

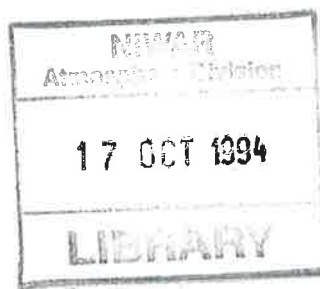


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Taihoru Nukurangi

A Key to Some Larval Fish From New Zealand Fresh Water

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A KEY TO SOME FRESHWATER FISH LARVAE IN NEW ZEALAND

1. Introduction

The morphology, anatomy, physiology and behaviour of many fish larvae are very different from the adult. In many species the larvae are orders of magnitude smaller than the adults, and features which are used to separate species may not develop until the fish is quite large. For example, the posterior dorsal fin of the common bully (*Gobiomorphus cotidianus*) does not appear until the larvae is 11 mm long, and the anterior dorsal fin does not appear until 14 -15 mm. As a result, larval bullies look similar to larval goldfish.

The information required to separate species at the larval stage is widely dispersed in reports and articles, or non-existent. This report collates information on fish larvae likely to be found in New Zealand freshwater, and presents some new data. It provides broad guidelines for identification of larvae to at least family, and in some cases to species level.

Data are drawn from two sources. Where possible, I have made new descriptions of larvae collected from New Zealand fresh water. Larvae were either raised in the laboratory from positively identified parents (for example, inanga) or sequences of wild caught larvae were used to "back identify" unknown specimens (for example, goldfish). Type specimens have been retained and are kept at NIWA - *Ecosystems* in Hamilton. Further additions to the collection will be welcome.

Where I have not been able to obtain eggs or larvae, I have relied on descriptions in the literature. In particular I have plagiarized Bracken and Kennedy (1967) to separate cyprinids. The source of the description is clearly identified for each species.

Species which are excluded from this key are identified with ? in Table 1. Some species are excluded because I have been unable to obtain specimens or published information (for example catfish); others because the larvae are unlikely to be found in freshwater (for example mullet). Grass carp and silver carp are unlikely to reproduce under New Zealand conditions. Sailfin molly, guppies and swordtails are restricted to thermal waters in volcanic plateau in the North Island.

Salmonid species present in New Zealand (for example, brown trout and rainbow trout) produce very large eggs, and salmonid larvae are referred to as fry. The salmonid structure and form is quite distinctive, and specimens may be identified by reference to (Glova 1988).

A cursory examination of the information below will reveal many gaps, and the key is therefore tentative. Corrections, improvements, and additions will be welcome. It is my intention to update the report as new data become available.

2. Terminology and definitions

Most workers use differences in morphology to distinguish life stages of fish (Balon 1984). In Balon's definitions, the embryonic period is characterised by endogenous nutrition from the yolk of the ovum. The larval stage begins with transition from endogenous to exogenous feeding and lasts until metamorphosis to the juvenile stage. At metamorphosis from larvae to juvenile, the axial skeleton is complete, the embryonic finfold is differentiated to true fins, and significant temporary organs replaced by permanent organs. In short, the juvenile fish is a miniature of the adult form except for the maturation of the gametes.

Other workers have distinguished additional stages, and although these definitions have physiological significance, Blaxter (1988) found considerable difficulty in resolving nomenclature of different workers. To maintain consistency with previous larval keys, these notes use the following definitions:

Embryo refers only to the developing animal up to the point of hatching.

Larvae refers to the developing animal from hatching until the absorption of the yolk sac

Post-larvae refers to the period between absorption of the yolk sac and metamorphosis.

Juvenile describes the period between metamorphosis and first spawning.

In the juvenile stage, the fins and fin ray counts have the adult form, and it should be possible to identify the species from an adult key. In most cases, refer in the first instance to (McDowall 1990). Alternative sources of information are Muus and Dahlstrøm (1971) or other guides to freshwater fish.

3. Methods of collection of ichthyoplankton

Five species of New Zealand fish have lacustrine pelagic larvae (*Retropinna retropinna*, *Gobiomorphus cotidianus*, *Galaxias gracilis*, *G. fasciatus*, *G. brevipinnis*.) At certain times of the year, substantial numbers of larvae and juvenile fish are present in the pelagic zone of North Island lakes (Stephens 1982, 1983; Rowe 1993). These species may be caught with towed ichthyoplankton nets, light traps (Secor et al. 1975), and baited bottle traps.

Larvae of other species are usually found in the benthic or littoral habitats and may be captured by a variety of means including push nets, light traps, baited bottle traps and rising Bagenal nets (Bagenal 1974).

Larvae should be immediately preserved in 4% formalin solution as the tissues decompose rapidly. However, if you intend to extract the otoliths in order to age the larvae, place the larvae in individual tubes, and freeze as soon as possible. Formalin is acid, and destroys the structure of the otolith. In some species, preservation in 70% iso-propyl alcohol may be satisfactory, but larval otoliths are small and delicate, and we find freezing is a more effective method. In all cases, larvae should be examined as soon as feasible, as melanophores may fade on preservation.

4. Examination of specimens

The fumes of formalin and iso-propyl alcohol are unpleasant. I prefer to rinse specimens in water and use a channelised slide to hold the larvae during examination. Channelised slides are made by cutting strips from one standard microscope slide, and gluing strips of a second slide on top, with 5 minute Araldite glue, to form channels one to three mm in width. The channels hold larvae in position.

Look at larvae through a stereo binocular microscope with an eye piece graticule, at between 6x and 30x magnification. The first key measurement is the vent ratio, which is the distance from the snout to the vent position, divided by the total length (see glossary). Other measurements are given in the species tables.

5. Organisation of the key

The key is arranged in standard dichotomous format. Down the left hand margin are numbered sections. In each section are two different descriptions marked 'a' and 'b'. These sections lead either to a number in the right hand margin, and a further pair of descriptions or the name of a fish. Follow the key through selecting the best description at each stage.

