Finding (bioluminescent) light in darkness

by Ragnhild Irene Jacobsen

The dark can be terrifying, thrilling or both at the same time. It is terrifying because you do not know what you might find, and it is thrilling for exactly the same reason. This is the allure of research. It is trying to find a light in the darkness, an answer, without knowing what it will be or even if you will find one. One place that is particularly dark is the ocean. In the deep, beyond the reach of the sun, the darkness seems complete. But is it? The few that have ventured down in person, or sent cameras in their place, report a different reality. A darkness interrupted by specks of light: bioluminescence. This heat-free form of light is produced through chemical reactions and is found in more than 75% of organisms dwelling in the open ocean. But they do not use it to serve a single purpose. The conspicuous anglerfish, for example, dangles a bioluminescent light bulb in front of its mouth and gobbles up the smaller organisms attracted by the mystical lure. Other organisms, like the tiny bean-shaped ostracod, produce fireworks of blue light when devoured by a fish, resulting in their instant release. But not all ostracods are this lucky. Some fish that cannot produce bioluminescence themselves steal the necessary proteins from unsuspecting ostracods. Their motive? To cover their belly with light so their silhouette is harder to see against the brighter ocean surface by predators lurking beneath. Predation, protection, and protein theft are not the only acts in which bioluminescence plays the protagonist. In the vast and dark ocean, light also helps potential mates find each other. But how do you know whether a flash of light is a flirtatious invitation, a consequence of your friend being attacked, or worse, someone luring you into their mouth?

Although bioluminescence is a major communication channel, lighting up the oceans, the meaning of its messages and how they are interpreted remains shrouded in darkness. However, there are clues indicating that this is a language full of variety and potential. One such clue lies in the patterns of light emission: bioluminescent communication signals can take many forms, from brief, repeated glimmers to steady glows. Some jellyfish set off a ‘burglar alarm’ when threatened – a circling sequence of light like the spinning cursor on a non-responsive computer – in the hopes that bigger animals will come and eat their attackers. Colour provides another clue: most marine creatures favour blue or green, while some stand out with more eccentric yellow or red varieties. Short wavelengths travel further in the ocean, which means that blue and green signals will reach a wider audience. But their popularity comes at a price, since many unintended recipients may be listening in. The much rarer yellow and red bioluminescent colours therefore provide more exclusive communication channels, but their long wavelengths also mean that their reach is limited. Perhaps the patterns and colours that different species use are ways to distinguish friendly flashes from enemy fire, but this remains an untested hypothesis.

For as spellbinding as these displays of light may be, why should we study a phenomenon that mainly exists in a world we so rarely venture into? The deep oceans are far removed from our own terrestrial, sun filled life, so far in fact that it may seem strange that they should possess the secrets to our own origins. After all, we did inhabit the ocean a long, long time ago before our distant ancestor decided to venture into the light. Hence, deciphering the language of species that still live in that dark world that we first developed in provides an opportunity to understand the origins of our own communication. But to do so we need to enter the dark both physically and metaphorically. First, we need a dark room to be able to observe individual flashes of light. Second, we need to look for answers to questions that no one has answers to. Some emerge willingly from the dark: we and others have found that some bioluminescent organisms are, perhaps unsurprisingly, sensitive to light. This indicates that they can detect and possibly interpret the signals of nearby individuals. Other answers

are harder to bring out of the dark: although these organisms are able to detect light, this does not mean that they will automatically respond by generating light themselves. To listen in to this communication channel we therefore first have to look for situations in which organisms do decide to bioluminesce and what effect these signals have on others. The dream is that one day we will be able to communicate with these organisms using their own language to better understand our own. Will we succeed? Nobody knows. Which is precisely what makes exploring the dark so thrilling.