DISTRIBUTION AND CONSERVATION STATUS OF SMALL FRESHWATER FISH IN THE RIVER MURRAY, SOUTH AUSTRALIA

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Summary

LLOYD, L. N. & WALKER, K. F. (1986) Distribution and conservation status of small freshwater fish in the River Murray, South Australia. *Trans. R. Soc. S. Aust.* **110**(2), 49-57, 30 May, 1986.

Most species of fish native to the lower Murray have declined over the past century, probably as a result of habitat changes and interactions with exotic species. Here, the range and relative abundance of the small species (17 native and two introduced) are assessed from collections made in 1982–84. Four habitat types are defined from 39 field sites. "River-edge" habitats have a more diverse assemblage (mean 7.6 species) than "backwater" (5.1), "billabong" (3.5) or "stream" habitats (2.6). Streams contain a distinctive assemblage, but billabongs and backwaters have a subset of species found in river-edge habitats. Distributions generally are patchy and densities are low, and none of the species can be considered secure. In the lower Murray four species are regarded as "endangered" and five as "vulnerable". Surveys are needed to determine the regional status of other Australian freshwater fish.

KEY WORDS: Fish, conservation, billabongs, River Murray, South Australia.

Introduction

Several authors recently have discussed the conservation of native Australian freshwater fish (e.g. Pollard *et al.* 1980; Ride & Wilson 1982; Cadwallader *et al.* 1984). Although it is widely believed that many species have declined (cf. Cadwallader 1979), most supporting evidence is circumstantial and anecdotal. Growing interest in this problem is shown in concern, notably by government agencies, about the vulnerability of certain species, and in the appearance of books concerned with regional faunas (McDowall 1980; Allen 1982; Cadwallader & Backhouse 1983).

Most information available for the fish of the Murray-Darling Basin is for commercial or recreational species, and very little is known of the status of the smallest species, sometimes misleadingly called "forage fish". Llewellyn (1984) and Cadwallader & Backhouse (1983) mapped the ranges of fish in the New South Wales and Victorian regions respectively, but there is no published information for the Murray in South Australia, arguably the most modified part of the river system (Walker 1981, 1982a, b, 1983, 1985). In this paper we report the status of the small species of the Murray below the Darling junction, as part of an investigation of the relationships between small species of native and exotic fish in the lower Murray (Lloyd unpublished).

Methods

The area surveyed was the basin of the lower River Murray (AWRC Basin IV-26: Dept National Development 1976), including the main channel, anabranches (Chowilla and Slaneys creeks), tributaries (Angas, Finniss and Marne rivers), backwaters and billabongs. During 1982–84 samples were taken from 39 stations (Fig. 1, Table 1). Four habitat types were defined, *viz.* "river-edge" environments (along the banks of the main channel), "backwaters" (slack waters connected to the main channel), "billabongs" (still waters isolated from the main channel except in floods) and "streams" (small, moderate- to fast-flowing tributary creeks). All had some aquatic vegetation, including stands of emergent and submerged plants. Most sites were sampled once or twice, but stations 3-7 and 15–18 were visited at about monthly intervals. Standard sampling included 10 hauls of a 2 m seine net (2 mm mesh), three hauls of a 5 m seine net (12 mm mesh), a dip-net collection over a 10 m strip and, at most sites, three collections using traps baited with meat, left overnight.

Fish were identified using the keys of Scott *et al.* (1974), McDowall (1980) and Cadwallader & Backhouse (1983). *Philypnodon grandiceps* (Krefft) (bigheaded gudgeon), was distinguished from an undescribed dwarf congener. Carp-gudgeons were referred to *Hypseleotris klunzingeri* (Ogilby), although Hoese *et al.* (1980) suggest there are undescribed species in this taxon. Supplementary data were obtained from South Australian Museum records, the published literature and personal communications.

