Diversity and Nestedness pattern of adult Odonata assemblages around Hadhinaru lake of Mysore, Karnataka

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ABSTRACT

Diversity and nestedness assemblages of adult insect Odonata around Hadhinaru Lake of Mysore was done for a period of three years. 23 species belonging to Dragonflies (Anisoptera) and Damselflies (Zygoptera) were recorded. Their diversity was not quite significant. The order of nestedness of species showed a hot matrix (36.7^0), with a maximum fill of 46.3%. Nested species were low while idiosyncratic species were abundant. Species appearance and disappearance was fairly common which may be attributed to the human disturbances in the lake. Odonates can help control small insects like mosquitoes and hence their conservation is of importance. The nestedness software serves as a handy tool in monitoring insect biodiversity.

Keywords: Dragonflies, Damselflies, Nestedness, Idiosyncratic, Temperature

INTRODUCTION

Odonata is an order of insects, encompassing Dragonflies (Anisoptera) and Damselflies (Zygoptera). About 5900 species have been described in this order. Most of these are regarded as beneficial because they feed on small insects like mosquitoes, but act as pests to beekeepers, since they eat honeybees also. Secondly they transmit *Prosthogoniums pellucidus*, a parasitic flatworm of poultry and hence are a matter of concern. Their scientific classification includes Kingdom: Animalia; Phylum: Arthropoda; Class: Insecta; Subclass: Pterygota; Infra class Paleoptera; Sub Order Odonatoptera and Order Odonata (*Fabricus,1973*). The suborders include Epiprocta (dragonflies) and Zygoptera (damselflies). These insects characteristically have large rounded heads covered mostly by well developed compound eyes, legs that facilitate catching prey, two pairs of long transparent wings that move independently and have an elongated abdomen. Dragonflies differ from damselflies in many recognizable traits. Dragonfly eyes occupy much of the animals head touching each other across the face, while in damselflies there is typically a gap between the eyes. Odonates are aquatic as juveniles and are often described as aquatic insects.

Nestedness is a measure of order in ecological systems referring to the order in which the number of species is related to the area or other factors. A challenge before ecologists is to

understand the structure and dynamics of biological communities and their relation to environmental variables. Werner and Peacor (1990) and Levins(1992) are of the opinion that understanding the community and its structure is a fundamental aspect of conservation biology. Spatial patterns for insect diversity have not been dealt with in detail and studies on Odonata diversity are very meagre. Soinen *et al*. (2009) says that dispersion and migration of communities at regional levels need to be stressed. Studies on nestedness assemblages, other than insects are those of Wright *et al*. (1998), Brown (1995) and Cook and Quinn (1995). However species assemblage patterns of tropical fresh water lakes in India are absolutely lacking. An attempt to study the nestedness pattern of Odonata insects around a very large lake (Hadhinaru Lake) of Mysore has been done. Nestedness assemblages are important in lake conservation strategies.

Material and Methods

Hadhinaru Lake is located at $12^0$2' north latitude and $76^0$4' east longitude at an altitude of 753 meters above MSL and is situated 16 kms away from Mysore city (Karnataka). It has an independent catchment area of 9.57sq.km with water spread over 10.10 hectares having a live capacity of 54.43 mcft. The maximum depth of the lake when full is five meters. It is important from the Social-Economic-Natural-Cultural-Lake-Ecosystem (SENCLE) of the area.

Adult Odonata sampling was done by direct counts made while observing habitats on hourly basis in the early, mid and late hours of the day during suitable flight conditions(during low wind, warm and sunny weather). An aerial net (30x15x60 cms) was used to catch the insects. Disturbance by a surveyor caused a flight response making sedentary insects visible (Moore, 1953). Counts were standardized based on time and catch per unit effort (CPUE). The insects were let free later (Foote *et al*.2005), Conard *et al*. 1999).Odonata naiads were however not accounted in the present study. The insects were identified using taxonomic keys of Fraser (1933-1934), Ward and Whipple (1959), Melamby(1963),Pennak(1978), Tonapi(1980), Emiliyamma *et al*.(2005) and Subramanian(2005).