For each species there is a table of information giving basic measurements in a standard format. Use this data with caution. Egg size and larval length may vary with location, season or habitat. For example, the eggs of Cran's bully from the Hunua ranges are much larger than those from Cran's bully sampled from the Hutt River (Eldon, NIWA, pers. comm.), and the dry weight of eggs from riverine smelt may be forty times greater than the dry weight of eggs from lacustrine smelt (pers. obs.). Where there is no data for

a particular species, that part of the table is left blank.

Key definitions are given in a glossary (page 11). I have followed, as far as possible, Faber and Gadd's (1983) guidelines for illustrating larval fish. Drawings were prepared from preserved specimens by *camera lucida*. Melanophores are shown as far as possible in life position. Myotomes are not shown; fin rays are not shown in detail. When present, the positions of the swim bladder (SB), oil globule (OG) and Yolk Sac (YS) are indicated. The fine detail of the jaw structure is not shown.

Table 1. Names of New Zealand fish species and source of description for larvae.**MARINE STRAGGLERS**

Grey mullet	<i>Mugil cephalus</i>	marine
Kahawai	<i>Arripis trutta</i>	marine
Yellow belly flounder	<i>Rhombosolea leporina</i>	marine
Cockabully	<i>Tripterygion nigripenne</i>	marine
Stargazer	<i>Leptoscopus macropygus</i>	marine
Yellow eyed mullet	<i>Aldrichetta fosteri</i>	marine

TRUE MIGRATORY SPECIES

Banded kokopu	<i>Galaxias fasciatus</i>	?
Giant kokopu	<i>Galaxias argenteus</i>	?
Inanga	<i>Galaxias maculatus</i>	Mitchell (1989)
Koaro	<i>Galaxias brevipinnis</i>	?
Shortjawed kokopu	<i>Galaxias postvectis</i>	?
Lamprey	<i>Geotria australis</i>	?
Longfinned eel	<i>Anguilla dieffenbachii</i>	marine
Shortfinned eel	<i>Anguilla australis</i>	marine
Common smelt	<i>Retropinna retropinna</i>	this key
Stockells smelt	<i>Stockellia anisodon</i>	?
Black flounder	<i>Rhombosolea retiaria</i>	?
Bluegilled bully	<i>Gobiomorphus hubbsi</i>	this key
Giant bully	<i>Gobiomorphus gobioides</i>	?
Redfinned bully	<i>Gobiomorphus huttoni</i>	McDowall (1968)
Torrent fish	<i>Chiemarrichthys fosteri</i>	?

NON MIGRATORY SPECIES

Common river galaxias	<i>Galaxias vulgaris</i>	Benzie (1968)
Longjawed galaxias	<i>Galaxias prognathus</i>	?
Alpine galaxias	<i>Galaxias paucispondylus</i>	?
Upland bully	<i>Gobiomorphus breviceps</i>	this key
Dwarf galaxias	<i>Galaxias divergens</i>	?
Cran's bully	<i>Gobiomorphus basalis</i>	this key
Dwarf inanga	<i>Galaxias gracilis</i>	?
Brown mudfish	<i>Neochanna apoda</i>	?
Black mudfish	<i>Neochanna diversus</i>	?
Canterbury mudfish	<i>Neochanna burrowsius</i>	?
Common bully	<i>Gobiomorphus cotidianus</i>	this key

INTRODUCED SPECIES

Brown Trout	<i>Salmo trutta</i>	Glova (1988)
Atlantic Salmon	<i>Salmo salar</i>	Glova (1988)
Brook Char	<i>Salvelinus fontinalis</i>	Glova (1988)
Makinaw	<i>Salvelinus namaycush</i>	?
Rainbow trout	<i>Oncorhynchus mykiss</i>	?
Quinnat Salmon	<i>Oncorhynchus tshawytscha</i>	?
Sockeye Salmon	<i>Oncorhynchus nerka</i>	?
Catfish	<i>Ictalurus nebulosus</i>	?
Grass Carp	<i>Ctenopharyngodon idella</i>	X
Silver Carp	<i>Hypophthalmichthys molitrix</i>	X
Koi carp	<i>Cyprinus carpio</i>	Bracken (1967)
Gold fish	<i>Carassius auratus</i>	this key
Tench	<i>Tinca tinca</i>	Bracken (1967)
Orfe	<i>Leuciscus idus</i>	?
Rudd	<i>Scardinius erythrophthalmus</i>	Bracken (1967)
Perch	<i>Perca fluviatilis</i>	Bracken (1967)
Mosquito fish	<i>Gambusia affinis</i>	this key
Sailfin Molly	<i>Poecilia latipinna</i>	?
Guppy	<i>Poecilia reticulata</i>	?
Swordtail	<i>Xiphophorus helleri</i>	?

DICHOTOMOUS KEY TO COMMON FISH LARVAE IN NEW ZEALAND FRESHWATER

1. a. Vent ratio >0.65 . (2)
 - b. Vent ratio <0.65 (7)
2. a. Slender larvae, maximum head and body depth of <0.1 of total length (TL). Yolk sac when present distinctly globular, short, round or elliptical. Oil globules present. Galaxids and smelt. (3)
 - b. Stouter larvae, maximum head and body depth > 0.1 TL. Yolk sac, when present, long and narrow tapering posteriorly with axis parallel to body and merging with it. Anterior part of yolk sac may show inflation in newly hatched larvae. No oil globules. Cyprinids (4)
3. a. Vent ratio $0.72 \text{ TL} \pm 0.008$. Oil globule small 0.1 of total yolk-sac volume. Yolk sac opaque white. The anterior edge of the dorsal fin develops in front of the vent, as a protuberance of the dorsal fin fold by 6 mm TL. *Retropinna retropinna* Smelt. (p26)

Lacustrine smelt hatch at 2-4 mm, A double line of closely spaced (cf inanga) stellate-dendritic melanophores is present on the ventral surface of the gut; and a single line of closely spaced stellate melanophores are present on the ventral surface of the caudal peduncle. Fin rays appear at about 0.65 TL, at about 10 mm TL. Larvae < 10 mm look bug eyed and swim with a distinct sinuous motion. Full adult characteristics develop by 16 mm.