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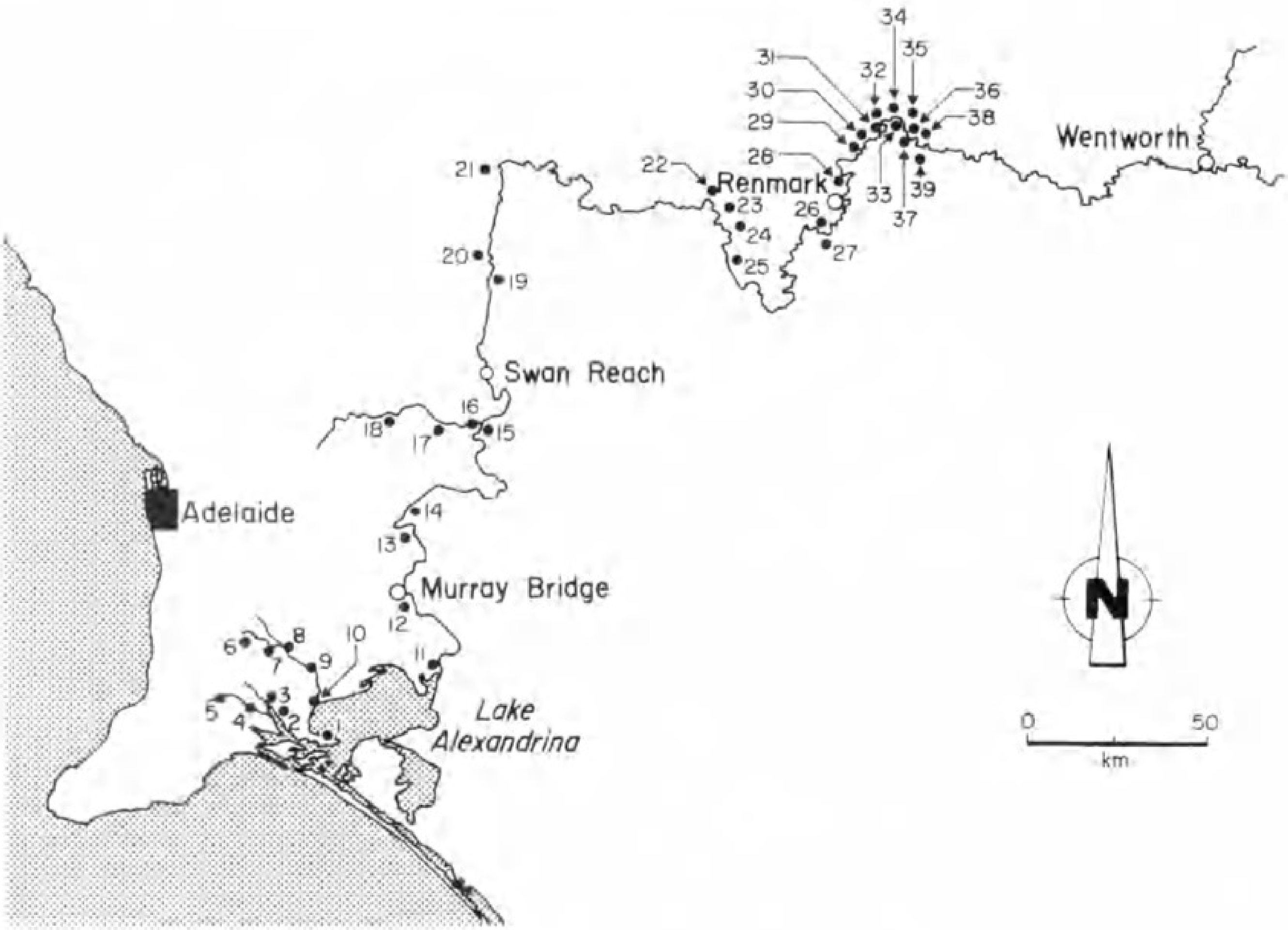

Fig. 1. Sites surveyed, 1982-84. See Table 1 for key.

