

N. G. Wilson

Site fidelity of mariametrid crinoids (Echinodermata: Crinoidea) in southeast Sulawesi, Indonesia

Received: 3 July 2003 / Accepted: 20 October 2003 / Published online: 13 January 2005
© Springer-Verlag 2005

Keywords Feather stars · Nocturnal · Behaviour · Competition

Introduction

Unstalked crinoids, or feather stars, in the family Mariametridae are nocturnal filter feeders commonly found on tropical Indo-west Pacific coral reefs. They are more mobile than other feather star groups, though they are normally attached to the substratum with their cirri and/or arms. Mariametrids usually crawl using their arms (Fishelson 1974), but can also swim short distances (Zmarzly 1985; Stevens 1989). During the day they hide within crevices in the reef and only emerge at dusk to their nocturnal feeding perch.

Most non-mariametrid crinoids may be active at various times throughout the diel cycle. Their feeding postures are related to current regimes rather than day–night cycles (Meyer et al. 1984), and they do not move to and from feeding perches. Anecdotal observations indicate that diel-active crinoids can remain on a single perch for long periods of time. Accounts of up to 2 years occupancy are known (Stevens 1989), although a single 5-year residence has been reported (Meyer 1973a). Zmarzly (1984) quantified site fidelity in diel-active crinoids over 6 months with all specimens remaining on their original perches with no observable mortality, emigration, or recruitment.

Meyer et al. (1984) used time-lapse cinematography to observe crinoid posture in relation to current. Two

mariametrids were observed during the study, and each individual used a different route to reach and exit its nocturnal perch. No information was given about whether individuals displayed any site fidelity, despite the film covering two day–night cycles. The ability to return to a site after a period of absence has never been examined.

Although crinoids are sensitive to photic, mechanical and chemical stimuli, they apparently lack sense organs *sensu stricto* (Heinzeller and Welsch 1994). The recent discovery of specific photosensory organs in similarly light-sensitive brittlestars (Aizenberg et al. 2001) opens debate about homologous sensory systems in their crinoid relatives. There is no doubt that mariametrids leave their nocturnal feeding perch during daylight hours. If they are able to consistently return to the same feeding perches over long periods of time, it raises interesting questions about the mechanisms they utilize to do so. This study investigates the temporal distribution and short-term site fidelity of individual mariametrid crinoids on a shallow coral reef system.

Materials and methods

The study site was Home reef, Palau Hoga (5°28'29"S, 123°45'40"E), which is located in the Wakatobi Marine National Park. This park covers part of the Tukang Besi archipelago, a remote island group off southeast Sulawesi in Indonesia. The reef topography consists of steep walls with some spurs extending out from the main reef. All the perch sites within this study were spread across the shallower region of one spur, ranging from 6 to 15 m. Night surveys were carried out using SCUBA 1 h after sunset and were conducted between July and September 2002. Crinoids belonging to *Stephanometra*, *Lamprometra*, and/or *Liparometra* were observed but were not fully identified since this is difficult in the field, and removal and return of specimens was not feasible. Mariametrid crinoids display variable and distinct color patterns that enabled recognition of individuals with the

Communicated by Editor R.E. Dodge

N. G. Wilson
Centre for Marine Studies,
University of Queensland, St Lucia,
4072, Australia
E-mail: nwilson@marine.uq.edu.au
Tel.: +61-7-33654333
Fax: +61-7-33654755



Fig. 1 Mariametrid crinoid on tagged perch; floating marker is not visible

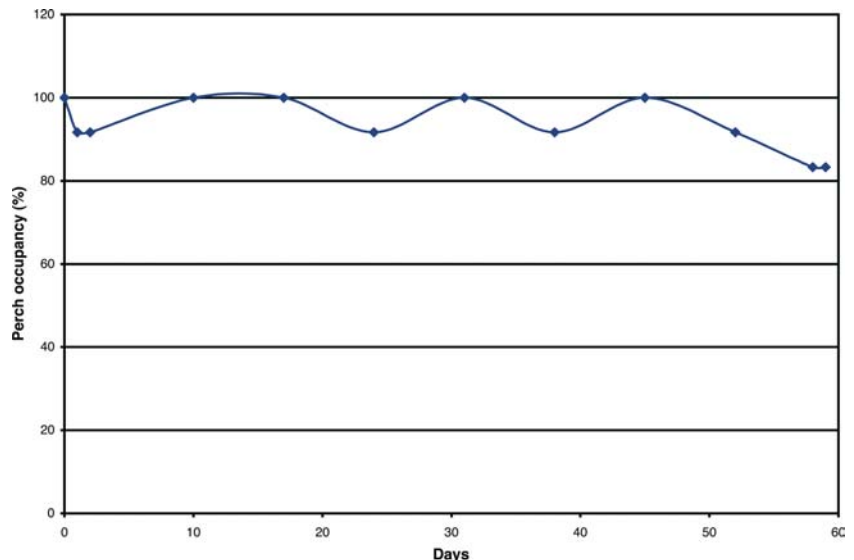
assistance of digital photography. Surveys recorded presence or absence of individuals within a 3-m radius of their original perch.

A total of 11 perches occupied by 13 mariametrid crinoids were tagged with a floating plastic marker attached with flagging tape (Fig. 1). The animals were photographed and had their position recorded (time zero). The site was then surveyed again 12 h later to determine if animals were also active during the day. Night surveys were carried out again 24 and 72 h after time zero and then at weekly intervals for 7 weeks (total 59 days).

