Is water an important resource for the snow leopard (*Panthera uncia*) in periods when terrain is covered with snow?

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**ABSTRACT**

Some mammalian species that inhabit cold environments are known to eat snow to fulfill their water requirements. However, there is a potential trade-off between eating snow and drinking water because of the considerable energy that the body invests in warming the ingested snow. It is claimed that the snow leopard (*Panthera uncia*) eats snow to fulfill its requirement of water, which is why several researchers do not consider water as a limiting resource when developing resource selection functions. In this study, we placed camera traps along the unfrozen river banks in the Shamshy Wildlife Sanctuary in Kyrgyz Republic from September 2018 to May 2019 with the objective of recording access to liquid water by animals during different times of the year. A snow leopard was recorded for the first time drinking water during winter when the entire ground surface was covered with snow. The animal drank water for nearly 58 seconds, indicating that the snow leopard preferred to drink liquid water as opposed to snow that was ubiquitously present. The observation has significant implications for snow leopard research and conservation strategies that tend to assume the nonrelevance of the availability of water to snow leopards.

Availability of water influences habitat selection and distribution of animals (Bleich, Marshal, and Andrew 2010), because water is essential for survival for physiological reasons (Storey 2005). Some mammals that inhabit cold environments where water resources are limited are known to eat snow; for example, the snow leopard (*Panthera uncia*; Schaller 2012), polar bear (*Ursus maritimus*; Derocher et al. 1990), American black bear (*Ursus americanus*; Bridges et al. 2004), caribou (*Rangifer tarandus*; Ion and Kershaw 1989), feral horses (*Equus ferus caballus*; Salt and Hudson 1979), and golden snub-nosed monkey (*Rhinopithecus roxellana*; Matsuwara 2017). Ingestion of snow fulfills the water requirements of the animal and can be considered as a behavioral adaptation to limited availability of water in cold environments. Additionally, eating snow possibly reduces the energy and time costs of searching for liquid water. However, the ingested snow needs to be warmed up to body temperature after consumption, which in turn incurs its own energy costs (Berteaux 2000). Even in cold environments, animals may have the option to drink liquid water if there is a spring that maintains a constant discharge (Andersen et al. 2002). There are various pros and cons to the eating of snow versus drinking water in cold environments (Hendricks 2008). Despite the importance of water ingestion in cold environments, our understanding of this dilemma for the wildlife is limited.

Several studies have reported a high poaching risk of mammals near rivers and ponds, presumably due to the ease with which these locations can be accessed and identified, not to mention their ability to attract wildlife from long distances (Maingi et al. 2012; Ferreguetti et al. 2018). Therefore, although the presence of water resources is critical to wildlife populations, they also increase the chances of unnatural mortality by facilitating poaching.

The snow leopard is an apex predator of the alpine ecosystem in central and south Asia, and threats to its population include poaching and illegal trade (Dexel and Deutschland 2002; Li and Lu 2014) as well as habitat fragmentation (Li et al. 2016) and conflict...
with livestock (Mishra 1997). The snow leopard is reported to eat snow (Schaller 2012), but whether they rely only on snow as a water source or on both snow and water has not been investigated. In the present study, we used camera traps to monitor the behavior of snow leopards close to river banks in the remote mountains of the Kyrgyz Republic to observe their behavioral imperatives with respect to water in different seasons.

The fieldwork was conducted in the Shamshy Wildlife Sanctuary, Kyrgyz Republic (Figure 1). The area was a former hunting concession area for Siberian ibex (Capra sibirica) that was converted into a wildlife sanctuary in 2015 through a joint memorandum of understanding between the Kyrgyz government and nongovernmental organizations (Snow Leopard Foundation in Kyrgyzstan and Snow Leopard Trust) for co-management. Hunting is no longer permitted in any part of the sanctuary. We placed two camera traps (BTC-8A; Browning, Morgan, USA) on the middle reaches of the river (unfrozen water flow with an approximate width of 1.5 m, depth of 20 cm; altitude of approximately 2,540 m) on 3 September 2018. Site selection was determined by the presence of snow leopard feces and a well-defined corridor of passage. The camera traps were set to record video for 20 seconds when the onboard infrared sensor detected a moving object in front of the camera. Both camera traps were working until their recovery on 4 May 2019 (243 days).

Although temperature data were not collected in this study, the videos confirm that the ground was covered by snow and the river was partially frozen from late October to early April during the recording period.

The cameras recorded four encounters with snow leopard along the river. One male and one female with two cubs was recorded, and the encounters were identified to be of separate individuals based on their pelage patterns. The camera triggered three sequential recordings of an event of an adult female snow leopard drinking water during the snow-covered period (on 24 March 2019; Figure 2a). The female was at the site with her two cubs (Figure 2b). The female walked on the snow-covered ground to approach the river bank and crouched to drink the flowing water. The individual drank water for approximately 58 seconds.

In addition to snow leopards, our cameras caught nine Siberian ibexes, two Eurasian lynx (Lynx lynx), and a wild boar (Sus scrofa). Incidentally, the cameras captured three encounters where the ibex were recorded eating snow but none where they drank water along the rivers bank during the snow-covered period (Figure 2c).

![Figure 1. Location of the study site, the Shamshy Wildlife Sanctuary, Kyrgyz Republic.](image-url)
To the best of our knowledge, we present the first ever record of a wild snow leopard drinking water during the snow-covered period. Our finding indicates that snow leopards drink water in liquid form even during the snow-covered period. That the snow leopard prefers to drink liquid water rather than eat snow is evidenced by the relatively long duration of drinking (~58 seconds). Even though it is an exciting event, we acknowledge that this single observation is insufficient to draw more conclusions. Snow leopards are known to eat snow (Schaller 2012). It is likely that snow leopards also compensate for the absence of liquid water in the environment by eating snow. However, further research based on rigorous study designs is required to understand the snow leopard’s dependence on water across its habitat. Various methods can be used, including telemetry, high-intensity camera trapping with multiple units, and potentially even animal-mounted cameras (Rutz et al. 2007; Kaczensky et al. 2019).

Our observation may have implications for the documented ecology of snow leopards. If it is assumed that snow leopards rely primarily on liquid water instead of snow in winter, it might influence their distribution and ranging patterns. Moreover, there could also be implications for conservation strategies including antipoaching initiatives that may benefit by prioritizing regular inspections of water bodies.

Ibexes, the main prey animal of snow leopards, were seen eating snow along the river bank. This indicates the possibility that ibexes could be less dependent on liquid water in winter, which could potentially cause a segregation of habitats between the snow leopards and its primary prey, ibex.

In conclusion, this study provides the first documented record of the water drinking behavior of snow leopards during the snow-covered period. Although further surveys are required to study the behavioral strategies associated with water intake, we suspect that water plays an important role in snow leopard ecology even during winter when most areas are covered under snow. This behavioral observation of a snow leopard drinking water during the snow-covered period is important not only for studying ecology but also for making adequate conservation strategies for snow leopards. Overall, our results have implications for the snow leopard’s adaptation to the cold environment, habitat selection, and conservation. The extent to which liquid water is limited and snow is available and the seasonal changes associated with water availability could affect the behavioral strategies of animals adapted to cold climates. More research on this aspect would be useful for understanding habitat selection and the adaptation of conservation measures as climates and environments change.

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Disclosure statement

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