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A new species of mudfish, *Neochanna* (Teleostei: Galaxiidae), from northern New Zealand

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A new species of mudfish, *Neochanna*, is described from Northland *Neochanna heleios* n sp is known from only three ephemeral wetland sites on the Kerikeri volcanic plateau and is abundant only at the type locality The new species has a head resembling that of the brown mudfish, *Neochanna apoda*, and a caudal region resembling that of the black mudfish, *Neochanna diversus* It can be distinguished from all *Neochanna* species in having a reduced number of principal caudal fin rays (13 or less) Morphometric and meristic comparisons with *N apoda* and *N diversus* are provided

Keywords *Neochanna Neochanna heleios* mudfish new species, Northland, New Zealand

INTRODUCTION

The genus *Neochanna* Gunther (1867) comprises a group of galaxiid fishes from Australia and New Zealand commonly known as mudfishes (McDowall 1997) They are scale-less, elongate, tubular bodied fishes with blunt heads and small eyes, and are characterised by reduced or absent pelvic fins and few or absent endopterygoid teeth All New Zealand species are non-diadromous and usually occupy ephemeral habitats that dry out over summer-autumn months, where these fish aestivate in damp refugia such as mud or moss, or under tree roots and logs

Neochanna apoda Gunther (1867), the brown mudfish, is considered the most specialised of the group with distinctly anguilliform characters It lacks pelvic fins and has long based and low dorsal and anal fins that are nearly confluent with the rounded caudal fin It is distributed through the southern part of the North Island and on the west coast of the South Island from north-west Nelson to Okarito

The black mudfish, *Neochanna diversus* Stokell (1949), which also lacks pelvic fins, differs from the brown mudfish in having a more rounded head, larger eyes, short-based dorsal and anal fins, and a more elongated caudal peduncle It is found north of Te Kuiti in the North Island

The Canterbury mudfish, *Neochanna burrowsius*, was originally described as *Galaxias burrowsius* Phillipps (1926) Later it was included in the genus *Neochanna* because its pelvic fins, though not absent, are very reduced in comparison to members of the genus *Galaxias* (McDowall 1970) It has many other characters that resemble the other New Zealand mudfishes including the ability to aestivate The Canterbury mudfish has the most restricted

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range of the known New Zealand mudfishes and, as its name suggests, is confined to the Canterbury region of the South Island.

Another species recently included in the genus *Neochanna* is the Tasmanian mudfish, *Neochanna cleaveri*, originally described as *Galaxias cleaveri* Scott (1934). McDowall (1997) described morphological similarities between this species and the New Zealand mudfishes, and regarded the Tasmanian mudfish as ancestral to the group. Such affinities, in general terms at least, are further supported by genetic analysis (Waters & White 1997).

A new species of *Neochanna* is described here on the basis of morphological data. It was discovered during a survey of black mudfish habitats in Northland. The status of this species is supported by a genetic analysis which has been presented elsewhere (Gleeson et al. 1999).

MATERIALS AND METHODS

Specimens of all fish examined were captured using Gee minnow traps (3 mm mesh) set overnight and slightly below the water surface. Fish were returned to the laboratory and maintained in aquaria. Measurements of morphometric and meristic characters were made mostly on anaesthetised specimens to prevent measurement distortion due to preservation. Point to point measurements of morphometric characters were made to the nearest 0.2 mm using digital display calipers. Methods for taking measurements and meristic counts were as described by McDowall & Wallis (1996). All measurements were made on the left-hand side of the fish. The following dimensions were measured: total length (TL); standard length (SL); head length (HL); head depth (HD); eye diameter (ED); snout length (SnL); snout to vent length (SVL); lengths of dorsal and anal fin bases (LDB, LAB); dorsal and ventral lengths of the caudal peduncle (DCPL, VCPL); caudal peduncle depth (CPD). Measurements are given as percentages of standard length unless otherwise stated. For meristic characters, counts included all segmented fin rays, with the exception of the caudal fin where counts were of principal fin rays (McDowall 1970). Vertebral counts of type specimens were taken from radiographs and include all vertebral centra excluding the urostyle.

