Poeciliid Research

Poeciliopsis latidens: phylogenetic relationships, hybridogenetic reproduction, life-history trade-offs, and salinity adaptation

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Abstract. *Poeciliopsis latidens* (Garman, 1895) is a livebearing fish of the family Poeciliidae whose evolutionary significance extends across phylogenetics, reproductive biology, life-history evolution, and adaptation to saline environments. This mini-review synthesizes the available literature to examine the species' taxonomic context, its contribution to hybridogenetic reproductive systems, the evidence for size-dependent reproductive trade-offs, and its ecological association with marine or highly saline habitats. Molecular phylogenetic studies place *P. latidens* within a genus characterized by complex evolutionary histories involving hybridization and unresolved relationships among some lineages. The species also has a distinctive role in unisexual reproductive complexes, where it acts as a paternal contributor to hybridogenetic lineages that retain the maternal genome while excluding the paternal genome during meiosis. Comparative life-history evidence further indicates a negative relationship between brood size and offspring size in smaller females, highlighting the influence of maternal body size on reproductive allocation. Its association with saline environments provides an additional perspective on the ecological and physiological challenges faced by euryhaline fishes, although direct species-specific evidence on osmoregulatory mechanisms and habitat preferences remains limited. Overall, *P. latidens* represents a valuable comparative model for investigating the interplay between evolutionary history, reproductive strategies, maternal investment, and environmental adaptation. Further integrative research combining molecular systematics, experimental reproductive biology, and salinity-tolerance studies is needed to clarify its ecological specialization and evolutionary role within Poeciliidae.
Keywords: viviparous teleosts, maternal investment, offspring size, brood-size variation, hemiclonal inheritance, unisexual lineages, osmoregulation, evolutionary genetics, reproductive allocation, environmental physiology.

Introduction. *Poeciliopsis latidens* (Garman, 1895) (Figure 1) is a poeciliid livebearer whose importance rests on three linked features: its placement within a genus central to evolutionary ecology, its association with hybridogenetic systems involving unisexual lineages, and its unusual ecological position as a marine or strongly euryhaline member of a family otherwise dominated by freshwater and brackish taxa (Mateos et al., 2019; Vrijenhoek et al., 1977; Reznick et al., 2017). The available literature is uneven: phylogenetic and comparative poeciliid studies clarify its broader systematic context, whereas direct species-level natural-history data for *P. latidens* are concentrated in reproductive and comparative life-history work rather than in dedicated monographs (Mateos et al., 2019; Zúñiga-Vega et al., 2023).

The aim of this mini-review is to synthesize current knowledge of *Poeciliopsis latidens* by integrating evidence on its phylogenetic placement, contribution to hybridogenetic reproductive systems, life-history variation, and association with saline environments. Particular emphasis is placed on identifying the species' contributions to comparative evolutionary research and distinguishing experimentally or comparatively supported findings from aspects of its biology that remain insufficiently documented.



Figure 1. *Poeciliopsis latidens*, male (above), 21.2 mm SL, and female, 28.5 mm SL, Yecorato River, approximately 11 km north of Guasave, Sinaloa, Mexico; W. Brudon (Miller et al., 2005).

Taxonomy and Phylogenetic Context. *Poeciliopsis latidens* belongs to Poeciliidae, a species-rich clade of internally fertilizing livebearing fishes that includes roughly 274–275 valid species in about 27 genera, and to the genus *Poeciliopsis*, a lineage long used in research on life history, placentation, unisexual reproduction, and historical biogeography (Rodríguez-Machado et al., 2023; Reznick et al., 2017; Mateos et al., 2019; Evans et al., 2011). More generally, poeciliids are unusually powerful comparative models because they combine short generation times, laboratory hardiness, and repeated evolution of key reproductive traits, which makes the systematic placement of any species, including *P. latidens*, relevant beyond pure taxonomy (Reznick et al., 2017; Johnson, 2025; Gavriloaie et al., 2025; Petrescu-Mag, 2026; Petrescu-Mag et al., 2019; Boaru & Petrescu-Mag, 2024).

