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Diversity of Aquatic Beetles (Insecta: Coleoptera) of Navegaon National Park, Maharashtra, India

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

The present study was carried out during the year 2017 to gain knowledge on diversity of aquatic beetles from Navegaon National Park in Maharashtra. A total of 19 species belonging to 13 genera and 3 families of aquatic coleoptera were recorded. Family Dytiscidae was found to be species rich group followed by Hydrohilidae and Gyrinidae. Sixteen species were recorded for the first time from the national park.

Keywords: Systematics; deccan plateau; diversity; protected area; Maharashtra.

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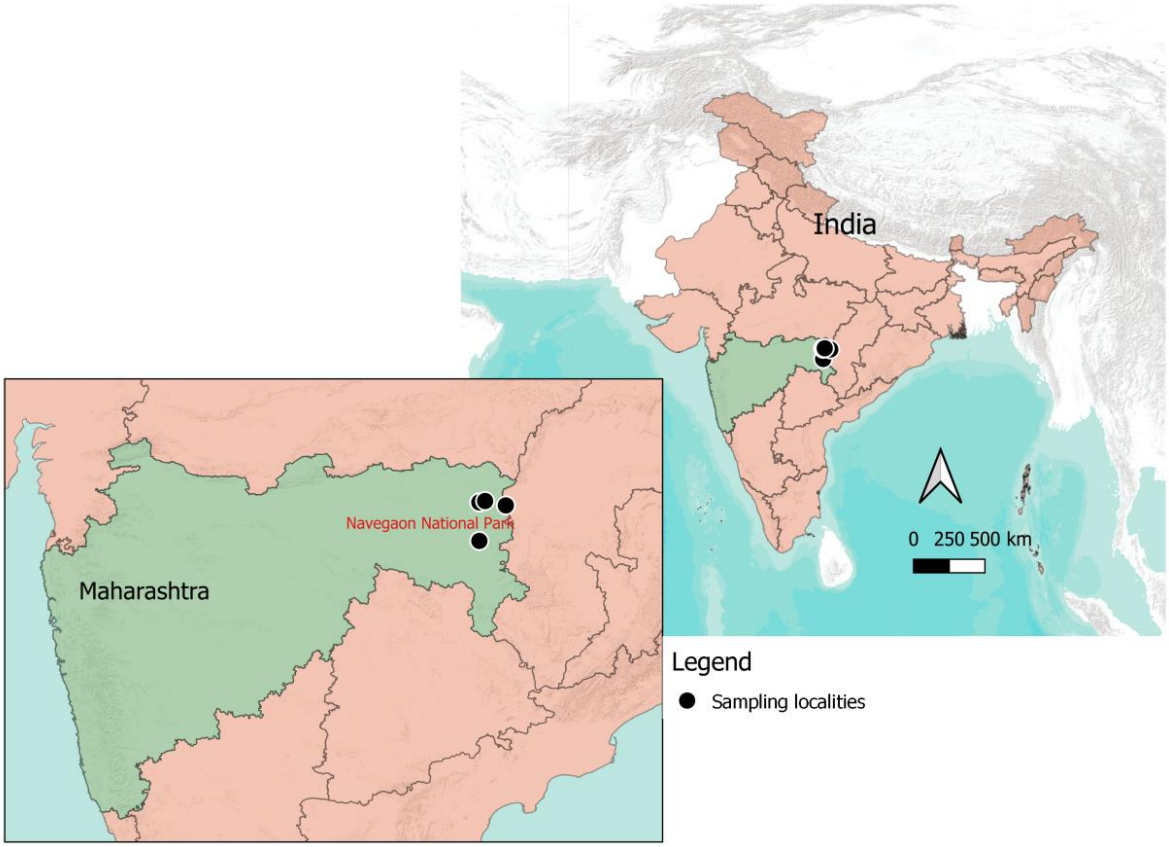
1. INTRODUCTION

