COMMENTARY

Why do zooplanktons migrate?

...we think we know the answer

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IN all regions, especially in the tropics, it has been observed for about a century that zooplanktons exhibit diurnal vertical migration, where they descend down the water column during the day and ascend during the night. This trip is done by large numbers of zooplanktons commonly called the deep scattering layer since it is capable of scattering the sonar waves used for echolocation and were often mistaken for submarines in the early part of the Second World War. They travel approximately 100 to 400 metres, which is analogous to a person walking 25 miles to work and 25 miles back home. But why are the migration patterns of this tiny organism so important? Well, this is because they play an important part of aquatic food webs, as they are food for organisms as higher trophic levels on the food webs. It is these larger organisms like fish that we depend on for food. Therefore, by understanding the mechanism that drives this migration we can determine the conditions they thrive in and how to preserve and protect it from environmental problems like global warming. This diurnal migration has been attempted to be explained by four main hypotheses each with their strengths and weaknesses.

The first hypothesis proposes that the purpose of the migration was to escape predation by visual diurnal predators, for example, fishes, birds and cephalopods. However, there are four main problems with this hypothesis. The first is that at the depth they migrate to, there is still sufficient light for them to be detected easily by predators. This is especially so in the tropics where light can easily reach depths of 500 metres. The second problem is that most of the zooplanktons have bioluminescent organs so even if they do reach complete darkness, they can easily be detected by predators. Also, the predators can adapt and migrate down the water column following their food source, especially since this diurnal migration has been taking place for more than a century. Finally, these large masses of zooplanktons make them an easy target for predators.

The second hypothesis is called the "light-damage avoidance hypothesis". Its name suggests that the zooplanktons migrate to avoid the harmful ultraviolet rays from the sun, which reaches its highest levels at midday which corresponds with the lowest depth in the zooplanktons' downward migration.

However, this one also has problems, since some zooplanktons have pigments, in this case, carotenoids that protect it from ultraviolet radiation. However, this same pigment gives them an orange or yellow colour which makes them easy to be spotted by predators.

The third hypothesis suggests that the Ekman spiral, which regards the ocean as comprising of different layers of water. Where the top layer moves at a 45o angle to the right of the direction of the wind, and each layer below it moving at 45o to the right of the layer directly on top of it, until there comes a depth where the action of the wind cancels. Therefore, when the zooplanktons swim down, they can go to another water column by stopping at the desired layer and let the current carry them to another water column, where the phytoplankton, which is their food source is plentiful.

The fourth and final hypothesis comprises of two parts. The first suggests that the phytoplankton must be allowed to reproduce and recover by the zooplanktons by ceasing their grazing on them for a period of time. The second part suggests that the zooplanktons obtain an energetic advantage by spending time in the deep cold waters as it slows down their metabolism. But, a problem occurs in the second part of this hypothesis since the energy expended in going down to cold water is more than what is saved when in cold waters.

Therefore the diurnal vertical migration in zooplanktons can be explained using four hypotheses, each having their own strengths and weaknesses. However, science aims for getting only one hypothesis to explain any phenomenon, although one might suggest that all of the hypotheses may contribute to the diurnal vertical migration of zooplanktons.