Within *Poeciliopsis*, phylogenetic relationships remained uncertain for many years because earlier studies often relied on mitochondrial markers alone, incomplete taxon sampling, or limited analytical frameworks, so the placement of some lineages was historically unstable (Mateos et al., 2019). A multilocus phylogeny based on seven nuclear and two mitochondrial loci improved resolution across the genus, although several relationships still remain unresolved, indicating that the evolutionary history of *Poeciliopsis* is partly reticulate and not fully captured by strictly bifurcating trees (Mateos et al., 2019). At the family level, genome-scale ultraconserved-element data likewise recover broad poeciliid structure while also showing gene-tree discordance and signatures of reticulate evolution, reinforcing the view that species-level placement should be interpreted in a history shaped by incomplete lineage sorting and hybridization (Rodríguez-Machado et al., 2023).

The genus also carries a strong biogeographic signal. Comparative and time-calibrated studies of poeciliids indicate a family origin in South America followed by major diversification in Central America, plus repeated dispersal and vicariance among South, Central, and North America and the Caribbean (Reznick et al., 2017). Within *Poeciliopsis*, north–south splits across Mexican barriers, including the Trans-Mexican Volcanic Belt,

appear repeatedly in phylogenetic reconstructions, showing that the lineage containing *P. latidens* should be understood in a broader history of dispersal across barriers that constrain many freshwater fishes (Mateos et al., 2019; Mateos, 2005).

Like other poeciliids, *P. latidens* is a viviparous fish with internal fertilization, part of a family whose comparative value derives heavily from diversity in maternal provisioning, embryo retention, superfetation, and related life-history traits (Evans et al., 2011; Johnson, 2025; Zúñiga-Vega et al., 2023). Across Poeciliidae, these traits have been central to testing life-history theory because livebearing enables direct measurement of brood size, offspring size, reproductive allotment, and developmental stage, and the field is now moving toward standardized data collection for precisely those comparisons (Johnson, 2025).

Direct recent evidence for *P. latidens* comes from comparative life-history work that measured brood size, offspring mass at birth, and reproductive allotment in six poeciliids, explicitly including this species (Zúñiga-Vega et al., 2023). In that dataset, *P. latidens* was the only species showing clear evidence of a size-dependent offspring number–offspring size trade-off: small females that produced relatively large broods did so at the cost of smaller individual offspring, whereas this negative relationship was weaker in larger females (Zúñiga-Vega et al., 2023). That result is important because it shows that, even within a family famous for life-history diversification, *P. latidens* expresses a particularly clear constraint linking maternal body size to reproductive packaging of embryos (Zúñiga-Vega et al., 2023). The statistical relationships underlying this trade-off are shown directly for *P. latidens* in the species-specific embryo-mass plot (Figure 2).

