International Journal of Scientific Research in Biological Sciences
Vol.7, Issue.6, pp.82-88, December (2020)
Research Paper
E-ISSN: 2347-7520

An Assessment of Entomofaunal Diversity in Narmada Canal Command Area of North Gujarat region, India

Kalavanti Mokaria[1]*, Ketan Tatu[2], R.D. Kamboj[3]

[1,2,3]Gujarat Ecological Education and Research (GEER) Foundation, Gandhinagar, Gujarat.

*Corresponding Author: kala303@gmail.com

Available online at: www.isroset.org

Received: 10/Nov/2020, Accepted: 10/Dec/2020, Online: 31/Dec/2020

***Abstract*—**An insects survey was conducted in Narmada Canal Command Area (NCCA) of North Gujarat region as a part of project "Study on Impact of Narmada Canal System on Environment and Ecology of the Areas benefited by the Canal System in Parts of North Gujarat, Saurashtra & Kachchh in Gujarat State". The study includes 4 districts falling in North Gujarat region viz. Gandhinagar, Banaskantha, Mehsana and Patan. Visual Encounter Survey (VES) was carried out to detect and record insects in these districts. A total of 126 species belonging to 11 orders and 56 families were recorded in North Gujarat region. During this study, out of total species encountered in North Gujarat region around 28.57 % of species diversity is contributed by Lepidoptera and 13.49 % of species diversity is contributed by Odonata order. In, Banaskantha District, a total of 43 species of insects were encountered which belonged to 11 orders. In, Patan District, a total 44 species of insects were recorded that belonged to 8 orders. In, Mehsana District, a total of 50 species of insects recorded that belonged to 8 orders. In, Gandhinagar district, a total of 83 species of insects were encountered which belonged to 11 orders. Insect are beneficial to ecosystem directly or indirectly. Insect perform various different roles within ecosystem like pollination, seed dispersal, control population of other organisms, nutrient cycling and maintain soil fertility and provide a major food source for other taxa. The major insect groups recorded during the study mainly belonged to the groups like Dragonflies, Damselflies, webspinners, Grasshopper, Cricket, Locusts, Roaches, Mantis, Termites, Bugs, Antlions, Lacewings, Beetles, Flies, Mosquitoes, Ants, Bees, Wasp, Butterflies and Moths.

Keywords— Banaskantha, Gandhinagar, Insect, Mehsana, North Gujarat, Narmada Canal Command Area (NCCA), Patan

I. INTRODUCTION

The Narmada canal network is world's largest lined irrigation canal network that extends for about 458 km up to Gujarat -Rajasthan border (Source: http//www.sardarsarovardam.org/main-canal.aspx). The Narmada main canal spreads over the State through 38 branch canals which benefit 17 districts, 79 talukas and 3125 villages of Gujarat (Source: http//www.sardarsarovardam.org/canal-network.aspx). The introduction of canal network in a region does not merely imply the water availability to aquatic entomofauna but it also indicates possibility of creation of new habitats for aquatic and terrestrial insects. Several regions of the Narmada canal command area are arid/semi-arid and drought-prone since remote past. Hence, artificial water availability in those regions due to gigantic Narmada Canal is expected to bring changes in habitats with respect to life requisites of entomofauna. Such changes, in the long run, may bring in changes in the insect diversity of the regions wherein the canal network has got operationalized. It is, therefore, highly desirable to understand the insect diversity of the regions falling in NCCA at this stage, so that the entomofaunal inventory built at this stage will function as a bench-mark for entomologists wanting to work in these regions in future. The present study has been conducted with this consideration with the focus on NCCA in North Gujarat region.

