

## DESCRIPTION OF A NEW SPECIES OF *GADOPSIS* (PISCES: GADOPSIDAE) FROM VICTORIA

By ANDREW SANGER

Department of Zoology, University of Melbourne, Parkville, Victoria 3052

**ABSTRACT:** Analysis of radiographs revealed a new species of *Gadopsis* from Victoria. The diagnostic character distinguishing the new species from *G. marmoratus*, the only described species, exhibits a range of values which does not overlap with that seen in *G. marmoratus*, even when sympatric with it. A separate species of *Gadopsis* from Tasmania, proposed by Parrish (1966), was found to be invalid when the same diagnostic characters as used by Parrish (1966) were examined.

The Gadopsidae is the only family of Australia's relatively depauperate freshwater fish assemblage which is both endemic to southeastern Australia and strictly confined to fresh water. Frankenberg (1974) considered the family to be a primary freshwater fish family, *sensu* Darlington (1957), although this view was not supported by McDowall (1981). Attempts to trace the relationships of the family have rarely reached common conclusions (see Thomson & Baldwin 1983, for a review).

*Gadopsis marmoratus* Richardson, the only described species, is variable in colouration and morphology, and detailed analysis of this variation may reveal a species complex. A separate species of *Gadopsis* from Tasmania was proposed by Parrish (1966) on the basis of morphological differences. His 'species' has frequently appeared in the literature under the proposed name without a formal description having been published. Despite a recommendation by Jackson and Llewellyn (1980) against its use, this *nomen nudum* continues to appear in publications (Cadwallader & Backhouse 1983), adding to the taxonomic confusion surrounding the group.

Preliminary sampling of *G. marmoratus* throughout its range revealed that specimens from King River and King Parrot Creek had distinct white margins to the outer edge of the dorsal, anal and caudal fins. The significance of this was investigated by comparing the morphometric and meristic variation within these populations with *G. marmoratus* from elsewhere in its range, in Victoria and Tasmania. Analysis of meristic variation (Table 1) revealed a new species of *Gadopsis* (described below) in King River and King Parrot Creek. The new species shares its geographic range with *G. marmoratus*, and is occasionally found in the same stream, although there appears to be a degree of habitat partitioning between them. The analysis did not support recognition of a separate Tasmanian species (Table 2).

### MATERIALS AND METHODS

Live fish were collected with a portable D.C. electroshocker from shallow pools in the King River and King Parrot Creek in northeastern Victoria. Specimens were examined by using the techniques of Hubbs and Lagler (1947), except that fin ray counts include all rays, whether branched or unbranched. Pectoral ray counts were obtained by removing the fleshy skin covering the

base of the fin, to expose the rays at their origin. All other counts were obtained from radiographs. Several specimens were cleared and stained following the technique of Mahoney (1973), in order to examine dentition. Type material has been deposited in the Museum of Victoria (NMV), and the Australian Museum, Sydney (AMS).

Collections of *G. marmoratus* used in the study are as follows (numbers of individuals at each site are indicated in brackets; \* indicates the collections used in Table 2): Stony Creek, 3 km upstream from junction with King River, Cheshunt, Victoria (4), 31 Oct. 1983, A. Sanger, S. Fisher and J. Rose; Kumbada Creek, 3 km upstream from junction with Stony Creek, Cheshunt, Victoria (6), 31 Oct. 1983, A. Sanger, S. Fisher and J. Rose; Kumbada Creek, 3 km upstream from junction with Stony Creek, Cheshunt, Victoria (20), 12 Dec. 1979, A. Sanger and P. Burrowes; Hurdle Creek, Bobinwarrah, Victoria (12), 6 Aug. 1979, A. Sanger and G. Gibb; Hurdle Creek, Bobinwarrah, Victoria (1), 19 Oct. 1983, A. Sanger; Chum Creek, Healesville, Victoria (15)\*, 20 Feb 1981, A. Sanger; Wonnonngatta River, 1 km downstream from junction with Hummfray River, near Dargo, Victoria (20)\*, 21 Apr. 1980, A. Sanger and P. Burrowes; Elizabeth Creek, 2 km north of Allambee South, Victoria (19)\*, 4 Feb. 1980, A. Sanger and D. Brock; Glenelg River, Victoria Valley Road, the Grampians, Victoria (7), 28 May 1982, A. Sanger and P. Murphy; Minnow River, near Lower Beulah, Tasmania (10)\*, 6 Sept. 1983, R. Sloane; Lake River, 24 km south of Cressy, Tasmania (10)\*, 20 Oct. 1982, A. Sanger.

### SYSTEMATICS

Class PISCES

Family GADOPSIDAE

Genus *Gadopsis*

*Gadopsis bispinosus* sp. nov.

Fig. 1

### ETYMOLOGY:

The species is named after the number of spines in the dorsal fin.

**MATERIAL:** Holotype, NMVA3281, female, 20.0 cm TL, coll. 15 Dec. 1979 on West branch of King River, 2 km upstream from junction with east branch of King River,

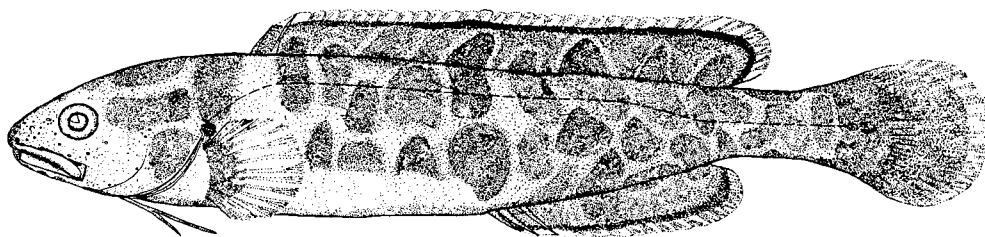


Fig. 1—*Gadopsis bispinosus*, sp. nov.; King Parrot Creek, 201 mm TL.

near Cheshunt, Victoria, 36°52'S, 146°23'E. Paratypes, NMVA3282, 5 specimens, coll. 15.xii.1979, A. Sanger and P. Burrowes, type locality. AMS I.24351-001, 6 specimens, coll. 15 Dec. 1979, A. Sanger and P. Burrowes, type locality. Other material examined, with numbers of specimens noted in brackets, King River (type locality) (8), 15 Dec. 1979, A. Sanger and P. Burrowes; King River (type locality) (6), 31 Oct. 1983, A. Sanger, S. Fisher and J. Rose; Stony Creek, 3 km upstream from junction with King River, Cheshunt, Victoria (3), 31 Oct. 1983, A. Sanger, S. Fisher and J. Rose; King Parrot Creek, 8 km downstream from Kinglake West, Victoria (13), 3 Nov. 1979, A. Sanger and C. Proctor; King Parrot Creek, 8 km downstream from Kinglake West, Victoria (7), 20 Oct. 1980, A. Sanger.

**DIAGNOSIS:** Differs from *G. marmoratus* in having two, or rarely one or three, spines in the dorsal fin (Table 1, Fig. 2) and prominent white fringe on the dorsal, anal and caudal fins. *G. marmoratus* has between six and thirteen spines in the dorsal fin (Table 1, Fig. 2), and lacks a prominent white fringe on the fins.

**DESCRIPTION:** (Holotypic values in parentheses.) A small to medium sized species; body narrow (width=0.13 of Standard Length (SL)), shallow (depth=0.19 of SL) and slightly compressed. Head narrow and slightly elongated (length=0.24 of SL); snout short (length=0.24 of Head Length (HL)); eye moderate (maximum width=0.19 of HL), inserted in upper half of head; suborbital depth large (0.53 of head depth at orbit); interorbital width narrow (width=0.21 of HL). Jaws long (length=0.40 of HL); with upper jaw extending to below the posterior half of the eye. Lips fleshy with upper overhanging lower. Teeth numerous; in premaxilla, an outer row of large conical teeth, within which there is a band of minute cardiform teeth becoming narrower towards posterior articulation; dentary similar to premaxilla; palatines and vomer bearing numerous small cardiform teeth. Two prominent rows of laterosensory pores on head; one along upper jaw margin extending upwards to behind eye; the other following lower jaw margin, extending along anterior margin of preoperculum and back towards opercular spine. Numerous smaller pores on head. Two prominent nostrils; one, halfway along snout, with fleshy tubular opening; the other, just in front of the eye, simple.

