Chemical Immobilization of Bornean Leopard Cats 
(Prionailurus bengalensis borneoensis) with Tiletamine and 
Zolazepam under Field Conditions in Borneo

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Alcázar Paloma 1 Nathan Senthivel 3 de Gaspar Iñaki 2 Revuelta Luis 2

Abstract

Nine wild Bornean leopard cats were anesthetized using a combination of tiletamine and zolazepam (Zoletil®) after being captured in humanely-designed live traps in Sabah, Malaysian Borneo, for the purpose of fitting radio-collars. For five leopard cats (group 1) a single dose of 6.92±1.06 mg/kg of Zoletil® was administered. The mean induction time from the initial Zoletil® dose was 7.9 ± 1.77 minutes, and the mean anesthesia time was 47.2 ± 25.1. For 4 leopard cats (group 2) after an initial mean dose of 6.92±1.06 mg/kg of Zoletil®, it was necessary to administer a second dose (or booster) of Zoletil® (mean dose 2.6±0.33 mg/kg) or ketamine (mean dose 3.5± 0.05mg / kg) to achieve complete immobilization. There were differences between the periods of anesthesia resulting from these boosters, which were 43.5 ± 2.1 minutes for ketamine and 89.5 ± 6.36 minutes for Zoletil®. We conclude that an initial dose of Zoletil® of 6.92 mg/kg can produce an adequate plane of anaesthesia without needing additional or booster injections of anaesthetic; if a booster is required, the use of ketamine in preference to Zoletil® has the benefit of shorter release times (245 minutes for ketamine booster compared to 350 minutes for Zoletil® booster) whilst providing adequate anesthetic times (mean 43.5 minutes for ketamine booster).

Keywords: Chemical immobilization, Ketamine, leopard cat, Prionailurus bengalensis borneoensis, Tiletamine, Zolazepam

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Introduction

Tiletamine is an anesthetic agent chemically related to ketamine, both are considered dissociative agents. Zolazepam is a diazepinone minor tranquilizer. Pharmacology of this drug combination is similar to that shown by the combination of ketamine and diazepam (Plumb, 2005). Tiletamine and zolazepam have been used extensively for chemical restraint of several species of non-domestic felines (Deem et al., 1998; Shindle and Tewes, 2000; Kreeger, 2002; Grassman et al., 2004). Among the advantages reported by authors using Zoletil® to perform anesthesia in wild cats in field conditions, two important features are its wide safety margin and the short induction period (Shindle and Tewes, 2000; Grassman et al., 2004). Recovery time when using this drug can be decreased using flumazenil (Spelman et al., 2004). In this study we assessed the use of Zoletil® to achieve chemical immobilization of wild leopard cats and compared the effects of booster doses of Zoletil® or ketamine on both anesthesia and release times.

Materials and Methods

The capture and chemical immobilization of leopard cats was carried out as part of an ecological study of this species in the Ulu Segama Forest Reserve, Sabah, Malaysian Borneo between May 2008 and March 2009. We used live-traps of various sizes, all were cage-style and triggered by a treadle
booster injections of either Zoletil® or ketamine
plane of anesthesia within 14 min, we administered
were required. If the animal did not reach the desired
Barcelona, Spain) in case booster anesthetic doses
1990). Therefore, we were prepared with additional
sized cats (Shindle and Tewes, 2000).

Booster doses of ketamine and Zoletil® have
been used by other authors in wild carnivores
following an initial dose of Zoletil®(Kreeger et al.,
1990). Therefore, we were prepared with additional
Zoletil® and or ketamine (Imalgene® 1000, Merial,
Barcelona, Spain) in case booster anesthetic doses
were required. If the animal did not reach the desired
plane of anesthesia within 14 min, we administered
booster injections of either Zoletil® or ketamine
(depending on availability) at a dose of 3 mg/kg
(Kreeger et al, 2002) intramuscular.

Leopard cats were injected into the
hindquarters by hand. We recorded the induction
time (time from injection of the drug until the head
rests on the floor), anesthesia time (time from the
head resting on the floor until the animal is able to lift
it again) and the release time (time from the animal
lifting its head after anaesthetic until full normal
behavior returns with no evidence of drug action,
and the animal is able to be released). We also recorded
the handling time during which the animals were
measured and weighed, radio-collars were fitted,
body temperature, respiratory rate, heart rate were
recorded, samples of hair were taken for genetic
studies and a blood sample was taken for hematology
and biochemistry analysis. Once the captured leopard
cats were weighed, we completed the calculation of
the actual dose received by the animal given in

Table 2 Induction, anesthesia, release and effective working times for animals in each of the two study groups. † Animals group 1; *Animals group 2.