Aquatic coleoptera is a diverse group and are reliable bio-indicators of ecological diversity and habitat quality of freshwater ecosystem [1]. They are integral part of freshwater ecosystems and play a very significant role in recycling nutrients and form a critical part of the food web [2]. They are one of the most abundant aquatic insect, with more than 13,000 described species [3]. In India about 786 species of aquatic beetles belonging to 137 genera, 17 families are reported [4-7].Deccan Peninsula is the largest biogeographic zones out of 10 biogeographic zones of India and it covers most of the central and southern part of India. So far, 264 species of aquatic beetles are reported from Deccan Peninsular Region [8]. Aquatic beetles of Maharashtra have been studied by [9-20] and aquatic beetles of protected areas of Maharashtra, in particular were carried out by [21] from Melghat Tiger Reserve; [22] from Karnala Bird Sanctuary; [23] from Phansad Wildlife Sanctuary; [24] from Koyna Wildlife Sanctuary. The current knowledge of aquatic beetle fauna of protected area of Maharashtra state is very limited. Therefore, the present study is focused on the aquatic beetle's diversity from one of the protected area of Deccan Peninsula 'Navegaon National Park'.

2. MATERIALS AND METHODS

Navegaon National Park (20.9756° N, 80.1652° E) is also known as Navegaon Bandh (Bandh: reservoir) is located at Navegaon, Tahsil Arjuni Morgaon, District Gondia of Maharashtra state of Deccan Peninsular Region of India on undulating hills, which form the catchment of Itiyadoh dam and Navegaon Bandh Lake. The national park covers an area of 133.78 km^2. Current report is based on collections made by Zoological Survey of India during the year 2017 from different locations (Map1) (Table 1).

A total of 263 specimens were collected from small forest streams, pool, pond and under aquatic vegetation with D-frame aquatic insect net having mesh size of 0.5mm and a simple kitchen strainer. The collected specimens were preserved in 75% ethanol in the repository of the



Map 1. Sampling localities of aquatic beetles from Navegaon National Park

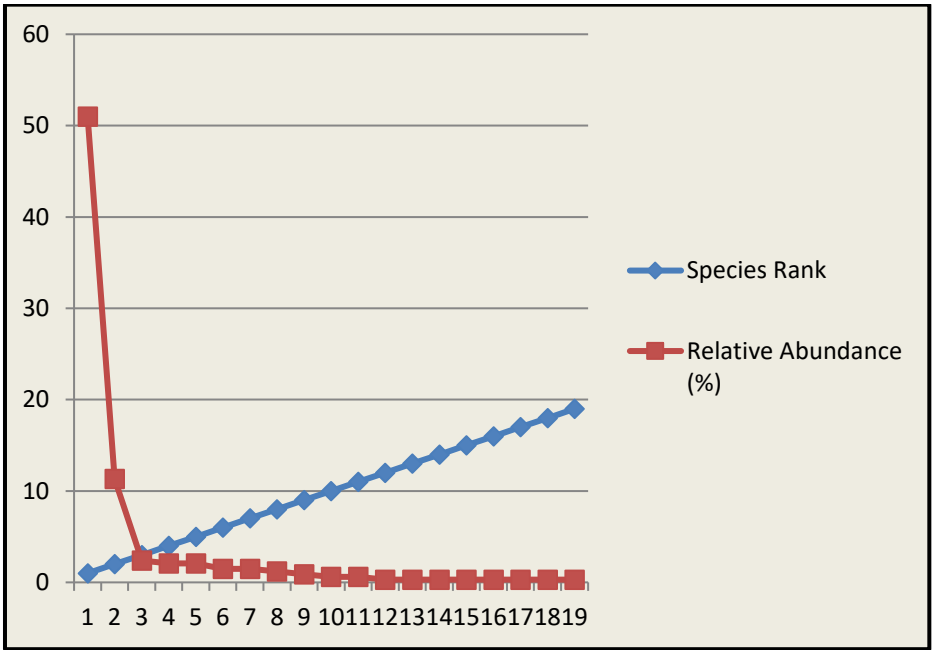
Table 1. Sampling locations of aquatic beetles from Navegaon National Park, Maharashtra

