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Tiletamine-zolazepam-xylazine Immobilization of Fishers (*Martes pennanti*)

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ABSTRACT: The effectiveness of tiletamine plus zolazepam (Telazol) and xylazine as an immobilizing combination for fishers (*Martes pennanti*) was evaluated. Ten fishers were intramuscularly injected using a 5:3 mixture of Telazol (2.9±0.6 mg/kg [mean±SD]) and xylazine (2.1±0.4 mg/kg) at Pictured Rocks National Lakeshore, Michigan (USA) during May to October, 2001–05. Mean induction time was 4.7±4.4 min; mean recovery time was 94.6±46.0 min. There was no relationship between the amount (mg/kg) of Telazol-xylazine injected and time to first effect of immobilants, dosage and time to induction, or between dosage and time to recovery. Mean heart rate remained constant through 20 min postinduction. Respiratory rate and body temperature declined through 10 and 20 min postinduction, respectively. No mortality occurred and no adverse effects were observed in individuals up to 19 mo later. It was concluded that a 5:3 mixture of Telazol-xylazine is a safe and effective immobilizing agent for fishers when conducting nonsurgical field procedures. Immobilizing fishers with 6–7 mg/kg of the combination (3.8–4.4 mg/kg Telazol and 2.3–2.6 mg/kg xylazine) should provide ≥30 min of handling time and allow full recovery in <90 min.

Key words: Chemical immobilization, field study, fisher, *Martes pennanti*, Telazol, tiletamine, xylazine, zolazepam.

Chemical immobilization of fishers (*Martes pennanti*) has been conducted with numerous injectable anesthetics including chlordiazeproxide (Irvine et al., 1964), phencyclidine-promazine (Seal and Erickson, 1969), ketamine (Frost and Krohn, 1994; Mitcheltree et al., 1999; Dzialak et al., 2002), ketamine-acepromazine (Kelly, 1977; Jessup, 1982), ketamine-xylazine (Belant, 1991), ketamine-medetomidine (Dzialak et al., 2001, 2002), and tiletamine-zolazepam (Petrini, 1992; Mitcheltree et al., 1999; Dzialak and Serfass, 2003). Atipamezole and flumazenil has been attempted to reverse medetomidine-ketamine and tiletamine-zolazepam restrained fishers, respectively (Dzialak et al., 2001; Dzialak and Serfass, 2003). Kreeger (1999) recommended using ketamine-xylazine, with alternative combinations of ketamine-acepromazine or tiletamine-zolazepam. More recently, Kreeger et al. (2002) recommended use of ketamine-medetomidine with atipamezole as a reversal agent.

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., Boever et al., 1977; Mitcheltree 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 alpha$_2$-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, this immobilizing combination was used successfully on grizzly bears (*Ursus arctos*), raccoons (*Procyon lotor*), and American martens (*Martes americana*) (Cattet et al., 2001; Belant 2004, 2005); use of Telazol-xylazine for immobilizing fishers has not been reported. The objective of this study was to assess the effectiveness of Telazol-xylazine for field immobilization of fishers.

The study was conducted from May to October 2001–2005 at Pictured Rocks

National Lakeshore, central Upper Peninsula of Michigan (46°27′N, 86°33′W). Ambient temperatures during the study ranged from about 4–32 C. Fishers were captured in live traps (Model 108, Tomahawk Live Trap Company, Tomahawk, Wisconsin, USA) baited with sardines or chicken and commercial trapping lures or incidentally in barrel traps set for American black bear (*Ursus americanus*). Fishers captured in barrel traps were transferred to cage live traps by placing the set live trap inside the barrel trap and opening the bait door located at the rear of the barrel trap. This action caused the fisher to move into the cage trap; it was then removed from the barrel trap. After visually estimating body weight, all fishers were intramuscularly injected in the gluteus maximus, gluteus medius, or vastus laterallis using a 3 ml (0.10 ml graduations) hand syringe containing a 5:3 combination of Telazol and xylazine. Each 500-mg vial of Telazol was reconstituted with 5 ml of sterile water to create a 91mg/ml solution. Xylazine (333 mg; 3.33 ml) was then added to the Telazol solution to create the 5:3 Telazol-xylazine combination.

