When the Beaches Turn Blue

PATRICK J. SCHEMBRI

Introduction

"The sand was blue!" That was how one person described to me the appearance of the shore at ix-Xlendi in late May this year. Then she continued to describe how on approaching closer to the shore, the reason for the 'blue sand' became apparent: the sand had not turned blue but was covered with thousands of small, blue-coloured jellyfish that the waves had washed up on the beach overnight, leaving them stranded on the sand when the sea became calmer. Earlier in the year, the same phenomenon occurred on a number of Gozitan and Maltese beaches, and the latest 'blue beach' reported to me was ix-Xatt l-Aħmar in early June. In fact, 'blue beach' events have become a common phenomenon but it does not seem to have been so in the past. I have been studying the local marine environment since my student days in the early 1970s and the first time that I saw a mass stranding of blue jellyfish, rather than a few odd individuals washed up on local shores, was in 2001. By 2004 mass strandings were large enough to make people wonder about them and for reports to appear in local newspapers; now, such events occur practically every year with the really large ones often making the news.

By-the-Wind Sailor

The blue creatures that carpet the shore in their thousands, and sometimes tens of thousands, look like jellyfish but are not really true jellyfish. A true jellyfish, which scientifically belongs to a group called the Scyphozoa, is a single animal that takes the form of an 'umbrella' which the animal opens and closes in order to propel itself, and from the underside of which emerge a number of tentacles that in most cases carry stinging cells which the animal uses to capture its food. The most familiar example nowadays is the so called Purple Stinger, scientifically *Pelagia noctiluca*, which is the mauve-coloured jellyfish that occurs in large swarms during the summer months and is a nuisance to swimmers.

The creature responsible for the 'blue beaches' is known popularly in English as By-the-Wind Sailor, or sometimes Purple Sailor or Admiral's Hat, and is scientifically called *Velella velella*. Although superficially they look like jellyfish, they belong to a different group called the Hydrozoa which is only distantly related to the true jellyfish. Moreover, the By-the-Wind Sailor is not a single individual but a whole group of them that not only live together but in which the tissues of each polyp (as each individual is called) are actually confluent with those of its neighbours. Such 'joined-up' organisms are described by biologists as being 'colonial' and coloniality allows nutrients and other substances to be passed from one individual

Plate 1. 'Blue beach' at ix-Xatt l-Aħmar in early June, 2016. The blue colour is due to thousands of individual By-the-Wind Sailor (*Velella velella*) stranded on the sand. [Photo credit: Stephen Schembri].

Plate 2. Close-up view of stranded By-the-Wind Sailor (*Velella velella*); blue individuals were recently deposited while the white ones were deposited earlier and have been bleached by the sun. [Photo credit: Stephen Schembri].

to the other; therefore, food is distributed evenly throughout the colony so it does not matter which individuals actually manage to capture prey as all will get a share. Coloniality has another advantage: it allows different individuals to specialise for different tasks, for example, feeding, defence and reproduction.

The By-the-Wind Sailor has long been considered a floating colonial hydroid but some recent work has suggested a different interpretation of the structure of the organism. Whatever its exact nature, the By-the-Wind Sailor is comprised of three different kinds of polyps, hanging from an elliptical plate some 4 – 6cm long and 3 – 4cm wide, made of a complex organic substance called chitin that the polyps secrete. This chitinous plate has gas-filled spaces inside and acts as a float, suspending the whole colony at the water's surface. The upper surface of the float is water repellent (rather like the non-stick coating of modern pots and pans), such that if the colony is overturned by a wave, it automatically returns to its original position with the float on top. The float also sports an upright sail that runs obliquely along the upper surface. When the wind catches this oblique sail, the colony is pushed at an angle of about 40° to the wind direction – in effect, the colony is able to sail in a similar manner to the way a yacht tacks the wind. This explains the common English name of the animal 'By-the-Wind Sailor', as well as the common names for this creature in Italian, 'Barchetta di San Pietro', and in French, 'Barque de la Saint-Jean'. It also explains the origin of the scientific name, 'vela' being 'sail' in Latin. The other common names 'Purple Sailor' and 'Admiral's Hat' refer to the beautiful purplish-blue colour of the living animal, and to the shape of the float, respectively. The blue hue is actually a defence against predators, since it camouflages the animal against the blue colour of the open oceanic water where it lives.

