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# Changes of ant species composition in the Indian Sunderbans in response to a tropical cyclone (Yaas)

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**Abstract**
The effects of tropical cyclone (YAAS) on the ant community in the Indian Sundarbans, world's largest mangrove forest are described in the present study. Ants are the most common, and widely distributed insect. Ants are very sensitive and respond fast to environmental changes. Therefore, the primary objective of the present study is to examine the variety and distribution of ant species in the Sunderbans after cyclonic disturbances. Ant samples were sampled after six months of that incident from five different locations of Indian Sunderbans during November, 2021 to March, 2022 using hand collection, pitfall traps, honey bait, and soil extraction techniques. Total 27 species from 19 genera and 5 subfamilies of ant species were found after cyclonic disturbances. The most speciose subfamily was Myrmicinae, which was followed by Formicinae, Dolichoderinae, Ponerinae and Pseudomyrmicinae. Ant genus *Tetraponera* (19.6%) was most abundant followed by *Monomorium* (18.3%), *Paratrechina* (16.7%), *Pheidole* (12%), *Camponotus* (11.8%) and *Crematogaster* (5.5%). The list of ant species found in the Indian Sunderbans was expanded to include *Technomyrmex bicolor* and *Trichomyrmex aberrans*.

**Keywords:** Tropical cyclone, ant, Sunderbans

## Introduction
Tropical cyclones pose a serious threat to tropical coastal areas, in terms of human lives and ecological damage. Geographical and geological setting of Indian Sunderbans made it particularly susceptible to cyclones and tidal surges.
Ants are a valuable group to include in studies of biodiversity because they are very diverse and dominate in terms of both number and biomass in nearly all habitats (Hölldobler and Wilson 1990, Agosti *et al*. 2000) [16, 4]. Ants have stationary nesting habits that allow them to be sampled over time (Brian *et al*. 1966, Bristow *et al*. 1992) [7, 8]. They are also sensitive to environmental change (Andersen 1990, 1995, Peck *et al*. 1998, Agosti *et al*. 2000) [1, 3, 22, 4]. Additionally, there is a good base of taxonomic knowledge (Creighton 1950, Bolton 2003) [18, 10].
In the earlier study, we reported 62 species of ants from 5 subfamilies, 30 genera from Indian Sunderbans (Bakra D, Sheela S. and Bhattacharyya S, 2022) [5]. The aim of this study is to examine the effect of clones on ant population around Indian Sunderbans.

## Methods and Methodology
### Study sites in Indian Sunderbans
Ants were collected from five different sites of Indian Sunderbans *viz*. Radhakrishnapur village (21°43'01"N/88°03'27"E) of Sagar Island (24 Parganas South), Bakkhali sea beach (21°34'20"N/88°17'53"E) (24 Parganas South), Bhagabatpur village (21°47'15"N/88°21'46"E) of Patharpratima (24 Parganas South), Dayapur village of Gosaba (22°7'51"N/88°50'10"E) (24 Parganas South) and Sahebkhali village of Hingalganj (22°21'1"N/88°59'8"E), 24 Parganas North.

### Data Collection
The data were collected during November, 2021 to March, 2022. A permit was secured from the forest department of West Bengal to study at the Bhagabatpur Crocodile Project site. The hand collection method was applied for collection of ants from leaves, flowers, and stems of

trees. The pitfall trap and honey bait method was also used to collect ants from soil, bushes and scrubs. Soil and litter-inhabiting ants were also extracted in the laboratory of Zoological Survey of India, Kolkata.

### Identification
We classified the collected ants into genera using the Bolton (1994) [9] identification key and used the Bolton-recommended subfamily classification (2003). According to Bingham, species identification was finished (1903).
Species richness, the Simpson diversity index (1-D), and the Shannon-Weiner index were used to calculate the alpha diversity index (H). The number of ant species found in each sample was used to calculate species richness (S). To characterize the relationship between species richness and abundance distribution among species, Pielou's evenness (J) index and Shannon- Weiner's diversity (H') index was utilized.

## Results
### Diversity and distribution of ants in selected localities of Indian Sunderbans
Ant species' composition, diversity, and abundance alter after the natural calamities were observed. It results from 27 species from 19 genera and 5 subfamilies of ant species. Myrmicinae, with 10 species (37%) and 7 genera was the most speciose subfamily, followed by Formicinae with 9 species (33.3%) and 6 genera, Dolichoderinae with 4 species (16.3%) and 3 genera, Ponerinae with 2 species (7.4%) and 2 genera and Pseudomyrmicinae contains 2 species (7.4%) with 1 genera. Most abundant subfamily was Myrmicinae (44.3%) followed by Formicinae (31.3%), Pseudomyrmecinae (19.7%), Ponerinae (2.6%) and Dolichoderinae (2.1%). Ant genus *Tetraponera* (19.6%) was most abundant followed by *Monomorium* (18.3%), *Paratrechina* (16.7%), *Pheidole* (12%), *Camponotus* (11.8%) and *Crematogaster* (5.5%). Two new species *Trichomyrmex aberrans* and *Technomyrmex bicolor* were discovered.
The Shannon Diversity Index value was 2.2, indicates very low diversity. Simpson Diversity Index was 0.8626, indicates dominance of one or few species. Margalef diversity index was between 2.3 indicates disturbed region.

