

OpenROV

Minimizing the Spread of Invasive Species

Invasive species can cause huge problems in new ecosystems. These guidelines will help users minimize accidental transport of invasive species via ROVs.

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INTRODUCTION

Remotely operated vehicles like OpenROV present a potential risk for the transmission of invasive species. This is particularly the case for small, low-cost microROVs that can be easily transported among ecosystems and if not properly cleaned and treated may introduce novel species into new regions.

We have established a set of 5 best-practice guidelines to reduce the risk of marine invasive species introduction for microROV operators. These guidelines include: educating ROV users about the causes and potential harm of species invasion; visually inspecting ROVs prior to and at the conclusion of each dive; rinsing ROVs in sterile freshwater following each dive; washing ROVs in a mild bleach (or other sanitizing agent) solution before moving between discrete geographic regions or ecosystems; and minimizing transport between ecosystems.

We encourage responsible ROV operators to follow these guidelines when traveling between ecosystems and deploying underwater drones in new areas.

A comprehensive discussion of these guidelines can be found in our paper: [Robots as Vectors for Marine Invasions: Best Practices for Minimizing Transmission of Invasive Species Via Observation-Class ROVs.](#)

Step 1 — Education and Awareness

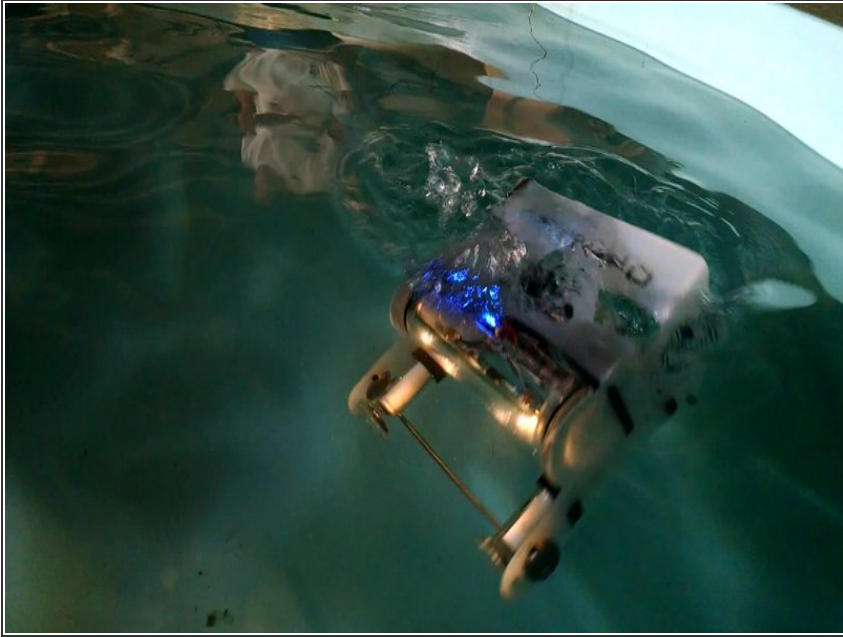


- Learn about species invasion in general and look up any specific invasive species issues in the area that you are diving.
- There are three different invasive species in this photo from an OpenROV dive in Lake George, NY. Can you spot them?
- Invasive species can be animals, plants, or microbes. Tiny larvae can be especially pernicious, resilient, and hard to see.
- [Invasive Species: What Everyone Needs to Know](#) by Daniel Simberloff is a great, accessible introduction to species invasion.

Step 2 — Visual inspection of each robot prior to and immediately following deployment

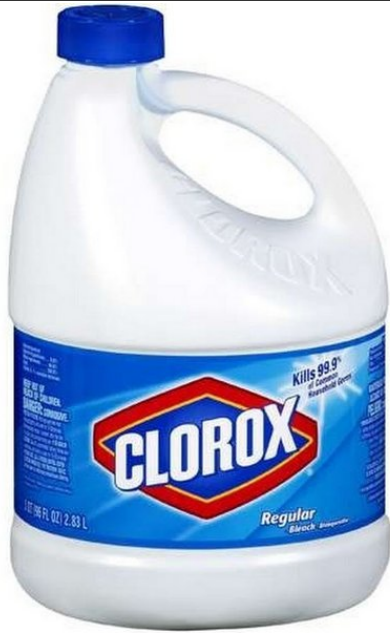
- Prior to any deployment, ROVs should be inspected to determine whether any visibly observable biological material is present on the vehicle.
- