

Environmentally induced subsymmetry in the hermit crab, *Calcinus dapsiles* Morgan (Decapoda, Diogenidae).

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Hermit crabs are well known for their adaptations to life in an acquired shelter, usually the empty shell of a gastropod mollusc. In particular, the abdomen is usually dextrally coiled, corresponding to the dextral twist of most gastropod shells. Additionally, the uropods which assist in grasping the inside of the shell are usually very asymmetrical, with the left uropod much larger than the right.

There are exceptions to this general pattern. The species comprising the family Pylochelidae, often referred to as 'symmetrical pagurids', rarely utilise gastropod shells, instead inhabiting pieces of wood, rock and sponge (Forest 1987). Within the family Paguridae, several genera, *Orthopagurus*, *Pylopagurus*, *Xylopagurus* and *Discorsopagurus*, usually inhabit non-coiled shelters, especially serpulid worm tubes and scaphopod shells. These hermit crabs have abdomens and uropods that are close to symmetrical (Caine 1980). In the family Diogenidae, only two genera, *Paguroopsis* and *Cancellus*, are semi-symmetrical. The former is monotypic, *P. typica* Henderson enfolding itself in a sea anemone. *Cancellus* contains ten species inhabiting soft rocks, wood, or pieces of coral or sponge, of which two, *C. typus* H. Milne Edwards and an unnamed species, occur in Australian waters (Mayo 1973; Morgan 1989).

In the above examples, habitation of a non-coiled shelter is normal for the species and their symmetrical morphology is so adapted. Most workers consider that the typical asymmetry of pagurid and diogenid hermit crabs reflects their utilisation of gastropod shells (e.g. Neville 1977; McLaughlin 1983) and that the symmetry of some genera is a secondarily acquired characteristic (e.g. Rabaud 1941; Russell 1962). There are few recorded examples of intraspecific variation in symmetry.

Calcinus dapsiles Morgan, the commonest hermit crab in shallow habitats of southwestern Australia (Morgan 1989) is typically dextrally coiled and asymmetrical. The species inhabits a very wide variety of shells usually reflecting the most abundant gastropods in any area, commonly used species being *Thais orbita* (Gmelin, 1791), *Turbo torquatus* Gmelin, 1790, *Thalotia conica* (Gray, 1827), *Cominella eburnea* (Reeve, 1846), *Campanile symbolicum* Iredale, 1917 and *Australium squamifera* (Koch, 1844). Recently a male specimen of *C. dapsiles* (shield length 4.0 mm) from the mouth of Princess Royal Harbour, near Albany, Western Australia was collected in an almost straight length of serpulid worm tube, probably *Ficopomatus* sp. On extraction it was found to be far more symmetrical than is usual for this species. The abdomen was very weakly coiled and the uropods only slightly asymmetrical. Comparison of the specimen with similarly sized normal examples of the species indicated that the altered relative

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length of the uropods was due more to overdevelopment of the right uropod than to diminution of the left (Figure 1).

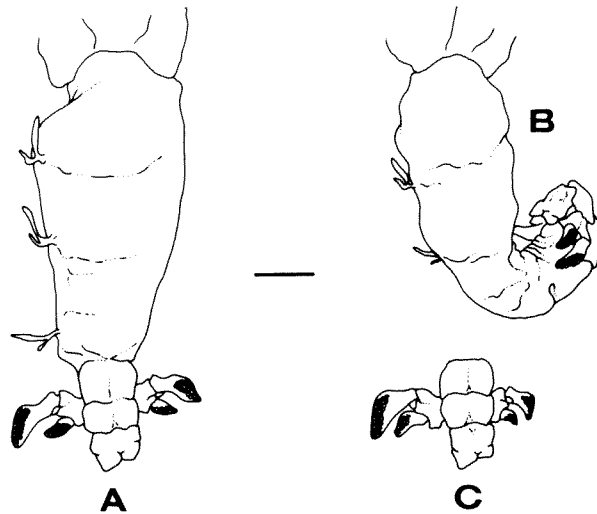


Figure 1. *Calcinus dapsiles* Morgan. A, abdomen and tailfan of aberrant, subsymmetrical male (SL 4.0 mm, WAM 564-88), dorsal view, tailfan reflexed slightly for purposes of illustration; B, abdomen and tailfan of normal male (SL 4.3 mm, WAM 140-88), dorsal view; C, tailfan of normal male (WAM 140-88), dorsal view. Scale = 2.0 mm.

