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The Empire gudgeon *Hypseleotris compressa* – a male from Rockhampton, Queensland

N.A.

THE GENUS *HYPSELEOTRIS* OF SOUTHEASTERN AUSTRALIA: its identification and breeding biology

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Introduction

My infatuation with this diminutive group of fishes began early in my native fish "career", around 1986. In fact, it was probably the second native fish I ever dipnetted! I discovered them in northern Victoria while on angling trips poking around in billabongs with ten inch aquarium nets and bringing them home and observing them in aquaria.

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... genus *Hypseleotris* ...

Since then I have developed a strong interest in this poorly known group, having kept and collected them throughout their ranges in southeastern Australia. For most people today this group remains a mystery, few can accurately identify which species is which, little published information exists, and for what is written, uncertainty often exists as to which species is being discussed. Adding to this uncertainty, many of the published photos are misidentified, which is not surprising given all the confusion.

The genus *Hypseleotris* was first named by Theodore Gill in 1863. As presently recognised, *Hypseleotris* has a broad distribution well beyond Australia. The taxonomy of the group outside of Australia is a mess, some feel only two species are represented, others suggest there may be several (Douglas Hoese, Tony Gill pers. comm.). Chameleon gudgeon (*H. cyprinoides*) is the most widespread species, occurring from Africa through Japan and south into Indonesia and northern New Guinea (NG). Another widespread species is the rainbow prigi (*H. guentheri*), occurring on several South Pacific islands. Two other species occur, *H. tohizonae* (no common name) in Madagascar and golden sleeper (*H. dayi*) in South Africa. Both species are closely related to chameleon gudgeon and may indeed be conspecific. There may also be several undescribed *Hypseleotris* species in the Philippines.

Within Australia, the empire gudgeon (*H. compressa*) is the most widespread, occurring from the Genoa River in Victoria (Vic) around the northern coast to the Murchison River in Western Australia (WA) in addition to southern NG. It was first described by Gerard Kreft from the Clarence River, New South Wales (NSW) in 1864 as *Eleotris compressus*. It was also described and named around nine additional times through 1897 due to its widespread range and early confusion! All the aforementioned *Hypseleotris* spp. are typically found at low elevation and are commonly found in estuarine conditions. Hence, their higher salinity tolerance may partially explain their wide occurrence. Presently eleven described and undescribed species are recognised from Australia with most being restricted in distribution. Western Australian species were revised by Hoese and Gerald Allen in 1983. Three new species were described, slender gudgeon (*H. ejuncida*), Barnett River gudgeon (*H. kimberleyensis*), and Prince Regent gudgeon (*H. regalis*), none of which have apparently been kept in aquaria. All are fairly restricted in range in the Kimberley. Additionally, golden gudgeon (*H. aurea*) occur in the southern Pilbara region, it was described by Bruce Shipway in 1950. He reported it to be a peaceful species which took prepared foods readily. According to Hoese and Allen these species fall into three groups on the basis of fin colouration, (1) empire gudgeon, (2) golden and slender gudgeon, and (3) Prince Regent and Barnett River gudgeon. All are considered to be evolved from an empire gudgeon like ancestor and are of a different lineage to the southeastern species. In 1989, a new species was found in the upper Katherine River in the Northern Territory (NT). It is under study by Helen Larson and appears to be related to Barnett River gudgeon. According to Larson it readily adapts to captivity. A further species was recorded by Hamar Midgley from the Limmen Bight River (NT) that was thought to resemble firetail gudgeon (*H. galii*), unfortunately the specimens have been misplaced and further

collecting in that area has not revealed additional examples (Larson pers. comm.). Hence, this species remains mysterious.

