



Foraging and substrate-dependent behavioural patterns of *Marphysa mossambica* (Peters, 1854) in captivity

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Abstract

The present study explores the behavioural and foraging patterns of *Marphysa mossambica*, a polychaete species of ecological and commercial significance, under controlled laboratory conditions. The primary objective was to assess the influence of habitat structure, specifically the presence or absence of artificial substrate, on the species activity, territorial interactions, and feeding behaviour. Specimens were housed in tanks equipped with plastic tubes (experimental group) or without substrate (control group). Observations revealed that individuals provided with substrate exhibited reduced territorial aggression and more consistent foraging behaviour, typically feeding from within their tubes with minimal exposure. In contrast, individuals in the control group demonstrated heightened territoriality, frequent aggressive encounters, and greater vulnerability. Feeding without substrate also involved more exposure, increasing the risk of stress or predation. These behavioural differences highlight the critical role of substrate in promoting welfare, reducing stress-related behaviours, and supporting stable feeding activity. Nonetheless, the results have practical implications for polychaete aquaculture, emphasizing the need for appropriate habitat structures to optimize rearing conditions and ensure the long-term viability of *M. mossambica* as a resource in aquaculture.

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Introduction

Polychaetes are marine invertebrates, vital to the health and stability of ocean ecosystems. Their remarkable diversity allows them to fulfil a range of key ecological functions, which include serving as a crucial food source for many marine species and contributing to the cycling and breakdown of nutrients within the seafloor environment (Wong *et al.*, 2015). Their role in maintaining ecological balance makes them indispensable to the functioning of marine habitats. In addition, polychaetes are widely recognized as valuable indicators for assessing the environmental condition of the seafloor and detecting long-term climatic variations (Moreira *et al.*, 2006). Polychaetes represent one of the principal groups of annelids having commercial significance, particularly in the fields of recreational fishing and aquaculture, where they are commonly used as bait and feed, respectively (Wang *et al.*, 2025). Polychaetes exhibit a wide range of trait combinations, encompassing various modes of locomotion, feeding strategies, reproductive methods, body sizes, and morphological features (Jumars *et al.*, 2015). This functional diversity enables them to carry out multiple ecological roles within marine ecosystems (Wrede *et al.*, 2018).

The family Eunicidae, within the class Polychaeta, is broadly distributed

across marine environments, ranging from intertidal zones to deep-sea habitats (Blake *et al.*, 1995). Species within this family inhabit a variety of ecological niches and exhibit a wide range of foraging strategies (Day, 1967). Eunicids are known for their active burrowing in sandy and muddy substrates. Species within the Eunicidae family may be either free-living or tubicolous and are predominantly carnivorous, preying on various small invertebrates. On the other hand, particular species of *Marphysa* are regarded as herbivorous or omnivorous (Fauchald & Jumars, 1979; Gathof, 1984). To date, however, no comprehensive quantitative studies have been conducted on the feeding habits of eunicids.

Competition for space and food represents a fundamental factor influencing species distribution and community organization within eunicids. These interactions serve as critical structuring forces for populations of sediment-dwelling species (Rosenberg *et al.*, 1997). In environments where food resources are abundant, space availability may become the primary limiting factor for population growth. Multiple studies on infaunal marine soft-bottom species have demonstrated that increased population density negatively impacts individual growth, larval recruitment and viability (Reise *et al.*, 2001; Safarik *et al.*, 2006). However, intraspecific interactions among benthic organisms, especially polychaetes, are more intricate, involving the simultaneous influence of several factors. Lemieux *et al.* (1997) propose that the capacity to exploit a habitat successfully is closely linked to an individual's ability to defend its burrow. Laboratory studies have demonstrated that increased population density generally correlates with heightened territorial behaviour and intensified competition for food resources (Scaps *et al.*, 1998; Grelon *et al.*, 2006).

Further detailed observations and a comprehensive understanding of polychaetes' foraging behavior and ecological traits are essential for the successful long-term maintenance of these organisms under culture conditions. This knowledge is fundamental given the economic significance of polychaete culture, which plays a crucial role in the bait supply sector as well as the aquaculture industry. Thus, recognition of this economic potential served as the primary motivation for undertaking the present study.

Materials and Methods

The *Marphysa mossambica* specimens were collected from the intertidal zone of Worli, Mumbai, India, during low tide in November 2024. The worms were retrieved from sediment depths ranging from 10-20 cm. The substrate in this area consisted of a mixture of sand and stones of varying sizes. The average weight of individuals was recorded as 0.97 ± 0.13 grams.

The experiment was conducted at the Wet Laboratory Complex, Old Campus, ICAR-CIFE, Mumbai. During the observation period, *M. mossambica* specimens

were housed in plastic containers (36 cm x 26 cm x 26 cm) equipped with a seawater flow-through system. This setup ensured continuous water circulation and aeration, thereby maintaining suitable laboratory conditions for the polychaetes over one week. Each container was filled with a 15 cm layer of beach sand comprising over 95% fine grains ($<50 \mu\text{m}$). Before use, the sand was screened to remove macroalgae and associated macrofauna, sun-dried, and thoroughly rinsed multiple times with alternating freshwater and seawater.