MATERIAL EXAMINED (Fig. 1)

Specimens of *Neochanna* n. sp. were obtained from Wiroa Conservation Area (NZMS 260 P05/932594), Ngawha Springs Conservation Area (NZMS 260 P05/890426), and Rakautao Forest (NZMS 260 P06/894392) in Northland, New Zealand. Comparative specimens of black mudfish were captured at the following sites supporting extensive populations; Waihuahua Swamp (NZMS 260 O04/313992), Whangamarino Swamp (NZMS 260 S12/973318), and Kopouatai Peat Dome (NZMS 260 T13/337208). Specimens from the geographically closest population of brown mudfish, were obtained from the Ngaere Swamp, Taranaki (NZMS 260 Q20/273997).

NMNZ numbers are fish collection registration numbers of the Museum of New Zealand Te Papa Tongarewa.

TAXONOMY

Neochanna Günther 1867

DIAGNOSIS: Elongate tubular body; scales absent; lateral line obvious; head small and rounded; eyes small; no canine teeth in jaws; single dorsal fin and anal fin placed well back on the body; dorsal and anal fins with fleshy bases; upper and lower caudal fin margins are fleshy and extend forwards over caudal peduncle to be almost continuous with dorsal and anal fins; pelvic fins reduced or absent.

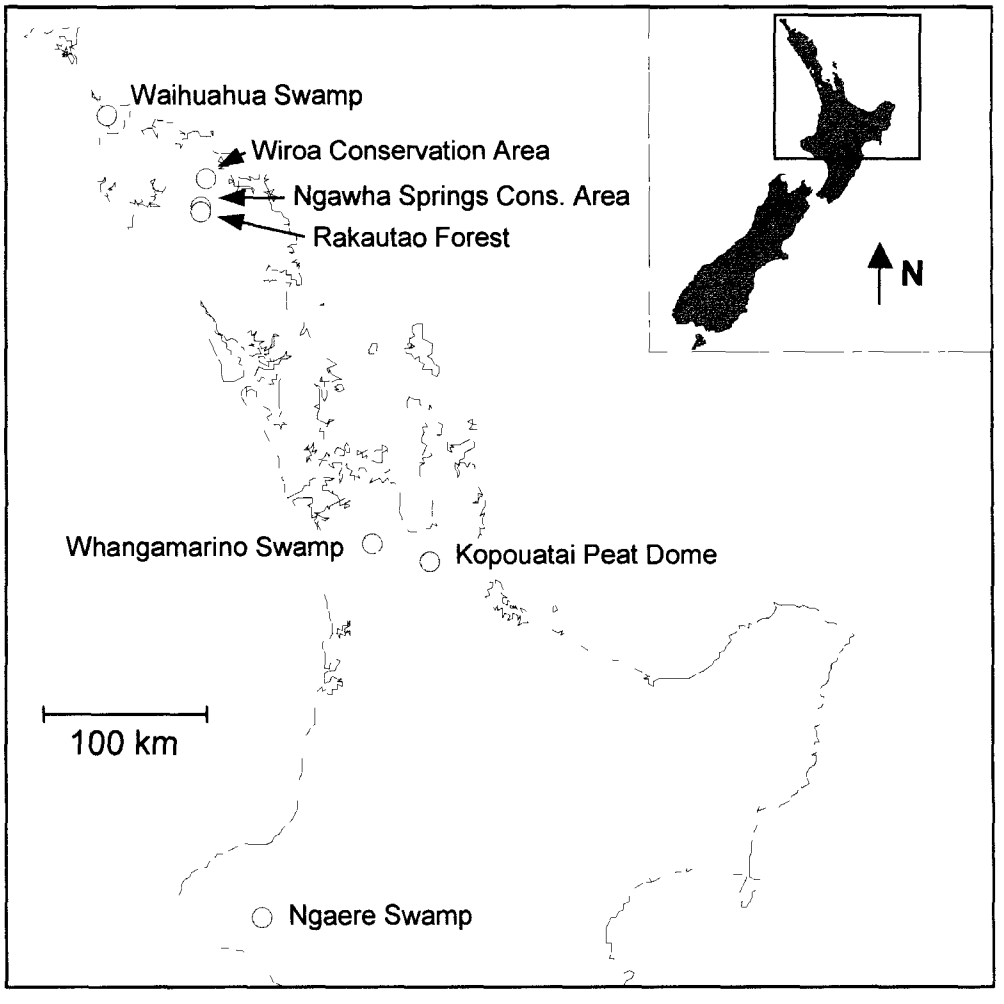

Fig. 1 Map showing the locations of material examined.

***Neochanna heleios* new species** (Fig. 2)

Holotype: NMNZ P. 37090, 69.8 mm TL, collected 16 June 1997 from Wiroa Conservation Area, Kerikeri Airport (NZMS 260 P05/932594).

A species of *Neochanna* with the following combination of characters: jaw extends to the posterior margin of the eye; the eye is small (10–15% of HL); the head displays a dorsal bulbous swelling behind the eye, particularly in larger individuals; the caudal peduncle is elongated (CPD = 76–113% of DCPL); 12–16 dorsal fin rays; 16–19 anal fin rays; 11–13 principal caudal fin rays (Tables 1 and 2).

