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Distribution patterns of Redfin Perch *Perca fluviatilis* Linnaeus and western Pygmy Perch *Edelia vittata* Castelnau in the Murray River System Western Australia

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Introduction

Various workers including Moyle (1976) and Jackson and Williams (1980) have presented evidence that introduced fish species have a negative impact on native species. Fletcher (1986) summarized what is known about the effects of introduced fish in Australian aquatic environments. One introduced species little known in this regard, is the redfin perch *Perca fluviatilis* Linnaeus. Cadwallader (1978) speculated that this species may have adversely affected some native fishes in the Murray Darling River system.

During research into the distribution of fishes in the Murray River System Western Australia, it was noted that the western pygmy perch *Edelia vittata* Castelnau was apparently absent from most of the main stream. This absence was surprising as *E. vittata* has been easily collected by dip net in 1979 between the mouth of Nanga Brook and Bob's Crossing (A and B Figure 1). Large numbers of pygmy perch were also noted in the Murray River in 1951 (Anonymous 1952). A recent addition to the fish fauna of the Murray River below Driver Road Ford (Figure 1) is the redfin perch *Perca fluviatilis*. A survey of anglers which commenced in 1987 (Hutchison unpublished), revealed that redfin first began to appear in anglers' catches in the early 1980's near Yarragil and the Baden Powell Water Spout. By 1986 anglers were capturing redfin from the vicinity of Coolup and Pinjarra. Previously redfin had only been known from near Driver Road Ford and further upstream (see Figure 1 for localities). Redfin were introduced to the upper Murray System early this century (Coy 1979), probably before 1912, by which time many perch were established in dams between York and Cranbrook (Braysich 1966). This paper documents the distribution of *E. vittata* and *P. fluviatilus* in the Murray River system and suggests that it represents circumstantial evidence for the possible elimination of *E. vittata* by *P. fluviatilis*.

Methods

Seventeen sites were used in this study (see Figure 1) to test the null hypothesis of independence of redfin perch *P. fluviatilis* and western pygmy perch *E. vittata* in the Murray River. Sites one to eight were located on the main stream and nine to 14 were located on the lower reaches of tributary streams below potential barriers (gauging weirs and major waterfalls) that might interfere with the distribution of western pygmy perch. It would have been better if all sites could have been located on the main stream, but

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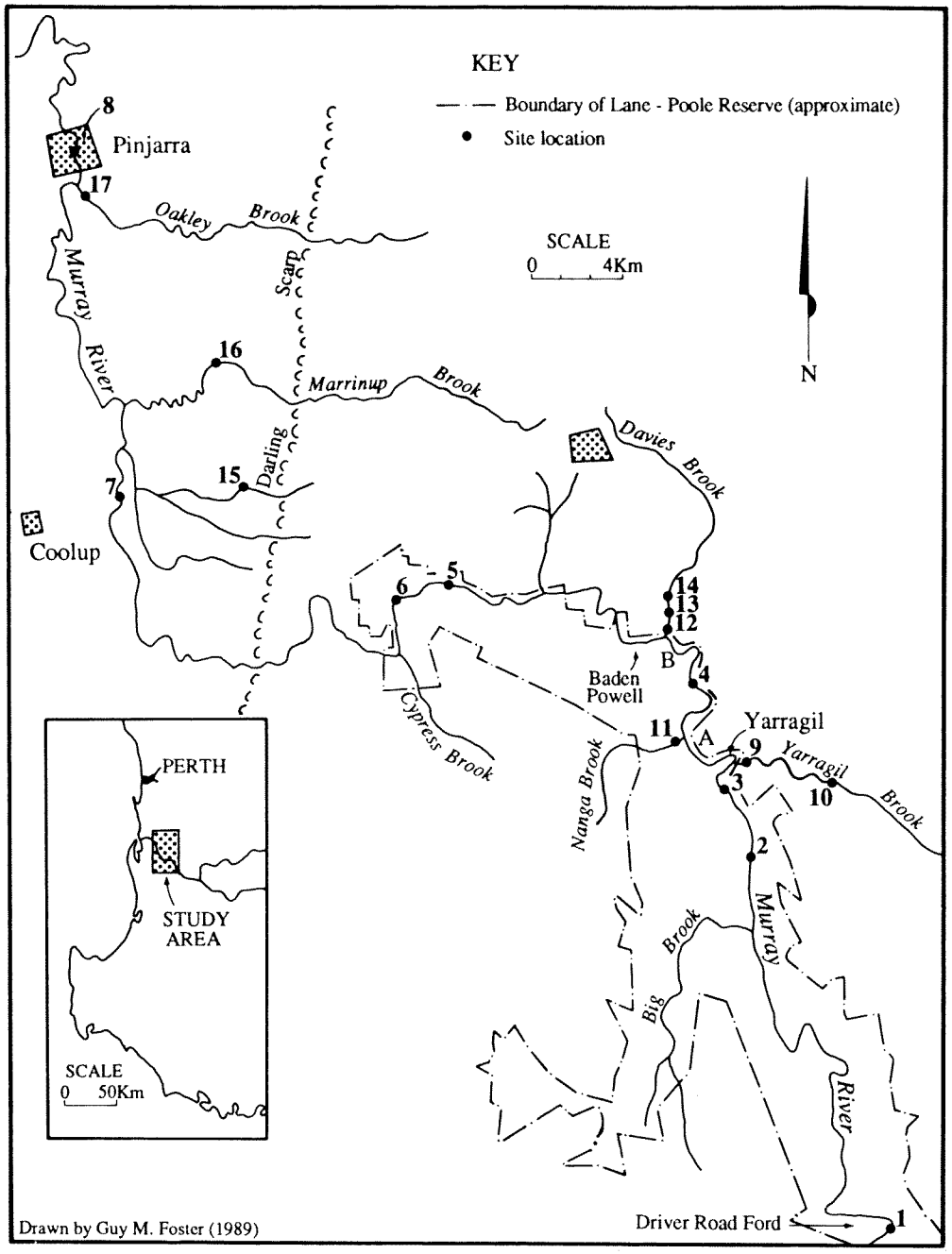