Sl. No.	Sampling Station	Habitat	District	Latitude	Longitude	Altitude (m)
1	Bhiv khidki and vicinity, Arjuni Morgaon	Seasonal stream	Gundia	20.296° N	80.056° E	329
2	Wadekasa Village, Arjuni Morgaon	Seasonal stream	Gundia	20.895° N	80.503° E	409
3	Forest Resthouse, Arjuni Morgaon	Seasonal stream	Gundia	20.946° N	80.056° E	389
4	Forest Core Area, Arjuni Morgaon	Seasonal stream	Gundia	20.969° N	80.153° E	282

Zoological Survey of India, Western Regional Centre, Pune with accession number from ENT-1/3440- ENT-1/3441; ENT-1/3466- ENT-1/3468; ENT-1/4082- ENT-1/4105. The specimens studied using Leica Stereo Zoom Microscope (S9i). Identification of specimens was based on [25-30,5,31] and their relative abundance has been calculated based on the literature [32] (Table 3) (Graph 1).

3. RESULTS AND DISCUSSION

A total of 19 species (Fig. 1) belonging to 13 genera and 3 families (Dytiscidae, Hydrophilidae, Gyrinidae) were recorded (Table 2). Species richness in family Dytiscidae was found to be more followed by Hydrohilidae and Gyrinidae (Fig. 2). *Sternolophus rufipes*, with an abundance of 171 individuals, appears to be the most dominant species. Species synonyms are only based on the original citation and the latest citation [33,30,34,31,35]. The latest citation is indicated by a colon symbol (:) between species and authors name. Based on the data obtained on aquatic beetle diversity in the Navegaon National Park, the species and their corresponding relative abundances were recorded (Table 3) (Graph 1). Overall, the results of this study contribute to the understanding of aquatic beetle diversity in the national park. The work provides important baseline information and serves as a foundation for future ecological research, conservation efforts, and ecosystem management strategies.



Graph 1. Rank/Relative abundance plot for the aquatic beetles from Navegaon National Park based on Table 3

