SURVIVAL OF 8-WEEK-OLD WILD EASTERN COYOTE PUPS FOLLOWING THE DEATH OF THEIR MOTHER

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Abstract: I monitored the survival of four 8-week-old eastern coyote (*Canis latrans*) pups after the death of their mother on Cape Cod, Massachusetts. At least 2 other adults were observed with the pups until the age of independence in September. This note documents the breeding female's death and the subsequent survival of her pups past the age of independence.

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A typical coyote (*Canis latrans*) social group consists of a breeding male and female plus from 1-5 resident associates (also called helpers or betas), which are usually older offspring that delay dispersal in order to assist their parents, to gain experience in raising their younger siblings, and to remain on a familiar territory (Andelt 1985; Harrison 1992*a,b*; Gese et al. 1996*a*; Crabtree and Sheldon 1999*a,b*; Patterson and Messier 2001; Way et al. 2002*a*). In undisturbed areas, coyote packs can be as large as 10 members (Gese et al. 1996*a,b*). During the first few months of a pup's life the breeding female is the most important member of a coyote family because she must nurse dependent pups (Harrison and Gilbert 1985, Parker 1995) that are not weaned until 6-8 weeks of age (Parks 1979, Silver and Silver 1969). However, prior to weaning, other pack members in addition to the breeding female bring food back to den sites and regurgitate it to the pups which begin eating solid food at about 3 weeks of age (Ryden 1975, Andelt et al. 1979, Mech et al. 1999, Parker 1995). Despite considerable research on coyote sociality, the lower age limit after which pups can survive without their mother is unknown. Mech (2000) reported that wolf (*Canis lupus*) pups in Minnesota could survive on their own when only 4-5 months old (Aug - Sep). Because coyotes in many areas suffer high mortality rates (Parker 1995) it is important to study survival of coyote pups under different conditions. This note documents the survival of 8-week-old coyote pups after the death of their dam during summer 2001 in the Town of Barnstable, Cape Cod, Massachusetts (Fig. 1).

METHODS

Average human density on the study site was 290 people/km^2 and road density was 4.7 km of roadway/km^2 (Cape Cod Commission 1998). Observations from this social group (the Centerville pack, Fig. 1) began on 20 May 2001 when a

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thin, lactating, yellowish-gray 15-kg female coyote (ID#0104) suffering from a mild case of sarcoptic mange was captured in a box trap (model 610C, 182.9 cm x 50.8 cm x 66.0 cm, Tomahawk Live Trap Co., Tomahawk, Wisconsin, USA; Way et al. 2002*b*) in a suburban yard and radiocollared as part of an ongoing study of eastern coyote ecology on Cape Cod (Way et al. 2002*a*, Way et al. 2004). To treat her for ectoparasites, I applied a topical dose of Frontline® (Merial Limited, Duluth, Georgia, USA) to the skin of her neck at the dosage for a 10-kg domestic dog.

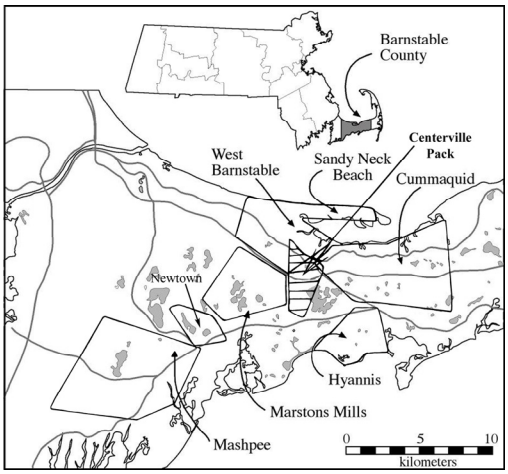

Fig. 1. Study area showing principal locations, main roads, and coyote packs within Barnstable County, Cape Cod, Massachusetts, 2000-2002. The range of the Centerville pack is stippled. Inset is a map of Massachusetts with county boundaries.