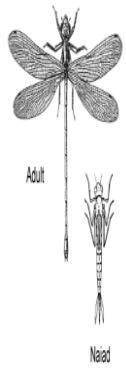
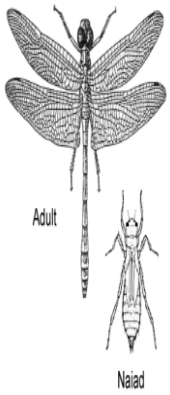
RESULTS AND DISCUSSION

In the present investigation, 23 species, both males and females were recorded separately wherever identifiable. Ten species of the order Anisoptera, Family Lebellulidae, one species each of Ashnidae and Gomphidae and four species of the order Zygoptera, Family Coenugrionidae and one species of Lestidae were found to be of common occurrence around the lake. The scientific and common names of the insects are presented in Table 1.

Nestedness analysis was carried out using the presence-absence matrix (Matrix having sites in rows and species in columns with"1" for presence and "0" for absence was considered for the insect diversity. The degree of nestedness was calculated using the "Nestedness Calculator" (Atmar and Patterson, 1993, 1995). The metric "T" of the Nestedness Calculator measures the extent of unexpected presences and absences in a maximally packed matrix, where sites are arranged in rows in descending order according to their species richness and the species are arranged in columns according to the number of sites in which they occur. The metric "T"=0^0 for a set of perfectly nested assemblages and "T"=100^0 for a completely disordered matrix is expressed. The null hypothesis that "T" is not lower (more nested) than expected by chance was tested using Monte Carlo permutations of 100 counts (Heino and

Moutka, 2005). The reorganized species vector is presented in Table 2. Different species recorded are shown in Plate 1 & 2 and the nestedness matrix is presented in Fig. 1.

Table 1. Species index of Odonata

Order/ Suborder	**Family**	**Scientific name**	**Common name**
Odonata: Anisoptera	Libellulidae	*Acisoma panorpoides* Ramb	Trumpet Tail
 Damselflies	 Dragonflies	*Brachydipax sorbina*(Ramb)	Nil
		Brachythemis contaminate (F.)	Ditch Jewel
		Crochothemis servilia(Durry)	Rudy Marsh Skimmer
		Crocothemis erythrea(Brulle)	Broad Scarlet
		Orthetrum pruinosum(Ramb.)	Crimson Tailed Marsh Hawk
		Orthetrum sabina(Durry)	Green Marsh Hawk
		Rhyothemis variegate (Linn.)	Common Picture Wing
		Tramea basilaris Kirby	Red Marsh Trotter
		Tramea limbata(Ramb.)	Black Marsh Trotter
		Tramea aurora(Burm.)	Crimson Marsh Glider
	Aeshnidae	*Anax parthenope*(Selys)	Yellow Ring Emperor
	Gomphidae	*Ictinogomphus rapax*(Ramb.)	Common Club tail
Zygoptera	Coenagrionidae	*Ceriagrion coromandelianum*(F.)	Coramandal Marsh Dart
		Ishnura senegalensis(Ramb.)	Senegal Golden Dart
		*Pseudagrion rubiceps(*Selys)	Saffron Faced Blue Dart
		Pseudogrion microcepahlum(Ramb.)	Blue Grass Dart let
	Lestidae	*Lestes elatus* Hagen	Emerald Spread Wing

The data indicates that the communities do not show a highly nested pattern (T=36.07^0 and P= 3.86e-21) and the matrix fill is only 46.3%. This is significantly a hot matrix. For matrix fills less than 50% a perfectly ordered matrix forms a concave meniscus in the upper left corner of the figure which is not observed in the present study. The Mean T= 65.4^0 for a Monte Carlo run count of 100 randomized matrix (Fig.1). Highly nested species were *Brachythemis contaminate* (♀), *Ishnura senegalensis*, *Orthetrum sabina*(♀),*Crocothemis*

erythera(♀) and *Lestus elatus*(♂) occupying the top five positions in the community occurring almost throughout the period of collection. These species are considered as highly nested. In comparison, idiosyncratic (unexpected species appearing and disappearing from the lake site) were very high.This may be because the lake receives water from a channel which often brings about a change in the physical and chemical conditions of the lake. This in turn changes the plank tonic diversity which has an impact on these insects. Only endemic species may survive continuously around the lake. Atmar and Patterson (1993) call this condition as statistical noise of local opportunities, which may be due to habit heterogeneity of lake waters.