The most likely explanation for this deviation from the normal morphology is that of environmental induction. Presumably the animal had inhabited the worm tube for sufficient time for the natural coiling of the abdomen to be modified. Gripping the interior of a non-coiled tube would be facilitated by uropods which were roughly symmetrical, or at any rate, very asymmetrical uropods would not convey any advantages in lodgement. Hermit crabs display symmetry or near-symmetry as zoeal and glaucothöe larvae and any modification to the normal development of asymmetry would presumably be more pronounced if the growing animal was subjected to environmental influence early in its development.

Intraspecific variation in hermit crab symmetry has occasionally been reported previously. Fenizia (1933) and Zibrowius (1978) recorded that *Calcinus tubularis* (Linnaeus), a Mediterranean species, often occurs in straight worm tubes. These specimens have a relatively straight abdomen, while those from coiled shells are correspondingly coiled. *Mixtopagurus paradoxus* A. Milne Edwards from the northwest Atlantic, the only pylochelid to typically inhabit gastropod shells, shows marked variation in symmetry of the uropods and telson. It is less certain that this variation corresponds to the shape of the shell utilised, however, as there is no evidence that the species inhabits anything but shells of the gastropod *Xenophora* (Forest 1987).

Morphoplasticity is recorded more commonly for species reflecting the shape of the inhabited shell in their body form. Specimens of *Dardanus lagopodes* (Forskål), a very common species in coral reef habitats of the Indo-West Pacific, are distinctly more dorsoventrally flattened through the thorax if inhabiting shells with narrow apertures (e.g. cones) than are specimens from more voluminous shells (Ball and Haig 1972; personal observations). Similar variation has been noted for *Petrochirus pustulatus* (H. Milne Edwards) of west Africa by Forest (1952) who also recorded some variation in *Trizopagurus strigatus* (Herbst), an Indo-West Pacific species typically occupying shells with narrow apertures.

References

- Ball, E.E. Jr. and Haig, J. (1972). Hermit crabs from eastern New Guinea. *Pacific Sci.* **26**: 87-107.
- Caine, E.A. (1980). Adaptations of a species of hermit crab (Decapoda, Paguridea) inhabiting sessile worm tubes. *Crustaceana* **38**(3): 306-310.
- Fenzia, G. (1933). Note biologiche sul *Calcinus ornatus* (Roux). *Boll. Soc. Natur. Napoli.* **45**: 129-142.
- Forest, J. (1952). Contributions a la revision des Crustacés Paguridae I. Le genre *Trizopagurus*. *Mem. Mus. natn. Hist. nat., Paris (A)* **5**: 1-40.
- Forest, J. (1987). Les Pylochelidae ou "Pagures symétriques" (Crustacea Coenobitoidea). *Mem. Mus. natn. Hist. nat., Paris (A)* **137**: 1-254.
- Mayo, B.S. (1973). A review of the genus *Cancellus* (Crustacea: Diogenidae) with the description of a new species from the Caribbean Sea. *Smith. Contrib. Zool.* **150**: i-iii, 1-63.
- McLaughlin, P.A. (1983). Hermit crabs — are they really polyphyletic? *J. Crust. Biol.* **3**(4): 608-621.
- Morgan, G.J. (1989). The hermit crabs (Decapoda: Anomura: Diogenidae, Paguridae) of southwestern Australia, with descriptions of two new species. *Rec. West. Aust. Mus.* **14**(3): 391-417.
- Neville, A.C. (1977). Symmetry and asymmetry problems in animals. In: R. Duncan and M. Weston-Smith (eds), *The encyclopaedia of ignorance*. Pergamon Press, Oxford, pp. 331-345.
- Rabaud, E. (1941). Recherches sur l'adaptation et le comportement des Pagures. *Arch. Zool. Exp. Gén.* **82**: 181-285.
- Russell, E.S. (1962). The diversity of animals. An evolutionary study. *Acta Biotheoretica.* **13**(suppl. 1): 1-151.
- Zibrowius, H. (1978). Première observation du Pagure *Calcinus ornatus* dans le Parc National de Port-Cros (côte méditerranéenne de France). Répartition et bibliographie. *Trav. sci. Parc. national Port-Cros* **4**: 149-155.