

**Status Survey of Himalayan Salamander**  
*Tylototriton verrucosus* Anderson  
**in Darjeeling Hills**

**V.D. HEGDE**  
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**ZOOLOGICAL SURVEY OF INDIA**

*Status Survey of Endangered Species*

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**Zoological Survey of India**  
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## INTRODUCTION

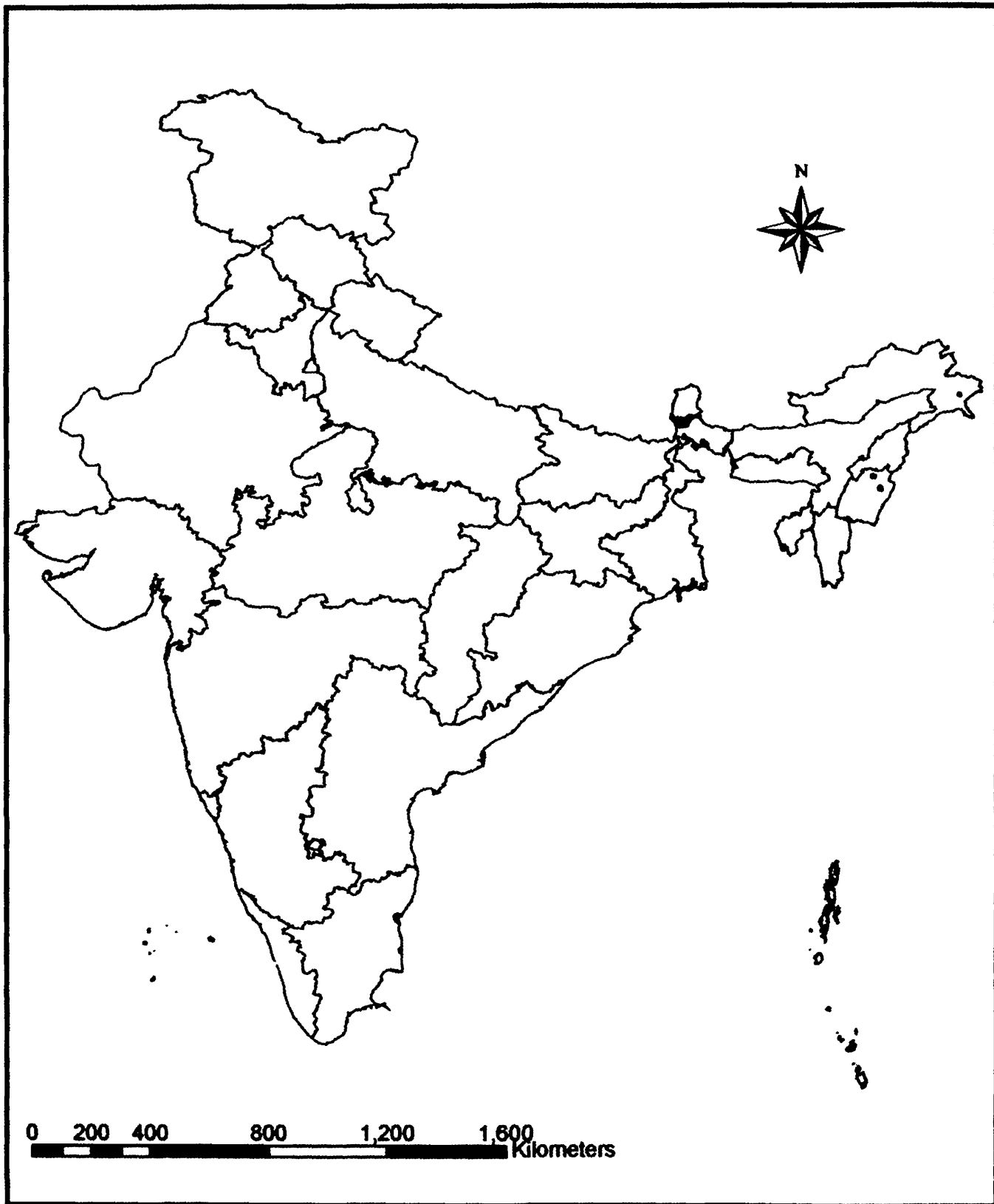
The Himalayan Salamander (*Tylototriton verrucosus* Anderson, 1871) is an unique and rare tailed amphibian which is protected under Schedule II of Indian Wildlife (Protection) Act, 1972. It is a keystone species of the lentic habitats in the Darjeeling hills.

