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Research Article

BATESIAN MIMICRY: THE MAIN CAUSE OF NON-VENOMOUS SNAKE DEATH IN ODISHA

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ABSTRACT

Snakes are the integral part of ecosystem. Some non-poisonous snakes undergo Batesian mimicry in order to escape from their predators. But this mechanism acts as a Boomerang. This often leads these harmless species towards their death. People kill these snakes considering as venomous. It was found that mimicry is the main cause of non-venomous snake depletion in Odisha. Barred wolf snake, common kukri snake and sand boa were the snakes found to be killed due to their mimetic mechanism. In state like Odisha where snakes are being worshipped in temple, this type of brutal killing of snakes is not acceptable. So there is an urgent need to create awareness among people of Odisha regarding the value of snakes.

INTRODUCTION

Throughout million years of evolution, animals have evolved numerous ways of defending themselves against predators. Mimicry is one of the most interesting phenomena among them. Natural selection can favors phenotypic convergence between completely unrelated species when an edible species receives the benefit of reduced predation by resembling an inedible species that predators avoid. Walter Bates (1862) suggested that close resemblances between unrelated species could evolve as an anti-predator adaptation. Mimicry is defined as the case where an organism (the mimic) simulates the signal properties of a second living organism (the model) which are perceived as signals of interest by a third living organism (the operator); such that the mimic species gains in fitness as a result of the operator incorrectly identifying it as an example of the model (Vane-Wright, 1980). In a mimicry system there are 3 elements; Model, Mimic and Operator (Predator).

Today mimicry is widely used as a testament to natural selection efficacy in prompting complex adaptation (Cott, 1940; Edmunds, 1974; Brodie & Brodie, 2004; Ruxton *et al*, 2004; Turner, 2005; Forbes, 2009). Mimicry is of several types. One of the major types of mimicry is defensive or protective mimicry. Defensive mimicry occurs when one species receives protection from predation because of its close resemblance to a second, already protected species. Traditionally the main forms of mimicry are Batesian and Müllerian, formulated in 1862 and 1878 respectively, and still thought to provide some of the most easily understandable examples of the way in which natural selection operates (Wickler, 1968; Pasteur, 1982; Malcolm, 1990; Mallet & Joron, 1998; Joron & Mallet, 1999).

Batesian mimicry is named after H.W. Bates. It is defined as an edible species evolves to resemble a conspicuous inedible species, thereby gaining protection from predation (Carpenter and Ford, 1933). In this type of mimicry only the mimic benefits. In the Batesian mimicry system, Model is the noxious non-prey species, Mimic is the palatable prey species that resemble the model and Operator is the signal receiver that cannot distinguish the mimic and the model.

Mullerian mimicry is named after Muller. It is defined as multiple undesirable species converge on the same warning signal, thereby sharing the cost of educating predators about their undesirability. Mullerian mimicry occurs when two or more distasteful or poisonous organisms resemble each other (Nicolson, 1927). Both species benefit because a predator who learn to avoid one species will most likely avoid the other too. Both predator and all mimic species benefits from Mullerian mimicry.

Snakes are limbless reptiles having an elongated body covered with scales (Sharma *et al*, 2013). A snake is characterized by a great elongation of body, accompanied by complete absence of anterior limbs, great reduction or complete absence of hind limbs, associated elongation of internal organs with reduction

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or loss of one of the lungs, a peculiarly efficient mode of locomotion by wriggling with extreme flexibility of vertebral column aided by distinctive character of transverse plates (Dutta *et al*, 2009). Snakes play an important role in the natural ecosystem and artificial agro-ecosystem. For farmers snakes are very useful because they help to control rodent populations by eating the rats and mice that would otherwise damage crops (Sharma *et al*, 2013).

Color pattern of snakes are varied. They typically function in helping snakes to avoid predators either through crypsis (King, 1987), aposematism (Brodies, 1993; Madsen, 1987; Whister *et al*, 2004) or mimicry (Brodie and Brodie, 2004; Greene and Mc Diamid, 2005; Wallace, 1867). Many color patterns associated with aposematism and mimicry consist of bright bands or rings that alternate along the body. Many experiments have demonstrated the mimetic function of these color patterns (Brodie and Brodie, 2004).

Odisha is rich in snake diversity with more than 80 snake species (Dutta *et al*, 2009). Many ophiologists of Odisha are working for the conservation of snakes but still snakes are not safe in Odisha. Snake-Human conflict has always existed. People's tolerance of snakes has dropped with time. In India nearly 50000 people are dying each year due to snake bite (Mohapatra *et al*, 2011). But the number of snake death by human activities is many more than the given number. Snake human conflict is driven by humans. So human should end this conflict. An investigation was performed in Odisha to explore different causes of snake death in Odisha. It yielded an interesting result.

MATERIALS AND METHODS

Study Area

Odisha is a biodiversity rich state of India with a geographical area of 155,707 sq. Km. It is located between 17° 47' - 22° 34' North and 81° 22' - 87° 29' East. The state is divided into 30 administrative districts. The total forest cover of Odisha is 47,033 sq Km (Forest survey of India, 2001). There are 18 wildlife sanctuary and 2 national parks in the state. Similipala is the only Biosphere reserve of Odisha. Odisha is an excellent habitat of many endangered flora and fauna.

