Scientific production trends on *Macrobrachium acanthurus*: A Bibliometric and network analysis based on Scopus

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ABSTRACT

Objective: This study presents a bibliometric analysis of scientific publications on *Macrobrachium acanthurus*, aiming to identify strengths and weaknesses in the development of research on this species.

Design/methodology/approach: One hundred scientific articles were retrieved from the Scopus database to identify the most relevant authors, institutions, countries, journals, and subject areas. The records were refined and standardized to avoid duplication, and a descriptive analysis was conducted using frequency and percentage distribution. Additionally, VOSviewer software was used to construct co-authorship, keyword co-occurrence, and international collaboration network maps.

Results: In terms of individual productivity, the authors Bertini, Hernández-Hernández, and Freire lead in number of publications. The journals with the highest number of articles were the Latin American Journal of Aquatic Research and Crustaceana. The thematic analysis identified five main areas: reproduction and development, conservation and sustainable aquaculture, genetics and molecular biology, nutrition and feed; and biotechnology and applications. VOSviewer maps confirmed the existence of consolidated collaboration clusters, although with some groups remained isolated, and highlighted the centrality of Brazil and Mexico in international networks.

Limitations on study/implications: The analysis was limited to the Scopus database; therefore, variations may arise if other databases are included.

Findings/conclusions: The results indicate that research is primarily concentrated in Brazil and Mexico. The University of São Paulo, São Paulo State University, the Federal University of Paraná, the National Autonomous University of Mexico, and the University of Guadalajara emerge as the leading academic institutions. This study provides an integrated overview of the dynamics, gaps and research opportunities related to *Macrobrachium acanthurus*, offering valuable insights to guide scientific agendas, foster collaboration strategies, and support the acquaculture development of native species.

Keywords: *Macrobrachium* sp., Bibliometrics, Scientific collaboration, VOSviewer, Sustainable aquaculture.

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INTRODUCTION

The genus *Macrobrachium* (Bate, 1868) comprises more than 238 species distributed in rivers and freshwater bodies across tropical and subtropical regions worldwide and represents the most diverse group within the family Palaemonidae. Many of these species support artisanal fisheries and hold economic, social, and cultural importance, in addition to their potential for aquaculture development.

Scientific research on the genus has shown a marked bias toward a few species of global commercial interest, particularly *M. rosenbergii*, which accounts for more than 60% of the published scientific output (Chong-Carrillo *et al.*, 2015).

In Latin America, previous analyses have identified Brazil and Mexico as leading research hubs in freshwater crustaceans, with significant advances in locally important species such as *M. amazonicum*, *M. tenellum*, and *M. americanum* (Chong-Carrillo *et al.*, 2018).

In Mexico, a recent analysis confirmed that although progress has been made in species of the genus *Macrobrachium*, their publication volume remains marginal compared with penaeid shrimps, particularly *Penaeus vannamei*, which accounts for approximately 75% of the national scientific output. In this context, *M. acanthurus* exhibits limited research production, reinforcing the need for specific studies to highlight its contributions and research gaps (Chong-Carrillo *et al.*, 2024).

The growing interest in *M. acanthurus* is justified by its wide distribution in American rivers, its importance in artisanal fisheries, and its potential for aquaculture.

From an aquaculture production perspective, limitations persist in the development of cultivation techniques, particularly during the larval stage, which continues to represent a technological bottleneck. There is also a need to further investigate aspects of nutrition, physiology, and immunology (Hernández-Hernández *et al.*, 2024).

Although *M. acanthurus* has approximately 100 articles indexed in Scopus, to date no analysis of the scientific production dedicated exclusively to this species has been conducted. Therefore, this study aims to fill that gap by systematizing the existing scientific output through a bibliometric analysis complemented by co-authorship, keyword co-occurrence, and international collaboration maps generated using VOSviewer.

This effort constitutes the first comprehensive approach to the publication dynamics surrounding *M. acanthurus*, including annual scientific production; production by authors, institutions, countries, journals, and subject areas; keyword connections; and co-authorship networks. Its main objective is to provide key information to guide future research and strengthen its potential aquaculture utilization.