It is about 15-20 cm in length. Females are slightly bigger and more robust. It has a triangular and flat head with distinct cranial ridges. The eyes are lateral and the ear-drums are indistinct. The upper jaw covers the lower one. The body is elongated with 15-18 dorsolateral glandules and a median vertebral ridge. The tail is laterally compressed with sharp edges. The tail height is more in males. The cloaca is longitudinal. It has four fingers in each arm and five toes in each foot.

The colour is chocolate brown with pale orange on the lower jaw, under the throat, on the palm and on the sole of the feet. The cloaca is deep orange during the breeding season (more so in females) and on the lower edge of the tail.

## DISTRIBUTION

The species is reported from Ilam and Jhapa districts of eastern Nepal (Soman, 1966; Shrestha, 1984), Darjeeling district of northern West Bengal between 1330-2220 metres altitude (Annandale, 1907; Smith, 1924; Daniel, 1962; Chaudhuri, 1966; Dasgupta, 1990), Lohit district of Arunachal Pradesh (Mansukhani *et al.*, 1976), Ukhrul and Senapati district of Manipur (Selim, 2001). It is also known from the Kakhyen hills of Myanmar, Chiang Mai province of northern Thailand and from western China (Anderson, 1871). The species may also occur in Sikkim and Bhutan.



Map showing occurrence of Himalayan Salamander in India.

## TAXONOMY

Kingdom	ANIMALIA
Phylum	CHORDATA
Class	AMPHIBIA
Order	URODELA
Family	SALAMANDRIDAE
Genus	<i>Tylototriton</i>
Species	<i>verrucosus</i>