Differs from *N. burrowsius* and *N. cleaveri* by lacking pelvic fins. Differs from *N. apoda* in having a longer caudal peduncle and fewer principal caudal fin rays. Differs from *N. diversus* in having small eyes, a bulbous swelling behind the head, and a mouth that extends to the posterior margin of the eye.

DESCRIPTION: In many respects, this species combines several characters of the black and brown mudfishes. Its tail more closely resembles that of the black mudfish, having a long and

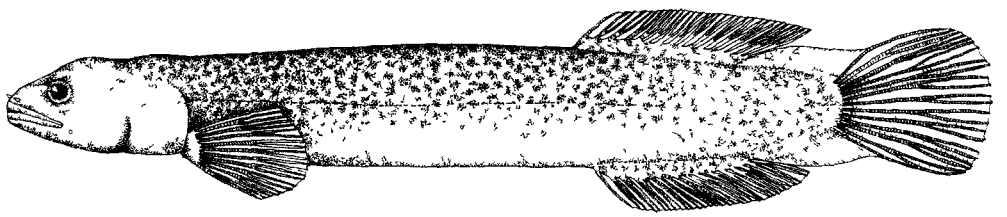

Fig. 2 *Neochanna heleios* new species. Holotype, NMNZ P. 37090, 69.8 mm TL, Kerikeri, Northland. Drawing by Catherine Beard.

relatively slender caudal peduncle and moderate sized dorsal and anal fins. However, its head is more similar to that of the brown mudfish, having a large mouth that extends back to the posterior margin of the eye. The eye is small, and the head displays a dorsal bulbous swelling behind the eye. The forehead slopes forward towards the mouth, unlike the rounded and blunted head of the black mudfish, and the jaw is less rounded than in the latter. The nostrils are tubular extending forwards over the mouth. There are large obvious laterosensory pores on the head. Dorsal and anal fins are intermediate in their length and the number of rays, and the fin bases and caudal peduncle are less fleshy than those of the black and brown mudfishes. Posterior fin rays are longest. Caudal fin is rounded with a reduced number of principal caudal fin rays (13 or fewer). The body is distinctly elongate and tubular as in other mudfishes.