Pelvis reduced to a single fleshy bifid ray inserted jugularly (insertion point=0.64 in HL). Branchiostegals seven; opercular spine single, with subopercular flap. Pectorals inserted laterally, below opercular spine (insertion point=0.94 in HL), rounded, moderate in size (maximum ray length=0.56 in HL), with fifteen to eighteen rays (16).

A single long dorsal fin (length=0.62 of SL), inserted posterior to the level of the pectorals (insertion point=0.28 of SL), bearing two, rarely one or three, weakly-calcified, slender spines and thirty-five to thirty-eight rays (II, 37). Anal fin long (length=0.27 of SL), originating about half way along body (insertion point=0.59 of SL), bearing three, strongly-calcified, stout, spines and seventeen to twenty rays (III (one vestigial), 20). Anal and dorsal fins, when adpressed, not reaching caudal fin. Caudal fin rounded, of about thirty rays (29), half of which are branched (15). Caudal peduncle shallow (depth=0.09 of SL) and compressed.

Lateral line, of about forty-eight tubercles, originating just above opercular spine, curving dorsally to follow dorsal profile for about the first five-eighths of the dorsal fin before descending gradually to follow midline for length of caudal peduncle.

Vertebrae forty-six to forty-nine (48), twenty-five to twenty-nine of which are caudal (27).

**COLOURATION:** Colouration variable, consisting typically of two uneven rows of dark brown blotches running entire length of body, extending onto dorsal and caudal fins. A third row of blotches often present, extending onto posterior half of anal fin. Brown blotches separated by paler areas; ventral surface uniformly pale from pelvic origin to anal origin. Outer edge of dorsal, anal and caudal fins white, often bordered on inner margin by an intense dark stripe. Fin rays in dorsal, anal and caudal often bright yellow in live specimens. Colour pattern more distinct in juveniles, often being obscured by intensified pigmentation in older specimens. In life, able to intensify or subdue base colouration to suit surroundings.

**LIFE HISTORY:** Essentially as described by Jackson (1978) and Cadwallader and Backhouse (1983), for *G. marmoratus*. Egg number varies with size of female, a 20.7 cm TL female bearing up to 350 mature eggs, 3.6 mm in diameter. Maximum TL observed, 25.7 cm, weight, 130 gm. Scales indicate fish of this size to be in their fifth year. Fish less than 10 cm TL normally juvenile (Sanger, unpubl.).

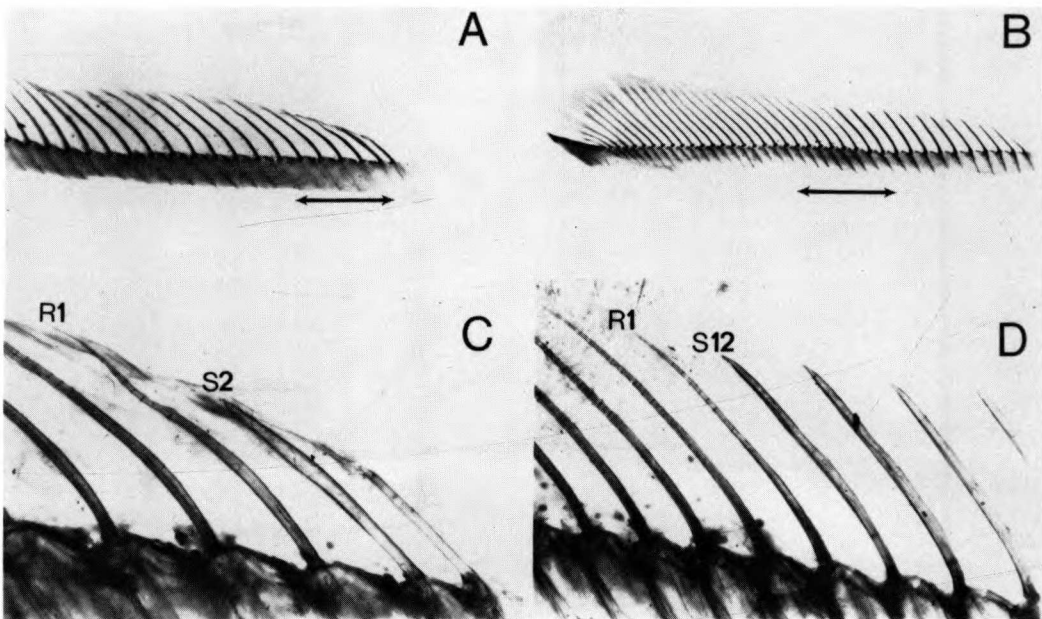


Fig. 2—Cleared and stained dorsal fins of: A, *Gadopsis bispinosus*, anterior section. B, *G. marmoratus*, entire fin. C, *G. bispinosus*, enlargement of arrowed section of A, S2 is the second spine, R1 is the first ray (note jointed appearance of rays). D, *G. marmoratus*, enlargement of arrowed section of B, S12 is the twelfth spine, R1 as above.

