

# Buoy-borne underwater dark field imaging system improves marine plankton monitoring capability

October 28 2021, by Zhang Nannan

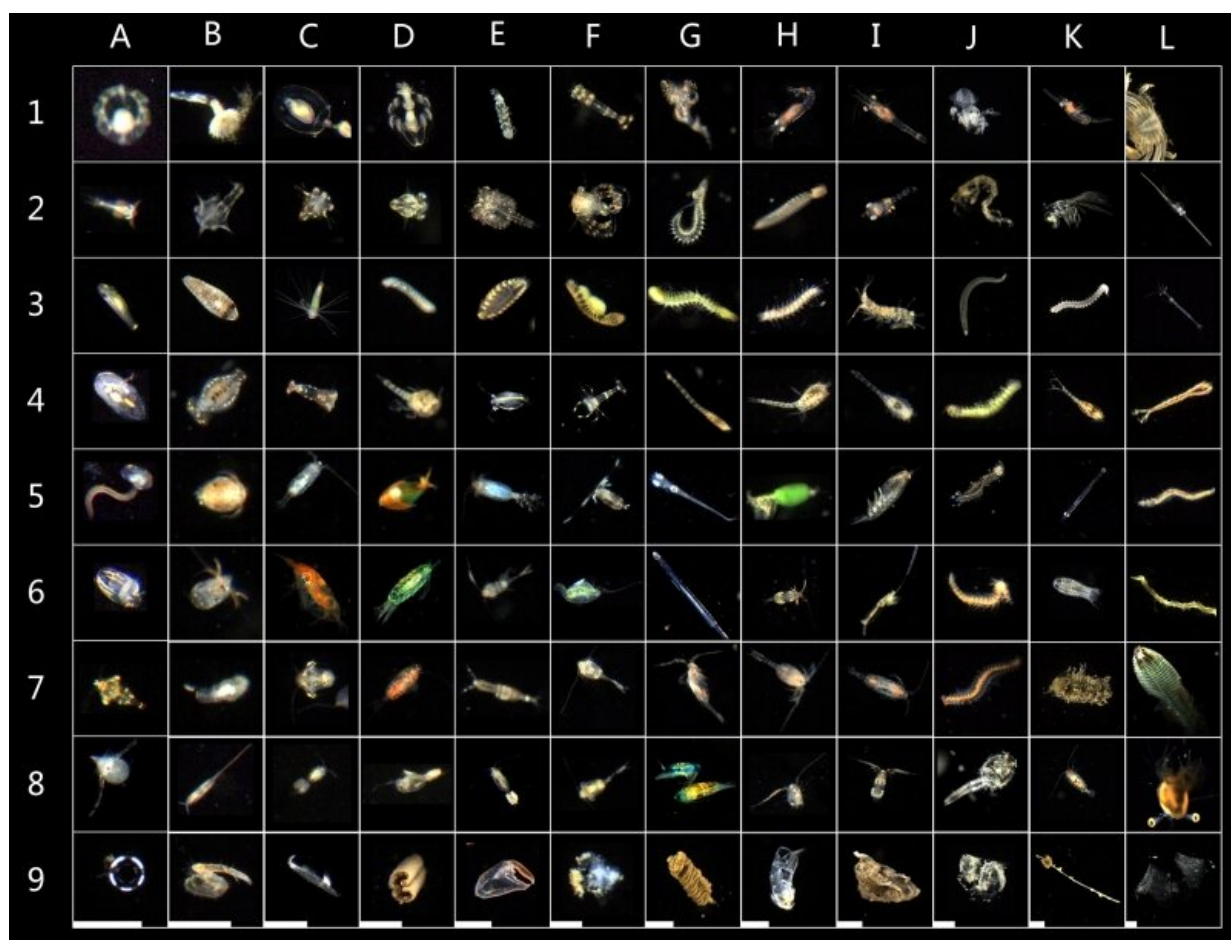


Fig. 1 Examples of mesoplankton and nonplankton particle ROIs captured by the underwater imager during coastal raft tests. Credit: LI Jianping's team

Mesoplankton refers to plankton with a body size between 200–20,000  $\mu\text{m}$ . Since mesoplankton are the key components of coastal ecosystems, their abundance and composition can promptly reflect environmental changes in local seawater.

A research team led by Dr. Li Jianping from the Shenzhen Institute of Advanced Technology (SIAT) of the Chinese Academy of Sciences has developed a buoy-borne underwater dark field imaging system that can expand the geographical and temporal marine [plankton](#) monitoring capabilities of a surface buoy network. Relevant results were published in *IEEE Journal of Oceanic Engineering* on Oct. 20.

The new imager in the trial system features a new strobe LED illuminator with a 360° inward convergent laminar lighting design. Such optical design not only facilitates high-quality underwater darkfield color photography of marine plankton, but also reduces light leakage to the local underwater environment and thereby minimizes the distortion of their distribution caused by phototaxis-induced aggregation of zooplankton.

In addition, installation of different lenses enables the imager to support switchable magnifications for imaging a size range of 200  $\mu\text{m}$ –40 mm. To reduce [data storage](#) and transmission loads, the imager is equipped with an embedded computer to perform online object detection preprocessing after [image acquisition](#).