II. RELATED WORK

Researchers/organisations had carried out insect surveys in various region within Gujarat including NCCA in the past [1], [2], [3]. But considerable time has passed after these studies, calling for the need of understanding recent entomofaunal status through field surveys in the regions falling in the NCCA. Moreover, the past studies had certain data gaps too. The present study was conducted to fill up this data gap, to reveal the insect diversity status in the most recent time-frame and to have some bench-mark entomofaunal species richness data that can be useful for the entomologists who would want to carry out similar studies in future in the same region

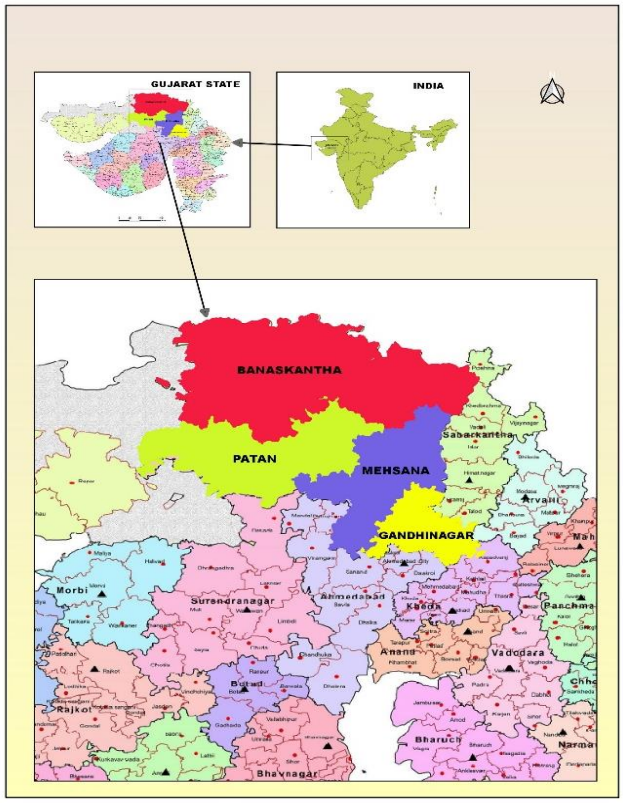
III. STUDY AREA

Gujarat state has 5 administrative regions, viz. North Gujarat, Central Gujarat, South Gujarat, Saurashtra and Kachchh. As the name suggests, North Gujarat is the Northern most administrative region besides Kachchh. It has six districts, viz. Gandhinagar, Banaskantha, Sabarkantha, Aravalli, Mehsana and Patan. Climate of North Gujarat region is arid to semi-arid. The rainfall is only around 735 mm per annum.

The present study covered 4 districts of North Gujarat as they fall in NCCA in North Gujarat region (Map 1). They

were Gandhinagar, Banaskantha, Mehsana and Patan district.

- **Banaskantha District** (24° 10' 45.59" N, 72° 25' 36.05" E): Banaskantha district shares its border with 4 districts of Gujarat i.e Sabarkantha (East), Kutch district (West), Patan district and Mehsana district in the South. Banaskantha district also shares its border with Rajasthan state towards North.
- **Patan District** (23° 50' 57.57" N, 72° 7' 35.85" E): Patan District shares its border with 4 districts of Gujarat i.e Mehsana district (east and southeast), Kutch District (west), Surendranagar district (south) and Banaskantha district (north and northeast).
- **Mehsana District** (23° 35' 12.33" N, 72° 22' 11.81" E): Mehsana district shares its border with 6 districts of Gujarat i.e. Sabarkantha district (East), Patan and Surendranagar districts (West), Gandhinagar and Ahmedabad districts (South) and Banaskantha district (north).
- **Gandhinagar District** (23° 14' 15.21" N, 72° 38' 52.01" E): Gandhinagar is capital city of Gujarat State. Gandhinagar district shares its border with 5 districts of Gujarat i.e. Sabarkantha and Aravalli (Northeast), Kheda (Southeast), Ahmedabad district (Southwest) and Mehsana (Northwest).



Map 1: Location of various districts of North Gujarat region covered during study

IV. METHODOLOGY

Visual Encounter Survey (VES) was carried out to detect and record insects in the select sampling villages of the four districts falling in Narmada Canal Command Area (NCCA). The study had covered 10% villages of each of the four districts of North Gujarat in which Narmada Canal has been operationalized. Entomofaunal habitats created/enhanced by the canal network mainly included wetlands (village ponds, countryside ponds, irrigation reservoirs etc.), croplands, fallow land, marshy areas along the canals, plantations done by SSNNL, hedgerows, canal over-bridges, earth cuttings and canal-side construction. All the major habitats were covered during the insect survey. The insect species were located, identified and photographed using a camera. The species which were difficult to identify were collected using insect collecting net. An insect once collected in a net was photographed from various angles and then was released back to nature. Such photographed insects were later identified using appropriate standard field guides. For identification of species well known and widely accepted field guides and published articles were used.

