes.

Running schedules of fox enclosures were dependent upon species of game and weather. During summer, foxes were often chased before daylight, when temperatures were coolest. In cooler seasons, foxes were chased after sundown. The optimal chasing times were apparently based upon the activity patterns of foxes and ambient temperatures. Coyotes were chased both before and after daylight at all times of the year.

Animals stocked in fox enclosures for chasing included red fox, gray fox, and coyote. When 26 operators were asked which species they preferred, 42% preferred coyotes; 27%, gray fox; 19%, red fox; while 12% preferred a combination. Operators considered coyotes faster and more durable than foxes, although red foxes were noted for long chases. Gray fox were considered by operators easier to maintain and could be obtained locally, though illegally.

Nine of 26 (35%) operators acknowledged that coyotes were present in their enclosures although only 1 operator had a current permit, required by Florida law, to possess coyotes. Coyotes were probably present in more fox enclosures than were admitted by operators. Fifty-four percent (N = 14) of enclosure operators said coyotes were preferred exclusively or in combination with foxes.

States listed most frequently as the source of animals for stocking the enclosures

were Florida (35%), Ohio (31%), Alabama (23%), and Georgia (23%). Other sources of animals, ranked by frequency, were Kentucky, Texas, Indiana, Mississippi, Arkansas, Illinois, and South Carolina. Animals stocked in fox enclosures were reported by operators to be wild-caught (77%), wild or pen-reared (12%), or all pen-reared (4%); 2 operators were unsure of the origin of stocked foxes. Condition of animals obtained for stocking was reported as "excellent" by over half (54%) of the operators, as "good" by 31%, and as "fair" by 8%. Prices paid for red foxes ranged from $100 to $165 each, and averaged $138. A single operator reported that the price paid for gray foxes was $25 each. Coyotes were purchased for $100 or $150 each.

Animals were vaccinated by operators or by trappers before being placed in 58% of the fox enclosures; 23% of operators did not vaccinate foxes; and vaccination histories of foxes in 19% of the enclosures were unknown. Vaccines used were standard 7-in–1 or 9-in–1 canine vaccines or, in 1 instance, feline vaccine for gray fox. Worm medicine (Ivermectin or Tramazol) was administered routinely in the food at 77% of the enclosures. Although these vaccines may help to reduce susceptibility of vaccinated individuals, they do not effectively reduce that individual's potential as a carrier. Similarly, worming may temporarily reduce an individual animal's parasite load; however, eggs are often shed in the environment and can cause future infection. Vaccination and worming do not prevent importation of diseases and parasites.

Chunk-style dogfood was the primary food supplied to foxes and coyotes in enclosures. Mean mass of dogfood provided was 43 kg/week, with a range of 9–113 kg/week. Other foods provided by 2 enclosure operators were road-killed animals (11 kg/week), chicken necks and scraps (9 kg/week), and beef lungs (14 kg/week). Mean total mass of food provided per week was 57.1 kg (range = 9.1–113.4 kg/week) and mass of food provided per animal per week was 3.0 kg/animal/week (range = 0.6–12.6 kg/animal/week). Feeding was probably sufficient, and amount fed was similar to ingestion rates reported for wild and penned foxes by Lockie (1959) and Sargeant (1978).

Only 3 operators reported incidences of fox mortality within the first week following stocking; causes of mortality were capture injury, antifreeze poisoning during shipment, and apparent adverse reaction to vaccination. According to operators, most mortality of animals within enclosures was attributed to dogs catching individuals during chases. Highest mortality rates reportedly occurred during field trials when >100 dogs were released into some enclosures. Other sources of mortality include interspecific and intraspecific fighting (usually involving coyotes), distemper and adverse reaction to vaccination, ticks, salmonella poisoning (from spoiled chicken necks), vitamin-A toxicity (from a diet solely of beef liver).

Regulations

In Florida, fox enclosures are regulated by the GFC. Enclosures must be ≥40 ha in size and contain adequate water, food, shelter, and escape cover. Annual

permits are granted free of charge to qualified applicants. Gray and red foxes are protected throughout Florida, necessitating importation of all foxes stocked in fox enclosures. Transportation permits and receipts are required. Coyotes are prohibited in fox enclosures except by permit (permittee must have ≥3 years experience with care of coyotes and must demonstrate adequate fencing).

Suggestions made most frequently by operators were for legalization of coyotes for chasing in enclosures (68%) and use of local gray and red fox (56%). Other suggestions included: (1) no further GFC regulations, (2) require training before granting enclosure permit, (3) have different regulations for commercial fox enclosures, (4) have uniform requirements for all fox enclosures, (5) require electric fencing, (6) require chain-link fencing, require vaccination, (7) require ear tagging of foxes, (8) have frequent GFC inspections of enclosures, (9) prohibit daylight running, (10) limit number of dogs according to size of enclosure, (11) limit number of nights run per week, and (12) have more frequent contact between operators and GFC personnel.

Enclosure operators requested information from GFC about vaccinations, fox diseases and parasites, and most-desirable species composition. A concise list of GFC regulations pertaining to fox enclosures is needed.

In general, hunters were satisfied with the hunt and enjoyed the social experience. Hunter complaints included enclosure crowding and that some enclosures had too few foxes. There was a contempt by hunters as well as operators for individual hounds which intercept foxes chased by other hounds, referred to as "cheating" or "cutting" dogs.

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