Box-trapping eastern coyotes in southeastern Massachusetts

Jonathan G. Way, Isaac M. Ortega, Peter J. Auger, and Eric G. Strauss

Abstract The humaneness of various coyote (*Canis latrans*) capture methods (especially foothold traps) is an issue that has made trapping controversial. In Massachusetts the use of padded foothold traps and snares became illegal in 1996. In response, we tested metal box traps as an alternative capture technique for eastern coyotes in a suburban environment within Barnstable County, Cape Cod, Massachusetts between March 1998–May 2000 and February 2001–April 2002. Box traps were in the field for 7,006 trap days and were set for 1,447 trap days. Trapping effort was 4,458 trap visits. Traps were sprung 447 times, and 387 animals of 12 species were captured. Twenty-two individual coyotes (12 adults, 5 subadults, and 5 pups) were captured 29 times; 3 adults were captured twice and 2 adults 3 times. Coyotes were captured during 11 of 12 months. Few injuries were sustained to coyotes captured in box traps, and no captured animals showed indicators of poor welfare; 1 coyote had minor limb damage, 2 had minor and 2 had moderate tooth damage, and no injuries to the body were documented. Box traps were undesirable to use for capturing coyotes because of trap expense, time involved in baiting and conditioning coyotes to traps, the high rate of nontarget captures, and the fact that it was difficult to capture >1 adult in a social group.

Key words box traps, *Canis latrans*, cage traps, capture, coyote, humaneness, Massachusetts, trapping injuries

Trapping in the United States is controversial; the humaneness of foothold traps appears to be the primary issue dividing pro- and anti-trapping groups (Gentile 1987, Jotham and Phillips 1994, Sahr and Knowlton 2000). Recent international standards have been agreed upon which stipulate acceptable thresholds for injury of captured animals; these agreements highlight the societal importance of using humane capture devices to capture wildlife (Jotham and Phillips 1994, United States of America-European Community 1997, International Organization for Standardization TC191 1999, International Association of Fish and Wildlife Agencies 2000). Previous studies have examined trap-related injuries sustained to wolves (*Canis lupus*) and coyotes (*C. latrans*) in various types of foothold traps and snare devices (Kuehn et al. 1986, Olsen et al. 1988, Gruver et al. 1996, Phillips et al. 1996, Shivik et al. 2000) and have generally concluded that padded foothold traps, when compared among all foothold devices, cause the least amount of damage to canids. Padded foothold traps are typically used to capture wild canids because they are effective when properly set (Linscombe and Wright 1988, Boggess et al. 1990, Windberg and Knowlton 1990, Linhart and Dasch 1992, Phillips and Mullis 1996). Sillero-Zubiri (1996) even used these traps to capture endangered Ethiopian wolves (*Canis simensis*).

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Padded foothold traps and snare devices became illegal in Massachusetts in 1996 (General Laws of Massachusetts, Chapter 131: Section 80A). Therefore, with foothold traps and snares now illegal and other means of capturing coyotes, such as helicopter netting, unsuitable in heavily forested or suburban areas (Gese et al. 1987), the use of box traps remains one of the few legal ways to live-capture coyotes in Massachusetts. Box traps are effective in capturing raccoons (*Procyon lotor*; Gehrt and Fritzell 1996), American martens (*Martes americana*; Naylor and Novak 1994), lynx (*Lynx canadensis*; Mowat et al. 1994), and bobcats (*L. rufus*; Fuller et al. 1995); however, these authors did not recommend use of box traps because of difficulty in transporting and high cost.