Prior to 1980, besides empire gudgeon, two species were considered to be present in southeastern Australia, firetail gudgeon in coastal drainages and western carp gudgeon (*H. klunzingeri*) in the Murray-Darling Basin and southeastern coastal drainages of Queensland (Qld) (where it was thought it may have been introduced). Firetail gudgeon was described by Douglas Ogilby in 1897 as *Carassiops galii* based on specimens introduced into the Sydney Botanical Gardens. They were discovered by Albert Gale, who spawned them in aquaria in or just prior to 1897! The first western carp gudgeon were reported from the Murray River in South Australia (SA) by Klunzinger in 1872 (and again in 1880) who mistook them for chameleon gudgeon. In 1898, Ogilby recognised Klunzinger's mistake and renamed the fish after him. Hoese, Larson, and Leighton Llewellyn revised the southeastern species and updated and expanded their distributions in 1980. Two additional species were recognised but not described, Midgley's carp gudgeon (*Hypseleotris* sp. 4 [or A]) and Lake's carp gudgeon (*Hypseleotris* sp. 5 [or B]). My own collecting and aquarium observations resulted in the recognition of an additional species which is hereby referred to as Murray-Darling carp gudgeon (*Hypseleotris* sp. 3). This species had been collected previously, its distinctiveness just was not recognised. Details of its peculiarities will be provided below.

The observations given here are based upon experiences from collecting and keeping western, firetail, Lake's, Midgley's, and Murray-Darling carp gudgeons from throughout the Murray-Darling Basin, Cooper Creek (Lake Eyre Basin), Bulloo R., and coastal Qld and NSW. Firetail gudgeon is the only species I have not spawned. When I mention carp gudgeon, it is the aforementioned species to which I am referring.

Identification

The following is a visual guide for distinguishing southeastern carp gudgeons. Some characters used, such as colour, are subject to interpretation, i.e., "red" versus "orange." Only experience with these fishes will overcome this. Errors in identification are common due to the fact that few resources have been available upon which to base identifications. Hence, most books have pictures of misidentified species. A list of incorrect photos with their correct identification is provided in Appendix 1.

Western carp gudgeon

Body colour: Grayish. Male body does not get as dark as any of the other species. Females have a yellowy-orange belly when in spawning condition, it is silvery at other times. There is usually a dark pattern associated with the margins of the midlateral scales that is not as prominent in the other species except empire gudgeons.

Fin colour: During spawning season, male anal and dorsal fins are blood red with a thin bright white line on the outer edge of the fin, tail is blood red. During other times of the year, fin colouration, especially the caudal, is far less pronounced and especially the white edging. Females have clear fins year round. ...

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Western carp gudgeon, *H. klunzingeri*, male, Brisbane River system N.A.



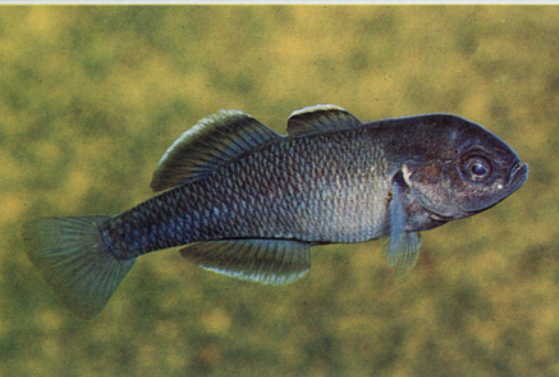
Western carp gudgeon, *H. klunzingeri*, female, from Gunbower Is., Murrumbidgee River N.A.



Lake's carp gudgeon, *Hypseleotris* sp. 5, male from Gunbower Is., Murrumbidgee River system N.A.



Lake's carp gudgeon, *Hypseleotris* sp. 5, female, collected from Gunbower Island N.A.



Midgley's carp gudgeon, *Hypseleotris* sp. 4, male from Fairbairn Dam, Fitzroy River system, Queensland N.A.



Midgley's carp gudgeon, *Hypseleotris* sp. 4, female, collected from Gunbower Island N.A.

Head bluntness: Males are the least blunt headed of all five species.

Size: Common to 4cm, rarely reaches 5-6 cm.