Results

Our collections included 15 of the 17 known small native fish species of the lower Murray (Table 2). In addition, the exotic mosquitofish, *Gambusia affinis holbrooki* (Girard) (see Lloyd & Tomasov 1985), occurred at all sites except Point Sturt and three small tributaries to Lake Alexandrina (stations 1, 4–9), and goldfish, *Carassius auratus* L., occurred at 18 sites.

Discussion

Distribution

The survey suggested that most species are widely but patchily distributed; examples are *H. klunzingeri*, *P. grandiceps*, *Retropinna semoni* (Weber) (Australian smelt), *Craterocephalus stercusmuscarum* (Günther) (Mitchellian hardyhead), *Melanotaenia splendida fluviatilis* (Castelnau) (crimson-spotted rainbowfish) and *Nematalosa erebi* (Günther) (juvenile bony bream). Others are restricted either because the species themselves are uncommon, or because suitable habitats are uncommon. In the latter category, species that frequent estuarine areas, for example *Pseudaphritis urvilli* (Valenciennes) (congolli), *Pseudogobius olorum* (Sauvage) (blue-spot goby) and *Galaxias maculatus* (Jenyns) (common galaxias), are most common in the region near the river mouth. Further, *G. olidus* Günther (mountain galaxias) is typical of mountain streams, an environment virtually absent from the lower Murray, and *G. rostratus* Klunzinger (flatheaded galaxias) favours the billabongs and backwaters of the uppermost reaches of the Murray. Another group of special interest here occurs in the few sites where exotic species have not penetrated or where major habitat changes have not occurred. These include *Mogurnda adspersa* (Castelnau) (purple-spotted gudgeon), *Nannoperca australis australis* Günther (pigmy perch) and *Gadopsis marmoratus* Richardson (river blackfish).

H. klunzingeri was widespread and showed no preference among the four habitat types (χ^2 = 6.0, 3 df, n.s.). However, other species did show an association with river-edge and backwater habitats; these were *G. a. holbrooki* (χ^2 = 10, 3 df, $P < 0.05$), *R. semoni* (χ^2 = 17, 3 df, $P < 0.01$), *P. grandiceps* ($\chi^2 2$ = 7.6, 2 df, $P < 0.05$) and juvenile *N. erebi* (χ^2 = 8.3, 2 df, $P < 0.05$).

TABLE 1. *Survey Sites, 1982-1984 (see also Fig. 1)*

Site No.	Site Name	Location	Habitat Type
1	Point Sturt	35°31' 139°02'	Backwater
2	Finniss R., Tosolinis	35°26' 138°51'	River edge
3	Finniss R., Reedlands	35°25' 138°50'	River edge
4	Tookayerta Ck, Two Bridges	35°25' 138°48'	Stream
5	Tookayerta Ck, Tooperang	35°24' 138°45'	Stream
6	Dawson Ck, Sutherlands	35°15' 138°50'	Stream
7	Dawson Ck, HT Reserve	35°18' 138°51'	Stream
8	Angas R., CC Reserve	35°15' 138°54'	Stream
9	Angas R., Airport Bridge	35°17' 138°57'	Stream
10	Angas R., Mouth	35°54' 138°59'	Backwater
11	Wellington	35°20' 139°23'	River edge
12	Swanport Billabong	35°08' 139°18'	Billabong
13	Zadows Landing	34°58' 139°18'	River edge
14	Mannum	34°55' 139°18'	River edge
15	Wongulla	34°43' 139°34'	River edge
16	Marne R., Mouth	34°43' 139°33'	River edge
17	Marne R., Wombat Reserve	34°18' 139°31'	Stream
18	Marne R., Blackhill Reserve	34°42' 139°28'	Stream
19	Blanchetown	34°18' 139°37'	Billabong
20	McBeans Pound	34°12' 139°38'	Backwater
21	Morgan	34°02' 139°40'	Billabong
22	Overland Corner	34°09' 140°20'	Backwater
23	Lock 3	34°11' 140°21'	River edge
24	Chambers Ck	34°12' 140°24'	Backwater
25	Spectacle Lakes Ck	34°23' 140°23'	Backwater
26	Dishers Ck Evap. Basin	34°15' 140°40'	Backwater
27	Murray at Dishers Ck Outlet	34°15' 140°40'	River edge
28	364 Mile Tree	34°07' 140°45'	Backwater
29	375 Mile Tree	34°03' 140°49'	Backwater
30	376 Mile Tree	34°01' 140°50'	Billabong
31	Chowilla Ck	34°00' 140°52'	River edge
32	Lock 6	34°00' 140°53'	Billabong
33	Bunyip Reach	33°58' 140°55'	River edge
34	Bunyip Reach Homestead	33°59' 140°55'	Backwater
35	395 Mile Tree	33°58' 140°56'	Billabong
36	Slaneys Ck	33°57' 140°56'	River edge
37	Border Cliffs	33°59' 140°58'	River edge
38	404 Mile Tree	34°01' 140°59'	River edge
39	405 Mile Tree	34°02' 140°59'	Backwater

