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Multiple feeding strategies observed in the cold-water coral *Lophelia pertusa*

Citation for published version:

Murray, F, De Clippele, L, Hiley, A, Wicks, L, Roberts, J & Hennige, S 2019, 'Multiple feeding strategies observed in the cold-water coral *Lophelia pertusa*', *Journal of the Marine Biological Association of the UK*, vol. 99, no. 6, pp. 1281-1283. <https://doi.org/10.1017/S0025315419000298>

Digital Object Identifier (DOI):

[10.1017/S0025315419000298](https://doi.org/10.1017/S0025315419000298)

Link:

[Link to publication record in Edinburgh Research Explorer](#)

Document Version:

Peer reviewed version

Published In:

Journal of the Marine Biological Association of the UK

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1 *Title:* Multiple feeding strategies observed in the cold-water coral *Lophelia pertusa*

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12

13 *Abstract*

14 Cold-water coral reefs are biodiversity hotspots of the deep sea. The most dominant reef building
15 cold-water coral in the Atlantic is *Lophelia pertusa* which builds vast and structurally complex
16 habitats. Studying the behaviours of deep-sea species is challenging due to the technological
17 difficulties in making prolonged observations *in situ* so little is known about the behavioural ecology
18 of this important species. Observations in laboratory studies can help to enhance our
19 understandings of the range of behaviours these species have. Here we present video evidence that
20 the cold-water coral *Lophelia pertusa* is capable of producing mucus nets as part of their feeding
21 strategy. This finding suggests that have a more diverse range of feeding strategies than previously
22 thought.

23

24 *Introduction*

25 Cold-water coral reefs are biodiversity hotspots of the deep sea. In contrast to their shallow, tropical
26 counterparts, these reefs are dominated by only a handful of reef framework-forming scleractinian
27 corals, yet these few species build vast and structurally complex reefs that support up to an estimated
28 1,300 species (Roberts et al. 2009). Since the discovery of the ecological importance of these diverse,
29 deep-sea communities, and the rapid technological advancement for exploring the deep sea at the
30 end of the last century, interest in cold-water corals has grown rapidly. For the North Atlantic, *Lophelia*
31 *pertusa* is the best studied, arguably most significant, and most widespread reef building cold-water
32 coral (e.g. Rogers 1999, Freiwald & Roberts 2005). Despite this attention, observations of the
33 behavioural ecology of *L. pertusa* remain limited due to the inaccessibility of their remote, deep-sea
34 homes. However, in contrast to many deep-sea species, *L. pertusa* has an extensive depth range (39
35 m - 3380 m, Mortensen et al. 2001) and is able to survive collection and transport to marine
36 laboratories where they can be maintained for months to years (e.g. Hennige et al. 2015). This allows
37 an insight into their behaviours that is beyond the scope of our current capabilities *in situ*. Here we
38 report on feeding behaviours recorded in laboratory mesocosms that suggest that the feeding
39 strategies of *L. pertusa* are more diverse than previously thought.

40

41 It has been established that the diet of *L. pertusa* consists predominantly of zooplankton and
42 phytodetritus (Carlier et al. 2009, Mueller et al. 2014), and previous laboratory observations reported
43 that polyps caught food items through nematocyst adhesion (Mortensen, 2001): that is, they capture
44 items that come into contact with their tentacles. Polyps then transfer particles to the centre of the
45 oral disc and into the pharynx for consumption. Mortensen (2001) noted that small amounts of mucus
46 were also excreted when potential prey had come into contact with the tentacles but had
47 subsequently escaped. Our understanding of the production of mucus in relation to feeding was
48 previously limited to Mortensen's observations and it was thought that *L. pertusa* was limited to

49 consuming food items that came into direct contact with its tentacles. Indeed, mucus excretion has
50 been predominantly reported as a disturbance response (Mortensen 2001), an antifouling strategy
51 (Reitner 2005) and to have a role in skeletal growth (Reitner 2005). However, we have now produced
52 video evidence on a freshly collected *L. pertusa* specimen that *L. pertusa* is able to construct mucus
53 nets that it casts into the water column to capture food.