Procedures used to document fisher response to immobilization followed Belant (1991, 1992). 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 the livetrap to different positions. The time to first effect was defined as the interval between injection and when the animal exhibited initial signs of immobilization (e.g., head bobbing, inability to keep eyelids open). Rectal temperature, respiratory rate, and resting heart rate were recorded as soon as practical after immobilization (≤3 min; hereafter 0 min) and at 10 and 20 min postinduction. Rectal temperature was recorded using 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 fisher's chest and counting beats for 30 or 60 sec. Each fisher was weighed and received a tag in each ear (Model 1005-1, National Band and Tag Co., Newport, Kentucky, USA) and a radio transmitter attached using a collar (Advanced Telemetry Systems, Inc., Isanti, Minnesota, USA). Fisher collars weighed 28 or 43 g and were <2% and 1.1% of female and male body mass, respectively. In addition, an upper first premolar was extracted for age determination (Strickland et al., 1982). Fishers were placed in their respective livetraps after handling procedures were completed. All animals were released at the capture site upon full recovery. To determine whether doses derived using estimated animal weights affected immobilization parameters, 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 with Tukey's multiple range test (SAS, 1988) were used to compare heart rate, respiratory rate, and rectal temperature at 0, 10, and 20 min postinduction. Means are reported with ±1 SD; statistical significance was established as $P \leq 0.05$. Although descriptive statistics for each sex are reported in tabular form, small sample sizes precluded inferential analyses.

Ten fishers (6 males, 4 females) were captured and immobilized; weights ranged from 2.0–6.0 kg. All but one male fisher were >1 yr old. Fishers generally moved rapidly within the trap when approached prior to immobilization. Mean initial doses of Telazol and xylazine injected were 4.7±2.1 and 2.6±1.2 mg/kg, respectively. A second injection of 9 mg of the immobilant combination was required on one occasion to sustain sedation during handling procedures.

Mean time to first effect of immobiliza-

TABLE 1. Initial doses, weight, and physiologic responses of fisher immobilizations using a 5:3 combination of Telazol and xylazine, May to October, 2001–05, Pictured Rocks National Lakeshore, Michigan, USA.

Parameter	Male (n = 6)				Female (n = 4)				Combined (n = 10)			
	n	Mean	SD	Range	n	Mean	SD	Range	n	Mean	SD	Range
Telazol (mg/kg)	6	3.7	1.4	2.3–3.6	4	6.0	2.5	3.8–9.5	10	4.7	2.1	2.3–9.5
Xylazine (mg/kg)	6	2.1	0.8	1.3–3.5	4	3.4	1.4	2.8–5.3	10	2.6	1.2	1.3–5.3
Weight (kg)	6	4.5	0.8	3.5–6.0	4	2.4	0.3	2.0–2.8	10	3.7	1.2	2.0–6.0
First effect (min)	6	1.71	0.96	0.95–3.18	4	1.0	0.55	0.43–1.76	10	1.46	0.85	0.95–3.18
Induction time (min)	6	5.9	5.3	1.8–16.2	4	3.0	2.0	0.9–5.0	10	4.7	4.4	0.9–16.2
Recovery time (min)	6	87.9	49.3	29.9–165.8	3	108.1	44.5	84.4–159.4	9	94.6	46.0	29.9–165.8
Heart rate at 0 min (beats/min)	6	153	29.5	120–182	4	162	28.4	120–180	10	157	27.8	120–182
Heart rate at 10 min (beats/min)	6	141	17.6	120–162	4	135	17.4	118–150	10	139	16.8	118–162
Heart rate at 20 min (beats/min)	5	137	14.0	126–160	3	137	15.3	120–150	8	137	13.4	120–160
Respiratory rate at 0 min (breaths/min)	6	66	28.7	40–116	4	76	42.0	48–158	10	70	32.6	40–138
Respiratory rate at 10 min (breaths/min)	6	41	11.7	28–62	4	41	15.6	23–60	10	41	12.5	23–62
Respiratory rate at 20 min (breaths/min)	5	29	4.6	22–34	2	17.5	0.7	17–18	7	26	6.8	17–34
Rectal temperature at 0 min (C)	6	40.1	0.3	39.6–40.6	4	39.8	0.3	39.6–40.3	10	40.0	0.4	39.6–40.6
Rectal temperature at 10 min (C)	6	38.7	0.8	37.2–39.5	4	38.0	1.9	35.4–39.8	10	38.4	1.3	35.4–39.8
Rectal temperature at 20 min (C)	5	37.7	1.3	36.2–39.1	2	34.5	0.4	34.2–3.7	7	36.8	1.9	34.2–39.1