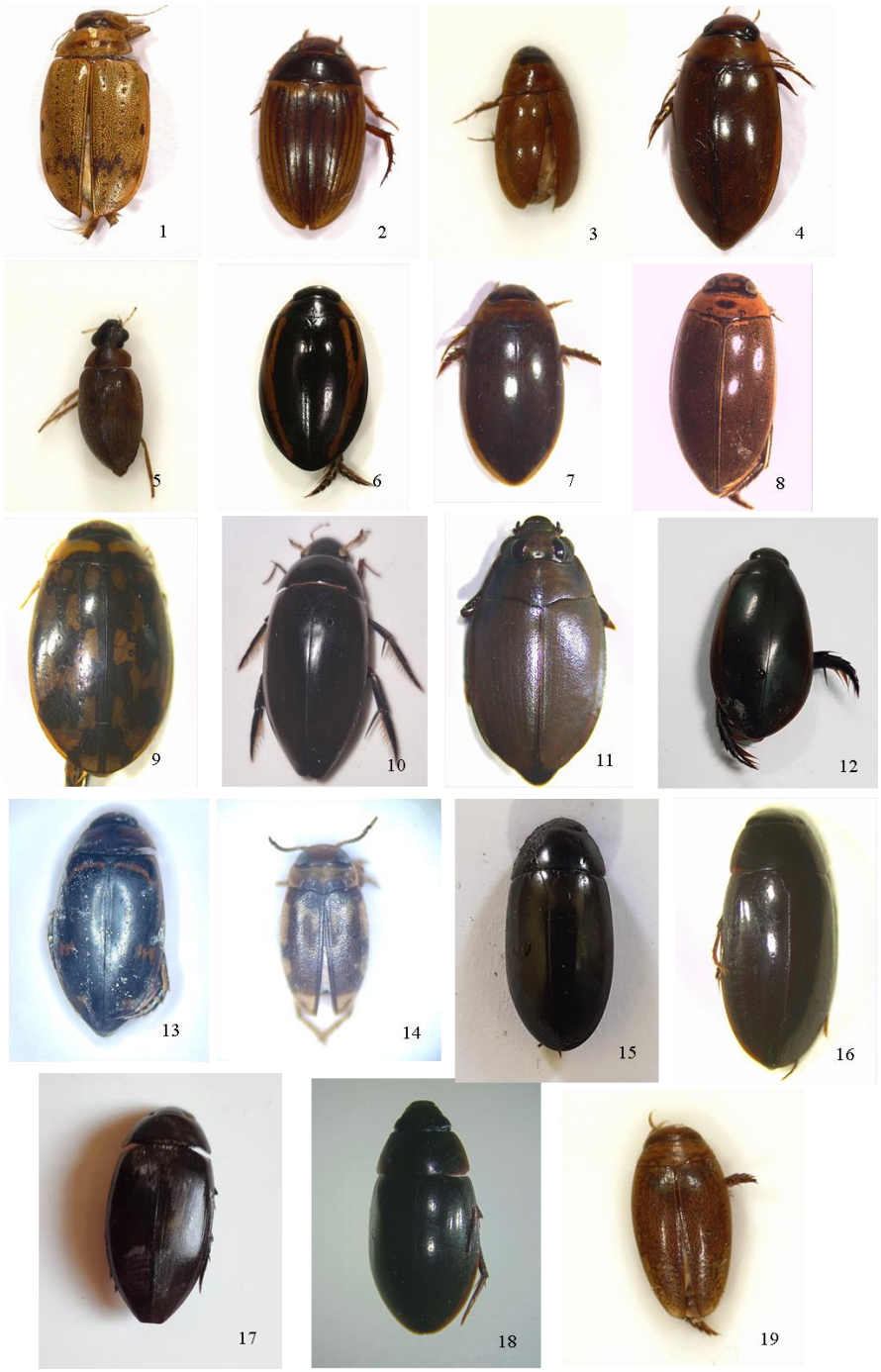


Fig. 1. Dorsal habitus of aquatic beetles collected from Navegaon National Park, Maharashtra. 1. *Eretes griseus* (Fabricius, 1781) 2. *Copelatus neelumae* Vazirani, 1973 3. *Enochrus esuriens* (Walker, 1858) 4. *Hydaticus (Prodaticus) incertus* Regimbart, 1888 5. *Berosus (Berosus) pulchellus* MacLeay, 1825 6. *Hydaticus (Prodaticus) vittatus* (Fabricius, 1775 7. *Hydaticus* (*Prodaticus*) *fabricii* Macleay, 1825 8. *Rhantaticus congestus* (Klug, 1833) 9. *Sandracottus dejeanii* (Aube, 1838) 10. *Hydrophilus olivaceous* Fabricius, 1781 11. *Dineutus (Cyclous) indicus* Aube, 1938 12. *Cybister (Cybister) limbatus* (Fabricius, 1775) 13. *Hydaticus (Prodaticus) discindens* Walker, 1858 14. *Hydroglyphus flammulatus* (Sharp, 1882) 15. *Hydrobiomorpha spinicollis* (Eschscholtz 1822) 16. *Sternolophus inconspicuus* (Nietner, 1856) 17. *Hydrophilus senegalensis* Percheron, 1835 18. *Sternolophus rufipes* (Fabricius, 1792) 19. *Laccophilus flexuosus* Aube, 1838

Table 2. List of species with their Indian & Global distribution found from Navegaon National Park, Maharashtra