Because of the effectiveness of foothold restraining devices, box traps have historically not been used to capture wild canids. Additional anecdotal evidence indicated that box traps were not efficient for capturing coyotes (Thompson 1976; United States Fish and Wildlife Service 1978; Wade 1983; Garrett 1988, 1999). However, Baker et al. (1998) captured 168 red foxes (*Vulpes vulpes*) in baited box traps in urban backyard gardens in a 1-km^2 study area in northwestern Bristol, United Kingdom from 1990–1994. Except for one study describing capture of coyote pups from dens using a modified box trap (Foreyt and Rubenser 1980), we did not find any published studies that had empirically documented the trapping success or injury rate of large canids in box traps. However, the Department of Animal Control in Los Angeles County (LADAC), California, in 16 years of effort, captured 545 coyotes in box traps for control purposes (D. Kroeplin, LADAC, Los Angeles County, Calif., personal communication). Using, on average, 20 152.4 × 50.8 × 66.0-cm Tomahawk box traps (Tomahawk Live Trap Co., Tomahawk, Wis.) per day, the LADAC reported capturing coyotes of all ages and of both sexes, including lactating females, during all seasons.

The objective of our study was to evaluate box-trapping for capturing coyotes in a suburban area in southeastern Massachusetts. Herein, we also report injuries sustained to coyotes captured in box traps.

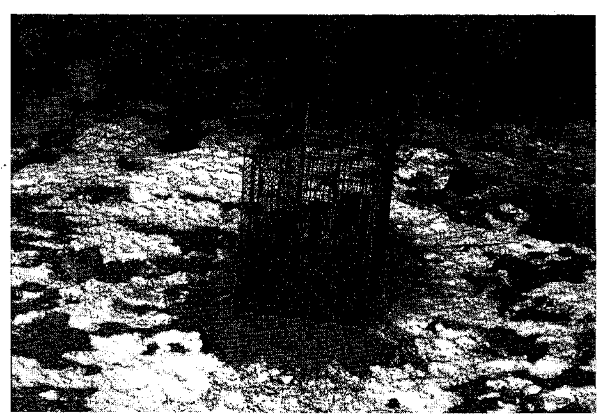
Study area

We conducted research between March 1998–March 2000 and February 2001–April 2002 within Barnstable County, Cape Cod, southeastern Massachusetts (approximately 250 km^2). The Town of Barnstable (155.5 km^2) was the core study site. Estimated human density in the Town of Barnstable was 290/km^2, whereas the entire Barnstable County had an average density of 203/km^2 (Cape Cod Commission 1998). The greatest human density in the study area was in Hyannis (556/km^2). Road density, defined as centerline km of roadway per km^2, was 4.7 for the Town of Barnstable and 4.0 for Barnstable County (Cape Cod Commission 1998).

Cape Cod (Barnstable County) was a man-made island (1,025 km^2) separated from the rest of Massachusetts by the Cape Cod Canal (<1 km wide × 15 km long). Two bridges, each approximately 1 km in length, enabled vehicle travel on and off Cape Cod. The Town of Barnstable was located within 15 km of the bridges at the western part of the Cape. The region was classified as a coastal temperate climate dominated by a subclimax forest of scrub oak (*Quercus ilicifolia*) and pitch pine (*Pinus rigida*).

Methods

We chose trapping areas based on reported coyote sightings or directly documented activity (i.e., tracks, scats, direct observations). We often prebaited an area before traps were initially deployed (Tomahawk models 610A [121.9 × 50.8 × 66.0 cm], 610B [152.4 × 50.8 × 66.0 cm], 610C [182.9 × 50.8 × 66.0 cm], and 109 [106.7 × 38.1 × 38.1 cm]). When coyote activity was detected, we deployed traps typically in areas of lower human density (e.g., small wetlands, the backs of cemeteries, adjacent to railroad tracks and powerlines, conservation areas). We spaced traps relatively evenly throughout the study area, including Hyannis, the most urban part of Cape Cod. Distance between



Wild eastern coyote box-trapped on Cape Cod, Massachusetts.

trap sites was usually a minimum of 4-5 km in an attempt to capture different coyote social groups (Way 2000).

We concealed box-trap bottoms with material that occurred naturally near deployed traps (e.g., soil, leaves, pine needles, grass, mulch, snow) to prevent animals from walking on metal and to stabilize the traps. We observed that coyotes did not approach the front of a trap when bare metal was exposed on the ground. Traps were not staked down, so they could be easily and quickly transported to different sites. Sides and tops of traps were left exposed, with the idea of keeping traps as open in appearance as possible. We kept trap doors wired open until set for capture. Signs alerting the public to this study were placed on traps or nearby trees.

