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Study on the gender identification of praying mantids (Dictyoptera: Mantodea)

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Abstract
Praying Mantis is very fascinating group of insect because of its prey capturing, carnivorous, camouflage and reproductive behavior. Insect laid eggs in complex ootheca, it is elongated and remain motionless for longer time. Apart from these all peculiarities its sex differentiation is too difficult. So, in the present study some basic tools are designed for gender identification. This parameter has been studied for first time.

Keywords: Praying mantids, carnivorous, camouflage, gender, identification, tools

1. Introduction
The members of order Mantodea occupy various localities and habitats; it also plays an important role in the bio-control agent of insect pests. Some groups live in tropical, sub-tropical and rainforests distributed around the equator, whereas others live in forests and deserts from Africa to Australia, and Asia. The praying mantids has predatory nature. Because of this reason, researchers fully concentrate on their vision, as it shows the optical system like mammals Hansson [3]. To investigate on other insects olfactory systems. Moreover, the praying mantids also share or uses olfaction for feeding and courtship behaviors, Allen *et al* [1]. Their antennae present typical features that might help to better understand the olfactory system. Praying mantids show notable differences in size: for example *Gonypetyllis semuncialis* (Wood-Mason, 1891) and *Oligonicella brunneri* (Saussure, 1871) scarcely reach one centimeter in length while *Macromantis ovalifolia* (Stoll, 1813) measures ten centimeters. Lelito [6]. The diversification in morphology/structural and variation in color guarantee a wonderful camouflage nature, which is very helpful for defense or capture strategies. For example, the genera *Calopteromantis* and *Pseudopogonogaster* have developed abdominal lobes that make them invisible in the substrates where they live. In general, male mantids are smaller / slender than females. The most appropriate way to sex-determination by counting abdominal segments. Begin just posterior to the hind legs, count each segment of the abdomen. Females have six segments between the hind legs and anus. Males have eight segments. This sexual selection has become a vast area of study and well supportive and helping phenomenon. According to current theory, sexual signals should be expensive and reveal male quality. Shine [13]. Said that sexual dimorphism affected by many factors, which are nearly related to the reproduction and lifestyle of the species. Schafer [15]. Carried detail work on sexual dimorphism, which are more abundant sensilla responding to sex-pheromones in males, which appear during the final molting. Carle *et al* [2]. Worked on the antennal sensilla which are macro –micro and ultra-structure of praying mantis *Tenodera aridifolia.* During the present study some basic tools for identification of sexes is being provided here.

2. Material and methods
2.1 Sampling
Sampling were done from vegetation cabbage, spinach, green chilli, bushes, grasses, bark of tree, and agriculture fields through standardized entomological sweep net during the year 2015-2016 from various localities of Sindh. And frequent surveys were also carried out at the night time because mantids are attracted towards light. The collected material was brought to the laboratory for detailed study. Identification was carried out with the aid of Maxwell *et al* [7] and Mohammad *et al* [8]. Sex was differentiated on the bases of abdominal segments mostly the female possess 6 abdominal segment and male with 8 segments.

2.2 Killing and preservation
The collected specimens were killed by means of potassium cyanide in standard entomological bottles after pinning the specimens they stretched on the stretching board and the attention was paid to the position of antenna, wings and legs in order to display important taxonomic characters. The fully dried specimen removed from the stretching boards and stored in the insect boxes with the labels showing locality, date and collector's name. The taxonomic material was properly mounted, labeled and sorted. Drawing lines of taxonomic importance was made and photographs of the various species were taken through camera (SONY. CORP. DSC. W630). Further, live samples collected from field were kept isolated in order to avoid their cannibalistic behavior.

