



Siphonophores eat fish larger than their stomachs

Francesc Pagès^{1,†}, Laurence P. Madin^{2,*}

¹ Institut de Ciències del Mar (CSIC), 08003 Barcelona, Catalonia, Spain

² Woods Hole Oceanographic Institution, Woods Hole, MA 02543, USA

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ABSTRACT

We report a collection of the siphonophore *Halistemma cupulifera*, collected at 20 meters depth during a night SCUBA dive in the Sargasso Sea. One of its stomachs (gastrozooids) contained a leptocephalus larva of the eel *Ariosoma* sp. folded in thirds to fit, but 8.3 cm in length fully extended. This finding shows that *in situ* observations can reveal previously unknown trophic interactions that may be significant in a changing world ocean where gelatinous organisms seem to increase at the expense of fish.

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1. Introduction

Relatively few marine invertebrates, mainly cnidarians and mollusks, are known to capture living fish as food (Möller, 1980; Terlau et al., 1996) and few of these consume fish exclusively. One example is the siphonophore *Physalia physalis* – the Portuguese man o' war – which preys almost entirely on larval and juvenile fish (Purcell, 1984). The siphonophores are a subclass of planktonic cnidarians abundant in all oceans. Cystonect siphonophores, the order that includes *Physalia*, prey on fish while the two other orders of siphonophores, physonects and calyphorans, prey mainly on crustaceans.

Prey items are caught by siphonophores on their tentacles and ingested by multiple gastrozooids that grow along the stem of the organism. Each tentacle has several contractile branches called tentilla that are studded with batteries of stinging cells or nematocysts. The tentilla sometimes have specific shapes that are thought to act as visual lures for attracting prey. In surface waters, fish larvae may be attracted to tentilla that resemble other fish larvae or prey items such as copepods (Purcell, 1980), while in deep waters, red-glowing bioluminescent tentilla may attract midwater fish (Haddock et al., 2005).

Usually only fish eyes or scales are found in the gastrozooids of fish-eating siphonophores, but intact fish up to 8 cm long have occasionally been reported (Purcell, 1984). In the absence of

direct evidence for this feeding behavior, such large prey have seemed unlikely in gastrozooids that are usually less than 5 mm long.

2. Results and discussion

We report here the finding of a 17 cm long individual of the physonect siphonophore *Halistemma cupulifera* Lens and van Riemsdijk, 1908 (Fig. 1A) collected at 20 meters depth during a SCUBA dive carried out at night in the Sargasso Sea (24°52'13N, 60°29'32W) on 19 April 2006. There are five species of *Halistemma* currently recognized; *H. cupulifera* is distinguished from the others by a distinctive acorn-shaped process on the end of the terminal filament of the tentillum. There appear to have been very few specimens of this species reported since its original description (Pugh and Youngbluth, 1988).

One of its gastrozooids (Fig. 1A–C) contained a leptocephalus larva of the eel *Ariosoma* sp. folded twice in the gastrozooid, but 8.3 cm in length when fully extended (Fig. 1D). The tentilla morphology of this siphonophore (Fig. 1C) does not appear to mimic any planktonic organism and we did not observe bioluminescence in this organ, but other detached parts (nectophores and bracts) emitted blue light when stimulated. Leptocephalus larvae migrate up into surface waters at night, and apparently in the darkness the leptocephalus encountered and was trapped by the siphonophore's tentacles. The larva's skin was covered by tentacles and exhibited tracks of discharged nematocysts from the head to the tail (Fig. 2). The diet of other species of *Halistemma* has not been reported, but Pugh and Youngbluth (1988) note the mature gastrozooids of *H. transliratum* have “very wide mouths”.

* Corresponding author.

E-mail address: lmadin@whoi.edu (L.P. Madin).

† Deceased, May 5, 2007.

