

Evaluation of the commercially important clam fishery in the Alvarado Lagoon System, Veracruz, México

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ABSTRACT

Objective: to evaluate the historical trends of clam fishery in Alvarado, Veracruz, Mexico, to determine the current state of its populations and to promote the incorporation of aquaculture activities, to conserve the resource and reduce the negative impact of its fishery.

Design/methodology/approach: data were obtained through the CONAPESCA on the arrival notices of clam fishery production from the offices in Alvarado, Veracruz. After analyzing this information, graphs on trends, composition, and proportion by species were made about the capture between the years 1998 to 2021 of the three most important species in the region (*Rangia cuneata*, *Rangia flexuosa* and *Polymesoda caroliniana*).

Results: the three clam species hit peak production in the years 2006 (*P. carolineana* with 700 t), 2012 (*P. carolineana* and *R. cuneata* with 650 t), and 2015 (*P. carolineana* with 800 t), respectively. Nevertheless, the trend in the last years shows an extraction decrease. Representing more than 50% of the composition, *P. carolineana* predominates the captures, even though this species enjoys special protection under NOM-059-SEMARNAT-2010.

Limitations of the research/implications: there were no limitations.

Findings/conclusions: the increase of clam fishery is not recommended due to the diminishing trend and the signs of overexploitation observed in the three species, maintaining less than 50% of peak production.

Keywords: *Rangia cuneata*, *Rangia flexuosa*, *Polymesoda caroliniana*, trends, artisanal fishery

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INTRODUCTION

In Mexico, the production of clams through fishery and aquaculture was 12,333 t in 2020, with a total value of 281.2 million MXN. By volume, it occupies the 18th place in the national fishery production and the 20th in its value. Since 2018, the production volume has decreased by around nine thousand tons annually (Table 1). Of the total national clam production, 8% of its volume was extracted from the shores of Veracruz through artisanal river fishery (CONAPESCA, 2020). Nonetheless, the Mexican government does not distinguish between clam species in these reports.



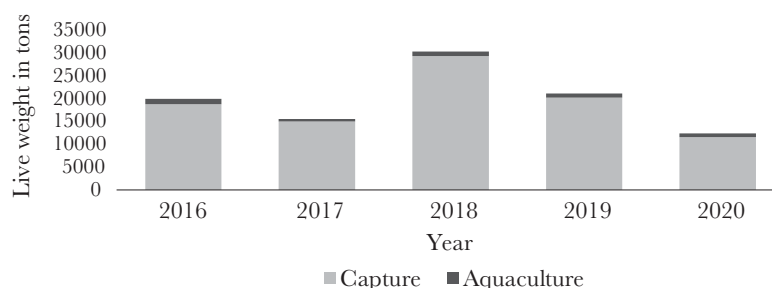
Table 1. Comparing the national clam production between the years 2016 to 2020.

Year	2016	2017	2018	2019	2020
Volume (live weight in t)	19,937	15,481	30,211	21,079	12,333
Value (thousands of MXN)	513,804	580,863	762,044	388,764	281,215

Even though clams are considered a high-value commodity and have high demand in the national and international markets, their fishery has had further development in the coastline states of the country. As a result, its production comes almost exclusively from the fishery (Figure 1), even though natural populations are getting closer, or in some cases, have exceeded their maximum sustainable production (Helm *et al.*, 2004), which highlights the need to turn to aquaculture as an option to propel the seed-production laboratories for producers.

In Veracruz, most species that comprehend this resource are exploited in the basin of the Papaloapan River, which includes the Alvarado Lagoon System, with 37 bodies of water between lakes and rivers. This lagoon system runs parallel to the coastline in an east-west direction through approximately 17 km, with a maximum width of 4.5 km and an area of 64 km² (Cruz-Escalona *et al.*, 2007). The species are exploited through artisanal methods (Baqueiro-Cárdenas, 2004), with the state of Veracruz occupying first place in clam production in the Gulf of México. During the period between the years 1993 to 2004, it comprised 94% of the total capture in Mexico with 15,505 tons (CONAPESCA, 2004).

The target fishery species in the coastal lagoons of the Gulf of Mexico is *Rangia cuneata*, at the same time, *Rangia flexuosa* and *Polymesoda carolineana* are incidental, the first one, given its size, and the second one for its low density. *R. cuneata* holds higher value and demand owing to its food appreciation, making it the most exploited clam species inhabiting the basin of the Papaloapan River (Rogers and García-Cubas, 1981). As for *P. carolineana* it is the second most captured clam species for human consumption in the Gulf of Mexico (CONAPESCA, 2014), even though it holds a place in the special protection category (NOM-059-SEMARNAT, 2010). The official statistics do not differentiate between species, not considering whether they are fresh, salt, or estuarine water species, just as it happens with other mollusks' fishery. In Veracruz, river clams constitute a significant fishery, sustaining and giving employment and income to several fishermen and their families. The fishery of *R. cuneata* is the only source of livelihood for around 400 to

**Figure 1.** National clam production through fishery and aquaculture between the years 2016 to 2020.

500 families. On this account, this investigation aims to evaluate the historical tendencies of clam fishery in the Alvarado Lagoon System, Veracruz.