In the experimental tank (T), polychaetes were provided with plastic tube substrate measuring 5-6 mm in diameter and approximately 15-17 cm in length. Behavioural observations were conducted on 10 individually maintained specimens kept under constant environmental conditions. A control group (C), maintained without any substrate (plastic tube), was also included in the study. Throughout the experimental period, the worms were fed chopped squid and open clams. Various behavioural activities of the polychaetes were recorded during this time.

Results and discussion

Behavioural observations

During the present study, in the experimental tank (T), the individuals initially appeared reluctant to occupy the provided plastic tubes. However, 6 out of 10 individuals eventually inhabited the tubes after acclimation. The observed behavioural patterns included periodic movements such as anterior and posterior crawling, head movements, and spontaneous as well as active tube irrigation. These behaviours were exhibited under stable environmental conditions; however, not all individuals displayed the complete range of responses during the observation period. Two distinct types of inactivity were identified: brief periods of inactivity lasting less than five minutes, which occurred during behavioural sequences, and extended periods of inactivity exceeding ten to twenty minutes, typically occurring between behavioural sequences. Overall, the behaviour of the worms was frequently organized into alternating cycles of activity and rest. On some occasions, individuals were observed with their proboscis everted during periods of inactivity (six instances) or tube irrigation (three instances). No territorial behaviour was noted among individuals in the tank containing tubes.

In the control group (C), territorial aggression was observed among individuals. In one instance, upon contact with an intruding worm, the resident exhibited biting behaviour. In two cases, resident individuals were evicted from their burrows following encounters with intruders with their head inside the burrow (Fig 1). Once the residents were displaced from their burrows, the likelihood of re-habitation and survival for these individuals was significantly reduced. Garces *et al.* (2021) confirmed this species' high level of aggressiveness and territoriality. As the worms grow,



Fig.1. Behavioural observations of *M. mossambica*

- (A) *M. mossambica* with anterior end protruding out of the tube (B) *M. mossambica* feeding on a clam
(C), *M. mossambica* with the anterior end protruding out of the burrow in sediment
(D) *M. mossambica* with the posterior tail portion out first, probably an intruder attack.

their body volume and the surface area of their territory increase, thereby raising the probability of encounters with conspecifics. In contrast, Scaps *et al.* (1998), in their study on *Perinereis cultrifera*, observed that the area surrounding the burrow entrance is not defended and does not constitute a defined territory. They suggested that *P. cultrifera* likely competes for burrow space but may tolerate sharing food resources.

All individuals in the control group exhibited active irrigation activity within their burrows, unlike the treatment group provided with substrate (PVC pipes). The spontaneous behavior observed in *M. mossambica* closely resembles that reported in other polychaete species, including *Perinereis cultrifera* (Scaps, 1998), *Nereis diversicolor*, *Nereis fucata*, and *Platynereis dumerilii* (Evans *et al.*, 1974; Evans and Downie, 1986; Evans and Rogers, 1978).

Foraging activity

In the experimental tank, individuals remained primarily within the tubes, partially extending only the tips of their antennae outside to make contact when the food was introduced into the tank for a brief period (Fig. 1). They quickly seize it using its eversible pharynx equipped with strong mandibles and maxillae (Fig 1). They readily consumed both chopped squid and open clams. In contrast, individuals in the control group exhibited greater freedom of movement during feeding. Food particles were consumed almost immediately, with some worms emerging entirely from their burrows and becoming fully exposed on the sediment surface.

Under the observation conditions of the present study, a few individuals exhibited increased agitation. They remained within their burrows, with no foraging activity observed, particularly in the control tank

(noted in four observations). These findings are consistent with previous reports on other polychaete species. For example, individuals of the aphroditid species *Aphrodita aculeata* have been shown to forage and feed while buried or within their tubes (Mettam, 1980), and *Glycera alba* was observed to refrain from feeding outside its tube gallery (Ockelmann & Vahl, 1970). Similarly, in aquarium settings, *Pholoe minuta* captured prey only when both the predator and prey were buried (Pleijel, 1983). Considering that the genus *Marphysa* comprises burrowing species (Day, 1967), it is probable that the species investigated in this study also feeds while remaining buried.

Conclusion

The present study provides valuable insights into the behavioural and foraging patterns of *Marphysa mossambica*, emphasizing the critical role of substrate availability in influencing intraspecific interactions and feeding strategies. These findings highlight the importance of habitat structure in promoting the well-being of polychaetes, particularly under captive or aquaculture conditions. Nevertheless, the observed behaviours may not represent the full range of activities exhibited throughout the life cycle, which is likely governed by a broader and more complex set of movements. A more comprehensive understanding of these behavioural traits is essential for improved management practices aimed at the sustainable exploitation and effective rearing techniques to support the intensive production of this species.

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