Riverine stocks of smelt hatch 6 mm. No line of melanophores along ventral surface of gut; no large oil globule; yolk sac not translucent.

- b. Vent ratio $>0.74 \text{ TL}$. Oil globule when present large translucent-yellow, round to elliptical. Line of widely spaced stellate melanophores along ventral surface and on caudal peduncle. Formalin preserved specimens appear yellow as opposed to white in smelt. Length > 6 mm on hatch. Dorsal fin appears directly above the vent, at about 10 mm length. *Galaxias maculatus* inanga. (p16)

At first sight, galaxid larvae and smelt are easily confused. However, consideration of the habitat and location of capture should assist with firm identification. Smelt occupy two major habitats lakes and rivers: Lacustrine smelt spawn in spring, and are usually small (2-4 mm at hatch). River smelt spawn in the autumn, are 6 mm at hatch, and are generally carried to the sea.

Land locked stocks of galaxids (Koaro, and Kokopu) are larger than smelt at any given stage. Therefore a large slender larvae with a yolk sac, found in a lake in spring is likely to be a galaxid. River stocks of autumn spawned galaxids and smelt can be separated on their total length, colour, size of oil globule and yolk

sac.

There are insufficient data to accurately identify larvae of other whitebait species. Four specimens of koaro (*G. brevipinnis*) had a double line of round melanophores on the ventral surface. Benzie (1968a) and Mitchell (1982) observed that *G. vulgaris* and *G. fasciatus* are similar to *G. maculatus*. *G. vulgaris* hatched at 7.2 mm and *G. fasciatus* hatched at 8.5 mm TL. I would expect the larvae of all land locked stocks of Galaxids, except for dwarf inanga to be larger than landlocked smelt. In general the proportions and melanophore pattern of all galaxids will be similar to those of inanga.

4. a. Melanophores developed on hatching; form a longitudinal series along dorsum; a mid lateral series and a ventral series along edge of tail and along top of gut. No line of melanophores ascending from thoracic region towards swim-bladder or its future site.

Dorsum citrus yellow. Dorsal melanophores large, round, or irregular. Melanophores on ventral aspect of the yolk sac large, especially posteriorly. Myotomal count never exceeds 39 - usually 37 -38. Length on hatching 5.2 mm -5.9 mm. On absorption of yolk sac about 8.0 mm.

In post larvae, melanophores on dorsum solid. Ventral melanophores stellate, with large "nuclei", not dendritic. Dorsal (≤ 10 rays) and anal fins complete at 12 mm; dorsal fin not 2x longer than anal fin. By 12 mm TL, swim bladder divided *Scardinius erythrophthalmus*. Rudd. (p24).

- b. Melanophores, when present, not so arranged. On either side of thorax, there may be a line of melanophores which diverge from the ventral series and ascend upwards and posteriorly towards the swim bladder or its future site. (5)
5. a. Melanophores present on dorsum and on ventral surface. (6)
- b. Melanophores entirely or largely confined to the ventral surface. Melanophores in dense band along ventral edge of tail and on top of gut, extending forward to eyes. Absent elsewhere. Myotomal count 40 -45, 27-29 in trunk and 13 - 16 in tail. Head round, rather like rudd. Eye large. length on hatching 4.0- 5.5 mm.

In early post-larvae, head and dorsum devoid of dark pigment. A dense black stripe of pigment extends from the eyes back along the top of the gut, and along the ventral edge of the tail from vent to tip. Later post-larval stages slender. Dark pigment stripe persists inferiorly, and terminates in a conspicuous black patch at end of caudal peduncle, intersected by upturned urostyle. In later stages, melanophores appear on head, dorsum and belly, and at this stage, the fish may be difficult to distinguish from Koi carp. However, the caudal fin not emarginate. Initial post larval length 6.0 -6.5 mm. *Tinca tinca* Tench (p28)

6. a. Melanophores present on dorsum or on dorsum and ventral surface, but mid-lateral series is absent. In post larvae, there is a dark, vertical crescentic

mark on the caudal peduncle. Body deeper and belly more protuberant than in corresponding stages of other cyprinids. Initial post-larval length 7.5 -8.0 mm. Dorsal fin may not be complete by 14 mm, but by this length, there are >16 rays. Dorsal fin 2x longer than anal fin; pelvic fin well in front of vertical line from anterior edge of dorsal fin. Swim bladder not divided. *Cyprinus carpio* Koi Carp. (p18).

Koi carp are likely to be confused with goldfish. In koi carp, there are 32-40 vertebrae and 35-38 myotomes. Gold fish have 29-36 vertebra and 28-33 myotomes. The pattern of melanophores is also different, but insufficient specimens from New Zealand have been examined to describe the differences accurately.

- b. Double line of round to stellate melanophores on dorsum, mid lateral series of stellate melanophores on flanks. At first there are no melanophores anterior of the eyes, but after 12 mm, the flanks and head are covered with stellate melanophores without definite pattern. *Carassius auratus* Goldfish. (p14)

Larval goldfish are distinguished from rudd by a diagonal line of melanophores which extends thoracic region posteriorly to the swim bladder. Post larvae have a deeply forked tail and a single chamber swim bladder.