3. Results
During present study, gender study of three species has been carried out. The following tools are supportive and helpful for recognition male and female praying mantids. This study is based on five tools, i-e 1) Counting of abdomen segments 2) Sexual dimorphism 3) Morphology of antennae, 4) Size and type of body and 5) Length of wings.
The description of these basic tools is under:

3.1 Abdomen segment's counting system
The segment counting segment can be helpful to identify all species of mantids these are older than L4 (fourth instar). Some species are much broad or robust to see than other species of mantids while small specimens are viewed through magnifying glass. The basic principle is very simple: female praying mantis has 6 abdominal segments while males have 8. The final segment of the female is much larger than the others while the male has several small segments towards the end of the abdomen. For computing the segments underside mantids are very useful. It's even easier than because the mantid is larger and its body completely bent. During microscopic analysis it was also noticed that last segment of adult female *Hierodula transcaucasica* is large and has a particular shape (Plate-I -b), a male of the same species has several small segments at the end of the abdomen and its shape is also different than female (Plate-I).

3.2 Sexual dimorphism
Sexual dimorphism means males and females look different from each other. In praying mantids species the central degree of difference between males and females are different i. e male is smaller than female and this differences become more prominent in adult mantids. This method helpful to sex –determination in L5 and L8 instar of mantids, but is mostly depending on the species (Plate-II).

3.3 Morphology of Antennae
Male generally has longer and thicker antennae than females. This can be seen most clearly when the mantids are adult, but as the nymph grows to become an adult it steadily develops the longer antennae. When comparing male and female nymphs it can be seen that the female has thin hair-like antennae while the male has thick antennae.
In family Empusidae male has feathered antennae ('hairy' antennae) while the female has smooth antenna opposing to this in family Tarachodiae male with bristle like antennae, on the other hand female has smooth antennae, beside this in Mantidae family male antennae hard and thick whilst female with smooth and slender antenna. The antennal segment measurements of different species of male praying mantis are calculated: 32-36 mm, 18-24 mm and 18-20mm for *Deiphobe infuscta, Empusa unicornis* and *Iris oratoria* respectively.

3.4 Size and type of body
Differentiation in body size of many praying mantids is very clear such as in *Hierodula Transcaucasica, Iris oratoria* and *Deiphobe infuscata* etc. it was also noted that some nymphs stay behind in size. Contrary to this, in male adult the difference is even more obvious as neither of the sexes will grow anymore. Male praying mantids are generally much more slender than female praying mantis. This can be seen especially well when looking at the thorax of insect. The body size of different species in praying mantids is about (96-105 mm), (54-70 mm) and *32*-38 mm for *Diephobe infuscate, Empusa unicornis* and *Iris oratoria* respectively (Fig –III).

3.5 Identification of mantids through wings
Wing difference can only be seen in adult mantids. The wings of a male praying mantids are generally longer from the female wings for example in *Hierodula transcaucasica* female reach to the end of her body, while in *Rivetina baetica* wing do not reach so far to her body. Beside this wings of the male are never shorter than the body. The wings of the male generally cover to the end of their body, because male praying mantids easy to fly to find mate partner, while females generally are too heavy and not fly faster. (Plate: IV-V). Length of wings i.e 29-45 mm and 25-44 mm for male and female of *Hierodula transcaucasica* in case of *Rivetina baetica* it was 40-42 mm for male and (19-24 mm) for female.

4. Discussion
The closest relatives of mantises are the termites, grasshoppers (Orthoptera), and cockroaches although detail gender/ sex-determination study has been done on mentioned groups but identification of praying mantids on gender base is still un-touch, however many researchers worked on the other aspects of praying mantids like. Rilling.*et al* [11] worked on the behavior of praying mantids, Holwell *et al* [4] studied the morphology of antenna of *Pseudomantis albofimbriata* and *Ciulfina biseriata*, Naheed [9] worked on the taxonomic status of praying Mantids of Sindh. Vollrath and Parker, [16] carried out work on spiders sex- ratios and sexual dimorphism in detail beside this, Partridge and Farquhar, [10] worked on the mating style of male in *Drosophila – melanogaster* Kristensen [5] studied on the moths and butterflies developmental and morphological process. Schafer [14] reported that sexual dimorphism in the distribution of antennal sense organs in five species of genus *Periplaneta*. Further, Saito, [12] highlighted some morphological characteristics for sex determination of the developing stages of *Periplaneta fuliginosa* (Serville).

5. Conclusion
In the present study basic tools for identification of praying mantids are provided which will be guideline for field workers for collection of both sexes (couple) for culturing intention so that its population could be available on large scale for best utilization of this creature in biological control.

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