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Evaluation of Status and Diversity of Odonates of Kondajji Lake, Kondajji Village, Harihar Taluk, Davanagere District, Karnataka, India

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Abstract
A study on diversity of odonates was conducted at Kondajji Lake of Kondajji Village located in Harihar Taluk, Davanagere District of Karnataka. The study was conducted to explore status, diversity and threats of Odonates during February 2007 to January 2008. The study revealed a total of 34 species of Odonates in 24 genera belonging to 6 families have been reported. Among them Anisoptera (Dragonflies) dominated with 25 species, followed by the Zygoptera (damselflies) with 9 species. The family Libellulidae dominated with 20 species among the Anisoptera. Among the Zygoptera, Coenagrionidae was found to be the dominant family with 6 species. Based on the frequency of occurrence 35% of the species were common, 23% were very common, 21% were rare, 15% were occasional and 6% were very rare. According to IUCN categorization all the odonate species recorded from the study area comes under 'Least Concern' (LC) category. The study provides the baseline data on Odonates diversity of some major wetland water bodies of Davanagere District of Karnataka state for research on their biology and the conservation.

Keywords: Zygoptera, Anisoptera, Dragonflies, Damselflies, Status, Odonates Diversity, Kondajji Lake, Kondajji village, Harihar taluk

1. Introduction
Globally 5740 species of odonates are known from the world, of which 474 species in 142 genera and 18 families exist in India [1]. Around 174 species of odonates have been reported from the Western Ghats, including 56 species endemic to the region [2, 3], while 154 species of odonates were reported from Kerala [4]. Odonates are gorgeous aquatic insects distributed throughout the world, which comprise dragonflies and damselflies, being the top predators at larval and adult stages are highly specific to their niche and depend heavily on water bodies for feeding and breeding and play a significant role in freshwater ecosystems [1, 5, 6].
Odonates survive in a wide range of aquatic habitats i.e., from flowing and stagnant water bodies, some have adapted to urban areas and exploit man-made water bodies [7]. Even though most the odonates species are highly specific to a habitat, they are more susceptible to habitat alterations induced by human activities. Dragonflies have been proposed as indicators to assess the ecosystem health of freshwater wetlands [8]. Besides, being important elements of the food chain; they predate on mostly of the harmful insects of crops, orchards and forest, other small insects like mosquitoes, moths, butterflies and thus have a regulatory impact on agro-forestry [9]. Odonates serve as an umbrella species in biodiversity conservation [10, 11] and represent specific biotic wetland assemblages.
For the first time the present study aimed to evaluate the status and diversity of odonates in order to understand the nature of their assemblages with reference to the habitat characters.

2. Materials and methods
2.1. Study area
The Kondajji Lake is a spectacular well known as recreational spot located in the mid of the forest surrounded by a minor hilly tropical scrub jungle. The lake is situated in Kondajji village of Harihar taluk, Davanagere District, Karnataka. A major scout and guide training center in South India is located on South direction of the lake. The lake is approximately about 145.27 acres and is located between 14º34'11" N latitude and 75º53'10" E longitude. This wetland provides water for drinking and irrigation to surrounding agricultural lands and also

for aquaculture practices. The lake is situated 13 Km from Harihar and 8.2 Km from Davanagere District. The lake has recreational value, which attracts many tourists for water sports activities like boating etc., and also ecological significance as an attracting sight for some important birds of both wetland and wetland dependent local and migratory species in different seasons throughout the year. The lake is free from sewage and agricultural drainage.

2.2. Sampling methods

Study was conducted during February 2007 to January 2008. Adult Odonates sampling was done by direct counts made while observing habitats on hourly basis. Data collection was conducted between 09:00 am and 01:00 pm when insects were most active. During the course of the survey Odonates observed in the field were identified by using field guides [12, 13]. The taxonomic and nomenclature has been followed as per [1]. The odonates were categorized into five groups such as, very common (80-100%), common (60-80%), occasional (40-60%), rare (20-40%) and very rare (below 20%) based on their abundance during the study period [14].