Distribution: Cooper Creek, Bulloo River, Murray-Darling Basin, coastal drainages from the Hunter River (NSW) north to Herbert Creek (~80 km north of Rockhampton, Qld). Coastal populations differ slightly to inland ones as they are stockier, have a blunter/deeper head, and have more prominent scale markings.



Murray-Darling carp gudgeon, *Hypseleotris* sp. 3, male from Reedy Swamp, Goulburn drainage N.A.



Murray-Darling carp gudgeon, *Hypseleotris* sp. 3, female. Collected from Reedy Swamp N.A.



Firetail gudgeon, *H. galli*, male from Coochin Creek, south-east Queensland N.A.



Firetail gudgeon, *H. galli*, female, Coochin Creek. Note the black anal spot N.A.

Midgley's carp gudgeon

Body colour: Brown-yan. Body in males often goes very dark when fish become excited, either when feeding, defending a territory against another male, or trying to attract a female. Females have a bright orange belly, sometimes turning pink when in spawning condition, at other times it is silvery.

Fin colour: Comments in the literature stating this species is somewhat variable depending on location are incorrect. This may in part be due to confusion with Murray-Darling carp gudgeon. Individuals of this species show the most extreme variation in degree and intensity of colouration due primarily to changes in mood and to a lesser extent, the time of year, males being brighter around spawning time. Variation in colouration with season is not as great as it is for some other carp gudgeons, as this species does not get as intensely coloured. The anal and dorsal fins are coloured as follows, basal third is clear to faint red; mid third consists of a blackish band; outer thinner band is usually white, often with a tinge of orange on the extreme edge; sometimes this white band may go from faint to bright blue. The caudal fin is clear or slightly dusky. Females have clear fins.

Head bluntness: Males have the bluntest head, as do Lake's carp gudgeon.

Size: Up to 4 cm. Some authors have stated they grow to 6cm, again, this is likely due to confusion with Murray-Darling carp gudgeon as I have never seen Midgley's carp gudgeon approach that size.

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Distribution: Cooper Creek, Bulloo River, Murray-Darling Basin, and Qld coastal drainages from the Brisbane River north to the Tully River.

Lake's carp gudgeon

Body colour: Brownish-tan. Body in males often goes dark when fish become excited, either when feeding, defending a territory against another male, or trying to attract a female. Female belly is orange during spawning season, turning bright pink when close to spawning, non spawning colouration is silvery.

Fin colour: The basal two thirds of the anal and dorsal fins is generally blackish, sometimes turning faintly orange when the fish is excited, bordered by a thin orange line with a thinner white line on the edge of the fin. Caudal fin is clear or slightly dusky. Variation in colouration with season is not as great as some other carp gudgeons as this species only has a small area of finnage that gets any obvious colouration. Females have clear fins.

Head bluntness: Identical to Midgley's carp gudgeon.

Size: Up to 4 cm.

Other distinctive features: They lack scales on the dorsal surface between first dorsal fin and head and the lower stomach from the anus forward. The "bald" area on the head frequently extends back around the base of the first dorsal fin to at least past its midpoint.

Distribution: upper Cooper Creek and Murray-Darling Basin. Also found in the Burnett River (coastal Qld), however I feel it is likely they were introduced accidentally as contaminants with hatchery raised sport fish as this has also occurred in southern Vic and southeastern SA with other carp gudgeons.

Murray-Darling carp gudgeon

Body colour: Brownish-tan. Males do not usually get quite as dark as Midgley's or Lake's carp gudgeon, (although occasionally they will). Female belly is orange during spawning season going bright pink when close to spawning. At other times it is silvery.

Fin colour: The bottom third of the anal and dorsal fins is faint orange; mid third is blackish; this is bordered by a brighter orange line (which looks very similar to the brighter marginal red line in male firetail gudgeons), often with a hint of a thin white line on the outside of the fin edge as well. Tail is orangy. Intensity of fin colouration, especially the caudal fin, varies seasonally, being brightest around spawning time. Females have clear fins.