Table 2: The presence-absence matrix and the reorganized species vector (2008-2010)

Name of the species	**Presence-absence matrix**
Brachythemis contaminate(♀)	**111111111111111111111111111111111111**
Ishmura senegalensis	**111111111111111111111111111111111111**
Orthetrum sabina(♀)	**111111111010011111111111111111111111**
Crocothemis erythera(♀)	**110111111111001111110111001111101111**
Lestus elatus(♀)	**111111111001111111011011111111111100**
Careogrion coramandelium	**011011011111111011010011111111111111**
Crocothemis servilia(♂)	**110111111111001111110111001111101111**
Anax parthenope	**111101111111101110011111111111011001**
Brachythemis contaminate(♂)	**000011111110011011110110010111111110**
Crocothemis erythera(♂)	**000111100010000111010000001111010010**
Acisoma pnorpoides	**110000011111000000001111100000001000**
Lestes elatus(♂)	**100001101110001000001110010100111100**
Ictinogomphus rapax	**000000100111000001001111000000100111**
Rhythemis variegata	**000001111010000101111000000101011000**
Pseudogrion rubiceps	**000000110000101100100100101000101100**
Ishmura elagans	**111000001000011000010000011000100000**
Orthetrum pruinosum(♀)	**000000111000000000110000000001101000**
Crocothemis servilia(♀)	**000000000110000000011000000000001100**
Tramea limbata	**000000010000000001010000000011000000**
Brachydiplax sorbina	**000000000000001001000000000000110000**
Pseudogrion microcephalum(♀)	**000000000100000000001000000110000100**
Orthetrum pruinosum(♂)	**000000000100000000001110000000000000**

Note: (1=presence; 0=absence during the respective months from January 2008 to December 2010)

Highly idiosyncratic species to the lake were *Orthetrum pruinosum*(♂),*Pseudogrion microcephalum*(♀), *Brachydiplax sorbina*, *Tramea limbata*, *Crocothemis servilia*(♀) and *Thrithemis aurora*.These occupy he bottom most right space of the matrix in Fig.1. Sometimes the idiosyncratic species may show sudden appearance in the community after they become locally extinct or may become the victims of competitive exclusion. Sometimes on a shorter time scale, some habitats may produce an intermittent matrix fill (Patterson, 1991). Nestedness of species during the months of May to August of every year was prominent, while idiosyncratic species appeared during November to June. There is every

possibility that in due course these idiosyncratic species may be lost forever from the regional biodiversity. These species can be identified by an idiosyncratic temperature higher than the systems temperature of the matrix (100^0). However such species were not recorded and in some manner were disconnected from the local ecological system.

Odonates constitute an important segment of lakes ecosystems and their conservation is an important aspect of ecology. Identifying nested and idiosyncratic species can be done using the Nestedness pattern of assemblages. Monitoring lake ecosystems is one way of maintaining a balanced population of diverse Odonata species, and in turn a balanced ecosystem.

CONCLUSION

Nestedness pattern of Odonata insect communities around Hadhinaru Lake of Mysore was not quite significant. The matrix temperature was hot (36.7^0). Secondly the matrix was not fully packed and idiosyncratic species (unexpected) were in higher numbers. Species that were nested were probably endemic. Allocathonous(disturbances due to human intervention) activities around the lake usually alter lake communities. The nestedness software serves as a basic tool to understand biodiversity of insects. Conserving insect diversity often provides a healthy aquatic ecosystem.