<table>
<thead>
<tr>
<th></th>
<th>Zoletil†</th>
<th>Zoletil + Zoletil*</th>
<th>Zoletil + Ketamine*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zoletil† (mg/kg)</td>
<td>6.92 ± 1.06</td>
<td>6.92 ± 1.06</td>
<td>6.92 ± 1.06</td>
</tr>
<tr>
<td>Booster (Zoletil or Ketamine) (mg/kg)</td>
<td>2.6 ± 0.33</td>
<td>2.6 ± 0.33</td>
<td>2.6 ± 0.33</td>
</tr>
<tr>
<td>Induction Time (min)</td>
<td>7.9 ± 1.77</td>
<td>9.5 ± 2.12</td>
<td>7.5 ± 2.12</td>
</tr>
<tr>
<td>Anesthesia time (min)</td>
<td>47.2 ± 25.1</td>
<td>89.5 ± 3.66</td>
<td>43.5 ± 2.1</td>
</tr>
<tr>
<td>Release Time (min)</td>
<td>236.2 ± 19.69</td>
<td>350.0 ± 70.7</td>
<td>245.0 ± 91.9</td>
</tr>
<tr>
<td>Effective Working Time (min)</td>
<td>36.0 ± 6.52</td>
<td>42.5 ± 3.54</td>
<td>40 ± 0.00</td>
</tr>
</tbody>
</table>

All statistical analyses were performed with
the software program SPSS program for Windows
(SPSS 15.0; SPSS Inc., Chicago, IL, USA). Relationships between measures of drug effect and
drug dosages were tested with a one-way ANOVA
test and confirmed with a Welch and Brown-Forsythe
Tests. Significance was accepted at p ≤ 0.05

Results and Discussion

We successfully trapped 9 leopard cats. The
estimated weights ranged between 2.0-2.45 kg in
males (n = 6) and 1.70-1.90 kg in females (n = 3). The
mean actual weight for males was 2.1±0.12 kg and
1.72±0.10 kg for females.

In five leopard cats (group 1), the average
Zoletil® dose used was 6.92±1.06 mg/kg. This dose
was enough to manage and perform all the required
procedures in the animals. In four leopard cats (group
2), however, an initial mean dosage of Zoletil® of
6.92±1.06 mg/kg was insufficient to produce the
complete muscle relaxation and loss of consciousness
necessary for the planned procedures within 14
minutes post-injection (Kreeger, 2002). We, therefore,
decided to inject an extra dose of 3 mg/kg of Zoletil®
in two animals and 3 mg/kg of ketamine in another
two animals. The results are shown in Table 2. For
group 2, the induction time started since the animal
rested it’s head on the floor after the booster was
injected.

In all cases the signs of drug effects were
observed during the induction time and were similar
to those previously reported for ocelots (Shindle and
Tewes, 2000) such as licking the nose and lips, loss of
control of head and neck and limb paralysis.
However, in group 2 up to 14 min after the injection
of Zoletil®, the leopard cats were still responsive to
low levels of environmental stimulation (e.g. slight
noise), indicating that the level of anesthesia was not
adequate for their safe removal from the trap and
subsequent handling. Therefore, we injected the extra
dose of 2.6±0.33 mg/kg of Zoletil® or 3.05±0.051
mg/kg ketamine (both intramuscular).
The ketamine boosters did not cause seizures in any cats. Seizures have been reported in wild cats (Kreeger, 2002; Grassman, 2004) and non-domestic cats in captivity with the use of ketamine. Of the cases in which a booster anesthetic injection was administered, we found a statistically significant difference \((p < 0.001)\) in the anesthesia and release times in those leopard cats immobilized with Zoletil® followed by a booster of the same drug compared to those receiving a booster of ketamine. Although the induction times obtained in our study differ from other previous research with free-ranging leopard cats, we find major differences in the anesthesia times, where using Zoletil® at a higher dose or Zoletil® plus a booster of Zoletil® increases the immobilization times.

In view of these results, we conclude that a relationship exists between the dose of Zoletil® and the times of anesthesia and release, being significantly longer when Zoletil® is used in higher doses or in those cases where a booster of Zoletil® is administered. For non-painful procedures in which animal handling is minimal, the estimated dose to use of 6.92 mg/kg appears to be adequate. In situations where the Zoletil® primary dose does not achieve an adequate anesthetic plane, we recommend a booster dose of 3 mg/kg of ketamine after the initial estimated dose of Zoletil® of 6.92 mg/kg if the planned procedure can be performed within the anesthesia time (mean 43.5 min). This protocol does not significantly lengthen the time of anesthesia nor the release time of the animal. Due to the extended anesthesia and release times resulting from administration of a booster dose of Zoletil®, we recommend the use of ketamine in preference to Zoletil® for booster doses after an initial dose of Zoletil®. In this study Zoletil® proved to be a useful and safe drug for chemical restraint of free-ranging Bornean leopard cats.

### Acknowledgements

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**Table 3** Anesthesia and induction times in groups 1 and 2 in comparison with previous studies. *Grassman et al., 2004; Group 1; **Group 2: ZH + ZH (Zoletil + Zoletil); ZH + KH (Zoletil + ketamine)

<table>
<thead>
<tr>
<th>Mean Dose (mg/kg)</th>
<th>Induction Time (min)</th>
<th>Anesthesia time (min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zoletil® 1</td>
<td>12.3 ± 2.8</td>
<td>4.2 ± 2.8</td>
</tr>
<tr>
<td>Zoletil® 2</td>
<td>6.92 ± 1.06</td>
<td>7.9 ± 1.77</td>
</tr>
<tr>
<td>ZH + ZH 1</td>
<td>6.92 ± 2.6</td>
<td>9.5 ± 2.12</td>
</tr>
<tr>
<td>ZH + KH 1</td>
<td>6.92 ± 3.04</td>
<td>7.5 ± 2.12</td>
</tr>
</tbody>
</table>

**References**