Sl no.	Suborder/Family/Species/Synonyms	Indian Distribution	Global Distribution
	Suborder Adephaga Schellenberg, 1806 Family Gyrinidae Latreille, 1810		
1.	***Dineutus (Cyclous) indicus*** Aube, 1938 1938. *Dineutus indicus* Aube, Species Coleopters, 6: 772. 1984. *Dineutus indicus*: Vazirani, Fauna of India, Coleop, p. 22.	Andhra Pradesh, Bihar, Chhattisgarh, Gujarat, Himachal Pradesh, Jammu & Kashmir, Jharkhand, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Odisha, Puducherry, Rajasthan, Tamil Nadu, Uttarakhand, Uttar Pradesh and West Bengal.	Pakistan.
	Family Dytiscidae Leach, 1815		
2.	***Cybister (Cybister) limbatus*** (Fabricius, 1775) 1775. *Dytiscus limbatus* Fabricius, *Systema Ent.*, 230. 2012. *Cybister (s.str.) limbatus*: Ghosh & Nilsson, *Skorvnopparn supplement* **3**: 20.	Andhra Pradesh, Bihar, Chhattisgarh, Gujarat, Himachal Pradesh, Jammu & Kashmir, Jharkhand, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Odisha, Puducherry, Rajasthan, Tamil Nadu, Uttarakhand, Uttar Pradesh and West Bengal.	Afghanistan, Pakistan; China, Japan, Indonesia, Philippines, Taiwan, Vietnam.
3.	***Hydaticus (Prodaticus) vittatus*** (Fabricius, 1775 1775. *Dytiscus vittatus* Fabricius, Syst. Ent.: 825. 2020. *Hydaticus (Prodaticus) vittatus*: Wewalka, Koleopterologische Rundschau, 90: 29	Andhra Pradesh, Assam, Bihar, Gujarat, Himachal Pradesh, Jammu & Kashmir, Jharkhand, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Odisha, Pondicherry, Rajasthan, Sikkim, Tamil Nadu, Tripura, Uttarakhand, Uttar Pradesh and West Bengal.	Bangladesh, Bhutan, Myanmar, Nepal, Pakistan, Sri Lanka, China, Indonesia, Japan, Korea, Philippines, Taiwan, Thailand, Vietnam, Australian region.
4.	***Hydaticus* (*Prodaticus*) *fabricii*** Macleay, 1825 1825. *Colymbetes fabricii* W.S. Macleay, Annulosa Javanica, Paris, P.134. 2012. *Hydaticus fabricii*: Ghosh and Nilsson, Skorvnopparn Umel supplement, 3: 25.	Andaman & Nicobar Islands, Andhra Pradesh, Assam, Bihar, Delhi, Goa, Gujarat, Himachal Pradesh, Kerala, Madhya Pradesh, Maharashtra, Manipur, Orissa, Punjab, Rajasthan, Sikkim, Tamil Nadu, Uttarakhand, Uttar Pradesh, West Bengal.	Afghanistan, Myanmar, Nepal, Pakistan, Sri Lanka; China, Indonesia, Iran, Japan, Philippines, Taiwan, Thailand, Vietnam; Australian region.
5.	***Hydaticus (Prodaticus) incertus*** Regimbart, 1888 1888. *Hydaticus incertus* Régimbart, Annali del Museo Civico di Storia Naturale,6:611 2012. *Hydaticus (Prodaticus) incertus*: Ghosh & Nilsson,	Delhi, Gujarat, Himachal Pradesh, Madhya Pradesh, Maharashtra, Tamil Nadu and Uttar Pradesh.	Bhutan, Myanmar, Nepal, Sri Lanka, China, Malaysia, Thailand.

