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Photographic catalogue of mantids of south Gujarat

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Abstract
A study on biodiversity of mantids in south Gujarat, India was carried out in south Gujarat by the Department of Entomology, N. M. College of Agriculture, Navsari Agricultural University, Navsari, Gujarat, India. Mantids are one among the most fascinating and elegant groups of insects usually found near water bodies, plains, hills, agroecosystem. Total 21 species of mantids belongs to 15 genera, from five families were recorded from different localities of south Gujarat. Among which 21 species belongs to five families Mantidae (12), Hymenopodidae (2), Liturgusidae (1) Empusidae (3) and Toxoderidae (3) along with a photographic catalogue prepared with the help of a digital camera. Out of the total record, 18 species were reported for the first time from Gujarat state.

Keywords: Photographic catalogue, Mantodea, mantids, diversity

Introduction
Mantids (Insecta: Mantodea), usually known as Praying Mantis, hold a significant place in the ecosystem as predators, mainly feed on grasshoppers, moths, butterflies, flies, beetles and they are well adapted in camouflage and mimicry [1]. Mantids have attained their common popular name from the way they raise their two fore legs in a posture of prayer. They are often found waiting still for hours together for their prey with their heads rotating 180° [2]. They are diurnal and are attracted to lights at night [3]. They are weak flies and are generally seen sitting on herbs, shrubs and trees [4]. There are around 2300 species of mantids under 434 genera all over the world [5]. From India 162 species of mantids under 68 genera belonging to six families were reported [6]. Research on mantids in India was further propelled by several researchers in India [7- 12]. So far 4 species and 4 genera of mantids have been recorded from all over Gujarat [6].To fill up the gaps in knowledge about different species of mantids with their photographic catalogue in south Gujarat, the present study was done.

2. Materials and Methods
The photographic catalogue is a useful tool for the identification of mantids in the state. Therefore, an attempt was made to prepare the colourful photographic catalogue of mantids of south Gujarat. Close up photographs of species and their behavioural patterns were captured with the help of a digital camera (Sony Alpha a7S digital camera). Live specimens from the field conditions were photographed, so that natural colouration and specific behavioural postures can be documented. When there is no camera, the mantids were collected, preserved and photographs of such preserved mantids were captured for documentation purpose in the form of phtographic catalogue.

3. Results and Discussion
Order: Mantodea
I. Family: Mantidea
1. *Mantis religiosa* (Burmeister, 1838)
Our measurements: Fore wing: 20.07 ± 0.06 mm, Hind wing: 22.16 ± 0.39 mm,Abdomen: 22.44 ± 0.08 mm
Morphological description: Colour: Yellowish green, brown, yellow, black;**Head:** triangular with a transverse dirty yellowish green patch across vertex and eye; **Forelegs:** coxal disc not flat, with six to seven submarginal granules, internally with marble callous spots; **Middle and Hindlegs:** slender, without lobulation, coxa broader and shorter than femur; **Wings:** both wings hyaline, costal area of forewing opaque; costal vein bifurcates distally; post radial vein

bifurcates at middle, lower branch again bifurcates distally in both forewing and hindwing. This is one of the most common species of mantid found in almost all parts of world (Image-1).

Habitat: Paddy, Mango, Pond, Grassland and Banana ecosystem.

2. *Hierodula keralenesis* (Vyjayandi and Narendran, 1995)
Our measurements: Fore wing: 42.10 ± 0.86 mm, Hind wing: 42.04 ± 0.39 mm, Abdomen: 44.60 ± 1.29 mm

Morphological description: Colour: Light green with slight ferrugeneous prozonal border; **Head:** triangular, **Eyes:** globular laterally, oval ventrally; **Antenna:** filiform, slender; **Forelegs:** stouter, coxa with many strong saw-like spines; **Middle and Hind legs:** slender, coxa shorter, femur and tibia almost equal in length; tibia more slender than femur; **Forewing:** with costal area moss green and opaque discoidal area light green, semihyaline, stigma yellow, veins light green (Image-2).
Habitat: Paddy and Grassland ecosystem.

