

The crayfishes (Decapoda: Astacidea: Astacidae) of Azerbaijan: taxonomic challenges and distributional insights

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Abstract

Azerbaijan hosts a historically contentious crayfish fauna shaped by the complex biogeography of the Ponto-Caspian region and a legacy of Soviet-era taxonomy. Crayfish species richness in the region has varied from one to six species, largely due to unresolved synonymies of *Pontastacus* Bott, 1950, the mixing of freshwater and Caspian brackish-water taxa, and persistent misinterpretations of early literature. The review provides the first comprehensive, country-level synthesis of the crayfish species of Azerbaijan evaluated within a modern systematic and biogeographic framework. By reassessing historical records, taxonomic revisions, and regional distribution data, we clarify the composition and status of crayfish taxa attributed to the fauna. The available evidence demonstrates that only two species, *Pontastacus leptodactylus* (Eschscholtz, 1823) and the endemic *P. pylzowi* (Skorikov, 1907), are reliably established in freshwater environments. *Pontastacus eichwaldi* (Bott, 1950) is known in the Lankaran sector of the Caspian basin but remains unverified, while the Caspian brackish-water *P. pachypus* (Rathke, 1837) and *P. kessleri* (Schimkewitsch, 1886) cannot be considered freshwater components of the fauna. The frequently cited *Astacus astacus* Kessler, 1876 is shown to represent a taxonomic artifact rather than a valid element. Documented population declines in the two confirmed freshwater species underscore the need for renewed field surveys, molecular barcoding to resolve species boundaries, and targeted conservation measures.

Keywords Crustacea, geographic distribution, native species, *Pontastacus leptodactylus*, *Pontastacus pylzowi*, Ponto-Caspian region

Introduction

Crayfishes serve as keystone components of freshwater ecosystems, where their burrowing, foraging activities, transportation of organic and inorganic materials, and vegetation removal strongly influence nutrient cycling, sediment structure, and trophic interactions across benthic and littoral food webs (Momot, 1995; Wilson & Williams, 2014; Harlioğlu & Farhadi, 2017; Harlioğlu, 2026). In addition, crayfishes have long supported commercial harvesting and local livelihoods in Eurasia (Harlioğlu & Holdich, 2001; Harlioğlu & Harlioğlu,

2005; Harlioğlu & Güner, 2007; Harlioğlu, 2008, 2009, 2026; Karimpour *et al.*, 2011, 2013; Aydın *et al.*, 2012, 2025; Chen *et al.*, 2025; Dvoretzky & Dvoretzky, 2025).

Freshwater crayfishes, primarily *Pontastacus leptodactylus* (Eschscholtz, 1823), have historically supported small-scale inland fisheries, particularly within the Kura–Aras basin and associated reservoirs of Azerbaijan. Evidence for this harvesting activity derives primarily from surveys, and field observations conducted during the late Soviet and early post-Soviet periods (e.g. Derzhavin, 1951b; Kasymov, 1965b;

Received: 15 February 2026; Accepted: 6 April 2026

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Khalilov & Ahmadov, 1983). These sources describe localized trapping and hand-collection of crayfishes by fishers operating in inland waters, although systematic catch statistics, export records, or nationwide data on fishing effort were rarely compiled during that period. Available reports indicate that crayfish harvesting was locally important during the late Soviet and early post-Soviet periods, although production levels and fishing activity have fluctuated and appear to have declined in recent decades. Consequently, while precise quantitative indicators such as total annual catches, numbers of active fishers, or export volumes remain poorly documented for Azerbaijan, multiple regional studies and hydrobiological surveys confirm that crayfish harvesting historically occurred and contributed to small local markets and subsistence use. While quantitative national statistics remain limited, regional studies suggest that crayfishes have continued to contribute to local subsistence use and small commercial markets (e.g. Guliyeva *et al.*, 2025). Azerbaijan's freshwater habitats, particularly those connected to the Kura-Aras river system, provide suitable environments for crayfish populations (Guliyeva *et al.*, 2025). Yet, despite their significance, research remains very limited compared to neighboring regions such as Türkiye (Turkey), Russia, and Iran, and no modern synthesis has critically reassessed the national fauna using modern taxonomic approaches that integrate recent morphological revisions, updated species concepts, and contemporary phylogenetic insights.