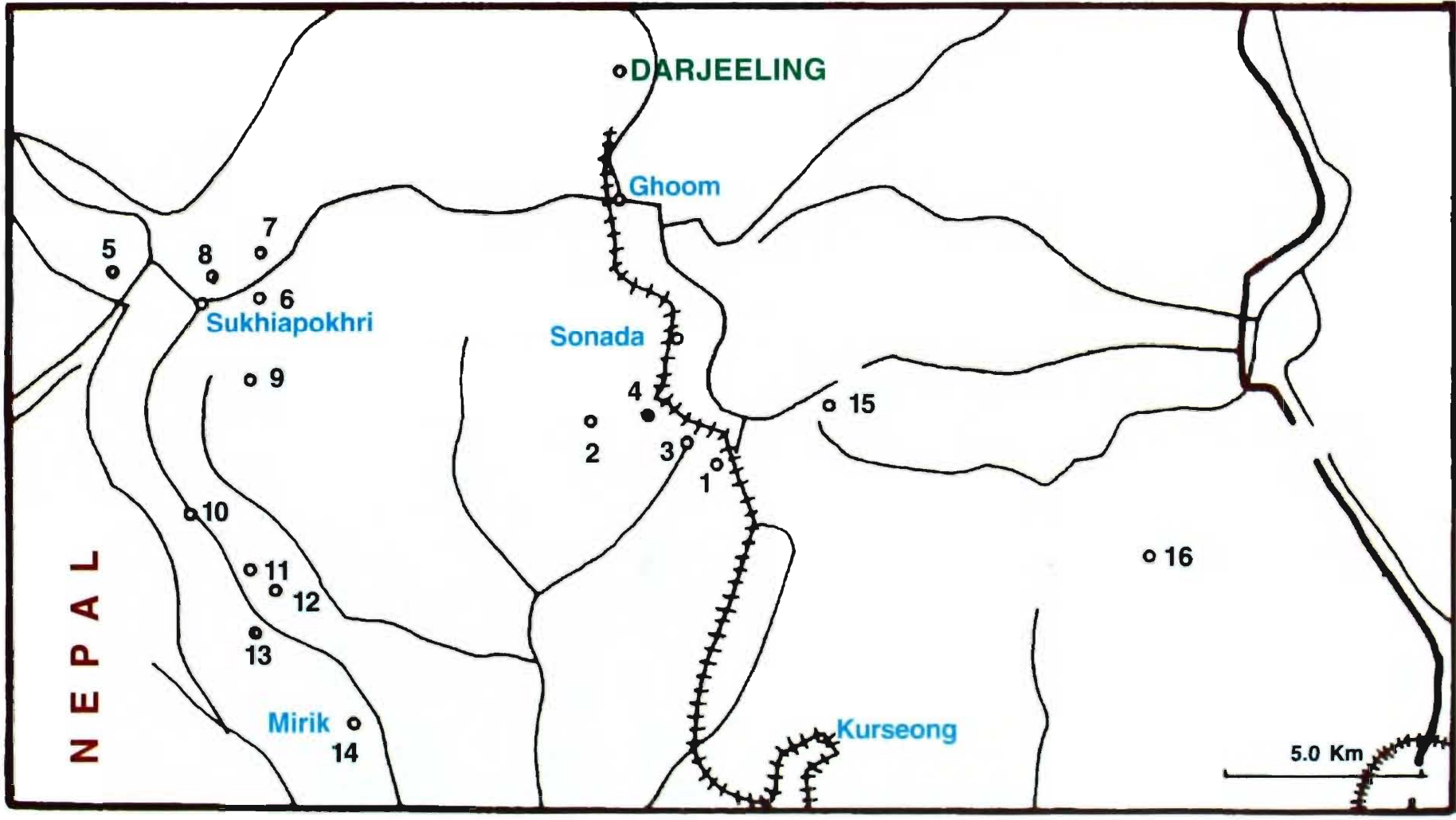
## PHYSICAL CHARACTERISTICS OF DIFFERENT STAGES

### Adult Salamander

Males are 14-17 cm in length. Females are 10-20% bigger (15-20 cm) and more robust than males. Somewhat lizard-like in appearance, both have a large obtusely triangular and flattened head. The head is slightly broader than long. The lateral cranial ridges on the head curve inwards like a scroll in front of the parotoids. The



Photo 1 : Adult Salamander.



Map showing distribution of Himalayan Salamander in Darjeeling district, WB  
(No. : 1-16 as per sites in the text)

snout is short and rounded and the upper jaw covers the lower one. Nostrils are semi-circular and widely separated, situated near the tip of the snout and provided with a valvular skin-flap for closing. The eyes are lateral, of moderate-size and



**Photo 2** : Female Salamander with orange-coloured swollen cloaca in breeding season.

projecting, provided with eyelids, the upper eyelid is prominent and granular. The ear-drums are indistinct. The body is cylindrical, the limbs are short and appear to be weak, with 4 fingers in the fore limbs and 5 toes in the hind limbs. The fingers and toes are without webs, nails or claws. There is a prominent broad median porous vertebral ridge commencing from the

scroll-like end of the cranial ridges and terminating at the root of the tail. There are longitudinal series of 15-16 knob-like porous glands on each side of the body, the last 3-4 behind the leg when it is extended at right angles to the body. The cloacal slit is ventral and longitudinal, the borders are not much swollen except in the breeding season. The tail which is almost as long as the head and body (80-95 mm) is laterally compressed with the upper margin sharp edged but rounded below. The tail height is more in males. The skin is rough and tubercular and covered with a slime secreted by the skin glands (Anderson, 1871; Chaudhuri, 1966; Shrestha, 1984).

The colour is chocolate brown with pale orange on the lips, lower jaw, chin, throat and on the palm and sole of the feet. The cloaca is deep orange during the breeding season (more so in females) and the lower edge of the tail is dull orange-yellow (Photos 1 and 2).

### **Age at Sexual Maturity**

The male attains maturity when it reaches 120-160 mm. The female reaches maturity when it reaches 150-200 mm. Males reach sexual maturity at considerably smaller sizes than females (Shrestha, 1989). Sexual maturity is often attained by the third year but mostly during the fourth year. There is no connection between the number of growth rings in bones and body length (Kuzmin, *et al.*, 1994). No evidence of neoteny was detected in captivity or in nature (Shrestha, 1994).

### Maximum Age known

The maximum age known is 11 years but the most frequent age class is 5-7 years (Kuzmin, *et al.*, 1994).

