

Naegleria fowleri (a brain eating amoeba): are we aware of this?

Naegleria fowleri is a free living, universally distributed amoeba, which is mostly found in natural, stagnant, warm water bodies such as ponds, lakes, etc. It is also reported to be present even in indoor water bodies, such as swimming pools within a temperature range of 40–45°C. *N. fowleri* infects the central nervous system of human body by entering through the nose during swimming and outdoor baths in natural stagnant water bodies, leading to meningoencephalitis. It is a condition of inflammation of cerebral tissues and membranes of the brain and is mostly fatal in nature. Casualties due to *N. fowleri* infections are reported all across the globe including a few in India but only seven survivors in the entire world have been reported till 2015 (refs 1–4).

Clinical symptoms of *N. fowleri* infection may be seen usually within the first 24 h to 8 days of infectivity in the form of severe fever with headache, chills, photophobia, confusion, etc. and in

adverse cases, coma⁵. The infection may be conventionally diagnosed by sampling and analysing the presence of *N. fowleri* in the cerebral spinal fluid of the suspect with the help of trichrome or Giemsa staining technique, followed by magnetic resonance imaging of brain to detect any possible abnormalities in midbrain and subarachnoid⁵.

Though *N. fowleri* infections are more often treated with antibiotics, prevention is better than cure, as there is no known permanent cure that exists till date¹. Water activities in freshwater bodies and, most importantly, abandoned ones should be avoided during summers when the temperature of water is higher. Proper chlorination of water bodies should be done on regular basis to prevent the growth of *N. fowleri*. It is also recommended to use nose clips during any outdoor water activities, which would decrease probability of the passage of *N. fowleri* through the nose.

1. Grace, E., Asbill, S. and Virga, K., *Antimicrobial Agents Chemother.*, 2015, **59**(11), 6677–6681.
2. Shenoy, S., Wilson, G., Prashanth, H. V., Vidyalakshmi, K., Dhanashree, B. and Bharath, R., *J. Clin. Microbiol.*, 2002, **40**(1), 309–310.
3. Sood, A., Chauhan, S., Chandel, L. and Jaryal, S. C., *Indian J. Med. Microbiol.*, 2014, **32**(2), 193–196.
4. Khanna, V. *et al.*, *Case Reports in Neurological Medicine*, 2011; doi:10.1155/2011/782539.
5. Visvesvara, G. S., Moura, H. and Schuster, F. L., *FEMS Immunol. Med. Microbiol.*, 2007, **50**, 1–26.

ANU CHAUBEY
DEBAJIT BORAH*

Department of Biotechnology,
Royal Global University,
Guwahati 781 035, India
*e-mail: dborah89@gmail.com

Foreign origin plastic litter predominate in Great Nicobar Island, a Biosphere Reserve

Great Nicobar Island is the southernmost island of Andaman & Nicobar Islands with an area of about 1044 sq. km (Figure 1). The population of the island is 8069 (2011 census), largely inhabited in the south-eastern part. This island is home to one of the most primitive tribes of India – *Shompens*. The island encompasses the Great Nicobar Biosphere Reserve (GNBR) that includes the Galathea National Park and the Campbell Bay National Park. The Biosphere Reserve was included in UNESCO-MAB (Man and the Biosphere Programme) Network in May 2013.

The island harbours a wide spectrum of ecosystems comprising tropical wet evergreen forests, mountain ranges and coastal plains. This island's rich flora and fauna with its high endemism for giant robber crab, crab-eating macaque, megapode bird, etc. play a vital role as a reservoir of biodiversity. This island is one of the major nesting grounds in