V. RESULTS AND DISCUSSION

A total of 126 species belonging to 11 orders and 56 families were recorded in North Gujarat region (Table 1). Major insect orders recorded during the entomofaunal surveys in the command area with operationalised canals included Odonata (Dragonflies and Damselflies), Orthoptera (Grasshoppers, Crickets, Locusts), Embioptera (Webspinners), Dictyoptera (Mantis and Roaches), Isoptera (Termites), Hemiptera (Bugs), Neuroptera (Antlions, Lacewings), Coleoptera (Beetles), Diptera (Flies, Mosquitoes), Hymenoptera (Ants, Bees, Wasps) and Lepidoptera (Butterflies and Moths). Maximum number of insect species that were encountered belonged to the order Lepidoptera (i.e. 36 species) followed by the orders Odonata (17 species) in that order (Table 1, Fig. 1).

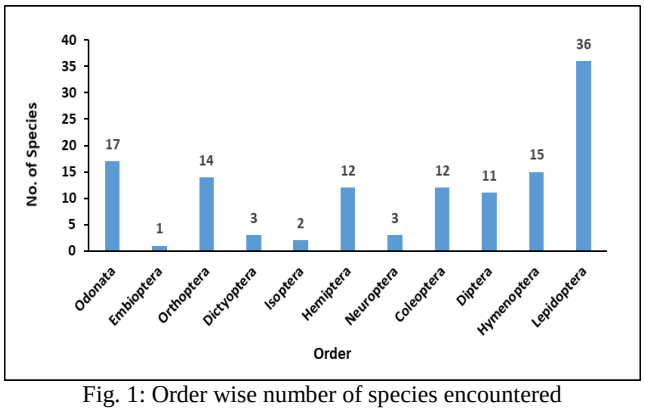


Fig. 1: Order wise number of species encountered during survey in NCCA in North Gujarat

Among all four districts surveyed, the highest number of insect species were encountered in Gandhinagar District, followed by Mehsana, Patan and Banaskantha districts in that order. District wise species richness is briefly discussed below:

Banaskantha District: A total of 43 species of insects were encountered which belonged to 11 orders (Table 1). Out of all the species recorded in the district, 69.8% were

terrestrial and 30.2 % species were semi-aquatic/aquatic. In Banaskantha district, order wise highest proportion of insect species was represented by order Odonata (i.e. 18.6 %) followed by the order Hymenoptera and Diptera (i.e 16.28 % each) (Fig 2).

Patan District: A total 44 species of insects were recorded that belonged to 8 orders (Table 1). Out of all the species recorded, 63.6% species were terrestrial, whereas 36.4% were aquatic/semi-aquatic. In Patan district, order wise highest proportion of insect species was represented by order Lepidoptera (i.e. 45.45%) followed by the order Odonata (i.e. 31.82%) (Fig 3).

Mehsana District: A total of 50 species of insects recorded in Mehsana district belonged to 8 orders (Table 1). With respect to the total number of species recorded in Mehsana district, higher proportion of terrestrial insect species was recorded as compared to the proportion of the aquatic/semi-aquatic species (i.e. 68% terrestrial species versus 32% of aquatic/semi-aquatic species). In Mehsana district, order wise highest proportion of insect species was represented by order Lepidoptera (i.e. 44 %) in followed by the order Odonata (i.e 28%) (Fig 4).

Gandhinagar district: A total of 83 species of insects were encountered which belonged to 11 orders (Table 1). Out of all the species recorded in the district, 86.7% species were terrestrial and 13.3 % species were semi-aquatic/aquatic. In Gandhinagar district, order wise highest proportion of insect species were represented by order Lepidoptera (i.e. 26.51%) followed by order Orthoptera (i.e.14.46 %) (Fig 5).

