1 Native Range and Status in the United States

Native Range
From Froese and Pauly (2018):

“South America: Rio de Janeiro, Brazil southward to Uruguay and Argentina [Lopez et al. 1987].”

According to CABI (2018), *P. caudimaculatus* is native to Argentina, Brazil, Paraguay, and Uruguay.

Status in the United States
This species has not been reported as introduced or established in the United States. In a search of the literature and online aquarium retailers, no evidence was found to suggest that this species is in trade in the United States.
Means of Introductions in the United States
This species has not been reported as introduced or established in the United States.

Remarks
From CABI (2018):

“Although “dusky millions fish” is the FAO sanctioned common name, the name “caudo” is prevalent particularly in England and America. In Australia *P. caudimaculatus* is commonly referred to as the “one-spot livebearer”.”

“*P. caudimaculatus* is closely related to, and morphologically similar to *Gambusia* spp.; most notably *G. holbrooki* and *G. affinis*. Due to the translocation of *Gambusia* worldwide as mosquito biocontrol agents, these species are likely to be found co-occurring with nonindigenous *P. caudimaculatus* populations. This similarity may have led to *P. caudimaculatus* being identified as *G. holbrooki* in Australia and New Zealand (Trendall and Johnson, 1981; McDowall, 1999; Maddern, [2007]).”

“As *P. caudimaculatus* is not commonly kept as an ornamental species, public awareness of its existence, and its identification, is low.”

2 Biology and Ecology

Taxonomic Hierarchy and Taxonomic Standing
From ITIS (2018):

“Kingdom Animalia
  Subkingdom Bilateria
    Infrakingdom Deuterostomia
      Phylum Chordata
        Subphylum Vertebrata
          Infraphylum Gnathostomata
            Superclass Actinopterygii
              Class Teleostei
                Superorder Acanthopterygii
                  Order Cyprinodontiformes
                    Suborder Cyprinodontoidei
                      Family Poeciliidae
                        Subfamily Poeciliinae
                          Genus *Phalloceros*
                            Species *Phalloceros caudimaculatus* (Hensel, 1868)”

From Fricke et al. (2019):

**Size, Weight, and Age Range**
From Froese and Pauly (2018):

“Max length : 3.5 cm SL male/unsexed; [Castro and Casatti 1997]; 6.0 cm TL (female)”

**Environment**
From Froese and Pauly (2018):

“Freshwater; brackish; pelagic; pH range: 7.0 - 8.0; dH range: 9 - 19; non-migratory.”

From CABI (2018):

“*P. caudimaculatus* […] will survive temperatures as low as 5°C (Hoedman, 1974). Sterba (1966) states it can be kept in unheated aquaria at 12-18°C but prefers 20-24°C, and will survive temperatures as high as 38°C (Rietzler et al., 1981).”

**Climate/Range**
From Froese and Pauly (2018):

“Tropical”

**Distribution Outside the United States**
Native
From Froese and Pauly (2018):

“South America: Rio de Janeiro, Brazil southward to Uruguay and Argentina [Lopez et al. 1987].”

According to CABI (2018), *P. caudimaculatus* is native to Argentina, Brazil, Paraguay, and Uruguay.

Introduced
From Maddern (2008):

“*[P. caudimaculatus]* was introduced to Malawi in Africa (Jubb 1977; Welcombe 1981) and is restricted to the Nswadzi River, a small tributary of the Ruo River. It has not spread into the latter river system since release in the early 1950s (Denis Tweddle, J.L.B. Smith Institute of Ichthyology, pers. comm.). In New Zealand, this species was recorded in several livestock water troughs near Kamo, in Northland (McDowall 1999), although the current status of this population remains unclear (McDowall 2004). Within Australia, *P. caudimaculatus* has been recorded in four Australian states/territories. Its presence has been noted in outdoor ponds in South Australia (Arthington & Lloyd 1989), and in the Todd River Drainage near Alice Springs, Northern Territory (Unmack 2001). Similarly, the present status of these populations is
unknown. In 2002, *P. caudimaculatus* was collected from a series of ponds in Long Reef Golf Course in New South Wales near Sydney (Rowley et al. 2005), and despite attempts to eradicate this population using rotenone, it thrives at the latter locality (Rayner & Creese 2006).

