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Research Article

# Prey Selection of the Invasive Gastropod Rapana venosa (Valenciennes 1846) from the Río de la Plata Estuary Under Laboratory Conditions

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**This study investigates the prey selection of the invasive gastropod *Rapana venosa* under controlled laboratory conditions in the Río de la Plata estuary. The results indicate a preference for the clam *Erodona mactroides* over the mussel *Mytilus edulis*, though *M. edulis* was consumed in larger biomass quantities. These findings align with the optimal foraging theory, emphasizing prey energy profitability and vulnerability. Further research is needed to assess the potential ecological impacts, particularly in areas of limited spatial overlap between predator and prey.**

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## Introduction

Marine ecosystems around the world face numerous ecological threats, but few are as pervasive and impactful as the spread of invasive species. The introduction of non-native species into marine environments can cause complex and often irreversible changes to local ecological networks[1] Among the multitude of invaders, the gastropod *Rapana venosa* stands out for its rapid proliferation and significant effects on marine biodiversity[2]. Native to the western Pacific (Sea of Japan, the Yellow Sea, and the East China Sea), this carnivorous gastropod has been inadvertently spread by human activities to various coastal regions, including the Mediterranean[2] and the Rio de la Plata estuary[3][4]. *Rapana venosa*, is a large predatory mollusk that preys primarily on bivalves, posing a direct threat to both commercial shellfish populations and the ecological balance of benthic communities[5]. Through its feeding habits, *R. venosa* has the potential to reshape community structures, alter habitat complexities, and influence nutrient cycling processes. Understanding the prey selection of *R. venosa* is a vital component in predicting and managing its impact on marine ecosystems. While some studies have provided initial insights into its dietary preferences[6][7][8], a comprehensive analysis of prey selection behaviors of *R. venosa* in the Rio de la Plata estuary is still required. Given the ecological significance and the relatively limited understanding of the feeding ecology of *R. venosa*, this study delves into the dietary preferences of the invasive gastropod. By examining its choice of prey under controlled laboratory conditions, this research aims to shed light on key aspects of *R. venosa* predation that could inform targeted approaches to mitigate its impact.

## Methods

Specimens of *R. venosa* were collected from the adjacent coastal zone of Montevideo harbor in February 2024 and acclimatized to laboratory conditions over 20 days (20ºC, salinity 20). An experimental design was implemented to discern the prey selection behavior of *R. venosa* under stable conditions of temperature, salinity, and a consistent 12/12-hour light-dark cycle. Regular water changes were performed tri-weekly to maintain optimal water quality. It is worth mentioning that two of the three snails produced egg clutches during acclimatization, so they can be considered as adult and female organisms. The

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experimental setup consisted of three individual 3l tanks, each housing one snail (mean length 90 mm). Over the 30-day study period, each *R. venosa* specimen was offered a choice of two clams (*Erodona mactroides*) and two mussels (*Mytilus edulis*) of similar sizes (0.8 ±0.4 mm). The consumed organisms were replaced by new live bivalve organisms of the same species at each feeding event. Feeding events were then performed each time the consumption of a new individual was detected, simulating a competitive feeding environment. Additionally, a control tank containing two clams and two mussels, but devoid of snails, was monitored to evaluate the potential for non-predation-related mortality or environmental degradation of prey items. Feeding events were attentively monitored, recording the consumption of prey by direct observational methods and by retrieving the remains of the bivalves, specifically their empty shells (Figure 1). This dual approach allowed for a comprehensive understanding of the feeding behavior and prey preferences of *R. venosa*. The average daily consumption rate (as wet weight) was also estimated for both *E. mactroides* and *M. edulis*).