MATERIALS AND METHODS

A total of 100 articles published on *M. acanthurus* between 1960 and 2024 were retrieved from Scopus. Duplicate documents, records without an available abstract, and documents not classified as scientific articles (*e.g.*, editorial notes or errata) were excluded. The documents were organized into CSV and Excel files. Based on the available information, authors, institutions, countries, journals, and abstracts were evaluated.

The records were cleaned and standardized to unify name variants and avoid duplication. Abstracts were examined and analyzed to identify thematic trends.

The descriptive analysis was performed using frequency counts and relative percentages, supported by spreadsheets and Python routines.

In addition to the descriptive analysis of authors, institutions, countries, journals, and abstracts, VOSviewer software (van Eck, N. J., & Waltman, L., 2010) was used to construct visualization maps of co-authorship networks, keyword co-occurrence, and international collaboration among countries. These maps enabled the identification of thematic and scientific collaboration clusters, represented in different colors according to the degree of connection.

RESULTS AND DISCUSSION

The bibliometric analysis of the 100 articles retrieved from the database made it possible to identify the main actors, institutional and geographic trends, as well as the predominant thematic areas in research on *M. acanthurus* and related species.

Scientific Production by Year (Temporal Fluctuation of Scientific Output)

The temporal analysis of publications reveals an irregular trajectory with an overall upward trend. Between the 1960s and the 1990s, scientific output remained low, ranging from 0 to 2 articles per year. A slight increase is observed after 2000, and the upward trend intensified from 2010 onward, reaching peaks of 7 to 8 articles in certain years.

These results indicate that scientific interest in *M. acanthurus* has increased markedly over the past two decades, in line with the expansion of aquaculture research and the growing recognition of the importance and conservation of native species in Latin America (Figure 1).

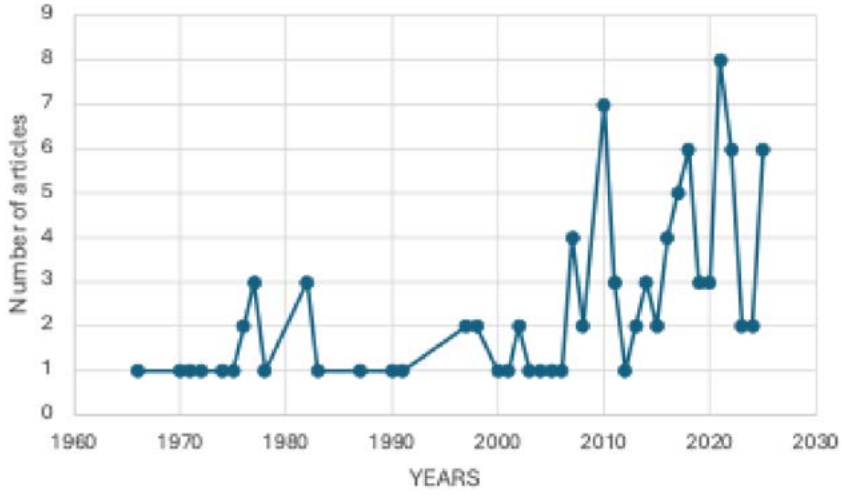

Figure 1. Chronology of publications on *Macrobrachium acanthurus* according to Scopus.
Source: Authors' own elaboration.

Author productivity

A marked concentration of scientific output was observed among a small number of researchers. The most productive author was G. Bertini, with nine publications, followed by L. H. Hernández-Hernández and C. Arruda Freire, each with eight articles. Other notable contributors included L. S. López-Greco (six articles), G. Soares Moreira (five), and a group with three to four contributions, among whom S. A. Frías-Gómez, M. A. Fernández Araiza, and F. Vega-Villasante stand out. This distribution indicates the presence of consolidated research cores, supported by recurrent collaborators.