tion was (1.46±0.85 min); mean induction time was (4.7±4.4 min; Table 1). Although not quantified, mean time to first effect and mean induction time appeared to occur more rapidly in females. The fisher with the longest induction time (16.2 min) received 5.2 mg/kg of the combination and accounted for much of the variation observed in induction time. Excluding this animal resulted in a mean induction time of 3.5±1.9 min. Full recovery from immobilization occurred in 94.6±46.0 min. No relationship between dose and time to first effect (y=2.61–0.16x, y=time to first effect in min and x=dose in mg/kg; r^2=0.38, P=0.06), between dose and induction time (y=8.52−0.51x, y=induction time in min and x=dose in mg/kg; r^2=0.15, P=0.26), or between total dose and recovery time for fishers (y=36.29+9.00x, y=recovery time in min and x=dose in mg/kg; r^2=0.17, P=0.27) was found. In contrast to mean time to first effect and mean induction time, mean recovery time appeared longer for females than for males.

There were no differences in mean heart rate (F=2.46; 2, 28 df; P=0.10) across 10 min intervals. There was a difference (F=14.96; 2, 27 df; P<0.01) in body temperature, with temperatures steadily declining (P<0.05) from 0 to 20 min postinduction. Although not quantified, females appeared to have lower mean rectal temperature at 20 min than did males (Table 1). Respiratory rates varied over time (F=12.00; 2, 27 df; P<.01) with rates at 0 min higher

($P<0.05$) than 10 or 20 min postinduction. Respiratory rates at 10 and 20 min postinduction were similar ($P>0.05$).

Induction was generally rapid; loss of coordination occurred initially in the rear legs, followed by the front legs, neck, and head. Although depth of anesthesia was not evaluated quantitatively, fishers did not respond to attachment of ear tags nor did they respond to tooth extraction by attempting to move their head away from the stimulus. No salivation or defecation was observed during anesthesia. Pedal and palprebal withdrawal reflexes were observed within 10–15 min in only one individual, which necessitated the second injection. However, no signs of spontaneous recovery were observed. Fishers frequently attempted to become upright before returning to a lateral recumbent position during recovery due primarily to a lack of coordination in the rear legs. Fishers regained coordination during recovery in the reverse order of induction.

No mortality was observed during this study as a consequence of immobilization. Two fishers were recaptured on three occasions up to 19 mo after initial captures. No adverse effects of immobilization were observed; behavior of recaptured individuals subjectively appeared similar to behavior of fishers captured initially.

Telazol and xylazine doses used for livetrapped fishers 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. Belant (2004, 2005) used this same combination to immobilize raccoons and American martens, recommending 5 and 7 mg/kg, respectively. Based on available literature, Kreeger (1999) recommended using 25 mg/kg ketamine plus 5 mg/kg xylazine, with alternative combinations of 20 mg/kg ketamine and 1 mg/kg acepromazine or 10 mg/kg tiletamine-zolazepam. That lower doses were used successfully in this study could be in part because Telazol is about 2.5 times more potent than ketamine (Beck, 1972).