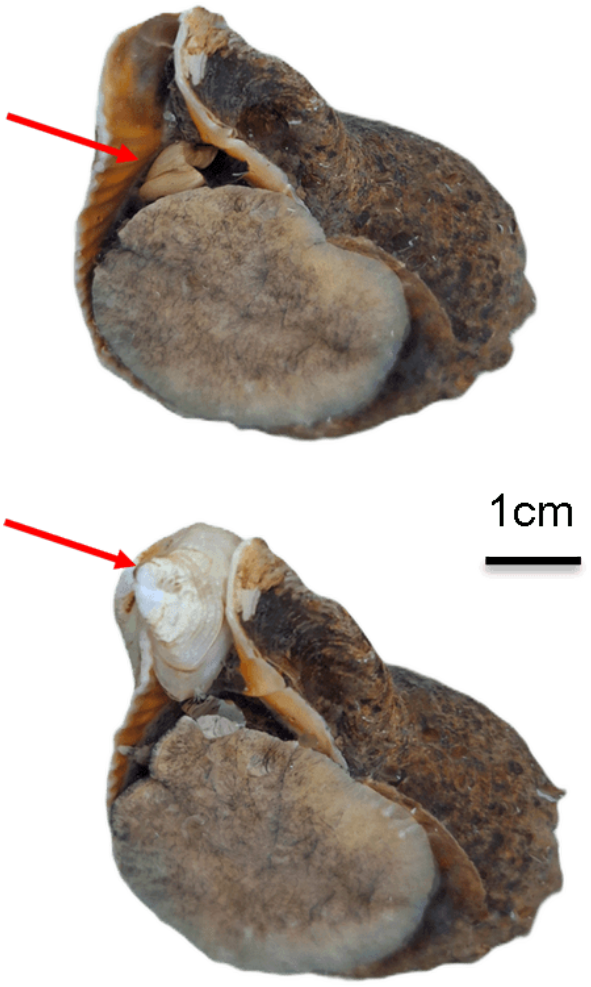


**Figure 1.** Photographs of a *Rapana venosa* individual feeding on the bivalve *Erodona mactroides*. Note the bivalve almost completely enveloped by the foot (above). Below, expulsion of the empty shells. Red arrow points to the ingested clam.

## Results & Discussion

The results indicated that, on average, the three snails examined consumed a notably higher quantity of *E. mactroides* (57%) in comparison to the intake of *M. edulis* (43%). Consumption preference over *E. mactroides* was maintained throughout the experiment (Figure 2). This consistent difference in consumption between the two food sources was observed across all evaluated individuals, with similar percentages recorded for each snail (see Figure 3).


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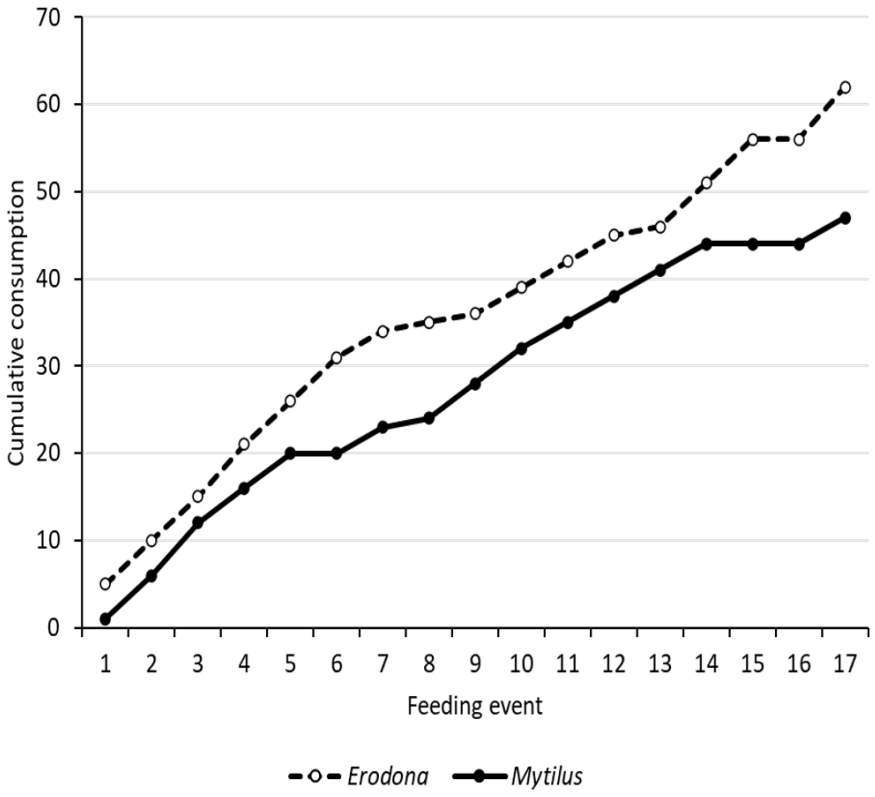


**Figure 2.** Cumulative consumption of the two bivalve species (*Erodona mactroides* and *Mytilus edulis*) by the *Rapana venosa* snails during the 30-day experiment.


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A *R. venosa* specimen of 90 mm average shell length (wet weight = 92 g) ate daily 0.19 g wwt/day *E. mactroides* and 0.3 g wwt/day *M. edulis*; the total daily food ingestion being 0.49 g wwt/day. The control tank without snails exhibited no significant mortality or degradation of the prey items, indicating that any observed consumption of clams and mussels was indeed due to predation by *R. venosa*.

