

Further feral poeciliid fish in New Zealand fresh waters, with a key to species

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Abstract The poeciliid fish, *Phalloceros caudimaculatus* (commonly referred to as the “caudo”), is recorded from the wild for the first time, occurring in stock-water troughs on a farm near Kamo in Northland, New Zealand. The populations in the stock troughs reputedly came from a nearby stream c. 10 years ago, although a preliminary search has failed to reveal them to be there now. Presence of an additional exotic fish in New Zealand fresh waters is a matter for concern, and requires management. To facilitate recognition of *P. caudimaculatus*, and its distinction from other poeciliids present here, a diagnosis is provided to enable identification, together with notes on natural history, and a key for the identification of the five species of Poeciliidae now known from natural waters in New Zealand.

Keywords New Zealand; Poeciliidae; *Phalloceros caudimaculatus*; caudo; feral population

INTRODUCTION

The family Poeciliidae (the “livebearers”) comprises nearly 300 species of freshwater and brackish-water fishes that occur naturally in south-eastern North America, Central America, northern South America, and Africa (Rosen & Bailey 1963; Nelson 1994). Although no poeciliids are endemic to natural habitats in New Zealand, many species are popular aquarium fishes, and some of them are widely kept in captivity by local aquarists. Much of the appeal of poeciliids to aquarists derives from their being easily kept, added to which is their habit of producing live young (rather than eggs) so that they breed relatively easily and repeatedly in aquaria. The same habit makes them aggressive and successful invaders when released into new ecosystems. In addition to the value of poeciliids as aquarium species, some species have a reputation for being valuable for the control of mosquito infestations in wetlands, and have been very widely introduced throughout the world as a biological control mechanism (Gerberich & Laird 1968, 1985; Welcomme 1981).

Four poeciliid species have hitherto been reported from the wild in New Zealand (McDowall 1990). The western gambusia or mosquitofish, *Gambusia affinis* (Baird and Girard), is known to have been present in New Zealand waters since c. 1930. Though the circumstances surrounding its original introduction and release into the wild are poorly documented, it is known that this fish was introduced for mosquito control (McDowall 1990). Records in the NIWA New Zealand Freshwater Fish Database (McDowall & Richardson 1983) show that it has become very widespread in northern New Zealand (Fig. 1). Three further species have more recently been reported as established in the wild, presumably as a result of releases from captivity by aquarists, though absolutely nothing is documented regarding their origin, release, or establishment. The sailfin molly, *Poecilia latipinna* (Le Sueur), is present in geothermal wetlands west of Tokaanu at the southern end of Lake Taupo (Fig. 1 (▲)); it was formerly also present in the Waipahihī Stream at the northern end