3. *Hierodula coarctata* (Saussure, 1869)
Our measurements: Fore wing: 30.12 ± 0.41 mm, Hind wing: 28.06 ± 0.41 mm, Abdomen: 28.01 ± 0.06 mm
Morphological description: Colour: Pale green, gray, black, yellow; Head: Thick, triangular wider than high; vertex smooth, **Eyes:** globular laterally, ventrally subconical; **Antenna:** filiform, slender without setae; **Pronotum:** Elongate, supra coxal dialation oval, with indistinct mid longitudinal carina; **Forelegs:** superior margin of coxa with 4 to 5 obtuse thick spines, outer surface ridged, inferior end not serrated; **Middle and Hind legs:** coxa short; femur slightly shorter than tibia in mid leg, longer than tibia in hind leg; **Wings:** longer than abdomen, forewing with opaque, broad coastal area (Image-3).
Habitat: Paddy and Grassland ecosystem.

4. *Hierodula grandis* (Saussure, 1869)
Our measurements: Fore wing: 48.39 ± 0.54 mm, Hind wing: 44.99 ± 0.75 mm, Abdomen: 44.98 ± 0.69 mm
Morphological description: This species is commonly known as giant Asian mantid and it is a large sized mantid which grows up to 6 inches long and is capable of eating small birds, reptiles and mammals; **Colour:** Green, brown; Head: Triangular, wider than high, vertex smooth, lateral lobes prominent; **Eyes:** globular laterally, subconical ventrally; ocelli large, closely placed; **Antenna:** slender, nonciliated; **Pronotum:** Oval shaped, slightly longer than fore coxa; **Forelegs:** coxa ridged dorsally; superior margin with five blunt spines; Middle and Hindlegs: Simple; **Wings:** Longer than abdomen, forewing costal area opaque (Image-4).
Habitat: Paddy, Mango, Pond and Grassland ecosystem.

5. *Hierodula viridis* (Burmeister, 1838)
Our measurements: Fore wing: 46.32 ± 0.07 mm, Hind wing: 46.71 ± 0.37 mm, Abdomen: 50.25 ± 0.06 mm
Morphological description: Color: Pale green; **Head:** Thick, triangular, vertex smooth, lateral lobes slightly pronounced; **Eyes:** globular laterally, ocelli larger; **Antenna:** filiform, slender without setae; **Forelegs:** superior margin of coxa with four to five obtuse thick spines, outer surface ridged, inferior end not serrated. **Middle and Hindlegs:** coxa short, femur slightly shorter than tibia in midleg, longer than tibia in hindlegs; **Wings:** longer than metasoma, forewing with opaque, broad coastal area, hindwings hyaline (Image-5).
Habitat: Paddy, Mango, Pond, Grassland and Banana ecosystem.

6. ***Hierodula venosa* (Olivier, 1792)**
Our measurements: Fore wing: 48.16 ± 0.18 mm, Hind wing: 44.43 ± 0.44 mm,Abdomen: 46.03 ± 0.65 mm
Morphological description: Colour: GoldenGreen; **Head:** Triangular, wider than high, vertex smooth, lateral lobes a little prominent; **Eyes:** globular dorsally, subconical ventrally, ocelli closely packed; **Antenna:** slender, without setae; **Pronotum:** Longer than forecoxa; supra coxal dialation oval, immediately narrows posterior to it; **Forelegs :** Coxa ridged externally, internally flat, with 6 to 7 strong, stout marginal spines; **Middle and Hind legs:** middle leg slightly shorter than hind legs, coxa short; **Forewing:** opaque except at apex, with dense reticulate veins; costal area broader (Image-6).
Habitat: Paddy, Mango, Pond, Grassland and Banana ecosystem.

7. *Hierodula membranacea* (Burmeister, 1838)
Our measurements: Fore wing: 44.36 ± 0.77 mm, Hind wing: 41.38 ± 0.90 mm, Abdomen: 44.98 ± 0.69 mm
Morphological description: The bite of this large species can be painful and possibly break the skin; **Colour:** light green; **Head:** triangular; **Antenna:** slender, filiform; ocelli conspicuous; **Forelegs:** coxa inner margin tuberculated. **Middle and Hind legs:** slender; coxa short; hind femur longer than coxa, slightly shorter than tibia; metatarsus as long as all other tarsal segments together; **Wings:** longer than metasoma, forewings costal area opaque, posterior radial vein bifurcates proximally; hind wing hyaline, radial veins bifurcate (Image-7).
Habitat: Paddy, Mango, Pond, Grassland and Banana ecosystem.