54

55 *Methods*

56

57 Colonies of *Lophelia pertusa* were collected using a modified video assisted van-Veen grab³ from 141
58 – 167 m depth at the Mingulay Reef Complex, Outer Hebrides, UK (56°49'N, 7°23'W, see Fig. 1 in
59 Hennige et al. 2014), in June 2011 during the RRS *Discovery* D366/7 Cruise. Upon return to the surface,
60 corals were placed in a holding tank at ambient seabed temperature conditions (9.5 °C) for 2 days, to
61 recover from collection, at which time polyps were extended and feeding and mucus was no longer
62 visibly being produced (Hennige et al. 2014). Corals were then carefully fragmented into smaller pieces
63 (Hennige et al. 2014). These fragments had 5-20 polyps, and were taken from the top of sampled
64 colonies to ensure that relatively young polyps were used consistently, as polyp age can determine
65 physiological response (Maier et al. 2009). Coral fragments were transferred to tanks in a 10 °C
66 temperature-controlled room, fed cultured *Artemia salina*, and acclimatised for five days,
67 (comparable to Naumann et al. 2014).

68

69 The fragment presented here was filmed for 1 hour using a Canon PowerShot G9. The video was edited
70 using Final Cut Pro X (version 10.3) and sped up 5 times.

71

72 *Results and Discussion*

73

74 Following the introduction of *A. salina*, small quantities of mucus were released creating two distinct
75 and separate mucus nets. Subsequently the nets and captured *A. salina* were consumed (Fig. 1). The
76 entire process from net production to consumption lasted approximately 18 minutes, far longer than
77 an ROV (remotely operated vehicle) generally spends on a single patch of coral during deep-sea
78 expeditions, making it difficult to observe such behaviours *in situ*. The key sequence is presented in
79 still images (Fig. 1) and video clips are included as a digital supplement (Video S1). Whilst corals
80 habitually produce mucus as a stress response when collected, our acclimation procedures and
81 observations that the mucus nets were only produced in the presence of food allows us to conclude
82 that this is a feeding behaviour.

83

84 These observations suggest that *L. pertusa* has a more diverse range of feeding strategies than
85 previously thought. The prevalence and frequency of the use of mucus nets remains unknown,
86 however other benthic species use a similar strategy and have been more comprehensively studied.
87 Polychaetes (e.g. *Hediste diversicolor*, Riisgård 1991) and gastropods (e.g. *Dendropoma maximum*,
88 Rybak et al. 2005) for example, produce mucus nets as part of their suspension feeding strategies. In
89 both cases, environmental cues, such as food availability, have been shown to influence choice of
90 feeding method.

91

92 Scleractinian coral mucus is functionally important and a prominent source of dissolved organic matter
93 (DOM) in both warm and cold-water coral reefs (Rix et al. 2016). It plays a key role in nutrient cycling
94 (Wild et al. 2008) and drives the “sponge loop”- the key trophic pathway to transfer DOM, the most
95 abundant nutrient rich resource on tropical coral reefs, to higher trophic levels (de Goeij et al. 2013).

96 Our observations suggest that the functions of mucus for the coral itself may also be more diverse and
97 important than first appears.

98

99 *Acknowledgements*

100

101 This paper is a contribution to the UK Ocean Acidification Research Programme supported by
102 Natural Environment Research Council NE/H017305/1, NE/K009028/1, NE/K009028/2.

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149

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151

152 *Figure legend*

153 Fig. 1: Production and consumption of mucus net: (a) free swimming *A. salina*, (b) production of mucus
154 net and trapping of plankton, (c-d) pulling in of mucus net towards oral disc, (g) absence of mucus net
155 after consumption. The black dots approximately represent visible *A. salina*.

156

157 *Appendix*

158 Video S1: *L. pertusa* catching and consuming *A. salina* using a mucus net.