hypoxia and benthic P-fertilization of Ganga. Because the river is exposed to a large number of point sources along its 2525 km course, the present study emphasizes the need to unravel the mosaic of fragmented habitats marked by hypoxia and sediment-P release. Also, the study identifies DOD_{sw}–AP linkages as a marker to trace benthic habitat fragmentation in large rivers.

This study provides a systematic database on point source-driven bottom hypoxia and ecosystem feedbacks in the Ganga. Since hypoxia shifts community composition, ecosystem feedbacks and ecological thresholds[19], DOD zones identified here indicate benthic habitat fragmentation with anomalous ecological conditions downstream point sources. If enough DO is not available, it may lead to fish kill as evidenced with the report of large number of dead fishes in the river at Kannoj[20]. In a recent field trial, we found that the plume of pollutants from the point sources exerts a strong influence up to 50 m reach[21]. This merits attention because the Ganga with large number of point sources of input encompasses habitats for several fish populations of economic importance[22]. Further, because local niche-based disturbances eliminate benthic diatoms[23,24] that reoxygenate the river bottom, benthic habitat fragmentation-coupled diatom species loss will continue to deteriorate the condition further. The present study strongly suggests the need to consider point-source downstream river responses for action plans to safeguard riverine life and habitats.

1. Diaz, R. J. and Rosenberg, R., *Science*, 2008, **321**, 926–929.
2. Chan, F. *et al*., *Science*, 2008, **319**, 920.
3. Conley, D. J., Carstensen, J., Vaquer-Sunyer, R. and Duarte, C. M., *Hydrobiologia*, 2009, **629**, 21–29.
4. Diaz, R. J., *J. Environ. Qual*., 2001, **30**, 275–281.
5. Scheffer, M., Carpenter, S., Foley, J. A., Folke, C. and Walker, B., *Nature*, 2001, **413**, 591–596.
6. May, R. M., *Nature*, 1977, **269**, 471–477.
7. Pandey, J., Pandey, U. and Singh, A. V., *Biogeochemistry*, 2014, **119**, 179–198.
8. Tare, V., Yadav, A. V. S. and Bose, P., *Water Res*., 2003, **37**, 67–77.
9. APHA, *Standard Methods for the Examination of Water and Wastewater*, American Public Health Association, Washington DC, USA, 1998.
10. Sànchez, E. *et al*., *Ecol. Indic*., 2007, **7**, 315–328.
11. Hu, W. F., Lo, W., Chua, H., Sin, S. N. and Yu, P. H. F., *Environ. Int*., 2001, **26**, 369–375.
12. Tabatabai, M. A. and Bremner, J. M., *Soil Biol. Biochem*., 1969, **1**, 301–307.
13. Ling, T. Y., Ng, C. S., Lee, N. and Buda, D., *World Appl. Sci. J*., 2009, **7**, 440–447.
14. Wang, W., *Water Res*., 1980, **14**, 603–612.
15. Rong, N. and Shan, B., *Environ. Sci. Pollut. Res*., 2016, **23**, 13438–13447.
16. Merseburger, G. C., Marti, E. and Sabater, F., *Sci. Total Environ*., 2005, **347**, 217–229.
17. Conley, D. J., Humborg, C., Rahm, L., Savchuk, O. P. and Wulff, F., *Environ. Sci. Technol*., 2002, **36**, 5315–5320.
18. Vahtera, E. *et al*., *Ambio*, 2007, **36**, 186–194.
19. Grantham, B. A. *et al*., *Nature*, 2004, **429**, 749–754.
20. *Hindustan*, Varanasi Issue, 14 May 2018, p. 4.
21. Jaiswal, D. and Pandey, J., *Environ. Res*., 2019, **178**, 108712.
22. ZSI, *Faunal Resources of Ganga, Part I*, Zoological Survey of India, Calcutta, 1991.
23. Karthick, B., Mahesh, M. K. and Ramachandra, T. V., *Curr. Sci*., 2011, **100**, 552–558.
24. Pandey, U., Pandey, J., Singh, A. V. and Mishra, A., *Curr. Sci*., 2017, **113**, 959–964.