8. *Ameles fasciipennis* (Kaltenbach, 1963)
Our measurements: Abdomen: 14.57 ± 0.16 mm
Morphological description: Colour: green; **Head:** small; eyes prominent; ocelli conspicuous; Antenna: thick and bristled; **Pronotum:** short rhomboidal with black stripe extending upto head; metazona a little longer than prozona; fore femur dialated with 4 external and 4 discoidal spines; metatarsus longer than all other, tarsal segments together. **Middle and Hind legs:** much longer; **Wings:** wingless or sometime wings pad present (Image-8).
Habitat: Grassland ecosystem.

9. *Tenodora sinensis* (Nurseryman, 1962)
Our measurements: Fore wing: 40.23 ± 0.07 mm, Hind wing: 44.70 ± 0.05 mm,Abdomen: 40.05 ± 0.05 mm
Morphological description: Colour: Black, straw yellow with a greyish brown tinge; **Head:** Thick, triangular; **Eyes:** globular laterally, ventrally subconical, emarginate; ocelli larger; **Antenna:** filiform, slender without setae; **Forelegs:** superior margin of coxa with four to five obtuse thick spines, outer surface ridged, inferior end not serrated. **Middle and Hind legs:** elongated, delicate, coxa short; femur as long as tibia; metatarsus as long as all other tarsal segments together; **Wings:** sub hyaline, subconical at tips; forewing with reticulate venation, superior border opaque with transverse

veins, without setae (Image-9).
Habitat: Paddy, Grassland and Banana ecosystem.

10. *Statilia maculata* (Thunberg, 1987)
Our measurements: Fore wing: 38.18 ± 0.24 mm, Hind wing: 34.70 ± 0.49 mm, Abdomen: 39.27 ± 0.14 mm
Morphological description: Colour: Green, fumy brown; **Head:** triangular; **Antenna:** slender, filiform; ocelli conspicuous; **Forelegs:** slender, coxa not flat with middorsal tuberculated ridge, ventrally submarginal area with 6 to 7 large well pronounced tubercles, internal apical lobes contiguous. **Middle and Hind legs:** coxa short; femur longer than coxa; **Wings:** both wings non-truncate with conical endings; costal area opaque, hindwings semihyaline, anterior radial vein bifurcates (Image-10).
Habitat: Paddy, Mango, Pond and Grassland ecosystem.

11. *Schizocephala bicornis* (Linnaeus, 1758)
Our measurements: Fore wing: 44.24 ± 0.10 mm, Hind wing: 42.25 ± 0.12mm,Abdomen: 82.50 ± 0.52 mm
Morphological description: Colour: Light green and Straw yellow with green tinge; **Head:** Triangular, narrow and long; **Eyes:** conical, pointed towards apex; **Antenna:** filiform, thick at base; **Forelegs:** elongate, coxa a little longer than femur, internal apical lobes divergent; **Middle and Hindlegs:** coxa short, femur as long as tibia in midlegs, tibia shorter than femur in hindlegs; **Wings:** short, leathery, reaches up to second metasomal segment, body length very long (Image-11).
Habitat: Paddy and Grassland ecosystem.