Head Bluntness: Not as blunt as Midgley's and Lake's carp gudgeon, but more so than western carp gudgeon. Most similar to firetail gudgeon.

Size: Commonly found to 4 cm, reaching about 6 cm.

Other distinctive features: In males, the anal and second dorsal fins are distinctively elongated and pointed, although not as extremely elongated as large firetail gudgeons may get. Females can be difficult to distinguish from Midgley's carp gudgeon outside of spawning season.

Distribution: Murray-Darling Basin although patchy in occurrence. It appears that two forms exist, one in the Darling, one in the Murray; they differ slightly in appearance, finnage, and colouration.

Firetail gudgeon

Body colour: Brownish-tan. Males generally do not get quite as dark as Midgley's or Lake's carp gudgeon (although occasionally they will). The female's belly is orange during spawning season, going bright pink when close to spawning, otherwise it is silvery.

Fin colour: The bottom third of the anal and dorsal fins are faintly red; mid third is blackish; this is bordered by a bright red line. Tail is red. Intensity of fin colouration varies somewhat with the time of year being brightest around spawning time. Females have clear fins.

Head Bluntness: not as blunt as Midgley's and Lake's carp gudgeon, but more so than western carp gudgeon. Most similar to Murray-Darling carp gudgeon.

Size: commonly found to 4 cm, reaching about 6 cm maximum.

Other distinctive features: anal and second dorsal fins are the most elongated and pointed in males of all the carp gudgeons. Large males have anal and second dorsal fins that reach beyond the caudal fin origin. Females can be separated from all other carp gudgeons as they have a black urogenital papilla (it looks like a black spot just by their anus). Females from the Burnett River north lack this black spot making identification more difficult.

Distribution: coastal drainages from the Georges River (Sydney) north to Baffle Creek (Qld.), with another in Waterpark Creek north of Rockhampton (where soft-spined sunfish and honey blue eye also occur).

Hybrids

I have seen a few fish that appeared to be hybrids. There is no easy way to identify these specimens except experience.

Natural Habitats

Murray-Darling Basin

Within the Murray-Darling basin carp gudgeons are ubiquitous in all habitats, typically only being absent in areas experiencing low temperatures. They are found upstream to the uppermost reaches of most Darling River tributaries and as well as those to the lower Murray River in SA. However, in Murray River tributaries upstream of the Murrumbidgee River they are typically found in areas below ~220 m. In the Murrumbidgee and Lachlan rivers they occur upstream to ~550 m. It is relatively rare to find only one species occupying an area (in my experience only western carp gudgeon, or occasionally Murray-Darling carp gudgeon). Typically western carp gudgeons are the only species found in arid drainages like the Warrego and Paroo rivers where I have only found a single Midgley's carp gudgeon. Wherever Midgley's carp gudgeons are found western carp gudgeons will also occur. Lake's carp gudgeon tends to be widespread like western and Midgley's carp gudgeons, but far less numerically abundant, hence all three are commonly found together with Lake's carp gudgeon only being found in small numbers. Murray-Darling carp gudgeon are not continuous throughout their range. I have found isolated populations in the following areas; Murray River and tributaries in SA, Murray River at Cohuna and Albury, Goulburn and Broken Rivers (Vic), Bland Creek (south of Forbes), Bogan River (NSW), Dumaresq River (NSW and Qld.) and parts of the Condamine River (Qld.). Within these areas it is typically common and all four species can be ...

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found together. Its patchy distribution has likely contributed to it not being previously recognised. Undoubtedly more populations exist, however, its patchiness does seem real as in some areas such as the Murray River between Cohuna and Albury I have sampled thousands of carp gudgeons and never seen Murray-Darling carp gudgeon.

Cooper Creek and Bulloo River

Within Cooper Creek and the Bulloo River western carp gudgeon are ubiquitous in all riverine habitats. Midgley's carp gudgeons are also widespread, though less abundant except in the upper reaches of the Barcoo River where Lake's carp gudgeon also occurs. I have only collected as far downstream as Avington Station (west of Blackall) and Lake's carp gudgeon were present at most sites above here, albeit in low numbers.

