Capture and Immobilization of African Wolves (Canis lupaster) in the Ethiopian Highlands

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ABSTRACT: We captured 14 individual African wolves (Canis lupaster) a total of 16 times in the Ethiopian Highlands in April 2015 and March 2016 by using rubber-lined foothold traps and immobilized them with dexmedetomidine-ketamine. Traps were baited with sheep meat and surveyed every 2 h. Capture efficiency (number of captures per number of visits) was 0.94, and capture rate (number of captures per number of trap nights) was 0.24. Trapped wolves were immobilized with 0.025 mg/kg dexmedetomidine and 8–10 mg/kg ketamine on the basis of respective estimated body mass. Mean (SD) induction times were 3.4 (0.5) min for subadults (n=4), 3.5 (0.3) min for adult males (n=4), and 4.7 (1.0) min for adult females (n=6). Inductions were calm, muscle relaxation was good, and all animals were completely immobilized. Apart from increased rectal temperatures, no major negative side effects were observed. Atipamezole at 10 mg intramuscularly per milligram of dexmedetomidine administered was used for reversal at a mean of 43.5 (7.7) min after administration of dexmedetomidine-ketamine. Recoveries were relatively smooth, and animals were on feet, leaving the site within a mean of 13.6 (3.9) min, after atipamezole administration. Our results indicate that African wolves can be safely captured and immobilized by using rubber-lined foothold traps and dexmedetomidine and ketamine.

Key words: Canis lupaster, dexmedetomidine, Ethiopian wolf, foothold traps, immobilization, ketamine.

Free-ranging canids are captured for research and management purposes. Typically, animals are trapped before administration of anesthetic drugs to enable safe handling (Larsen and Kreeger 2014). Physical restraint and induction of anesthesia are stressful procedures and require the use of optimal methods, equipment, and drugs (Caulkett and Arnemo 2015). Different physical capture techniques have been used in canids, depending on the target species, habitat, and available resources and expertise. For instance, foothold traps proved to be effective in capturing side-striped jackals (Lupulella adusta), black-backed jackals (Lupulella mesomelas), and Ethiopian wolves (Canis simensis; Sillero-Zubiri 1996).

A combination of medetomidine and ketamine has been widely used to immobilize free-ranging canids (Kreeger and Arnemo 2012). Medetomidine is a potent alpha-2 adrenoceptor agonist that produces sedation, analgesia, and muscle relaxation. Combined with a relatively low dose of ketamine, it induces anesthesia (Larsen and Kreeger 2014). Medetomidine is composed of equal parts of two optical enantiomers (dexmedetomidine and levomedetomidine), but its pharmacologic effects are due almost exclusively to dexmedetomidine (Ansah et al. 1999). Although dexmedetomidine may have clinical benefits compared with medetomidine as a sedative in dogs (Kuusela et al. 2001), recent studies on dexmedetomidine and medetomidine as adjuncts to anesthesia in brown bears (Ursus arctos) are contradictory (Fandos Estérelas et al. 2017). A new wolf species, the African wolf (Canis lupaster), was discovered in the Ethiopian Highlands in 2011 and...
confirmed as a distinctive species that diverged over a million years ago from its ancestral canids (Koepfli et al. 2015). Here, we report the safe capture and immobilization of free-ranging African wolves by using rubber-lined foothold traps and dexmedetomidine-ketamine.

We trapped African wolves in the Guassa Community Conservation Area (GCCA; 10°27’S; 39°45’-39°49’E) in April 2015 at three sites approximately 1.4 km from each other and in the Borena Saynt National Park (10°50’-10°53’S; 38°40’-38°54’E; Fig. 1) in March 2016 at three sites approximately 2.5 km from each other. The GCCA has an area of 111 km² with an elevation of 3,200–3,700 m. The Borena Saynt National Park comprises 132 km² at an elevation of 1,900–3,700 m. Both areas are habitats for the world’s rarest canid, the Ethiopian wolf, which is endemic to the Ethiopian Highlands.