Participating institutions

Brazilian universities were predominant in the institutional distribution of publications. The Universidade de São Paulo led the ranking with 13 articles, followed by the Universidade Estadual Paulista "Júlio de Mesquita Filho" and the Facultad de Estudios Superiores Iztacala (UNAM, Mexico), each with 12 publications. Other prominent institutions included the Universidade Federal do Paraná (9 articles) and the Universidad Nacional Autónoma de México (8).

Figure 2 illustrates the strong presence of Brazilian and Mexican academic centers in research on freshwater crustaceans.

Geographic distribution

In terms of countries, Brazil accounted for the largest share of scientific output, with 59 articles (59%), followed by Mexico with 23 (23%). To a lesser extent, contributions were

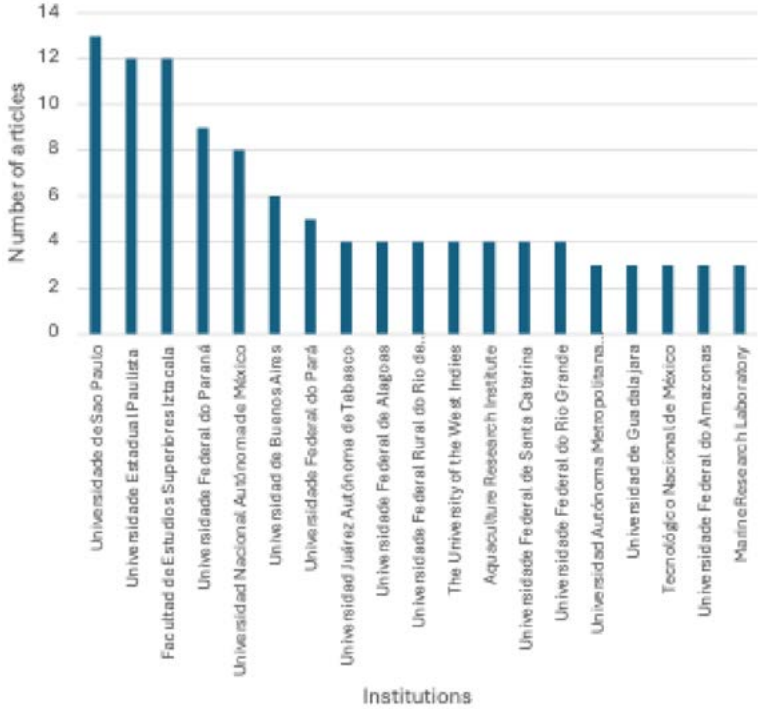

Figure 2. Most frequently cited institutions in articles on *Macrobrachium acanthurus* indexed in Scopus. Source: Authors' own elaboration.

recorded from the United States (14), Argentina (6), and Venezuela (11), as well as from European countries such as Germany and Spain, which showed sporadic contributions.

Figure 3 illustrates the predominance of Brazil and Mexico, which may be explained by the natural distribution of the genus Macrobrachium and the consolidation of specialized research groups focused on aquaculture and the ecology of native species.

Main publication journals

The articles were published in a diverse range of journals specializing in aquaculture, invertebrate biology, and ecology. The most representative were Latin American Journal of Aquatic Research and Crustaceana, each with seven articles, followed by Invertebrate Reproduction and Development (six articles) and Aquaculture (four).

Figure 4 suggests that publication in indexed international journals reflects a sustained effort by Latin American researchers to provide global visibility to studies conducted in the region (Figure 4).

Thematic areas

The analysis of the abstracts allowed the classification of the articles into five major knowledge areas (Figure 5):

Reproduction and development: 45 articles (24.7%), with emphasis on fecundity, morphotypes, reproductive strategies, and larval development.

Conservation and sustainable aquaculture: 34 articles (18.7%), focused on diversity, geographic distribution, population biology, and sustainable management.

Genetics and molecular biology: 33 articles (18.1%), covering gene expression, transcriptomic analyses, and molecular studies of hemocyanins.

Nutrition and feeding: 20 articles (11%), addressing diet evaluation, nutritional requirements, and micronutrient bioassays.