Coastal drainages

Only firetail and western carp gudgeon occur in coastal NSW. Both seem to be patchy in the southern portion and found at lower elevations. However, from at least the Clarence River north they appear to be found in both up and lowland regions and are somewhat less patchy. These two species and Midgley's carp gudgeon are found from the Brisbane River north to Baffle Creek in most habitats and elevations. Western carp and firetail gudgeons are frequently found together. Midgley's carp gudgeon are a little more patchy in occurrence and are virtually always found in conjunction with one or both species. North of Baffle Creek, Midgley's and western carp gudgeon are widespread and relatively common, and one population of firetail gudgeon is known from Waterpark Creek. North of Herbert Creek, only Midgley's carp gudgeon are present. They have a patchy, although broadly continuous distribution to the Murray-Tully Swamps and are found at all elevations.

General Observations

Typically, the largest population sizes occur in habitats where considerable cover exists, usually aquatic vegetation since this is the densest cover. They tend to be more abundant in billabongs or intermittent streams with abundant aquatic vegetation rather than flowing habitats. However, they are also found in barren shallow turbid lakes with little cover, albeit in low numbers, and perennial streams/rivers whether they be small, large, turbid, or clear. Few obvious habitat preferences amongst the species exist. Murray-Darling carp gudgeon seem to be most commonly found in smaller creeks where the foothills meet the plains as well as billabongs. These creeks tend to be intermittent with narrower deeper pools with some instream structure such as wood debris or aquatic plants. Western carp gudgeon seem to cope much better with harsh conditions in low gradient intermittent streams with shallow turbid water and little cover other than some wood debris. This is usually the type of habitat where they are the only hypseleotrid found or at least the most abundant one.

Aquarium Care

Carp gudgeons are not commonly available in aquarium stores hence, one needs to collect their own (none are threatened or endangered so this should not be a big problem). They are typically quite abundant, thus they can be easily

collected with anything from seine nets to small aquarium nets—the first firetail gudgeon I ever saw was collected in an aluminium can in the Logan River (Qld)! I lifted it out of the water, emptied it back into the river and heard a tink tink tink. I added water, and then emptied it into a bucket. To my surprise, I found a beautiful male looking back at me! The most likely places to find carp gudgeons are where aquatic vegetation exists or where overhanging vegetation and debris exists over an undercut bank. Spring is typically ideal, as young adult sized fish are common (2-3cm) and they are more likely to be coloured up making identification easier. Larger fish are more difficult to find later in the season, although very young fish are usually common then. Adult fish are typically quite robust. Losses during handling in the field and transportation are usually minimal provided basic care is given.

I prefer to keep groups of fish in 2 ft aquariums. I provide a number of potential hiding places using rocks, or any other suitable objects without giving them so much cover that they are never observed. It also helps to strategically provide hiding places such that you can see into them! Carp gudgeons do not have a reputation for being jumpers, however, since I keep lids on all my aquaria it is difficult for me to be sure! When I first introduce wild fish I avoid feeding them for a couple of days. I have never consistently been able to get carp gudgeons to eat artificially prepared foods like flakes and pellets. A few individuals will, although some just will not. I usually start feeding by frequently offering small amounts of live food while I sit and watch. I feel this helps to train the fish, such that when I enter the room they all come out expecting food! After a few days I start feeding dead foods such as frozen brine shrimp and bloodworms. Occasionally it can be difficult to get wild fish to eat food that does not move, hence that is why I begin with live food. Once they are used to eating frozen foods they can typically be weaned onto most “real” foods as they will pick at anything thrown in their tank. I have fed live and frozen brine shrimp, daphnia, blood worms, and mosquito larvae as well as finely chopped up frozen fish such as carp.