- 7. a. Gut distinctly kinked. Vent ratio 0.45 ± 0.01 TL Maximum body and head depth $< 0.12 \pm 0.01$ TL. Live larvae swim with distinctive jerky movements. When present, yolk sac round or elliptical, oil globule present. *Gobiomorphus spp.* Bullies (p12)

Common bullies hatch at 3.4 -3.8 mm. The yolk sac is consumed by 4.0 mm. The swim bladder is filled soon after hatching. Melanophores develop along the dorsal surface of the swim bladder, so that from above and against a white background, the larvae look little black dots jerking through the water. Anterior edge of posterior dorsal fin develops at 0.5 TL at between 6 and 7 mm, and the anterior dorsal fin appears from 13 mm, at 0.35 TL, just forward of the vent. From 13 mm, fish have adult features and proportions.

- b. Gut not distinctly kinked. Vent ratio 0.41 - 0.48. Maximum body and head depth > 0.15 . (8)



(Both perch and mosquito fish are much larger than common bullies but could be confused with Cran's bully. However, Cran's has a distinctly kinked gut at hatch, and the pattern of melanophores is quite different from perch and mosquito fish larvae.)

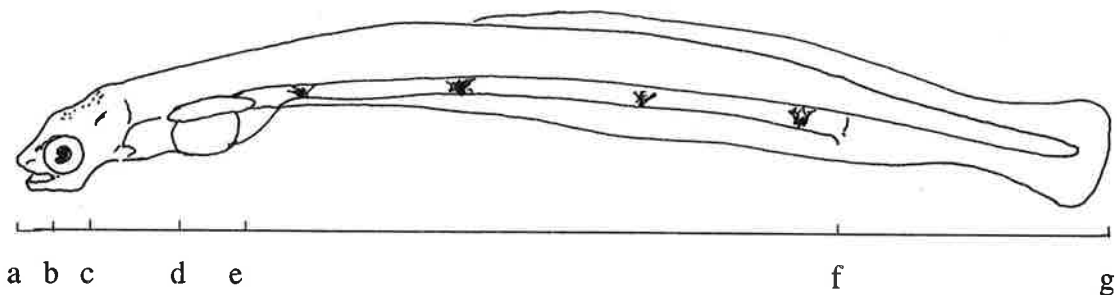
- 8. a. Length at birth 8.0 mm. Vent ratio 0.41 ± 0.01 , anterior position of dorsal fin 0.52 TL with 5-6 rays. Melanophores well developed at birth, initially forming diagonal pattern on flanks. A checkered pattern is clear by 9 - 10 mm. Seven dorsal fin rays are present by 12 mm length, and adult features are present at 15 mm. *Gambusia affinis* Mosquito Fish. (p20)

- b. Length on hatch about 6.0 mm. One fairly large oil globule. Black pigment

only present. Melanophores few and mainly along ventral edge of tail and in a patch over the end of the rectum. Later the melanophores develop along the dorsum. Some very fine black strokes on sides, on myotome edges. Length at absorption of the yolk-sac 7.5-8.0 mm. In post larvae, fine black strokes on some of the myotomal edges, suggestive of marks made with indian ink by a fine nib. Round or stellate melanophores on head, dorsum, ventral edge of tail and over rectum. Very transparent. Swim bladder does not become divided (unlike rudd). Second dorsal, anal and pelvic fins complete at 15 mm, but spinous dorsal fin does not appear until later. *Perca fluviatilis* Perch. (p22)

GLOSSARY

Dendritic	Tree like.	
Dorsum	Used by Bracken (1967) to describe the upper muscle blocks from behind the head to caudal region	
Emarginate	Having a notch at the tip.	
Endogenous	Arising from within the organism. In this context, feeding from yolk sac.	
Exogenous	Originating from outside the organism. In this context, feeding on external food particles.	
Globular	Globe shaped or spherical.	
Larva	From hatching to absorption of yolk-sac.	
Melanophore	A pigmented body, containing melanin.	
Metamorphosis	A marked structural change from larval to the adult form.	
Myotome	A block of voluntary muscles deriving from a single segment.	
Post-larva	From absorption of yolk sac to completion of adult fin structure.	
Stellate	Star like (cf dendritic).	
Thorax	Part of the trunk between the neck and the abdomen, hence thoracic.	
Urostyle	Set of bones below the tail formed by the fusion of parts of the tail vertebra and supporting the lower lobe of the tail fin.	
Ventral	Of or on the abdomen or lower surface.	
Vent ratio	Distance of Snout to vent/total length.	



Total length	a to g
Vent	a to f
Anterior position Yolk Sac	a to d
Length of Yolk sac	d to e
Orbit	b to c
Snout	a to b
Vent ratio	$(af)/(ag)$

Depth measurements taken at right angles to the main body axis. Head depth is measured immediately behind the orbit, and maximum body depth is measured

COMMON BULLY*Gobiomorphus cotidianus*

Egg Diameter	1.2 mm
Dry weight	0.06 mg
Time to 50% hatch	About 7 days

DIMENSIONS OF LARVAE AT HATCH

Total length	3.4 - 3.8 mm
Vent ratio	$0.42 \pm .010$
Maximum depth	0.34 mm
Head depth	0.33 mm
Head width	0.33 mm
Snout	0.10 mm
Orbit	0.20 mm
Anterior position of yolk sac	0.60 mm
Length of yolk sac	about 0.3 mm
Depth of yolk sac	about 0.1 mm

