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Field Immobilization of Raccoons (*Procyon lotor*) with Telazol and Xylazine

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ABSTRACT: The effectiveness of tiletamine plus zolazepam (Telazol) and xylazine was evaluated as an immobilizing combination for raccoons (*Procyon lotor*). Fifteen raccoons were injected intramuscularly with a 3:2 mixture of Telazol (3.2 ± 0.6 mg/kg [mean \pm SD]) and xylazine (2.1 ± 0.4 mg/kg) at Pictured Rocks National Lakeshore, Michigan, USA, during May–October, 2001–03. Mean induction time was 4.8 ± 3.8 min; mean recovery time was 128.5 ± 48.4 min. No linear relationships were found between the amount (mg/kg) of Telazol-xylazine injected and induction ($r^2 = 0.06$, $P = 0.40$) or recovery times ($r^2 = 0.01$, $P = 0.78$). Mean heart rate, respiratory rate, and body temperature declined through 20 min after induction ($P < 0.05$). No mortality occurred and no short-term adverse effects were observed in recaptured individuals. I conclude that a 3:2 mixture of Telazol-xylazine is a safe and effective immobilizing agent for raccoons when conducting nonsurgical field procedures. Immobilizing raccoons with Telazol at 3 mg/kg and xylazine at 2 mg/kg should provide up to 60 min of handling time and usually allow full recovery in about 120 min.

Key words: Chemical immobilization, field study, *Procyon lotor*, raccoon, Telazol, tiletamine, xylazine, zolazepam.

Field immobilization of raccoons (*Procyon lotor*) has been conducted with several injectable anesthetics, including sodium pentobarbital (Mech, 1965), ketamine (Bigler and Hoff, 1974; Gregg and Olson, 1975), ketamine-xylazine (Deresienski and Rupprecht, 1989; Belant, 1995), and Telazol (Gehrt et al., 2001). Kreeger (1999) recommended a 5:1 combination of ketamine at 20 mg/kg and xylazine at 4 mg/kg, with alternative drugs of ketamine at 20 mg/kg and acepromazine at 0.1 mg/kg or Telazol at 12 mg/kg.

Telazol (100 mg/ml, Fort Dodge Animal Health, Fort Dodge, Iowa, USA) contains a 1:1 combination of tiletamine and zolazepam and has been used effectively on numerous wildlife species (e.g., Mitchell-

tree et al., 1999; Golden et al., 2002). Advantages of Telazol include a high therapeutic index, minimal respiratory effects, and good cardiovascular support (Kreeger, 1999). Xylazine (Xyla-ject®, 100 mg/ml, Phoenix Pharmaceutical Inc., St. Joseph, Missouri, USA) is an α_2 -adrenergic tranquilizer also used to immobilize wildlife, typically in combination with other anesthetics (Kreeger, 1999). Telazol-xylazine has been used on several ungulate species, including white-tailed deer (*Odocoileus virginianus*) and bighorn sheep (*Ovis canadensis*) (Kilpatrick and Spohr, 1999; Merwin et al., 2000; Murray et al., 2000). For carnivores, Cattet et al. (2001) successfully used this immobilizing combination on grizzly bears (*Ursus arctos*); use of Telazol-xylazine for immobilizing raccoons has not been reported. My objective was to assess effectiveness of Telazol-xylazine for field immobilization of raccoons.

The study was conducted from May to October, 2001–03, at Pictured Rocks National Lakeshore, central Upper Peninsula of Michigan, USA ($46^\circ 27'N$, $86^\circ 33'W$). Ambient temperatures during the study ranged from about 4 C to 30 C. Raccoons were captured in live traps (model 108, Tomahawk Live Trap Company, Tomahawk, Wisconsin, USA) baited with sardines or chicken and commercial trapping lures. Raccoons were captured incidental to a study of fisher (*Martes pennanti*) and American marten (*Martes americana*). After visually estimating body weight, all raccoons were intramuscularly injected in the gluteus maximus, gluteus medius, or vastus lateralis by using a 1-ml syringe containing a 3:2 combination of Telazol and xylazine. Each 500-mg vial of Telazol was reconstituted with 5 ml of sterile water to

TABLE 1. Dosages, weight, and physiologic responses for 15 raccoons immobilized with a 3:2 combination of Telazol and xylazine, May–October 2001–03, Pictured Rocks National Lakeshore, Michigan, USA.

Parameter	Mean	SD	Range
Telazol (mg/kg)	3.2	0.6	2.3–4.9
Xylazine (mg/kg)	2.1	0.4	1.5–3.2
Weight (kg)	6.3	2.0	2.2–9.3
First effect (min)	1.7	0.6	0.8–3.2
Induction time (min)	4.8	3.8	1.1–12.4
Recovery time (min)	128.5	48.4	55.3–231.8
Heart rate at 0 min (beats/min)	100	20	66–130
Heart rate at 10 min (beats/min)	94	24	54–130
Heart rate at 20 min (beats/min)	87	20	58–122
Respiratory rate at 0 min (breaths/min)	27	13	10–56
Respiratory rate at 10 min (breaths/min)	24	8	10–36
Respiratory rate at 20 min (breaths/min)	24	8	12–38
Rectal temperature at 0 min (C)	38.3	1.2	35.7–39.8
Rectal temperature at 10 min (C)	38.1	1.4	34.7–39.7
Rectal temperature at 20 min (C)	37.9	1.1	35.6–39.3

create the 100-mg/ml solution. Xylazine (333 mg; 3.33 ml) was then added to the Telazol solution to create the 3:2 Telazol-xylazine combination.