**Table 1:** Check list of ants found in the Indian Sunderbans research area in 2021–2022.

| Subfamily | Genus | Species |
|---|---|---|
| Dolichoderinae | *Tapinoma* | *Tapinoma melanocephalum* (Fabricius, 1793) |
| | | *Tapinoma indicum* (Forel,1895) |
| | *Dolichoderus* | *Dolichoderus taprobanae* (Smith,F.,1858) |
| | *Technomyrmex* | *Technomyrmex bicolour* (Emery, 1893) |
| Formicinae | *Anoplolepis* | *Anoplolepis gacilipes* (Smith,F.,1857) |
| | *Camponotus* | *Camponotus compressus* (Fabricius, 1787) |
| | | *Camponotus sericeus* (Fabricius,1798) |
| | | *Camponotus dolendus* (Forel,1892) |
| | *Oecophylla* | *Oecophylla smaragdina* (Fabricius,1775) |
| | *Paratrechina* | *Paratrechina longicornis* (Latreille,1802) |
| | *Nylanderia* | *Nylanderia* sp. |
| | *Lepisiota* | *Lepisiota sericea* (Forel, 1892) |
| | | *Lepisiota* sp2 |
| Myrmicinae | *Monomorium* | *Monomorium floricola* (Jerdon,1851) |
| | *Crematogaster* | *Crematogaster anthracina* (Smith, F.,1857) |
| | | *Crematogaster* sp2 |
| | *Pheidole* | *Pheidole* sp1 |
| | | *Pheidole* sp2 |
| | *Trichomyrmex* | *Trichomyrmex scabriceps* (Mayr, 1879) |
| | | *Trichomyrmex aberrans?* (Forel, 1902) |
| | *Solenopsis* | *Solenopsis geminata* (Fabricius, 1804) |
| | *Tetramorium* | *Tetramorium* sp1 |
| | *Carebara* | *Carebara affinis* (Jerdon, 1851) |
| Ponerinae | *Diacamma* | *Diacamma rugosum* (Le Guillou,1842) |
| | *Pseudoneoponera* | *Pseudoneoponera rufipes* (Jerdon, 1851) |
| Pseudomyrmicinae | *Tetraponera* | *Tetraponera rufonigra* (Jerdon, 1851) |
| | | *Tetraponera nigra* (Jerdon,1851) |

**Table 2:** Total number and percentage of Genera and Species per Subfamily during post monsoon season of 2021-22 in Indian Sunderbans

| Ant Subfamily | No. of Genera (% of total) | No. of species (% of total) |
|---|---|---|
| Dolichoderinae | 3 (15.8) | 4 (16.3) |
| Formicinae | 6 (31.6) | 9 (33.3) |
| Myrmeciinae | 7 (36.8) | 10 (37) |
| Ponerinae | 2 (10.5) | 2 (7.4) |
| Pseudomyrmeciinae | 1 (5.3) | 2 (7.4) |
| Total | 19 | 27 |

