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GUARDIANS OF QUETTA'S SKIES: AESHNIDAE DRAGONFLIES EXPLORED

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Abstract

Objective: *With an emphasis on exploring the species richness of dragonflies (family Aeshnidae) throughout the city, this study aimed to improve knowledge of Odonate biodiversity in Quetta. The study's objective was to provide insightful information about Quetta's dragonfly (Aeshinidae) population, highlighting a comparatively neglected feature of the area's biodiversity.*

Methodology: *The surveys were conducted throughout the summer seasons spanning from 2022 to 2023. A total of 212 specimens of dragonflies were captured with the help of sweep nets. Identified specimens up to species level and then preserved.*

Results: *The results showed that the Anax partheope (55%) and Anax immaculifrons (45%) were identified from the family Aeshinidae of genus Anax. Comprehensive information is available for each species, including their valid scientific names, habitat descriptions, ecological observations, and distributional ranges.*

Conclusion: *A notable contribution to the biodiversity of Odonates in Balochistan has been made with the identification and recording of Anax immaculifron in Quetta. The recognition of Anax immaculifron for the first time in Quetta highlights the necessity of extending the study, conservation efforts, expansion in range,potential for further research and to conduct out more observations and studies to fully understand the behaviour, distribution patterns, and ecological preferences of Anax immaculifron in Quetta.*

Keywords: *Aeshnidae, Anax immaculifrons, Anax parthenope, Blochistan, Dragonfly, Quetta*

INTRODUCTION

Quetta is located in the Balochistan province of Pakistan and has an average elevation of 1,680 metres (5,510 feet) above sea level, distinguishing it as Pakistan's lone major city at such a high altitude (1). The city is exposed to a cold semi-arid climate, observing notable temperature fluctuations in the seasons. The summer season spans from late May to early September. Moreover, Quetta is deficient having a monsoon period characterized by heavy rainfall. The highest recorded rainfall within a 24-hour span in Quetta was 113 millimetres (4.4 inches), an event documented on 17 December 2000 (2).

Odonates stand out as a well-recognized category of insects. They are large-sized predators compared to other insects and occupy a wide range of aquatic environments. More than 6300 documented species are present, their characteristics differ markedly depending on the habitat, the prey they hunt, and the particular ecological demands for their populations to expand (3). Odonates can be categorized into two suborders: Zygoptera, commonly known as damselflies, and Anisoptera, referred to as true dragonflies (4). These insects go through incomplete metamorphosis, with the larval (naiad) stages progressing through 10 to 15 instars. Typically, the larvae select strategies to hide themselves, including burrowing within substrates, navigating through fine sediments and debris, or clinging to vascular plants (5).

Dragonflies mainly dwell in diverse freshwater environments such as rivers, streams, marshes, lakes, and even small ponds and rice fields. Odonates are used as valuable indicators of environmental shifts due to their responsiveness to alterations in habitats, atmospheric temperature, and weather patterns. In addition, they serve as biocontrol agents, in agroecosystems performing an essential duty in managing pest populations (6) Being sizable and active diurnals, they are conspicuously viewable during the afternoon hours (7).

Dragonfly species stand out as colorful and large-eyed insects that exhibit features such as sexual dimorphism, color transitions, and color polymorphism (8). Their identifiable characteristics distinguish them from other insects, such as a lengthy and slim abdomen, prominently globular eyes on their head, short antennae, and a double set of wings (9).

The life cycle of a dragonfly is completed in three stages – egg, larva, and pupa – all of which take place within aquatic ecosystems. Eggs are deposited in water and later hatch into larvae, which display predatory behavior. These larvae then undergo modification to become adult dragonflies. However, these adults can be harmful to many crops and fruits as pests (10). Adult dragonflies are easily recognizable due to their possession of two pairs of slim, transparent wings, an oblique thorax, and a body that outstrips the wings in length. Conversely, the juveniles or nymphs lack wings and well-camouflaged coloration resembling sediment or water (11).

