

Exploring chemical immobilization: a case study on the Himalayan Marmot using Ketamine-Xylazine anaesthesia in Ladakh, India

The Himalayan Marmot *Marmota himalayana* (Hodgson, 1841) is one of the 15 globally recognized marmot species found in the alpine and sub-alpine regions of Trans-Himalaya and lives in colonies of up to 30 individuals (Armitage 2013). It inhabits the Himalayan mountain ranges, including regions in Nepal, Tibet (China), Pakistan, and various parts of India such as Ladakh, Himachal Pradesh, Uttarakhand, Arunachal Pradesh, and Sikkim (Chaudhary et al. 2017; Chetia & Chatakonda 2023). The elevation gradient for Himalayan Marmot ranges 3500–5200 m (Chaudhary et al. 2017; Nikol'skii & Ulak 1841). The Himalayan Marmot displays a range in head-body length from 47–67 cm and a tail length of 12–15 cm, while typically weighing between 4–9 kg on average (Thorington et al. 2012).

The Himalayan Marmot is recognized as an ecosystem engineer due to its burrowing activity, which has a significant impact on the fertility of the soil and the diversity of plants within mountainous ecosystems (Aryal et al. 2015; Chaudhary et al. 2017). Burrows are categorized based on their functions into three main types: hibernation burrows, summer-living burrows, and temporary burrows (Wang & Hou 2021). Abandoned or even live burrows can be used by other carnivores. For example, Siberian

Marmot burrows have been observed to be used by Corsacs *Vulpes corsac* with both corsacs and marmots emerging within two minutes of each other (Murdoch et al. 2009). Marmots are significant prey for wolves, foxes and large raptors forming an important part of the food chain (Aryal et al. 2015; Wang & Hou 2021).

The Himalayan Marmot, despite its crucial role in the ecosystem, remains one of the most understudied species in the region (Chaudhary et al. 2017). There is limited information available regarding its ecological significance, behaviour, dietary habits, and the potential consequences of climate change on this particular species (Aryal et al. 2015; Nikol'skii & Ulak 1841). It is classified as a 'Least Concern' species according to IUCN Red List (Shrestha 2016). They hibernate during the winter season for usually six months (Oct–March) and are active during the summer season (April–September) (Chen et al. 2023).

This note reports the first successful chemical immobilization of an adult female Himalayan Marmot *Marmota himalayana* with a weight of 5.15 kg. The Himalayan Marmot was captured chemically at Khaspang, Leh for an ongoing radio telemetry study by the Wildlife Institute of India and the Department of Wildlife Protection, Leh, UT-Ladakh.

After selecting the adult animal in a field in Khaspang, Leh, the animal was chemically immobilized estimating a body weight of 4 kg using a combination of ketamine (KETAMINA, 100mg/ml, Biowet Pulawy, Poland) and xylazine (100 mg/ml; XylaMed, 50 ml, Bimeda, Cambridge, Ontario) at a dose rate of 50 mg/kg and 5 mg/kg body weight, respectively. The drug was remotely delivered employing a 3.0 ml dart with a plain needle [N1520 needle, (1.5 mm x 20 mm)] in a daninject JM model dart gun from a distance of 10 m over the right quadriceps muscle.

Drug induction time was calculated from the time of darting to sternal recumbency. Physiological parameters such as respiration rate based on the visual movement of the belly, body temperature based on rectal temperature and heart rate by chest auscultation were assessed based on per minute just after complete induction and approaching the animal. Yohimbine (20 mg/ml; YOHIMBE, 20 ml, Equimed USA) at dose rates of 0.125 mg/kg body weight was used for drug reversal following the completion of necessary procedures.

Results

The induction took place after three minutes of administering the Ketamine-Xylazine mixture with respiration rate (60/minute), heart rate (135/minute), body temperature (36.6°C) and eye open position along with minimal salivation and no response to stimuli showing excellent analgesia. The animal did not show any signs of respiratory depression, hyperthermia and

profuse salivation. The animal was found healthy with no external injury on visual health assessment and a radio collar was placed as per standard procedure. The actual weight of the Himalayan Marmot was found to be 5.15 kg. Thus, the actual dose received by the animal was (Ketamine @38.83 mg/kg body weight and Xylazine @3.88 mg/kg body weight). The total immobilization time was 40 minutes and then reversal was injected by hand with a disposable syringe.

The first sign of recovery was noticed within 15 minutes of administering the reversal, and the animal exhibited drug reversal within 45 minutes of administering the reversal injection. The whole capture time was of 85 minutes from the administration of the Ketamine and Xylazine combination till its complete revival. The animal was released back after the reversal was complete. Overall recovery was progressive and smooth.

Discussion

Radio telemetry plays a crucial role in wildlife conservation by providing researchers with valuable insights into animal behaviour, movement dynamics such as migratory routes and stop-over sites, habitat usage such as home range and territory as well as threat monitoring of animals (Gutema 2015). It involves attaching radio transmitters to animals and tracking their movements remotely using specialized receivers and antennas. Along with other conservation implication studies, rescue operations and disease treatment, radio telemetry studies require capturing of animals. Various capture

procedures can be stressful and cause fear leading to eventual death (Ebedes et al. 1989).

Chemical immobilization of a wild animal is considered a safe and effective strategy as it causes minimal stress (Neilson 1999).

There are no recorded studies on the chemical capture of Himalayan Marmot. The drug combination of Ketamine and Xylazine mixture used during this incident to capture the Himalayan Marmot was found to be effective at a dose rate of 38.83mg/kg body weight for Ketamine and 3.88 mg/kg body weight for Xylazine. The drug dose used in this study to immobilize a Himalayan marmot is lower than the combinations of Ketamine and Xylazine used for Alpine Marmot *Marmota marmota* (Beiglbock & Zenker 2003).

It is important to acknowledge the limitations of a study, especially when it involves a small sample size and does not account for various factors. In the case of the drug combination study with the Himalayan Marmot, it appears that the research is based on the experience with a single individual and lacks consideration for factors such as variations within sub-populations, forage availability, sex differences, subspecies variations, weather conditions, and different drug combinations.

A larger sample size would indeed be advantageous in making the results more rigorous and insightful. With a larger sample size, researchers can obtain a more representative understanding of how the drug combination affects Himalayan Marmots as

a whole. However, conducting subsequent studies with larger sample sizes and accounting for relevant variables would be crucial for a comprehensive understanding of the drug combination's effects on Himalayan Marmots.

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