

## Facultative monogamy in an early Eocene brooding oyster and its evolutionary implications

Kalyan Halder and Aniket Mitra

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Dwarf males of *Ostrea jibananandai* sp. nov. from the lower Eocene rocks of the Cambay Basin, western India, are found attached inside the anterior end of the hinge of large females. Commonly, one male is found inside a female shell. Equivalent associations are known in the extant oyster *Ostrea puelchana* and the Neogene “*Cubitostrea*” *alvarezii* from Argentina. This association increases successful fertilization of eggs by reducing sperm loss in these spermcasting/brooding oysters. The sperms, released into water, are normally brought in with the inhalant water current before fertilization inside the body of the female in brooding oysters. This male-female association reduces the uncertainty involved in fertilization because sperms are released directly inside the female shell. The phenomenon is christened here as facultative monogamy. With this discovery, its evolution in oysters is pushed back more than 40 myr to over 54 Ma. Facultative monogamy evolved only in these three species over its long history in spite of its obvious advantages. Facultative monogamy reduces evolutionary flexibility by decreasing phenotypic variability. It is argued here that the phenomenon evolved by trading off morphological variability in favour of successful fertilization in response to environmental perturbations that tend to disrupt sperm transport in open water. Rapid global warming is hypothesized to potentially cause environmental perturbation, because two of the three cases of facultative monogamy in oysters, Eocene *O. jibananandai* sp. nov. and Recent *O. puelchana*, occurred at the early stages of hyperthermal events.

**Key words:** Bivalvia, *Ostrea*, internal fertilization, global warming, spermcasting, Eocene, Cambay Basin, India.

Kalyan Halder [[kalyan.geol@presiuniv.ac.in](mailto:kalyan.geol@presiuniv.ac.in)] and Aniket Mitra [[ani.vastuni@gmail.com](mailto:ani.vastuni@gmail.com)], Department of Geology, Presidency University, 86/1 College Street, Kolkata 700073, West Bengal, India.

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