Results and discussion

Some reports exist of *Stephanometra* spp. being active during daylight hours (Meyer and Macurda 1980; Meyer et al. 1984; Stevens 1989), but in this study all of the mariametrid crinoids showed strictly nocturnal habits. Initially, 13 mariametrid crinoids were monitored during the survey period. One individual moved to a new perch 5 m away after only 3 days of study and did not return to its original perch during the remainder of the study.

Fig. 2 Perch occupancy of mariametrid crinoids in southeast Sulawesi, Indonesia, over 59 days ($n = 12$)



This animal was subsequently removed from perch occupancy data shown in Fig. 1. Three different individuals were absent during one survey and were not visible in close surroundings; two of these instances were on the last survey (59 days). One other individual disappeared for two consecutive surveys (3–9 days) at the beginning of the study period, returned to its original perch for 3 weeks, then disappeared for another survey, and then returned again for the rest of the study period. The remaining eight mariametrids were present on the same perch during all surveys within the study period. Figure 2 illustrates that the percentage of crinoids occupying original perches never dropped below 80%.

Although high site fidelity is apparent for mariametrid crinoids, short-term fluctuations in perch occupancy also occur (Fig. 2). These fluctuations do not correlate with lunar or tidal cycles, and the cause remains unknown. Site-fidelity patterns in diel-active crinoids contrast markedly, with no changes recorded over a 6-month period (Zmarzly 1984). It is unlikely that the absence of an individual mariametrid crinoid from a survey did not reflect true absence, i.e., the individual had not yet reached its nocturnal perch. Previous studies have shown that mariametrids take 15–35 min to reach their nocturnal perch (Fishelson 1974; Meyer and Macurda 1980) and emerge an hour before or at sunset (Rutman and Fishelson 1969; Fishelson 1974; Meyer and Macurda 1980; Meyer et al. 1984). Since these surveys were carried out at least 1 h after sunset, it is reasonable to assume that all individuals that were going to emerge had done so already.

Many perches were shared by a number of individuals, both mariametrid and other crinoids. While aggregations have been suggested to improve feeding efficiency for members of the group by temporarily slowing water current (Meyer 1973b), Shaw and Fontaine (1990) also reported intraspecific competition for perches in the antedonid *Florometra serratissima*, in which the winner repelled the loser from a perch. The

influence of body size on these strategies may be important even within a species, as smaller individuals of the tropiometrid *Tropiometra carinata*, tended to aggregate, while larger individuals were more likely to be solitary (MacCord and Duarte 2002). Competition for perch space has been regarded as an unlikely selective pressure given that no crinoids were known to be active during the day and retreat from their perches at night (Meyer and Macurda 1980). Although that activity pattern is still not recorded for any crinoids (Vail 1987), mariametrids exhibit the reverse pattern, raising the possibility that they are forced to compete for their perch space at the beginning of each night.

Acknowledgements I would like to thank Operation Wallacea for providing the support necessary for this study. I also extend thanks to Magnus Johnson, David Thompson, Liz Barlow, Jon Shrives, and Paul Rollinson for assistance with fieldwork. Greg Rouse provided invaluable discussion and advice, and provided comments on the manuscript along with an anonymous reviewer.

References

- Aizenberg J, Tkachenko A, Weiner S, Addadi L, Hendler G (2001) Calcitic microlenses as part of the photoreceptor system in brittlestars. *Nature* 412:819–822
- Fishelson L (1974) Ecology of the northern Red Sea crinoids and their epi- and endozoic fauna. *Mar Biol* 26:183–192
- Heinzeller T, Welsch U (1994) Crinoidea. In: Harrison FW, Chia FS (eds) *Microscopic anatomy of invertebrates*, vol 14. Wiley-Liss, New York, pp 9–148
- MacCord FS, Duarte LFL (2002) Dispersion in populations of *Tropiometra carinata* (Crinoidea: Comatulida) in the São Sebastiao Channel, São Paulo State, Brazil. *Estuarine Coastal Shelf Sci* 54:219–225
- Meyer DL (1973a) Distribution and living habits of comatulid crinoids near Discovery Bay, Jamaica. *Bull Mar Sci* 23:244–259
- Meyer DL (1973b) Feeding behaviour and ecology of shallow-water unstalked crinoids (Echinodermata) in the Caribbean Sea. *Mar Biol* 22:105–129
- Meyer DL, Macurda DB (1980) Ecology and distribution of the shallow-water crinoids of Palau and Guam. *Micronesica* 16:59–99
- Meyer DL, LaHaye CA, Holland ND, Arneson AC, Strickler JR (1984) Time-lapse cinematography of feather stars (Echinodermata: Crinoidea) on the Great Barrier Reef, Australia: demonstrations of posture changes, locomotion, spawning and possible predation by fish. *Mar Biol* 78:179–184
- Rutman J, Fishelson L (1969) Food composition and feeding behaviour of shallow-water crinoids at Eilat (Red Sea). *Mar Biol* 3:46–57
- Shaw GD, Fontaine AR (1990) The locomotion of the comatulid *Florometra serratissima* (Echinodermata: Crinoidea) and its adaptive significance. *Can J Zool* 68:942–950
- Stevens TF (1989) Species composition and distribution of the comatulid crinoids of Heron Island and Wistari reefs. Department of Zoology, University of Queensland, Brisbane
- Vail L (1987) Diel patterns of emergence of crinoids (Echinodermata) from within a reef. *Mar Biol* 93:551–560
- Zmarzly DL (1984) Distribution and ecology of shallow-water crinoids at Enewetak Atoll, Marshall Islands, with an annotated checklist of their symbionts. *Pac Sci* 38:105–122
- Zmarzly DL (1985) The shallow-water crinoid fauna of Kwajalein Atoll, Marshall Islands: ecological observations, interatoll comparisons, and zoogeographic affinities. *Pac Sci* 39:340–358