### Egg of Salamander

The intraovarian egg measures 6-8 mm in diameter. Nearly all mature intraovarian eggs showed early developmental stages. The egg is greenish-yellow, transparent, spherical and is enveloped by an outer layer of loose jelly and an inner layer of tenacious fluid of greater density (Annandale, 1907) (Photo 3). Its envelope is membranous, of glassy transparency and is covered with a clear viscid matter in which the embryo is so attached that it can move freely in every direction as it grows (Chaudhuri, 1966). The eggs are somewhat variable in size measuring when



Photo 3 : Salamander eggs.

the gelatinous envelope is fully distended by the developing embryo, between 6-10 mm in diameter (Smith, 1924). The freshly laid large eggs measure 10-15 mm in diameter. The diameter of the internal egg ranges from 8-12 mm. The thickness of the egg envelope ranges from 2.0-2.5 mm. 40-90 eggs are laid by a female. The average clutch size is 60 (Shrestha, 1989).

### Larva of Salamander

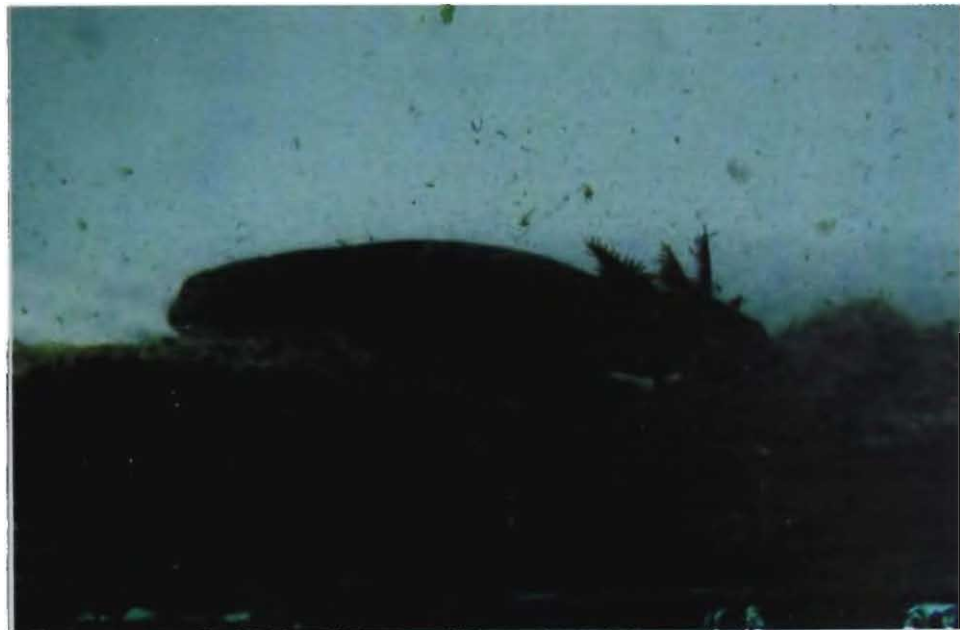
**Early larva :** The embryo shows interesting twisting movements inside the egg capsule. When the eyes develop the embryo is ready to break out of the egg envelope and escape into the water (Chaudhuri, 1966). It soon breaks its transparent double-layered envelope and becomes free. This usually happens during the last week of July or first week of August. The embryos hatch long before the yolk is used and feeding becomes necessary only after all yolk is used up. The time of hatching is influenced considerably by the amount of mechanical disturbance to the egg. It seems to make little difference to the embryo whether it is within or outside

the egg membrane. The advantage of early hatching or hatching at a pre-feeding stage may be that it allows dispersal from the nest site to escape desiccation or predation (Shrestha, 1989).

The escaping early larva measures 9-11 mm in length of which 3 mm is occupied by the tail. The head is small and round measuring 1.5 mm in length. The body is rounded owing to the large amount of yolk held in the belly but the tail is laterally compressed and has a lanceolate outline. The greatest depth is 1.75 mm. At this stage the larva closely resembles the sac-fry larva of fish. The eyes are large but not protrudent, they are covered by a skin-fold but the eyeballs are quite distinct. There are four delicate external gills on either side, each set being arranged in a graduated series from above downwards. The mouth is transverse and relatively large and open externally, behind it there is a conspicuous fold of the body wall. The anus is still imperforate. The belly is white but the crested tail and back and sides of the body are brownish-black with large melanophore cells forming black reticulate patterns (Annandale, 1907).