3. Results and discussion

A total of 34 species of Odonates in 24 genera belonging to 6 families have been reported. Among them the highest percentage composition and diversity of odonates was contributed by the Anisoptera (Dragonflies) with 25 species of under 3 families, followed by the Zygoptera (damselflies) with 9 species of belonging to 3 families, which account for 74% and 26% of total odonates recorded at Kondajji Lake, Harihar Taluk, Davanagere District, Karnataka, India (Table 1 and Fig. 1).

Table 1: List of Odonates along with their status in the Kondajji Lake, Harihar Taluk, Davanager District, Karnataka.

Sl. No	Common name	Scientific name	Status	IUCN
Order: Anisoptera (Dragonflies)				
1. Family: Aeshnidae				
1	Blue-tailed Green Darner	*Anax guttatus*	VC	LC
2	Blue Darner	*Anax immaculifrons*	C	LC
3	Parakeet Darner	*Gynacantha bayadera*	R	LC
2. Family: Gomphidae				
4	Common Clubtail	*Ictinogomphus rapax*	VC	LC
5	Common Oartail or Hooktails	*Paragomphus lineatus*	C	LC
3. Family: Libellulidae				
6	Trumpet Tail	*Acisoma panorpoides*	C	LC
7	Little Blue Marsh Hawk	*Brachydiplax sobrina*	C	LC
8	Ditch Jewel	*Brachythemis contaminata*	VC	LC
9	Ruddy Marsh Skimmer	*Crocothemis servilia*	C	LC
10	Scarlet Marsh Hawk	*Aethriamanta brevipennis*	C	LC
11	Granite Ghost	*Bradinopyga geminate*	VC	LC
12	Ground Skimmer	*Diplacodes trivialis*	VC	LC
13	Pied Paddy Skimmer	*Neurothemis tullia*	O	LC
14	Brown-backed Red Marsh Hawk	*Orthetrum chrysis*	VR	LC
15	Blue Marsh Hawk	*Orthetrum glaucum*	O	LC
16	Crimson-tailed Marsh Hawk	*Orthetrum pruinosum*	VC	LC
17	Green Marsh Hawk	*Orthetrum Sabina*	VC	LC
18	Wandering Glider	*Pantala flavescens*	C	LC
19	Common Picture Wing	*Rhyothemis variegate*	O	LC
20	Crimson Marsh Skimmer	*Trithemis aurora*	C	LC
21	Black Stream Skimmer	*Trithemis festiva*	C	LC
22	Long-legged Marsh Skimmer	*Trithemis pallidinervis*	O	LC
23	Black Marsh Trotter	*Tramea limbata*	R	LC
24	Red Marsh Trotter	*Tramea basilaris*	VR	LC
25	Coral-tailed Cloud Wing	*Tholymis tillarga*	R	LC
Order: Zygoptera (Damselflies)				
4. Family: Coenagrionidae				
26	Pigmy Dartlet	*Agriocnemis pygmaea*	O	LC
27	Coromandel Marsh Dart	*Ceriagrion coromandelianum*	C	LC
28	Golden Dartlet	*Ischnura aurora*	C	LC
29	Senegal Golden Dartlet	*Ischnura senegalensis*	VC	LC
30	Elegant Sprite	*Pseudagrion decorum*	R	LC
31	Blue Grass Dartlet	*Pseudagrion microcephalum*	C	LC
5. Family: Lestidae				
32	Emerald Spreadwing	*Lestes elatus*	R	LC
6. Family: Platycnemididae				
33	Blue Bush Dart	*Copera vittata*	R	LC
34	Yellow Bush Dart	*Copera marginipes*	R	LC

VC-Very common; C-Common; O-Occasional, VR-Very Rare and R-Rare,

On the basis of the family wise species occurrence, the family Libellulidae dominated with 80% (n=20) species among the Anisoptera followed by the Aeshnidae with 12% (n=3) and Gomphidae with 8% (n=2) (Fig. 2). Among the Zygoptera, Coenagrionidae was found to be the dominant family with 67% (n=6) species followed by the Platycnemididae with 27% (n=2) and Lestidae with 11% (n=1) of total odonates recorded from the study area (Fig. 3). Based on the frequency of occurrence of odonates species, 35% (n=12) were common, 23% (n=8) were very common,

21% (n=7) were rare, 15% (n=5) were occasional and 6% (n=2) were very rare (Fig. 4). According to IUCN categorization all the odonate species recorded from the study area comes under 'Least Concern' (LC) category (Table 1).