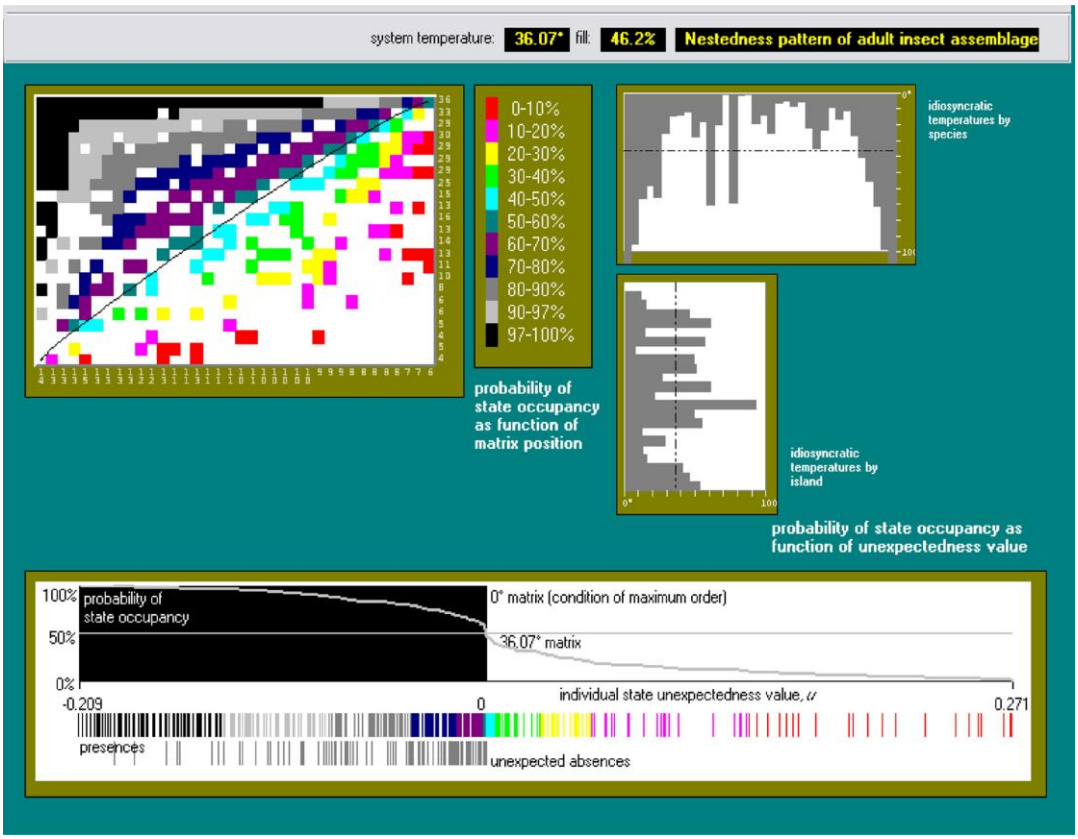


Fig.1. Nestedness assemblages for Odonata species

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Anax parthenope **(Selys)**

Lestes elatusHagen(♂)

Brachythemis contaminate **(F.)**(♂)

Lestes elatus Hagen (♀)

Brachythemis contaminate (F.)(♀)

Crocothemis erythrea(Brulle) (♂)

Crocothemis servellia (Drury)(♂)

Crocothemis erythra (♀)

Crocothemis servillia(Drury)(♀)

Tramea limbata(Ramb.)

Rhyothemis varigata(Linn.)

Trithemis aurora(Burm)

Plate 1

Tramea basilaris(Kirby)(♀)

Ictinogomphus rapax(Ramb.)

Orthetrun sabina(Drury)(♂)

Orthetrum pruinosum(Ramb.)(♀)

Orthetrum pruinosum(Ramb.)(♂)

Ischnura senegalensis(Ramb.)


Pseudogrio microcephalum(Ramb.)


Ceriagrion coromendelianum(F.)


Pseudagrion rubriceps(Selys)


Ischnura elegans


Acisoma panorpoides Ramb


Brachydiplax sorbina (Ramb.)

Plate 2

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