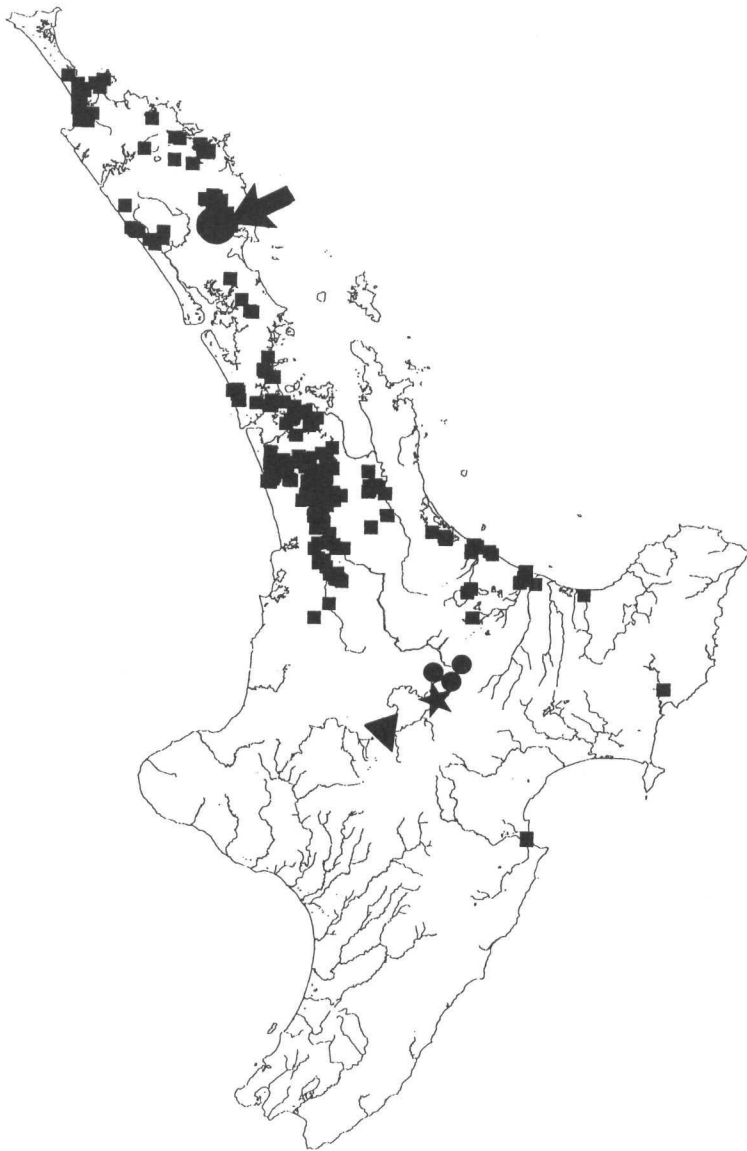


Fig. 1 Distribution of introduced poeciliids in New Zealand. (◐●, *Phalloceras caudimaculatus*; ■, *Gambusia affinis*; ▲, *Poecilia latipinna*; ●, *Poecilia reticulata*; ★, *Xiphophorus helleri* (data from NIWA New Zealand Freshwater Fish Database and McDowall 1990).)

of the lake (Winterbourn & Brown 1967; Fig. 1 (★)) until extirpated there by a change in the flow conditions of this geothermal stream (McDowall 1990). The guppy, *Poecilia reticulata* Peters, has been reported from several small geothermal streams near Reporoa in the central North Island (Fig. 1 (●)), and periodically spreads down stream to occupy waters along the margins of the much cooler Waikato River nearby, possibly only in summer; it, too, was once present in the Waipahihi Stream, near Taupo (Fig. 1 (★)), but was extirpated under the circumstances described for the sailfin molly, above. The

swordtail, *Xiphophorus helleri* Heckel, has also been found in the Waipahihi Stream (Fig. 1 (★)), its release and survival there apparently post-dating the events that had earlier extirpated the sailfin molly and guppy (McDowall 1990).

A further poeciliid has now been identified from New Zealand fresh waters. This fish was first noticed as being distinct from the western gambusia by Mr Mike McGlynn, in an aquarium in Paihia, Northland, and its origins were traced to several stock-water troughs on a farm near Kamo in Northland (Fig. 1 (◐●)). The farm owner reported that the fish had