Although there are insufficient data for more statistical comparisons, a few points deserve comment. *C. auratus, M. s. fluviatilis* and *Philypnodon* sp. (dwarf bigheaded gudgeon) all occurred in three to four habitat types. *G. maculatus, C. stercusmuscarum* and *C. eyresii* (Steindachner) (Lake Eyre hardyhead) were found only in river-edge and backwater habitats (and near the river mouth in the case of *G. maculatus*). *P. olorum* and *P. urvilli* occurred in river-edge collections; most of these were near the Murray mouth, although a single specimen of *P. urvilli* was collected at the Marne inflow, 215 river-km upstream. Populations of *N. a. australis, G. marmoratus* and *G. olidus* were found only in stream habitats, although two individual *N. a. australis* were found in river-edge habitats near stream-living populations of that species. No habitat preferences can be assigned to *A. castelnaui, G. rostratus* or *M. adspersa*, as too few specimens were found.

River-edge habitats supported significantly more species (mean 7.6, N = 14) than the three other habitat types (Table 3; ANOVA, $F = 10.6$ with 3,35 df; $P < 0.01$). Backwaters had significantly more species (mean 5.1, N = 11) than billabongs (3.5, 6) and streams (2.6, 8) (ANOVA, $F = 5.7$ with 1,15 df; $P < 0.05$). Spearman rank correlations suggest that billabong and backwater species may be regarded as a subset of river-edge species (rho = 0.62 and 0.82 respectively, both $P < 0.05$). There was no significant difference between the number of species in billabongs and streams (ANOVA, $F = 1.2$ with 1,12 df; $P > 0.05$), but the species involved were different. Spearman rank correlations show that streams had a distinctive fish fauna, as there were no significant correlations with assemblages in other habitats (river-edge *v.* streams:

TABLE 2. *The small freshwater fish of the lower Murray, their habitats and conservation status.*
**Denotes exotic species*