During the present investigation, it was revealed that Anisoptera (dragonflies) was found to be abundant; this similar pattern of predominance was also reported by different researchers from different parts of India, i.e., from Chinnar Wildlife Sanctuary, southern Western Ghats [14], from Goa [15], from Coimbatore and Salem districts in Tamil Nadu [16] and from Padmatola wetland of Balasore in Odisha [17] this might be due to their high dispersal ability and adaptability to wide range of habitats [18, 19]. Less abundance of Zygoptera (damselflies) was may be due to their limited dispersal ability and changing environment [18, 20, 21] and partial or absence of shade cover [22] afforded by the temporary water bodies.

The encounter of damselflies in study area could be attributed to the existence of shade over the habitat from the trees present around the water bodies and also to the occurrence of aquatic vegetation. The study also revealed that shade and aquatic vegetation could favour the Zygoptera more than the Anisoptera [12]. During the present investigation, the record of abundant Libellulidae (Anisoptera) and Coenagrionidae (Zygoptera) in study area might be due to their shorter life cycle and widespread distribution and tolerant to wide range of habitats [23, 24, 25].

The maximum diversity of Odonates in Kundavada Lake might be due to their larger size. The size of the water bodies also becomes an important factor to determine the species richness and diversity of Odonates [18, 26, 27]. Odonates belonging to the families Corgulegasteridae and Cordulidae of Anisoptera and Protoneuridae, Calopterygida, Chloroyphidae, Euphaeidae and Platystictidae of Zygoptera are not found in the study area probably because most of the species of these families are restricted to high altitude and/or breed in running water streams in forest landscape [17].

In wetland habitat the odonates function as good indicators of environment health. In agro-ecosystems they are important bio-control agents helping in controlling insect pest population. However, during the study it was found that, the odonates and their habitats are under threat due to anthropogenic activities, like intensive agricultural practice around the wetland area and lack of integration in local and regional land use planning, firewood collection, grazing pressure, large scale habitat fragmentation or loss and irreversible damage to their breeding habitats by draining of the swamps, contamination of water bodies, presence of predators, habitat alterations such as construction of dams, sand mining, pollution and eutrophication are affecting assemblage of Odonate species in temporary water bodies [17, 23, 28].

The data recorded in the present study may give valuable information about odonates fauna of Kundavada Lake as a baseline data for assessing the changes of environmental conditions in the area, thereby helping in formulating future conservation measures to preserve the wetland habitats and to maintain the ecosystem health.