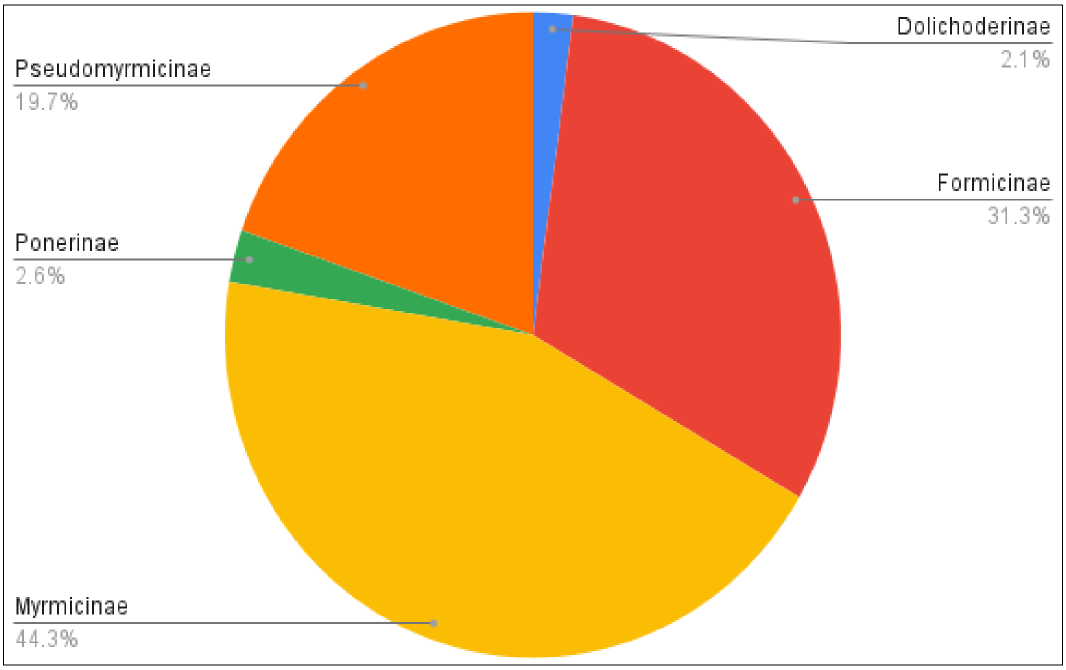


**Fig 1:** Pie chart showing percentage wise distribution of ant subfamilies in Sunderbans, India

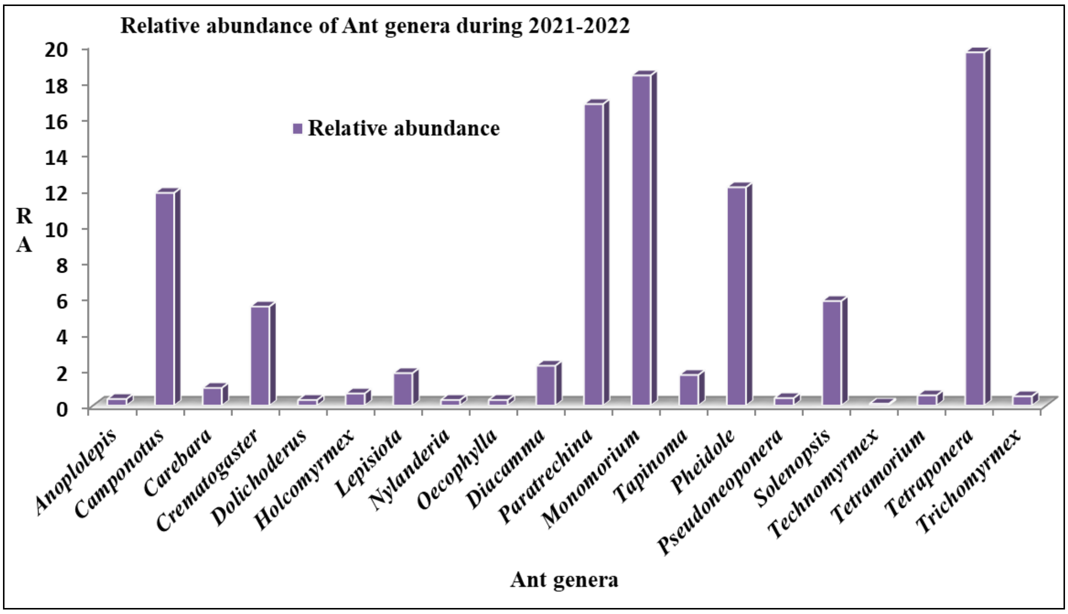


**Fig 2:** Relative Abundance of Ant Genera during 2021-2022

## Discussions

In this study we examined whether species richness and abundance decrease after natural disasters and ant diversity remain stable or in moderate condition at the initial stage of succession. We observed that species richness and abundance decrease after natural disasters except invasive species *viz. Paratrechina longicornis*, and *Monomorium floricola*. The tropical climate specialist (*Tetraponera* sp. and *Solenopsis geminata*), subordinate Camponotini (*Camponotus* sp.) and the generalised Myrmicinae (genera *Monomorium*, *Pheidole and Crematogaster*) can overcome the impact of natural calamities. It has been well studied that ant diversity remains in moderate condition after severe natural disasters, flooding, heavy rain, storms and other unpredictable events. Generalist Myrmicinae species are the most common in most habitats and are fiercely competitive (Hallack, 2010) [17]. Some species prefer more open habitats (Lassau; Hochuli, 2004) [25]. Species in this group are widely distributed in warm temperature areas (Andersen, 2000) [2]. They also have a very wide diet (Brandão *et al*., 2012) [6]. According to Morini *et al*., 2007 [26], the genus *Solenopsis* contains opportunistic and generalist species that are frequently found in wide spaces with few trees or in degraded environments. *Crematogaster* species, on the other hand, are found in every zoogeographic region. Those that are found in tropical regions can be found in a variety of forest strata, from the soil to the canopy. They can be found nesting in live or decaying trunks, burlap, and branches, interacting with other animals and certain plant species, and being common in urban areas (Felizardo, 2010) [27].

Generalists and opportunists are the dominant species in most studies on disturbed or more homogeneous habitats because they can exploit changes at the base of the food chain, particularly when disturbance confers a competitive advantage (Philpott *et al*., 2010) [28].

Tropical climate specialists are found in humid tropical locations, which are typical of habitats with low Dolichoderinae abundance. They are also frequently non-specialist ants found outside of their livable habitat (Andersen, 1995) [1].

In light of the aforementioned, this study offers funding for research on the conservation of mangrove forest areas.

## Conclusion

It can be concluded that ants have ability to resist total submersion and they often show a remarkable ability to adapt to extreme environmental conditions. A particularly astounding display of ant adaptability can be found in the mangrove swamp, where the ants are subjected to extreme environmental challenges. There are so many fascinating biological adaptations that have yet to be discovered about the ant fauna in mangroves because it has generally received relatively little research.

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