Odonata, through their defined habitat preferences, brings out their distribution patterns, primarily within microhabitats. Certain species of dragonflies are employed as biological indicators for assessing water quality, distinguishing between pure and impure conditions (12). The existence of *Anax junius* is indicative of poor water quality, whereas the presence of *L. disjunctus* signifies good water quality (13). Dragonflies feature the ability to serve as indicators of environmental attributes. They play dual roles in the food web, acting as both prey and predators in their larval and adult stages (14). A decrease in environmental attributes is often accompanied by a step-down in the diversity and population of dragonflies (15).

These insects accumulate their eggs in or around freshwater sources, making their intensified presence in an area a direct reflection of freshwater quality (16).

The Aeshnidae family, commonly known as “Hawk dragonflies” among enthusiasts, repose its nickname to their robust appearance. These dragonflies are dignified by their considerable size and can exhibit a range of colors such as blue, brown, yellow, or green, often underlined by prominent black markings. Their large eyes meet toward the centre of their heads, and their wings are predominantly clear. As highly proficient fliers, they are frequently spotted at considerable distances from water sources. Many species allocate an evidential part of their daytime hours to mobile activity, reducing their rest time. During moments of rest, they often choose an upright position and modify themselves with their bodies pointing downward. Female members of the species accumulate their eggs in aquatic plants, debris, or directly in the water (17).

MATERIALS AND METHODS

SAMPLE COLLECTION

The techniques outlined by Zia et al., (2011) for sample collection and preservation were followed up (18). A tough, foldable net with an 18” diameter and a length ranging from 3 to 5 feet was used for sampling. To kill the dragonflies, ethyl acetate was used in the glass containers. The killed specimens were transferred to boxes containing essential details such as collection date, location, and collector's name. Each box denoted a distinct collection site; ensuring specimens were not overly crowded.

PRESERVATION, PINNING AND STORAGE

The preservation methodologies outlined by Zia et al., (2011) were employed. The specimens were shifted onto mounting boards, and pinning was done following the prescribed process. After the specimens had thoroughly dried, they underwent labelling, and naphthalene balls were kept for storage. To safeguard against possible attacks by ants, beetles, and other minor insects, the anti-ant powder was gently sprinkled at the corners of the storage boxes.

IDENTIFICATION OF SPECIMENS

Using the taxonomic keys of Fraser 1933-36 (19) and Zia et al., (2011) (18), the collected specimens were meticulously examined under microscopes (Leica EZ4E) to check their classification down to the species level. Measurements of various body parts, including the abdomen, fore wing, and hind wing, were taken using a precise divider and a standard steel scale.

Further character identification was carried out using Fraser's (1936), enabling the specimens to be pinpointed up to the specific level (19).

RESULTS

The enumeration of distinct dragonfly species observed in the course of this study is presented herewith. From a total collection of 212 dragonflies, 115 individuals (54%) were conclusively identified as *Anax parthenope,* whereas the remaining 97 specimens (45%) were categorized as *Anax immaculifrons* (Fig. 1). This taxonomic distribution sheds light on the prevalence and coexistence of these two Anax species in the studied habitat, contributing valuable insights into the ecological dynamics of dragonfly populations in the research area.