Azerbaijan, located at the intersection of the Caucasus and the Ponto-Caspian biogeographical regions, possesses a mosaic of inland waters that historically supported multiple crayfish lineages. Early descriptions from the mid-20th century referred broadly to “Caspian crayfish,” reflecting the limited taxonomic resolution available at the time (Birshtein, 1950; Kutikova & Starobogatov, 1977). As a result, freshwater, brackish-water, and marine-associated taxa were often treated together in early accounts. Subsequent advances in crayfish systematics, particularly following modern revisions of the family Astacidae (Crandall & De Grave, 2017), necessitate a re-evaluation of these earlier interpretations. Recent morphological analyses of Caucasian astacid taxa have further clarified the taxonomic boundaries of regional genera and species (Kawai & Crandall, 2016).

In the South Caucasus and wider Ponto-Caspian region, *Pontastacus leptodactylus* (Eschscholtz, 1823) is widely regarded as one of the most ecologically and economically important freshwater crayfishes (Bláha *et al.*, 2023; Guliyeva *et al.*, 2025). It occurs across a broad range of riverine and lacustrine systems, supports local fisheries, and functions as a key benthic omnivore influencing macrophyte dynamics, invertebrate communities, and nutrient cycling. This species has historically been the primary crayfish species exploited for consumption and trade in Azerbaijan, particularly within the Kura-Aras basin (Bláha *et al.*, 2021, 2023; Guliyeva *et al.*, 2025). Consequently, uncertainty regarding its taxonomic status, distributional limits, and population structure has direct implications for fisheries management, biodiversity assessments, and conservation planning at both national and regional scales.

Azerbaijan also hosts the regionally endemic *Pontastacus pylzowi* Skorikov, 1907, a narrowly distributed species associated primarily with cold, well-oxygenated mountain streams

of the South Caucasus and adjacent parts of the western Caspian basin (Machino & Holdich, 2006; Kouba *et al.*, 2014; Aliyev, 2023). Endemic taxa such as *P. pylzowi* are of particular conservation concern due to their restricted ranges and heightened vulnerability to habitat alteration, water abstraction, and climate-driven hydrological change. By contrast, several other taxa historically attributed to Azerbaijan, including *P. pachypus* (Rathke, 1836) and *P. kessleri* (Schimkewitsch, 1886), are primarily associated with brackish or marine environments of the Caspian Sea and differ fundamentally in ecology and conservation relevance from true freshwater species (Machino & Holdich, 2006; Policar *et al.*, 2017; Aliyev, 2023). These species exhibit ecological adaptations typical of Ponto-Caspian coastal crayfishes. *Pontastacus pachypus* is a euryhaline species capable of tolerating moderate to high salinity and typically inhabits shallow coastal waters, estuarine environments, and brackish lagoons of the Caspian basin. By contrast, *P. kessleri* is more closely associated with nearshore benthic habitats and river mouths, where salinity levels fluctuate due to freshwater inflow. Both species display life-history traits linked to brackish-water environments and are not known to maintain stable populations in inland freshwater systems. Historical reports from the Caspian basin occasionally mention these species in transitional environments such as estuaries or river mouths where freshwater mixes with coastal brackish water; however, there are no well-documented records demonstrating the persistence of either species in inland freshwater habitats in Azerbaijan. Consequently, any occurrences near river outlets should be interpreted as coastal or estuarine extensions of their brackish-water range rather than evidence of true freshwater populations. Clarifying the ecological affiliation and taxonomic validity of these taxa is therefore essential not only for accurate faunal inventories, but also for identifying species of genuine conservation priority.