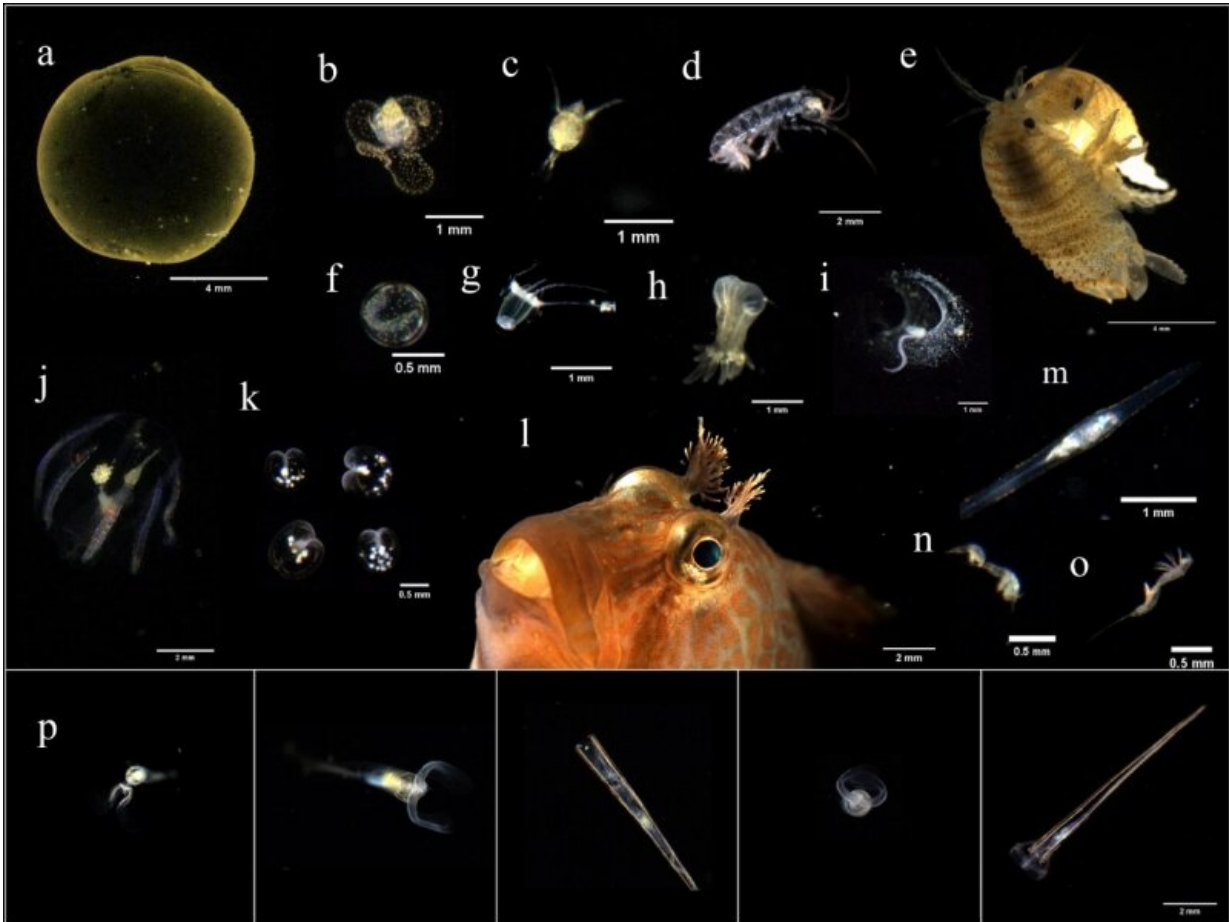


Fig. 2 Examples of plankton ROIs collected by the underwater imager during buoy trial. Credit: LI Jianping's team

The system can detect individual plankton and suspended particles from raw images. It can then transmit the cropped region of interest (ROI) vignettes instantly to a [remote server](#), where they are further identified and quantified by cloud computing-based deep learning algorithms to obtain monitoring information for end users' remote retrieval.

Through raft and buoy trials, 46,804 plankton and suspended particle images have been annotated through a human-machine mutually assisted effort. The result is a data set with 90 categories.

The imager system was integrated into the surface buoy and deployed in Daya Bay in the northern South China Sea for eight months. It transmitted a total of 1,545,187 region-of-interest images back to the server, thanks to its high-frequency and long-time continuous sampling capability.

It also observed plankton diel vertical migration phenomena with a higher temporal resolution, and, for the first time, an unprecedented outbreak of *Creseis acicula* in the waters near the southwest coast of Daya Bay.

"This is the first successful trial of deploying a submersible imager under a moored surface buoy for long-term, continuous, [high-frequency](#) and in situ monitoring of marine plankton in coastal waters," said Dr. Li. "The popularization of such a paradigm especially with a networked deployment will reduce the cost, enlarge the spatial coverage, increase the sampling frequency, and extend the deployment time of the marine plankton monitoring programs."

**More information:** Jianping Li et al, Development of a Buoy-Borne Underwater Imaging System for In Situ Mesoplankton Monitoring of Coastal Waters, *IEEE Journal of Oceanic Engineering* (2021). [DOI: 10.1109/JOE.2021.3106122](https://doi.org/10.1109/JOE.2021.3106122)

Provided by Chinese Academy of Sciences

Citation: Buoy-borne underwater dark field imaging system improves marine plankton monitoring capability (2021, October 28) retrieved 30 May 2023 from <https://techxplore.com/news/2021-10-buoy-borne-underwater-dark-field-imaging.html>

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