	Sites present per habitat				Total (%)	Status
	River Edge	Backwater	Billabong	Stream		
1 *mosquitofish, *Gambusia affinis holbrooki* (Girard)	14	10	6	2	32 (82%)	Common
2 carp gudgeon, *Hypseleotris klunzingeri* (Ogilby)	12	9	5	4	30 (77%)	
3 Australian smelt, *Retropinna semoni* (Weber)	13	5	2	1	21 (54%)	
4 big-headed gudgeon, *Philypnodon grandiceps* (Krefft)	12	6	2	0	20 (51%)	
5 bony bream, *Nematalosa erebi* (Günther)	11	6	1	0	18 (46%)	
6 *goldfish, *Carassius auratus* Linnaeus	9	5	3	1	18 (46%)	
7 crimson-spotted rainbowfish, *Melanotaenia splendida fluviatilis* (Castelnau)	9	4	2	0	15 (38%)	
8 Mitchellian hardyhead, *Craterocephalus stercusmuscarum* (Günther)	8	4	0	0	12 (31%)	
9 dwarf big-headed gudgeon, *Philypnodon* sp.	4	3	0	1	8 (21%)	Rare
10 Lake Eyre hardyhead, *Craterocephalus eyresii* (Steindachner)	4	2	0	0	6 (15%)	
11 mountain galaxias, *Galaxias olidus* Günther	0	0	0	5	5 (13%)	Vulnerable
12 common galaxias, *Galaxias maculatus* (Jenyns)	2	2	0	0	4 (10%)	
13 flat-headed galaxias, *Galaxias rostratus* Klunzinger	0	0	0	0	0 (0%)	
14 congolli, *Pseudaphritis urvilli* (Valenciennes)	3	0	0	0	3 (8%)	
15 blue-spot goby, *Pseudogobius olorum* (Sauvage)	2	0	0	0	2 (5%)	
16 pigmy perch, *Nannoperca australis australis* Günther	2	0	0	4	6 (15%)	Endangered
17 river blackfish, *Gadopsis marmoratus* Richardson	0	0	0	3	3 (8%)	
18 Chanda perch, *Ambassis castelnaui* (Macleay)	1	0	0	0	1 (3%)	
19 purple-spotted gudgeon, *Mogurnda adspersa* (Castelnau)	0	0	0	0	0 (0%)	

TABLE 3. *Site records (×) of small freshwater fish species in the lower Murray region. Species and sites are identified by numbers (see Tables 1 and 2, respectively). The bold numbers on the righthand margin indicate the numbers of species recorded at each site.*

	Species 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
Site 1			×	×	×			×				×								**5**
2	×	×	×	×	×	×	×	×	×	×		×		×	×	×				**14**
3	×	×		×		×		×	×	×		×		×	×	×				**11**
4											×					×				**2**
5											×					×				**2**
6		×														×	×			**3**
7		×									×					×				**3**
8		×																		**1**
9		×																		**1**
10	×	×		×					×	×		×								**6**
11	×	×	×	×	×		×													**6**
12	×	×					×													**3**
13	×	×	×	×	×		×	×												**7**
14	×	×	×	×	×	×	×	×												**8**
15	×	×	×	×	×	×	×	×		×										**9**
16	×	×	×	×	×	×	×	×	×	×				×				×		**12**
17	×		×			×			×		×						×			**6**
18	×										×						×			**3**
19	×	×		×																**3**
20	×	×				×														**3**
21	×	×	×		×	×														**5**
22	×	×			×	×	×	×												**6**
23	×		×		×			×												**4**
24	×	×		×				×	×											**5**
25	×	×	×		×	×	×	×	×											**8**
26	×			×		×				×										**4**
27	×		×	×	×	×	×													**6**
28	×	×	×		×		×													**5**
29	×	×	×	×	×															**5**
30	×	×	×	×			×													**5**
31	×	×	×	×	×		×													**6**
32	×	×				×														**3**
33	×	×	×	×	×															**5**
34	×	×				×														**3**
35	×					×														**2**
36	×	×	×	×		×			×											**6**
37	×	×	×			×														**4**
38	×	×	×	×	×	×	×	×												**8**
39	×	×	×	×	×		×													**6**

rho = −0.35; backwaters v. streams: rho = −0.29; billabongs v. streams: rho = −0.25; all $P > 0.05$). Finally, there was no significant difference between the mean numbers of species in sites sampled once (mean 4.8) and those sampled monthly (mean 6.5; Student's $t = 1.66$, 3 df; $P > 0.05$).

Conservation Status

The conservation status accorded each species in the lower Murray is indicated in Table 2, using a scheme comparable to that of the International Union for the Conservation of Nature (cf. Goodwin & Holloway 1972).

Common species are widespread and probably form an important part of the food chain. For example, *H. klunzingeri* occurred at more than 60% of sites although, as noted earlier, this taxon may contain more than one species. Other widespread species (at more than 30% of sites) were *R. semoni, P. grandiceps*, juvenile *N. erebi, C. stercusmuscarum* and *M. s. fluviatilis*. All are recorded as common (e.g. Scott *et al.* 1974). None should be considered secure, however, given their generally low numbers and the likelihood of continuing changes to the Murray environment.