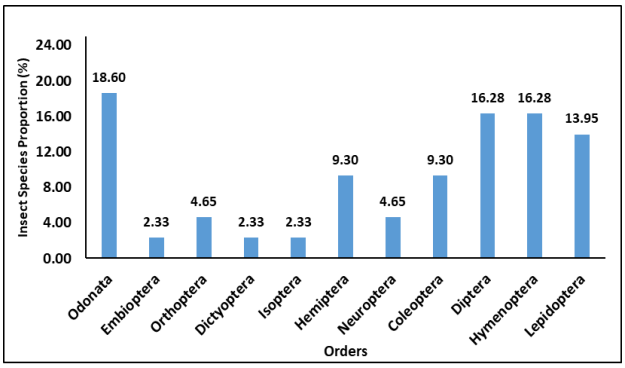


Fig 2.: Order Wise Species Richness and Species Proportion (%) of the Insects recorded in Banaskantha District

The major insect groups recorded during the study were mainly dragonflies, damselflies, webspinners, grasshopper, cricket, locusts, roaches, mantis, termites, bugs, antlions, lacewings, beetles, flies, mosquitoes, ants, bees, wasp, butterflies and moths. All insects recorded during the study play very important role in ecosystem. The predominant families in the North Gujarat region were found to be Lycaenidae, Nymphalidae, Pieridae (all the three being butterfly families), Libellulidae (a dragonfly family), Coenagrionidae (a damselfly family), Acrididae (a grasshopper family) and Apidae (a bee family).

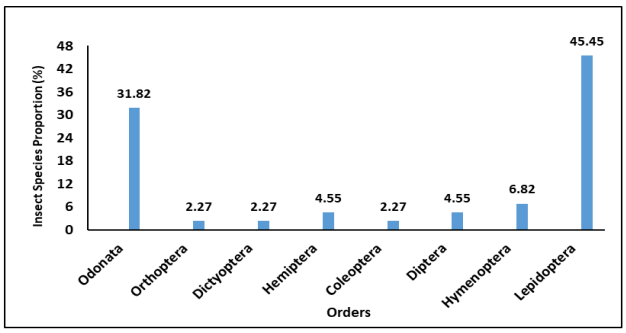


Fig 3 Order Wise Species Richness and Species Proportion (%) of the Insects recorded in Patan district

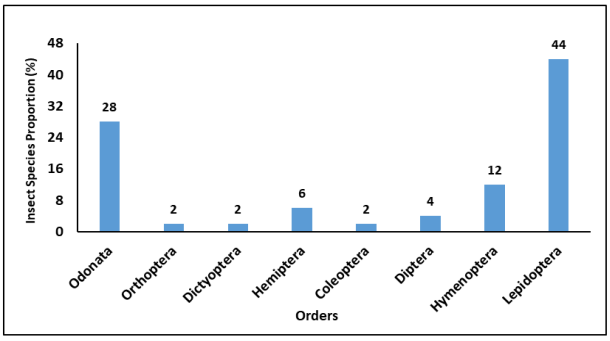


Fig 4: Order Wise Species Richness and Species Proportion (%) of the Insects recorded in Mahesana District

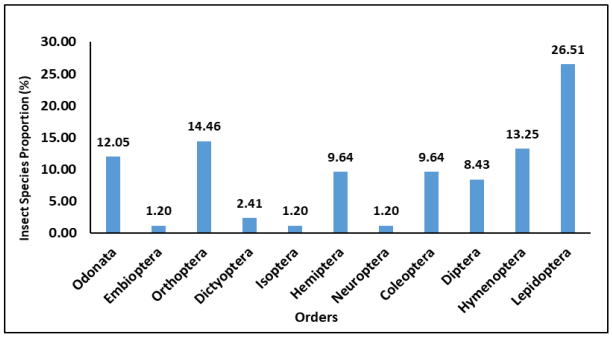


Fig 5.: Order Wise Species Richness and Species Proportion (%) of the Insects recorded in Gandhinagar District