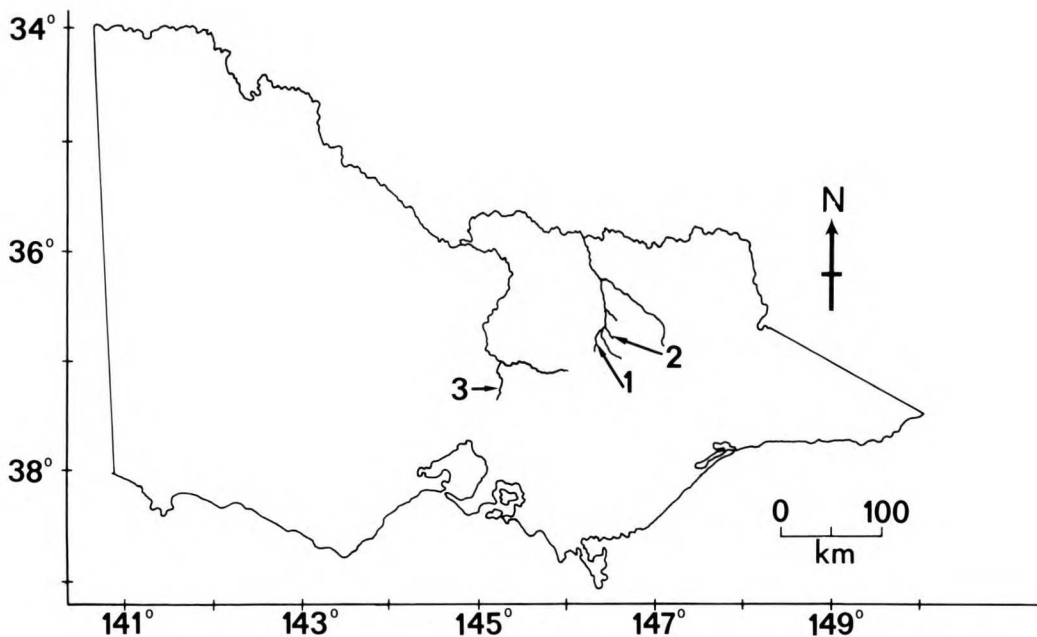


Fig. 3—Known distribution of *G. bispinosus*. 1, King River, west branch, type locality; 2, Stony Creek, near Cheshunt; 3, King Parrot Creek, near Kinglake West.

TABLE 1  
MORPHOMETRIC AND MERISTIC VARIATION IN TWO SPECIES OF *Gadopsis* BASED ON THE MATERIAL EXAMINED.

Morphometric measurements other than total length are expressed as percentages of the total length. (Note the non-overlapping ranges of dorsal spine and dorsal ray counts, used to justify species separation.)

	<i>Gadopsis bispinosus</i>			<i>G. marmoratus</i>		
	Range	Mean	Std. dev.	Range	Mean	Std. dev.
Total length (TL) (cm)	116-251	173.9	34.94	101-354	207.3	62.85
Head length	17.8-22.2	19.9	1.011	18.9-25.1	22.5	1.331
Snout length	4.7-6.4	5.4	0.443	4.7-7.0	6.0	0.443
Upper jaw length	7.4-9.6	8.3	0.535	3.8-10.3	8.7	0.893
Interorbital width	3.8-5.1	4.4	0.254	4.1-6.9	5.8	0.518
Body width	9.0-12.9	10.6	1.053	9.6-14.8	12.3	1.308
Body depth	13.0-18.4	15.7	1.353	15.0-25.1	19.3	1.733
Caudal fin length	15.0-20.0	18.2	1.052	14.7-21.5	18.7	1.124
Caudal peduncle depth	6.1-7.7	6.9	0.395	6.6-9.7	8.3	0.848
Dorsal fin depth	4.3-8.0	6.1	0.871	4.6-9.7	7.4	0.892
Dorsal spines	1-3	2.0	0.243	6-13	10.9	1.416
Dorsal rays	35-38	36.9	0.772	22-31	26.6	1.447
Pectoral rays	15-18	16.5	0.701	15-19	17.7	1.402
Anal spines	3	3	0	2-4	3.1	0.378
Anal rays	17-20	18.8	0.690	16-20	18.1	1.078
Total caudal rays	28-31	29.3	0.802	27-35	30.1	1.825
Branched caudal rays	13-16	15.0	0.594	15-18	16.4	0.950
Total vertebrae	46-49	48.3	0.780	40-50	46.5	1.726
Caudal vertebrae	25-29	27.7	0.867	24-28	26.5	0.937
Number of fish measured	Morphometrics 38; Meristics 35			Morphometrics 79; Meristics 103		