“[…] *P. caudimaculatus* is widely dispersed throughout the Swan/Canning catchments in metropolitan Perth [Western Australia] and occupies drains and highly modified urban creeks as well as larger rivers, such as the Canning River, that contain endemic ichthyofauna.”


“The survey discovered a strong population of *P. caudimaculatus* within permanent reaches of upper Willunga Creek [greater Adelaide region, South Australia].”

**Means of Introduction Outside the United States**

From CABI (2018):

*P. caudimaculatus* was introduced to Malawi in the early 1950s, possibly as a mosquito biocontrol agent (Jubb 1977; D Tweddle, JLB Smith Institute of Ichthyology, South Africa, personal communication, 2005).”

From McDowall (2004):

“Another poeciliid, the caudo (*Phallocera caudimaculatus*), could have been a "close call". It was initially thought that a population in a stockwater pond near Whangarei [New Zealand] had originated in a small stream nearby (McDowall 1999), though subsequent information has not corroborated that and the status of this species in the wild remains uncertain.”

From Maddern (2008):

*Phalloceros caudimaculatus* may have been translocated and released as a mosquito biocontrol agent in Australia (Arthington & Blühdorn 1995), and Malawi (Denis Tweddle, J.L.B. Smith Institute of Ichthyology, pers. comm.). Ornamental fishes have been released into dams to control mosquitos in Queensland (McKay 1978), and it is reasonable to speculate that *P. caudimaculatus* may have been maintained in outdoor ponds in South Australia (Arthington & Lloyd 1989) for this purpose.”

While conducting field research between 2002 and 2006 in metropolitan Perth, anecdotal reports and direct conversations suggested that *P. caudimaculatus* was irregularly collected from two locations for stocking outdoor ponds and private aquaria, and at least once for commercial profit.”
**Short Description**  
From Froese and Pauly (2018):

“Dorsal soft rays (total): 7-9. Dorsal fin short; pectoral fin small, not reaching back to level of pelvic fin bases; body and fins covered with a profusion of black patches; tip of gonopodium of male with a distinctly downturned hook [McDowall 1999].”

From Global Invasive Species Database (2018):

“A small, stout fish with a slightly arched back and deep belly in front of the anal fin. The mouth is small and upturned, and the tail is rounded. Males possess a modified anal fin called a gonopodium. This has a terminal hook and is used for internal fertilisation of the female. Colour can be variable, but is often grey-olive with dark coloured scale margins, which form a hatching pattern on the sides. Jet black blotches and speckles are distributed over the sides and on the fins (McDowall, 2000).”

**Biology**  
From Froese and Pauly (2018):

“Inhabits swamps and drains of Perth metropolitan area, Western Australia [introduced range; Allen et al. 2002]. Omnivorous.”

“After about 24 days gestation, 10 to 50 young are born.”

From CABI (2018):

“*P. caudimaculatus* is a fecund, livebearing fish with wide environmental tolerances and broad dietary preferences. Of particular note is that the species is cold tolerant and thus will occupy temperate aquatic environments unlike many invasive tropical ornamental fishes.”

“*P. caudimaculatus* collected from Brazilian streams [where native] were omnivorous, with detritus/organic matter and algae principally consumed (e.g. Sabino et al., 1990; Aranha et al., 1998; Aranha and Caramaschi, 1999; Esteves and Lobon[-Cervia], 2001). The diet of *P. caudimaculatus* in southwestern Australia [where introduced] is similar with larger fish consuming vegetal matter/algae, silt and detritus and lesser quantities of terrestrial and aquatic invertebrates. Juveniles displayed greater carnivorous tendencies though they also consumed appreciable quantities of vegetal matter and detritus (Maddern, 2003).”

**Human Uses**  
From Froese and Pauly (2018):

“Aquarium: commercial”
From CABI (2018):

“*P. caudimaculatus* is sold as an aquarium fish and is also used as a biocontrol agent.”