There was predominance of insect groups known for their pollination (e.g. three families of butterflies and one family of bees). Their predominance may be considered as an indication of desirable ecological conditions in terrestrial ecosystems. Members of butterfly families are very important links in the food chain. Their larvae and pupae are useful as food of birds and parasitic entomophagous insects. The adults are important pollinators and constitute food for birds and reptiles [4]. Moreover, predominance of families like Libellulidae and Coenagrionidae (i.e. dragonflies and damselflies respectively) may indicate good balance of aquatic ecosystems as the members of these families include semi-aquatic insects. Species belonging to these families are often predators considered as biological controls agents for other macroinvertebrates and some species belonging to these families are often considered as indicators of wetland health [5], [6], [7].

Table 1: Checklist of insects encountered during the entire survey in North Gujarat regions of SSNNL study area in each District

SN	Scientific name	Family	Banaskantha	Mehsana	Gandhinagar	Patan
Order: Odonata						
1	*Brachythemis contaminata*	Libellulidae	+	+	+	+
2	*Bradinopyga geminata*	Libellulidae		+	+	+
3	*Crocothemis servilia*	Libellulidae	+	+		+
4	*Diplacodes trivialis*	Libellulidae			+	
5	*Orthetrum sabina*	Libellulidae	+	+	+	+
6	*Pantala flavescens*	Libellulidae	+	+	+	+
7	*Tramea basilaris*	Libellulidae		+		+
8	*Trithemis aurora*	Libellulidae			+	
9	*Trithemis festiva*	Libellulidae		+		+
10	*Trithemis pallidinervis*	Libellulidae		+	+	+
11	*Agriocnemis pygmaea*	Coenagrionidae	+	+		+
12	*Ceriagrion coromandelianum*	Coenagrionidae		+		+
13	*Ischnura aurora*	Coenagrionidae			+	
14	*Ischnura senegalensis*	Coenagrionidae	+	+	+	+
15	*Pseudagrion decorum*	Coenagrionidae	+	+	+	+
16	*Rhodischnura nursei*	Coenagrionidae	+	+		+
17	*Lestes umbrinus*	Lestidae		+		+
Order: Embioptera						
18	*Embia sp.*	Embiidae	+		+	
Order: Orthoptera						
19	*Acrida conica*	Acrididae			+	
20	*Acrida ungarica*	Acrididae			+	
21	*Amblytropidia mysteca*	Acrididae			+	
22	*Choroedocus sp.*	Acrididae			+	
23	*Chorthippus biguttulus*	Acrididae			+	
24	*Hieroglyphus banian*	Acrididae			+	
25	*Omocestus viridulus*	Acrididae			+	
26	*Schistocerca gregaria*	Acrididae			+	
27	*Gryllus campestris*	Gryllidae	+			
28	*Atractomorpha crenulata*	Pyrgomorphidae			+	
29	*Poekilocerus pictus*	Pyrgomorphidae		+	+	+
30	*Paratettix sp.*	Tetrigidae			+	
31	*Tetrix ceperoi*	Tetrigidae	+			
32	*Conocephalus sp.*	Tettigoniidea			+	
Order: Dictyoptera						
33	*Mantis religiosa*	Mantidae			+	
34	*Humbertiella ceylonica*	Liturgusidae	+	+		+
35	*Periplaneta americana*	Blattidae			+	