Figure 1. Location of study sites and localities mentioned in the text.

according to reports from anglers, most of the river, had been colonised by perch. Sites one to eight were all large perennial pools 70 to 200 metres in length, with maximum depths in excess of 1.5 metres and bounded at each end by cascades or riffles, runs or flats (the type varying according to seasonal flow variations) as classified by Jackson (1978). These Sites were chosen because each provided a range of habitats and were spaced as evenly as access allowed along the main river. Site 1 was not linked by flow to any other pools during February and March in 1988. Sites one to six were all located on the Darling plateau, whilst sites seven and eight were located on the coastal plain.

Sites nine to 17 were located on the tributary streams and although smaller in area than the sites located on the main stream, also provided a range of habitats. Each of these sites was approximately 25 metres in length and consisted of a pool up to 1.5 metres in depth bounded at either end by a cascade or a riffle, run or flat according to seasonal flow variations. All sites, except nine and 10 contained permanent water. Sites nine and 10 flowed only between May and January inclusive and as such aquired fish fauna as migrants from the river. These two sites therefore could be expected to reflect the situation in the adjacent main stream. Sites nine to 14 were located in valleys on the Darling Plateau and 15 to 17 on the coastal plain. All sites were sampled at least five times between January 1988 and October 1989.

Table 1 Captures and or observations of *Edelia* and *Perca*.

	Capture and observation rates						
	Obs/torch survey Fish/seining unit Fish/trap set Fish/angling hour Fish/polaroiding unit						
Sites	P	E	P	E	P	P	E
1	1.1	0.0	1.7	0.0	3.6	0.7	0.0
2	X	X	X	0.0	0.4	4.9	0.0
3	0.8	0.0	4.3	0.0	1.4	0.4	0.0
4	X	X	X	0.0	0.9	0.3	0.0
5	X	X	X	0.0	0.0	0.2	0.0
6	0.0	0.0	0.0	0.0	1.6	2.8	0.0
7	X	X	X	0.1	0.2	0.0	0.0
8	X	X	X	0.7	0.0	0.0	0.0

Key: E = *Edelia vittata* P = *Perca fluviatilis* X = Method not used

Sites in the tributary streams were sampled using baited fine mesh plastic fish traps (which have been successfully employed to capture *E. vittata*) (Pen* pers. comm.), set for 24 hours, and fifteen minutes of electrofishing using charges between 300 and 400 volts. Since the main stream sites all had salinities in excess of 1%, the electrofishing technique could not be used. In the main stream, fish traps were used at all sites to detect western pygmy perch. Angling was used at all main stream sites to verify the presence of redfin perch. Seine netting at night with 12 mm mesh was used at suitable sites to capture small (<10cm) redfin. On each occasion two sweeps were made with the seine net (one seining

unit), covering a total area of approximately 160m^2. At these same locations a torch survey of 20 x 0.1m^2 grids at four metre intervals, followed by a general search of 80 metres of shoreline was used to record the presence of Edelia and Perca. At all main stream sites, prior to angling, a reconaissance of 50 metres of shoreline was made with the aid of polaroid sun glasses. Observed fish were dip netted for positive identification.

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The presence or absence of Edelia and Perca at each site was recorded and put into the form of a 2 x 2 contingency table. Fisher's exact probability test (Fisher 1941)

Formula $$p = \frac{(a+b)!\ (c+d)!\ (a+c)!\ (b+d)!}{n!a!b!c!d!}$$

was applied to the data to test the null hypotehsis of independence.

Fisher's test was used rather than a χ^2 test because of the small number of sites (n=17) involved.

