PT. 1.1 *Neoscorpiops deccanensis* 
(Tikader and Bastawade)
Chapter - 1

INTRODUCTION

General Account of Class Arachnida

Neoscorpiops deccanensis, (Scorpiones : Euscorpiiidae) the species of scorpion I worked on, chosen for present study; distributed on and around the Fort Singhgad, 30 kms away from city of Pune, Maharashtra, India. Fort Singhgad is a part of hilly forested tracks of western Ghat.

Neoscorpiops deccanensis, (Tikader and Bastawade 1977) is recently discovered species (Tikader and Bastawade D. B. 1983). It is easily available and no previous work on any Indian species known under this family Euscorpiiidae done on its anatomy and histology. It is necessary to study this species to compare with known data. Present study also needs to explore this species in the view of future viability for studies of this endemic group of scorpion species.

Reasons to choose Neoscorpiops deccanensis for research work

Considering the medical and biological importance of scorpions, this is the first attempt to work on anatomy and histological studies of Neoscorpiops deccanensis in India. It is unfortunate that we are still relatively ignorant about them. Neoscorpiops deccanensis is easily available. Very little work done about distribution, habits, habitat, anatomy and histology of scorpions in India. Scorpions show well advanced reproductive systems, like viviparous reproduction and very systematic pattern of nourishment of developing embryos. Scorpions show good parental care of young ones. Nervous system is well functioning and remains advanced for millions of years. Scorpions have role in conservation of nature. Scorpion’s venom has medicinal importance. They might be a biological control for pest.

1.1 Historical resources.

Scorpions are most venomous Arachnids which comprise the order Scorpionida. The literature during second half of the nineteenth century shows that the families under order Scorpionida described in 1860 to 1900. Studies on scorpions of India have received very little attention as compare to other animal groups. Indian and African species used to be described under the genus Hetorometrus. Thorell was the first to distinguish between the Indian and African scorpion species. Family Vaejovidae was erected by Thorell(1876).
While studying Indian scorpions, many species recorded by various authors. The works on Indian Arachnids published in various journals which were compiled initially by Pocock (1900) for the first time in his classical work as Fauna of British India: Arachnida (including Burma and Sri Lanka), in which he described many new species and genera of scorpions. Tembe and Awati (1944) have studied the external morphology and anatomy of Buthus tamulus (Fabricius). Remarkable work on embryology of some Indian scorpions done by Mathew (1948-60). Deoras (1960-1970) has added considerable knowledge on collecting and rearing techniques of scorpions. Recently Vachon (1940-78) has revised the order scorpionida and the family Buthidae from the world. Vachon revised family Vaejovidae (1990) According to his revision Family Vaejovidae is named as Euscorpiidae.

Tikader (1973) has listed the scorpion fauna existing in Deccan. Very recently Tikader and Bastawade D. B. (1977) has described a new species Neoscorpiops deccanensis from Fort Singhgad, Pune, Maharashtra, India.

Tikader and Bastawade D. B. (1983) have attempted a revisionary faunal work in their monumental compressive work as FAUNA OF INDIA SCORPIONES, which serves as a fundamental reference to take scientific work on Indian Scorpions. The scorpion fauna of India constitute 5 families; 19 genera and about 127 species (Bastawade D. B. 1977-2005)

The anatomical and histological work have been attempted in four Indian species namely, Buthus tamulus (Fabr.) = Hottotota tamulus tamulus, Family Buthidae by Tambe and Awati (1947), Palamneaus Fulvipes Pocock (=Heterometrus fulvipes) family Scorpionidae by Bhadhuri (1960), Hetrometrus xanthopus family Scorpionidae and Orthochirus bicolor family Buthidae by Giramkar S. G. (2008) The scorpion species belonging to families Chaeliiredae and Liochilidae have not so far been attempted by any researcher in India.