OTHER DISTINGUISHING FEATURES

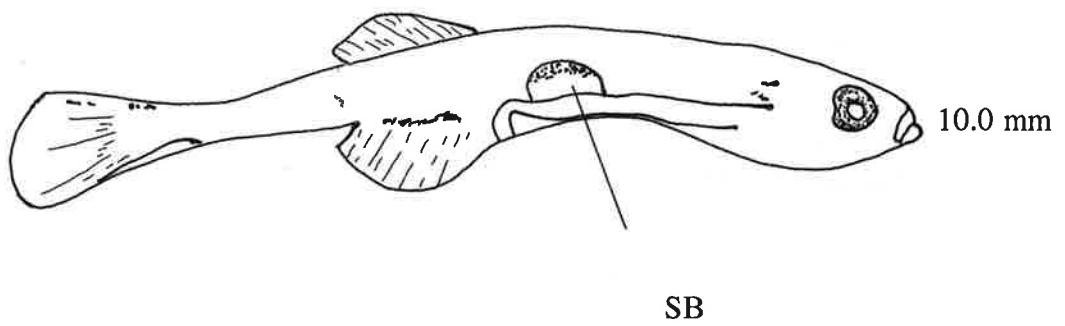
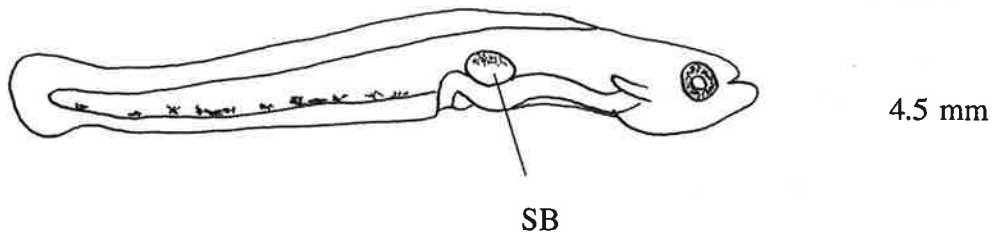
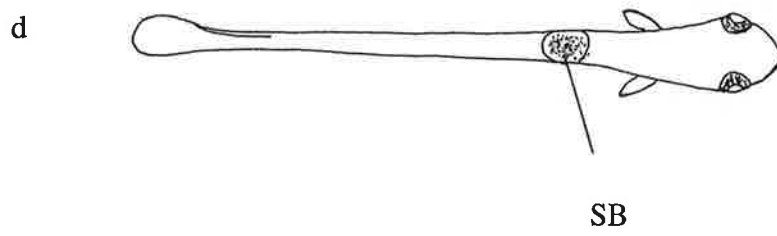
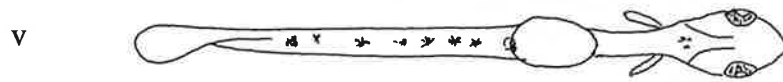
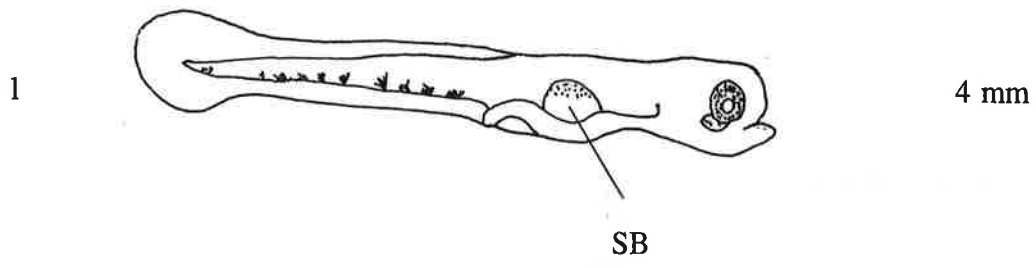
Vent ratio increases to $.452 \pm .010$ by the time the larvae is 5.0 mm long. Melanocytes present over air bladder by 5.0 mm. Posterior dorsal fin develops at 8.0 mm and anterior dorsal fin by 15 mm. Oil globule present.

SOURCE OF INFORMATION

This key. Specimens from Lake Rotorua, Rotokauri, Waikato region.

DISTRIBUTION

Widespread and common.



GOLDFISH *Carassius auratus*

Egg Diameter

Dry weight

Time to 50% hatch

DIMENSIONS OF LARVAE AT HATCH

Total length	5.3 mm
Vent ratio	$0.66 \pm .017$
Maximum depth	0.9 mm
Head depth	0.9 mm
Head width	0.7 mm
Snout	0.1 mm
Orbit	0.4 mm

Anterior position of yolk sac (n/a)

Length of yolk sac

Depth of yolk sac

OTHER DISTINGUISHING FEATURES

Yolk sac long, narrow, tapering posteriorly; large eyes, single chamber air bladder. Dorsal fin develops by 10 mm. 28-36 myotomes (cf *Cyprinus carpio* and other cyprinids).

SOURCE OF INFORMATION

Wild caught larvae from Lake Rotokauri.

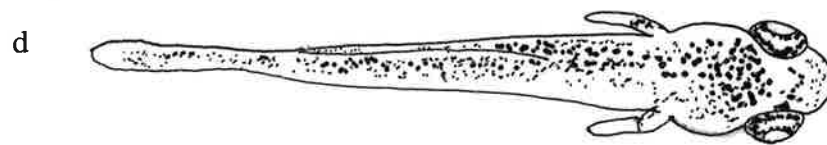
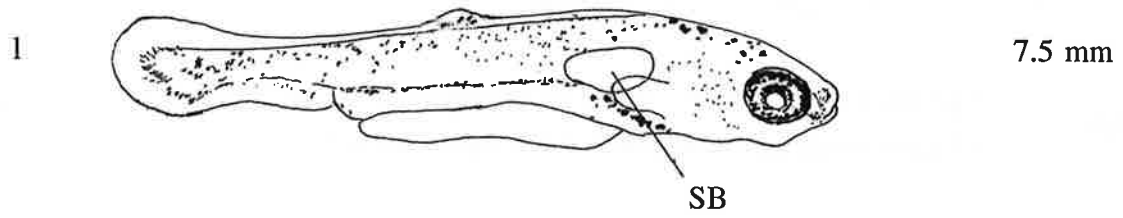
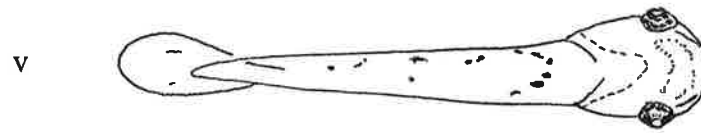
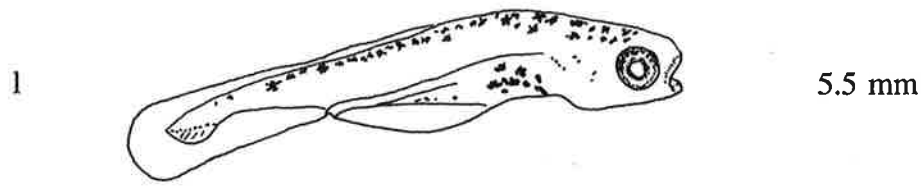
KEY REFERENCES