MATERIALS AND METHODS

Through the Sub-delegation of the National Commission of Aquaculture and Fisheries (CONAPESCA) in Veracruz, data was obtained on the arrival notices of the clam fishery production from the fishery office in Alvarado, Ver. (the most extensive extraction area in the Gulf of Mexico). The information was analyzed, and trend composition and proportion graphs were made on the captures between the years 1998 to 2021 for the three most important species in the region: *Rangia cuneata*, *Rangia flexuosa* and *Polymesoda caroliniana*. The Alvarado Lagoon System duels in the northeast central region of the Gulf of Mexico, and is integrated by several coastal lagoons: Camaronera, Buen País, Alvarado, Tlalixcoyan, and Popuyeca, amongst others (Figure 2).

RESULTS AND DISCUSSION

The capture trend from 1998 to 2021 (Figure 3) shows that the extraction of the three species has had essential variations. It can be observed that the three clam species experimented with production peaks in the years 2006 (*P. carolineana* with 700 tons), 2012 (*P. carolineana* and *R. cuneata* with 650 tons), and 2015 (*P. carolineana* with 800 tons); nevertheless, as reported by the trend followed during the last years, its extraction has diminished.

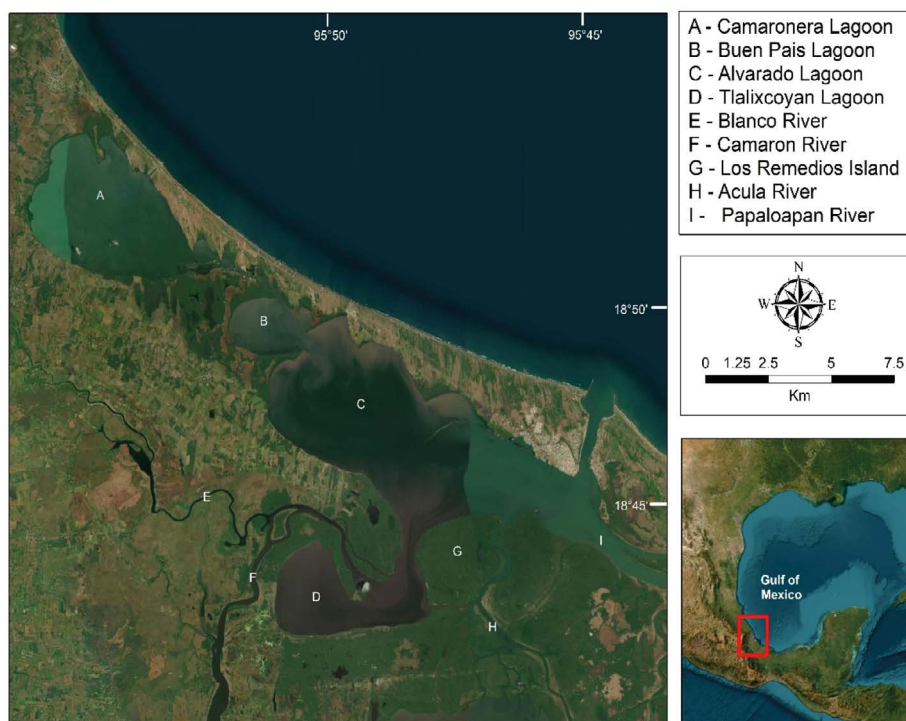


Figure 2. The Alvarado Lagoon System.

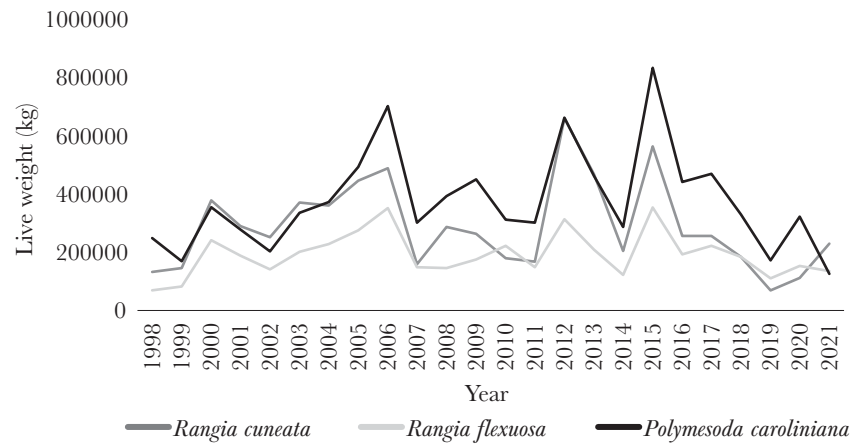


Figure 3. The trend of clam capture in the Alvarado Lagoon System, Ver., according to official production data (arrival notices) of *Rangia cuneata*, *Rangia flexuosa* and *Polymesoda caroliniana* species.