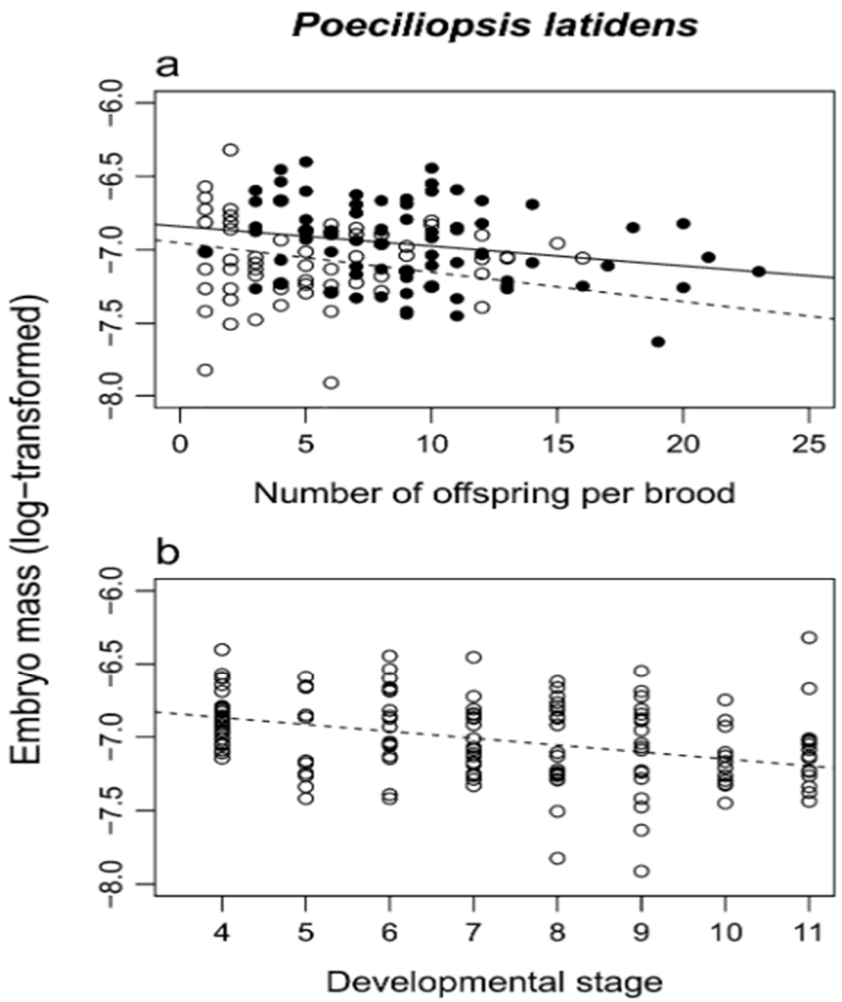


Figure 2. Female size and brood-size trade-off in *Poeciliopsis latidens* (Zúñiga-Vega et al., 2023).

A second major reproductive context for *P. latidens* is its role in the unisexual complexes of *Poeciliopsis*. Classic work showed that several all-female diploid forms in the genus arose by hybridization between sexual species, and one of the paternal contributors to these unisexual lineages is *P. latidens* (Vrijenhoek et al., 1977; Schultz, 1966, 1971). In these hybridogenetic forms, sperm from a sexual host fertilizes the egg, a hybrid soma is produced, but only the maternal genome is transmitted through the egg because the paternal genome is excluded during meiosis (Vrijenhoek et al., 1977; Schultz, 1971). *P. latidens* is therefore not only a sexual species in its own right but also part of the reproductive scaffold that has made *Poeciliopsis* one of the best-known vertebrate systems for studying the maintenance of sex, sperm dependence, hybrid origin, and the ecological genetics of clonal–sexual coexistence (Vrijenhoek et al., 1977; Schultz, 1971; Mateos et al., 2019).

These hybrid systems also help explain why *P. latidens* matters beyond descriptive natural history. Hybridogenetic *Poeciliopsis* combine high heterozygosity with continued access to locally adapted host genomes, and their persistence has been interpreted as deriving from heterosis, maintenance of advantageous heterozygosity, and demographic advantages of all-female reproduction, especially in fluctuating environments (Vrijenhoek et al., 1977). Because one of the recurrent paternal hosts in these systems is *P. latidens*, the species sits directly inside one of the canonical empirical frameworks for thinking about the evolutionary stability of sexual and hemiclonal reproduction in vertebrates (Vrijenhoek et al., 1977; Schultz, 1971).

Ecology, Habitat, and Salinity. The most distinctive ecological claim associated with *Poeciliopsis latidens* in the user's question is that it is the only truly marine poeciliid. The corpus supports the broader interpretation that poeciliids as a subfamily are predominantly fishes of fresh and brackish waters, and that salinity is a primary environmental axis structuring fish distributions, with fluctuating saline habitats favoring euryhaline species over stenohaline ones (Reznick et al., 2017; Kültz, 2015; Seale & Breves, 2022; Smyth & Elliott, 2019). It also supports that *P. latidens* is singled out in searches and comparative work precisely because of its marine or strongly saline ecology, but the supplied species-specific papers do not provide a direct indexed sentence explicitly stating the "only truly marine poeciliid" formula, so that exact wording should be treated cautiously on the basis of this evidence set.