As is typical for most Australian fish, water conditions are not critical. They do not appear to be fussy in regards to pH, hardness, or salinity. They can likely tolerate temperatures from 4-37°C, although they certainly appear most comfortable between 15 and 25°C. The most important factors in maintaining healthy fish are good quality food and regular large water changes. I have found them to be quite compatible with other slow moving fishes. I say slow moving, as I always tend to keep fish with similar swimming abilities together or else I find the faster species get too much food. Carp gudgeons are not typically aggressive towards other species, although they can get a little nippy if they get too hungry. I suspect most species will live for 3-5 years in captivity, and I have heard of empire gudgeons being kept for over 20!

Breeding Biology

Of all the Australian species, only four (empire, firetail, western, and Midgley's carp gudgeons) have anything on their breeding biology published. Here I provide additional observations on the latter two species and Lake's and Murray-Darling carp gudgeons. All carp gudgeons are sexually dimorphic, with males being brighter coloured than females which are typically relatively plain, ...

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except for their belly colouration. It is a good idea to provide a number of potential spawning sites. Males tend to be territorial and will setup home in a small cave, tube, or flowerpot which is where they will spawn. Western carp gudgeon could probably benefit by having something hard and vertical to spawn on near the water surface. The four species treated here all mature once they reach around 3 cm.

Western carp gudgeon

Clarence Blewett appears to have been the first person to breed this species in 1928. He noticed a male trying to entice a female into its territory, so he moved them to a tank on their own. Much to his surprise, three days later, on February 27th they spawned, not amongst the rocks he laid out for them, but ~5 cm from the water's surface. He stated, "on the third day after spawning the eggs disappeared, apparently eaten by the parents." It is more likely they hatched and the fry were too small for him to notice.

John Lake observed that spawning occurred in shallow water from 5 to 25 cm below the water surface. Spawning was observed at 22.5°C at 3 pm during early November in ponds at Narrandera (NSW). Prespawning behaviour consisted of males nudging females. Eggs were laid on sticks or grass and were 0.4-0.5 mm in diameter. Females examined had between 1-2000 ova present. Males maintained a vertical position, either tail up or tail down fanning and guarding eggs until hatching which occurred 47-53 hours later. Newly hatched larvae are 1.8-2.1 mm long. After hatching, larvae drift head first towards the bottom, then suddenly turn 180 degrees and swim vertically for 1-5 cm. After 5 days feeding commences and by day 6 they are free swimming. While some algae was found in the gut, no larvae survived beyond 9 days due to a lack of suitably sized food. Lake observed that spawning occurred over several weeks and appeared related to temperature rather than flooding. Based on the number of ova present in females, it appears that females lay all or most ova in one spawning. It is unknown if females spawn more than once per season.

Some have questioned the identity of the species that Lake observed since no specimens were retained and three species occur at Narrandera. However, my following observations make it clear it was western carp gudgeon. I have only had one spawning despite having kept this species for many years, albeit in low numbers. My fish were from the Murray River in Chinaman's Lagoon between Cobram and Yarrawonga (Vic). About two or three fish were being kept in a 45 cm aquarium with only a box filter. No gravel or additional ornaments were present. Eggs were first observed on the 23rd of December around 10 pm. Temperature was not recorded, although would have been in the low 20's. Eggs were estimated to be about 0.5 mm in diameter spread over an area of ~ 40 x 60 mm within 5-10 cm of the water's surface. The next day at 8 pm the temperature was 17°C and by 10 am on the 25th most had hatched (42 hours after being first observed). The fry had a small rounded head with a long thin tail being around 3 mm long overall. Fry drifted around the tank tail up and head down, making occasional bursts towards the surface. By the 27th, all fry had disappeared, probably due to predation by the adults. Unique egg size, hatching time, and fry behaviour are all specific to western carp gudgeon relative to

southeastern Australian carp gudgeons covered in this article. Interestingly, there are some similarities between this species and empire gudgeon. Empire gudgeon lay several thousand eggs (they are a larger species). The eggs are about half as large, and they hatch in half the time of western carp gudgeon. The fry also have the same drifting patterns with occasional bursts towards the surface. This, combined with the similar dark scale margin pattern down the midline of smaller empire gudgeon, suggests they could be more closely related than they are presently considered to be.