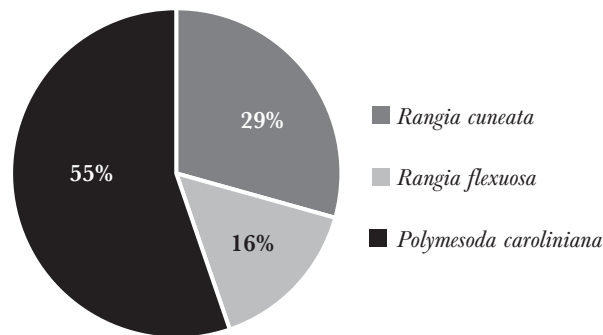


Figure 4. Composition by species of the captures in the Alvarado Lagoon System from 1998 to 2021.

Under the obtained data, the composition of the captures in the latest years in Alvarado, Ver., has been dominated in 50% by *Polymesoda caroliniana*, even though this species is placed under special protection by the NOM-059-SEMARNAT-2010 (DOF, 2010). The second place is *Rangia cuneata* (Figure 4) considered the target species for coastal lagoon fishery in the Gulf of Mexico (Rogers and García-Cubas, 1981; Baqueiro-Cárdenas, 2004).

The proportion of annual captures by species is shown in Figure 5, where *P. caroliniana* was found in higher proportion in the captures during the years 1998, 2007, 2009, 2015, 2017, and 2020, covering 50% of the captures in Alvarado, Ver. Although in 2021 its fishery diminished by more than half of what was reported in the year 2020; this capture represents 15% of the fishery of *P. caroliniana* compared it with 2015, where 800 t were obtained. The extraction of *Rangia cuneata* has stayed constant throughout time, with its most significant captures occurring in 2005, 2006, 2012, and 2015. As for *Rangia flexuosa*, the proportion it's been captured has less than the other two species. Its extraction percentage has remained constant across the period between 1998 to 2021, with its most considerable percentage occurring in 2015. In their 2002 study, Froese and Kesner-Reyes suggested an approach for diagnosing the fishery's state based on historic statistics, demonstrating that in Alvarado, Ver., the clam fishery is overexploited. For

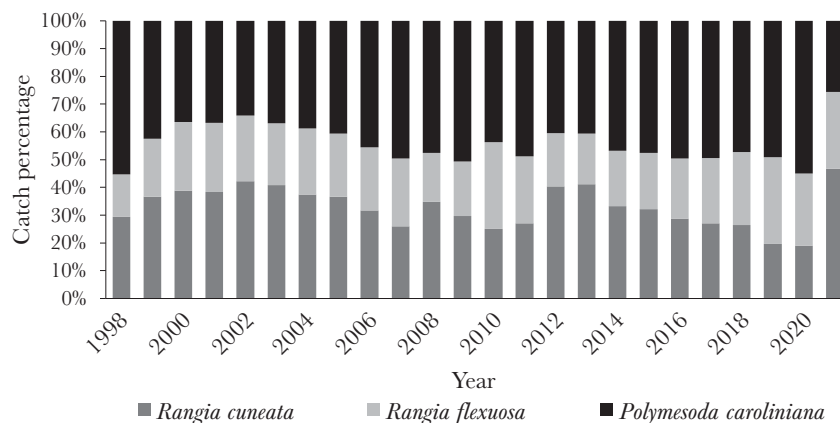


Figure 5. The proportion by species of the annual capture in the Alvarado Lagoon System, Veracruz, by arrival notices.

example, in the years following the highest registered capture, only 50% to 10% of the maximum value has been reached.

CONCLUSIONS

Limited information exists on clam beds and their biology, making imperative the need for the actualization of their distribution, biomass estimation, and density of the many species that conform to them, with the intent of knowing their availability to establish management measures for extraction. The increase of fishery is not recommended due to the declining trend observed through the last years, with the three species showing overexploitation signs, reaching only 50% of production peaks. Better overseeing the arrival data reports in fishery offices is needed; an option is elaborating a catalog for the accurate identification between clam species to make fishery statistics more precise as a response to the current inaccurate arrival data reports caused by species misidentification. An alternative for conserving and recovering the clam resource is promoting aquaculture investigation and reducing the negative impact of fishery where the population has been affected.

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