

12. Nayar, M. P. and Sastry, A. R. K. (eds), *Red Data Book of Indian Plants*, Botanical Survey of India, Calcutta, 1990, vol. 3, pp. 243–244.
13. Nayar, M. P. and Sastry, A. R. K. (eds), *Red Data Book of Indian Plants*, Botanical Survey of India, Calcutta, 1987, vol. 1, pp. 217–218.
14. Prabhugaonkar, A., Mesta, D. K. and Janarthnam, M. K., *J. Threat. Taxa*, 2014, **6**(2), 5503–5506.
15. Santhakumaran, L. N., Singh, A. and Thomas, V. T., *Wood*, 1995, **October** 24–28.
16. Santhakumaran, L. N., Singh, A. and Thomas, V. T., *Wood*, 1996, **April–June**, 6–7.
17. Rao, G. R., Threatened tree species of swamps and riparian habitats of central Western Ghats, Lake 2014, Conference on the Conservation and Sustainable Management of Wetland Ecosystems in Western Ghats, 2014.
18. Henry, A. N., Kumari, G. R. and Chithra, V., *Flora of Tamil Nadu*, Botanical Survey of India, Coimbatore, 1987, vol. 2, p. 258.
19. Kumaran, K. P., Limaye, R. B., Puneekar, S. A., Rajaguru, S. N., Joshi, S. V. and Karlekar, S. N., *Quat. Int.*, 2013, **286**, 3–18.

ACKNOWLEDGEMENTS. We thank Narayan Desai, Pravin Desai and Makranth Naik

for helping us with the field visits to the site. We also thank Dr M. K. Janarthnam from the University of Goa for help in identifying some of the plant species at the site.

GAYATHRI SREEDHARAN<sup>1,\*</sup>  
MALHAR INDULKAR<sup>2</sup>

<sup>1</sup>CSIR-Centre for Cellular and Molecular Biology,  
Hyderabad 500 007, India

<sup>2</sup>Nityata River Otter Conservancy,  
Bengaluru, India

\*e-mail: gayathris@ccmb.res.in

## *Litopenaeus vannamei* (Boone, 1931), the Pacific whiteleg shrimp in River Cauvery

The Pacific whiteleg shrimp, *Litopenaeus vannamei* (Boone, 1931) is a natural inhabitant of tropical marine waters along the Eastern Pacific coast, from the Gulf of California (Mexico) to Tumber (North of Peru), where the year-round water temperature normally exceeds 20°C (refs 1, 2). Presently, it is the most widely cultured shrimp species all over the world. Its farmed area is expanding mainly due to the availability of specific pathogen-free (SPF) seeds in the international market and its phenomenal success in farming systems due to the ability to tolerate wide salinity ranges (0–45 ppt), fast growth rate, low dietary protein requirement (30–35%), column feeding habit and amenability for crowding and very high stocking densities<sup>3,4</sup>.

Shrimp farming is a major production system contributing about 70% of India's

total seafood in value<sup>5</sup>. In India, large-scale culture of *L. vannamei* commenced from 2009 with the import of SPF broodstock for revitalization of the ailing shrimp farming sector, which was constantly incurring heavy losses owing to the outbreak of white spot disease in farmed tiger shrimp (*Penaeus monodon*). The area under *L. vannamei* farming in India increased from 283 ha in 2009–10 to 50,241 ha in 2014–15 (ref. 6), while production increased from 1731 to 353,413 tonnes. Though system-specific as well as cost-effective better management practices and bio-security measures have been implemented in the country for sustainable *L. vannamei* farming<sup>4</sup>, possible accidental/unintentional escape of the farmed stock to natural waters and consequent ecological impacts have not been completely addressed despite

speculations within the scientific community regarding potential adverse impacts of the species on native ecosystems and biodiversity<sup>7–9</sup>.

During fish habitat assessment surveys (July and December 2017) along the lower estuarine stretch of River Cauvery at Poompuhar (Sirkazhi taluk, Nagapattinam district, Tamil Nadu), four specimens (one male and three females) of *L. vannamei* (length range 61–150 mm; total weight range 1.5–21 g) were captured in experimental cast netting operations near the estuarine mouth. The specimens were identified based on standard taxonomic keys<sup>1</sup>. The fresh specimen (Figure 1) was translucent white with a greenish tinge throughout carapace and abdomen; tips of telson and uropods with bluish hue and the rostrum armed with two ventral teeth and eight dorsal teeth. All

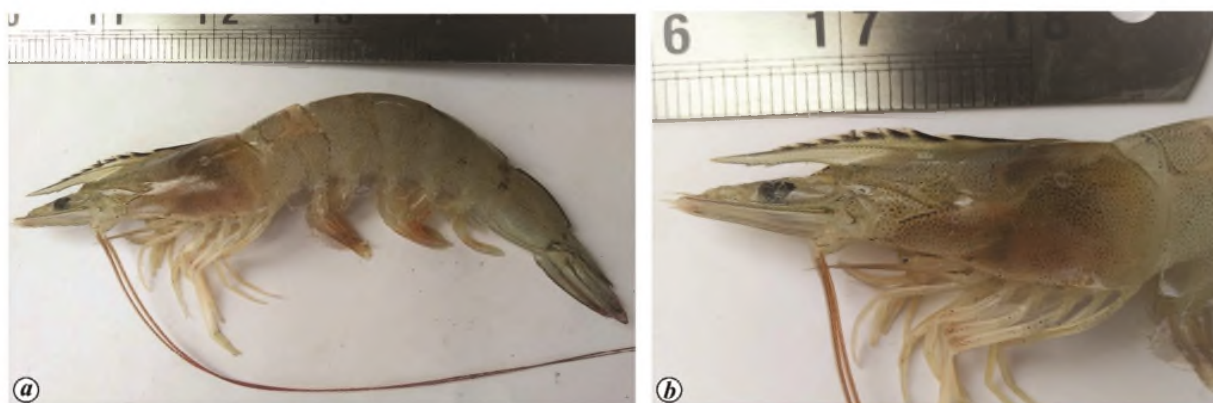


Figure 1. **a**, *Litopenaeus vannamei* specimen (male) collected from the Cauvery estuary. **b**, *L. vannamei* – carapace view.