Authors throughout the Soviet period attributed five or more species to Azerbaijan's fauna, including *P. colchicus* and several nominal forms of *P. leptodactylus*. Many of these names are now recognized as junior synonyms, ecological misclassifications, or taxonomic artifacts, while others refer to Ponto-Caspian brackish-water species that do not inhabit freshwater ecosystems (World Register of Marine Species (WoRMS); <https://www.marinespecies.org/>). Divergent species lists presented by Derzhavin (1951a), Kasymov (1965a, 2004), Holdich (2002), Machino & Holdich (2006), Kouba *et al.* (2014), and Aliyev (2023) illustrate the persistence of these inconsistencies and underscore the absence of a critical, integrative reassessment.

Given the fragmented nature of the literature and the lack of recent molecular or field-based studies confirming species identities, reported crayfish diversity in Azerbaijan has remained highly uncertain, complicating biodiversity assessments and conservation planning. Although the presence of some taxa, particularly *P. leptodactylus*, has been confirmed in recent regional studies, the taxonomic status, distributional limits, and occurrence of several historically reported species remain insufficiently verified. This review addresses these issues by synthesizing historical records, modern taxonomic frameworks, and regional biogeographic knowledge to clarify which crayfish species can be reliably considered part

of Azerbaijan's freshwater fauna. Specifically, the re-evaluation presented here involves: 1) reviewing historical species records and resolving taxonomic synonymies, 2) reassessing previously reported distributions through comparison with updated biogeographic knowledge, 3) distinguishing true freshwater taxa from brackish-water or marine-associated species that have been historically misattributed to inland waters, and 4) identifying records that require confirmation or may represent erroneous or unsupported reports.

This study provides an updated account of crayfish diversity and distribution in Azerbaijan by identifying verified freshwater species, taxa requiring confirmation, brackish-water species erroneously included in freshwater lists, and unsupported historical records. Where relevant, the review also considers whether certain records may reflect historical introductions or misidentifications. Clarifying species identities and distributions is particularly important for management and conservation decisions, including the establishment of sustainable harvest limits for commercially exploited populations of *P. leptodactylus*, the identification of priority habitats for protection, and the delineating biologically meaningful stock units for fisheries management. By establishing a clarified and evidence-based baseline, the review also aims to support future taxonomic, ecological, and conservation-oriented research in Azerbaijan and comparable Ponto-Caspian systems. At a minimum, effective management will require updated field surveys combined with standardized fishery indicators such as catch-per-unit-effort (CPUE), population size-frequency distributions, and molecular analyses of genetic structure to resolve species boundaries and assess population connectivity.

Freshwater Crayfishes Reported from Azerbaijan

The freshwater crayfish fauna of Azerbaijan has long been characterized by taxonomic ambiguity, inconsistent species lists, and gaps in contemporary field verification. Positioned at the biogeographical convergence of the Caucasus, the Caspian Basin, and Eastern European freshwater systems, Azerbaijan hosts habitats suitable for members of Astacidae, particularly in *Pontastacus* Bott, 1950. Despite this, the number of crayfish species reported from the country has fluctuated widely across sources, ranging from a single species to as many as six.

To compile and evaluate these records, a literature review was conducted using major scientific databases, including Web of Science, Scopus, Google Scholar, and regional bibliographic sources. Searches included English- and Russian-language publications, as well as selected Azerbaijani sources where available, reflecting the multilingual nature of historical zoological literature in the region. Keywords included combinations of “crayfish,” “Astacidae,” “*Pontastacus*,” “Caspian,” and “Azerbaijan.” Historical monographs, regional faunal surveys, hydro-biological reports, and modern taxonomic revisions were screened for relevance. Records were included when they provided identifiable species names, geographic locality information, or ecological context. Sources

that relied on outdated nomenclature without sufficient locality or diagnostic information were evaluated cautiously and classified as unverified or taxonomically obsolete where appropriate. These discrepancies largely reflect historical classification practices, synonymy issues, and the ecological overlap between freshwater, brackish, and marine taxa in the Ponto-Caspian region (Birshtein & Vinogradov, 1951, 1953; Kakauridze, 1963).