Family Euscorpiidae (=Vaejovidae, Scorpioopsidae) shows an interesting patchy distribution in Indian sub-continent. It includes 1 sub family, 3 Genera and 15 species (Bastawade D. B, 1995). The sub family Scorpiopsinae have mobile finger of chelicera forked dorsal and ventral fangs sub equal in length and dorsal fang is always distinctly shorter than ventral fang. (Stanke, 1974). Sub family Scorpiopsinae comprises six genera namely 1. Scorpiops Peters (1861), 2. Parascorpiops Banks
Genus *Scorpiops* is known from Himalayas and one place Satpura range in Madhya Pradesh (Bastawade D. B, 1995). This genus comprises 15 species and 7 subspecies. The genus *Scorpiops* Peters incourse of evolution has diverged in to three separate Genera among Indian species into 4 genera namely 1. *Scorpiops* Vachon (Nominal), 2. *Neoscorpiops* Vachon (Vachon 1980) 3. Genera *Euscorpiops* Vachon., 4. *Alloscorpiops* Vachon (Vachon 1980). Among these except *Neoscorpiops* the remaining three have been reported from Indian Himalayan ranges. Genus *Euscorpiops* is restricted only to North East Indian States, where as the *Neoscorpiops* is known only from Western Ghat region between Tapi and Krishna valleys and Gujrat. Genus *Neoscorpiops* have patella with 22 to 26 Trichobothridia on external ventral surface. Pincers relatively thin. Telson without constrictions at the base of aculeus. So far there are only 3 known species. *Neoscorpiops* tenuacauda from Matheran, *Neoscorpiops deccanensis* (Tikader and Bastawade 1977, 1983) from Sinhagad and *Neoscorpiops sataresis* from Mahabaleswar.

1.2 Type genus: *Neoscorpiops* Vachon (Vachon 1980),
Species: *deccanensis* (Tikader and Bastawade :1977,1983)

**Distribution:**

Among various families of Indian Scorpions, the Euscorpids are flat scorpions and habit in cracks and crevices of soft to hard rocks. They are distributed in Himalayan ranges as well as at some places of Sahyadri ranges in Deccan especially the hilly region of Western Ghats.

**Habit and habitat:**

"Habitat" refers to the environment where an organism lives in, in the wild. *Neoscorpiops deccanensis* is strictly nocturnal, found under stones, crevices, and dark damp corners of vertical rocks. It is carnivorous, feeds on beetles, cockroaches and other small arthropods. *Neoscorpiops deccanensis* rock dwelling (lithophilous), distributed in Sahyadri ranges in Deccan the hilly region of Western Ghats especially from Sinhagad, 30 Kms, and South west of Pune City near Pune, Maharastra, INDIA.
Classification
Phylum – Arthropoda (L. H. Hymen)
1. Triploblastic, bilaterally symmetrical, metamerically segmented animals.
2. Body is covered with chitinons cuticle forming an exoskeleton.
3. Body cavity is haemocoel. The true coelom is reduced to the spaces of the organs.
4. Digestive system is complete. Mouth parts show adaptations for various modes of feeding.
5. Circulatory system is open.
6. Respiration occurs by gills, trachae, lungs
7. Excretion by green gland, Malpighian tubules
8. Sexes are separate, internal fertilization and development direct or indirect.

Class – Arachnida (Foelix R.L.)
1. Body is divided into cephalothorax and abdomen
2. Antennae are absent
3. Legs are attached to cephalothorax, 4 pairs of legs are present.
4. Sexes are separate
5. Viviparous development is direct

Arachnida may be characterized as animals in which the body in the adult is never composed of 18(somites) segments.

Subfamily – Scorpiopsinae
Movable finger of chelicera forked dorsal and ventral fang as subequal in length.

Genus: Neoscorpiops Vachon (Vachon 1980),

species: deccanensis (Tikader and Bastawade: 1977, 1983)

Taxonomic characters of Neoscorpiops deccanensis (Tikader and Bastawade: 1977, 1983)

Large scorpion with big elongated chela and the patella of pedipalp bearing sixteen to seventeen setal pores on ventral side as in text-figure 5. General coloration of entire scorpion dark-brown to black; but the carapace and first two tergites variegated with yellowish tint. Lateral ocular region dark. Pedipalp uniform brown but carinae and fingers dark. Tips of the legs pale. Caudal region dark; telson yellow and the aculeus brown. Ventral side pale yellowish brown to dark.

.. 4 ..
1) Dorsal view of male
2) Carapace, dorsal view
3) Lateral eyes, lateral view
4) Movable finger of chelicera, inner view
5) Manus & fingers, exterior view
6) Cephalothoracic sternum, genital operculum & pectines, ventral view
7) Patella of pedipalp, ventral view
8) Telson, lateral view
9) Telson & distal portion of segment V, ventral view

Fig. 1.2 Morphology of male *Neoscorpiops deccanensis*
Measurements: Total body length 50 mm. Carapace 8 mm long; Pre-abdomen 22.50 to 28 mm long; Post-abdomen (Cauda + Telson) 24.50 mm long. (Bastawade 1997).