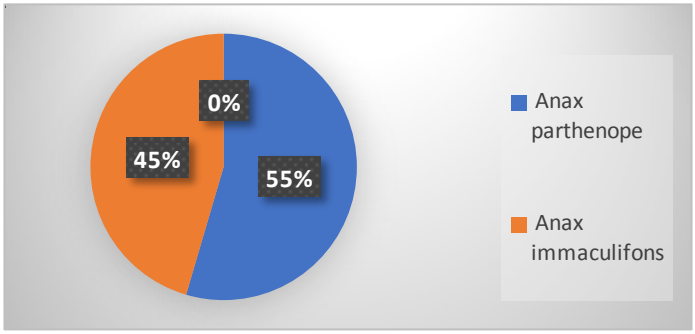

Fig. 1. Showing the percentage of species recorded from Quetta

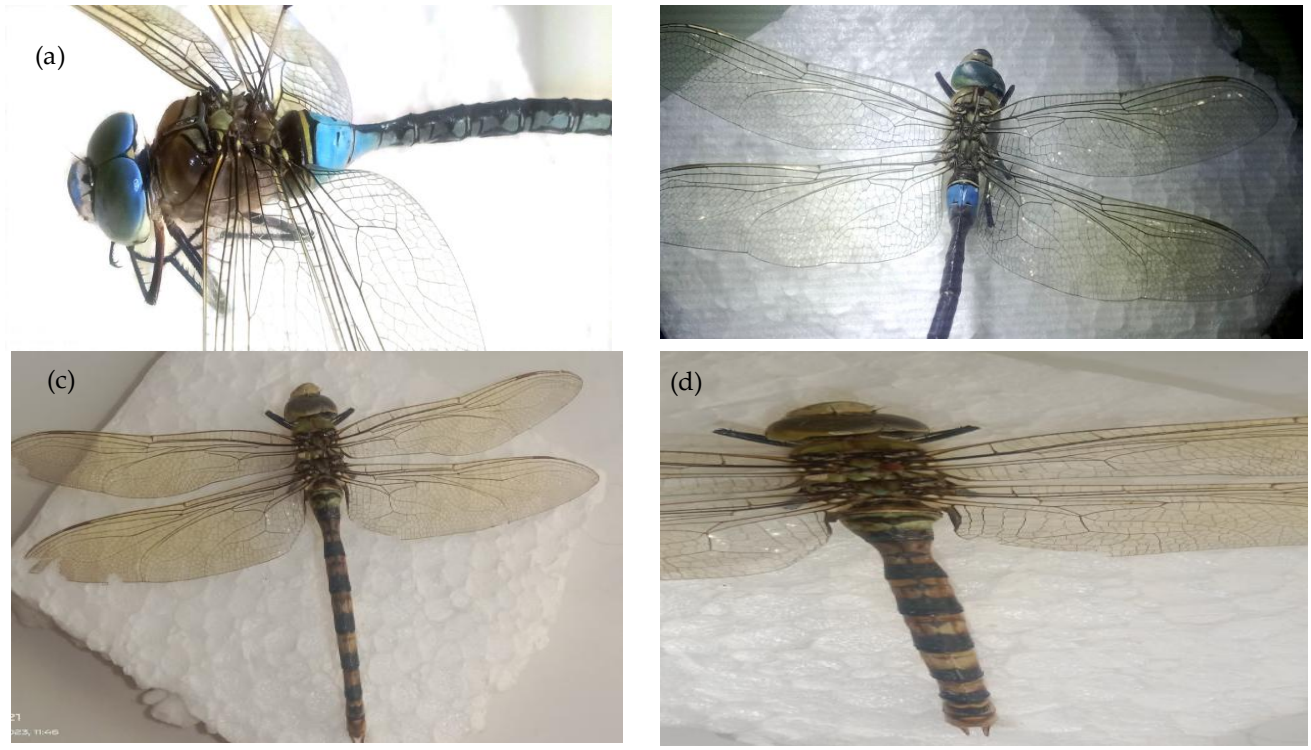

Fig. 2 (a, b). *Anax parthenope and* (c, d) *Anax immaculifrons*

The Table I presents data on the distribution of two dragonfly species, *Anax parthenope* and *Anax immaculifrons*, across different localities. In Hanna Valley, a predominant presence of *Anax parthenope* was observed, with n=95 individuals compared to n=80 of *Anax immaculifrons*, making up a total of 175 dragonflies (83% of the sample). Kharkhasa Valley observed with a more balanced distribution, with n=12 *Anax parthenope* and n=10 *Anax immaculifrons*, totaling n=22 dragonflies (10% of the sample). Hazar Ganji exhibited a smaller population, with n=8 *Anax parthenope* and n=1 *Anax immaculifrons*, amounting to n=9

dragonflies (4% of the sample). These findings highlighted variations in the composition of dragonfly species across different locations, with Hanna Valley being a notable hotspot for *Anax parthenope.*

Table I. Distribution of *Anax parthenope* and *Anax immaculifrons* across different localities

Localities	*Anax parthenope*	*Anax immaculilfrons*	Total (n=212)	%age
Hanna valley	95	80	175	83%
Kharkhasa valley	12	10	22	10%
Hazar Ganji	8	1	9	4%

Remarkably, there is a notable difference in population density for these species between the summer months of May through September and the winter season. Their population density was much lower in the winter and much higher in the summer. This implies that the abundance of these organisms is temperature-dependent, increasing in higher temperatures and decreasing in lower ones. Morphological and ecological characteristics of *Anax parthenope* and *Anax immaculifrons* are comparatively discussed in Table II.

