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Cross-fostering in coyotes: Evaluation of a potential conservation and research tool for canids

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ABSTRACT

Cross-fostering has been attempted opportunistically with endangered canids as a means of increasing populations. Due to the usefulness of cross-fostering for conservation, an understanding of factors influencing success rates is essential. Using captive coyotes (*Canis latrans*) as a model, we assessed the willingness of adult pairs to foster young born to other parents. We assessed the efficacy of fostering pups into existing litters (augmentation) and completely switching litters (replacement). We augmented four litters with two pups of similar age when pups were <7 days old. In addition, we replaced four entire litters when pups were <10 days old. We also augmented litters with pups 3–4 and 6–7 weeks of age. Survival, weight gain, and dominance status of pups were monitored for six weeks and compared to four control litters to determine success. All complete litter replacements were successful with survival rates among replaced pups (89.5%) similar to those of control litters (90%). For augmented litters, pup survival was dependent on the age at which fostering occurred. All pups fostered into 4 litters at <1 week of age survived beyond 6 weeks of age, two of three fostering attempts with 3–4-week-old pups succeeded, while neither of two attempts to foster 6-week-old pups succeeded. Surviving fostered pups appeared to be at no disadvantage. Weight gains were similar for pups in all treatments, and there was no evidence of reduced dominance status among fostered pups as compared to natal pups in the same litters. These results illustrate that genetic relatedness is not essential for successful fostering and does not appear to alter dominance patterns; however the age at which pups are fostered may affect the success of fostering attempts.

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1. Introduction

Cross-fostering, the rearing of non-maternal young by either intraspecific or interspecific surrogate parents, is a potentially useful tool in conservation efforts and research. However, current information on fostering success in canids is limited to anecdotal records and opportunistic attempts. There is little documentation of the inclination of canids to engage in cross-fostering or the factors enhancing or pre-

cluding the acceptance of foreign offspring by reproductive females.

Cross-fostering laboratory animals, especially rodents, has been used to study density effects as well as the effects of genetic, behavioral, and nutritional regimes (e.g., Christian and Lemunyan, 1958; McGuire, 1988). For example, Huck and Banks (1980) found interspecific cross-fostering of two species of lemmings (*Dicrostonyx groenlandicus* and *Lemmus trimucronatus*) resulted in altered adult social preferences and behavior.

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Cross-fostering has been used in bird species to evaluate kin recognition and mate choice (Clayton, 1987; Todrank and Heth, 2001; Slagsvold et al., 2002). Fostering has also aided conservation efforts in marsupials (Sterneberg and Rose, 2002), birds (Powell and Cuthbert, 1993; Drewien and Bizeau, 1977), and rodents (Murie et al., 1998).

Cross-fostering of canid pups has several applications for enhancing reproduction in recovery programs of threatened and endangered species. Fostering young can aid conservation efforts by introducing captive-bred young into wild populations to increase the population numerically (US Fish and Wildlife Service, 2004a) or enhance genetic diversity, and provide rearing opportunities for wild young that have been orphaned. Introducing animals into a population as pups allows them to learn natural behaviors, increasing their chances of survival and successful reproduction over animals introduced as adults (US Fish and Wildlife Service, 2004b).

Cross-fostering has been attempted in captive canids during opportunistic events. Fostering attempts have been made in red wolves (*Canis rufus*) with all fostered wolves surviving to weaning (Waddell et al., 2002). In addition, the litter of a female gray wolf (*Canis lupus*) was introduced to another female who had had her pups removed (Goodman, 1990). There have been occasional attempts at cross-fostering canid pups into wild populations. One of two red wolf pups fostered into a wild litter in 1998 survived to weaning (Waddell et al., 2002).

Two captive-born red wolf pups were inserted into a wild litter of two pups in 2002 (US Fish and Wildlife Service, 2004a). Both pups were accepted by the foster mother, remained with the pack, and were seen to exhibit natural behaviors as yearlings. Cross-fostering has also been attempted with Australian dingoes (*Canis familiaris dingo*, pers. comm. L. Corbett) and the endangered African wild dog (*Lycan pictus*, McNutt personal communication). In 2002, one 6-week-old African wild dog pup was introduced into a litter of five pups. The mother nursed the pup immediately and the pup was still alive two months later.