Carapace: Entire surface smooth, no keels except slightly raised lateral ocular tubercles. Median ocular tubercle smooth, armed with a pair of short setae on posterior side of median eyes and provided with two yellowish bands, which extend up to the notch of anterior margin. Anterior margin armed with six setae. Three pairs of contiguous lateral eyes small. Lateral margins slightly crenulated on anterior part and armed with single seta. Posterior margin smooth and nearly straight. Median eyes situated anteriorly in the ratio 1:2 as in figure. Chelicera with dorsal surface of basal segment smooth with black reticulations and more dark on anterior end. Ventral side pale yellows, smooth and covered with tuft of thin short silky hairs. Fingers more dark and brownish at the tips. Immovable fingers much shorter than movable finger and armed with a double and a single teeth. Movable finger armed with three triangular sharp teeth on dorsal arm and ventral arm provided with six small triangular sharp teeth, grouped in 3, 2, 1 as in (fig. 1.2.4.). Femora of pedipalp slightly longer than carapace, dorso-ventrally flat; intercarinal space granular; inner surface with five large tubercles on crenular carina. Patella shorter than femora but longer than carapace with dorsal posterior carinae smooth and anterior carina granular; carinae on exterior or outer surface smooth, inner surface armed with two strong and weak triangular tubercles. Carinae on ventral surface slightly crenellate on inner side than on outer side and outer carina provided with a row of sixteen to seventeen setal pores and from each pore a long thin seta arises. Hand of pedipalp large, elongated and longer than patella or femora. Fingers short, nearly half the length of hand. Dentation on fingers scalloped, double dentate; scallops near the base not much deep. Nine teeth on fixed finger and eight teeth on movable finger Trichobothrial patterns: C type and as shown in (fig. 1.2: 9, 10 and 11.) Legs brownish, carinae on femora and patella crenulated on inner side and carinae on tibia crenulated on outer side. A row of five stout sharp spinules on ventral side of tarsus. Pectenses well developed and medium size, twice as long as wide. Middle lamellae separated into 6 sub-circular segments or digits as in text figure 3. Triangular fulcra well distinguished between the adjacent teeth. Teeth long and seven in number. Basal piece simple. Lamellae and basal piece sparsely clothed with microscopic red setae. Genital operculum completely divided.
1) Dorsal view of Female
2) Carapace, dorsal view
3) Lateral eyes, lateral view
4) Movable finger of chelicera, inner view
5) Manus & fingers, exterior view
6) Cephalothoracic sternum, genital operculum & pectines, ventral view
7) Patella of pedipalp, ventral view
8) Telson, lateral view
9) Telson & distal portion of segment V, ventral view

Fig. 1.3 Morphology of Female *Neoscorpiops deccanensis*
and a pair of conspicuous genital papillae protruding from the posterior edge of sclerites.

**Pre-abdomen:** All tergites smooth with a pair of yellow elliptical spots on middle portion except on VII tergite as in text-figure 1. Simple median keel, smooth and poorly developed; no lateral keels but a pair of setae on the posterior margin of each tergite. Tergite VII with a pair of smooth lateral keels. Sternites I-IV smooth, pale but dark on lateral and posterior margins and armed with black setae. Stigmata of book lungs slit-like. Sternite V more black than rest of the sternites, smooth and without keel.

**Post-abdomen:** Cauda twice as long as carapace. Basal segment as wide as long. Segments I-IV provided with dorsal keels slightly serrated but more spiniform on IV segment. Dorsolateral keel smooth and visible upto half of the anterior of IV segment. Lateral keels smooth. Inferior laterals and inferior keels weakly crenulated on I, noticeably serrated on II and III than IV segments. Fifth segment as long as width of understand; dorsal keels serrated; lateral keels and single inferior median keel more serrated. Anal rim of this segment provided with crenulate serrated tubercules. Inter-carnial space provided with fine granules.

**Telson** smooth and without annular ring at the base of aculeus, vesicle conspicuous yellow in colour and as long as fifth caudal segment. Setation sparse and a pair of setae on aculeus as in text-figures 6 and 7. Aculeus less curved and its length almost half of the telson.