Rare species are regarded as those that occur in small populations and are either restricted in range or scattered over a broad area. Thus *C. eyresii* and *Philypnodon* sp. were found at 15% and 20% of sites respectively, usually in low numbers. *C. eyresii* was commonest in Dishers Creek Evaporation Basin, where salinities were high (c. 10 g/l) due to the inflow of saline irrigation water.

Vulnerable species are regarded as those likely to become endangered if their range and abundance decline farther. *Galaxias* spp., *P. urvilli* and *P. olorum* all have restricted distributions and probably are constrained by the scarcity of suitable habitats. They may be considered vulnerable in the lower Murray, although each is well-represented elsewhere in SE Australia. *P. urvilli, P. olorum* and *G. maculatus* are constrained by their need for access to the limited estuarine environment associated with barrages near the Murray mouth. As mentioned, *G. olidus* is typical of upland environments that are rare on the lower Murray; those that do occur are modified by agriculture or inhabited by trout (*Salmo* spp.), which are predatory. *G. rostratus* is commonest in billabongs and backwaters along the Murray in NSW, and South Australian Museum records suggest that it was never common in the lower Murray.

Endangered species are here regarded as those threatened by imminent local extinction. In the lower Murray four species may be so classified: *Ambassis castelnaui* (Macleay), *M. adspersa, N. a. australis* and *G. marmoratus*. Each of these species appears to have undergone a substantial reduction in range over the past 100 years or so, for reasons probably associated with habitat changes and interactions with exotic species (cf. Fig. 2; Reynolds 1976; Cadwallader 1978). Their former ranges cannot be determined accurately, but from the few museum records and published reports it appears likely that all four species were once widespread in the lower Murray (Gale 1914; McCulloch & Waite 1918; McCulloch & Ogilby 1919; Scott 1962; Scott *et al.* 1974; Cadwallader 1977, 1979; Cadwallader & Backhouse 1984; Hoese *et al.* 1980; Jackson & Llewellyn 1980; Pollard *et al.* 1980; Llewellyn 1980a,b, 1984; Hume *et al.* 1983; Jackson & Davies 1983; Walker & Hillman 1977).

A. castelnaui was collected only once in the present survey, although several specimens have been recorded by the South Australian Museum over the last 20 years, the last being in 1973. This suggests that populations are rare and patchily distributed, and may have declined in recent years. The species may never have been regionally abundant, but now appears threatened with local extinction. A similar decline is evident in other parts of its range (Cadwallader & Backhouse 1983; Llewellyn 1984).

M. adspersa was not collected in this survey, but again isolated specimens from the Murray have been lodged with the South Australian Museum over the past 20 years, the last being in 1973. These records and other observations (J. Pillar, S. Aust. Dept Fisheries, pers. comm.) suggest that populations now are small and patchily distributed, whereas the species probably was common in backwaters and river-edge habitats, two of the principal habitat types sampled in this survey. The apparent decline may be associated with the spread of *G. a. holbrooki*, although the supporting evidence is circumstantial. Similar declines have occurred elsewhere in SE Australia (McDowall 1980; Cadwallader & Backhouse 1983).

N. a. australis also was once widespread in the lower Murray but has apparently declined; the last S.A. Museum record is 1946, and the only known regional habitats now are two small streams flowing to Lake Alexandrina. The species prefers shaded, weedy habitats of the kind often destroyed by "stream improvement" practices. In addition, its absence from suitable habitats occupied by *G. a. holbrooki*, and the absence of this species from the two streams mentioned above suggest that interactions between these species could have been responsible. *N. a. australis* is locally common in SE S. Aust. and Vict. (Cadwallader & Backhouse 1983; Glover 1983; Llewellyn 1984; Lloyd 1984).