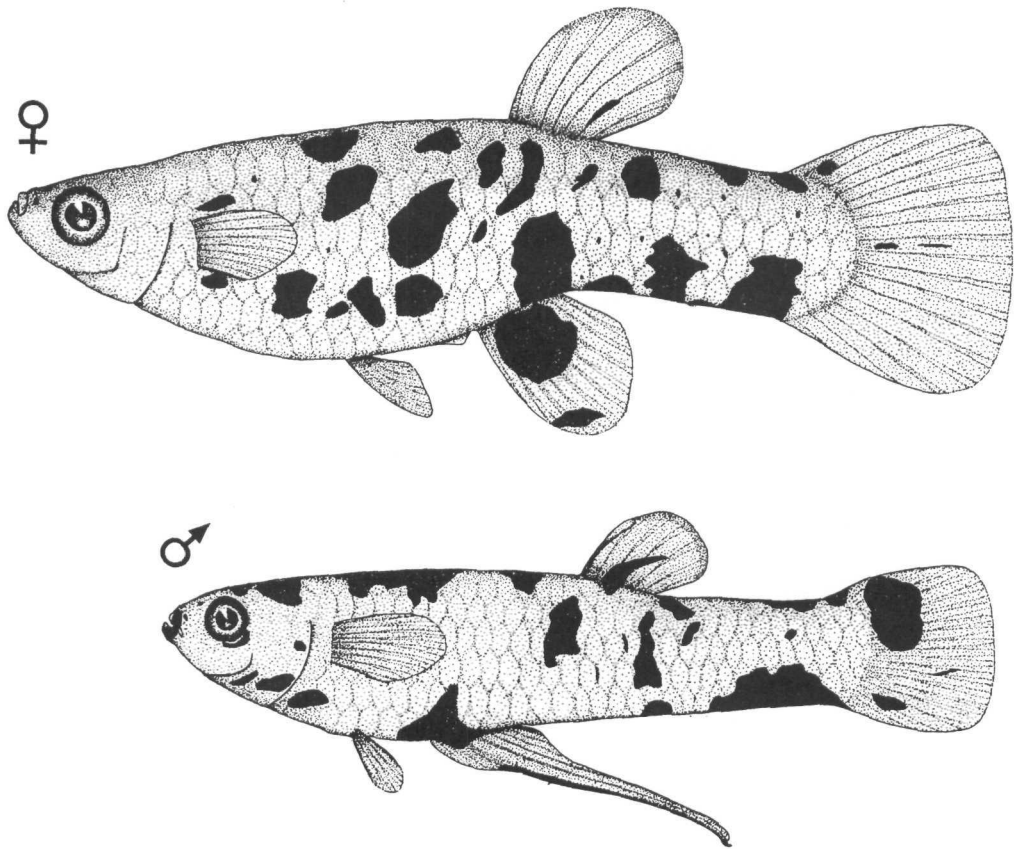


Fig. 2 *Phalloceros caudimaculatus* (Hensel 1862), from a stock-water trough near Kamo, Northland, New Zealand: above, female (38 mm total length (TL)); below, male (27 mm TL) (NMNZ P.36209).

entered the troughs c. 10 years earlier, when water was pumped from a nearby stream. Study showed these fish to be the caudo, *Phalloceros caudimaculatus* (Hensel 1868) (the species name often misspelt *caudomaculatus*), a quite well-known aquarium fish that originates in eastern South America—in Brazil from about Rio de Janeiro southwards, and also in Paraguay and Uruguay (Rosen & Bailey 1963; Wheeler 1985). It is commonly known as “caudo”, and sometimes “dusky millionsfish”. This species is less popular amongst aquarists than many other livebearers owing to its lack of spectacular coloration and the absence of elaborate fin development, though it is regarded by some as worthy of greater popularity than it has (Axelrod et al. 1980). Absolutely nothing is known of where the New Zealand fish, now present in the several farm troughs, originally came from or when they became established, but it must be presumed that they originated in aquaria and were

released at some time. There are anecdotal reports of similarly-coloured poeciliid-like fishes from around Auckland (M. McGlynn pers. comm.), though there is presently insufficient information to identify them.

The status of the stocks near Kamo is somewhat unclear. Notwithstanding the report of the landowner on whose property the stock troughs are found, that the fish were pumped into the troughs from a nearby stream c. 10 years ago, a search of the relevant stream in the vicinity, and down stream, of the pump intake revealed no *P. caudimaculatus* present there. The failure to find the species there could have several explanations including: their being present in very small numbers; being present further up stream than was searched with occasional movement down stream to the pump intake site; recent extirpation of the species from the stream; or their origin was not the stream but some other source. In view of this

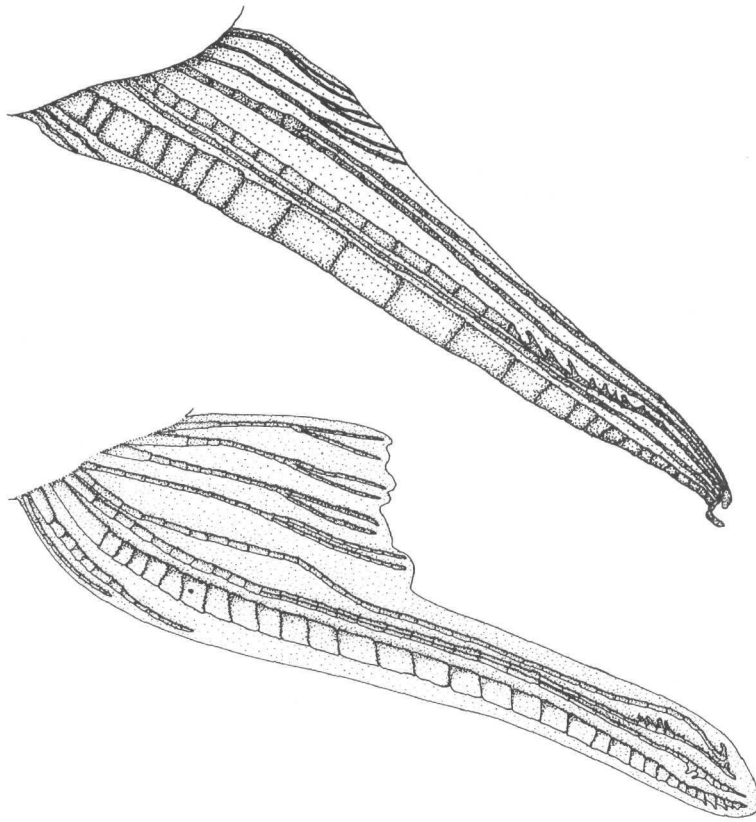


Fig. 3 Gonopodium of male: above, *Phalloceros caudimaculatus*; below, *Gambusia affinis*.