From Maddern (2008):

“Although *P. caudimaculatus* appeared to be a popular aquarium species decades ago (e.g. Innes 1946; Frey 1970; Axelrod et al. 1971; Hoedman 1974) when fewer fish species were available commercially, it was mentioned only once (Sandford 2004) in a brief survey of current aquarium literature aimed at general hobbyists (e.g. Mills 1984; Dawes 1987; Stanislav 1992; Bailey & Dakin 1998; Alderton 2003; Evans 2006). *Phalloceros caudimaculatus* was not observed in commercial aquarium outlets in metropolitan Perth in 2005, although it was available from aquarium shops in the past (Kevin Griffiths, pers. comm.). Corfield et al. (2007) listed the importance of *P. caudimaculatus* as a commercial aquarium fish species in Australia as “low”. The species is kept by hobbyists in NSW (Rowley et al. 2005) and is available commercially in Victoria (Anon 2007).”

**Diseases**

No OIE-reportable diseases (OIE 2019) were reported for this species.

Hassan et al. (2008) reported *P. caudimaculatus* as being a host for “a parasitic copepod found on the skin and gills of freshwater fishes” known as *Lernaea cyprinacea L*.

**Threat to Humans**

No threats to humans were reported for this species.

**3 Impacts of Introductions**

From CABI (2018):

“[…]* P. caudimaculatus* thrives in urban, aquatic habitats (e.g. degraded creeks and storm-water drains) and has dominated habitats in southwestern and eastern Australia that previously contained high densities of *Gambusia holbrooki*, a highly invasive species with documented impacts on aquatic ecosystems and endemic ichthyofauna. Eradication was attempted from ponds in NSW [New South Wales], Australia using rotenone which failed. *P. caudimaculatus* is listed as a Class 2 noxious species under the NSW Fisheries Management Act and is listed on the Global Invasive Species Database (ISSG) (http://www.issg.org).”

“No definitive data is available on the environmental impact of *P. caudimaculatus*, though generalisations can be made regarding the diet, reproduction and ecology of the species. Although *P. caudimaculatus* principally consumes algae/detritus (Maddern, 2003), appreciable quantities of aquatic invertebrates are also eaten. Thus, there is great potential for competition with indigenous ichthyofauna (Maddern, 2003; Morgan et al., 2004). For example, *P. caudimaculatus* is found in the Canning River in southwestern Australia, which is also inhabited by the indigenous carnivorous fishes *Edelia vittata* (Percichthyidae), *Bostockia porosa*
(Percichthyidae) and *Galaxias occidentalis* (Galaxiidae) (Storey et al., 2000). Furthermore, there is also the potential for *P. caudimaculatus* to consume the fry of these sympatric native fishes.”

“Comparisons can also be made between the documented negative ecological impacts of *G. holbrooki* (e.g. McKay 1978; Merrick and Schmida, 1984; Arthington, 1991; Gill et al., 1999; Allen et al., 2002; Morgan et al., 2004) and the potential impacts of *P. caudimaculatus* as an introduced species. In southwestern Australia, *G. holbrooki* undergoes population explosions (in summer), and population crashes (in winter) as noted by Pen and Potter, (1991) in the Collie River south of Perth. These authors speculated that these drastic population changes allowed the indigenous species to successfully co-exist with *G. holbrooki*. Co-occurring natives reproduced during late winter/early spring when the densities of *G. holbrooki* were lowest, thus predation of offspring was minimised. Sampling of *P. caudimaculatus* populations indicates that this does not occur with only moderate seasonal changes in fish densities (Maddern, 2003; Maddern, [2007]). Thus, predation of the juveniles of co-occurring indigenous species may be greater in waterways inhabited by *P. caudimaculatus*, in comparison with those inhabited by *G. holbrooki*.”

From Global Invasive Species Database (2018):

“Displacement of native freshwater fishes through competition is the main potential impact for this species (Morgan et. al, 2004).”

From Rowley et al. (2005):

“The ecological impacts of nonindigenous populations of *P. caudimaculatus* remain unknown. However, given the well-documented negative effects of the closely related *G. holbrooki* (Gill et al. 1999; NSW NPWS 2003) such impacts could be substantial and unpredictable. For example, there is some evidence to suggest that *P. caudimaculatus* may be capable of displacing *G. holbrooki*.”

“However, there appears to be little impact of *P. caudimaculatus* on native species, in either Western Australia or at LRGC [Long Reef Golf Course, near Sydney, Australia], some of which are likely to consume similar aquatic invertebrates to *G. holbrooki* (Kennard et al. 2001).”
4 Global Distribution

Figure 1. Known global distribution of *Phalloceros caudimaculatus*, reported from eastern South America, Malawi, and Australia. Map from GBIF Secretariat (2019). Occurrences in the ocean and in the Amazon, Tocantins, and São Francisco River basins of Brazil were excluded from the climate matching analysis because they are outside the described native range of the species and there is no known introduction history within Brazil. The occurrence in central Australia was excluded from the climate matching analysis because it does not represent an established population.