Tracking protocols were described by Way et al. (2002*a*) and Way (2003). Portable receivers (Custom Electronics, Urbana, Illinois, USA) and hand-held 3-element Yagi antennas were used to radio-track coyotes both on foot and from a vehicle. I approached radio-collared coyotes as close as possible without disturbing them. I used binoculars, 15-45x spotting scopes, and video-cameras when observing coyotes at den and rendezvous sites (Way et al. 2001, Way 2003), and spotlighting and headlights when following coyotes at night with a vehicle (Way et al. 2002*a*, Way et al. 2004).

Collared coyotes were often seen with untagged companions. A detailed description (size, color, distinguishing markings, and behavior) of the uncollared animals was made during every direct observation. In this manner, the unmarked coyotes were identified based on appearance, as described by Way et al. (2002*a*). Overall, I identified as many coyotes as possible from the Centerville group and other groups within the study area (Way et al. 2002*a*, Way 2003).

RESULTS

Two days after capture (22 May 2001), female #0104 was found localizing in an area 4.4 km north (straight-line distance) of her capture location (Figs. 1 and 2). On 29 May 2001 a litter of 4 healthy, approximately 7-week-old pups was observed at a wooded den site tended by #0104 just 400 m north of Cape Cod's only major highway (Route 6). The pups were all light brownish in color. The den was situated on the top of the southeast side of a natural hill with a bowl-like ravine to the immediate north of the den. I observed the pups for a total of 3 hours during 4 separate periods of time at this den site.

On 30 May 2001, #0104 was recaptured at the same trap site as her initial capture (Fig. 2) and was released without handling. After release, #0104 traveled 4.4 km predominantly through neighborhoods, crossed the 4-lane highway, and returned to the den site in

daylight. Previous data with other known breeding female coyotes indicated that only dams with dependent pups made brazen movements during the daytime (Way et al. 2004). Based on 35 radio-locations taken 6 hours apart (time determined for independence between locations; Way et al. 2001) between 20 May and 8 June 2001, it became clear that #0104 regularly bedded down near the den during the day then crossed the 4-lane highway at night and foraged in suburban neighborhoods. During this time span, #0104 was located at the den site on 56% of 27 independent locations. At noon on 8 June 2001, #0104 attempted to cross Route 6 and was struck and killed by a vehicle (Fig. 2). Inspection of her carcass indicated she was healthy and appeared to be recovering from the mange. Her drying mammary glands indicated that she had completed lactation. Following #0104's death, I irregularly (once or twice per week) provided bait (meat scraps and road-kills) near a box trap situated within 300 m of the den site in order to feed the pups (at least indirectly via the other adults regurgitating to them) with the aim of eventually catching one of them.

In late May and early June, coyote #0104 was observed and videotaped with 2 other coyotes on 3 occasions: one was brown in color and also suffered from mange (named "Rope-tail"), the other was robust and was light gray in color (named "Gray Male"). Based on behavioral observations of submissiveness around #0104 and Gray Male, Rope-tail was most likely a resident associate or helper coyote, whereas Gray Male appeared to be the breeding male. Gray Male was observed raise leg urinating on a shrub, which indicates dominance in canids. I could not identify Rope-tail's gender.

I made 10 additional observations of

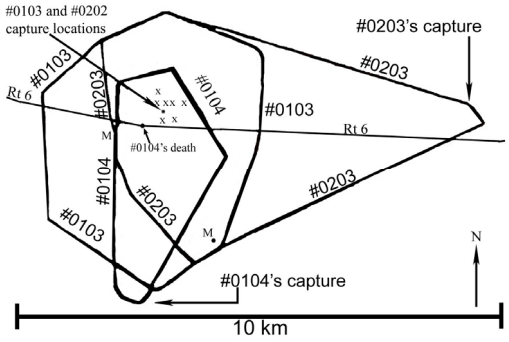

Fig. 2. Detailed map of the range of the Centerville pack Barnstable County, Cape Cod, Massachusetts, 2001-2002. 'M' refers to sightings of #9902; 'X' indicates sightings of coyote pups during summer 2001 after the death of #0104. #0203 was captured off the group's range within the range of the Cummaquid pack. Home range sizes during the study period were: #0104, 7.6 km^2 ; #0103, 18.8 km^2 ; #0203, 22.7 km^2 .

the Centerville group during summer and early fall 2001. In addition, I received reports from landowners that 4 pups were seen with 2 adults on a complex of 3 2-ha cultivated cranberry bogs that were all within 300 m from the original den site. Observations indicated that the remaining two adult coyotes were tending the pups. One sighting of 4 pups and 2 adults took place during early September, when pups typically become independent (Harrison 1992*a*, Parker 1995). The pups were all light brownish in color and based on video analysis the adults appeared to be Rope-tail and Gray Male.