**DISTRIBUTION AND ABUNDANCE:** Collected from the upper reaches of the King River and its tributaries, and from the upper reaches of the King Parrot Creek (Fig. 3). Common in both these streams, which have similar rocky beds and cool, clear water. Likely to be found in many of the northeastern Victorian streams which also have these characteristics.

**DISCUSSION:** Parrish (1966) discussed variation in dorsal spine number in populations of *G. marmoratus* from several localities throughout its geographic range. He recognised that samples from western Victoria had fewer dorsal spines than those from the rest of Victoria and from Tasmania. A sample from Violet Creek, a tributary of the Glenelg River, Victoria, showed a range of seven to nine (mean=8.2). The sample from the Glenelg River included in this study, with a range of six to nine (mean=7.6), conforms with these observations. These values, while low, partially overlap with the ranges seen for populations from other areas and, on that basis, do not warrant the erection of a separate western Victorian taxon. *G. bispinosus*, on the other hand, exhibits a non-overlapping range in this character. This is not a case of clinal variation, since *G. bispinosus* is found in sympatry with *G. marmoratus*. *G. marmoratus*, from Stony Creek, which is within 10 km of the type locality for *G. bispinosus*, exhibit a dorsal spine range of nine to eleven (mean 10.4), well within the normal range for *G. marmoratus*. The sample sites used by Parrish did not include any which were likely to have contained *G. bispinosus*, namely, clear, cool, rocky-bottomed streams in northeastern Victoria.

*G. bispinosus*, although sympatric with *G. marmoratus* in the upper King River, is apparently better adapted to life in clear, rocky-bottomed streams, and *G. marmoratus* to slower flowing, more turbid, soft-bottomed streams north of the Great Dividing Range. It should be noted that *G. marmoratus* occur in clear, rocky-bottomed mountain streams south of the Great Dividing Range. This distribution is analogous to that of the percichthyid genus *Maccullochella*, also found in this area (Cadwallader & Backhouse 1983). The Trout Cod, *M. macquariensis*, although rare now, was typically found in the cooler upper reaches of streams throughout the Murray-Darling system, whereas the Murray Cod, *M. peeli*, is widespread throughout the lower reaches of these streams becoming scarcer towards the headwaters. There is some evidence that these two species form interspecific hybrids in a population inhabiting Cataract Dam on the Nepean River, New South Wales (Cadwallader & Backhouse 1983). No evidence of interspecific hybrids between *G. bispinosus* and *G. marmoratus* was detected in the present study.

Whilst the past distribution of *G. bispinosus* is unknown its local abundance suggests that it may not be suffering the same reduction in numbers as has been seen in the Trout Cod. Although inhabiting trout angling waters and preyed upon by brown trout, *Salmo trutta* (Sanger, unpub.), *G. bispinosus* is the most abundant member of the fish fauna at the localities shown in Figure 3. Although three localities are hardly adequate to form an opinion, the preliminary indications are that *G. bispinosus* should not be considered a rare or en-

TABLE 2

MERISTIC VARIATION IN POPULATIONS OF *G. marmoratus* FROM TASMANIA AND FROM SOUTH OF THE GREAT DIVIDING RANGE IN VICTORIA.Based on the samples marked with an \* in the lists of material. 't' value represents the result of a two-tailed Student's t-test for difference between means. Significance level, n.s. -  $p > 0.01$ .

