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THE SYSTEMATICS AND BIOLOGY OF THE SPIDER NEPHILA PILIPES AND CLAVIPES (FAMILYNEPHILIDAE) IN THE GADCHIROLI REGION (M.H.) INDIA

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Abstract:
Gadchiroli district is famous for glory of forest and it is considered to be one of the biodiversity rich areas of eastern Maharashtra as well wild life diversity of flora and fauna is seen among the dense forest region. Gadchiroli district is located in south –eastern corner of Maharashtra State in India and is bounded by Chandrapur district to the west, Gondia district to the north Chhattisgarh state to the east and Telangana state to the south. The main river basin of the district is Godavari which flows to west to east and form southern boundaries. The major tributaries of Godavari are Indrawati and Pranhita which is turn from by the confluence of the Waingangā and the Wardha near Chaprala village. Aheri and Sironcha Talukas in the eastern part of the district are covered by the forest. Hills are found in Bhamragad, Tipagad and Palasgad and Surjagad area. The average area covered by Gadchiroli district is **14,412**km^{2}among which **79.36%** area covered by forest. The spider as a group is one of the most abundant predatory groups in terrestrial ecosystems with more than **40,000** described species. These are famous for extreme sexual size dimorphism in which males are many times smaller than the giant females. In the present observation, spiders were identified and recorded for morphological structure and diversity. But the conservation efforts are limited due to lack of documentation and studies on this area. This study was designed not only to document species richness of this small area but also to find out distribution patterns of these spiders along various microhabitats along the Gadchiroli district, eastern part of Maharashtra.
Keywords: Nephila pilipes and Nephila clavipes; biodiversity, richness, Gadchiroli, Maharashtra.

Introduction:

The golden orb spider *Nephila pilipes*and *Nephila clavipes* are a common species of spider that can be found in the primary and secondary forest of Maharashtra and its eastern part of Gadchiroli district. *Nephila pilipes* (Fabricius 1793) and *Nephila clavipes*(Linneus) occurs in the closed forests of eastern area of Maharashtra. They are probably best known to the public for their ability to build large, spectacular webs with spider silk that is stronger than Kevlar. However, large webs mean for more number of prey caught.Like all spiders from the family *Nephilidae*,female gigantism is extremely pronounced and this results in large sizes of mature female spiders achieving body lengths of **40** mm to **60** mm. Despite its huge size and common status, it is surprising to note that there are not many studies which focus on its biology, unlike its American counterparts *(Nephilaclavipes*). Recent studies demonstrated that golden orb weaving spiders *(Nephila*) is most prominent and most researched tropical arachnids (Kuntner, 2005, 2006, 2007a; Harvey et al., 2007).

Hence, this species hopes to serve for two purposes:

- Asan interesting read for whomever that is interesting in finding out more about its biology.
- For spiders enthusiasts who are keen to learn about its morphology, anatomy and how to go about indentifying one.

Material and Methods:

The present study was carried out from June 2014 to May 2015. The observation were carried out by using a field binocular (10x50 magnification) during the morning (6 to 11 AM) and in the evening (4 to 7 PM) and the spider population was estimated by direct count method. After detection, specimen was photographed by using camera photographs are taken and identified with the help of keys and methods suggested by Joseph K H Koh. Few of them are collected using collection bag.

Result and Discussion:

ABOUT NEPHILA:

An orb weaver producing silk from its spinnerets. The abdomen has no appendages except those that have been modified to form one to four pairs of short, movable spinnerets, which emit silk. Each spinneret has many spigots, each of which is connected to one silk gland. Silk is mainly composed of a protein very similar to that used in insect silk. It is initially a liquid, and hardens not by exposure to air but as a result of being drawn out, which changes the internal structure of the protein. It is similar in tensile strength to nylon and biological materials such as collagen, chitin and cellulose,

but is much more elastic in nature. In other words, it can stretch much further before breaking or losing shape. Some spiders have cribellum, a modified spinneret with up to 40,000 spigots, each of which produces a single very fine fiber. The fibers are pulled out by the calamistrum, a comb-like set of bristles on the jointed tip of the cribellum, and combined into a composite woolly thread that is very effective in snagging the bristles of insects. The earliest spiders had cribella, which produced the first silk capable of capturing insects, before spiders developed silk coated with sticky droplets. However most modern groups of spiders have lost the cribellum.