### **Free-swimming tadpole larva**

The free-swimming tadpole larva has an elongated body with long well-developed plumose external gills in which red blood is seen to circulate. The head is longer than broad and the eyes and mouth are well-developed. They have a pair of elongated balancers which originate from a point behind and below the eye in a line in continuation with the mouth backwards. Only the rudimentary and budding forelimbs are present. The tail is lanceolate and bears dorsal and ventral crests, the dorsal crest extends over the trunk and ends just behind the head. They measure 15-40 mm in total length (Smith, 1924; Dasgupta, 1988; Shrestha, 1989). Free-swimming tadpole larvae (Photo 4) occur in great abundance from early August to last week of September (Shrestha, 1989).



**Photo 4 : Salamander larva.**

### Advanced tadpole larva

The free-swimming tadpole larva changes into advanced tadpole larva by the end of October but still shows photonegative and geopositive response (Shrestha, 1989). The advanced tadpole larva is characterized by well-developed limbs. These develop rapidly and all four legs along with their digits are quite complete by now. The so-called balancers of the earlier stage disappears completely at this stage, although vestiges remain in the form of small tubercles at the point of their origin (Smith, 1924).

### Surveys done on the Himalayan Salamander

Annandale (1907-1908), Smith (1924), Daniel (1962), Chaudhuri (1966) and Dasgupta (1990) all reported the occurrence of the Himalayan Salamander from the Darjeeling hills of northern West Bengal. Soman (1966), Shrestha (1984, 1989) noted its distribution in Nepal. Mansukhani *et al.* (1976) reported it from Arunachal Pradesh and Selim (2001) from Manipur.

The first survey on the species in the Darjeeling hills was conducted by Ritwik Dasgupta from 1983-1988 who reported the species from 10 sites (Dasgupta, 1990). The second survey was conducted by Daniele Seglie *et al.*, in the year 2002 who reported the species from 16 sites in the Darjeeling hills (Seglie *et al.*, 2003). Our survey from June, 2005 to July, 2006 observed the species in 20 sites.

### Study Area

The Study area comprised only the Darjeeling hills of northern West Bengal. The Darjeeling hills occur in Darjeeling district of West Bengal and is administratively divided into three sub-divisions, viz., Darjeeling, Kurseong and Kalimpong. The Teesta river divides the Darjeeling hills with the Darjeeling and Kurseong sub-divisions on the west and the Kalimpong sub-division on the east. We could find the Himalayan Salamander only on the west side of the Teesta river and mainly in Darjeeling sub-division between the altitudes 1550-2263 metres above mean sea level. Most of these areas are bordering eastern Nepal. Although Seglie *et al.* (2003) reported the species from Algarah on the east of the Teesta river, we could not find it in the Kalimpong sub-division.

### Habitat of the Salamander

Adults live in diverse habitats: leaf-litter on the forest floor and at the edge of woods, meadows and pasturelands covering the shores of mountain ponds and lakes, tea estates, vegetable gardens at the backyard of human habitations, boulder-

strewn hill streams and flooded rock pools at an altitude of 1330-2220 metres above mean sea level. These areas experience a warm wet summer from March to October (air temp. : 18-27°C) and a mild wet winter from November to February (air temp: 7-16°C) besides an annual rainfall of 1300-1400 mm, most of which falls between June-July (800-900 mm) and August-September (400-500 mm) (Kuzmin *et al.*, 1994; Shrestha, 1994).

### **Methodology**

To find out the exact locations of this species in the Darjeeling hills of northern West Bengal, a status survey was conducted by us in the area from June, 2005 to July, 2006. The specific small ponds (locally called "Pokhries") which serve as breeding sites for the Himalayan Salamander were visited during three surveys to the area each consisting of 10-15 days duration. The physical parameters of the sites like area, depth, altitude, covering vegetation, surrounding vegetation, were recorded. The co-ordinates of the site were also noted. The number of salamanders were estimated per sq. meter area.

## **OBSERVATIONS**

### **Sites where salamanders were found**

1. **Lake inside Margaret Hope's Tea Estate :** It is a natural lake having cement bund on the lower side and marshy land on the upper side surrounded by tea bushes. A few hundred salamanders were found and it is protected by Forest department and it is a good place for breeding of salamanders.

2. **Site inside the Oaks Tea Estate :** It is an artificial dam made for generating hydroelectricity with marshes on upper side. A few scores of salamanders were found which were affected by pollution from pesticides used by the Tea Estate.

