Video Plankton Recorder II (VPRII)

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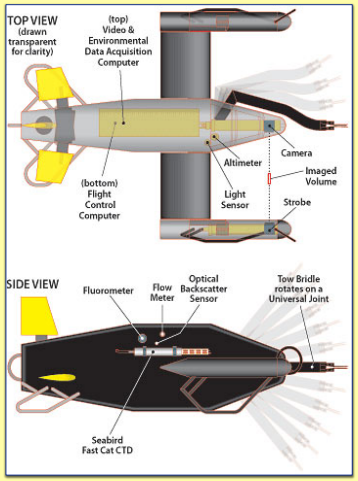
What is it and why do we use it?

The Video Plankton Recorder (VPR II) is an underwater video microscope system that takes images of plankton and particulate matter as small as 50 microns and up to a few centimeters in size. The instrument is used to help scientists quickly measure the distributional patterns of plankton without destroying their delicate forms, as can happen when using nets and bottles.

Much of the living matter in the ocean is plankton -- small animals, plants, and microbes that drift passively with currents. Among them are copepods, arguably the most numerous animals on Earth and a critical link in the food chain between primary producers and higher levels, such as fish. Studying plankton helps scientists understand many other things about the ocean, such as changes in fish stocks, pollution, and climate.



The VPR II system automatically identifies the plankton and displays their distributional patterns in real time. The VPR II is eight feet long and six feet wide. It is comprised of an aluminum frame covered in a fiberglass skin. It weighs 450 kg in air and 50 kg in water.

The figure shows the various components of the VPR II system. The steel tow bridle shown in black, with shadows representing the range of motion-is attached to the forward midpoint of the wing spar, and protrudes from the left side of the nose cone. Researchers use this bridle to tow the VPR II behind a vessel. As the VPR II moves, so does the arm to compensate movement.

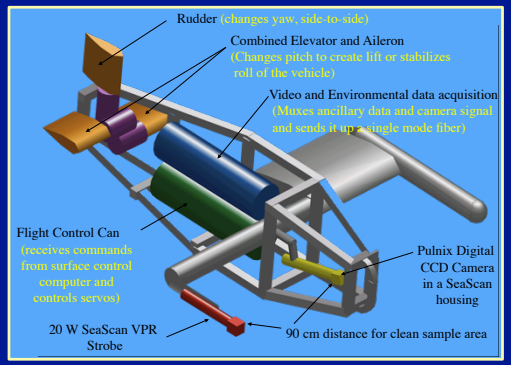
A digital video camera is housed in the nose cone, and a strobe is in the right wing tip. The volume imaged by the VPR II is in undisturbed open water between the camera and strobe. The tail fins and rudder are controlled by the flight-control computer and cause the VPR II to undulate between two selected depths, or follow a constant depth. They enable the instrument to move off to the side, out of the ship's wake when sampling near the surface.

In addition to video, data collected from other sensors measure ambient light, fluorescence (a measure of phytoplankton), optical backscatter (an index of turbidity), CTD (for salinity, temperature, and depth), flow rate (speed of VPR II), and the altitude of the VPR II off the bottom. The VPR II has been towed for thousands of miles through the ocean, including a transatlantic crossing on the research vessel Knorr.

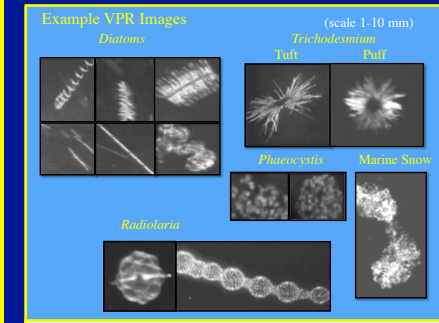
How does it work?

A video camera mounted in one of the arms focuses on a point midway between the two arms. A strobe on the other arm illuminates the imaged volume and flashes 30 times per second, producing 30 images per second of the particles and plankton in the water. The images are then sent via fiber optic cable to the surface and stored on the data logging and ROI extraction PC.

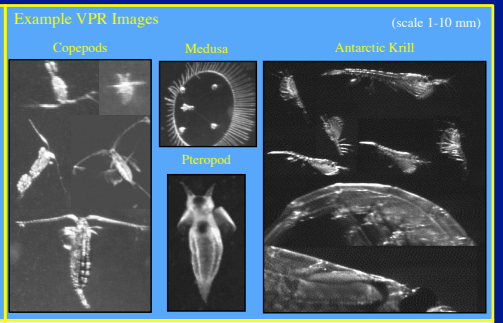
The instrument is deployed from the stern of the ship. CTD, fluorometer, turbidometer, and light sensor are mounted on the VPR to collect environmental data at the same time as each video image. The instrument undulates from near surface to a maximum depth of 350 meters profiling plankton/particle abundance along with environmental data.



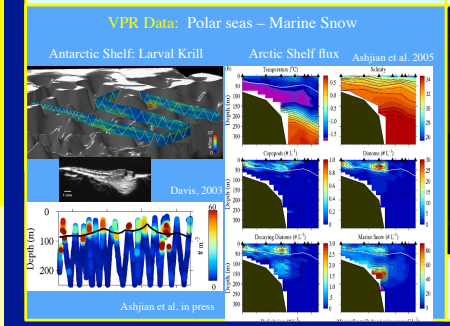
What do the ROI images and data displays look like?

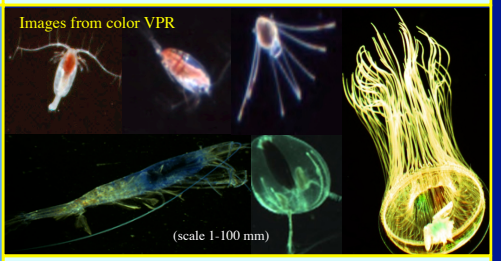


The majority of VPR images are of fragile forms, marine snow in particular. Chain forming and colonial diatoms are very common, the Chaetoceros socialis (lower right diatom) colonies are especially fragile and easily destroyed by bottle and net sampling. The important cyanobacteria colonies of Trichodesmium are also fragile but sampled well optically.



Here are some example images from the VPR showing various copepods, Antarctic krill, a hydroid medusa from Georges Bank, and a Clione pteropod.





The new Digital Autonomous Video Plankton Recorder, (DAVPR) has a color camera, which provides additional discriminate features that we are presently incorporating into our automatic identification methods.

VPR III?

- A future system would include a towfish that is designed for 12 Knots and will have half the linear dimension of VPR II.
- It would include a color camera camera and ring illuminator similar to the DAVPR.
- The Data Acquisition, Plankton Identification and Visualization and Flight control computer would be upgraded
- There are three main driving factors requiring upgraded computer systems.
  1. The system is currently extracting sub-images, (Regions of Interest, or ROIs) of the larger, in focus objects because the current system doesn't have the storage capacity to save full frame video. The future system will be able to store full frame video topside as it comes up the FO at 30 frames per second, 30MBps for 8-bit images.
  2. More processing capability required to utilize color information in identification of plankton and particles.
  3. While working in the Gulf of Mexico during OC470-02 and off Barbados during OC471, (See WHOI website for synopsis), we encountered very high concentrations of plankton and were not able to identify them in real time. In order to process ROIs faster than our present rate of ~5 ROI/sec, the system needs to move into parallel processing, utilizing a Graphical Processing Unit. Using this approach, we feel the system will have no problems keeping up with real-time data rates while incorporating higher resolution cameras.

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