We used rubber-lined Soft Catch foothold traps (Woodstream Corporation, Lititz, Pennsylvania, USA) sizes 1.5 and 3. The traps were set in the buffer zone of the respective protected areas. African wolves were frequently observed in these areas, whereas Ethiopian wolves were rarely seen during our 3 mo of assessment of the distribution of canids. Two foothold traps were buried on a 1-m² plot free from stones and other potentially harmful materials. Each trap was anchored with two metal sticks buried about 60 cm into the ground. The traps were set from 1600 hours to 0600 hours and checked every 2 h to reduce risk of stress and injuries in trapped animals and to release nontarget species, in particular the Ethiopian wolf. During each trapping session, four to eight trap stations were set up with sheep meat as bait (Rowe-Rowe and Green 1981; Kaunda 2001). Once trapped, the wolves were covered by a blanket and manually restrained for administration of 0.025 mg/kg of dexmedetomidine (Dexdomitor® 0.5 mg/mL, Orion Pharma Animal Health, Turku, Finland) followed by 8 mg/kg of ketamine (subadults) or 10 mg/kg of ketamine (adults; Ketamine® 50 mg/mL, Rotexmedica, Trittau, Germany) on the basis of estimated body weights. The drugs were injected into the semimembranosus muscle by using a handheld syringe. The induction time (time from administration of dexmedetomidine-ketamine to no response to handling) was recorded. To evaluate capture efficiency of the traps, the number of
captured animals per visit was calculated (Kamler et al. 2008). In addition, we calculated capture rate as the number of captures divided by the number of trap nights (number of traps multiplied by number of nights; Rowe-Rowe and Green 1981; Kaunda 2001).

Immobilized wolves were wrapped in a blanket to maintain body heat, as recommended by Sillero-Zubiri (1996). The ambient temperature during the capture ranged from 1 C to 8 C. Animals were weighed, and their reproductive condition was assessed. Heart rates (using a stethoscope), respiratory rates (counting chest movements), and rectal temperatures (using a digital thermometer) were recorded once the animal became immobilized and failed to respond to stimuli. All animals were examined by an experienced veterinarian for possible trauma, especially to teeth and feet. Animals were classified as adults or subadults based on tooth wear (Landon et al. 1998). All wolves were fitted with a very high frequency radio collar (Telemetry Solutions, Concord, California, USA).

For reversal of immobilization, we administered 10 mg of atipamezole per milligram of dexmedetomidine-ketamine to injection of atipamezole). Recoveries were observed, and the times from administration of atipamezole to first signs of arousal (ear movements), and standing and starting to leave the site (on feet and leaving) were recorded.

Fourteen wolves were trapped, 10 adults (three males and seven females) and four subadults (two males and two females). Two of the females were trapped twice. Also, two domestic dogs were captured. On average, six traps were set at each site for 11 d. During 66 trap nights, 16 wolves were captured. The capture efficiency was 94%, and capture rate was 24%. Most of the wolves (94%) were captured between 1700 hours and 2300 hours, whereas 6% were captured between 0400 hours and 0600 hours. Summary statistics for body mass, physiologic variables, drug doses and effects, and recovery were collected (Table 1). Inductions were calm, and muscle relaxation was good. Most immobilized animals had higher rectal temperatures than expected, and some were considered hyperthermic (rectal temperature above 40 C). The blanket was, therefore, removed. No other obvious side effects were observed. None of the wolves needed additional drugs to maintain immobilization. No trauma from the traps was observed. Recoveries were relatively smooth, and all wolves left the capture site

Table 1. Summary statistics for African wolves (Canis lupaster) immobilized with dexmedetomidine-ketamine in the Ethiopian Highlands in April 2015 and March 2016.a