G. marmoratus occurred in the Murray in the 1930s, according to S.A. Museum records, and there

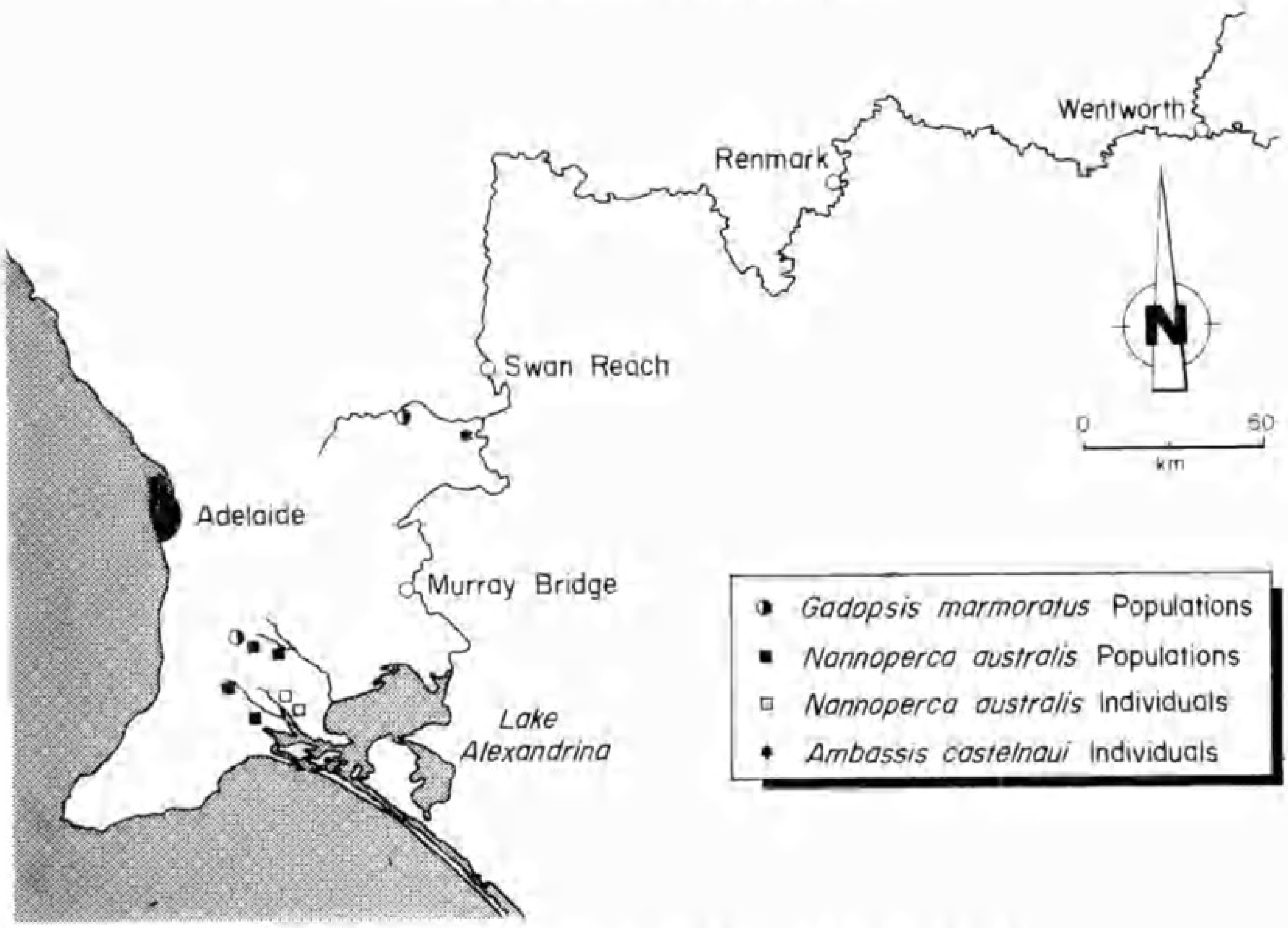

Fig. 2. Survey records of the four species here regarded as endangered in the lower Murray.