Table 2 2 x 2 contingency table for association of *Perca* and *Edelia*.

	Fish/15 minutes electrofishing		Fish/trap set
	P	E	E
Sites			
9	0.2	0.0	0.0
10	0.0	0.0	X
11	0.0	0.0	0.0
12	0.0	2.3	3.0
13	0.0	4.9	1.5
14	0.0	5.2	X
15	0.0	2.8	1.0
16	0.0	2.9	X
17	0.0	7.2	14.6

Key: E = *Edelia vittata* P = *Perca fluviatilis* X = Method not used

Results and Discussion

The presence or absence of *P. fluviatilis* and *E. vittata* at each of the study sites is shown in Table 1. This data is presented in the form of a contingency table in Table 2. It should be noted that there was only one site from which *Perca* and *Edelia* were both recorded. Based on Fisher's exact probability test, the probability of obtaining a result as in Table 2, or a more extreme result in which *Edelia* and *Perca* do not co-occur at any site is 0.0021.

Table 3 Mean capture and observation rates of *Perca* and *Edelia* by different methods at main stream sites.

	Perca fluviatilis present	*Perca fluviatilis* absent	
Edelia vittata			
present	a 1	b 7	a + b = 8
absent	c 7	d 2	c + d = 9
	a + c = 8	b + d = 9	n = 17

Although this result does not indicate a casual relationship, and evidence of the effect of *P. fluviatilis* on *E. vittata* is only circumstantial, there is good reason for suspecting *P. fluviatilis* of having eliminated *E. vittata* from much of the Murray River, particularly when *E. vittata* is known to have occurred in the Murray River prior to its invasion by redfin.

Perca fluviatilis is known to be a piscivore and Baxter *et al.* (1985) considered it unwise to release trout fingerlings into a redfin dominated water owing to heavy predation of fingerlings by redfin. Popova (1978, 227) presented a table showing an average absolute prey size of approximately 2.5cm for 10cm perch, 4cm for 20cm perch and 7cm for 30cm perch. Western pygmy perch fall within this general prey size range and Pen (personal

Table 4 Mean capture rates of *Edelia* and *Perca* by different methods at tributary stream sites.

Site	*Edelia*	*Perch*
1	*yes*	*no*
2	*yes*	*no*
3	*yes*	*no*
4	*yes*	*no*
5	*yes*	*no*
6	*yes*	*no*
7	*yes*	*yes*
8	*no*	*yes*
9	*yes*	*no*
10	*no*	*no*
11	*no*	*no*
12	*no*	*yes*
13	*no*	*yes*
14	*no*	*yes*
15	*no*	*yes*
16	*no*	*yes*
17	*no*	*yes*

communication) has found western pygmy perch to be the main fish species taken by juvenile redfin perch in the Collie River. *Edelia vittata* is diurnal and slow moving. Therefore unless it has adequate cover, probably presents itself as an easy prey item for the diurnal *P. fluviatilis.*

The only site where *P. fluviatilis* and *E. vittata* were recorded together in the Murray System was Site seven near Coolup. This site was one of the most recently invaded by redfin and densities of *P. fluviatilis* appear to be low (Table 3). Even so the capture rate of *E. vittata* from fish traps at this site is between seven and 146 times lower than the capture rates at sites with *E. vittata,* but from which *P. fluviatilis* was not recorded during this study (Tables 3 and 4).

P. fluviatilis and *E. vittata* occur together in the Collie River, South Western Australia, (Pen, pers. comm.). However different environmental circumstances are known to produce different outcomes in interactions between species (e.g. Zaret 1979) and as suggested above, cover may be important to the survival of *E. vittata* in the presence of *P. fluviatilis.*

Conclusion

The disappearance of *E. vittata* from the Murray River should be treated with concern. Sites one to six and sites nine to 11 occur within the Lane—Poole Conservation and Recreation Reserve (see Figure 1), and yet none yielded *E. vittata.* All sites where *E. vittata* were recorded, were outside the boundaries of the reserve. If it is considered desirable for the reserve to contain representatives of all of the Murray System's native fish species, then the boundaries of the reserve will probably need to be extended*. A logical step would be to include Davies Brook in the reserve as it lies only just outside the reserve's boundaries. If redfin are responsible for the disappearance of pygmy perch, the tributaries containing *Edelia* offer a source for future recolonization of the main stream should redfin ever decline, or some steps be taken to eliminate them. Although the two species may be able to coexist in some situations, it would be prudent to consider *P. fluviatilis* as a potential threat to *E. vittata* and its introduction to other waters containing this native fish should be discouraged.

*The perennial Big, Cypress and Kyabram Brooks which occur in the Lane-Poole Reserve have not yet been extensively surveyed. Preliminary investigations have not yet located western pygmy perch in the latter 2 streams which have very steep gradients and may be unsuitable habitats. Low densities occur in Big Brook.

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*Undated, date as estimated by W.A. State Reference Library.

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