Specimens studied: 8 male, two immature males, all types 12 mature females, gravid females are observed for present study. For histogological studies normal HE method is used

1.3 **Scope of Project**

Histology is a branch of science that deals with knowledge of tissues and formation of organs by different tissues. The word histology is derived from two Greek words histos means tissue and logia means knowledge.

Knowledge of histology is useful for the following purposes:

- To be familiar with normal cells and tissues and to distinguish them from abnormal ones. It helps to diagnosis of abnormalities.
To understand formation and construction of organs.
To correlate between structures and functions of an organ.

Cell: Basic functional unit of body
Tissue: Group of Cells which are identical in structure and function
Organ: It is a complex structure having interaction of different types of tissues to perform particular action.

Scorpions present a model research vehicle for addressing many basic questions. Obviously, more research needs to be conducted on almost all aspects of scorpion biology. For example, we know practically nothing about the natural history or field behavior of any of the deadly species.

This lack of information is paradoxical; because scorpions exhibit many characteristics that make them well suited as research organisms. They occur in high densities in many habitats and survive well in captivity. Their cuticle fluoresces under ultraviolet light (Lawrence 1954, Pavan and Vachon 1954), and they are thus readily detected in the field with portable UV lights (Stahnke 1972a). This feature allows the rapid collection of animals for laboratory research and facilitates field studies in behavior or ecology. Scorpions live for many years and are large enough for easy study. Because their anatomy is fairly simple and relatively well known, they are ideal for various physiological and neurobehavioral studies. Finally, comparative research is easily conducted because scorpions are often locally diverse and there is considerable interspecific variation in behavior and physiology.

Information of Sinhagad, Pune City, Maharashtra, INDIA.
(From Bombay state Gazetteer, Poona District, vol. XX)

Pune is well known City of Maharashtra state, located in the western part of INDIA. It is situated at the hilly region of Western Ghats, at 18° 31' 22.45" North, 73° 46', east latitude on the Deccan plateau.

Fort Sinhagad

Fort Sinhagad, 30 Kms, South west of Pune City stands on one of the prominent points of Sinhagad-Bhuleshwar range nearly 4322 ft. above the Pune plain. It is deciduous forest of basalt rock, Greenish grey in colour, Brownish tints also met with. The specific gravity is 2.9 on an average. Rocks have prismatic and columnar jointing. Scorpions hide in these rocks.
Distribution of *Neoscorpiops deccanensis* in Western Ghat.

**Fig. 1.1**
1. Map Showing family Euscorpiidae; its genera and subgenera
2. Distribution Genus *Neoscorpiops* in Maharashtra
3. Distribution of *Neoscorpiops deccanensis* fort Singhgad; Pune, INDIA
PT. 1.2 Type locality and habitat of *Nd.* Singhgad fort, 30 km south west to Pune City, Maharashtra India 3rd June 2008

PT. 1.3 Singhgad fort Top View in rainy season surrounded with mist.
Climatic conditions:

Climate: dry and invigorating
Temperature: Highest 110°F, Low 35°F.
Altitude: 4322 ft. from sea level.
Humidity: Mean humidity is about 84% (relative humidity is more in the morning but considerably reduced in the evening.
Vapour pressure:
- March: 9.8 – 8.0
- April: 8.9- 8.2
- September: 15.0
- June: 13.2
Season:
- Cold: November to February
- Hot: March to May.

Wet: June to October

Time of Collection: 11 AM to 4.30 PM

(Indian Meteorological department, Pune)

It is a famous fort Kondhana from historical times. In 1340 a Koli chieftain Nag Nayak resisted Muhammad Tughlak for 8 months. Then it appears among the forts of Pune which fell to Malik Ahmad, the founder of Nizamshahi (1490-1608). Shahajiraje (father of Shivaji Maharaj) had charge of fort on the behalf of Ahmadnagar for a time. Shivajimaharaj changed old name of fort Kondana as Sinhagad in the honor of brave Maratha warrior Tanaji Malusare (1670). Recently the fort is a popular picnic spot and health resort because of the splendid climate and beautiful nature. Sinhagad-Bhuleshwar range a 50 miles of dense deciduous forest of Western Ghats and forest is having great biodiversity in it’s flora and fauna. The species selected for present study (Neoscorpiops deccanensis) distributed strictly and abundantly in columnar jointing of prismatic basalt rocks.