Figure 1 Map of Odisha showing all districts

The climate of Odisha is generally hot and humid. The temperature ranges from 20° C to 41° C. Precipitation occurs mainly during monsoon from September to December.

This investigation was carried out only in 5 districts of Odisha; Jagatsinghpur, Ganjam, Mayurbhanj, Cuttack and Balasore.

METHODOLOGY

The duration of the study was 3 months, from June 2017 to August 2017. The study was focused on exploring the main causes of snake death in Odisha. Studies were conducted by literature survey, exhaustive interview with local people of Odisha, and extensive photo documentation of some snakes.

RESULTS AND DISCUSSION

The study yielded several causes of snake death. The major causes include habitat loss by destruction of forest, pollution based snake death, climate change, vehicular accident, predation by predators, unscientific handling of snakes by snake catchers, netting by fisherman and snake-human conflict. Snake-human conflict is the foremost reason of snake declination. In every year numerous snakes are killed by peoples. Many snake-human conflicts originate due to mimetic mechanism of some snakes. Batesian mimicry is the main cause of non-venomous snake death in Odisha. In both rural and urban areas snakes are being killed by peoples. Local self called taxonomist think almost all snake as venomous and kill them mercilessly. Batesian mimicry is associated with a risk factor, i.e. people think these snakes venomous and hurt them in fear of being bitten (Dwibedy, 2017).

Figure 2 *Lycodon striatus* (Mimic) and *Bungarus caeruleus* (Model)

Figure 3 *Oligodon arnensis* (Mimic) and *Bungarus fasciatus* (Model)

Figure 4 *Gongylophis conicus* (Mimic) and *Daboi russelli* (Model)

Figure 5 Bifurcating cross band in Barred Wolf Snake

Figure 6 Paired cross band in Common Krait

Figure 7 Alternating yellow and black rings of same widthin Banded Krait

Figure 8 Two inverted 'V' mark on Common kukri head

Figure 9 Three rows of elliptical spots on Russel viper

Figure 10 Irregular spot on Sand Boa

The non-venomous snakes rapidly killed due to Batesian mimicry are *Lycodon striatus* (Barred wolf snake), *Oligodon arnensis* (Common kukri) and *Gongylophis conicus* (Sand boa).

Barred wolf snake resembles with *Bungarus caeruleus* (Common krait), which is a deadly poisonous snakes. People consider *L.striatus as B.caeruleus* because both are of same color. These two snakes are black colored with several white cross bands.

Common kukri snake is also killed due to its resemblance with banded krait. Common Sand Boa and Russell's viper are similar in appearance. People often mistaken the harmless sand boa as poisonous Russell's viper and kill them without any mercy. The figure of the mimic and their model are given in Figure 2-4.

Table 1 Table showing the similarities and differences between the mimetic snake and its model

Mimic	Model	Similarities	Differences
Lycodon striatus	***Bungarus caeruleus***	1.Black colored (Some wolf snakes are also of brown colored) 2.Presence of white rings 3.Nocturnal 4.Ventral coloration white	1. In Common kraits the white stripes are absent in the head and neck region. 2. White stripes of barred wolf snake are broader than common krait. 3. The stripes of common krait snakes are paired while the wolf snakes cross bands bifurcate laterally. 4. The body shape of common krait is triangular with a ridge along the vertebral line, while the body of common wolf snake is roundish. 5. The scales of common krait along its vertebral line are hexagonal.
Oligodon arnensis	***Bungarus fasiatus***	1. Presence of inverted'V' mark on head. 2.Nocturnal 3.Alternate banding coloration	1. In Kukri snake 2 inverted 'V' marks are present while in banded krait a single 'V' mark is present. 2. In Banded krait broad black and yellow glistening bands encircle the body. In kukri black and brown cross bands are present. 3. In banded krait both the yellow and black rings are of approximately same breadth but in kukri the bands are of varied breadth. 4. Body shape of banded krait is triangular while banded kukri is rounded.
Gongylophisconicus	***Vipera russelli***	1. Body stout and fatty. 2.Tail is short and pointed. 3. Ventral coloration white. 4.Nocturnal 5.Cylindrical 6. Distinctive head. 7. Similar coloration.	1. In Russell viper 3 longitudinal rows of large elliptical dark bordered spots are present. 2. Head of Russell viper contains two large dark triangular markings. 3. Different scalation.

By scientific observation we can differentiate the venomous and non venomous snakes. The difference and similarities of the non-venomous snakes and their model are given in Table 1. Some characteristics feature of the mimic and their model are showed in pictures (Figure 5-10).

CONCLUSION

Lord Mahadev bear snake around his neck. This symbolize that snakes are the friend of humans. Humans are living with snakes from ancient times. In state like Odisha where snakes are being worshipped in temple, this type of brutal killing of snakes is not acceptable. The snakes are the top predators within the habitat they are found and so they play a potentially important role in functioning of many ecosystems. So there is an urgent need to create awareness among people regarding value of snakes. Neither venomous nor non venomous snakes should be killed or harmed. Snake never attack people as humans are not the prey of snakes. Only people come across snakes just like coming across cat and dog every day. So we should carefully avoid snakes without harming them.

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