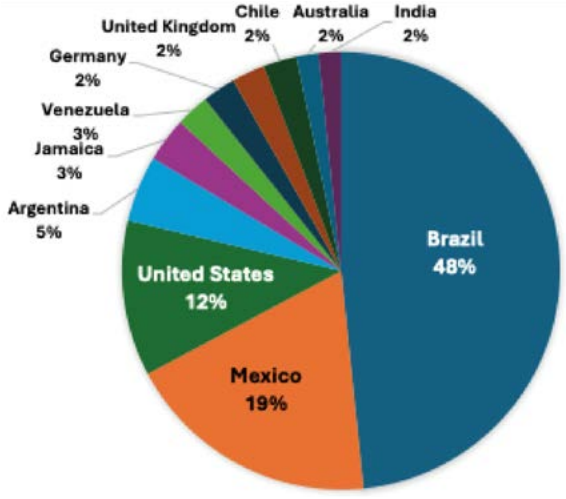

Figure 3. Publications on *Macrobrachium acanthurus* by country, with percentage of participation.
Source: Authors' own elaboration.

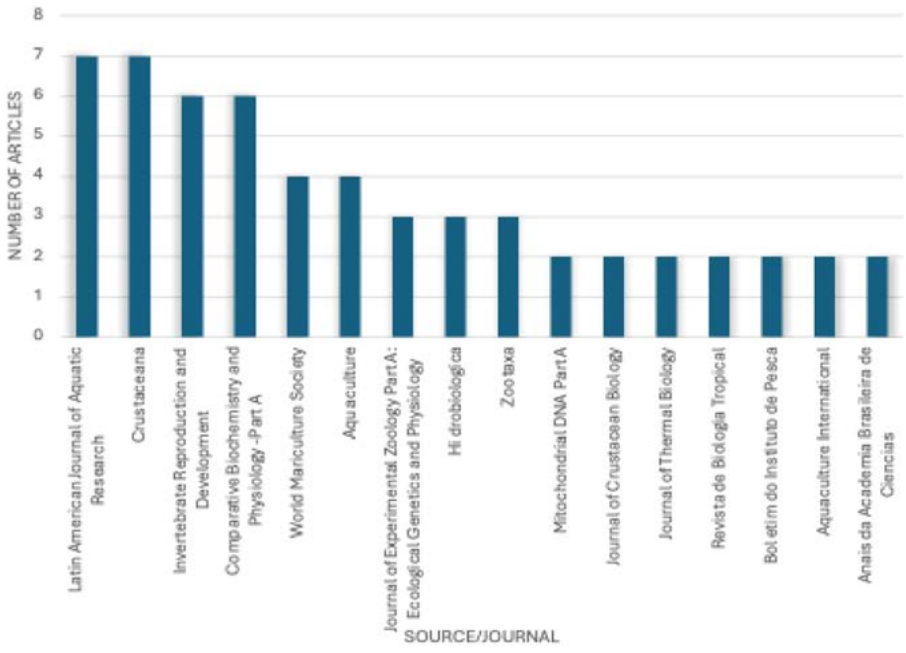

Figure 4. Most frequently cited journals in articles on *Macrobrachium acanthurus* indexed in Scopus.
Source: Authors' own elaboration.

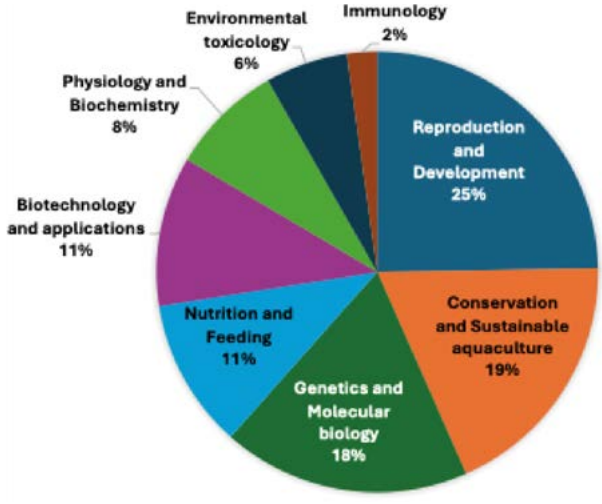

Figure 5. Thematic areas in scientific publications on *Macrobrachium acanthurus* indexed in the Scopus database, showing percentage share of participation.
Source: Authors' own elaboration.