Sl no.	Suborder/Family/Species/Synonyms	Indian Distribution	Global Distribution
	Skorvnopparn supplement, 3: 25.		
6.	***Hydaticus (Prodaticus) discindens*** Walker, 1858 1858. *Hydaticus discindens* Walker, The Annals and Magazine of Natural History (3) 2: 212 2020. *Hydaticus (Prodaticus) bipunctatus*: Wewalka, Koleopterologische Rundschau, 90: 22	Andhra Pradesh, Karnataka, Maharashtra, Odisha, Tamil Nadu, West Bengal.	Sri Lanka
7.	***Rhantaticus congestus*** (Klug, 1833) 1833. *Hydaticus congests* Klug, Symb. Physicae, Insectes Madagascar, p. 48. 2012. *Hydaticus (Prodaticus) incertus*: Ghosh & Nilsson, Skorvnopparn supplement, 3: 18.	Andhra Pradesh, Arunachal Pradesh, Delhi, Jharkhand, Madhya Pradesh, Maharashtra, Manipur, Orissa, Rajasthan, Tamil Nadu, Uttarakhand, Uttar Pradesh, West Bengal	Bangladesh, Nepal; China, Japan, Madagaskar, Philippines, Saudi Arabia, Sunda Islands, Taiwan; Afrotropical region, Australian region, North Africa.
8.	***Sandracottus dejeanii*** (Aube, 1838) 1838. *Hydaticus dejeanii* Aube, in Dejean´s Species Coleopteres, 6: 165. 2012. *Sandracottus dejeanii*: Ghosh & Nilsson, Skorvnopparn Umel supplement, 3: 18.	Arunachal Pradesh, Andhra Pradesh, Chhattisgarh, Himachal Pradesh, Gujarat, Jharkhand, Kerala, Madhya Pradesh, Maharashtra, Odisha, Rajasthan, Tamil Nadu, Uttarakhand, Uttar Pradesh and West Bengal	Pakistan, Iran, Afrotropical region and Australian region.
9.	***Eretes griseus*** (Fabricius, 1781) 1781. Dytiscus griseus Fabricius, Species Ins., 1: 293. 2012. Eretes griseus: Ghosh & Nilsson, Skorvnopparn supplement, 3: 23.	Himachal Pradesh, Jammu & Kashmir, Maharashtra and Uttar Pradesh.	Afghanistan, Bhutan, Nepal, Pakistan, China, Iran, Iraq, Japan, Kuwait, Oman, Sinai, South Korea, Syria, Turkey, Yemen, Afrotropical region, Australian region, Russia, Europe, North Africa.
10.	***Copelatus neelumae*** Vazirani, 1973 1973. *Copelatus neelumae* Vazirani, Jr. of the Bombay Nat. Hist. Soc., 70: 224 2018. *Copelatus neelumae:* Sheth, Ghate & Hajek, Zootaxa, 4459: 248.	Goa, Karnataka, Kerala, Maharashtra, Tamil Nadu.	Sri Lanka & Nepal.
11.	***Laccophilus flexuosus*** Aube, 1838	Andaman & Nicobar Islands, Andhra Pradesh,	Bangladesh, Cambodia,

Sl no.	Suborder/Family/Species/Synonyms	Indian Distribution	Global Distribution
	1838. *Laccophilus flexuosus* Aubé: 430. 2012. *Laccophilus flexuosus*: Ghosh and Nilsson, Skörvnöpparn, Umeå, Suppl., 3: 48	Bihar, Delhi, Gujarat, Haryana, Himachal Pradesh, Jharkhand, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Odisha, Puducherry, Punjab, Rajasthan, Sikkim, Tamil Nadu, Tripura, Uttarakhand, Uttar Pradesh, and West Bengal.	China, Myanmar, Nepal, Pakistan, Sri Lanka, Indonesia, Iran, Iraq, Japan, Taiwan, and Vietnam.
12.	***Hydroglyphus flammulatus*** (Sharp, 1882) 1882. *Bidessus flammulatus* Sharp: Sci. Trans. R. Dublin Soc., 2: 359. 2012. *Hydroglyphus flammulatus*: Ghosh& Nilsson, Skorvnopparn supplement3: 29.	Assam, Andhra Pradesh, Bihar, Gujarat, Himachal Pradesh, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Orissa, Rajasthan, Sikkim, Tamil Nadu, Tripura, Uttar Pradesh and West Bengal.	Pakistan and China.
	Suborder Polyphaga Emery, 1886 Family Hydrophilidae Latreille, 1802		
13.	***Sternolophus rufipes*** (Fabricius, 1792) 1792. *Hydrophilus rufipes* Fabricius, Entom. Syst., 1: 183. 2017. *Sternolophus rufipes*: Nasserzadeh & Komarek, Zootaxa, 4282(2): 237.	Andhra Pradesh, Bihar, Chhattisgarh, Gujarat, Haryana, Himachal Pradesh, Jammu and Kashmir, Kerala, Maharashtra, Manipur, Meghalaya, Odisha, Punjab, Sikkim, Tamil Nadu, Tripura, Uttar Pradesh, and West Bengal.	Bhutan, Cambodia, China, Macau, Indonesia, Japan, Malaysia, Myanmar, Nepal, Philippines, Singapore, Sri Lanka, Taiwan, Thailand and Vietnam.
14.	***Sternolophus inconspicuus*** (Nietner, 1856) 1856. *Hydrous inconspicuus* Nietner, Unkown publisher, Colombo, 2: 15 2017. *Sternolophus rufipes*: Nasserzadeh & Komarek, Zootaxa, 4282(2): 223.	Madhya Pradesh, Maharashtra, Meghalaya, Tamil Nadu, Uttar Pradesh.	Cambodia, China, Hong Kong, Indonesia, Japan, Laos, Myanmar, Nepal, Philippines, South Korea, Sri Lanka, Taiwan, Thailand, Vietnam.
15.	***Berosus (Berosus) pulchellus*** MacLeay, 1825 1817. *Berosus pulchellus* Macleay, Annul. Jav, 35. 1999. *Berosus* (*Berosus*) *pulchellus*: Hansen, World Cat. Insect., **2**, Hydrophilioidea (s. str.) (Coleoptera): 92.	Andaman and Nicobar Island, Haryana, Karnataka, Kerala, Maharashtra, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, and West Bengal.	Australia, Bangladesh, China, Iran, Japan, Saudi Arabia, Indonesia, Laos, Malaysia, Myanmar, Nepal, Philippines, Sri Lanka, Taiwan, Thailand, and Vietnam.
16.	***Enochrus esuriens*** **(**Walker, 1858) 1858. *Philiphydrus esuriens* Walker, Ann. Mag. Nat. Hist., (32) 2:	Andaman & Nicobar Is., Madhya Pradesh, Maharashtra, Manipur, Tamil Nadu, West Bengal.	Australia, Indonesia, Philippines, Sri Lanka.