Females are larger in size and grow to a body size of 30-50mm (overall size up to 20 mm), with males growing to 5-6 mm. it is one of the biggest spiders in the world.Legs of spider is made up of several parts, coxa,trochanter ,femur , patella ,tibia ,metatarsus , tarso and at the tip of tarso there is presence of hairs known as artigli .mouth parts consists of artigli dei chelicerae , mandible ,maxilla ,labium ,labrum which helps in mastication of foods. On each sides of abdomen there is presence of spiracles which helps in respiration. Sense organs consists of photoreceptors eyes which are made of near about **2000** ommatidia lenses ,ocelli each and tango receptors hairs on the surface pedipalps.

BIOLOGY OF NEPHILAS (*Nephilapilipes and Nephila clavipes):*

Compared with most spiders, the biology of *Nephila* has beenwell studied, mostly for one species, *N. clavipes* from theNew World, which has become a favoured model for research onthe reproductive biology and behavior of orb-weaving spiders. Biological information on *Nephila pillipes* for the Australianregion has been gradually accumulating since the early work on *N. pilipes* (= *N. maculata*) from New Guinea (Robinson and Robinson 1973, 1976, 1980) and *N. plumipes* from the Sydney region (misidentified as *N. edulis*).More recently, numerous authors (Herberstein and Elgar 1994; and Vollrath 1998*a*, 1998*b*; Schneider *et al.* 2000); Here we present a summary of what is known about the biology of *Nephila pillipes*. from Gadchiroli and briefly compare these findings with the major works published on *N. clavipes* and other species from outside Gadchiroli district in an attempt to highlight similarities and differences among taxa and regions. It should be noted that this section does not represent a comprehensive review of *Nephila*sbiology, which was beyond the scope of the current study, but rather serves to provide complementary biological information to support the taxonomic revision undertaken here.

WEB STRUCTURE:

Nephila spp. construct large orb-webs that are asymmetric inshape and include extensive yellow silk elements 'golden orb-weavers'. The orb of most adult*Nephila*s is0.5–1.0 m in diameter, but the extensive anchor lines, frame andbarrier web substantially extend the dimensions of the structure.These are enhanced further when females aggregate (Rypstra1985) and the webs become connected and therefore continuousover many square meters.The orb is asymmetric in that the hub is centered inthe upper part of the web, so that the sticky elements of the preycatching area are concentrated disproportionally in the lowerhalf of the web (Robinson and Robinson 1973).*Nephila* remain permanently in their webs,which are they permanent structures that function as aprey-catching device during both the day and night. As a consequenceboth juveniles and adult females are possibly moreexposed to diurnal hunting predators over relatively longperiods of time, and their webs are exposed to damage frombirds, grazing mammals and large insects. Several physical andbehavioral adaptations have resulted to minimize these effects.The extensive 'barrier' web either side of the orb of large juvenilesand adults has been postulated by Higgins (1992*a*) toprotect or warn the resident spider of large aerial predators.Aggregating behavior, where the webs of multiple females areinterconnected, further reduces predation, but the results of studies to examine the functionof this behaviour are contradictory. For *N. clavipes*, studiesby Rypstra (1985) indicate thataggregating behavior has positive benefits for prey captureefficiency and reduced predation, while Farr (1976) proposedthat 'web clumping' is a random process influenced by populationdensity and results in decreased predation success. Contrasts with members of the sister genus, *Nephilengys* L.Koch, where the spiders are positioned in their web at night andin a retreat during the day (Kuntner 2007).Juveniles sometimes construct a 'stabilimentum' above andbelow the hub (Robinson and Robinson 1973, 1974*a*, 1978*a*). In *N. pilipes* stabilimentahave only been observed in 5% or less of juvenile webs. This structure has been examined experimentally in a range oforb-weaving spiders and may act to reducedamage by birds (Eisner and Nowicki 1983), although

this maynot be the only function of stabilimenta (Robinson andRobinson 1973, 1974*a*; Herberstein *et al*. 2000; Bruce 2006).*Nephila* also characteristically places wrapped prey in a line above or below the hub. Apart from acting as a food reserve, this structure also serves other functions,if partly damaged, the webs of *N. pilipes* arerepaired by the resident spider within 10–60 min after disturbance,but if the damage is severe, the spider will usuallyconsume the remaining web, rest in the vegetation and then constructa new web at the same or a nearby locality. Repeated disturbanceof the web or lack of prey inevitably results inrelocation of the web to a nearby site, usually within 2–10 meter.Gravid females do not repair their webs for the few days beforeoviposition and they can appear somewhat tattered if damagedduring this time (Robinson and Robinson 1973).