Fishers immobilized with Telazol-xylazine exhibited decreases in respiration and body temperature through 10 and 20 min post induction, respectively. American martens immobilized with this same combination exhibited declines in these parameters 10 min post induction (Belant, 2005). In contrast, raccoon respiration and body temperature remained constant through 20 min postinduction (Belant, 2004). Although baseline physiological values vary among species, mean initial respiration rate and body temperature of fishers was more similar to martens (Belant, 2005), and both were greater than those reported for raccoons (Belant, 2004). These differences could be a consequence of variation in physiology between genera. Alternatively, differences in behavior could have contributed to results observed. Both fishers in this study and martens (Belant, 2005) exhibited increased excitation and movements in cage traps prior to immobilization compared with raccoons (Belant, 2004), which could have resulted in elevated respiratory rates and body temperature observed.

A 3.2 C decline in body temperature through 20 min postinduction was observed. Body temperatures declined more rapidly than temperatures of fishers immobilized with ketamine-xylazine (Belant, 1991) or Telazol only (Mitcheltree et al., 1999), but were generally similar to temperatures reported in those studies and were within the temperature range reported by Frost and Krohn (1994) for fishers immobilized with ketamine. That females appeared to have lower body temperatures than males at 20 min postinduction was likely a consequence of females receiving higher dosages of Telazol-xylazine. Physiological depression can be induced by xylazine, which is known to cause respiratory depression and disruption of thermoregulation (Kreeger, 1999), and Cattet et al. (2001) reported that grizzly bears immobilized with Telazol-

xylazine had depressed respiration for 15 min postinduction compared with immobilization using Telazol only. However, physiological depression was not observed in fishers in this study or in raccoons or American martens immobilized with Telazol-xylazine (Belant, 2004, 2005).

The initial mean respiration rate in this study was comparable to rates reported for fishers immobilized with ketamine (Belant, 1991) and Telazol (Mitcheltree et al., 1999). Similarly, respiration rates at 20 min postrecovery were similar to fishers immobilized with Telazol but less than individuals immobilized with ketamine or ketamine-xylazine (Mitcheltree et al., 1999). Reduced respiration rates observed could be indicative of mild respiratory depression observed in these immobilants (Mitcheltree et al., 1999; Cattet et al., 2001).

That a significant decrease in heart rate did not occur was not surprising. A previous study similarly failed to detect changes in heart rate of immobilized fishers (Dzialak et al., 2001; Dzialak and Serfass, 2003). Initial mean heart rate was similar to the mean initial rate reported by Belant (1991) but maximum values exceeded those of previous studies (Belant, 1991; Dzialak et al., 2001).

Little information is available on resting heart rate, respiration, and body temperature of nonimmobilized fishers to compare with immobilized individuals in this study. Research to describe these physiological parameters, as suggested by Mitcheltree et al. (1999), is warranted. Additionally, obtaining data on these metrics from active fishers to more fully compare and describe the effects of immobilization on fisher physiology is recommended.

Mean recovery time in this report was shorter than those of fishers immobilized with ketamine-xylazine, ketamine-medetomidine, or Telazol (Belant, 1991; Mitcheltree et al., 1999; Dzialak et al., 2001), but longer than fishers immobilized with ketamine (Mitcheltree et al., 1999). Observed mean recovery time was comparable to immobilized male fishers that were chemically remobilized 20 min postinduction (Dzialak, 2001). Shorter recovery times observed in this study were likely in part a consequence of generally lower mean dosages used.