3. **Pacheng Bazar:** It is a natural marsh in the town of Pacheng, but dry as it is threatened by drainage for agriculture. A few scores of salamanders were found.

4. **Site beside Shanti Rani High School, Pacheng:** It is an artificial reservoir made for generating hydroelectricity but now dry and filled with herbs and grasses. A few scores of salamanders and eggs were also found. During most of the time it is filled with water, it is a good site for breeding.

5. **Majhidhura (Near Sukhiapokhri) :** It is a natural marshy land surrounded by grassland. A few dozens of salamanders were found

6. **Dungdungia (Near Sukhiapokhri)** : It is a natural marshy place at the top of a hill surrounded by *Cryptomeria* trees. Less than 10 salamanders were found.

7. **Jorepokhri** : The two ponds at the top of the hill are cemented and converted into a recreational park by DGHC. A small pool beside the road to Jorepokhri was containing less than 10 salamanders.

8. **Maneybhanjang** : It is a small permanent pool with marshy land on lower side. Most of the marshy land is now converted into football ground. Less than 10 salamanders were found and the pool is polluted by washing clothes and utensils (Photo 5).



**Photo 5** : Small pool at maneybhanjang.

9. **Simana** : A small rain puddle beside a permanent stream between Simana and Fatak. Surrounded by bushes and grasses and less than 10 salamanders were found.

10. **Solimore** : A natural pool between Fatak and Seeyok surrounded by grasses and herbs. Less than 10 salamanders were found.

11. **Seeyok** : It is a temporary marsh opposite to DGHC view point surrounded by grass and less than 10 salamanders were found.

12. **Nakhapani** : It is a natural pond inside Gopal Dhara Tea Estate surrounded by tea bushes and a few dozens of salamanders were found (Photo 6).



13. **Ninth mile upper pond** : It is a natural pond inside a village, surrounded by bushes and trees. Less than 10 salamanders were found and they are threatened by release of commercial fishes (Photo 7).

**Photo 7** : Upper pond at Ninth Mile.

14. **Ninth mile lower pond** : Two natural ponds near Thurbo Tea Estate, surrounded by trees and bushes and partially by marshy land. Less than 10 salamanders were found and threatened by release of commercial fishes.

15. **Mirik - Social Forestry Area** : Many artificial pools made by Forest Department for breeding salamanders. A few scores of salamanders were found.

16. **Mirik - Raidhap Area** : Two rock pools beside a hill stream and few rain puddles in a football ground were found. A few dozens of larvae of different stages were found in the rock pools.

17. **Pokhritar** : A big natural pond inside Pokhritar village, near Bagora,



surrounded by human habitation. A few scores were found and the pond is polluted by domestic sewage (Photo 8).

18. **Debrapani** : It is a small natural pool surrounded by bushes and trees and partially by marshy land. Less than 10 salamanders were found. Pool is filled by plant debris.

Photo 8 : Pond at Pokhritar village, Bagora

19. **Satdobate** : A big natural marshy land and a sacred place for local people. A few scores of salamanders were found and it is a good place for their breeding.

20. **Namthing Pokhri** : It is a big natural lake fenced and protected by a NGO (NEWS). A few hundreds of salamanders were found and it is a good place for their breeding (Photo 9).



Photo 9 : Namthing Pokhri

**Table 1.** : Showing the descriptions about the sites where the salamanders were found.

Name of the Site	Type	Area (Sq m)	Depth (metres)	Latitude N	Longitude E	Altitude (metres above m.s.l.)
Margaret Hope T.E.	Natural	3150	2.0	26°56'580"	88°16'864"	1600
Oaks T.E.	Artificial		1.0	26°56'893"	88°15'199"	1550
Pacheng Bazar	Natural	1540	-	26°57'085"	88°15'878"	1740
Shanti Rani H.S.	Artificial	252	-	26°56'910"	88°15'621"	1690
Majhidhura	Natural	750	0.15	26°59'580"	88°09'864"	2148
Dungdungia	Natural	600	0.30	26°56'580"	88°16'864"	2227
Jorepokhri	Natural	0.04	0.30	26°59'240"	88°09'149"	2263
Maneybhanjang	Natural	12	0.30	26°59'299"	88°07'346"	1934
Simana	Natural	01	0.15	-	-	-
Solimore	Natural	07	0.50	26°55'580"	88°08'217"	1996
Seeyok	Natural	112	0.15	26°55'597"	88°08'488"	2057
Nakhapani	Natural	144	0.60	26°55'064"	88°08'933"	1728
9 <sup>th</sup> mile upper pond	Natural	88	1.00	-	-	1614
9 <sup>th</sup> mile lower pond	Natural	78	0.50	26°54'321"	88°09'508"	1584
Mirik Social forestry area	Artificial	105	1.00	26°53'146"	88°11'235"	1577
Mirik-Raidap area	Natural	04	0.30	26°53'186"	88°11'285"	1607
Pokritar	Natural	1750	2.00	26°58'28"	88°07'42"	1854
Debrapani	Natural	09	1.50	26°58'186"	88°09'933"	1728
Satdobate	Natural	10000	0.50	26°57'656"	88°10'018"	1874
Namthing pokhri	Natural	5250	2.00	26°55'424"	88°23'551"	1737