uncertainty, it seems important that the possible existence of a feral population, in this stream near Kamo, and perhaps elsewhere, should be documented. The superficial similarity of *P. caudimaculatus* to *G. affinis* may have meant that, up until now, anyone seeing them just dismissed them as unusually strongly-coloured specimens of the latter species. *P. caudimaculatus* has been recorded in Western Australia in very similar circumstances—found in the wild and originally confused as *Gambusia* and the source of the wild population totally undocumented (Trendall & Johnson 1981). The importance of accurate identification is accentuated by significant recent increasing interest in dispersion of *G. affinis* only in part prompted by the arrival in New Zealand of additional species of mosquito, some with the capacity to carry viruses of human health concern. Therefore it is critical that information should be accessible to facilitate identification, should there be further reports of *C. caudimaculatus*, or other poeciliids, and also to ensure that the identity of any fish transferred is known with certainty.

DIAGNOSTIC CHARACTERS

Description is based on samples from a stock trough at a property in Pipiwai Road, Kamo, Northland and deposited in the Museum of New Zealand sample number NMNZ P.36209.

Female (Fig. 2 (above))

A small stocky fish, compressed towards tail; eye large; mouth terminal, small, and upturned; a single, small, rounded dorsal fin with 7–9 fin rays, fin origin distinctly posterior to mid-point of body length and posterior to level of anal fin origin; tail with 13–14 principal caudal rays, fin rounded to truncated; anal fin with 8–10 rays, origin about midway between upper limit of opercular opening and base of tail; pelvic fins with 5 rays, small, mid-abdominal; pectoral fins small, paddle-shaped and high on sides behind head, 9–10 rays; scales large, 28–30 along sides, no lateral line.

Coloration Colour in natural range reported to be highly variable. Stocks established in New Zealand have background colour grey-olive, with distinct

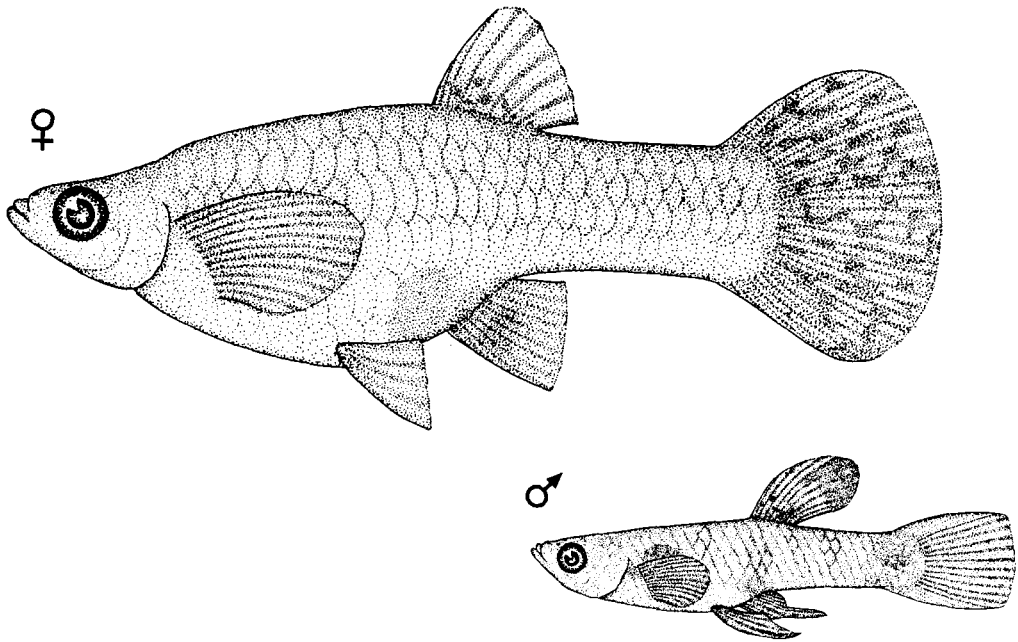


Fig. 4 *Poecilia reticulata* Peters, 1859: above, female (44 mm total length (TL)); below, male (23 mm TL) (after McDowall 1990).

hatching on sides, especially upper sides, caused by dark pigmentation matching scale margins; distinctive blue-green iridescence on opercles; widespread, highly erratic and variable bold, and sometimes striking, jet black blotches and speckling on sides, spreading onto fins; fins otherwise pale, brassy-gold, fringe of dorsal fin dusky; belly silvery-white; eye silvery gold.