Biotechnology and applications: 20 articles (11%), related to biomedical and biotechnological uses of crustacean-derived compounds, as well as innovations in cultivation techniques.

These results reflect the thematic diversity of the research field, with a clear predominance of studies focused on reproductive biology and conservation, followed by molecular and applied approaches.

Keyword connections

Figure 6 shows that the co-occurrence analysis of terms in abstracts and keywords reveals clearly defined thematic clusters centered on reproduction, physiology, toxicology, and conservation. The largest nodes correspond to terms such as *Macrobrachium acanthurus*, reproduction, development, and aquaculture, which function as organizing axes of the literature (Figure 6).

Co-authorship networks

The co-authorship maps shown in Figures 7a and 7b reveal the existence of well-defined clusters of researchers, with strong links among the most productive authors and their respective research groups. Some clusters are interconnected, whereas others remain isolated, indicating the presence of consolidated collaborative networks alongside independent research cores.

The international collaboration map highlights Brazil and Mexico as the main production hubs, with visible connections to the United States, Argentina, and several European countries. However, a considerable number of countries show no international linkages, reflecting asymmetries in scientific cooperation (Figures 7a and 7b).

The bibliometric analysis conducted highlights the central role played by Brazil and Mexico in research on *M. acanthurus* and related species. This geographic predominance is not unexpected, as both countries harbor the greatest diversity of species within the genus and maintain strong academic communities in aquaculture and invertebrate biology.

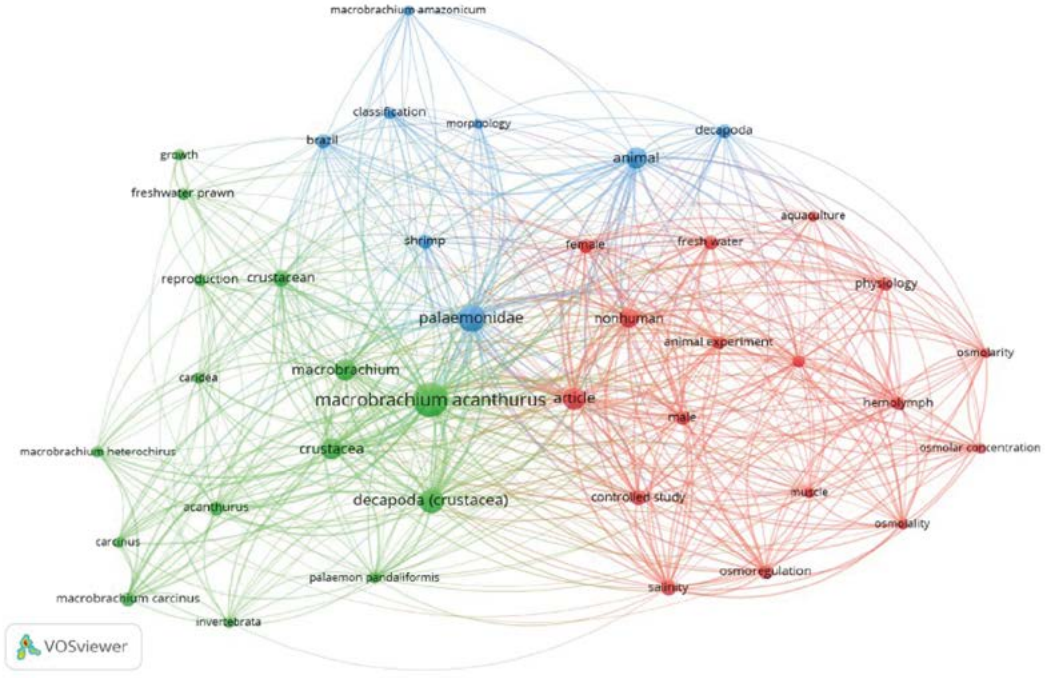

Figure 6. Most frequently used keywords in articles published on *Macrobrachium acanthurus*, according to the Scopus database. Different colors indicate clusters of related topics.
Source: Authors' own elaboration.