## THREATS TO THE SPECIES

Expanding human population and ensuing habitat destruction has contributed to the endangering of the species. The population is depleted throughout its original range in the Darjeeling hills due to the following reasons:

1. The species is threatened because of rapid modification of its lentic habitats, which are being drained for housing and agriculture. As a result many of its breeding pools have dried up and its eggs and larvae are stranded during the dry season.
2. They do not survive in areas where there has been considerable alteration of habitat due to deforestation and implementation of various developmental projects such as construction of motorable roads. During thunderstorms road kills also occur (Photo 10).

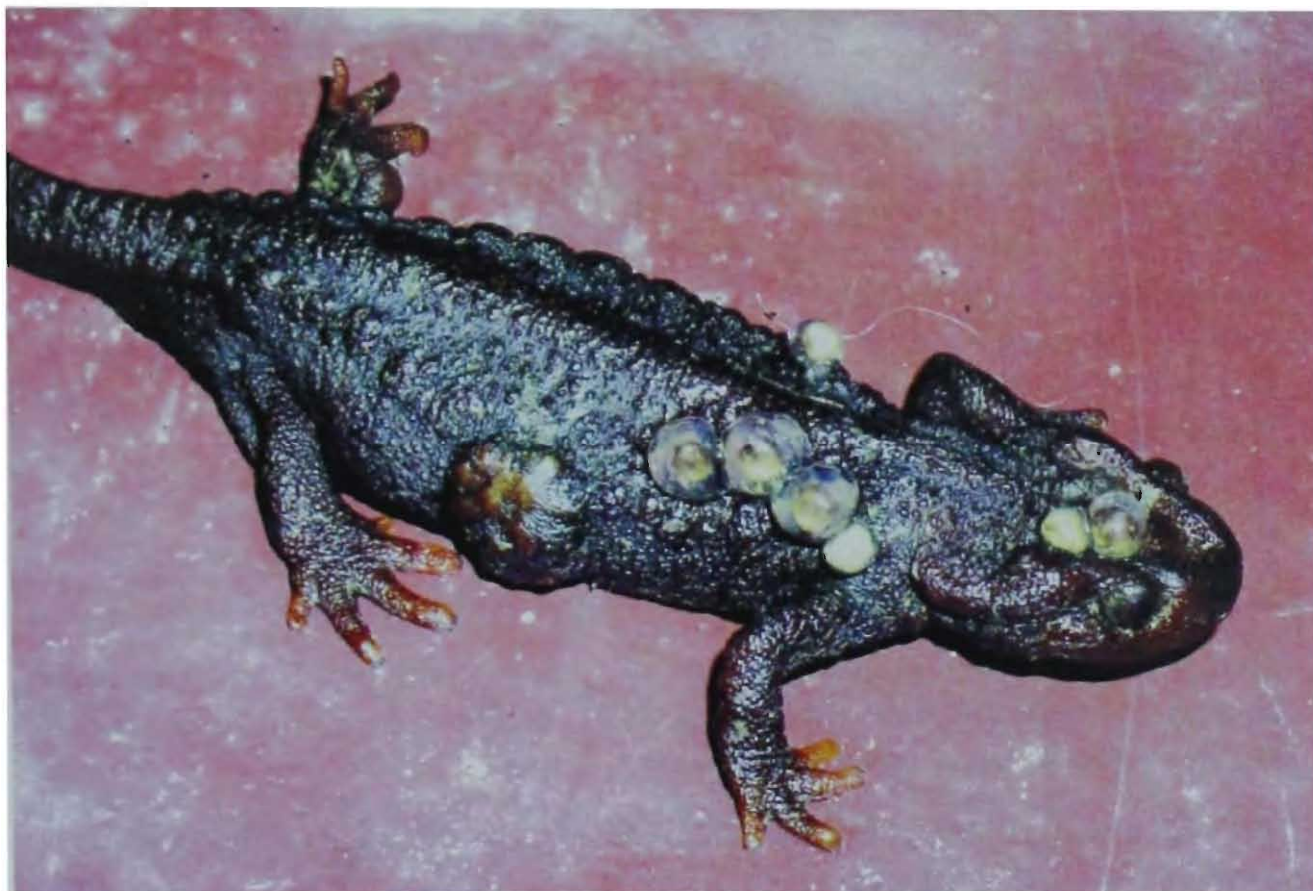


**Photo 10** : A road killed Salamander.

3. Detergents and agricultural pesticides washed down into the waterbodies from the tea gardens by rain causes considerable mortality of developing eggs and larvae. Mortality is also high during embryonic stage due to domestic pollution. All stages of the life history are especially vulnerable to water pollution because most spend atleast part of their lives in water. We encountered salamanders killed by pollutants in the pond at Oaks tea estate (Photo 11), the survivors had visible signs of tumours on the skin (Photo 12).



**Photo 11** : Salamander killed by pesticides at Oaks Tea Estate.



**Photo 12** : Salamander with tumour on body.

4. Many of the smaller waterbodies are being used as garbage dumps and public urinals thus totally destroying them as breeding sites for salamanders.
5. The eggs and larvae of salamanders will die if acid levels are too high in their breeding pools. Many salamanders breed in small rock pools that result from spring rains and melting snow. Such pools tend to be especially acidic because humic acid accumulates over winter with each snowfall.
6. Grazing by sheep and goats is another factor as soil eroded by hooves causes pond siltation thereby decreasing the volume of water.
7. A very serious threat is the introduction of carps and other freshwater fishes into Mirik lake and some ponds which are potential predators of salamander eggs and larvae.
8. Over-collection is suspected to be another reason for decline in population. The regions around Darjeeling used to be collection centres for supply to the biological product dealers in Calcutta.