Early faunal surveys and Soviet-era monographs documented several crayfish in the rivers and reservoirs of the Kura-Araz system and in the coastal waters of the Caspian Sea (Birshtein, 1940; Birshtein *et al.*, 1968). Many of these records were based on morphological identifications made prior to modern taxonomic revisions, leading to persistent confusion regarding species boundaries. Recent systematic treatments, most notably the global revision of crayfishes by Crandall & De Grave (2017), have clarified the composition of *Pontastacus* and the identity of taxa historically attributed to Azerbaijan. At the same time, regional surveys (Derzhavin, 1951b; Kasymov, 1965b), biogeographical analyses (Holdich, 2002; Machino & Holdich, 2006), and subsequent conservation assessments (Aliyev, 2023; Aliyev *et al.*, 2023) provide a valuable framework for distinguishing confirmed freshwater species from coastal or taxonomically obsolete records.

We evaluate all crayfish species ever reported from Azerbaijan and categorize them according to current taxonomic understanding and ecological relevance. The synthesis indicates that only two species, *P. leptodactylus* and the regionally endemic *P. pylzowi*, are reliably confirmed in freshwater environments of the country. This conclusion is consistent with available regional syntheses and recent taxonomic treatments of Ponto-Caspian astacids (e.g., Bláha *et al.*, 2021, 2023; Imentai *et al.*, 2023). We refer specifically to the confirmed composition of the freshwater crayfish fauna of Azerbaijan and does not imply that these species are restricted to the country. In particular, *P. leptodactylus* is widely distributed across the Ponto-Caspian region and adjacent parts of Eastern Europe and Western Asia (e.g. Bláha *et al.*, 2021, 2023). An additional species, *P. eichwaldi*, is historically associated with the southwestern Caspian coast near Lankaran but lacks confirmation. Two other taxa, *P. pachypus* and *P. kessleri*, inhabit brackish or marine habitats of the Caspian Sea and cannot currently be considered established freshwater species within Azerbaijan, although related Ponto-Caspian taxa may occur in both brackish and freshwater habitats elsewhere in their broader regional distribution (e.g. Imentai *et al.*, 2023). The frequently cited *P. colchicus* represents a historical taxonomic artifact rather than a confirmed component of the Azerbaijani fauna. Modern phylogenetic and taxonomic studies have clarified the status of *P. colchicus* in the Caucasus region and do not support the occurrence of the taxon in Azerbaijan (Holdich, 2002; Machino & Holdich, 2006; Crandall & De Grave, 2017; Bláha *et al.*, 2021).

Historical sources indicate that crayfishes have long been regarded as natural components of the inland waters of the Caspian basin, occurring in lakes, reservoirs, and riverine systems associated with the Kura-Aras drainage and adjacent foothill regions (Birshtein, 1950; Kutikova & Starobogatov, 1977). Early accounts, however, were often based on fragmentary surveys, limited sampling coverage, and taxonomic

frameworks that predated modern revisions of Astacidae. As a result, interpretations of crayfish diversity and distribution in Azerbaijan have shifted substantially over time, reflecting changes in nomenclature, species concepts, and the spatial extent of hydro-biological research.

The first systematic records of crayfishes in Azerbaijan appeared in early Soviet zoological literature, which documented populations primarily identified as *P. leptodactylus* and *P. pylzowi* across the Kura River basin and in foothill streams of the Greater Caucasus (Birshtein & Vinogradov, 1934; Dengina, 1949; Derzhavin, 1951b). During this period, taxonomic distinctions between freshwater and Ponto-Caspian brackish-water crayfish were poorly defined, leading to the routine inclusion of coastal Caspian brackish-water or marine-associated forms such as *A. pachypus* (now *P. pachypus*), which in Azerbaijan is known only from coastal and estuarine environments of the Caspian Sea and has not been confirmed in inland freshwater habitats, in broad accounts of the region's "Caspian crayfish." These early works, though foundational, relied on limited morphological criteria and reflected the taxonomic conventions of their time.