Conner et al. 1985

Muus and Dahlstrom 1967

DISTRIBUTION

Widespread in the North Island; recorded in ponds and slow moving water around Christchurch.



INANGA *Galaxias maculatus*

Egg Diameter	1.2 mm
Dry weight	0.23 mg
Time to 50% hatch	14 - 28 days

DIMENSIONS OF LARVAE AT HATCH

Total length	5.8 - 7.0 mm
Vent ratio	0.74
Maximum depth	0.35 mm
Head depth	0.35 mm
Head width	0.35 mm
Snout	0.10 mm
Orbit	0.25 mm
Anterior position of yolk sac	0.70 mm
Length of yolk sac	0.35 mm
Depth of yolk sac	0.25 mm

OTHER DISTINGUISHING FEATURES

Large translucent-yellow, round to elliptical oil globule. Line of widely spaced melanophores along ventral surface and on caudal peduncle.

SOURCE OF INFORMATION

Laboratory raised fish from Ohiwa harbour and Waikato river stock.

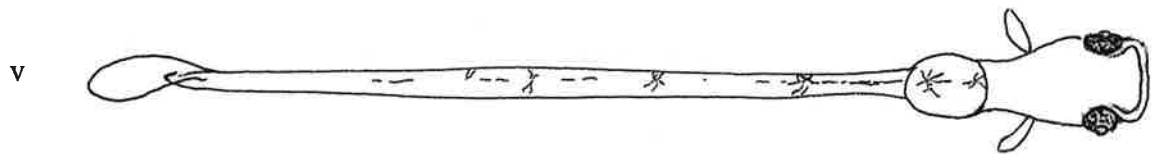
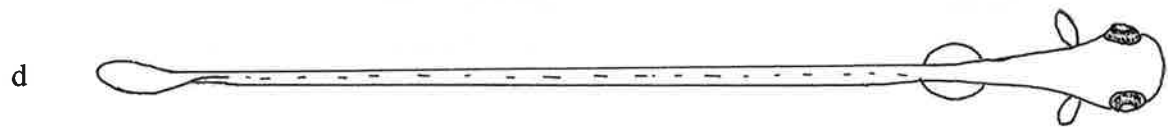
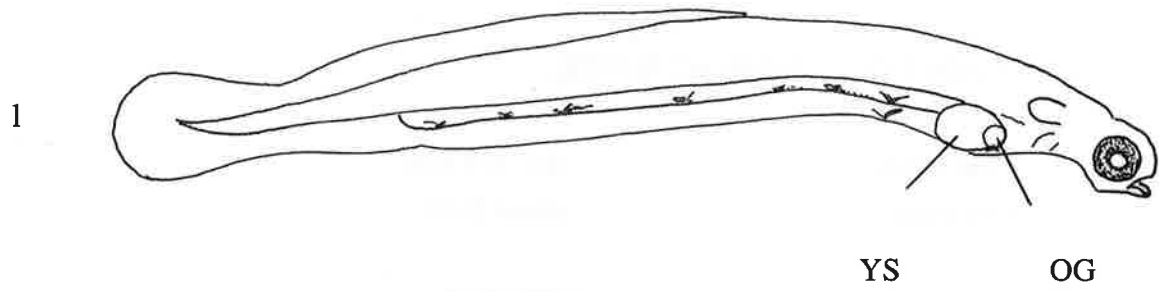
DISTRIBUTION

In lowland rivers throughout New Zealand

KEY REFERENCES

Benzie 1968a, b; Mitchell 1989

Inanga larvae, one day post hatch, 6.5 mm.



KOI CARP *Cyprinus carpio*

Egg Diameter

Dry weight

Time to 50% hatch

DIMENSIONS OF LARVAE AT HATCH

Total length	4.8 -6.4 mm
Vent ratio	about 0.69
Maximum depth	about 1.2 mm
Head depth	about 1.0 mm
Head width	unknown
Snout	about 0.2 mm
Orbit	about 0.4 mm
Anterior position of yolk sac	n/a
Length of yolk sac	n/a
Depth of yolk sac	n/a

OTHER DISTINGUISHING FEATURES

Melanophores on head and dorsum. About 7.5 mm long on absorption of yolk sac.
32-41 myotomes

SOURCE OF INFORMATION

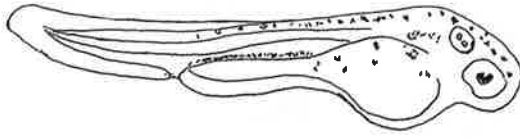
Bracken and Kennedy (1967)

Conner et al. (1980)

DISTRIBUTION

Waikato river, ponds and streams around Auckland, Tauranga, Taranaki and Hauraki Plains.

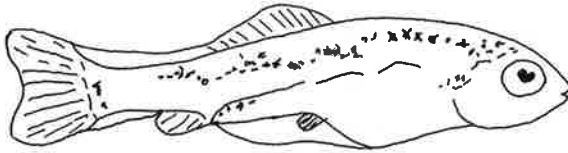
Lateral views of *Cyprinus carpio* larvae and post larvae.