Sl no.	Suborder/Family/Species/Synonyms	Indian Distribution	Global Distribution
	209. 1924. *Enochrus esuriens*: Kinsch, Col. Cat., 14(79): 209.		
17.	***Hydrophilus olivaceous*** Fabricius, 1781 1781. *Hydrophilus olivaceous* Fabricius, Spec. ins., 1:289. 2022. *Hydrophilus olivaceous*: Przewoźny M, Catalogue of Palearctic Hydrophiloidea (Coleoptera):20	Andhra Pradesh, Bihar, Chhattisgarh, Gujarat, Himachal Pradesh, Karnataka, Kashmir, Kerala, Madhya Pradesh, Maharashtra, Manipur, Odisha, Punjab, Puducherry, Rajasthan, Tamil Nadu, Uttarakhand, Uttar Pradesh and West Bengal.	Pakistan.
18.	***Hydrophilus senegalensis*** Percheron, 1835 1835 *Hydrophilus senegalensis* Percheron, Gen. Ins. 3 (5). t. 9, f. 1. 2022. *Hydrophilus senegalensis*: Przewoźny M, Catalogue of Palearctic Hydrophiloidea (Coleoptera):20	Maharashtra, Uttar Pradesh	Algeria, Angola, Cameroon, Egypt, Ethiopia, Kenya, Mauritania, Mozambique, Namibia, Niger, Pakistan, Saudi Arabia, Senegal, Somalia, South Africa, Sudan, Tanzania, Uganda, Yemen, Zaire.
19.	***Hydrobiomorpha spinicollis* (Eschscholtz 1822)** 1822. *Hydrobiomorpha spinicollis* **.** Eschscholtz, Entomographien: 41 2022. *Hydrobiomorpha spinicollis*: Przewoźny M, Catalogue of Palearctic Hydrophiloidea (Coleoptera): 19	Maharashtra, Tamil Nadu.	Taiwan