Table II. Comparison of morphological and ecological characteristics between *Anax parthenope* (Lesser Emperor) and *Anax immaculifrons* (Magnificent Emperor) dragonflies

Characteristics	*Anax parthenope* (Lesser emperor)	*Anax immaculifrons* (Magnificent Emperor)
Common name	Lesser emperor	Magnificent Emperor
Latitude (N)	30.24	30.24
Altitude (E)	67.09	37.09
Temperature	32°C	31°C
Diagnostic characteristics (Male)	**Head:** The color of labium and labrum is golden yellow,eyes blue face and frons olivaceous to greenish yellow **Prothorax:** Blakish brown **Thorax:** Pale brown **Legs:** Reddish brown **Wings:** Hyaline with a blackish membrane and yellowish emfumigation, pale yellow pterostigma **Abdomen:** Segment 1 has a dark brown spot on each side.Segment 2 is turquoise blue with two finely traversed black stripes on the subdorsum and a minute black point side at its end. Segment 3 has a considerable triangular patch at the base of each side and a wide black stripe running the middle of the dorsum that divides the wide bluish-grey bands on either side.segment 4–9 featuring a black mid–dorsal stripe and fine black lateral ridges.segment l0, which has a narrow blackish-grey apical border and sides. **Anal appendages:** Compared to superior anal appendages(appear reddish brown), inferior anal appendages are much shorter	**Head:** Labrum greenish-yellow, face and frons pale bluish-green, labium dirty or pale ochreous, with a thin black border at the base of the frons above **Prothorax:** Reddish brown, with a hairy fringe on the posterior lobe **Thorax: P**ale bluish green. **Legs:** Black **Wings:** Hyaline, shaded from the discoidal cell's apex to base with amber yellow. Pterostigma has an ochreous to reddish brown color, with a perhaps white membrane at the base **Abdomen:** The first portion is completely black.Segment 2 is sutures black, greenish blue in color.Segment 3's base is lateraly greenish blue, while the top half is black.The apical half of segments 4–8 is reddish brown at the base and black throughout. Segment 9 is reddish brown laterally, black at the dorsum base, and less so towards the apex.segment 10 varies; black on the dorsum or reddish brown (black limited to base). **Anal appendages:** inferior narrowly triangular, apex notched, pale brown or ochreous
Morphometry	Abdomen : 56mm Hind wing: 56mm Fore wing: 58mm	Abdomen: 56mm Hind wing: 56mm Fore wing: 58mm
Habitat	These dragonflies have a reduced body color and are quite large. when laying eggs, the males of this species typically follow the females in a conjunction formation, which is not	This particular species of dragonfly is known for its fast roaming pattern; it is frequently seen close to streams, stagnant bodies of water, and occasionally lakes. Additionally, they

	the case with other aeshnid species. These particular dragonflies were taken from ponds and sources of stagnant water.	are known to go to areas far from water supplies, especially in areas that are hilly or sub-mountainous. From March through September, these dragonflies are active and usually avoid standing water.
Distribution	Frequently found in Asia, the Middle East, North Africa, and Southern Europe.	There are numerous Asian nations where it is prevalent, but very few European nations.

DISCUSSION

Anax immaculifrons have been reported first time from Balochistan, so far identified from the other areas of Pakistan. This study signifies the undiscovered fauna. More faunistic surveys encompassing the entire province are made possible by this study, which also promotes taking action to ensure their survival and protection during times of pest management. This study will help other researchers in biodiversity assessment, habitat conservation, as indicator species and in many ecological researches.