Midgley's carp gudgeon

Ray Leggett described the spawning of Midgley's carp gudgeon as follows. It spawns at 20-24°C. A female will deposit 250-500 eggs in less than one hour on a leaf or log. Hatching occurs in 6-9 days. He initially raised the fry on egg yolk followed by infusorians.

I had many spawnings in aquaria, mostly with fish from Reedy Swamp at Shepparton (Vic) and Fairbairn Dam near Emerald (coastal Qld). There were no apparent differences in breeding biology between coastal and Murray-Darling populations. Most spawnings I have notes on occurred during late November through early January when water temperatures were around 20-24°C. However, none of my tanks were regulated, hence it could have been either the time of year, and/or temperature that induced spawning. Eggs were normally laid on the roof of a cave and guarded by the male, females play no further role once eggs are laid. Eggs hatch in 8-9 days. Up to around 400 eggs are laid. Eggs were estimated to be approximately 0.8 mm. One male will spawn with several females over a season, although it is not clear if females spawn more than once. Based on belly colouration (which is indicative of readiness to spawn) only a few females appeared ready at any one time. Upon hatching fry were about 4 mm. Fry would live for around 2-3 days with no food. I tried raising fry in green water and I was able to get a few to live up to ~6 days and on one occasion one lived for 11 days. Vinegar eels were too large to be a first food.

Actual spawning was observed twice, the first time on fish from Reedy Swamp, the second from Fairbairn Dam. On the first occasion, spawning was in progress at 1 pm. The male appeared to have the female trapped in the cave. The male had his fins erect and every now and again would quiver for a second or two. Every so often he would turn upside down to presumably fertilise the eggs which were being laid on the upper side of the cave. The female appeared to be upside down the entire time, however she was difficult to see. A small male entered the cave and the spawning male chased him out. At the same time the female also left the cave. The spawning male quickly lost his dark body and bright fin colouration. Despite the female's efforts to re-enter the cave and presumably continue spawning the male refused to let her in. In this situation, spawning likely ended prematurely as the female still had a large belly. The second spawning was not as well documented, although it appears similar except I noted that the male did not appear to nudge the female at all as reported for western carp gudgeon by Lake. Based on a photograph of the eggs, they appear to be laid in random trails, often following a linear pattern, although at other times they were irregular in pattern. There also tended to be a lot of vacant space between the eggs, at times up to 4 mm. ...

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Lake's carp gudgeon

I only had two spawnings of this species and neither made it to hatching. The fish were originally collected in a billabong in the upper Murray River near Jingellic (NSW). Fish were collected the 22nd of December, 1992. They were housed in a 45 cm aquarium with little cover except some 1 inch pvc pipe. Spawning occurred overnight on the 29-30th of January 1993 at a temperature of 23°C. On the morning of the 31st it was 23°C, rising to 25°C by evening. The next morning many eggs had turned white and the temperature was 26°C. Some eggs were still present the following evening although the temperature had risen to 29°C. By midnight on the 3rd, all were gone and temperature was 31°C. The second spawning occurred sometime on the 2nd prior to 11:30 pm at between 26 and 29°C. By midnight the next day most had gone white or disappeared. All were gone the morning of the 4th. In both cases it is likely the high temperature somehow affected the eggs, possibly either via lower oxygen levels or by being beyond their temperature tolerance or some other unknown factor.

Murray-Darling carp gudgeon

I only briefly recorded a few details of their spawning. Fish originated from Reedy Swamp. All spawnings occurred in December at temperatures around 20-24°C. Larger numbers of eggs were laid compared to Midgley's carp gudgeon, although, this could be because the female Murray-Darling carp gudgeon were larger. In one batch, I counted approximately 500 eggs. Eggs hatched in 4-5 days, larvae were around 4 mm at hatching and survived around 4-5 days without food before dying.