12. *Archimantis latistyla* (Serville, 1838)
Our measurements: Fore wing: 37.64 ± 0.07 mm, Hind wing: 35.61 ± 0.39 mm,Abdomen: 47.02 ± 1.55 mm
Morphological description: Colour: Green, brown **Head:** Triangular, wider than high, vertex smooth, eyes globular, ocelli closely placed; **Antenna:** slender, non-setaceous; **Pronotum:** Elongated, longitudinally carinated; Middle and Hind legs: simple; **Wings:** both wings longer than abdomen forewings with opaque costal and semihyaline (Image-12).
Habitat: Paddy and Grassland ecosystem.
II. Family: Hymenopodidae

13. *Tropiodo guttatipennis* (Stal, 1877)
Our measurements: Fore wing: 20.07 ± 0.07 mm, Hind wing: 20.84 ± 0.73 mm, Abdomen: 22.13 ± 0.06 mm
Morphological description: Colour: green; **Head:** dark wood brown with fuscous patches, **Antenna:** filiform; **Forelegs:** coxa dorsally with longitudinal ridge, ventrally smooth; **Middle and Hindlegs:** coxa short, middle leg shorter; **Wings:** forewings opaque, posterior radial vein bifurcates twice proximally; hindwings sub hyaline (Image-13).
Habitat: Mango and Grassland ecosystem.

14. *Creobroter apialis* (Audinet-Serville, 1839)
Our measurements: Fore wing: 30.15± 0.07 mm, Hind wing: 32.17 ± 0.15 mm, Abdomen: 28.56 ± 0.32 mm
Morphological description: Colour: green; **Head:** trapezoid, eyes conical, projecting upwards; **Antenna:** slender, filiform, ocelli conspicuous; **Forelegs:** coxa inner margin tuberculated. **Middle and Hind legs:** middle legs a little longer than hind legs, mid femur twice as long as mid tibia; **Wings:** longer than metasoma, costal and anal areas of forewing transparent; forewing green with yellow markings; hindwings coloured in female (Image-14).
Habitat: Paddy and Grassland ecosystem.

III. Family: Liturgusidae
15. *Humbertiella ceylonica* (Saussure, 1869)
Our measurements: Fore wing: 26.39±0.40, Hind wing: 20.84±0.73mm,Abdomen: 22.13±0.06mm
Morphological description: Colour: Wood brown with black tinge; **Head:** dark wood brown with fuscous patches; **Antenna:** filiform; **Forelegs:** coxa dorsally with longitudinal ridge, ventrally smooth; **Middle and Hindlegs:** coxa short, middle leg shorter; **Wings:** forewings opaque, costal area reticulately veinated, posterior radial vein bifurcates twice proximally; hindwings sub hyaline (Image-15).
Habitat: Paddy and Grassland ecosystem.
IV. Family: Empusidae

16. *Empusa guttula* (Thunberg, 1815)
Our measurements: Fore wing: 35.57±0.55mm, Hind wing: 34.50±0.60mm, Abdomen: 35.40±0.54mm
Morphological description: Colour: light yellow, Deep brown, green; Head: Bluntly triangular, eyes round, projecting laterally; **Antenna:** Pectinate; **Pronotum:** Longer than fore coxa; depressed, **Forelegs:** simple, coxa a little shorter than femur, without spines; femur simple with a single median spine, tibia short, without external or internal spines, tibial claw well developed; **Wings**: longer than abdomen; forewing semi opaque, leathery (Image-16).
Habitat: Grassland ecosystem.

17. *Gongylus gongylodes* (Linnaeus, 1758*)*
Our measurements: Fore wing: 26.69±0.07mm, Hind wing: 24.87±0.07mm, Abdomen: 36.61±0.06mm
Morphological description: This species known as the wandering violin mantis, ornate mantis or Indian rose mantis; **Colour:** brown, yellow or yellowish green; **Head:** small, vertex with protuberance; **Antenna:** filiform in the case of female and pectinate in male; **Fore legs and Hindlegs:** slender, coxa with external lobes; femur with distal, triangular lobe dorsally and semicircular lobe ventrally; **Wings:** well developed; in males wings longer and in female shorter than metasoma (Image-17).
Habitat: Paddy and Grassland ecosystem.

18. *Gongylus trachelophyllus* (Burmeister, 1838)
Our measurements: Fore wing: 33.19±0.15mm, Hind wing: 35.65±0.43mm, Abdomen: 34.59±0.72mm
Morphological description: Colour: brown, light green or yellowish green; **Head:** small, vertex with protuberance; **antenna:** filiform in the case of female, pectinate in male; **Pronotum:** slender with superior border of fore femur dialated; with 5 external and 4 discoidal spines; **Mid and Hind legs:** slender, coxa with external lobes; femur with distal, triangular lobe dorsally and semicircular lobe ventrally; **Wings:** well developed; in males rhomboidal dialation; fore coxa with backwardly directed, wings longer and in female shorter than abdomen (Image-18).
Habitat: Grassland ecosystem.