**Figure 2.** Google Earth image showing the site of collection (11°08'14"N; 79°51'22.47"E) of *L. vannamei*.

these morphological attributes were in conformity with the basic taxonomic identifying characters of *L. vannamei*<sup>1</sup>. There have been no earlier records of an exotic decapod in natural inland open waters of India. The specimens were caught along with native shrimp species, *Fenneropenaeus indicus* (Indian white shrimp) and *Metapenaeus monoceros* (speckled shrimp) at the estuarine channel (11°08'14"N; 79°51'22.47"E) adjacent to shrimp farms (Figure 2).

Worldwide, several studies have reported the presence of *L. vannamei* at locations outside its natural geographic range, viz. Texas, South Carolina, Hawaii, Gulf of Thailand, Venezuela, Brazil, Puerto Rico and Vietnam<sup>10</sup>. The effect of escape and establishment of *L. vannamei* remains unknown, but the main risks include competition with native species for food and space, interfering with breeding behaviour or breeding success of native shrimp species and spreading of alien pathogens<sup>3,11,12</sup>. *L. vannamei* has been reported from fishers' catches in Thailand (Andaman and Gulf of Thailand coasts) and is presumed to be established in Hawaii and Gulf of Mexico<sup>7</sup>.

Intensive observations and long-term monitoring are required to derive inferences regarding the degree of establish-

ment of *L. vannamei* populations and its impacts on native aquatic biodiversity. The observations in the present study may, nevertheless be considered as a warning signal of imminent ecological consequences. It calls for a review of the status of implementation of biosecurity measures and code of conduct adopted by *L. vannamei* farms in India as well as risk assessment of all exotic species that have been proposed for introduction to Indian aquaculture sector.

1. Perez-Farfante, I. and Kensley, B., *Penaeoid and Sergestoid Shrimps and Prawns of the World – Keys and Diagnoses for the Families and Genera*, Memories du Museum National D'Historie Naturelle, Paris, France, 1997, p. 233.
2. Alcivar-Warren, A. D., Meehan-Meola, S., Won Park, Xu. Z., Delaney, M. and Zuniga, G., *J. Shellfish Res.*, 2007, **26**(4), 1259–1277.
3. Briggs, M., Funge-Smith, S., Subasinghe, R. and Phillips, M., *Introductions and movement of Penaeus vannamei and Penaeus stylirostris in Asia and the Pacific*, Food and Agriculture Organization of the United Nations, RAP Publication, 2004/10, 2004, p. 92.
4. Ravichandran, P., Panigrahi, A. and Kumaran, M., *Biology and Culture of Litopenaeus vannamei vis-à-vis Penaeus monodon – Handbook on Seed Production and Farming of Litopenaeus vanna-*

*mei* 46, CIBA Special Publication, Chennai, 2009, p. 70.

5. Kumaran, M. *et al.*, *Aquaculture*, 2017, **468**, 262–270.
6. [www.mpeda.org](http://www.mpeda.org)
7. Regunathan, C. and Kitto, M. R., *Aquacult. Asia*, 2011, **XVI**(2), 32–35.
8. Singh, A. K. and Lakra, W. S., *Rev. Aquacult.*, 2011, **3**, 3–18.
9. Roy, M. K. D. and Nandi, N. C., *J. Aquacult. Mar. Biol.*, 2017, **5**(2), 00115.
10. Wakida-Kusunoki, A. T., Amador-del Angel, L. E., Alejandro, P. C. and Brahm, C. Q., *Aquat. Invasions*, 2011, **6**(1), S139–S142.
11. Senanan, W., Panutrakul, S., Barnette, P., Chavanich, S., Mantachitr, V., Tangkrook-Olan, N. and Viyakarn, V., *Aquacult. Asia*, 2009, **XIV**(4), 28–32.
12. Panutrakul, S., Senanan, W., Chavanich, S., Tangkrook-Olan, N. and Viyakarn, V., In *Tropical Deltas and Coastal Zones: Community, Environment and Food Production at the Land–Water Interface*, CABI Publishing, Oxfordshire, UK, 2010, pp. 80–92.

**ACKNOWLEDGEMENTS.** We thank the Indian Council of Agricultural Research (ICAR) for financial support to carry out this study. We also thank Shuvra Saha (Technical Officer, ICAR-CIFRI) for assistance in the laboratory. The work was carried out under the ICAR-CIFRI Project No. REF/17-20/07.

C. M. ROSHITH<sup>1,\*</sup>  
V. R. SURESH<sup>1</sup>  
S. K. KOUSHLESH<sup>1</sup>  
R. K. MANNA<sup>1</sup>  
S. K. SHARMA<sup>1</sup>  
S. SIBINAMOL<sup>2</sup>  
AJOY SAHA<sup>2</sup>  
R. C. MANDI<sup>1</sup>  
M. E. VIJAYAKUMAR<sup>2</sup>  
A. ROY CHOWDHURY<sup>1</sup>  
B. K. DAS<sup>1</sup>

<sup>1</sup>ICAR-Central Inland Fisheries Research Institute, Barrackpore,

Kolkata 700 120, India

<sup>2</sup>Bangalore Research Centre of ICAR-CIFRI,

Hessarghatta Lake Post,

Bengaluru 560 089, India

\*e-mail: varumasree2003@yahoo.com