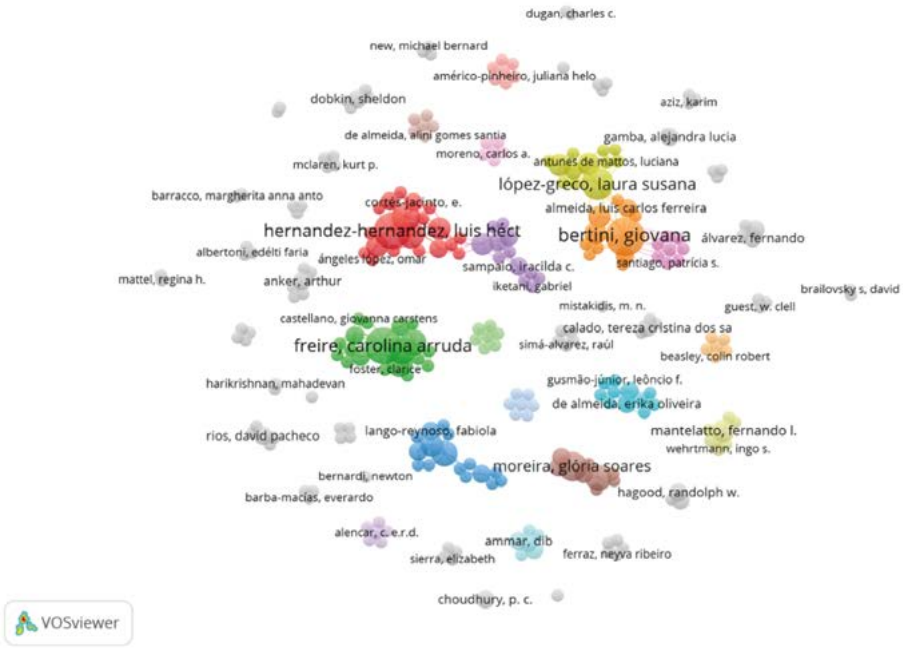

Figure 7a. Author nodes of published research on *Macrobrachium acanthurus* based on the dataset retrieved from Scopus.
Source: Authors' own elaboration.

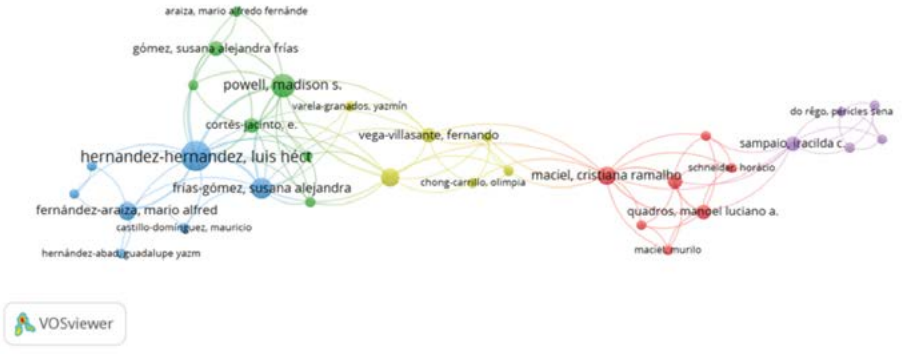

Figure 7b. Author nodes of published research on *Macrobrachium acanthurus* based on the dataset retrieved from Scopus.
Source: Authors' own elaboration.

However, the contrast with the limited representation of other Latin American countries such as Chile, Colombia, and Peru reveals a regional asymmetry that may constrain the integration of research within a broader continental framework.