| Variable          | Units | Adults | Subadults | | |
|-------------------|-------|--------|-----------|---|
| Body mass         | kg    | 9.0 (0.6) | 8.1 (0.7) | 6.8 (0.54) | 6-8 |
| Dexmedetomidine   | mg/kg | 0.026 | 0.029 | 0.030 | 0.029-0.03 |
| Ketamine          | mg/kg | 8.35 (0.47) | 8.36 (0.53) | 8.81 (1.35) | 8-10 |
| Induction time    | min   | 3.5 (0.3) | 4.7 (1) | 3-6 | 3.4 (0.5) | 3-4 |
| Respiratory rate  | beats/min | 17 (1) | 18 (3) | 14-20 | 16 (3) | 12-18 |
| Heart rate        | beats/min | 78 (9) | 86 (7) | 70-96 | 89 (25) | 70-126 |
| Body temperature  | C     | 41.0 (1.3) | 40.1 (1.7) | 37-41 | 39.1 (0.8) | 38-40 |
| Time to reversal  | min   | 51.0 (11.1) | 53.5 (4.7) | 43-67 | 46.0 (5.4) | 40-53 |
| Ear movements     | min   | 6.0 (0.4) | 6.7 (2.7) | 5-11 | 6.0 (1.7) | 4-9 |
| On feet (start leaving) | min | 15.5 (4.9) | 14.2 (3.6) | 10-22 | 10.7 (2.5) | 8-13 |

a Atipamezole at 10 mg per milligram of dexmedetomidine was given for reversal. Values are presented as means (SD) and ranges.
10–22 min after atipamezole administration. All wolves survived for at least 1 yr. Hence, the rubber-lined Soft Catch foothold traps used in this study appeared to be an effective and safe method for the capture of African wolves. Our results supported the importance of this method, which has been used for a wide range of carnivore species, including Ethiopian wolves (Sillero-Zubiri 1996). We captured no Ethiopian wolves, regardless of their presence in close vicinity of the trapping site. In human-dominated landscapes, carnivore activity is influenced by human activities, and a certain period of the day might provide the highest capture rates (Virgós et al. 2016). In our study, the highest capture rate was recorded between 1700 hours to 2300 hours, which is a suitable period for trapping African wolves in the Ethiopian Highlands.

A combination of dexmedetomidine and ketamine was effective for immobilization of African wolves. Inductions were fast, duration of immobilization was sufficiently long for all procedures to be completed, and recoveries were relatively quick and smooth after administration of atipamezole. The main side effect was hyperthermia. Rectal temperatures higher than 40 C are cause for concern, and attempts should be made to cool the animal (Caulkett and Arnemo 2015). In future studies on African wolves, the rectal temperature should be measured in 5- to 10-min interval to detect thermoregulatory problems. Also, monitoring for respiratory depression (e.g., with pulse oximetry) is recommended. Supplemental oxygen should be available in case of hypoxemia. Admasu et al. (2004) used a relatively high dose of medetomidine (0.09 mg/kg, equivalent to 0.045 mg/kg of dexmedetomidine) and a low dose of ketamine (2.8 mg/kg) to anesthetize seven African wolves. Inductions (5.0 min) were longer than in our study. Recoveries, however, were quicker, and the wolves moved away 6.3 min after reversal with atipamezole (0.45 mg/kg), most likely due to the low dose of ketamine. Admasu et al. (2004) found no obvious adverse effects of anesthesia but did not report data on physiologic variables. Medetomidine (0.09 mg/kg) and ketamine (1.5 mg/kg) were also used to immobilize Ethiopian wolves for vaccination (n=77) and revaccination (n=19) against rabies (Knobel et al. 2008), but the authors gave no details on anesthetic effects or recoveries after reversal with atipamezole. On the basis of the 1–2 yr follow-up (radio tracking, observations, and behavior) of our animals, there were no apparent long-term effects from the captures. In conclusion, we recommend rubber-lined Soft Catch foothold traps and dexmedetomidine-ketamine and atipamezole for capture and reversible immobilization of African wolves.

We acknowledge the Ethiopian Wildlife Conservation Authority for permission for this project. We thank the staff of the Menz-Guassa Community Conservation Area and Borena Saynt National Park for assistance during the field work. We are grateful to the Ethiopian Wolf Conservation Programme for providing the capture equipment and to Alo Hussein, Burqa, and Kassim for assistance setting up traps and handling the animals. We thank the Rufford Small Grants Foundation, the Mohamed bin Zayed Species Conservation Fund, the Centre for Ecological and Evolutionary Synthesis, and Quota Scheme for financial support.

**LITERATURE CITED**


Submitted for publication 24 March 2017.

Accepted 23 August 2017.