Bait consisted of supermarket meat scraps, domestic chickens, and road-killed animals (mainly gray squirrels [*Sciurus carolinensis*], woodchucks [*Marmota monax*], and cottontail rabbits [*Sylvilagus floridanus*]). We did not use road-killed opossums (*Didelphis virginiana*) or raccoons as bait because, except during the middle of winter, coyotes did not regularly eat them even when placed outside of traps (J. G. Way, unpublished data). Bait was initially placed outside traps until sign indicated coyotes were taking the scraps. We then gradually placed the bait inside the trap and, eventually, behind the trap pan. We initially wired bait to the top rear of cages to increase the probability that animals would step on trap pans and trigger the traps, but we quickly captured a large number of American crows (*Corvus brachyrhynchos*) using that technique. Therefore, we placed almost all bait on the ground behind the trap pan. Typically, when all bait (including bones) was gone, we felt that coyotes were present. In many cases this was confirmed by coyote tracks and scats found at trap sites. We did not document any other species that consumed all of the bait. Traps were usually not set for capture until we were confident that coyotes were consistently taking bait from the back of traps. Generally, we baited traps for 2-3 months (conditioning period) and checked them every 2-3 days until we decided they were ready to be set; between March and mid-May 1998 and February and mid-May 2001, all traps were wired open to condition coyotes to them.

We did not conceal human scent, for 2 reasons. First, we had to regularly walk around (and sometimes crawl inside) box traps to bait and re-bed the trap in order to make it functional (raccoons, when captured, would commonly dig and scratch throughout the trap). Second, box traps were exposed (unlike foothold traps, which are hidden in the ground); thus, coyotes knew traps were there. Plastic gloves were mainly used to handle and transport raw meat (i.e., they were not used for purposes of covering up human scent when handling traps). It appeared that coyotes were aware of human scent and became conditioned to humans being around trap sites (all bait would regularly be eaten by coyotes if put immediately outside traps). We did, however, stay away from the traps whenever possible (e.g., if a trap was unsprung, set for capture, and baited sufficiently, we would stay >3.5 m away the trap when we checked it).

We did not use a specific pan-tension device (Phillips and Gruver 1996) to influence the capture of heavier animals such as coyotes. We set traps during all seasons and weather conditions and checked traps twice daily when set for capture. The first check was as close to dawn as possible, and the second was just before dusk. Only coyotes were individually identified because they were given a radiotag (i.e., implant or collar); thus, all noncoyote captures reported herein are number of captures of a particular species. When certain noncoyote species (primarily raccoons, dogs, opossums, and crows) were repeatedly captured at the same trap site, we moved traps within 1-2 weeks.

We defined a "capture" as an instance in which an animal was trapped and held until the next trap check (Skinner and Todd 1990). We defined a "trap day" as one trap being in the field for one 24 hr-period. We defined "trapping effort" as the number of times trap sites were visited by researchers (e.g., pre-baiting, baiting wired open traps, checking traps twice/day when set). We defined "capture efficiency" as captures/1,000 set trap nights (Skinner and Todd 1990) and "effort efficiency" as captures/1,000 trapping efforts. We did not calculate "capture rate" (number of captures per potential captures of that species), because we could not (except in fresh snow) always determine when an animal stepped on a trap pan and did not cause the trap door to shut, or, if there was an empty trap, what animal escaped.

We immediately released noncoyote captures, whereas we gave captured coyotes a hand-held intramuscular injection of 8 mg of telazol® (A. H. Robins Co., Richmond, Va.) per kilogram of estimated coyote weight based on body size. All animals over 1 yr old, based on body size and dentition, were classified as adults (Bekoff and Jamieson 1975). Subadults were animals 8–<12 months of age.

We recorded all limb, oral, and body injuries sustained to coyotes captured in box traps (Engeman et al. 1997). After handling, we placed coyotes back in box traps to recover from sedation. We covered traps with blankets, which appeared to calm coyotes, judging by lack of movement and noise in traps. We checked coyotes every 1–2 hr while they recovered from sedation. We did not release coyotes from traps until they were fully recovered and alert (approximately 6–12 hr after capture and handling). We released all coyotes within 24 hr at their respective capture sites, except for 1 juvenile with mange that we rehabilitated (WildCare, Brewster, Mass.) for 6 weeks before releasing.