Between the 1950s and 1970s, ichthyological and hydro-biological surveys expanded coverage to newly constructed reservoirs along the Kura River system, where crayfishes were sufficiently abundant to support localized commercial harvesting (Khalilov & Ahmadv, 1983; Aliyev et al., 2010). The hydrobiology of Lake Aggol was investigated during the 1960s (Kasymov, 1972), 1970s (Kasymov, 1981), and 1980s (Aliyev et al., 1986). *Pontastacus leptodactylus* was reported from Lake Aggol only during the 1960s and again in the 1980s, indicating a temporally discontinuous occurrence, although the causes of this apparent gap remain unclear. No confirmed outbreaks of crayfish plague (*Aphanomyces astaci*) have been documented in Azerbaijan, and the discontinuity may instead reflect irregular sampling effort, local population fluctuations, or environmental changes affecting lake habitats during that period. Soviet-era monographs consistently listed three freshwater species, *P. leptodactylus*, *P. pylzowi*, and *P. colchicus*, but subsequent taxonomic and biogeographic analyses have shown that records of *P. colchicus* from Azerbaijan are unsupported and likely reflect historical misidentifications or outdated nomenclature rather than the presence of a naturally occurring or established population (Holdich, 2002; Machino & Holdich, 2006; Crandall & De Grave, 2017; Bláha et al., 2021). Much of the literature during the mid-20th century therefore reflects a combination of observations and taxonomically outdated interpretations, which have contributed to the persistent inconsistencies in reported species lists for Azerbaijan.

During the Soviet period, freshwater crayfish were occasionally translocated within parts of Eastern Europe and the Caspian basin to enhance local fisheries or to establish populations in newly created reservoirs. Such human-mediated movements have been documented for *P. leptodactylus*, which has been widely introduced outside its presumed native range through fishery activities, aquaculture transfers, and stocking programs (Kouba et al., 2014). Newly constructed reservoirs along major river systems during the mid-20th century also facilitated the secondary spread of crayfishes through

intentional stocking or passive dispersal associated with fish transfers. Detailed documentation of such translocation events within Azerbaijan is nevertheless limited. Soviet hydro-biological reports occasionally mention the presence of crayfishes in recently impounded reservoirs of the Kura-Aras system, but they rarely specify whether these populations originated from natural colonization or human-mediated introductions (Kasymov, 1965b; Khalilov & Ahmadv, 1983). Consequently, while localized translocations of *P. leptodactylus* associated with reservoir fisheries cannot be excluded, available evidence suggests that most recorded populations in Azerbaijan likely represent natural components of the Ponto-Caspian crayfish fauna.

The modern re-evaluation of the taxonomy of Astacidae taxonomy by Crandall & De Grave (2017), reshaped the interpretation of earlier Azerbaijani records. *Pontastacus* was revised to include eight valid species together with one species represented by two recognized subspecies, accompanied by updated synonymies that clarified numerous long-standing nomenclatural ambiguities in the Ponto-Caspian region (Crandall & De Grave, 2017). Subsequent studies (Aliyev, 2023; Aliyev et al., 2023) confirmed the continued but declining presence of *P. leptodactylus* and *P. pylzowi*, while failing to verify freshwater occurrences of Caspian taxa such as *P. pachypus* and *P. kessleri* within inland waters of Azerbaijan. Although these species have been reported from both brackish and occasionally freshwater habitats elsewhere in the wider Ponto-Caspian region, available records from Azerbaijan are restricted to coastal or estuarine environments of the Caspian Sea, and no stable inland freshwater populations have been documented to date. These findings underscore the gap between historical assumptions and present-day species distributions.

Early observations, mid-20th-century surveys, and modern taxonomic reassessments reveal how shifting nomenclature, evolving morphological criteria, and inconsistent sampling contributed to a fragmented understanding of Azerbaijan's crayfish fauna. We examine herein the current population distribution of all crayfish taxa historically attributed to Azerbaijan, based on the synthesis of historical literature, modern taxonomic studies, and available regional surveys.

A comprehensive summary of the distributional status, habitat associations, and supporting sources for all crayfish species reported from Azerbaijan is provided in [Supplementary material Table S1](#); the spatial distribution of confirmed and records in [supplementary material Fig. S2](#).

