



Bronze and Wild Goldfish

There is some confusion between *wild type* and *bronze* goldfish. This article attempts to distinguish between the two.

Bronze goldfish

Bronze is an overall brown colouration, sometimes lighter on the underparts but sometimes an even colour all over that arises during the breeding of ornamental goldfish. Adult bronzes are goldfish that never attain the red, yellow, silvery-white, etc, adult metallic colouration, and they are usually only kept if they possess particularly fine features such as body shape, finnage, etc, which the breeder hopes to introduce into fish with ornamental colouration through breeding with such bronzes. However, bronze fish with some red pigmentation are called chocolate fish, as in the chocolate oranda, and these are valued. And all-grey fish, such as some orandas and veiltails, are sometimes marketed as 'blue'.



Bronze goldfish are seldom seen as adults in UK; this one was exhibited at BAS 2002.

'Wild' goldfish

Wild goldfish are a matter of contention as to exactly which species are the wild ancestors of domesticated (ornamental) goldfish. Wild type colouration is adaptive for camouflage, having a dark grey upper body surface (for camouflage when viewed from above) and silvery-grey flanks (for camouflage when seen from the sides and below). Apparent wild type is the colour of all young ornamental metallic goldfish until they gain adult colouration, apart from the bronzes.

It has been observed that ornamentally coloured goldfish will revert to the wild type colour if left to themselves for a number of years.

Gibel (Prussian) carp

The gibel carp (*Carassius gibelio*, formerly *Carassius auratus gibelio*^a), according to prevailing wisdom, is the wild origin of ornamental goldfish. It is a species that naturally shows a wide range of morphological variation when raised in different environments. It has a very wide distribution throughout Eurasia and in China it inhabits rivers, streams, ponds, lakes and ditches, living in

running, still and even stagnant water from 10°C to 32°C, growing to about 30 cm in length and 2.5 kg in weight within 2-3 years and living for about 10 years. It crosses readily with any ornamental goldfish, producing viable offspring.

Here are some pictures of gibel carp from Hong Kong, where (as elsewhere in the Far East) it is eaten as a food fish.



Gibel carp on sale in the Shamchun Street Market, Argyle Street, Hong Kong, for eating. Photographs taken in June and August 2014.



This individual was on the point of sale and despatch when photographed. Notice the absence of mouth barbels and the deeper body than is found in smaller individuals including most common goldfish. Length about 27 cm (10.5 inches) including the tail; body depth about 9 cm (3.5 inches).



Wild and ornamental goldfish photographed together in a market in Lijiang, Yunnan, China, in January 2013. Apart from colour, the main difference is in the size; in outline, the fish otherwise look very closely alike.

The gibel carp are fished locally in Hong Kong, where they are known as 鰱鱼 zéi yú (鰱魚 zak⁶ yu²). The taste is rather bland, so they need an interesting sauce or they are used to make soup, and there are many small bones. In Romania, where they invade commercial fish ponds, gibel carp are regarded as a drain on resources because there is no market for them in Europe.

So where do goldfish really come from?

Recent research has produced results which, however, do not seem to be definitive — hobbyists might be disappointed by such lack of a conclusive picture, but, given the propensity of the various *Carassius* species to hybridize and the long history of the ornamental goldfish, it is perhaps unsurprising. The prevailing view (as published, for instance, in the articles on gibel carp and goldfish in Wikipedia) is that goldfish were derived from gibel carp. However, here is a summary of recent papers, which gives cause for reflection.

