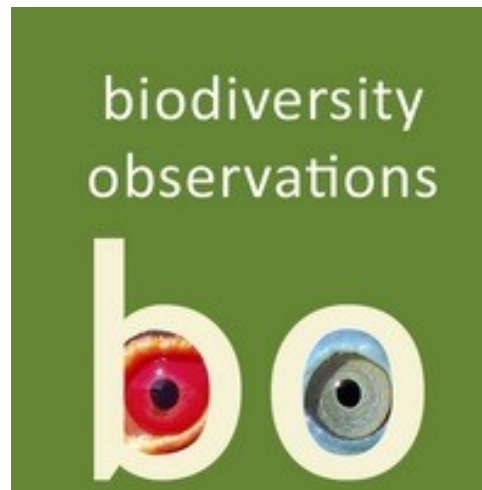


# Ecological invasion of the giant African snail *Lissachatina fulica* (Bowdich, 1822) in a semi-arid forest of western India

Vishal Rasal, Meenu Dhakad and Dharmendra Khandal



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## Invasive Species

### Ecological invasion of the giant African snail *Lissachatina fulica* (Bowdich, 1822) in a semi-arid forest of western India

Vishal Rasal<sup>1</sup>, Meenu Dhakad<sup>2</sup> and Dharmendra Khandal<sup>1</sup>

<sup>1</sup>Tiger Watch, India

<sup>2</sup>Wildlife Conservation Society, India  
rasalvishal090@gmail.com

#### Abstract

The giant African snail *Lissachatina fulica* (Bowdich, 1822) (also known as *Achatina fulica*) is indigenous to the coastal region of continental East Africa. It is one of the most invasive ecological pests in the world and threatens native flora, agriculture, human and animal health outside its natural range. While dry and semi-arid climatic regions are supposed to be immune to its invasion, our data show that this is not always the case. Ranthambhore National Park is dry, deciduous forest located in semi-arid part of western India. We have observed the progressive invasion of *L. fulica* in this fragile landscape since its first introduction in 2010. Subsequently, it has spread over a large area at an alarming rate. We discuss the observations on behaviour and the factors responsible for the rapid spread of *L. fulica* in the park.

#### Introduction

Invasive alien species are a threat to biodiversity, agriculture and the health of humans and other animals (Lowe *et al.* 2000). *Lissachatina*

*fulica* (Bowdich, 1822), commonly known as the giant African snail, is listed as one of the worst 100 invasive alien species in the world (Figure 1) (Lowe *et al.* 2000). It is indigenous to the coastal region of continental East Africa but has become an ecological pest in almost every part of the world with a tropical and humid climate (Badal *et al.* 2014, Ramdwar *et al.* 2018). Typically, it has been introduced as a food source, through the pet trade, or accidentally through international transportation (Peterson 1957, Ajayi *et al.* 1978). *L. fulica* is a voracious feeder with a wide range of food. Its diet consists of plants, carrion and other snails. (Thiengo *et al.* 2007). Although *L. fulica* flourishes in climates with a temperature range between 9–29 °C, it survives cold temperatures by hibernation and extreme heat by aestivation (Rahman & Raut 2010).



**Figure 1:** A specimen of giant African snail *Lissachatina fulica* in its natural range in Kenya. The snail is about 10 cm in length. Photo credit: Laban Njoroge, National Museums of Kenya, Nairobi.

Dry and semi-arid areas are believed to be immune to invasion by *L. fulica* (Sridhar *et al.* 2014, Sharma *et al.* 2015). However, in 2010, we observed a few individual *L. fulica* at Ranthambhore, a semi-arid forest area in Rajasthan State, western India. In this paper, we report our observations and document the spread of this snail and its behaviour across this landscape

## Methods and Materials

### Study Area

The Ranthambhore National Park (25° 30' to 26° 21' N and 75° 51' to 77° 12' E) is situated at the junction of the Vindhya and Aravalli mountain ranges (Singh & Srivastava 2007). The park has a dry, semi-arid climate and is prone to drought. It receives an average annual rainfall of 800 mm between July and September. The park experiences a minimum temperature of 2 °C in January and a maximum temperature of 47 °C in May during peak summer (Singh & Srivastava 2007, Alam *et al.* 2011).

The vegetation of Ranthambhore National Park consists of northern tropical, dry, deciduous forest and northern tropical thorn forest, dominated by Dhok trees, *Anogeissus pendula*. Some gorges retain moisture due to perennial water sources and this habitat is considerably cooler in temperature than the adjacent forest (Singh & Srivastava 2007).

The Ranthambhore National Park is the core of the Ranthambhore Tiger Reserve, and is one of the most famous localities at which to observe the Bengal Tiger *Panthera tigris tigris*. It attracts large number of tourists annually and there are around 100 hotels and resorts located just outside the park's boundary

### Field Work

We have conducted field surveys to document biodiversity in and around Ranthambhore National Park since 2010. Scattered observations were made between 2010 and 2015. Thereafter, regular obser-

uations were made between 2015 and 2019, except during the summer months (April to June) when *L. fulica* snails are in aestivation to protect themselves from the intense heat. Local farmers, horticulturists, shepherds and naturalists were routinely interviewed to determine the occurrence of the snails.