Order: Isoptera						
36	*Coptotermes formosanus*	Rhinotermitidae	+			
37	*Reticulitermes flavipes*	Rhinotermitidae			+	
Order: Hemiptera						
38	*Aphis nerii*	Aphididae	+	+	+	
39	*Philaenus spumarius*	Aphrophoridae			+	
40	*Platypleura octoguttata*	Cicadidae			+	
41	*Cletus bipunctatus*	Coreidae			+	
42	*Corixa punctata*	Corixidae	+			
43	*Gerris lacustris*	Gerridae		+		+
44	*Limnogonus fossarum*	Gerridae	+	+		+
45	*Lygaeus hospes*	Lygaeidae			+	
46	*Lygaeus kalmii*	Lygaeidae			+	
47	*Oncopeltus sp.*	Lygaeidae	+			
48	*Eysarcoris sp.*	Pentatomidae			+	
49	*Dysdercus cingulatus*	Pyrrhocoridae			+	
Order: Neuroptera						
50	*Chrysoperla carnea*	Chrysopidae	+			
51	*Myrmeleon immaculatus*	Myrmeleonidae			+	
52	*Palpares sp.*	Myrmeleonidae	+			
Order: Coleoptera						
53	*Buprestis aurulenta*	Buprestidae			+	
54	*Brachinus sp.*	Carabidae	+		+	
55	*Charidotella sp.*	Chrysomelidae			+	
56	*Crioceris sp.*	Chrysomelidae			+	
57	*Coccinella transversalis*	Coccinellidae	+			
58	*Conotrachelus posticatus*	Curculionidae			+	
59	*Artipus sp.*	Curculionidae			+	
60	*Mylabris pustulata*	Meloidae			+	
61	*Anoplotrupes sp.*	Geotrupidae			+	
62	*Heteronychus arator*	Scarabaeidae	+			
63	*Onthophagus sp.*	Scarabaeidae		+		+
64	*Paederus littoralis*	Staphylinidae	+			
Order: Diptera						
65	*Promachus sp.*	Asilidae			+	
66	*Bombylius major*	Bombyliidae			+	
67	*Calliphora vomitoria*	Calliphoridae			+	
68	*Aedes aegypti*	Culicidae	+		+	
69	*Anopheles sp.*	Culicidae	+			
70	*Dolichopus sp.*	Dolichopodidae	+			
71	*Musca domestica*	Muscidae	+	+	+	+
72	*Sarcophaga sp.*	Sarcophagidae	+		+	
73	*Eristalis sp.*	Syrphidae	+	+		+
74	*Bactrocera cucurbitae*	Tephritidae	+			

75	*Bactrocera sp.*	Tephritidae			+	
Order: Hymenoptera						
76	*Apis dorsata*	Apidae	+	+	+	+
77	*Apis florea*	Apidae			+	
78	*Apis Indica*	Apidae			+	
79	*Amegilla cingulata*	Apidae			+	
80	*Xylocopa auripennis*	Apidae			+	
81	*Xylocopa sp.*	Apidae	+	+		
82	*Opius sp.*	Braconidae			+	
83	*Camponotus compressus*	Formicidae	+	+	+	+
84	*Monomorium minimum*	Formicidae			+	
85	*Monomorium pharaonis*	Formicidae	+			
86	*Ischnojoppa sp.*	Ichneumonidae	+			
87	*Campsomeriella sp.*	Scoliidae	+			
88	*Delta esuriens*	Vespidae	+	+	+	+
89	*Icaria variegata*	Vespidae		+	+	
90	*Polistes wattii*	Vespidae		+	+	
Order: Lepidoptera						
91	*Catochrysops strabo*	Lycaenidae			+	
92	*Chilades trochylus*	Lycaenidae			+	
93	*Lampides boeticus*	Lycaenidae	+	+		
94	*Luthrodes pandava*	Lycaenidae	+			
95	*Tarucus nara*	Lycaenidae		+	+	+
96	*Tarucus plinius*	Lycaenidae			+	
97	*Zizeeria lysimon*	Lycaenidae		+		+
98	*Zizeeria karsandra*	Lycaenidae	+	+		+
99	*Pseudozizeeria maha*	Lycaenidae	+	+		+
100	*Zizina otis*	Lycaenidae		+	+	+
101	*Zizula hylax*	Lycaenidae			+	
102	*Acraea terpsicore*	Nymphalidae		+		+
103	*Cynthia cardui*	Nymphalidae	+	+	+	
104	*Danaus chrysippus*	Nymphalidae		+	+	+
105	*Danaus genutia*	Nymphalidae		+	+	+
106	*Hypolimnas bolina*	Nymphalidae		+	+	+
107	*Hypolimnas misippus*	Nymphalidae		+		+
108	*Junonia almana*	Nymphalidae		+		+
109	*Junonia orithya*	Nymphalidae		+	+	+
110	*Melanitis leda*	Nymphalidae		+		+
111	*Graphium agamemnon*	Papilionidae			+	
112	*Pachliopta aristolochiae*	Papilionidae		+	+	+
113	*Papilio demoleus*	Papilionidae			+	
114	*Belenois aurota*	Pieridae		+		+
115	*Catopsilia pomona*	Pieridae			+	
116	*Catopsilia pyranthe*	Pieridae		+		+