Thus, there are good indications that cross-fostering can be successful in canids as a population management strategy for threatened and endangered species, and as a tool to facilitate experimental designs. However, information is needed on the success rates and factors influencing success of fostering procedures, especially in threatened species for which controlled studies are logistically difficult. While the coyote (*Canis latrans*) is not threatened, the species makes a good model for other canids. Coyotes share numerous behavioral and physiological attributes with other threatened canids that are relevant to the likelihood of success of fostering, including dominance hierarchies, territoriality, and social suppression of reproduction (e.g., Macdonald and Sillero-Zubiri, 2004). Mating patterns and parental care are often similar among canid species; the pervasive mating system in canids is obligatory monogamy (Kleiman, 1997), canids usually breed once a year, young have a relatively long period of dependency, and bi-parental care is common (Kleiman and Eisenberg, 1973). Since the 1970s, numerous studies have suggested that collaborative care of young may be a fundamental aspect of canid sociology (Macdonald et al., 2004). The use of information gathered on factors influencing fostering success in coyotes for other canids is further warranted by

the fact that successful fostering attempts have been made in red wolves and African wild dogs (Waddell et al., 2002; US Fish and Wildlife Service, 2004a; McNutt personal communication). We provide information from a controlled study on the success rates that could be expected from cross-fostering efforts and the effects of fostering on dominance status of litter mates. In addition, we examined the effect of pup age on the probability of acceptance of fostered young.

2. Methods

Coyotes are a monogamous species and it has been shown that mated pairs breed for life (Bekoff and Wells, 1980). Litter sizes generally range between 3 and 12 with both sexes participating in parental care. Pups are weaned between 5 and 7 weeks. Sixteen adult coyote pairs and their litters were maintained in facilities (0.1 ha pens) at the USDA Predator Research Facility, Millville, Utah. Coyotes were fed identical diets obtained from a furbreeders cooperative. All, but 1 parent was captive-bred at the facility, and parents were generally experienced breeders with between 1 and 5 years breeding experience. None of the foster pups were genetically related to foster parents.

We investigated the success of cross-fostering under two regimes: augmenting litters by adding two pups to existing litters (litters then consisted of two fostered pups and two or three natal pups), and complete litter replacement. All litters were standardized to four or five pups in order to avoid bias of litter size in weight and survival measurements. Thus pups from large litters were augmented into small litters, and in one case, two pups from a large litter were removed from the study. We assessed the success of augmentation for pups at three ages: ≤ 1 week (4 litters); 3–4 weeks (3 litters); and 6–7 weeks (2 litters). Efforts were made to augment existing litters with pups of similar ages (difference in ages was ≤ 3 days for 1-week augments, ≤ 9 days for 3–4-week augments, ≤ 4 days for 6–7-week augments, and ≤ 6 days for replacements). This also reduced the likelihood of introducing a bias from differences in weights of fostered and natal pups; weights of treatment groups were in fact similar (Fig. 1). Where possible, the

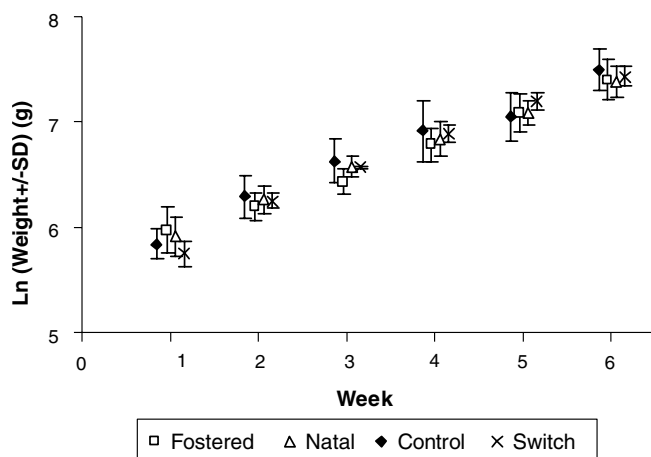


Fig. 1 – Mean weight gains of natal and fostered coyote pups in control, replaced and 1- and 3-week augmented litters. Kitchen and Knowlton: cross-fostering among canids.

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