## Results

### *Chronology of the spread of Lissachatina fulica in Ranthambhore*

In 2010, the first individuals of *L. fulica* were observed in the garden of an hotel situated just outside the boundary of the Ranthambhore National Park. We identified the specimens using the 'Terrestrial Mollusc Tool' developed by White-McLean (2011). After discussions with horticulture staff working at the hotel, it was presumed to have been introduced through horticultural supplies such as soil, exotic plants, etc.

Our field surveys and interviews show that until 2016, the spread of *L. fulica* was limited to hotel gardens on the boundary of the national park, as well as in nearby farmhouse and private gardens. However, during the rainy season of 2017, it was recorded inside the forested area of the Ranthambhore Tiger Reserve. In 2017, we collected approximately 800 specimens in a 500 m<sup>2</sup> area encompassing the hotel garden where it was first recorded. Since then, numbers increased rapidly. In 2018 and 2019, we collected and buried (with salt) 1200 and 1800 snails respectively in the same area. In 2019, we recorded snails as far as 10 km from the place of introduction.

During the monsoon season, the snails were observed crawling up walls and poles in large numbers. They also covered roads and trails in large numbers. It was difficult to drive or walk without trampling them and they have the potential to cause minor vehicle accidents.

*Observation of the behaviour of Lissachatina fulica in the Ranthambhore landscape*

Our field surveys showed that *L. fulica* individuals emerged from their hiding places just after the first rains of the monsoon season in July and started breeding (Figure 2). The young offspring began to appear at the same time and then grew rapidly. By the end of August, the snails had dispersed throughout the area. Daytime weather in the park is hot even during the monsoon season. The snails were mainly active during the night and early morning. During the remaining

hours, they were located hiding under the soil, in crevices of rocks or in any suitable moist place. They remained active until the end of monsoon season in September. During the remainder of the year, snails and eggs were observed buried in soft soil near waterbodies, between the roots of plants and in other moist places.

Except for the three months of the monsoon season, the climate of the Ranthambhore National Park is too harsh for *L. fulica*. Hotels and farmhouses on the border of park maintain lush green gardens, lawns and swimming pools. This creates an ideal micro-climate and suitable



**Figure 2:** Giant African snail *Lissachatina fulica* laying eggs at Ranthambhore, Rajasthan, India, on 8 August 2021. The eggs are 4–5 mm in diameter. Photo credit: Dharmendra Khandal.

'niche habitat' for *L. fulica* to survive in this otherwise semi-arid environment.

#### *Feeding habits in the study area*

*L. fulica* was seen feeding on leaves of *Tecoma stans*, *Catharanthus* spp., grasses, *Bauhinia* spp. and others. It was also seen consuming algae, aquatic plants in seasonal ponds, young shoots, fallen leaves, animal droppings and carrion. In addition, snails have been recorded feeding on limestone monuments and other structures.

#### *Predators*

During the monsoon season, thousands of snails are seen on the roads and large numbers are crushed by passing vehicles. Indian grey langurs *Semnopithecus entellus* (Dufresne, 1797) are routinely observed feeding on flesh of crushed *L. fulica*. Apart from this, no other animal or bird has been seen feeding on them.

### Discussion and Recommendations

The dry, deciduous forest ecosystem of Ranthambhore National Park is extremely fragile and suffers periodic droughts. *L. fulica* is literally encircling the forest due to suitable habitat in hotel gardens surrounding the park. Despite the prevailing climate, the forest contains deep gorges where *L. fulica* can easily thrive. These gorges contain soil that retains moisture, are cooler than the adjacent forest throughout the year, and thus support a higher diversity of flora and fauna. These gorges may be responsible for the rapid spread of the snails within the park.

The further spread of *L. fulica* poses a threat to the park and to surrounding farms. In many states of India, the snail is already a serious large-scale agricultural pest (Rai *et al.* 2014). Horticultural orchards around Ranthambhore National Park are moist throughout the year.

Therefore, there is a potential risk to these orchards and the livelihoods of the farmers. In addition, because of its habit of feeding on

limestone for minerals, it is also a threat to archaeological monuments and other structures in the region.

The Forest Department should take the initiative to urgently control the spread of *L. fulica* in the Ranthambhore National Park. Firstly, there should be regular monitoring of this species. Secondly, an awareness programme should be carried out in hotels, on farms and in schools surrounding the park to educate the community about the threat posed by *L. fulica*. Thirdly, snails should be manually collected and killed. Carcasses should be buried in a pit with salt. Lastly, the gardens of all hotels, private homes and farmhouses must be planted with only native species. Exotic plants increase the risk that further invasive alien species will be introduced to the area

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*Biodiversity and Development Institute*

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