Although observed recovery times were not unusually long, additional studies could be conducted with varying doses and combinations of Telazol and xylazine. Use of an antagonist such as yohimbine could further reduce recovery times. Yohimbine reverses the sedation effects of xylazine (Hsu and Lu, 1984) and, although its use has not been reported for fishers, yohimbine has been used for other medium-sized carnivores (Deresienski and Rupprecht, 1989). Cattet et al. (2001) reported that yohimbine was generally effective in reversing Telazol-xylazine immobilization in bears. Antagonists were not used in this study because of the overall low sample size and importance of characterizing immobilization without use of reversal agents. Finally, use of a Telazol-medetomidine combination for fisher immobilization should be explored. Medetomidine is more potent than xylazine and has been used successfully with Telazol to immobilize polar bears (*Ursus maritimus*) (Cattet et al., 1997, 1999). Medetomidine has also been used in combination with ketamine to immobilize fishers (Dzialak et al., 2001) and this combination has been recommended for fishers (Kreeger et al., 2002).

A 5:3 mixture of Telazol and xylazine is a safe and effective immobilization agent for fishers for minor field procedures. Although fishers in this study were immobilized with this mixture at doses ranging from 3.4–9.4 mg/kg, I recommend using combined 7 mg/kg (4.4 mg/kg Telazol, 2.6 mg/kg xylazine) for standard field procedures (e.g., tooth extraction, radiotagging, blood sampling). This dose should provide $\geq$30 min of handling time and allow full recovery in $<$90 min.

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LITERATURE CITED

BECK, C. C. 1972. Chemical restraint of exotic species. Journal of Zoo Animal Medicine 3: 3–66.

BELANT, J. L. 1991. Immobilization of fishers (*Martes pennanti*) with ketamine hydrochloride and xylazine hydrochloride. Journal of Wildlife Diseases 27: 328–330.

———. 1992. Field immobilization of American martens (*Martes americana*) and short-tailed weasels (*Mustela erminea*). Journal of Wildlife Diseases 28: 662–665.

———. 2004. Field immobilization of raccoons (*Procyon lotor*) with Telazol and xylazine. Journal of Wildlife Diseases 40: 786–789.

———. 2005. Tiletamine-zolazepam-xylazine immobilization of American marten (*Martes americana*). Journal of Wildlife Diseases 41: 659–663.

BOEVER, U. J., J. HOLDEN, AND K. K. KANE. 1977. Use of Telazol® (CI-744) for chemical restraint and anesthesia in wild and exotic carnivores. Veterinary Medicine-Small Animal Clinician 72: 1722–1725.

CATTET, M. R., N. A. CAULKETT, S. C. POLISCHUK, AND M. A. RAMSAY. 1997. Reversible immobilization of free-ranging polar bears with medetomidine-zolazepam-tiletamine and atipamezole. Journal of Wildlife Diseases 33: 611–617.

———, ———, ———, AND ———. 1999. Anesthesia of polar bears (*Ursus maritimus*) with zolazepam-tiletamine, medetomidine-ketamine, and medetomidine-zolazepam-tiletamine. Journal of Zoo and Wildlife Medicine 30: 354–360.

———, ———, AND G. B. STENHOUSE. 2001. The comparative effects of chemical immobilizing drug and method of capture on the health of grizzly bears. Thirteenth International Conference on Bear Research and Management, Jackson, Wyoming, 20–26 May, p. 40 [Abstract].

DERESIENSKI, D. T., AND C. E. RUPPRECHT. 1989. Yohimbine reversal of ketamine-xylazine immobilization of raccoons (*Procyon lotor*). Journal of Wildlife Diseases 25: 169–174.

DZIALAK, M. R., AND T. L. SERFASS. 2003. Effects of flumazenil on fishers, *Martes pennanti*, restrained with tiletamine-zolazepam. Wildlife Biology 9: 235–239.

———, ———, AND T. L. BLANKENSHIP. 2001. Reversible chemical restraint of fishers with medetomidine-ketamine and atipamezole. Journal of Wildlife Management 65: 157–163.

———, ———, D. L. SHUMWAY, L. M. HEGDE, AND T. L. BLANKENSHIP. 2002. Chemical restraint of fishers (*Martes pennanti*) with ketamine and medetomidine-ketamine. Journal of Zoo and Wildlife Medicine 33: 45–51.