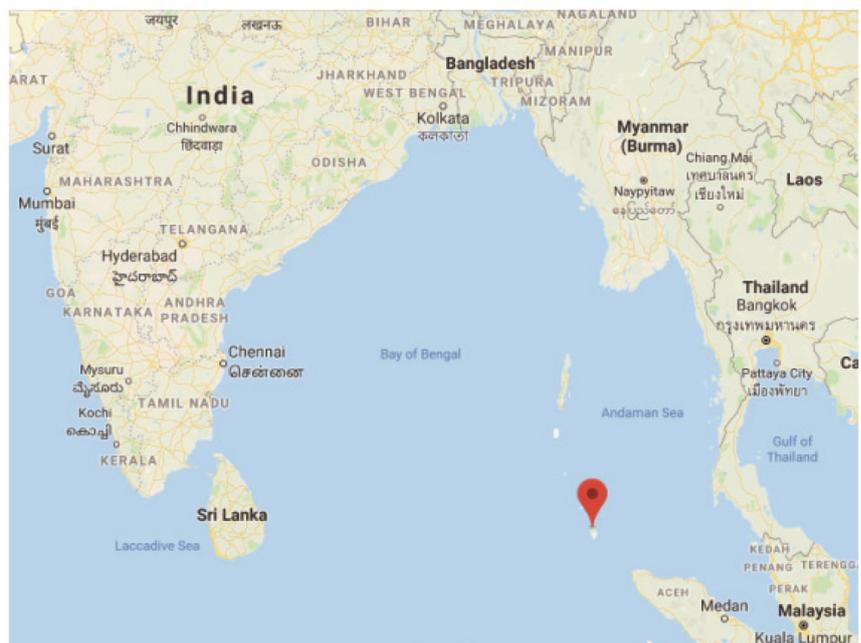


Figure 1. Map showing the location of Great Nicobar Island (Source: Google Maps).

CORRESPONDENCE

the world for leatherback sea turtles (*Dermochelys coriacea*)¹.

The world's biological diversity is declining due to human activities, and the problem is so critical that the combined human impacts have accelerated the present extinction rates to 1000–10,000 times the natural rate². One particular type of human impact constitutes pollution by plastic debris in coastal ecosystems. The plastic pollution is emerging as one of the most severe threats to ocean ecosystem; their concentrations have reached 580,000 pieces/km² and production is increasing exponentially³. Plastic represents 83% of the marine litter found and the remaining 17% is mainly textiles, paper, metal and wood⁴. Plastic has reached every part of the earth – from the deep Mariana Trench⁵ to the uninhabited mountains. Plastic litter enters the marine environment via rivers, beaches, maritime activities and illegal dumping at sea⁶. A wide range of marine life, includ-

ing marine mammals, reptiles and birds, is impacted by plastic pollution through entanglement or ingestion⁷. We report here the dominance of foreign plastic litter in the pristine Great Nicobar Island.

A survey was made in five beach areas (S-1 to S-5) in the eastern part of the Great Nicobar Island. Around 60 plastic bottles were picked-up in each site to determine their country of origin. It was observed that 97.8% of the plastic litter was of non-Indian origin. Major portion of the litter was of Malaysian origin (40.5%). It was followed by Indonesia (23.9%) and Thailand (16.3%). Other countries contributed a minor portion. All the five sites have shown the plastic litter dominance of the above countries. The litter of Indian origin had an average value of 2.2% with the range of 0.9–5.5% (Table 1).

Most plastic production occurs in the developed world; most of the marine plastic pollution comes from developing

nations, with more than 50% of estimated global plastic pollution originating from just five nations: China, Indonesia, the Philippines, Vietnam and Sri Lanka⁸.

A total of 10 countries including India contributed to the plastic litter in the island. They were Malaysia, Indonesia, Thailand, Singapore, the Philippines, Vietnam, India, Myanmar, China and Japan in the decreasing order of the plastic abundance. The dominance of plastic from the first three countries was reasoned to be owing to its closeness to the island. It can be inferred that the litter presence of other south-east Asian countries in this island is through water current via the channel Malacca Strait. This channel happens to be a major passage for ships. Dharani *et al.*⁹ also observed that the marine litter is of foreign origin in this island. They opined that huge quantities of marine debris observed in this island might be due to improper handling of the solid waste from fishing/mariculture activity and ship traffic. From that period to this study, the amount of litter has increased hugely (Figure 2). In Andaman Islands, the litter of Indian origin on beaches and in mangroves is continuously increasing. This is due to lack of proper and strict guidelines in these islands and decrease in tourist : monitoring staff ratio.