Table 3. List of species and their relative abundances

Sl. No.	Species	Abundance	Relative Abundance (%)
1	*Sternolophus rufipes* (Fabricius, 1792)	171	51
2	*Sternolophus inconspicuus* (Nietner, 1856)	38	11.31
3	*Dineutus (Cyclous) indicus* Aube, 1938	8	2.38
4	*Hydaticus* (*Prodaticus*) *fabricii* Macleay, 1825	7	2.08
5	*Enochrus esuriens* (Walker, 1858)	7	2.08
6	Hydaticus *(Prodaticus) incertus* Regimbart, 1888	5	1.49
7	*Berosus (Berosus) pulchellus* MacLeay, 1825	5	1.49
8	*Hydroglyphus flammulatus* (Sharp, 1882)	4	1.19
9	*Hydrophilus senegalensis* Percheron, 1835	4	0.89
10	*Hydaticus (Prodaticus) discindens* Walker, 1858	3	0.6
11	*Copelatus neelumae* Vazirani, 1973	2	0.6
12	*Eretes griseus* (Fabricius, 1781)	2	0.3
13	*Cybister (Cybister) limbatus* (Fabricius, 1775)	1	0.3
14	*Rhantaticus congestus* (Klug, 1833)	1	0.3
15	*Hydaticus (Prodaticus) vittatus* (Fabricius, 1775	1	0.3
16	*Laccophilus flexuosus* Aube, 1838	1	0.3
17	*Sandracottus dejeanii* (Aube, 1838)	1	0.3
18	*Hydrobiomorpha spinicollis* (Eschscholtz 1822)	1	0.3
19	*Hydrophilus olivaceous* Fabricius, 1781	1	0.3
	Total	263	100%

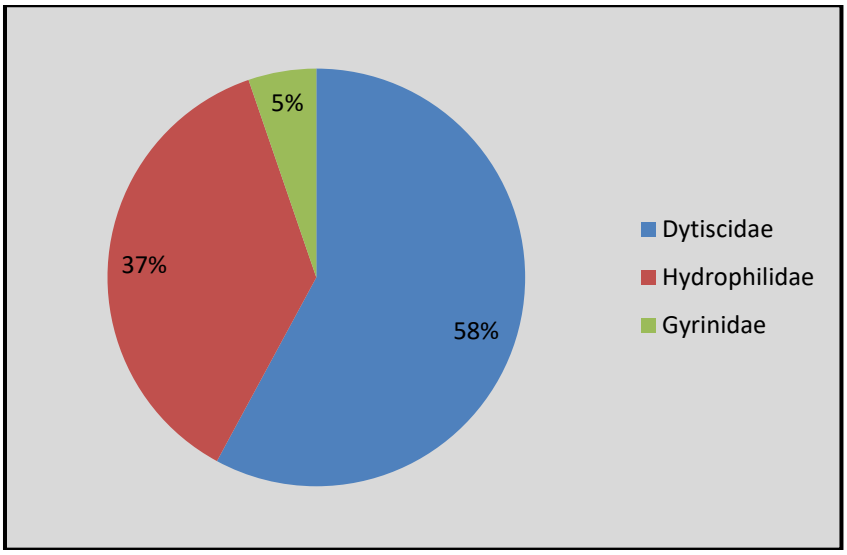


Fig. 2. Family wise species composition of aquatic beetles from Navegaon National Park, India

4. CONCLUSION

In the present study a total of 263 examples of aquatic coleoptera were identified belonging to 19 species under 13 genera and 3 families (Fig. 1). Although there is report on aquatic beetles of that area [36], this study recognized 19 species, which is six times more than the previously recorded species count.

Further investigations and comprehensive assessments are necessary to understand the underlying factors influencing the observed diversity patterns and to support effective

conservation and management strategies for these important aquatic ecosystems especially being located at the Deccan plateau which receives less rainfall and comparatively dry region. Comparing these results to other similar studies or established benchmarks is essential for a comprehensive assessment. It allows us to contextualize the diversity index value and evaluate the ecological health of the studied area. Additionally, examining the local environmental conditions and considering the historical context can provide further insights into the diversity patterns observed. Therefore, the current study on the aquatic beetles of the Navegaon National Park is a baseline study to understand the diversity of aquatic beetles, which may be helpful in the future to understand the diversity of aquatic beetles in the protected areas of Deccan plateau to help with better management plan.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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