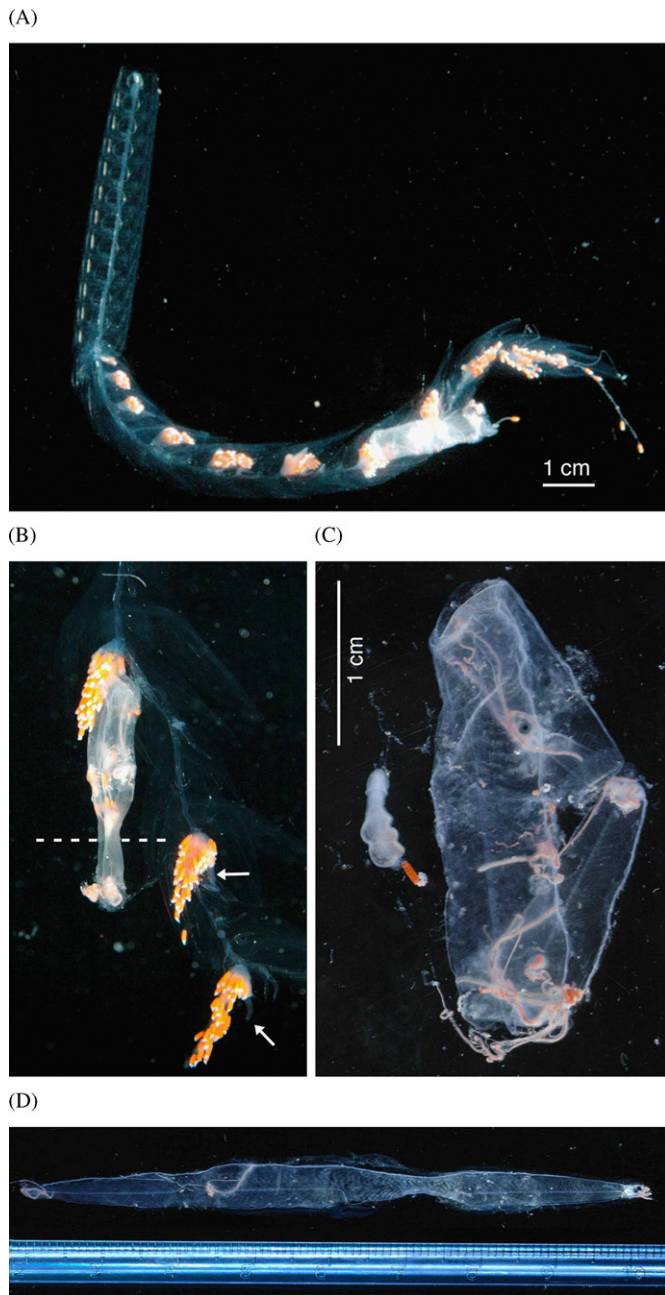


Fig. 1. (A) *Halitemma cupulifera* photographed in an aquarium two hours after capture. (B) Detail of the siphonophore stem showing 3 cormidia (repeating sets of polyps). Note the size of the single gastrozooid containing the leptocephalus in comparison with the groups of empty ones (arrows). The dashed line indicates the gastrozooid mouth. (C) The gastrozooid that engulfed the eel larvae - detached 4 hr after siphonophore capture- in comparison with an empty one. (D) Full-extended *Ariosoma* sp. after being removed from the gastrozooid; scale in centimeters.

Both siphonophores and eel larvae are enigmatic organisms whose life histories remain largely unknown. Our observation shows that some physonect siphonophores do not prey only on crustaceans, but can catch and ingest fish that are several times larger than their stomachs. The poorly known ecology of siphonophores has impeded their inclusion with other gelatinous predators in estimates of the vulnerability of fish to predation. Similarly, the biology of leptocephalus larvae is highly speculative and factors responsible for their mortality are largely unknown.

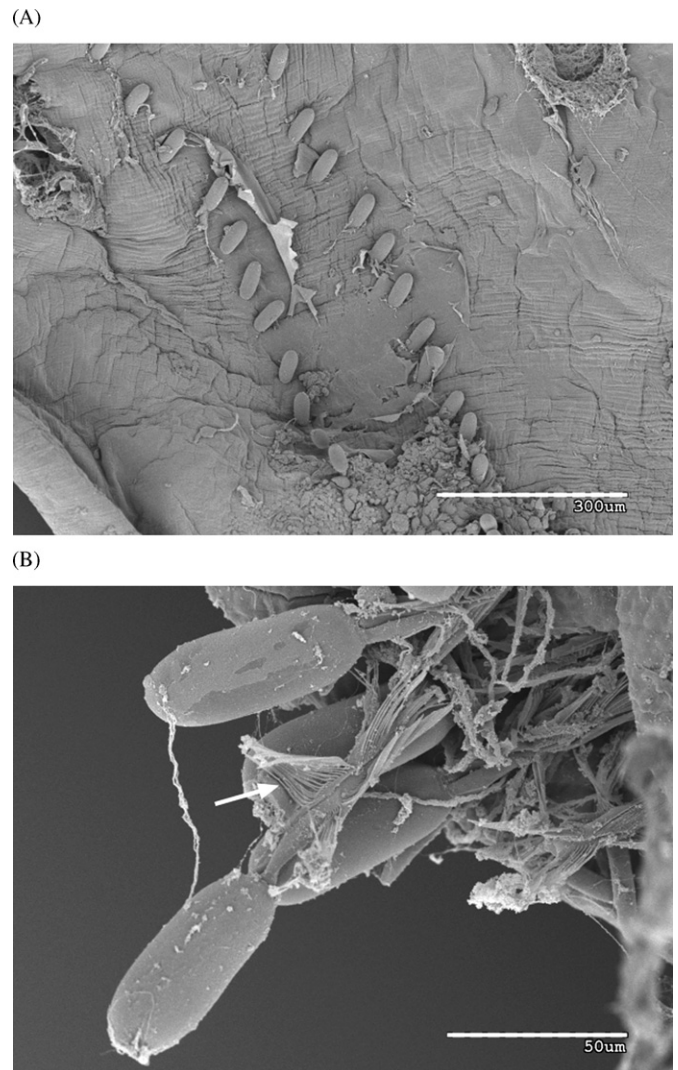


Fig. 2. (A) Nematocysts embedded in the leptocephalus body; the two lines of nematocysts mark the edge of an area previously covered by a siphonophore tentillum. (B) Nematocysts almost completely embedded in the leptocephalus skin; note a set of compressed spines (arrow) near the capsule that would anchor the attachment when penetrating the prey tissues.

Our finding demonstrates that in a changing world ocean where gelatinous organisms seem to increase at the expense of fish (Mills, 2001), *in situ* observations can reveal previously unknown trophic interactions that may be significant links in pelagic food webs.

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