PREY AND FEEDING:

Nephila spp., like most diurnal orb-weavers, is opportunisticthough sometimes selective predators, feeding on any suitableprey that adheres to their web. Various studieshave documented a large number of prey groups, includingvarious species of Orthoptera, Diptera, Coleoptera, Lepidopteraand, generally to a lesser degree, Hymenoptera and Odonata .Most well studied *Nephila* spp.have also been observed to avoid or remove particular insectsfrom their webs without feeding on them. These include vespid wasps alate ants (Higgins 1987),'unpalatable' butterflies and numerous 'obnoxious' groups including lycidbeetles, Hemiptera and Neuroptera that produce distastefulsecretions (Robinson and Robinson 1973).*Nephila*sis clearly able to deal with a largesize range of prey,from 2 mm in length up to insects larger and heavier thanthemselves. The study found that have examined the predatorybehaviour of *Nephila*. In brief, these show that the stimulus for orientation andapproach is mediated through web vibrations, and that the attack behavior varies for prey of different sizes. Essentially, small prey aresimply 'seized and removed' from the web, while large prey arebitten by the resident spider that then waits for the venom tosubdue the prey before it is cut out of the web and wrapped insilk (Robinson 1971; Robinson and Robinson1973). Predatory behaviour also changes dramatically from theearly free-living spider ling stage, when they livein a communal web and apparently feed opportunitistically, tosecond and third instars that capture live prey in individual webs.Adult females of *N. clavipes*respond to decreased food availability by moving their webs (Vollrath 1985), and this phenomenonmay be common for several species. However, thefrequency of occurrence and selective advantage of thebehaviour is unclear given that *N. piliipes* also shifts its websrandomly, independent of prey availability. *Nephila*sspp. is also known to construct food caches,usually above the hub of the web, which are utilized when thereis a shortage of food.Caches vary in size and composition and are influenced by preydensity, encounter rates and prey type .Large caches may contain as many as 12–15 prey items and maybe 10–12 cm in length. When prey is added to the cacheit is usually densely wrapped in silk and placed at either the topor bottom of the cache so the connected prey forms a near vertical line.

MATING:

Mating behaviour of *Nephila*shas been well documented for several species including those found inGadchiroli. In addition, it has been used to examine more fundamental aspects of mating systems in spiders, particularly the evolution of sexual sizedimorphism, sperm competition and sexual cannibalism (Vollrath and Parker 1992). *Nephilas* is typified by extreme sexual size dimorphism where males can be 4–10 times smaller than females. Once males reach adulthood in early summer they leave their own web and search for those of mature or subadult females, possibly using web characteristics and web-based chemical cues to locate and recognize specific webs . Although short-distance pheromonal stimulation of males ispostulated for *Nephilas*, there is no evidenceof long distance pheromone-based attraction to femalewebs. It is common for multiple males to occupy the web of asingle female, who normally mates with more than one male(Elgar *et al*. 2003*a*). Further, males will alter the frequencyand duration of copulation depending on the number and size ofcompeting males in the same web, and the mating history of thefemale (Elgar *et al*. 2003*a*, 2003*b*).

Sexual cannibalism is generally uncommon in orb-weavingspiders, but in *Nephila* spp. its frequency differs among species(Robinson and Robinson 1980;) but also possibly a result of environmental,behavioural and physiological factors such as time of the year,nutritional and reproductive state of the female, age of thefemale, and number and size of males on the web (Schneider *et al*. 2000; Elgar and Schneider 2004). Severalbehavioural adaptations in males have been identified that act toreduce sexual cannibalism. In particular

this includes matingwith newly moulted adult females that are largely inactive, andmating when the female is feeding, but also, to a lesser degree,approaching the female on the opposite side of the orb web.Matingbehaviour in *N. pilipes* departs significantly from that described for the abovespecies. *Nephila pilipes* has a more complex prematingbehaviour that includes the male laying down a fine mat of silkon the dorsal side of the abdomen and pedicel of the female;matings are of much longer duration which is of 30 min,are far less aggressive and sexual cannibalism appears to bevery rare (Robinson and Robinson 1973, 1976).