Verified Azerbaijan Records of Freshwater Crayfishes

Pontastacus leptodactylus (Eschscholtz, 1823)

Pontastacus leptodactylus is consistently documented as the most widespread freshwater crayfish species in Azerbaijan, occurring extensively throughout the Kura River basin and major reservoirs such as Mingachevir, Shamkir, Yenikənd (Yenikand), and Varvara (Kasymov, 1965a; Khalilov & Akhmedov, 1983; Aliyev et al., 2023). There are also reports of the presence of the species in the waters of Nakhchivan, including the Araz Reservoir in the Nakhchivan Autonomous Republic along the border with Iran (Bayramov, 1990, 1993, 2007;

Bayramov *et al.*, 2001; Talibov *et al.*, 2017). The species has also been reported from brackish areas along the Caspian Sea, particularly near river mouths (Cherkashina, 1970). Its broad regional presence is further supported by earlier faunal assessments (Machino & Holdich, 2006) and global taxonomic syntheses (Crandall & De Grave, 2017). Despite its historical abundance, recent studies indicate that *P. leptodactylus* populations have experienced significant declines, largely attributable to overharvesting (Aliyev *et al.*, 2023).

***Pontastacus pylzowi* (Skorikov, 1907)**

Pontastacus pylzowi is an endemic, headwater-associated species inhabiting cold, fast-flowing mountain streams on the southern slopes of the Greater Caucasus, with confirmed localities in the Alazan, Ayrichay, Adzhiganchay, Goychay, and Girdymanchay tributaries (Derzhavin, 1951a; Kasymov, 1965b; Machino & Holdich, 2006). Although its range appears relatively stable, recent assessments indicate that population numbers are declining (Aliyev, 2023).

Unverified Azerbaijan Records of Freshwater Crayfishes

***Pontastacus eichwaldi* (Bott, 1950)**

The species, described from the southwestern Caspian coast near Lankaran, has long been associated with Azerbaijan's coastal zone (Crandall & De Grave, 2017). Although Crandall & De Grave (2017) recognized sub-specific status of the species (e.g., *Pontastacus eichwaldi eichwaldi*), we follow the species-level designation *P. eichwaldi* because subspecies boundaries and distributions within the Caspian basin remain insufficiently resolved. No modern field studies have nevertheless confirmed its presence in either inland or coastal ecosystems, leaving its Azerbaijan occurrence possible but unverified. Several species repeatedly listed in the literature have not been corroborated by recent field observations or museum material (Holdich, 2002; Machino & Holdich, 2006; Crandall & De Grave, 2017; Bláha *et al.*, 2021). The records of *P. colchicus* in Soviet-era literature, is treated below questionable. Isolated mentions of other *Astacus* or *Pontastacus* taxa lack verifiable specimens and likely reflect taxonomic confusion. These records are therefore best interpreted as unsubstantiated and excluded from the current freshwater fauna.

Brackish/Marine Ponto-Caspian Species

***Pontastacus pachypus* (Rathke, 1836)**

Pontastacus pachypus, commonly known as the “thick-clawed” or “Caspian” crayfish, is a primarily brackish-water species inhabiting the Caspian, Black, and Azov Seas. Across its broader Ponto-Caspian distribution, the species has occasionally been reported from low-salinity or freshwater environments, particularly in river mouths, estuarine zones, or coastal lagoons influenced by freshwater inflow (e.g. Holdich, 2002; Kouba *et al.*, 2015; Imentai *et al.*, 2023). Recent studies further indicate that the current geographic range of the species extends to both fresh- and brackish-water habitats in parts of Eastern Europe and the Caspian basin,