5.0 mm



6.7 mm



13.7 mm

MOSQUITO FISH*Gambusia affinis*

Egg Diameter	live bearer
Dry weight	n/a
Time to 50% hatch	n/a

DIMENSIONS OF LARVAE AT HATCH

Total length	7.9 mm
Vent ratio	$0.41 \pm .007$
Maximum depth	1.3 mm
Head depth	1.3 mm
Head width	1.4 mm
Snout	0.24 mm
Orbit	0.85 mm
Anterior position of yolk sac	n/a
Length of yolk sac	n/a
Depth of yolk sac	n/a

OTHER DISTINGUISHING FEATURES

Distinct checkered pattern of melanophores visible in caudal region by 8.0 mm. Head large, domed, fin position and vent ratio distinct from Cyprinidae and Eleotridae.

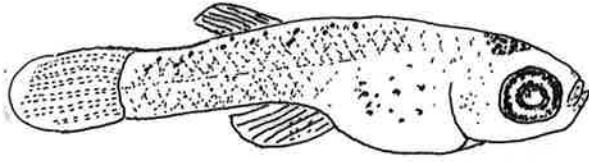
SOURCE OF INFORMATION

New Zealand specimens from Waikato Region

DISTRIBUTION

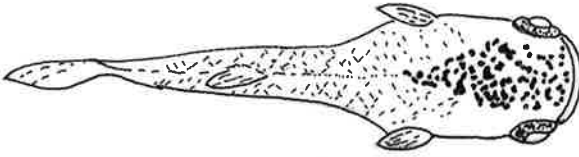
Widespread in the northern regions of the North Island, and Hawke Bay.

l

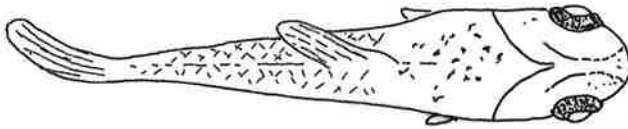


8.5 mm

d



v



PERCH *Perca fluviatilis*

Egg Diameter	2.5 mm
	(Egg capsule double)
Dry weight	
Time to 50% hatch	

DIMENSIONS OF LARVAE AT HATCH

Total length	6.0 mm
Vent ratio	about .45
Maximum depth	about 1.2 mm
Head depth	about 1.0 mm
Head width	not known
Snout	about 0.2 mm
Orbit	about 0.4 mm
Anterior position of yolk sac	about 1.0 mm
Length of yolk sac	about 1.5 mm
Depth of yolk sac	about 0.8 mm

OTHER DISTINGUISHING FEATURES

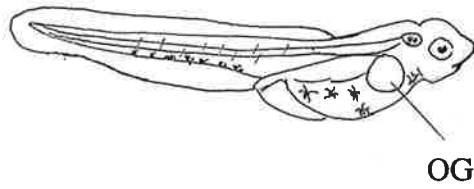
Black pigment only present. Melanophores few, some very fine black strokes on flanks, along myotome edges. Length on absorption of yolk sac 7.5 - 8.0 mm.

SOURCE OF INFORMATION

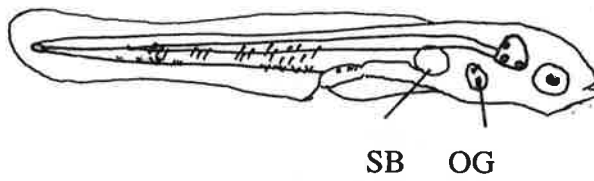
Bracken and Kennedy (1967)

DISTRIBUTION

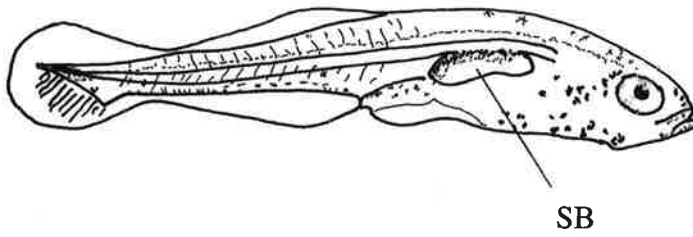
Slow flowing rivers and still water in North and South Islands

Lateral views of *Perca fluviatilis* larvae and post-larvae

6.0 mm



7.8 mm



11.5 mm

RUDD *Scardinius erythrophthalmus*

Egg Diameter	1.4 -1.8 mm. Colourless or pale yellow.
Dry weight	0.19 mg
Time to 50% hatch	unknown

DIMENSIONS OF LARVAE AT HATCH

Total length	5.9 mm
Vent ratio	0.60
Maximum depth	about 1.0 mm
Head depth	about 0.8 mm
Head width	unknown
Snout	about 0.2 mm
Orbit	about 0.4 mm
Anterior position of yolk sac	n/a
Length of yolk sac	n/a
Depth of yolk sac	n/a

OTHER DISTINGUISHING FEATURES

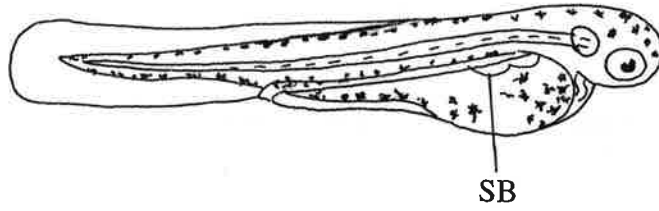
Dorsum citrus yellow. Dorsal melanophores large, round and irregular. 37 - 38 myotomes, never more than 39. About 8.0 mm on absorption of yolk sac.