Size The female is reported to grow to 60 mm total length (TL).

Male (Fig. 2 (below))

Resembles female but somewhat more slender; pelvic fins small and, at maturity, migrate forward to lie below pectoral fins, pelvics when pressed against abdomen scarcely reaching origin of anal fin; anal fin origin forward of one third distance between opercular opening and base of tail, fin highly modified to form an intromittent gonopodium which is long, exceeding half distance from opercular opening to base of tail, and has a tripartite tip which forms a distinctly downturned hook (Fig. 3 (above)); by contrast, the tip in *G. affinis* is not downturned, Fig. 3 (below)).

Coloration Largely as for female, though there may be more extensive black blotching in male than female.

Size The male grows to only c. 30 mm TL.

Natural history The natural history of *P. caudimaculatus* seems little reported in the literature, though it is variously said to be an omnivore or a carnivore (small aquatic invertebrates) in still or gently-flowing, fresh and brackish waters (Paxton & Hoese 1989; Skelton 1993). It is capable of gestating more than one brood of young at a time (Sterba 1962) and produces litters of 20–80 young at intervals of 5–6 weeks (Wheeler 1985). Trendall & Johnson (1981) report that the breeding season in Western Australia is during autumn.

Published comment on temperature tolerances suggest that this fish has the adaptability to colonise still and slow-flowing waters throughout much of New Zealand e.g., Hoedman (1974) noted that it is found in “mountain creeks” within its natural range in Brazil where water temperatures may be as low as 5°C. Preferred temperatures are in the low–mid 20s. Thus, substantial range extension can be anticipated in New Zealand if there is no control of populations.

Welcomme (1981) reported that this species has been introduced into Malawi for the control of mosquitoes, where it became established but was regarded as undesirable (Jubb 1977). However, it

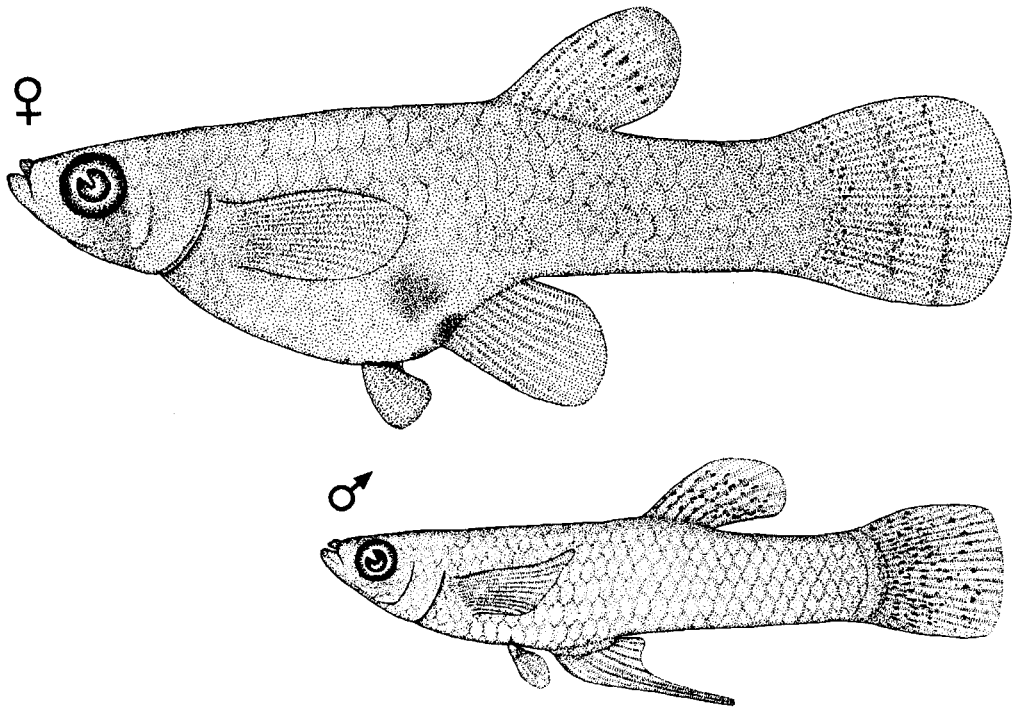


Fig. 5 *Gambusia affinis* (Baird and Girard 1854): above, female (28 mm total length (TL)); below, male (16 mm TL) (after McDowall 1990).

appears to be little-used in biological control, and in a review of larvivorous fish (Gerberich & Laird 1985) was not listed amongst species regarded as useful in the biocontrol of mosquitoes.