including Ukraine, Russia, and several countries surrounding the Caspian Sea such as Azerbaijan, Kazakhstan, and Turkmenistan (Kouba *et al.*, 2015; Policar *et al.*, 2017; Imentai *et al.*, 2023). It has been historically recorded along Azerbaijan's Caspian coastline, including Baku and the Kura estuary (Derzhavin, 1951a; Cherkashina, 1970, 1999a, b; Holdich, 2002; Holdich *et al.*, 2006, 2009; Kouba *et al.*, 2015; Kawai & Crandall, 2016; Bláha *et al.*, 2021; Imentai *et al.*, 2023). Available records from Azerbaijan are restricted to coastal or estuarine sectors of the Caspian basin, and there are currently no well-documented occurrences demonstrating the existence of stable inland freshwater populations within the country. Although listed among Azerbaijan's crayfish fauna (Kasymov, 2004; Kouba *et al.*, 2014), its occurrence in Azerbaijan appears to be largely associated with brackish coastal habitats rather than clearly documented inland freshwater ecosystems. Contemporary field data are lacking, and the current population status in the region remains uncertain (Policar *et al.*, 2017).

***Pontastacus kessleri* (Schimkewitsch, 1886)**

The species was reported by Kasymov (2004) from the Caspian Sea sector of Azerbaijan, but not supported by recent reviews. Its occurrence in freshwater is improbable, and historical records from Azerbaijan require re-evaluation.

Questionable Records

***Pontastacus colchicus* Kessler, 1876**

Although sometimes listed as occurring in Azerbaijan (Machino & Holdich, 2006), earlier authorities clearly indicate that this taxon does not naturally occur in Azerbaijan and has never established following past introductions (Derzhavin, 1951b; Kasymov, 1965a).

Drivers of Historical and Contemporary Distribution Patterns

Geological and biogeographical context

Azerbaijan's connection to the broader Ponto-Caspian drainage network facilitated the historical exchange of crayfish lineages. *Pontastacus pachypus* and *P. eichwaldi* demonstrate strong ties to Caspian coastal environments, while *P. leptodactylus* expanded inland through both natural dispersal and human-mediated translocations.

Anthropogenic pressures

Intensive exploitation during the mid-20th century, combined with habitat modification and potential pollution in lower Kura stretches, contributed to population declines in *P. leptodactylus* (Mammadov & Akhmedov, 2019; Aliyev *et al.*, 2023). *P. pylzowi* faces pressure from land use change and the reduction of cold headwater flows.

Misidentifications

Confusion regarding subspecies and morphological forms contributed to inflated species lists throughout the Soviet era. The modern recognition of *Pontastacus* species based on

Crandall & De Grave (2017) significantly reduces historical ambiguity. Overall, Azerbaijan's confirmed freshwater crayfish fauna consists solely of *P. leptodactylus* and *P. pylzowi*. Other names historically attributed to the region represent either coastal species not found in freshwater habitats, misidentifications, or legacy records incompatible with contemporary taxonomic standards.

Both confirmed freshwater species show signs of decline: *P. leptodactylus* due to overharvesting and habitat degradation in the Kura basin, and *P. pylzowi* due to anthropogenic impacts on cold mountain streams. The uncertain status of *P. eichwaldi* represents an additional knowledge gap, particularly given its historical association with the Lankaran coastal zone. Renewed field surveys, including targeted sampling of the southern Caspian coast and mountain tributaries, are urgently needed.

Future research priorities

Research priorities include molecular barcoding to confirm species boundaries and resolve historical synonymies, particularly within the *P. leptodactylus* complex. In addition, systematic and standardized sampling across both freshwater and brackish habitats is necessary to reassess current distributional limits and verify the presence or absence of historically reported taxa. Long-term population monitoring programs should be established to evaluate trends in abundance, population structure, and conservation status of both endemic and declining species, especially *P. pylzowi*. Furthermore, comprehensive assessments of anthropogenic pressures, including habitat modification, water abstraction, pollution, and overharvesting, are required to better understand their impacts on crayfish populations in major river basins and headwater systems.

Supplementary Material

Supplementary material is available at the *Journal of Crustacean Biology* online.

Table S1. Distribution of crayfishes reported from Azerbaijan
Fig. S2. Spatial distribution of confirmed records of crayfishes of Azerbaijan.

Funding

None declared.

Acknowledgements

We thank the two anonymous reviewers for their helpful comments and suggestions.

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