A number of studies have been conducted to investigate the species complex of dragonflies, and a total of about 70 species have been identified from various parts of Pakistan (20). Compared to its neighbours, Pakistan's Odonata fauna has not been as thoroughly studied. 46 species and subspecies of anisomerous dragonflies from 24 genera and 6 subfamilies were gathered and identified in 1972 from different locations in Pakistan (21). Yousaf (1972), initiated the work on dragonflies, published information about dragonflies at the country level has been reported (22).

Aeshna juncea (Linnaeus, 1758), *Anax parthenope* (Selys, 1839), *Cephalaeschna masoni* (Martin, 1907), *Anax immaculifrons* (Rambur, 1842), *Anax indicus* (Lieftink, 1942), *Anax nigrofasciatus* (Fraser, 1935), *Gynacanthaeshna sikkima* (Karsch, 1891), and *Hemianax ephippiger* (Burmeister, 1839) were the only eight species of the Family Aeshnidae that were reported from Pakistan (23-29).

Odonates are essential to all biological research, and Pakistan's dragonfly fauna will sustain all future entomological projects, including faunistic, ecological, zoogeographic, and other research that will give essential assistance to numerous additional research fields. These fresh findings will advance our understanding of the biodiversity and species distribution in Pakistan.

During the 2016–2017 seasons, Akbar and coworkers performed a field survey in the Swat area with the main goal of collecting Anax dragonflies. Two separate species, *Anax imperator* (Leach, 1815) and *A. parthenope* (24) comprised the genus Anax, which included 251 specimens that were gathered and categorized within the Aeshnidae family. Additionally, this study provides insightful information about the geographic distribution of these species as well as extensive data on their physical characteristics (30).

Chaudhary and associates (2016) conducted extensive field surveys from 2006 to 2011 to improve our understanding of the Anisoptera fauna in the nation. Their findings identify sixty-eight different species of Anisoptera spread throughout five families and thirty-nine genera. Notable is the fact that seven of these species are being reported for the first time in the nation. A total of 1,349 specimens from 5 families, 39 genera, and 68 distinct species were gathered and classified. Of them, the Aeshnidae family has nine species distributed over six genera, whereas the Cordulegasteridae family had just one species. The Gomphidae family featured an incredible 12 species spread among their two genera, whereas the Corduliidae family contained 3 species from 2 genera among nine distinct genera, and the Libellulidae family included an astounding forty-three species from twenty-one genera. Furthermore, this study reports the first-ever existence of seven species of dragonflies in the nation. This publication provides an extensive inventory of dragonflies that may be found in Pakistan (31).

Mehmood et al., (2021) focused on the Aeshnidae family in their study, which was carried out in the Hazara region of Pakistan. A total of 125 individuals were thoroughly collected over the course of this study and classified into two different species that belong to the same genus. The main goal of the study was to investigate the phylogenetics and molecular traits of the Aeshnidae family. The obtained datasets provided important new information about the relationships between different Aeshnidae species and genus evolution. These outcomes highlight the potential for combining conventional morphological traits with

advanced molecular biology methods, such as nucleotide sequence analysis in phylogenetic studies, to validate and improve the taxonomic categorization of Aeshnidae species (32).

CONCLUSION

To sum up, dragonflies, which are members of the Aeshnidae family, are remarkable creatures that have captured people's attention for ages. They are a fascinating subject of study and appreciation in both the scientific and artistic fields because of their elegant flight, bright colors, and complicated behaviors.

The order Odonata contains the diverse family Aeshnidae, which includes a large number of dragonfly species that live in different ecosystems all over the world. They are distinguished from other insects by their unique qualities, which include their enormous size, strong flight, and striking appearance. Because of their special characteristics, members of this family can live in a variety of environments, including dense forests and freshwater ponds. They also play a vital role in regulating insect populations, which contributes to maintaining ecological balance.

The Aeshnidae family of dragonflies is a living example of the diversity and adaptability of nature. They are a subject of ongoing research and admiration because of their complex behaviors, ecological roles, and cultural significance. These amazing insects serve as an indicator of the mutual dependence of all living things and the significance of conserving biodiversity for future generations as we work to preserve and value the natural world.

Conflict of Interests: The authors have no conflict of interests.

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