- Mitochondrial DNA analysis¹ points to the existence of two separate species under the present name *C. gibelio*: one, a wider-ranging species, is found from eastern Europe through Russia to Mongolia and north China; the other, a narrower-ranging species, is found in Mongolia and northern China. So, if goldfish are derived from the gibel carp, there are two separate species, both known as gibel carp, found in the region where goldfish were first domesticated, both of which need to be considered.
- Mitochondrial DNA analysis² indicates that Japanese goldfish are not related to Japanese Crucian carp (*Carassius auratus langsdorfi*) and that all the goldfish examined by the researchers (44 samples of a variety of goldfish from Japan and China as well as common and crucian carp) originated from one of the two groups of the Chinese crucian carp *C. gibelio* (NB this is the gibel carp, not the crucian carp). These results support the prevailing view as to the origin of the goldfish.
- Mitochondrial DNA analysis³ indicates Chinese goldfish have a matrilineal origin from native southern Chinese *Carassius auratus* (formerly *Carassius auratus auratus*^a), especially the lineages from the lower Yangtze River (NB it is the highly-conserved, mitochondrial DNA from the female's eggs that is used in such studies, hence the term matrilineal origin). These results argue that goldfish derive from *C. auratus* rather than from *C. gibelio*.

- Mitochondrial DNA analysis⁴ indicates there are two superlineages of *C. auratus* in East Asia, one mainly distributed in the Japanese islands and one in various regions in and around the Eurasian continent. So, if goldfish are derived from wild *C. auratus*, there are two superlineages, either or both of which could be the ancestor/s of ornamental goldfish.
- Evaluation⁵ of the phenotype, ploidy level, gonadal structure and 5S rDNA of an experimental goldfish indicates that goldfish originated from hybridization of red crucian carp (*C. auratus*) × common carp (*Cyprinus carpio*): the authors produced an experimental hybrid goldfish by crossing the red crucian carp with the common carp followed by gynogenesis^b. So here, in contrast, is evidence that goldfish originated by hybridization between two closely related species (neither of which, in this investigation, was *C. gibelio*). (NB the crucian carp is called by some authorities *C. carassius* rather than *C. auratus*).

This recent research (2009—2014) identifies three contenders for the wild ancestor of the goldfish: *Carassius gibelio*, *C. auratus* or a hybrid between *C. carassius* (identified as *C. auratus* by the researchers) and *Cyprinus carpio*.

So where does this leave us? Or, to rephrase the question, how can scientists unravel the four million year old history of speciation and hybridization between closely-related species that led to the ornamental goldfish? Did, indeed, the goldfish arise just the once? Or were there more than one original, attractive red goldfish type that were conserved and in turn hybridized through the attentions of mankind?

At any rate, you can take it that the fish in the photographs above, if they have not unequivocally contributed their genes to the ornamental goldfish, nonetheless closely resemble the ancestor/s of the goldfish. They are larger, camouflaged (as described) — and not actually all that exciting to eat!

References

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5. Wang, J., Liu, S., Xiao, J., Tao, M., Zhang, C., Luo, K., & Liu, Y. (2014). *Evidence for the evolutionary origin of goldfish derived from the distant crossing of red crucian carp × common carp*. doi:10.1186/1471-2156-15-33

Notes

a. *Carassius gibelio* and *Carassius auratus* were formerly held to be subspecies of the same species, and they were called *Carassius auratus gibelio* and *Carassius auratus auratus*. This, according to

some, now leaves *Carassius auratus* as the wild form and *Carassius auratus auratus* (i.e. a subspecies) as the ornamental form of the species these days called *Carassius auratus*. All a little confusing, as not all the scientific sources agree with each other on species definition and nomenclature. There are morphological indicators of species, such as fin shapes, the number of gill elements and the number of pores along the lateral line that were used for identifying species before DNA analysis became cheap, but hybrids confuse the issue. Maybe the Website Author will find the time to add information of this sort, in due course. Angling websites such as The Crucian Website give such information.

b. Gynogenesis is the production by triploid females (individuals with three of each chromosome type) of viable eggs that are not fertilized by sperm; the females exhibit the full, natural mating behaviour but the male's sperm do not penetrate and contribute to the DNA in the nucleus of the egg: thus the female alone is the parent. Gynogenesis occurs in a number of species of fish. Polyploidy (having more than the normal complement of two of each chromosome type, one from the male and one from the female) arises through hybridization between species.

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