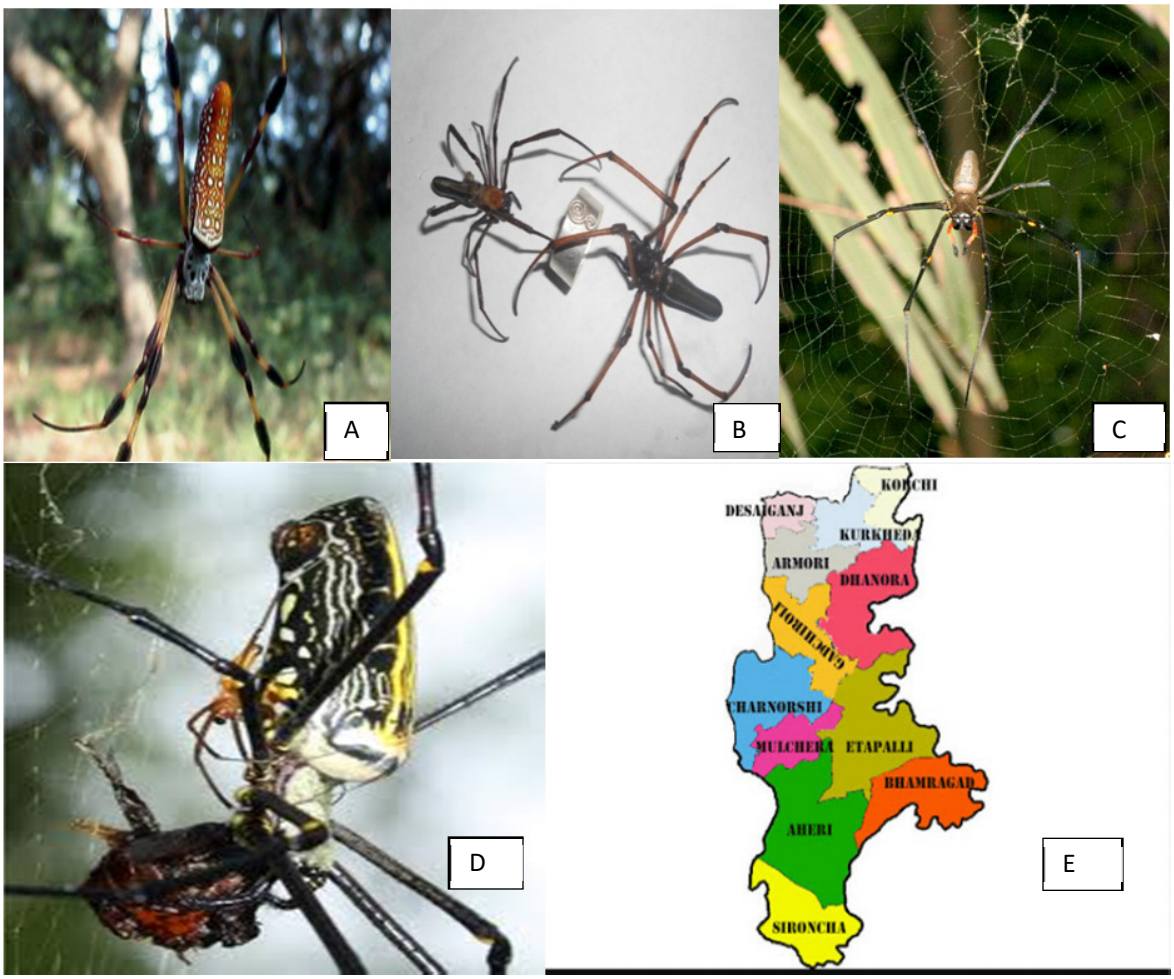

Fig**. A**and B showing dorsal side of *Nephilla clavipes* Fig **C** showing dorsal side of *Nephillapilipes* Fig. **D** showing mating *Nephilla pilipes* ,Fig.E. Represent map of Gadchiroli district where spider commonly occurred.

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Conclusion:

From above all information it is conclude that the data written over the world wide spider species of *Nephilas spp.* is exactly match with *Nephilas spp.*In Gadchiroliregion.

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