Conclusion

Carp gudgeons are one of the most underrated groups of Australian aquarium fishes. They are widespread, abundant, hardy, attractive, peaceful, and relatively undemanding in general. They have provided me with many years of enjoyment and fascination. I am sure, given half a chance, they can do the same for you.

Acknowledgements

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Appendix 1. Corrections to published photos

Correct identification	Misidentification	Reference
Midgley's carp gudgeon	Western carp gudgeon	Lake 1978 p. 147
Midgley's carp gudgeon	Western carp gudgeon	McDowell 1981 p. 126
Murray-Darling carp gudgeon	Western carp gudgeon	Cadwallader & Backhouse 1983 p. 206
Murray-Darling carp gudgeon	Western carp gudgeon	Merrick & Schmida 1984 p. 291
Midgley's carp gudgeon	Firetail gudgeon	Merrick & Schmida 1984 p. 288
Midgley's carp gudgeon	Firetail gudgeon	Leggett & Merrick 1987 p. 213
Midgley's carp gudgeon	Firetail gudgeon	Allen 1989 p. 136
Midgley's carp gudgeon	Lake's carp gudgeon	Allen 1989 p. 141
Western carp gudgeon	Firetail gudgeon	McDowell 1996 p. 214
Murray-Darling carp gudgeon	Western carp gudgeon	McDowell 1996 p. 216
Midgley's carp gudgeon	Lake's carp gudgeon	McDowell 1996 p. 219

Note: the photo in McDowell (1996 p. 219) of Midgley's carp gudgeon may be misidentified as Lake's carp gudgeon due to an apparent lack of scales on its head. However, close examination shows scales are present around the base of the dorsal fin (they are usually lacking in Lake's carp gudgeon) and scales are present on the lower belly region (absent in Lake's carp gudgeon).

Also, having collected, observed, and provided the fish to Neil Armstrong to photograph. I had ample time to carefully identify it. Furthermore, the colour pattern is different to Lake's carp gudgeon.

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GLASSFISH AND SYSTEMATICS, endangered subject behind the scene of glassfish study

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In June 1996, I came to Australia for the first time to work on the systematics of Ambassidae, commonly known as glassfish, for my Ph.D. Since I started this project, I have come to realise two issues; the current status of systematics as a biological discipline and the difficulties of revising the current systematics of glassfish. I strongly believe that systematics is the backbone of all fields of biology simply because you cannot conduct any biological research without knowing the identity of the organisms you are studying. However, increasingly less attention is being paid to this area of biological research with fewer taxonomists being appointed to research institutions. Instead, more attention is paid to areas of biology that have more immediate applied outcomes.

Recently, I had a chance to give a presentation about the systematics of glassfish as part of the requirement for my Ph.D. program. The room was packed for a speaker who gave a presentation about molecular biology. As my turn came, much of the audience left for other presentations. This is an unfortunate environment for taxonomists as they have less support from biologists in other fields of research. I am not against molecular biology at all. In fact, I have begun to use molecular technologies as an essential tool in my revision of the systematics of glassfish.

About 40 species of glassfish are known from the east coast of Africa, India, southeast Asia, Papua New Guinea, Indo-Pacific and Australia. In Australia and Papua New Guinea regions, about 20 species in four genera (*Ambassis*, *Denariusa*, *Parambassis* and *Tetracentrum*) have been described inhabiting coastal marine, estuarine and fresh water conditions. Generally, glassfish are small, about 10 cm on length and, as their common name implies, they are transparent. However, some glassfish, such as Penny Fish (*Denariusa bandata*) display several dark vertical stripes on the body and Giant Glassfish (*Parambassis gulliveri*) have a distinctive pattern of colouration.

The latest revision of the systematics of glassfish of Australia and Papua New Guinea was made by Allen and Burgess (1990) and Roberts (1994) published a systematic revision of the tropical Asian freshwater glassfish. However, these revisions of glassfish systematics are based solely on external morphology. For Australia and Papua New Guinea glassfish, there remain some serious ...