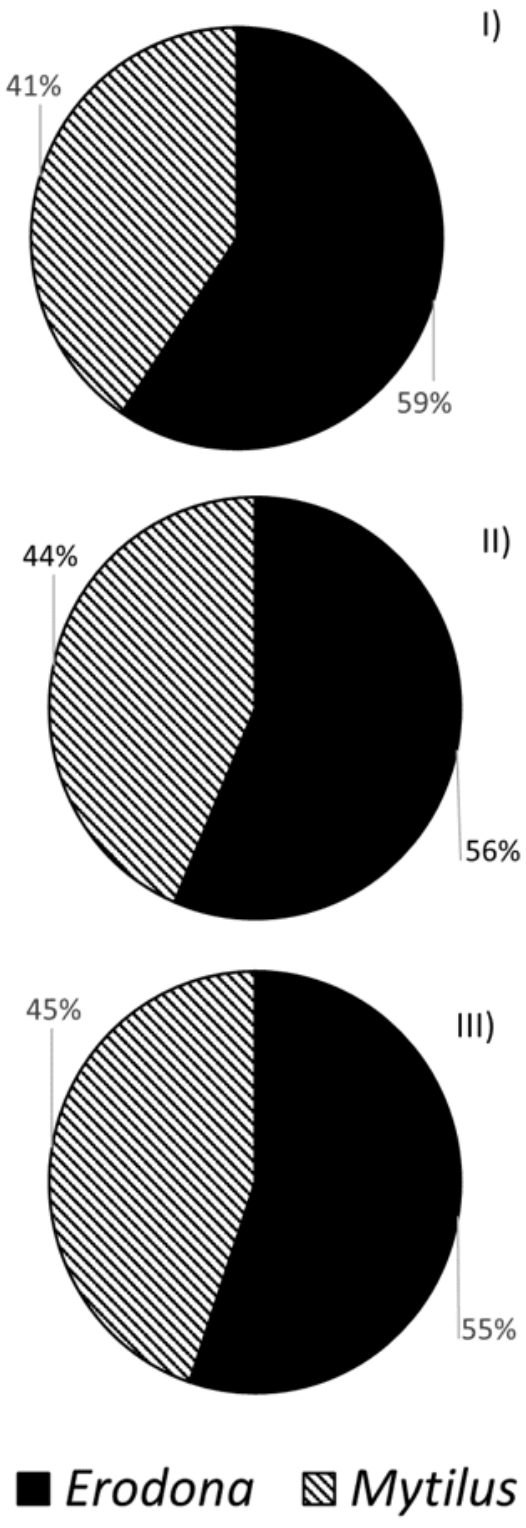


**Figure 3.** Consumption preference of each of the three individual *Rapana venosa* snails for each of the two bivalve species (*Erodona mactroides* and *Mytilus edulis*) offered during the 30-day experiment.


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The findings of this study permit the discussion of the prey selection preferences of *R. venosa* in a controlled feeding environment. The results demonstrate a clear preference for the clam *E. mactroides* clam over the mussel *M. edulis*, with the gastropods consistently consuming a higher quantity of *E. mactroides* than *M. edulis*. However, in terms of total biomass consumed daily, the gastropods ingested a greater mass of *M. edulis* compared to *E. mactroides*. These results suggest that while *R. venosa* shows a preference for *E. mactroides* as a food source, it can still consume significant quantities of *M. edulis* when available. The potential predation of *R. venosa* on *E. mactroides* (and other clam species) has been previously noted due to their overlapping distribution within the estuary[9] and by laboratory experiments[6]. Although our test is not directly comparable due to differences in conditions and the food supply provided to *R. venosa*, our results align with those reported by Giberto[6] regarding the intake of *E. mactroides* and *M. edulis* by *R. venosa*. However, we observed differences in bivalve preference; in our study, *E. mactroides* were preferred, whereas Giberto[6] reported a major preference for *M. edulis*. These results agree with previous similar experiments in different systems and with different prey species[5][7]. *R. venosa* exhibited similar prey selection and foraging behavior when offered clams, mussels, and oysters, preferring clams probably due to their higher energy content and easier capture, consistent with optimal foraging theory. Mussels were second in preference, while oysters, with their stronger shells, were the least selected. This suggests that prey selection is driven by energy profitability and prey vulnerability[10]. The preference for certain food may be explained by a foraging strategy that maximizes net energy gain, meaning the gastropods select prey that can be captured and consumed more quickly than other available species[5]. If this theory holds, clams would be preferred due to their higher energy content and profitability, even though handling times among the three prey species are similar. In this sense, in addition to species preferences, prey selection by size could also play a role in *R. venosa* consumption patterns. Although our experiment did not vary prey size, previous studies[7] have shown that gastropods of all sizes consume significantly more medium (20-30 mm) than small-sized (15-19 mm) mussels. This highlights the importance of size in prey selection and adds another layer of complexity in evaluating the potential effects of *R. venosa* on invaded ecosystems. Impact of prey selection on *E. mactroides* populations and cascading effects in the Río de la Plata ecosystem may be marginal, as *E. mactroides* is estuarine and leans toward freshwater habitats, while *R. venosa* tends to inhabit mixohaline areas, suggesting limited spatial overlap. However, this has not been extensively studied. Further research on the distribution of *R. venosa* along the estuarine gradient and determining its inner estuarine range is needed. Additionally, experiments testing lethal salinity and temperature ranges would be useful in predicting potential impacts in native mollusk fauna.

## Statements and Declarations

### *Ethics*

This study involved laboratory observations of Rapana venosa, Erodona mactroides, and Mytilus edulis, all of which are marine invertebrate species. According to local normative on animal experimentation (Uruguayan Law No. 18.611, 2009, Article 31), ethical review procedures apply exclusively to species classified within the phylum Chordata, subphylum Vertebrata. Therefore, no formal ethical approval was required for this research. Nevertheless, all experimental procedures were conducted in accordance with institutional laboratory protocols, ensuring the humane treatment of the organisms and minimizing stress during acclimatization and observation.

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## Declarations

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