ACKNOWLEDGEMENTS. We thank the Head, and Coordinators, Centre of Advanced Study in Botany and Department of Science and Technology-Fund for Improvement of Science and Technology Infrastructure, Department of Botany, Banaras Hindu University, Varanasi and Dean, Faculty of Science and Technology, MGKVP, Varanasi for providing the necessary facilities, and Council of Scientific and Industrial Research, New Delhi for financial support.

Received 16 July 2018; revised accepted 5 November 2019

JITENDRA PANDEY[1,]*
DEEPA JAISWAL[1]
USHA PANDEY[2]

[1]*Ganga River Ecology Research Laboratory,*
Environmental Science Division,
Centre of Advanced Study in Botany,
Institute of Science,
Banaras Hindu University,
Varanasi 221 005, India
[2]*Department of Botany,*
Faculty of Science and Technology,
Mahatma Gandhi Kashividyapith University,
Varanasi 221 002, India
**For correspondence.*
e-mail: jiten_pandey@rediffmail.com

Yellow pan traps as an additional gadget for collecting sandhopper amphipods

Yellow pan traps (YPTs) or Moericke traps are known for their efficiency to catch a wide variety of insects, including herbivores and predators[1,2]. These colour traps work on the principle that yellow colour attracts insects[3]. An isolated sampling event is described in this study, where sandhopper amphipods were collected in large numbers, in YPTs, originnally set for collecting insects. Amphipods under order Amphipoda of subphylum Crustacea are classified into four groups – palustral talitrids, beachfleas, sandhoppers and landhoppers[4]. Generally sleds, dredge, grabs, cores, sediment sieving, baited traps, light traps, pitfall traps and even handpicking methods are used for collection of amphipods from different habitats like deep seafloor, seaweed assemblage, mudflat sediment, beach soil, coral rubble and rotten leaf litter[5]. Collection employing YPTs has advantages over other methods because it is simple, more time-efficient and not dependent on trained or skilled collectors[6,7].

The sampling was conducted on 29 November 2017, from 11 am to 3 pm, at Cheriam Island, Union Territory of Lakshadweep, situated in the Laccadive Sea, off the southwestern coast of India (10°06′99″N and 73°66′05″E) as part of inventorying the terrestrial fauna of Lakshadweep islands, by a team from

Figure 1. Sampling of terrestrial invertebrate fauna using yellow pan traps method.

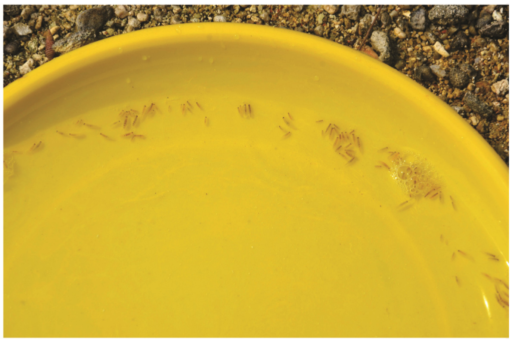

Figure 2. Collection of amphipods (*Talorchestia* sp.) in yellow pan traps.

Zoological Survey of India, Kolkata. Accordingly, 25 YPTs (a few were rectangular plastic bowls of 15 cm × 10 cm × 5 cm, and the rest were circular plates of 20 cm diameter and 3 cm depth) were placed in two rows (Figure 1), approximately 1 m apart, on the banks of a sea-fed, small inland water body near the beach at Cheriam. The front row was in proximity to the waters, while the other was more towards the shrubby vegetation on the bank. The traps were half filled with water, and a few drops of an odourless detergent were added in order to break the surface tension of water and drown the landing insects. The traps started collecting a good number of amphipods (Figure 2). Thus, 25 YPTs captured nearly 1000 amphipods in 4 h, indicating their high population density at the site. The amphipods jumped into the YPTs from their sand burrows and were actively swimming inside. They were then filtered and preserved in absolute alcohol. Other than amphipods, only a few ants were collected in the YPTs.