SOURCE OF INFORMATION

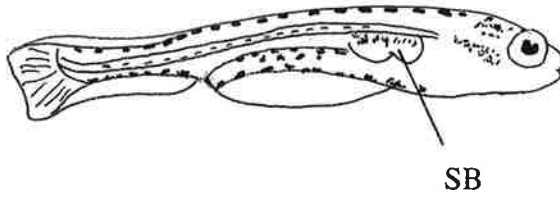
Bracken and Kennedy (1967).

DISTRIBUTION

Widespread north of Taupo, throughout the Waikato River and in ponds and still waters north of Auckland.

Lateral views of *Scardinius erythrophthalmus* larvae and post-larvae

6.0 mm



9.2 mm

SMELT *Retropinna retropinna* (lacustrine stocks)

Egg Diameter	0.64 mm
Dry weight	0.17 mg
Time to 50% hatch	

DIMENSIONS OF LARVAE AT HATCH

Total length at hatch	2.0-4.0 mm
Vent ratio	$0.72 \pm .008$

Maximum body depth at hatch	0.2 mm
Head depth	0.3 mm
Head width	0.3 mm
Snout	0.06 mm
Orbit	0.17 mm

Anterior position of yolk sac	0.51 mm
Length of yolk sac	0.30 mm
Depth of yolk sac	0.12 mm

OTHER DISTINGUISHING FEATURES

Oil globule present in lacustrine smelt; pale white colour. double line of closely spaced melanophores on ventral surface of gut.

Note: Eggs obtained from fish caught at Huntly were 0.72 mg dry weight and 1.2 mm diameter.

SOURCE OF SAMPLES

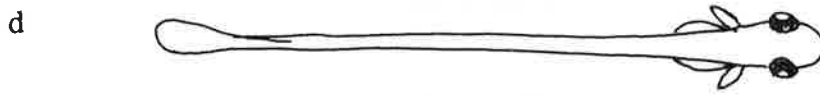
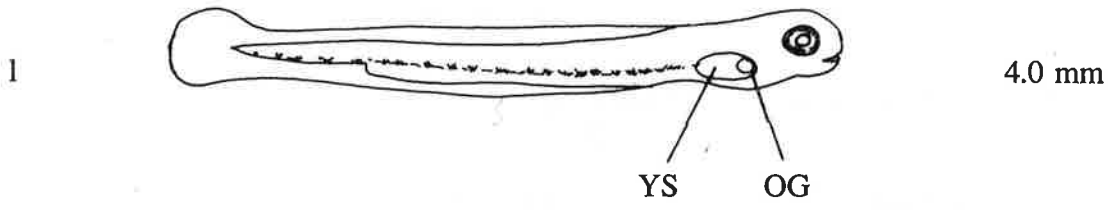
Lake Rotokauri, Rotomanuka, Rotorua,

KEY REFERENCES

Jolly (1967); Cryer (1988); Stephens (1983, 1984); Northcote and Ward (1985); Ward et al. (1989)

DISTRIBUTION

Widespread in lakes and rivers throughout New Zealand.



TENCH *Tinca tinca*

Egg Diameter	1-1.4 mm pale yellow, occasionally greenish.
Dry weight	not known
Time to 50% hatch	not known

DIMENSIONS OF LARVAE AT HATCH

Total length	4.0 - 5.5 mm
Vent ratio	about 0.68
Maximum depth	about .8 mm
Head depth	about .8 mm
Head width	
Snout	about .15 mm
Orbit	about .38 mm
Anterior position of yolk sac	n/a
Length of yolk sac	n/a
Depth of yolk sac	n/a

OTHER DISTINGUISHING FEATURES

Melanophores in dense band along ventral edge of tail and on top of gut, absent elsewhere. 40 -45 myotomes.

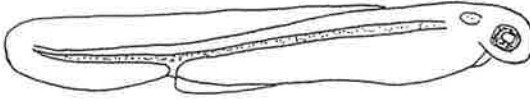
SOURCE OF INFORMATION

Bracken and Kennedy (1967). No New Zealand samples examined.

DISTRIBUTION

Widespread in the Auckland region.

1



5.0 mm

DATA ON SPECIES NOT INCLUDED IN THE KEY

OTHER GALAXIIDAE

		Egg (mm)	Weight (mg)	Length on hatch (mm)
Banded kokopu	<i>G. fasciatus</i>	1.7	0.84	8.5-9.0
Giant kokopu	<i>G. argenteus</i>	1.4-1.7		
Koaro	<i>G. brevipinnis</i>			
Short jawed kokopu	<i>G. postvectis</i>			2.0-2.5
Common river galaxias	<i>G. vulgaris</i>	1.4-2.4	-	7.2
Longjawed galaxias	<i>G. prognathus</i>			1.8 - -
Alpine galaxias	<i>G. paucispondylus</i>	2.2	-	-
Dwarf galaxias	<i>G. divergens</i>	2.0	-	-
Dwarf inanga	<i>G. gracilis</i>	0.8	-	-
Brown mudfish	<i>N. apoda</i>	2.4-2.6		
Black mudfish	<i>N. diversus</i>		no data	
Canterbury mudfish	<i>N. burrowsius</i>			1.4 - 6.0-7.5

Bonnett (1992); Cadwallader (1976); Eldon (1978); Eldon (1979); Hopkins (1971); Jellyman 1979); McDowall (1990); Ots and Eldon (1975).

ELEOTRIDAE

Blue gill	<i>G. hubbsi</i>	0.9	0.010	2.6
Giant bully	<i>G. gobioides</i>		no data	
Red finned bully	<i>G. huttoni</i>	1.0	-	3.0
Upland bully	<i>G. breviceps</i>	2.0	-	4.6
Cran's bully	<i>G. basalis</i>	1.5	0.53	5 - 6.0

Bonnett (1992); Cadwallader (1976); Eldon (1978, 1979); Hopkins (1971); Jellyman (1979); McDowall (1965); Mitchell (1989); Ots and Eldon (1975); Staples (1975).

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