COLOUR: In life: upper body slate grey to black with a distinct reddish tinge particularly on fins, fine dark speckled markings covering most of the body and fins, underside lighter. In preservative: dark grey with fine speckled markings, paling towards belly.

SIZE: The largest specimen recorded is 118 mm TL. It is commonly 90–110 mm TL.

VARIATION: Morphometric: see Table 1. Meristic: see Table 2.

DISTRIBUTION: Known only from three sites on the Kerikeri volcanic plateau at altitudes of around 150–200 m. All sites are small ephemeral wetlands on peaty soils. Possibly more widespread in this area in suitable marshy habitat, although little of this type of habitat remains. It is abundant at the most extensive site, Wiroa Conservation Area, where we recorded catch rates up to seven fish per trap per night, but rare elsewhere.

CONSERVATION STATUS: Threatened, possibly endangered, due to restricted distribution and loss of suitable habitat. Only the type locality, Wiroa Conservation Area, is reasonably large in area and seems to support an extensive population. The site near Ngawha Springs is very small (<1 ha) and only adults have been recorded there, although fry have been seen in adjacent streams and drains. The site at the Rakautao Forest is a deep swampy stream surrounded by *Pinus radiata* plantations, and recent fishing expeditions at this site have failed to find any specimens. A recently observed deterioration in water quality may have eliminated the species from this locality.

ETYMOLOGY: *heleios*, from Greek, meaning "dwelling in a marsh".

Table 1 Morphometric variation in populations of *Neochanna heleios*, *Neochanna diversus*, and *Neochanna apoda*. Figures are percentages of denominators in ratios, figures in parentheses are number of specimens, boxes enclose characters that are significantly different from *Neochanna heleios* (Student's *t* test, $P < 0.05$). *, values for formalin fixed specimen.

