A better ROV/AUV for behavioral ecology

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Current ROV and AUV instruments are poorly designed for behavioral ecology studies. They are designed for continued movement with the capability of hoovering for short periods, but only by using continuous propulsion. Operation without lights is also difficult for ROVs. Crawlers have the ability to maintain position for long periods, but are slow and have high impacts on the benthos. Crawler operation in heterogeneous habitats is problematic.

In order to be effective tools for behavioral studies, ROVs and AUVs need to be able to remain in place at one location for long periods of time while remaining quiet and often without lights. The ability to quickly move to new positions with minimal environmental impact is critical. Finally, minimal instruments needed include both standard and infrared video cameras (ideally stereo cameras), one or more hydrophones, and basic environmental sensors (DO, temperature, Salinity, pressure, turbidity, current speed and direction). Optionally, other modes of observations such as sonar and acoustic imaging can be included. While many professional grade ROV/AUVs are designed for operation on the high seas and carry numerous instruments, and hence, are very large machines, there is a need for small and highly mobile ROVs useful both in the deep-sea and shelf waters, but also in shallow coastal and freshwater habitats. In particular, ROVs are needed that can be piloted by a single pilot from shore or a small boat, and operate in very shallow (30 m to <1 m depths), turbid, and high current environments, often at night.

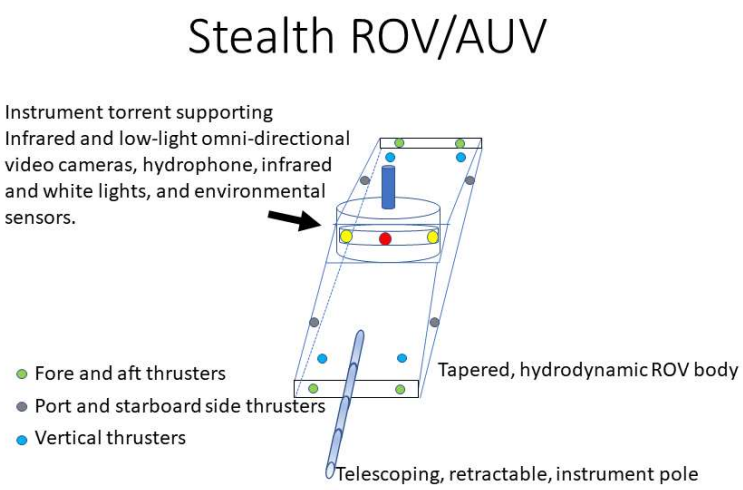

Figure 1. Concept of a stealth ROV.

To meet these objectives, I propose the concept of a "Stealth ROV/AUV" (Fig 1). The ROV would be negatively buoyant and have multiple small, quiet, thrusters to allow precise maneuverability. Cameras and lights would be mounted on a rotating torrent on the top of the ROV to allow maximum visibility in all directions and of the sea-floor. A camera providing an overhead view would be included. It is critical that the ROV/AUV have the ability to remain stationary on the seafloor for long periods to allow undisturbed observation under lighted and unlighted conditions. Video cameras can either be pan/tilt to provide 360° view, or provide a continuous 360° panoramic view.

There are many different sampling strategies for marine census and behavior observation techniques, each with their own biases. One basic technique is the random point survey in which a SCUBA diver will swim to randomly chosen locations where they would sit on the sea floor for standard time periods to census fish and observe behavior. The method is particularly useful for cryptic species which tend to be disturbed by an approaching observer but return to normal activity after acclimating to the diver's presence. Conventional ROV and AUV's make poor platforms for conducting this type of census. However, the proposed Stealth ROV would be

ideally suited for this type of work (Fig. 2). An important accessory on the stealth ROV would