V. Family: Toxoderidae
19. *Aethalochroa ashmoliana* (Westwood, 1841)
Our measurements: Fore wing: 50.13±0.20mm, Hind wing: 50.60±0.36mm,Abdomen: 51.00±0.43mm

Morphological description: Colour: brown; bizzare shaped; Head: small, wider than high; **Antenna:** filiform; **Pronotum:** spiny or tuberculated; prozona spatulate, supra coxal dialation well pronounced; metazona carinated, as long as fore coxa fore coxa with inner distal serrated lobe. **Middle and Hind legs:** short and stout; coxa short; femur slightly foliaceous with internal and external distal lobes, **Forewings:** semihyaline; costal area more opaque, hind wing longer than forewing (both wings shorter, up to three fourth of metasoma) (Image-19).
Habitat: Mango, Grassland and Banana ecosystem.

20. *Aethalochroa insignis* (Wood-Mason, 1878)
Our measurements: Fore wing: 43.45±0.56mm, Hind wing: 41.15±0.32mm, Abdomen: 58.08±0.85mm
Morphological description: Colour: black, lightgrey, looks like dried leaves; **Head:** small, more or less globular; Eyes: globular, not projecting much; **Antenna:** simple, slender, filiform, Forelegs: simple, slender, coxa triangular in cross section; ridged middorsally, tuberculated inferiorly; **Middle and hind legs:** short and stout; coxa short; femur slightly foliaceous with internal and external distal lobes; **Forewings:** semihyaline; costal area more opaque, hind wing longer than forewing (both wings shorter, up to three fourth of metasoma) (Image-20).
Habitat: Mango, Pond, Grassland and Banana ecosystem.

21. *Toxoderopsis spinigera* (Wood-Mason 1889)
Our measurements: Fore wing: 40.23±0.07mm, Hind wing: 44.70±0.05mm, Abdomen: 40.05±0.05mm

Morphological description: Colour: grayish-black, looks like dried leaves; **Head:** wide, vertex centrally with a triangular elevation; **Antenna:** filiform, slender with minute dispersed setae; **Forelegs:** long and slender, coxa with anterior crest up to two-fifths of its length, trochanter small, tuberculated, femur narrow, slender; **Middle and Hind legs:** short and weak; **Wings:** both shorter than metasoma, semihyaline, forewing with costal area opaque, with reticulate venation, costal veins bifurcate peripherally (Image-21).

Habitat: Paddy, Mango, Pond, Grassland and Banana ecosystem.
All the morphological descriptions and measurements of different species were more or less in accordance with the finding of Sureshan [1] and Vyajayandi [11]

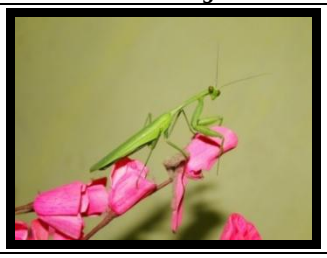
Photographs of different species of mantids (Mantodea)

1. Mantis religiosa

2. Hierodula keralenesis

3. Hierodula coarctata

4. Hierodula grandis



5. Hierodula viridis

6. Hierodula venosa

7. Hierodula membranacea

8.Ameles fasciipennis

9. Tenodora sinensis

10. Statilia maculata

11. Schizocephala bicornis

12. Archimantis latistyla

13. Tropiodo guttatipennis	*14. Creobroter apialis*	*15. Humbertiella ceylonica*	*16. Empusaguttula*	
				
17. ***Gongylus gongylodes***	**18.** ***Gongylus trachelophyllus***	**19.*Aethalochroa ashmoliana***	**20. *Aethalochroa insignis***	**21. *Toxoderopsisspinigera***

4. Conclusion

The photographic catalogue of 21 species of Mantids of south Gujarat has been documented with detailed morphological description of each species with their morphometrics.

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