		TL (mm)	TL /SL	HL /SL	SVL /SL	LDB /SL	LAB /SL	DCPL /SL	VCPL /SL	HD /HL	SnL /HL	ED /HL	VCPL /DCPL	LDB /DCPL	LAB /DCPL	CPD /DCPL	LDB /LAB
Neochanna heleios																	
Holotype	*	69.8	114.8	20.6	67.9	17.8	19.5	9.7	9.8	52.0	22.0	16.4	101.2	184.5	201.2	110.5	91.7
		71.3	112.9	19.9	69.5	18.4	18.3	10.9	10.3	52.9	22.8	13.4	93.8	168.1	167.2	98.3	100.5
Wiroa Cons. Area (9)	Max.	83.1	115.0	20.3	72.3	19.3	21.0	12.9	12.1	52.9	22.8	14.2	95.7	172.1	188.1	105.4	100.5
	Mean	75.2	113.4	19.3	68.8	17.6	19.7	11.8	10.0	47.4	19.7	12.9	84.9	150.8	168.3	94.5	89.6
	Min.	71.0	12.5	18.4	67	16.1	18.3	10.3	7.9	41.9	17.8	11.5	76.9	131.5	152.0	82.9	83.5
	S.D.	3.7	0.9	0.7	1.8	1.0	0.7	1.0	1.4	3.6	1.6	1.0	7.2	15.8	13.4	7.5	5.5
Ngawha Springs	Max.	99.5	113.7	22.5	71.0	15.3	19.2	13.1	12.8	50.8	23.5	14.7	110.3	144.1	185.5	113.6	84.6
C. A. (10)	Mean	86.1	112.2	19.3	70.1	13.7	17.6	11.6	11.1	47.9	22.5	12.7	96.1	119.3	153.8	99.2	77.6
	Min.	80.0	109.9	18.0	67.7	12.4	16.4	10.2	9.6	41.8	21.8	10.1	83.6	102.8	128.7	86.9	70.6
	S.D.	7.3	1.0	1.4	1.0	1.0	0.9	0.9	1.0	2.8	0.5	1.4	9.1	13.9	17.1	7.9	4.4
Rakautao Forest (1)		65.2	112.6	20.6	62	15.5	19.6	14.5	12.6	44.5	25	14.9	86.7	106.8	135	75.5	79.0
TOTAL	Mean	79.1	112.9	19.3	68.6	15.4	18.7	11.9	11.1	49.7	21.4	13.5	93.3	130.7	158.5	95.9	82.2
	S.D.	9.0	1.2	1.2	2.2	2.1	1.4	1.1	1.0	5.4	2.0	1.8	8.0	21.4	17.6	9.4	6.6
Neochanna diversus																	
Waihuahua Swamp	Max.	93.5	114.1	20.1	72.4	15.3	17.6	13.9	12.6	47.8	18.8	20.2	99.3	123.6	149.3	104.4	100.2
(13)	Mean	77.3	112.6	19.1	71.1	14.0	15.8	12.5	11.3	45.2	16.5	15.9	91.0	112.3	127.1	91.4	89.8
	Min.	64.4	111.4	18.0	69.2	12.5	13.8	10.9	9.6	43.1	13.8	14.7	81.9	101.2	105.6	82.3	73.6
	S.D.	9.0	0.9	0.7	0.8	0.8	1.1	0.9	0.8	1.5	1.6	1.6	5.0	8.0	14.7	8.0	9.1
Whangamarino	Max.	134.7	113.3	20.3	71.4	14.4	19.2	15.0	12.5	51.7	20.6	22.6	101.8	117.5	148.2	115.2	83.3
Swamp (11)	Mean	109.3	112.2	18.9	69.9	13.0	17.2	13.7	11.6	46.4	17.7	15.7	85.0	95.3	126.1	97.3	75.7
	Min.	50.7	110.0	17.0	68.6	11.4	14.6	12.3	10.1	42.0	15.9	13.1	75.8	79.8	103.6	78.4	68.2
	S.D.	23.0	0.9	1.0	0.9	0.8	1.3	0.8	0.7	2.7	1.5	2.5	7.6	10.2	13.4	11.1	5.0
Kopouatai Peat	Max.	107.3	115.4	21.6	71.8	14.8	17.1	15.1	12.9	46.3	19.8	21.3	96.1	118.1	138.9	112.7	86.8
Dome (11)	Mean	85.2	113.6	19.7	70.2	13.2	16.3	13.1	11.4	44.6	17.3	17.3	86.8	101.1	125.0	100.0	80.9
	Min.	63.5	112.6	18.2	68.6	11.7	15.3	12.0	9.3	41.7	15.4	14.9	74.8	86.4	102.0	80.4	74.9
	S.D.	15.3	0.9	1.0	1.0	0.8	0.6	0.9	1.1	1.7	1.2	1.9	6.1	9.7	10.3	9.7	4.1
TOTAL	Mean	89.8	112.8	19.3	70.4	13.4	16.4	13.1	11.4	45.4	17.1	16.3	87.8	103.4	126.1	95.9	82.3
	S.D.	21.0	1.1	0.9	1.0	0.9	1.2	1.0	0.9	2.1	1.5	2.1	6.6	11.6	12.7	10.0	8.6
Neochanna apoda																	
Ngaere Swamp (12)	Max.	98.1	114.8	21.9	74.4	21.3	21.5	7.8	6.5	61.6	22.8	14.8	93.0	370.5	395.3	211.6	109.7
	Mean	81.1	113.6	20.9	72.6	19.3	20.5	6.6	5.3	50.3	20.0	12.9	81.8	297.0	315.1	168.8	94.3
	Min.	68.5	112.5	19.6	69.8	16.8	19.4	5.2	4.3	41.5	16.9	10.9	63.4	237.9	259.5	140.8	83.2
	S.D.	9.4	0.8	0.7	1.2	1.4	0.7	0.7	0.7	7.1	1.8	1.1	10.0	39.3	37.1	20.8	7.5

Table 2 Meristic variation in populations of *Neochanna heleios*, *N. diversus*, and *N. apoda*. Boxes enclose characters that are significantly different from *Neochanna heleios* (Student's *t* test, $P < 0.05$). *, data for holotype; **, data for holotype and 4 paratypes only.