Establishment of an additional exotic fish species in New Zealand waters is a matter for concern. In general, exotic fish species have the potential to seriously perturb natural ecosystems (McDowall 1968; Townsend 1991a). Moreover another poeciliid species, *Gambusia affinis*, that has long been present here, has an enduring reputation for being aggressive and troublesome when introduced into new fish communities; this reputation was based initially on reports by Myers (1965), and has been augmented by reports of ecosystem distortion as a result of predation on aquatic invertebrates (Stephanides 1964; Hurlburt et al. 1972). Gerberich & Laird (1985) were distinctly scornful of this reputation and vigorously promoted the use of *G. affinis* in mosquito control. However, although studies in laboratory tanks of interactions between this species and the endemic New Zealand black mudfish, *Neochanna diversus* Stokell, did not reveal harmful interactions on the latter (Barrier & Hicks 1994), Rowe (1998) actually

watched aggressive behavioural interactions between *G. affinis* and the dunelakes galaxias, *Galaxias gracilis* McDowall, in Lakes Waikare and Taharoa (near Dargaville) resulting in severe mutilation of living fish, and death for some, confirming Myers' (1965) concerns about the aggressive behaviour of *G. affinis*. Moreover, Rowe (1987) reported a decline in the abundance of the dragonfly *Hemianax papuensis*, and related circumstantial evidence that *G. affinis* contributed to this decline.

Thus prolonged, and now accelerating, concern about the effects of *G. affinis* (McDowall 1968, 1979, 1990; McCullough 1998; Grace 1999) appear well justified. Studies of the diet of *G. affinis* in New Zealand (Mansfield & McArdle 1998) certainly indicate that dragonfly larvae form part of the diet of *G. affinis*, making credible the suggestions of a decline in dragonfly abundance owing to predation by *G. affinis*. In the light of these facts, the presence of another exotic poeciliid fish species in natural habitats in New Zealand is a matter for some concern.

Reports on the behaviour of *P. caudimaculatus* suggest that it is a relatively non-aggressive and rather "peaceable", docile species in captivity