Results

Generally, 5–6 traps were operable each of 1,146 field days during 7,006 trap days (TD). Traps were wired open for 5,559 TD and were set for 1,447 TD. Trapping effort was 4,458 trap visits. We captured 387 animals in 447 sprung traps; traps were sprung 74 times without a capture. We captured 134 raccoons, 65 American crows, 51 opossums, 43 striped skunks (*Mephitis mephitis*), 29 coyotes, 22 domestic dogs, 21 domestic cats, 9 red foxes, 6 red-tailed hawks (*Buteo jamaicensis*), 4 gulls (*Larus* spp.), 2 northern harriers, (*Circus cyaneus*), and 1 muskrat (*Ondatra zibethicus*), including 9 pairs of crows, 2 pairs of raccoons, and 3 raccoons (an adult female and 2 juveniles) that were captured together. We commonly noted turkey vultures (*Cathartes aura*) close to traps, but none were captured during the study.

Twenty-two individual coyotes (12 adults [5 M, 7 F], 5 subadults [4 M, 1 F], and 5 pups [3 M, 2 F]) were captured 29 times; 3 adults (1 M, 2 F) were captured twice and 2 adult females 3 times. Of the 5 coyote pups, 4 were captured during the summer and 1 during the fall. All coyotes were captured at night. Coyotes were captured during all months except September. Five coyotes were captured during May and 4 during January, March, and June. Capture efficiency was 20.0/1,000 set TD and effort efficiency was 6.5/1,000 trap visits. Fourteen coyotes were captured in model 610B traps (n=3) and 15 in model 610C traps (n= 4). Trap models 610A and 109 each captured 1 coyote (an adult female and a 4-month-old pup, respectively).

Coyotes suffered few injuries in box traps, and no captured animals showed indicators of poor welfare. Two (8%) of the 24 adult and subadult captures (including recaptures) moderately injured teeth by biting on the trap; one lost half of a lower canine and an entire incisor, and the other chipped 2 lower canines to the gum line. One of these adults was recaptured and had no further injuries. Another adult had a chipped canine tooth that appeared unrelated to its capture. Of 4 pups captured during summer, 2 had minor tooth-chipping damage from biting on traps. One (4%) adult had superficial cuts on 1 paw; it was seen running without a limp the night of its release and for the rest of the study period. No injuries to the body were documented for any captured coyotes. One juvenile had mange when captured but did not have any trap-related injuries. The 3 adult coyotes with visible trap-related injuries were still alive as of 31 March 2002 (2 were originally captured in 1998, the other in 1999).

We did not capture >1 adult in a coyote social group within 1 yr of each other. When more than 1 coyote were simultaneously radiomonitored in the same social group, it was because an adult(s) and pup were both radioinstrumented (n=3), 2 adults were captured >1 yr apart (n=2), 2 adults originally captured in separate social groups pair bonded during the study (n=2), or 2 pups were radioimplanted (n=1). Additionally, 3 adult-subadult combinations were captured within 2 months of each other. However, 2 of the subadults were captured away from their group's territory, to which they subsequently returned (J. G. Way, unpublished data); the third coyote was captured on its territory, but that group was conditioned to 2 traps; the subadult was captured in 1 trap and the adult in the other.

Discussion

Box-trap techniques

Box traps were undesirable for capturing coyotes. Although our box traps caught some animals, they were expensive, frequently caught other species, and required lengthy (months) and labor-intensive pre-baiting periods. An additional and important drawback to using box traps to catch coyotes was their ineffectiveness at catching >1 adult member of a social group.

When the use of box traps is necessary, we would recommend use of the Tomahawk model

610B trap. It was long enough to effectively capture coyotes and much easier to transport in the bed of a pickup truck than the 610C. The model 610A trap was too short for eastern coyotes and contained inadequate space between the trap pan and the rear door for bait. The smaller and lighter model 109 trap might be effective in capturing pups at known den and rendezvous sites until they are 4 months old (Parker 1995, Way 2000).