	Dorsal Fin Rays									
	10	11	12	13	14	15	16	17	18	19
Neochanna heleios										
Wiroa Cons. Area					3	3	3*			
Ngawha Springs C. A.			2	4	3	1				
Rakautao Forest				1						
Total			2	5	6	4	3			
Neochanna diversus										
Waihuahua Swamp	1	6	4	2						
Whangamarino Swamp		3	3	5						
Kopouatai Peat Dome	2	4	3	1	1					
Total	3	13	10	8	1					
Neochanna apoda										
Ngaere Swamp							2	1	6	3

	Anal Fin Rays									
	12	13	14	15	16	17	18	19	20	21
Neochanna heleios										
Wiroa Cons. Area					1	5*	1	2		
Ngawha Springs C. A.					3	5	2			
Rakautao Forest							1			
Total					4	10	4	2		
Neochanna diversus										
Waihuahua Swamp	1	10	2							
Whangamarino Swamp		1	1	5	3	1				
Kopouatai Peat Dome		4	4	2	1					
Total	1	15	7	7	4	1				
Neochanna apoda										
Ngaere Swamp						3	3	5		1

	Caudal Fin Rays								
	11	12	13	14	15	16	17	18	19
Neochanna heleios									
Wiroa Cons. Area	1	5*	3						
Ngawha Springs C. A.		4	6						
Rakautao Forest	1								
Total	2	9	9						
Neochanna diversus									
Waihuahua Swamp			2	1	7	1	2		
Whangamarino Swamp						6	1	2	2
Kopouatai Peat Dome					2	2	3	3	1
Total			2	1	9	9	6	5	3
Neochanna apoda									
Ngaere Swamp				4	6	2			

	Pectoral Fin Rays						**Vertebrae		
	10	11	12	13	14	15	55	56	57
Neochanna heleios									
Wiroa Cons. Area		1	7*	1			1	1	3*
Ngawha Springs C. A.	2	4	3	1					
Rakautao Forest		1							
Total	2	6	10	2					
Neochanna diversus									
Waihuahua Swamp			10	3					
Whangamarino Swamp			4	4	2	1			
Kopouatai Peat Dome			4	5	2				
Total			18	12	4	1			
Neochanna apoda									
Ngaere Swamp		3	8	1					

DISCUSSION

In recent years, careful examination of some native fish populations (Allibone et al. 1996; Allibone & Townsend 1997) has revealed a number of new species. In fact, New Zealand's galaxiid fauna has increased by more than 50% since 1990. Further studies, particularly those in relatively inaccessible habitats, may continue to expand the New Zealand fauna. Detailed information on the abundance and ecology of mudfishes has been relatively slow to emerge. Perceived difficulties in catching these cryptic and nocturnally active fish (Eldon 1992) have been overcome in recent years by the use of unbaited fine-mesh Gee minnow traps set overnight in wetland habitats (Hicks & Barrier 1996). This method of fishing has provided reliable semi-quantitative estimates of mudfish abundance in all habitats examined so far.

A new species of mudfish, *Neochanna heleios* is described here. Three allopatric species of mudfish, *Neochanna* spp., have previously been recognised in New Zealand, with the northern black mudfish being widely distributed in suitable habitat throughout the Waikato and Northland regions (McDowall 1990). Continuing destruction by agricultural drainage of wetland habitat suitable for black mudfish throughout its range has restricted this species to relatively few secure habitats and a number of minor and tenuous refuges. Survey work in Northland, mostly by the Department of Conservation, has been restricted to establishing the presence or absence of mudfish at likely sites, rather than any detailed examination of the fish themselves.