The ecological concerns associated with plastic use are not only because of the amount of litter, but also the leaching of substances out of it. Components used in plastics, viz. Bisphenol-A (BPA), polybrominated diphenyl ethers (PBDE), tetrabromobisphenol-A (TBBPA) and phthalates, are released from plastic products, and these are known as endocrine disruptors owing to their ability to alter the endocrine system¹⁰. Phthalates function as anti-androgens and the main action attributed to BPA is oestrogen-like activity. PBDE and TBBPA have been shown to disrupt thyroid hormone homeostasis while PBDEs also exhibit anti-androgen action.

75% of land-based marine plastic pollution stems from uncollected waste¹¹. The rest is due to poor waste management. Therefore there should be an improved waste collection system. It is needed to improve the collection rates of plastic waste in countries with weak formal waste management infrastructure.

The threat of plastics to the marine environment has been ignored for a long time and deleterious environmental

Table 1. Country-wise plastic litter (in %) found on the beaches of Great Nicobar Island

Country	S-1	S-2	S-3	S-4	S-5
Indonesia	24.2	23.8	23.5	22.6	25.2
Malaysia	37.4	45.0	44.7	39.6	36.0
Vietnam	2.2	1.3	2.4	2.8	2.7
Thailand	15.4	12.5	18.8	17.0	18.0
Myanmar	2.2	2.5	0.0	1.9	3.6
Singapore	6.6	10.0	5.9	9.4	5.4
China	2.2	0.0	2.4	1.9	3.6
The Philippines	2.2	2.5	1.2	2.8	3.6
Japan	2.2	0.0	0.0	0.9	0.9
India	5.5	2.5	1.2	0.9	0.9



Figure 2. Plastic litter on the beach of Great Nicobar Island.

effects of plastics were entirely overlooked. As the plastic is not of local origin, we need a global network to work towards cleaning/reducing the plastic pollution. To take immediate action, we suggest that the plastic litter of these islands be collected manually to maintain the cleanliness of the islands and protect the marine and island organisms.

1. Andrews, H. and Shanker, K., *Kachhapa*, 2002, **6**, 19.
2. May, R. M., Lawton, J. H. and Stork, N. E., *Extinction Rates*, Oxford University Press, Oxford, 1995, p. 233.
3. Wilcox, C., Van Sebille, E. and Hardesty, B. D., *Proc. Natl. Acad. Sci. USA*, 2015, **112**(38), 11899–11904.
4. UNEP, *Marine Litter: A Global Challenge*, Nairobi, UNEP, 2009, p. 232.
5. Chiba, S. *et al.*, *Mar. Policy*, 2018, **96**, 204–212.
6. Ryan, P. G., Moore, C. J., van Franeker, J. A. and Moloney, C. L., *Philos. Trans. R. Soc.*, 2009, **364**, 1999–2012.
7. Sahu, B. K., Pati, P. and Panigrahy, R. C., *Curr. Sci.*, 2013, **104**(9), 1133–1134.
8. Jambeck, J. R. *et al.*, *Science*, 2015, **347**(6223), 768–770.
9. Dharani, G., Abdul Nazar, A. K., Venkatesan, R. and Ravindran, M., *Curr. Sci.*, 2003, **85**(5), 574–575.
10. Talsness, C. E., Andrade, A. J. M., Kuriyama, S. N., Taylor, J. A. and Vom Saal, F. S., *Philos. Trans. R. Soc. London, B Biol. Sci.*, 2009, **364**(1526), 2079–2096.
11. *Stemming the Tide: Land-based Strategies for a Plastic-Free Ocean*, McKinsey

& Company and Ocean Conservancy, New York, 2015, p. 48.

ACKNOWLEDGEMENTS. B.S.K. thanks DST, Government of India for SERB-NPDF fellowship (PDF/2017/000522).

BIRAJA KUMAR SAHU^{1,*}
B. BASKAR²

¹*Environment and Sustainability
Department,
CSIR-IMMT,
Bhubaneswar 751 013, India*
²*Department of Immunology,
Mayo Clinic, Rochester,
Minnesota 55905, USA*
**e-mail: birajkumar@gmail.com*