5 Distribution Within the United States

No introductions have been reported for the United States.

6 Climate Matching

Summary of Climate Matching Analysis

The climate match (Sanders et al. 2018; 16 climate variables; Euclidean Distance) for *Phalloceros caudimaculatus* in the contiguous United States is high overall, represented by a Climate 6 score of 0.177. (Scores of 0.103 or greater are classified as high.) Locally, much of the southern contiguous United States had high or medium match, with the highest matches occurring in California, peninsular Florida, coastal North Carolina, and along the Gulf Coast. Low matches were found in New England and in the Great Lakes, north-central, Rocky Mountain, and Pacific Northwest regions of the contiguous United States.
Figure 2. RAMP (Sanders et al. 2018) source map showing weather stations selected as source locations (red; Brazil, Paraguay, Uruguay, Argentina, Malawi, Australia) and non-source locations (gray) for *P. caudimaculatus* climate matching. Source locations from GBIF Secretariat (2019).
Figure 3. Map of RAMP (Sanders et al. 2018) climate matches for *Phalloceros caudimaculatus* in the contiguous United States based on source locations reported by GBIF Secretariat (2019). 0=Lowest match, 10=Highest match.

The “High”, “Medium”, and “Low” climate match categories are based on the following table:

<table>
<thead>
<tr>
<th>Climate 6: Proportion of (Sum of Climate Scores 6-10) / (Sum of total Climate Scores)</th>
<th>Climate Match Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.000≤X&lt;0.005</td>
<td>Low</td>
</tr>
<tr>
<td>0.005&lt;X&lt;0.103</td>
<td>Medium</td>
</tr>
<tr>
<td>≥0.103</td>
<td>High</td>
</tr>
</tbody>
</table>

7 Certainty of Assessment

A considerable amount of information on the biology, ecology, and distribution of *Phalloceros caudimaculatus* is available for review. Although nonnative populations are established in multiple locations, the realized impacts of *P. caudimaculatus* introduction are largely unknown except for displacement of another nonnative species. Without further information on impacts of introduction, certainty of this assessment is low.
8 Risk Assessment

Summary of Risk to the Contiguous United States

*Phallocerus caudimaculatus*, Dusky Millions Fish, is a small, stout fish species native to Brazil, Argentina, and Uruguay. Possessing a high tolerance to a wide range of water temperatures, *P. caudimaculatus* can thrive in a wide range of habitats where it primarily feeds on detritus and algae. Introductions have been reported in Malawi, Australia, and New Zealand, and established populations are confirmed for Malawi and Australia. Some introductions could have been intentional attempts to control mosquito populations. *P. caudimaculatus* used to be popular in the aquarium trade in Australia but is now rare. No impacts of *P. caudimaculatus* on native species have been documented, although there is concern over competition and predation on native fishes. *P. caudimaculatus* has been documented to displace previously established nonnative populations of a closely-related species, *Gambusia holbrooki*. History of invasiveness is classified as “None Documented.” No introductions of *P. caudimaculatus* have been reported within the contiguous United States. However, the overall climate match is high, with most of the southern contiguous United States having high or medium match. Certainty of assessment is low because of the lack of information on impacts of introduction. The overall risk assessment category for *P. caudimaculatus* is “Uncertain.”

Assessment Elements

- History of Invasiveness (Sec. 3): None Documented
- Climate Match (Sec. 6): High
- Certainty of Assessment (Sec. 7): Low
- Remarks/Important additional information: None
- Overall Risk Assessment Category: Uncertain

9 References

Note: The following references were accessed for this ERSS. References cited within quoted text but not accessed are included below in Section 10.


### 10 References Quoted But Not Accessed

**Note:** The following references are cited within quoted text within this ERSS, but were not accessed for its preparation. They are included here to provide the reader with more information.


Maddern, M. G. 2003. The distribution, biology and ecological impacts of three introduced freshwater teleosts in Western Australia. Murdoch University, Perth, Australia.