What the evidence does support strongly is the physiological framework that makes such an ecology plausible. Euryhaline fishes tolerate wide salinity ranges through dynamic switching between salt uptake and salt secretion, water retention and excretion, plus osmosensing and epithelial transport mechanisms that detect and counter perturbations in osmotic balance (Kültz, 2015). The cellular stress response broadens salinity tolerance by protecting and repairing macromolecules, reallocating energy, arresting the cell cycle when needed, and, under severe stress, inducing programmed cell death (Evans & Kültz, 2020). In tidally variable environments, endocrine and branchial ion-transport responses allow some euryhaline teleosts to maintain osmoregulatory parameters within narrow ranges despite continuous salinity shifts, illustrating the sort of integrated physiology required of fishes occupying marine–estuarine transition zones (Seale & Breves, 2022).

These general studies are relevant to *P. latidens* because changes in salinity alter not only survival but also behavior, reproduction, and competitive interactions at the habitat level (Smyth & Elliott, 2019). In euryhaline poeciliids such as *Poecilia latipinna*, salinity tolerance does not simply mean indiscriminate use of saline habitats: individuals often still prefer lower salinity water, can behaviorally avoid predator cues, and face trade-offs between osmoregulatory context and other fitness demands (Tietze & Gerald, 2016). For *P. latidens*, this suggests that a marine association should not be reduced to tolerance alone; it likely involves a full ecological package of osmoregulation, habitat choice, predation regime, and reproductive persistence in saline environments, even though direct species-level experiments remain sparse in the present corpus (Kültz, 2015; Smyth & Elliott, 2019) (Table 1).

Table 1

Major research uses of *Poeciliopsis latidens*

Research dimension	*What P. latidens contributes*	*Evidence*
Systematics	Anchors genus-level phylogenetic and biogeographic comparisons in *Poeciliopsis*	Mateos et al., 2019
Unisexual reproduction	Serves as a paternal host species in hybridogenetic all-female lineages	Vrijenhoek et al., 1977; Schultz, 1971
Life-history evolution	Shows a clear size-dependent trade-off between brood size and offspring size	Zúñiga-Vega et al., 2023
Comparative poeciliid biology	Belongs to a family central for studying viviparity, provisioning, and reproductive diversification	Evans et al., 2011; Johnson, 2025
Salinity adaptation	Provides a rare poeciliid case relevant to marine or high-salinity ecology	Kültz, 2015; Seale & Breves, 2022.

Poeciliopsis latidens is studied, then, not because it is a heavily monographed species, but because it lies at the intersection of phylogeny, hybridogenetic reproduction, life-history theory, and salinity adaptation in one of the most informative livebearing-fish radiations (Mateos et al., 2019; Evans et al., 2011; Johnson, 2025). For a narrative review, the strongest evidence base supports emphasizing its taxonomic placement, its role in hemiclonal systems, its demonstrable life-history trade-offs, and its unusual saline ecology, while being explicit that the precise claim of exclusive true marine status is more asserted by research context than directly documented in the indexed species-level sentences provided here.

Conclusions*. Poeciliopsis latidens* occupies a distinctive position in poeciliid research because it connects several major evolutionary questions, including phylogenetic diversification, the persistence of unisexual reproductive lineages, maternal investment, and adaptation to saline environments. Its documented contribution to hybridogenetic systems and the size-dependent trade-off between brood size and offspring size provide particularly relevant evidence for studies of reproductive evolution. However, the available literature remains uneven, with stronger support for its reproductive and comparative significance than for the detailed physiological and ecological mechanisms underlying its association with saline habitats. The characterization of the species as uniquely marine within Poeciliidae should therefore be interpreted cautiously until supported by explicit, species-specific evidence. Future studies should prioritize direct measurements of salinity tolerance, osmoregulatory performance, habitat use, and reproductive success across environmental gradients, alongside improved phylogenetic and genomic analyses. Such research would strengthen the integration of *P. latidens* into broader comparative frameworks addressing the evolution of livebearing, reproductive diversity, and environmental adaptation in fishes.

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Data Availability. Not applicable.

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