is anecdotal evidence that populations persisted until the 1950s (R. Mason, Strathalbyn Naturalists Club, pers. comm.). In this survey only two populations were discovered (lower Marne River and upper Angas River catchment). The species is not easily caught by seining, but is attracted to baited traps. At one of the two sites juveniles are readily collected using artificial substratum samplers, but no juveniles have come from similar samplers used in extensive benthic surveys of the lower river (M. B. Thompson, Univ. Adelaide and P. J. Suter, Engineering & Water Supply Dept, Adelaide, pers. comms). *G. marmoratus* formerly ranged from southern Queensland to the lower Murray and now is most common in Victoria, although present also in SE South Australia and the upper Murray and Murrumbidgee drainages (NSW). The species is vulnerable particularly because of its unusual mode of reproduction, whereby the eggs are attached to submerged hollow logs and the larvae remain attached until their yolk sacs are resorbed (Jackson 1978a). Hence, despite parental care the eggs and larvae are exposed to predation for over one month. It is noteworthy that Sanger (1984) has reported a new species of *Gadopsis* from central Victoria, and shown that other isolates may be genetically dissimilar (A. Sanger, Univ. Melbourne, pers. comm.).

Conclusion

The maintenance of genetic diversity within animal populations is essential for effective conservation (e.g. Ahern 1982). Fish, in particular, are easily isolated in separate drainage basins, or in habitats within the same basin, and may undergo genetic divergence as a result. Thus, even for the small Murray-Darling fish fauna there are recent instances of new species being found in groups thought to be taxonomically well-known (e.g. Hoese *et al.* 1980; Merrick & Schmida 1984; Sanger 1984). Genetic diversity within species also is important, especially where populations have developed ecotypes to survive in particular habitats. There is evidence of subspecific variation in the Murray-Darling fauna (e.g. Allen 1980; Allen & Cross 1982; Ivantsoff 1980; Cadwallader & Backhouse 1983).

In order to conserve genetic diversity, the survival of a species throughout its range is crucial, and knowledge of the range and the nature of the habitats within is no less important. Regional surveys provide this information, and are to be preferred to national or state-wide surveys because they can be designed to correspond to manageable environmental units rather than arbitrary political divisions. The drainage basins recognized by the Australian Water Resources Council (Dept National Development 1976) are environmental units (and hence potential regional survey units) as they are more-or-less discrete river systems and natural boundaries to the distributions of fish (and many other aquatic animals).

At least three steps might be taken to prevent the further decline and possible extinction of native Australian freshwater fish. First, coordinated regional surveys could be undertaken of the distributions and abundances of fish throughout Australia. These would supplement existing collections, and provide a more comprehensive database for use in planning future conservation initiatives. Second, more could be done to promote research on the biology of freshwater fish. Many species are uniquely Australian but unknown to conservation authorities, and those without commercial value are often overlooked by the fisheries authorities. All have conservation value nevertheless, and require protection. Third, a watch could be kept over threatened species (endangered, vulnerable and rare) to provide for early diagnosis of problems and, when necessary, rapid implementation of protective measures.

The fact that probably no native freshwater fish has become extinct in the past 200 years gives no assurance that none will become so in future. Indeed, the threat of imminent losses is a real one, given the declines in range and abundance now so general and apparent.

Acknowledgments

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A NEW SPECIES OF SUEZICHTHYS (PISCES: LABRIDAE) FROM THE GREAT AUSTRALIAN BIGHT

BY BARRY C. RUSSELL

Summary

A new species of labrid fish, Suezichthys bifurcatus sp. nov., is described from two specimens collected from the Great Australian Bight, off Western Australia. It is characterised by having 2½ transverse scale rows above the lateral line; a low scaly sheath along the base of the dorsal and anal fins; and a black spot at the upper origin of the pectoral fin. It is distinct from all other species of Suezichthys in having lateral-line scales with a bifurcate canal tube.