The collected amphipods, which were semiterrestrial and supratidal, were identified as an undescribed species of sandhoppers, under genus *Talorchestia* Dana, 1852 of the family Talitridae. These sandhoppers lived in shallow burrows on the sandy beaches and were nocturnal in habits[4]. Among the total 132 species of amphipods from marine intertidal zone of India, only 3 fall under genus *Talorchestia*[8]. A similar sampling event was reported from a subtropical rainforest on Mount Yonaha, Okinawa, Japan, in which several landhopper amphipods were collected in YPTs, the most dominant species being *Talitroides topitotum* of the same family Talitridae[9]. According to the present study, YPTs attracted not only the landhoppers, but sandhopper amphipods too. More experimental evidences are needed to explain how the YPTs are able to attract the amphipods. Whether they are attracted to the yellow colour as in the case of general insects[9–11], or is it due to any other factors, is worth studying.

In any faunal diversity studies, whether meant for community structure assessment, species inventory, to ascertain diversity patterns or environmental monitoring, the sampling protocol has to be ideal, so as to provide reliable representativeness of the target taxa or assemblage. It is also important to use standardized sampling protocols when developing large-scale monitoring programmes[12,13]. YPTs are a standard and widely used collecting device for terrestrial insects. The present study in unison with the earlier published work on landhopper amphipods, confirms the effectiveness of YPTs in sampling terrestrial amphipods.

1. Kirk, W. D., *J. Econ. Entomol.*, 1984, **9**, 35–41.
2. Leksono, A. S., Takada, K., Koji, S., Nakagoshi, N., Anggaeni, T. and Nakamura, K., *Insect. Sci.*, 2005, **12**, 199–206.
3. Hollingsworth, J. P., Hartstack Jr, A. W. and Lingren, P. D., *J. Econ. Entomol.*, 1970, **63**, 1758–1761.
4. Bousfield, E. L., *Bernice P. Bishop Mus. Spec. Publ.*, 1984, **72**, 171–210.
5. Hughes, L. E. and Ahyong, S. T., *J. Crustac. Biol.*, 2016, **36**(4), 584–588.
6. Cane, J. H., Minckley, R. L. and Kervin, L. J., *J. Kansas Entomol. Soc.*, 2000, **73**(4), 225–231.
7. Wilson, J. S., Griswold, T. and Messinger, O. J., *J. Kansas Entomol. Soc.*, 2008, **81**, 288–300.
8. Surya Rao, K. V., *Proc. Indian Natl. Sci. Acad. Part B*, 1972, **38**(3–4), 190–205.
9. Kodama, M. and Shimizo, S. O., *Crustaceana*, 2017, **90**(5), 639–642.
10. Friend, J. A. and Richardson, A. M. M., *Ecol. Bull.*, 1977, **25**, 24–35.
11. Friend, J. A. and Richardson, A. M. M., *Annu. Rev. Entomol.*, 1986, **31**, 25–48.
12. Westphal, C., Bommarco, R. and Carré, G., *Ecol. Mon.*, 2008, **78**, 653–671.
13. Williams, N., Minckley, R. L. and Silveira, F. A., *Ecol. Soc.*, 2001, **5**(1), 7.

Received 2 February 2019; revised accepted 30 October 2019

K. Rajmohana[1,*]
J. N. Trivedi[2]

[1]*Zoological Survey of India,*
M Block, New Alipore,
Kolkata 700 053, India
[2]*Department of Life Sciences,*
Hemchandracharya North Gujarat University,
Patan 384 265, India
**For correspondence.*
e-mail: mohana.skumar@gmail.com