The most abundant type of polyps are the long tentacle-like individuals found round the periphery of the float. These are the feeding polyps whose function is to capture food by 'harpooning' it using microscopic filaments shot out from stinging cells that cover their body. These stinging cells are similar to those of the true jellyfish such as the Purple Stinger already mentioned. However, in *Velella* the toxin injected by the stinging cells is less potent than that of the Purple Stinger and other stinging jellyfish and is also injected in much smaller amounts so that it is practically harmless to people unless one is especially sensitive to it. Most people would not feel anything if they come in contact with a *Velella* but some report a mild burning sensation. The prey are microscopic planktonic animals that occur close to the water's surface – *Velella*'s tentacles are very short so they can only capture the surface plankton. Once immobilised, the food is passed to a large central polyp that has a mouth leading to an ample stomach, where the food is digested; in effect this is a communal stomach, to which all members of the colony have access and nutrients are therefore distributed throughout the colony in this way. However, a close look at the underside of a living *Velella* will show that some of the polyps have a yellowish brown colour instead of the intense blue of the peripheral tentacles and the float. These polyps house microscopic unicellular algae known as 'zooxanthellae' in their tissues. Zooxanthellae are photosynthetic, that is, they use the energy of sunlight to manufacture organic compounds in the same way that green plants do. The association between the zooxanthellae and *Velella* is a mutually beneficial one for both organisms – the zooxanthellae shelter in the tissues of *Velella* and are exposed to bright light given

that the colony floats at the water's surface, and the *Velella* obtains organic compounds from the algae. Therefore, even if prey is scarce, the colony has a backup food source.

The third type of individuals in a *Velella* colony are the reproductive polyps which bud off tiny medusae that look like microscopic jellyfish. These medusa are free-swimming and sink to deep water where they produce sperm and eggs which are shed in the water for fertilisation. The fertilised eggs become swimming embryos that then rise to surface again to become the next generation of adult By-the-Wind Sailors.

Velella colonies come in two forms. One has the sail running diagonally to the right and the other to the left. It appears that these forms occur in unequal proportions such that the most common form at any given locality is that which veers away from the major winds that tend to blow the animals towards the coast. No one has yet looked at the relative proportion of left and right handed colonies beached on our shores, but this would be an interesting exercise, especially if the results are then correlated with wind and current patterns. Normally, *Velella* is a creature of the open seas; however, prolonged episodes of winds blowing from an unusual direction or very strong winds in which *Velella*'s sail is not effective, will blow these animals onto the coast where they are then stranded in their multitude on the shore. This is what has been happening locally in recent years between early spring and summer.

A question that many people are asking is why are these mass strandings occurring almost annually when previously they were rare events? There is no simple answer to this. Numerous factors affect the rate of reproduction and survival of the By-the-Wind Sailor – obviously, the more young that are produced and the more that survive, the larger the generation that results; an unusually large generation is referred to as a 'bloom'. Reproductive output and survival depend on the availability of the food for both adult *Velella* and their developing offspring, as well as on reduced competition for food with other organisms coupled with diminished predation of, again, both adults and young. Although the reason for By-the-Wind Sailor blooms may be complicated to work out, many scientists are taking the increased frequency of such blooms as a sign that the Mediterranean marine environment is undergoing important and rapid changes.

Plate 3. Living By-the-Wind Sailor (Velella velella) floating at the water's surface. Note the raised transparent 'sail' and that in all four individuals shown, this runs obliquely from left to right. [Photo

When there is lots of food and few competitors and predators, a bloom will result and if the wind and currents are in the right direction, there will be mass strandings and the beaches will turn blue, at least for a couple of days until the floats are bleached by the sun and become transparent and are eventually blown away by the wind.

Acknowledgements

This article is partly based on one originally published on 27 June, 2004 in 'The Sunday Times' that was written when the first mass strandings of the By-the-Wind Sailor started occurring. I am grateful to Dr Stephen Schembri and Ms Jacqueline Galea for providing the photographs that illustrate this contribution.

Patrick J. Schembri is Professor of Biology at the Department of Biology of the University of Malta.