FROST, H. C., AND W. B. KROHN. 1994. Capture, care, and handling of fishers (*Martes pennanti*). Maine Agricultural and Forest Experimental Station, Technical Bulletin 157. University of Maine, Orono, Maine, 58 pp.

GOLDEN, H. N., B. S. SHULTS, AND K. E. KUNKEL. 2002. Immobilization of wolverines with Telazol from a helicopter. Wildlife Society Bulletin 30: 492–497.

HSU, W. H., AND Z.-X. LU. 1984. Effect of yohimbine hydrochloride on xylazine-ketamine anesthesia in cats. Journal of the American Veterinary Medical Association 185: 886–888.

IRVINE, G. W., L. T. MAGNUS, AND B. J. BRADLE. 1964. Restocking of the fisher in the lake state forests. Transactions of the North American Wildlife and Natural Resources Conference 29: 307–315.

JESSUP, D. A. 1982. Restraint and chemical immobilization of carnivores and furbearers. *In* Chemical immobilization of North American wildlife, L. Nielsen, J. C. Haigh and M. E. Fowler (eds.). Wisconsin Humane Society, Stevens Point, Wisconsin, pp. 227–244.

KELLY, G. M. 1977. Fisher (*Martes pennanti*) biology in the White Mountain National Forest and adjacent areas. PhD Dissertation, University of Massachusetts, Amherst, Massachusetts, 177 pp.

KILPATRICK, H. J., AND S. M. SPOHR. 1999. Telazol-xylazine versus ketamine-xylazine: A field evaluation for immobilizing white-tailed deer. Wildlife Society Bulletin 27: 566–570.

KREEGER, T. J. 1999. Handbook of wildlife chemical immobilization, 3rd Edition. Wildlife Pharmaceuticals, Fort Collins, Colorado, 342 pp.

———, J. M. ARNEMO, AND J. P. RAATH. 2002. Handbook of wildlife chemical immobilization, International Edition. Wildlife Pharmaceuticals, Fort Collins, Colorado, 412 pp.

MERWIN, D. S., J. J. MILSPAUGH, G. C. BRUNDIGE, D. SCHULTZ, AND C. L. TYNER. 2000. Immobilization of free-ranging Rocky Mountain bighorn sheep, *Ovis canadensis canadensis*, ewes with Telazol and xylazine hydrochloride. Canadian Field-Naturalist 114: 471–475.

MITCHELTREE, D. H., T. L. SERFASS, W. M. TZILOWSKI, R. L. PEPER, M. T. WHARY, AND R. P. BROOKS. 1999. Physiological responses of fishers to immobilization with ketamine, ketamine-xyla-

zine, or telazol. Wildlife Society Bulletin 27: 582–591.

MURRAY, S., S. L. MONFORT, L. WARE, W. J. MCSHEA, AND M. BUSH. 2000. Anesthesia in female white-tailed deer using telazol and xylazine. Journal of Wildlife Diseases 36: 670–675.

PETRINI, K. 1992. The medical management and diseases of mustelids. Proceedings of the Joint Meeting of the American Association of Zoo Veterinarians and American Association of Wildlife Veterinarians 1992: 116–135.

SAS INSTITUTE. 1988. SAS user's guide, Version 6.03., SAS Institute, Cary, North Carolina, 1076 pp.

SEAL, U. S., AND A. W. ERICKSON. 1969. Immobilization of Carnivora and other mammals with phencyclidine and promazine. Federation of American Societies for Experimental Biology 28: 1410–1419.

STRICKLAND, M. A., C. W. DOUGLAS, M. K. BROWN, AND G. R. PARSONS. 1982. Determining the age of fisher from cementum annuli of the teeth. New York Fish and Game Journal 29: 90–94.

ZAR, J. H. 1984. Biostatistical analysis, 2nd Edition. Prentice Hall, Inc., Englewood Cliffs, New Jersey, 718 pp.

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