The temporal evolution of publications on *M. acanthurus* confirms a pattern of late and uneven growth, characterized by low productivity until the late twentieth century and a sustained increase beginning in 2010. This trend is consistent with the findings of Chong-Carrillo *et al.* (2015, 2018), who note that research on *Macrobrachium* has historically been concentrated within a limited number of groups and has intensified only in recent periods. In Mexico, as reported by Chong-Carrillo *et al.* (2024), this increase has not been

homogeneous across species: whereas *M. tenellum* and *M. americanum* have experienced specific upturns, *M. acanthurus* has maintained moderate but steady growth. Hernández-Hernández *et al.* (2024) emphasize that although the species has attracted attention due to its ecological and aquaculture relevance, the lack of progress in larviculture and cultivation techniques has constrained the consolidation of a sustained line of applied research. In this regard, the temporal curve reflects both the growing scientific recognition of the species and the structural limitations that have hindered development comparable to that of other species within the genus.

At the institutional level, the strong participation of Brazilian universities (USP, UNESP, UFPR) and Mexican institutions (UNAM and University of Guadalajara) demonstrates the consolidation of specialized research cores capable of sustaining continuous scientific production. These institutions not only lead in terms of publication volume, but also act as centers for training human resources, thereby ensuring the continuity of research lines. Interinstitutional collaboration, reflected in international co-authorships, reinforces the idea that the study of *Macrobrachium* represents a shared agenda among Latin American research groups and some international partners, mainly from the United States and Europe. This pattern is consistent with Chong-Carrillo *et al.* (2015), who emphasize that scientific production on *Macrobrachium* has historically depended on concentrated and relatively isolated research groups, with still incipient international linkages. In the case of Mexico, the situation reflects a relative lag within the genus itself. Although *M. tenellum* and *M. americanum* have shown peaks in scientific productivity, *M. acanthurus* has remained at low and constant levels, without notable upturns in recent decades (Chong-Carrillo *et al.*, 2024). This situation is related to what the same authors describe as a bias toward the cultivation of penaeids —mainly *Penaeus vannamei*— which has relegated native *Macrobrachium* species. The consequence is limited technological development for these species and a dependence on production models centered on exotic species.

The pattern observed in publication journals is consistent with the profile of the research topics addressed. The high frequency of articles in specialized journals such as Crustaceana, Invertebrate Reproduction and Development, and Latin American Journal of Aquatic Research reflects an orientation toward basic biology, reproduction, and ecology, whereas the presence of publications in Aquaculture highlights the applied relevance of these species. However, the limited publication in higher-impact international journals suggests an ongoing challenge in the internationalization and global visibility of regional research.

Regarding thematic areas, the clear predominance of studies on reproduction and development (24.7%) reflects the importance of understanding life cycles and reproductive strategies in order to overcome the main bottlenecks in the cultivation of *M. acanthurus*. In turn, the significant presence of the conservation and sustainable aquaculture category (18.7%) highlights concern for the management of natural populations and the valuation of biodiversity, responding both to artisanal fishing pressure and habitat degradation. The growing attention to genetics and molecular biology (18.1%) indicates a process of methodological modernization aimed at integrating frontier approaches to explain physiological and adaptive processes.

Finally, studies on nutrition (11%) and biotechnology (11%) provide practical solutions for cultivation systems and open up opportunities for utilization in biomedical and biotechnological sectors. This is consistent with the patterns reported by Hernández-Hernández *et al.* (2024), who emphasize that research on *M. acanthurus* has been oriented primarily toward reproductive and physiological biology, while technological application —particularly larval cultivation— continues to represent a bottleneck. Our results reinforce this critical perspective by revealing a gap between basic biological research and aquaculture application. Overall, the findings indicate that research on *Macrobrachium* is in a phase of thematic and methodological consolidation, in which classical lines of inquiry (reproduction, nutrition, physiology) coexist with emerging areas (molecular biology, biotechnology, conservation). However, several gaps persist: (i) the lack of comprehensive studies linking wild population ecology with aquaculture development; (ii) the need for stronger regional and global collaboration; and (iii) the challenge of publishing in higher-impact international journals in order to position Latin American research within a global context.