	Tasmania			<i>t</i>	Southern Victoria		
	Range	Mean	Std. dev.		Range	Mean	Std. dev.
Dorsal spines	11-13	11.9	0.641	2.09	9-13	11.4	0.900
Dorsal rays	24-28	26.3	1.031	n.s. 1.35	24-31	26.8	1.559
Pectoral rays	17-19	18.6	0.605	n.s. 1.23	17-19	18.7	0.499
Anal spines	3	3	0	n.s. 0.96	2-3	3.0	0.211
Anal rays	17-20	18.6	0.681	n.s. 0.51	16-20	18.7	0.795
Total caudal rays	29-33	30.5	1.100	n.s. 2.60	27-35	31.4	1.421
Branched caudal rays	16-18	16.9	0.447	n.s. 0.69	15-18	17.0	0.571
Total vertebrae	45-49	47.4	0.940	n.s. 1.25	42-50	47.5	1.170
Caudal vertebrae	25-28	26.6	0.883	n.s. 0.49	25-28	26.9	0.734
Number of fish measured		20		n.s.		44	

dangered species, or, at this stage, be afforded any protection distinct from that given *G. marmoratus*.

Table 2 clearly demonstrates that the Tasmanian populations sampled belong to *G. marmoratus*. Parrish (1966) proposed a separate species on the basis of a larger number of branched caudal rays, pectoral rays, vertebrae, and lateral line pores. The first three of these characters, when examined in the present study, were not significantly different than in populations of *G. marmoratus* from south of the Great Dividing Range in Victoria, and in fact almost complete overlap in the range of values is seen. These observations should end reference to an undescribed, and apparently non-existent, Tasmanian species. A future paper will examine the question of variation within *G. marmoratus* in more detail, with reference to biochemical information as well as morphological data.

#### ACKNOWLEDGEMENTS

I thank Martin Gomon, Museum of Victoria, for access to X-ray facilities, Murray Littlejohn and Graeme Watson for critically reading earlier drafts of the manuscript, and the many friends and colleagues who assisted in the field. The Australian Museum Trust, and the Victorian Fisheries and Wildlife Division, contributed funds towards meeting field work costs.

#### REFERENCES

- CADWALLADER, P. L. & BACKHOUSE, G. N., 1983. *A guide to the freshwater fish of Victoria*. Victorian Government Printing Office, Melbourne, 252 pp.
- DARLINGTON, P. J., 1957. *Zoogeography: the geographical distribution of animals*. Wiley, New York, xiv and 684 pp.
- FRANKENBERG, R. S., 1974. Native freshwater fish. In *Biogeography and ecology in Tasmania*, W. D. Williams, ed., D. W. Junk, The Hague, *Monographiae Biologiae* 25: 113-140.
- HUBBS, C. L. & LAGLER, K. F., 1947. *Fishes of the Great Lakes Region*. Cranbrook Institute of Science, Bulletin No. 26, 186 pp.
- JACKSON, P. D., 1978. Spawning and early development of the River Blackfish, *Gadopsis marmoratus* (Gadopsiformes: Gadopsidae), in the Mackenzie River, eastern Australia. *Aust. J. mar. Freshwater Res.* 29: 293-298.
- JACKSON, P. D. & LLEWELLYN, L. C., 1980. Family Gadopsidae. In *Freshwater Fishes of South-Eastern Australia*, R. M. McDowall, ed., A. H. & A. W. REED, Sydney, pp. 160-161.
- MCDOWALL, R. M., 1981. The relationships of Australian freshwater fishes. In *Ecological Biogeography of Australia*, A. Keast, ed., D. W. Junk, The Hague. *Monographiae Biologiae* 41: 1251-1273.
- MAHONEY, R., 1976. *Laboratory techniques in zoology*, 2nd edition, Butterworth and Co. Ltd., London, 518 pp.
- PARRISH, R. H., 1966. A revision of the Gadopsidae with description of a new species from Tasmania. Unpubl. MSc Thesis, Oregon State University, U.S.A., 47 pp.
- THOMSON, J. & BALDWIN, J., 1983. Lactate dehydrogenases of the Australian Freshwater Blackfish *Gadopsis marmoratus* Richardson: identification of isoenzymes and immunochemical comparison of blackfish LDHM4 with the homologous enzyme from proposed marine ancestors. *Comp. Biochem. Physiol.* 74B: 307-314.