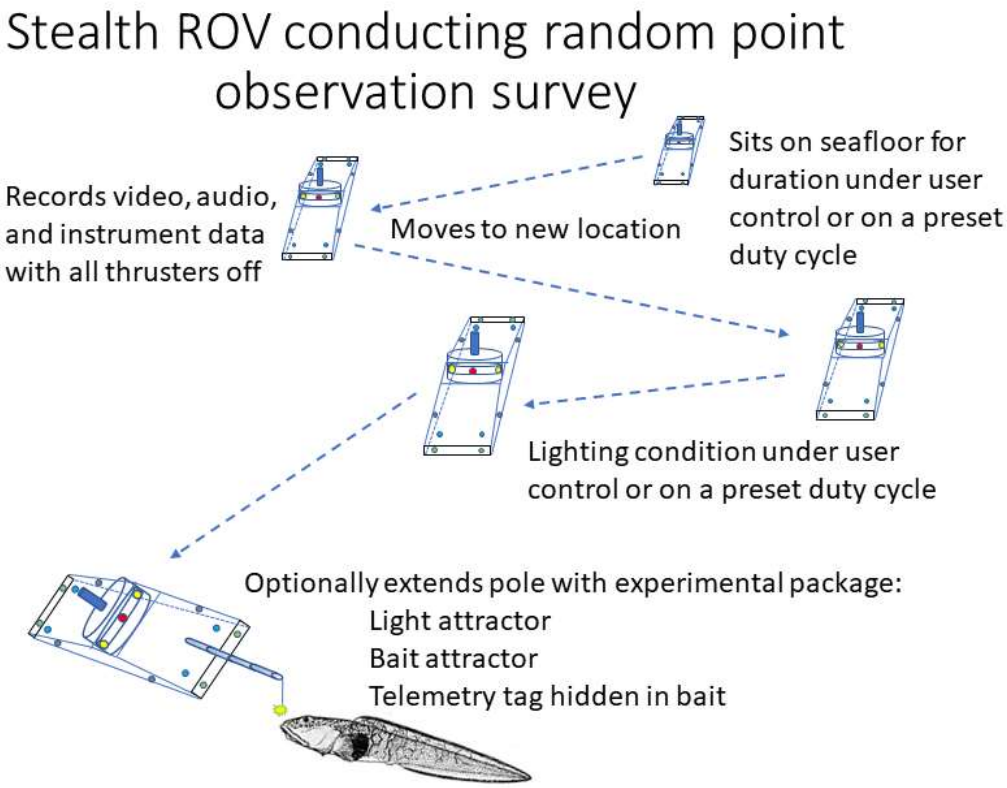

Figure 2. Typical operational scenario for a stealth ROV/AUV.

be a telescoping pole to support experimental instruments or devices. For example, a bait or light lure. Of particular interest would be the ability to present a telemetry tag hidden in a bait to a specific specimen encountered during the survey, rather than the typical method of setting out bait and waiting for unknown individuals to be attracted. Here, researchers would have the ability to select ideal specimens, rather than leaving selection to chance.

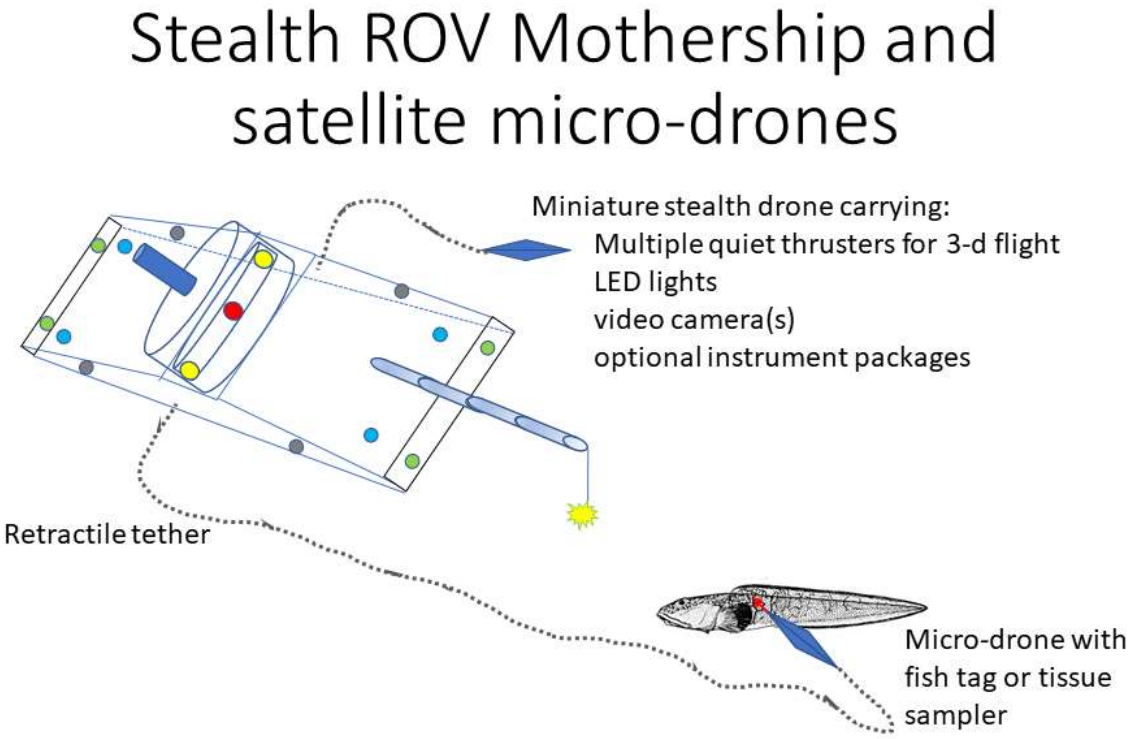

Figure 3. Stealth Mothership ROV with satellite micro-drones.

I propose an enhanced stealth ROV, the "Stealth ROV Mothership", would be a particularly useful type of ROV for behavioral studies in all habitat types from the deep-sea to shallow freshwater (Fig. 3). The stealth mothership would carry one or more micro-drones that would enable a pilot to "explore" the area around a ROV sitting on the sea-floor, and to conduct specialized sampling. The micro-satellite drone would be <30 cm long and carry a micro-camera. It would have multiple micro-thrusters for 3-D maneuverability. The micro-drone would be useful for close inspection of objects, but would be particularly useful as a unique method to obtain tissue samples, or remotely tag specific fish (for example, this would work well

for sablefish). I believe the micro-drones would be more versatile and effective (cause less disturbance to targets) than more conventional manipulator arms.