The VOSviewer maps allow the quantitative results to be contextualized. The co-authorship structure confirms the existence of consolidated research cores in Brazil and Mexico, although with limited international connections, which is consistent with the fragmentation previously reported by Chong-Carrillo *et al.* (2015, 2018). Likewise, the keyword network reinforces the centrality of topics such as reproduction, development, and aquaculture, reflecting both the continuity of traditional priorities and the absence of a strong shift toward emerging areas. Although most research is concentrated within well-defined clusters, isolated groups persist that could benefit from greater cooperation.

The keyword network supports the thematic classification derived from the abstracts, highlighting the centrality of reproduction, physiology, and conservation. This finding confirms that research priorities are aligned with the main bottlenecks in cultivation and the need to protect natural populations.

Finally, the country collaboration network underscores the regional relevance of Brazil and Mexico, while also pointing to the urgency of expanding collaboration into broader international contexts. The lack of extensive linkages may constrain the global visibility of these studies and their integration into wider scientific debates.

Overall, the evidence indicates that research on *M. acanthurus* is in a phase of thematic and methodological consolidation, but faces three main challenges: (i) overcoming the gap between basic research and technological application, particularly in larval cultivation (Hernández-Hernández *et al.*, 2024); (ii) expanding international collaboration and reducing cluster fragmentation (Chong-Carrillo *et al.*, 2015; 2018); and (iii) diversifying the research agenda in Mexico and Latin America to reduce the lag behind more extensively studied species within the genus and compared with cultivated penaeids (Chong-Carrillo *et al.*, 2024).

From a science policy perspective, these findings suggest the need to strengthen funding for native species, promote regional research networks, and link basic research with technological development in sustainable aquaculture.

CONCLUSIONS

The present bibliometric analysis of 100 articles on *M. acanthurus* reveals a scientific output concentrated in Brazil and Mexico, countries that host both the greatest natural diversity of the genus and well-established academic institutions in aquaculture and invertebrate biology. The Universidade de São Paulo (USP), Universidade Estadual Paulista "Júlio de Mesquita Filho" (UNESP), Universidade Federal do Paraná (UFPR), Universidad Nacional Autónoma de México (UNAM), and the University of Guadalajara stand out as research hubs and centers for training human resources.

The co-authorship network analysis conducted with VOSviewer confirms the presence of consolidated clusters of researchers, particularly in Brazil and Mexico, although isolated cores persist, reflecting collaboration that remains limited at the global scale. Complementarily, the country collaboration map shows the centrality of Brazil and Mexico in scientific output, with linkages primarily to the United States, Argentina, and several European countries, highlighting the need to expand international networks.

Specialized journals in invertebrate biology and aquaculture have been the main dissemination channels, ensuring thematic relevance but limiting the international visibility of the results. Integration into higher-impact forums represents both a challenge and a strategic opportunity to enhance the global projection of this research.

Regarding thematic axes, the analysis of abstracts and the keyword co-occurrence map generated in VOSviewer consistently highlighted the centrality of studies on reproduction and development, followed by conservation and sustainable aquaculture, genetics and molecular biology, and, to a lesser extent, nutrition and biotechnology. These patterns reflect a field in transition, combining classical approaches with more modern and applied approaches.

Overall, the results indicate that research on *M. acanthurus* is undergoing a phase of consolidation and diversification, although it still faces significant challenges: integrating ecological and cultivation studies, strengthening international cooperation, and achieving greater visibility in higher-impact journals.

The VOSviewer maps complement this overview by revealing the structure of collaborations and thematic interconnections, providing an integrated perspective on current dynamics and future development opportunities within the field. It is expected that the knowledge and experience generated with other species such as *M. rosenbergii* at the international level, and *M. tenellum* and *M. americanum* at the national level, will guide the direction of future R&D&I efforts related to *M. acanthurus* over the coming decades.

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