117	*Colotis amata*	Pieridae		+	+	+
118	*Colotis vestalis*	Pieridae		+		+
119	*Eurema hecabe*	Pieridae		+	+	+
120	*Cepora nerissa*	Pieridae		+		+
121	*Ixias marianne*	Pieridae			+	
122	*Stenoptilia sp.*	Pterophoridae			+	
123	*Pyrrharctia Isabella*	Erebidae			+	
124	*Utetheisa pulchella*	Erebidae	+			
125	*Hyperythra lutea*	Geometridae			+	
126	*Borbo cinnara*	Hesperiidae			+	

Note: "+" - Presence of species

VI. CONCLUSION

The four districts covered for the entomofaunal surveys have good insect diversity (i.e., 126 species). Dominance of the families of pollinating insects (i.e. butterflies and moths) on one hand and that of biological controllers (dragonflies and damselflies) on the other hand indicate balanced ecological conditions. Members of these families also act as very important links in the food chain.

ACKNOWLEDGMENT

Authors would like to express their thanks to Sardar Sarovar Narmada Nigam limited (SSNNL) for financial and logistic support. Authors are also thankful to Gujarat Forest Department for all the necessary logistic support during every field investigation. Authors wish to thank Mr. Vikram Singh Manager, GEER Foundation for the helping in managing administrative aspect of the project. The authors also acknowledge Mr. Kamlesh Shrinath, Tracer, GEER Foundation for preparing the base map of the study area and Ms. Saraswati Vankar, Technical Assistant (TA) of GEER Foundation for their help during field surveys.

REFERENCES

[1] A. B. Vora, R. Y. Gupte, A. A. Ahluwalia and C. K. Shah, "Environment Impact Assessment Studies on Flora and Fauna of Command Area North of River Sabarmati up to Rajasthan". *Sardar Sarovar Narmada Nigam limited.* Gandhinagar, **Gujarat, India** pp. **1-582, 1995.**

[2] B. Pilo, B. Pathak, B. A. Kumar, V. K. Murukesan, K. R. Vinod, and S. Kumari, "Biological Diversity of Gujarat" *Gujarat Ecology Commission GERI Campus*, Vadodara**, Gujarat, India 1996.**

[3] GEER "Collection of Baseline Data Pertaining to Biodiversity and Socio-Economics in the Dholera Special Investment Region, Gujarat" *Report no DSIR/64/2012 Gujarat Ecological Education and Research (GEER) Foundation, Gandhinagar*, **Gujarat. India** pp. **1-374, 2012.**

[4] V. H. Resh and R. T. Cardé "Encyclopedia of Insects" *U.S.A.: Academic Press*, **U.S.A**. pp **1-1168, 2009.**

[5] Imms, A.D. Richards, O.W. and Davies, R.G. (Eds.), "Imms' General Textbook of Entomology Volume 2: Classification and Biology", *Springer, Dordrecht, ISBN 978-94-011-6516-7*, Volume **2, pp. 1-1279, 1977.**

[6] K. A. Subramanian, "Dragonflies and Damselflies of Peninsular India-A Field Guide. E-Book of Project Lifescape" *Centre for Ecological Sciences, Indian Institute of Science and Indian Academy of Sciences*, **Bangalore, India.** pp. **1-118, 2005.**

[7] K. Bashar, S. Reza, M. A. Razzak, M. D. Khondoker, Z. Rahman, P. Goda, and A. J. Howlader, "Faunistic study of Odonata (Dragonfly & Damselfly) in some selected regions of Bangladesh" *Journal of Entomology and Zoology Studies, ISSN 2320-7078*, Vol Vol **2 (4),** pp. **1-6, 2014.**