We made little effort to cover the top and sides of the traps, believing that covering the traps would make it less attractive to coyotes because it would tend to enclose the area. Uncovered traps might have appeared bigger and more open because animals inside the trap were able to see around them. O'Farrell et al. (1994) concluded that it was easier to capture rodents using an open trap (mesh) that could be seen through rather than an enclosed box (Sherman trap). However, additional research should investigate the effects of covered box traps in order to evaluate the success of capturing coyotes under a variety of circumstances. Also, efforts should be directed toward the design of wider and taller traps (152.4 cm was sufficient length). There is a large variety in available trap sizes, and these traps, which are untested, are worthy of future investigation. Logically, it seems that the bigger an opening, the more likely an animal as wary as the coyote will be to enter the trap (Garrett 1999).

We did not record the number of times a trap was approached and avoided by coyotes (Skinner and Todd 1990, Mowat et al. 1994), because we tried to keep the area around traps as natural as possible. We did not consistently find tracks near a trap unless there was snow on the ground or coyotes dug at the trap site. We usually knew that coyotes visited the trap site by the amount of bait remaining. Coyotes were the only species in this study area that would consume all the bait (including bones). Domestic dogs occasionally hauled bones away (based on direct observations and finding partially consumed bones near where dogs were last observed) but were not documented to consume all bait at a site. We usually waited for all bait to consistently be consumed behind the trap pan before setting traps. We believed it was important to keep traps unset but baited for a length of time because non-coyote species (e.g., raccoons, opossums) were quickly captured.

In some instances coyotes and possibly other species (e.g., raccoons) managed to close trap doors without being captured. Possible reasons included: 2 animals going into a trap with 1 tripping the trap door onto the other and both managing to escape, or an animal moving a trap from the outside, causing the door to close (staking traps into the ground to stabilize them may have reduced this problem). Coyotes also seemed to avoid trap sites when a sprung trap and fresh animal activity were noted nearby. We believe that many, if not most, of the sprung traps were due to humans letting their pet dogs out of the box traps or possibly because people did not realize traps were there for research purposes.

Our capture efficiency rate for eastern coyotes was higher than values from Person's (1988) study that used padded leghold traps to capture eastern coyotes in nearby Vermont, Skinner and Todd's (1990) project that used padded and unpadded foothold traps and footsnares to capture coyotes in Alberta, Canada, and the LADAC effort that used box traps to control problem coyotes. However, these numbers are misleading because other studies expended considerably more effort, given that foothold traps are less expensive than box traps (thus it is possible to have more foothold traps) and foothold traps are set for capture when in the field. For example, Skinner and Todd (1990) had over 6,600 TD for each of 4 trap types and the LADAC (D. Kroeplin, personal communication) had an estimated 116,800 TD (16 years of trapping using 20 traps/day). To reduce their effort, the LADAC required homeowners to check deployed traps (which were always set when in the field) twice per day (D. Kroeplin, LADAC, personal communication). Because we usually spent over 2 months driving to traps an average of 2–3 times per week to condition coyotes to open traps, and checked traps twice per day when set, we also included trapping effort in our results, which would be comparable to using foothold traps that have to be checked every day they are in the field. Our effort efficiency (6.5) was much closer to the capture efficiency values of 4.7 for the LADAC; 4.4 for Person (1988), who prebaited but did not include those values in his trapping data; and 3.0 (varying from 1.5–4.8 for different footholding devices) for Skinner and Todd (1990). Therefore, we believe that our results, based on trapping effort, are more realistic (i.e., than capture efficiency values). The long conditioning period, coupled with the low number of expensive traps (n=5–6), severely limited our efforts to capture a large sample size of coyotes. Rather, we focused on capturing specific animals in specific areas, which is typical of coyote control efforts as opposed to typical fur-trapping activities.