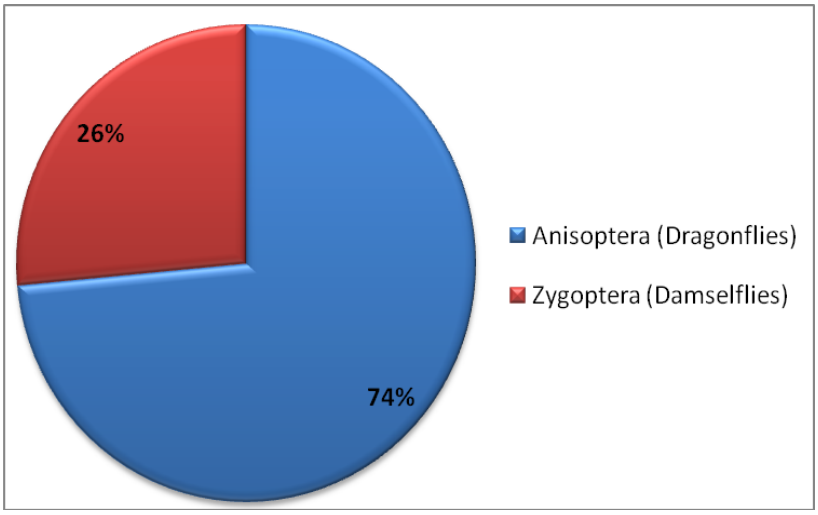

Fig 1: Percentage composition of Odonates (Anisoptera- Dragonflies and Zygoptera-Damselflies) at Kondajji Lake

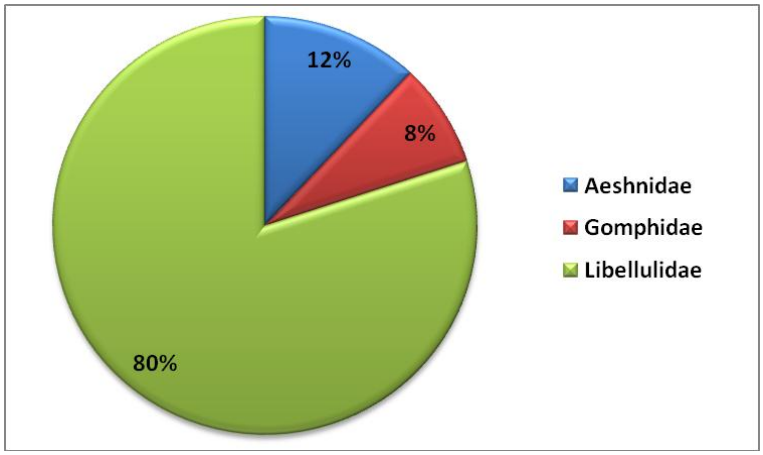

Fig 2: Percentage composition of Dragonflies (Order: Anisoptera) at Kondajji Lake

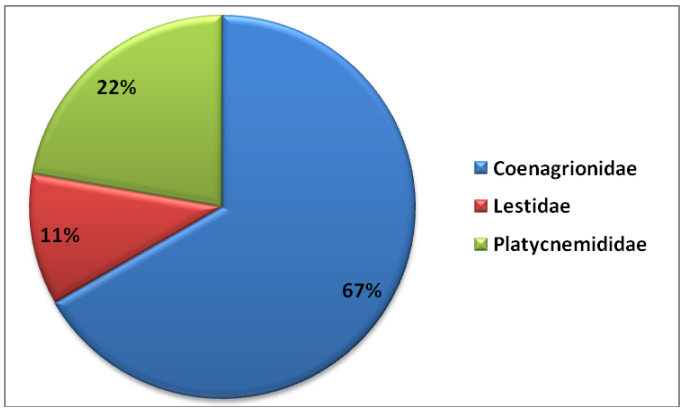

Fig 3: Percentage composition of Damselflies (Order: Zygoptera) at Kondajji Lake.

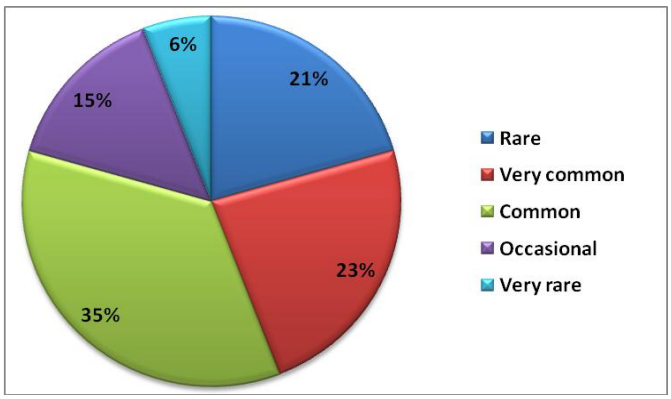

Fig 4: Status of Odonates based on the frequency of occurrence at Kondajji Lake.

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