On 22 December 2001, an 18-kg gray adult male (#0103) was captured within this group's rendezvous site; based on appearance, age (adult, >2 years old), and behavior when released, it appeared to be Gray Male. In addition, subsequent video analysis indicated a close affinity between the appearance of #0103 and that of Gray Male including a grayish color with black

tipped fur, a white chest, a light white shoulder stripe, and a dark tipped tail. Coyote #0103 focused his activities around this group's summer rendezvous site (Fig. 2) and was observed traveling with 2-3 other coyotes, including #9902 (originally collared 27 February 1999), a 13.4-kg distinct white and brown adult female that was originally part of the Hyannis group earlier that summer (i.e., when coyote #0104 was still alive). Coyote #9902 was displaced from her original group in Hyannis (Fig. 1) during late summer 2001 (based on direct observation and wide ranging movements previously not documented for her - J. Way, unpublished data) and joined #0103 that fall around the same time that her collar failed. Based on behavior around other coyotes (n = 4 observations), #0103 was the dominant male of the pack and #9902 appeared to be vying to be his mate.

On 23 February 2002, #0203, a 15.9-kg grayish-brown male, which was aged at 10 ½ months based on tooth wear (Landon et al. 1998), was captured within the Cummaquid pack's range (Figs. 1, 2). However, two days after capture, #0203 was found with #0103; subsequently the two were found together 59% of 49 locations into early summer 2002 (Because #9902's collar failed I had to make visual observations of her; I did not observe #9902 with #0203). Besides #0103, coyote #0203 was observed with 1-2 other light brown coyotes within the rendezvous site on 4 separate occasions during winter 2002.

DISCUSSION

I assumed that #0203 was on a predispersal foray (Way et al. 2002*b*, Way et al. 2004) when captured and then subsequently returned to his natal range. Way et al. (2002*a*) and Way et al. (2004) noted that young coyotes regularly leave their natal range and return within a day or two. Coyote #0203 looked similar to the juveniles observed within the Centerville group and also like #0104 and #0103; it is highly probable that he was an offspring from the 2001 litter – genetic testing is underway to verify this (B. White, Trent University, unpublished data). I noted that other offspring (n = 4) from known parents (i.e., when all 3 were radio-collared simultaneously) in eastern Massachusetts looked similar to their parents, yet distinct from other coyotes within this study area.

Coyote packs typically form when pups delay dispersal to remain with their natal pack (Harrison 1992*a,b*; Way 2003). The present observation provides evidence that at least two pups (including #0203) survived well past the summer. It is possible that others from the original litter dispersed after becoming independent in early fall 2001. However, this observation should be treated conservatively since providing bait near or in the box trap had an unknown influence on the coyote pups' survival.

This observation suggests that ≥2 coyotes other than the mother raised these pups from a young age. It has been recorded that single female coyotes are capable of raising pups (Sacks and Neale 2001), so perhaps the survival of 8-week-old pups without their mother should not be surprising given that other group members, such as the female's mate and beta animals help raise young (Way et al. 2001). Nevertheless, the observation described here combined with the territorial nature of coyotes (Messier and Barrette 1982, Person and Hirth 1991, Patterson and Messier 2001, Way et al. 2002*b*), provides evidence that pups from

#0104's 2001 litter survived past the critical period of 5 months (Harrison 1992*a*), and that some stayed within their territory until adulthood (e.g., #0203 and a second brown young looking coyote traveling with #0203 were observed on 29 March 2002).

No doubt the actions of Gray Male (probably #0103) and Rope-tail facilitated the survival of the pups. Assuming that Gray Male and Rope-tail were related to the pups or the deceased female (probably her mate and an older offspring, respectively) the increased fitness (Hamilton 1964) that the adult coyotes would receive from raising related offspring would provide an incentive for them to tend this litter (Moehlman 1979).

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