Procedures used to document raccoon response to immobilization followed those of Belant (1991). Induction time was defined as the interval between injection and lack of responsiveness to tactile stimuli. Recovery time was the interval between immobilization and the animal's ability to maintain an upright posture and respond to external stimulation, including moving within the live trap to different positions. Rectal temperature, respiratory rate, and resting heart rate were recorded as soon as practical after immobilization (≤ 3 min) and at 10 and 20 min after induction. Rectal temperature was recorded with a digital thermometer. Respiratory rate was determined by counting complete thoracic cycles (inhalation and exhalation) for 30 or 60 sec. Resting heart rate was determined by placing fingertips against the raccoon's chest and counting beats for 30 or 60 sec. Each raccoon was weighed and received a tag in each ear (model 1005-1, National Band and Tag Company, Newport, Kentucky, USA). Three raccoons received radiotransmitters attached with a collar (Advanced Telemetry Systems, Inc., Isanti,

Minnesota, USA). Raccoons were returned to their live traps after handling procedures were completed. Animals were released at the capture site upon full recovery. Linear regression (Zar, 1984) was used to determine the relationships between dose and time to first effect, induction time, and recovery time. Repeated measures analysis of variance (Zar, 1984) was used to compare heart rate, respiratory rate, and rectal temperature at 0, 10, and 20 min after induction. Means are reported with ± 1 SD; statistical significance was established as $P \leq 0.05$.

The 15 raccoons (11 males and four females) that were captured and immobilized weighed 2.2–9.3 kg. Mean doses of Telazol and xylazine injected were at dosages of 3.2 ± 0.6 and 2.1 ± 0.4 mg/kg, respectively. No additional injections were required to sustain sedation during handling procedures.

Mean time to first effect of the drugs was 1.7 ± 0.6 min and mean induction time was 4.8 ± 3.8 min (Table 1). Full recovery from immobilization occurred in 128.5 ± 48.4 min. No linear relationships were found between dose and time to first effect ($r^2 < 0.01$, $P = 0.84$), dose and induction time ($r^2 = 0.06$, $P = 0.40$), or dose and recovery time ($r^2 = 0.01$, $P = 0.78$). No dif-

ferences were found in mean heart rate ($F=1.18$; $df = 2,41$; $P=0.32$), respiratory rate ($F=0.54$; $df=2,41$; $P=0.59$), or body temperature ($F=0.41$; $df=2,41$; $P=0.67$) from 0 min to 20 min after induction. Physiologic parameters of one raccoon recorded at 30 min after induction demonstrated it remained stable after 20 min. Although depth of anesthesia was not evaluated quantitatively, raccoons did not respond to attachment of ear tags.

No mortality was observed during this study. Six raccoons recaptured up to 12 mo after initial capture displayed no obvious adverse effects of prior immobilization.

Telazol and xylazine doses used for live-trapped raccoons in this study provided satisfactory induction times and adequate anesthesia for minor field procedures. Cattet et al. (2001) successfully used a 3:2 combination of Telazol and xylazine at 5 mg/kg to immobilize grizzly bears. Gehrt et al. (2001) used Telazol 5 mg/kg to immobilize raccoons in Illinois but provided no data on induction or recovery times. Based on available literature, Kreeger (1999) recommended ketamine at 20 mg/kg and xylazine at 4 mg/kg. That lower doses were used successfully in this study is in part because Telazol is about 2.5 times more potent than ketamine (Beck, 1972).

Although recovery times I observed were not unusually long, additional studies could be conducted to assess effects of varying doses and combinations of Telazol and xylazine on recovery time. The lowest dosage used on a raccoon in this study was Telazol and xylazine at 2.3 and 1.5 mg/kg, respectively. Induction and recovery times for this individual were 10 and 125 min, respectively. Thus, lower mean doses than reported in this study may provide adequate anesthesia in raccoons. Use of an antagonist such as yohimbine could further reduce recovery times. Finally, use of a Telazol-medetomidine combination for raccoon immobilization should be explored.

A 3:2 mixture of Telazol and xylazine is

a safe and effective immobilization agent for raccoons for minor field procedures. Although raccoons in this study were immobilized with this mixture at dosages ranging from 3.8 mg/kg to 8.2 mg/kg, I recommend using combined drugs at 5 mg/kg (Telazol at 3 mg/kg and xylazine at 2 mg/kg) for standard field procedures (e.g., tooth extraction, radiotagging, and blood sampling). This dosage will provide ≤ 60 min of handling time and allow full recovery in about 120 min.

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