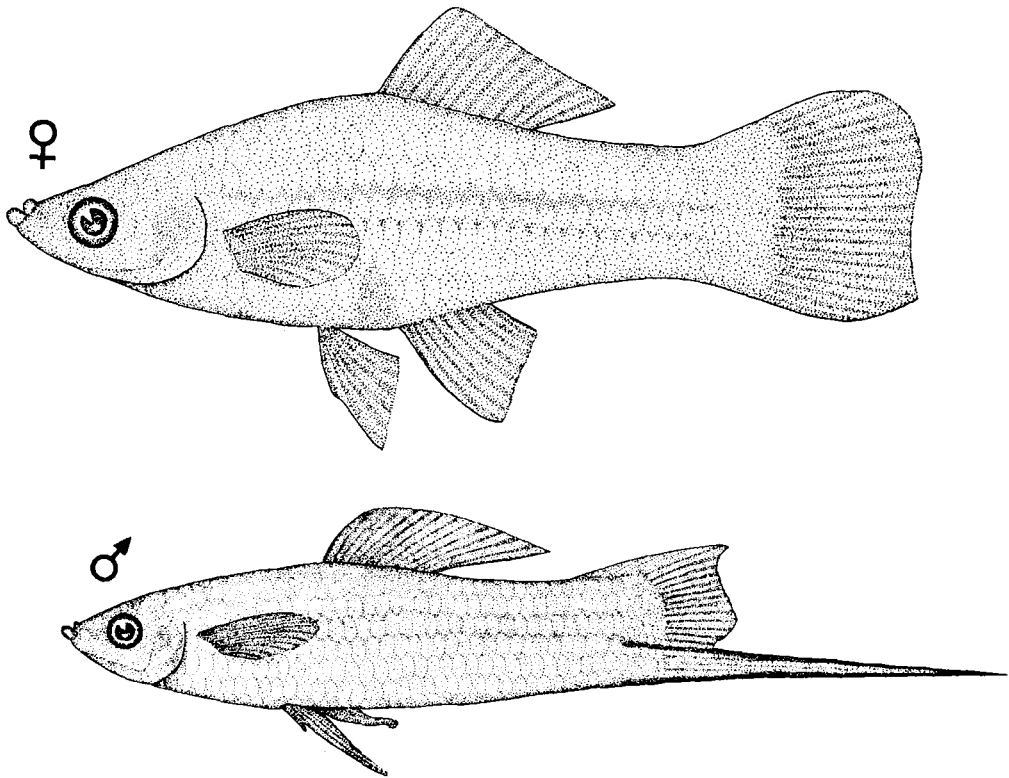


Fig. 6 *Xiphophorus helleri* Heckel 1848: above, female (64 mm total length (TL)); below, male (71 mm TL, excluding sword) (after McDowall 1990).

(Sterba 1962; Axelrod et al. 1980), and this may partly alleviate such concerns. Nevertheless it appears a time to avoid risks and to take action to prevent spread of an additional potential threat to our aquatic biota. New Zealand's indigenous freshwater fauna has already suffered substantial impacts from the introduction of exotic fish species on both indigenous fishes (McDowall 1968, 1979, 1990; Townsend & Crowl 1991), and stream insects (Tillyard 1920; Flecker & Townsend 1994; McIntosh & Townsend 1995). These fish introductions have varied from approved and lawful, to unauthorised and unlawful (McDowall 1990). It seems to me appropriate that there should be conservative, precautionary management of this possible feral occurrence of *P. caudimaculatus* as generally recommended for fish introductions by Townsend (Townsend 1991a,b; Townsend & Winterbourn 1991). In the present instance of *P. caudomaculatus* there needs to be a thorough search for any feral stocks and consideration of extermination of any discovered—based only in part, on an evaluation of any known harmful impacts

where elsewhere established as an exotic species. In all likelihood the potential impacts of this species in our fish communities will only emerge with time and may not reflect experience elsewhere.

Regardless of any actions taken to control feral populations, possession of *P. caudimaculatus* in captivity/aquaria, including having populations in stock troughs on farms as discussed above, is not proscribed by any existing statute. Therefore re-release or re-escape of fish into the wild remains a constant threat, not only from *P. caudimaculatus*, but also from other relatively cold-tolerant freshwater fish species that are widely and lawfully kept by New Zealand aquarists (of which there is probably quite a list, e.g., the cyprinid white cloud mountain minnow, *Tanichthys albonubes* Lin 1932).

The finding of *P. caudimaculatus* highlights our vulnerability to the release of additional exotic fish species. Importation of all cold-water fishes into New Zealand was prohibited under the Animals Act 1970, during the 1970s, so that additional fish species likely to survive in the wild