We captured coyotes during 11 of 12 calendar months but did not gather enough data to statistically compare capture efficiencies among months. Effort (trap visits) differed among months, but a few observations are noteworthy. Generally, more effort resulted in more captures. An exception was March, when only 53 set TD resulted in 4 captures. Although 6 coyotes were captured in June and July combined, 3 of the animals were pups, 2 adults were conditioned to traps from March–June before the traps were finally set for capture, and the sixth coyote was a recapture; prior trap experience may have influenced her capture. Future long-term studies should collect sufficient monthly data to accurately assess whether certain months are better for capturing coyotes. Food is often less available during late fall and winter, and pups are more vulnerable in June and July because they are making the transition from living in a den to foraging on their own (Parker 1995).

Coyote pups became wary of traps. Once a pup was captured, the other pups in a litter stayed away from traps. In addition, 1 adult female that was recaptured in April (and was not sedated or handled) clearly avoided box traps after that incident. Andelt et al. (1985) found that coyotes were seldom retrapped after initial capture. A significantly lower visitation rate on their study area suggested that trap-shy adults relayed this information to group members.

It was rare to capture a second adult coyote in an existing social group. In general, it appeared that once a coyote social group (typically consisting of 3 animals [Way 2000]) saw one of its members get captured in a box trap, the rest of the animals avoided the traps for an extended period of time. Thus, we are convinced that it is not possible to use box traps to capture and radiomark coyotes with the purpose of capturing as many as possible in a small area. However, it was significant that 2 coyotes (a subadult and an adult) were captured within 2 months of each other in the same territory using 2 traps; future studies should determine whether it is feasible to condition coyote groups to multiple traps in order to capture multiple group members.

The recapture of adult coyotes was not expected. However, all of the animals were anesthetized during their original capture. It seems possible that sedated coyotes might have forgotten what happened or been confused by the whole event, especially since they were able to get out of the trap (i.e., when released). Possibly, some animals repeatedly entered traps because of food rewards associated with the traps.

Future research should investigate untested capture methods (*see* Schemnitz 1994) such as large cage traps, corral traps (Mace 1971, Rempel and Bertram 1975), or netting (Okarma and Jedrzejewski 1997) to capture coyotes in jurisdictions that prohibit the use of foothold traps and snares.

Injuries

Although injuries sustained by coyotes captured in box traps in our study were minor when compared to reported limb and oral damage from foothold traps (Van Ballenberghe 1984; Kuehn et al. 1986; Olsen et al. 1986, 1988; Onderka et al. 1990; Phillips et al. 1996), we noted that coyotes did have the potential to injure themselves, especially their teeth and mouths, when caught in metal box traps. Additionally, because their limbs were not restrained when contained in box traps, coyotes had the potential to gain momentum and injure their bodies against the sides of cages.

It should be noted that we checked our traps twice per day, whereas previous researchers using foothold traps checked theirs once per day (Linhart et al. 1981, 1988; Person 1988; Skinner and Todd 1990). Although frequency of trap checks may affect the severity of injuries sustained to captured animals, all coyotes in our study were captured during the night and found the next morning during the dawn trap check. Therefore, our dusk trap checks were done mainly to make sure the trap was functional for the night. In other words, we do not believe that our twice-a-day trap-check schedule prevented injuries to coyotes when compared to previous studies.

Although differing devices, methods, and criteria were used among prior research to assess trap-related injuries in canids, we documented fewer injuries than in other studies (Van Ballenberghe 1984, Kuehn et al. 1986, Olson et al. 1988, Onderka et al. 1990, Phillips et al. 1996). Future studies should conduct a comparison of injuries sustained to coyotes captured in foothold and box traps and snare devices (Mowat et al. 1994) to account for differences between prior research projects.

Although we documented few oral injuries, we still recommend the development of wire that is strong enough to contain captured coyotes but minimize tooth damage (possibly by being soft or pliable or by having closer mesh or wires). We believe traps need to be large to capture coyotes effectively; thus, there will always be a tradeoff between optimum cage size for capture efficiency and minimum size to restrict movement to prevent injury. Because coyotes did not injure their bodies in the traps, we recommend using bigger box traps with the wire type mentioned above.

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