The similar appearance of the new species to the black mudfish, and the

fact that it occurs within the geographic range of the black mudfish, have effectively prevented its discovery until now Specimens were taken from only three sites and two of these were listed in the New Zealand Freshwater Fish Database for black mudfish The third is a new record for any species of mudfish However, we have not found any black mudfish at these sites indicating that the two species do not co occur All sites are restricted in extent and threatened by development of adjacent land

Extensive recent efforts to survey other recorded mudfish sites in Northland, and other potential habitat that could harbour the new species, have failed to find any new populations (N Ling unpubl data) All three known sites are restricted to an area of central Northland known as the Kerikeri volcanic plateau, at elevations of around 200 m Most other known mudfish habitats in Northland are at lower elevations and coastal Other than this geographic or altitude disparity, there is nothing unique about the habitat characteristics of either of these species, which both seem to prefer infertile wetlands An understanding of Northland's geological history suggests that *Neochanna heleios* may be an ancestral Northland mudfish species, and the black mudfish a more recent immigrant (Gleeson et al 1999) We therefore suggest applying the common name Northland mudfish to the new species to acknowledge its endemicity to this region The restricted distribution of *Neochanna heleios*, and the possible destruction of its remnant habitats through localised land development, make this species a high priority for conservation action

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REFERENCES

Allibone, R M Townsend, C R 1997 Reproductive biology, species status and taxonomic relationships of four recently discovered galaxiid fishes in a New Zealand river *Journal of Fish Biology 51* 1247–1261

Allibone, R M , Crowl, T A , Holmes, J M , King, T M , McDowall, R M , Townsend, C R , Wallis, G P 1996 Isozyme analysis of *Galaxias* species (Teleostei Galaxiidae) from the Taieri River, South Island, New Zealand a species complex revealed *Biological Journal of the Linnean Society 57* 107–127

Eldon, G A 1992 The difficulties of capturing mudfish *Freshwater Catch 48* 16–17

Gleeson, D M , Howitt, R L J , Ling, N 1999 Genetic variation, population structure and cryptic species within the black mudfish, *Neochanna diversus*, an endemic galaxiid from New Zealand *Molecular Ecology 8* 47–57

Gunther A 1867 On a new form of mudfish from New Zealand *Annals and Magazine of Natural History 3* 305–309

Hicks B J , Barrier, R F G 1996 Habitat requirements of black mudfish (*Neochanna diversus*) in the Waikato region, North Island, New Zealand *New Zealand Journal of Marine and Freshwater Research 30* 135–151

McDowall R M 1970 The galaxiid fishes of New Zealand *Bulletin of the Museum of Comparative Zoology Harvard University 139* 341–431

McDowall, R M 1990 New Zealand freshwater fishes a natural history and guide Auckland, Heinemann Reed

McDowall R M 1997 Affinities, generic classification and biogeography of the Australian and New Zealand mudfishes (Salmoniformes Galaxiidae) *Records of the Australian Museum 49* 121–137

McDowall, R M , Wallis, G P 1996 Description and redescription of *Galaxias* species (Teleostei Galaxiidae) from Otago and Southland *Journal of the Royal Society of New Zealand 26* 401–427

Phillipps, W. J. 1926: New or rare fishes of New Zealand. *Transactions and Proceedings of the New Zealand Institute 56*: 529–537.

Scott, E. O. G. 1934: Observations on some Tasmanian fishes, with descriptions of new species. Papers and Proceedings of the Royal Society of Tasmania, 1933. Pp. 31–53.

Stokell, G. 1949: The systematic arrangement of the New Zealand Galaxiidae. Part II. Specific classification. *Transactions of the Royal Society of New Zealand 77*: 472–496.

Waters, J. M.; White, W. G. 1997: Molecular phylogeny of the Tasmanian and New Zealand mudfishes (Salmoniformes: Galaxiidae). *Australian Journal of Zoology 45*: 39–48.

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