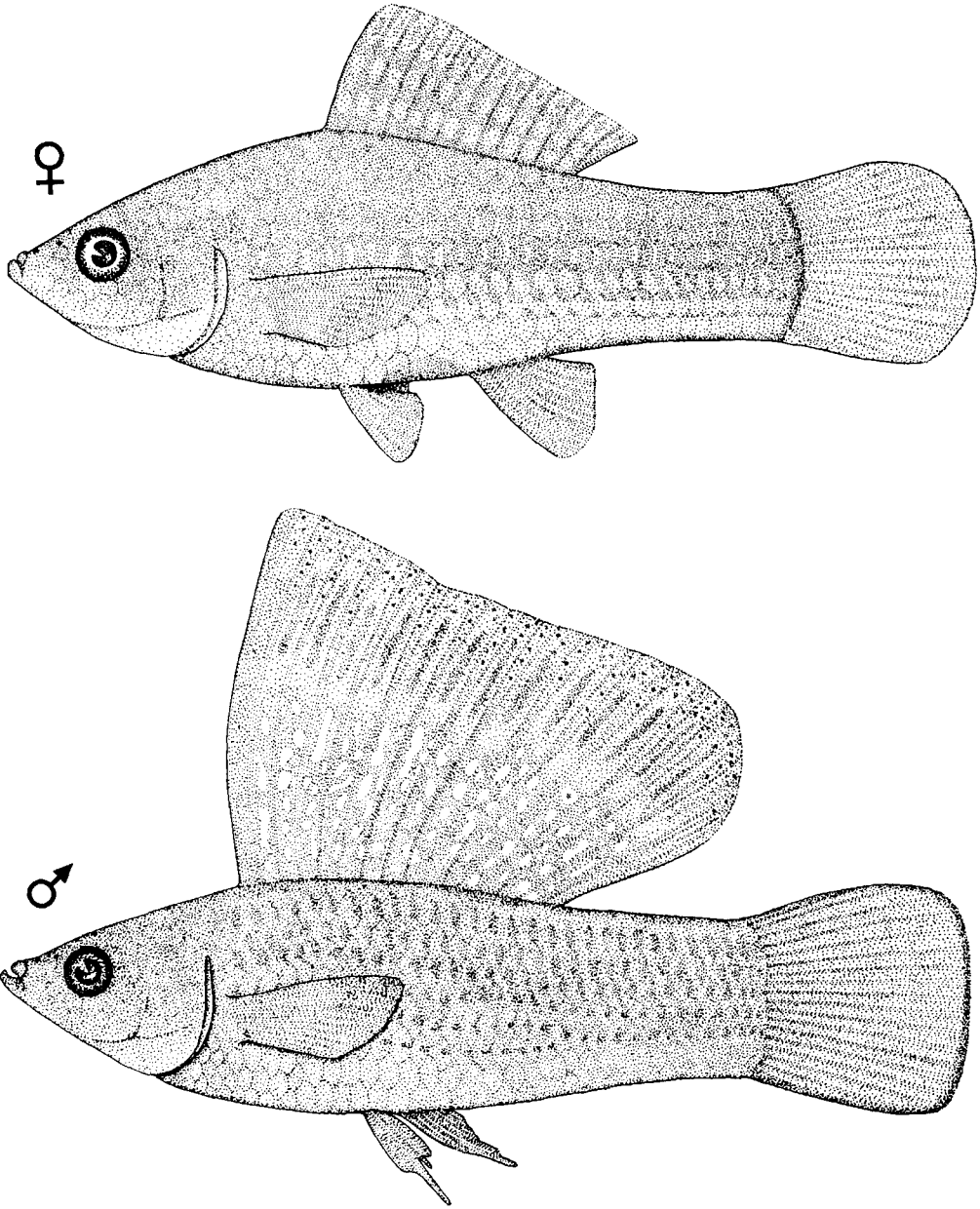


Fig 7 *Poecilia latipinna* (Le Sueur 1821): above, female (65 mm total length (TL)); below, male (72 mm TL) (after McDowall 1990).

may no longer be brought here lawfully (McDowall 1990). However, not only have additional species been brought here clandestinely since that prohibition was invoked (such as European rudd, *Scardinius erythrophthalmus* Linnaeus), but this and other species that were

already present have been actively and widely distributed, some probably by accidental transport but others by deliberate, illegal activities of individuals with little concern for either the law or the well-being of our aquatic ecosystems (McDowall 1990). *P. caudimaculatus* is the latest

of these, although the circumstances relating to its presence remain unknown.

A key for identification of poeciliid fishes known

from natural waters in New Zealand is included, below, to facilitate identification of poeciliid fishes presently known here.

KEY TO SPECIES OF POECILIID FISH REPORTED FROM NEW ZEALAND FRESH WATERS

- 1. Dorsal fin short with 7–9 rays; gonopodium longer than head 2
 Dorsal fin long with 11 or more rays; gonopodium shorter than head 4
- 2. Pectoral fin with only 9–10 rays; 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 (Fig. 3) *Phalloceros caudimaculatus* (Fig. 2)
 Pectoral fins with 12 or more rays; fin larger, reaching back further than level of pelvic fin bases; no profusion of black patches on body and fins, though there may be finer speckling on some fins; tip of gonopodium of male straight, not downturned or hooked (Fig. 3) 3
- 3. Dorsal fin origin directly over anal fin origin in female and a little behind anal fin origin in male; 22–28 lateral scales; male with brightly coloured patches on trunk and fins *Poecilia reticulata* (Fig. 4)
 Dorsal fin origin distinctly behind anal fin origin in both sexes; 29–32 lateral scales; males drably coloured and lacking bright coloration *Gambusia affinis* (Fig. 5)
- 4. Scales cover basal half of caudal fin, lower margin of fin extended as a long sword in male; origin of dorsal fin at or a little behind level of pelvic fins, dorsal fin of male no bigger than that of female; bright orange coloration with a narrow mid-lateral black stripe *Xiphophorus helleri* (Fig. 6)
 Scales do not cover basal half of caudal fin; lower margin of caudal fin not extended as a long sword in male, which may have a greatly enlarged dorsal fin; origin of dorsal fin distinctly anterior to level of pelvic fins, just behind head in male; coloration more drab, with longitudinal rows of orange-gold spots along sides, no black mid-lateral stripe *Poecilia latipinna* (Fig. 7)

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