### **CONSERVATION SUGGESTIONS**

The Himalayan Salamander is on the verge of extinction and the future of the species is uncertain as there is no ecological stability for the salamander in the Darjeeling hills. The following measures should be undertaken for its conservation in the area :

1. Waterbodies (locally called "Pokhries") which are breeding sites for the salamanders should not be drained or filled up. Strong legislation in support of this should be developed. Smaller waterbodies should not be used as garbage dumps or public urinals.
2. At certain places like Jorepokhri, Sukhiapokhri, Maneybhanjang, Simana, Fatak, Seeyok etc, small pools (5 m X 5 m X 1m) should be dug which can act as breeding pools for the salamanders. These should not have steep walls.
3. Deforestation of the watershed areas of natural ponds and lakes should be actively prevented. Developmental projects in the vicinity of such natural wetlands should be stopped immediately.
4. The use of agricultural pesticides in tea gardens and detergents in households in the hills should be reduced.

5. Carps and other exotic freshwater fishes should not be released into any lakes or ponds at altitudes between 1300-2200 metres as they destroy salamander eggs and larvae.
6. Stringent control over the wildlife trade by Forest Department can prevent collection of salamanders for exhibits and medicinal practices. Public awareness should be enhanced for enforcing of wildlife protection laws as the salamander is included under Schedule II part I of the Indian Wildlife (Protection) Act, 1972.
7. Forest Departments, Tea Estates and NGOs should come forward and protect atleast some of the major breeding lakes or ponds of the salamanders as has been done by at Margaret Hope TE and at Namthing Pokhri. Similarly Nakhapani lake at Gopal Dhara TE; the reservoir at Oaks TE; tank near Shanti Rani High School, Pacheng; pond at Pokhritar village, Bagora hill and marshes at Majhidhura near Sukhiapokhri High School and that near Maneybhanjang High School, Maneybhanjang should be fenced and protected as these are the last breeding sites for salamanders in those areas in the Darjeeling hills.

### ACKNOWLEDGEMENTS

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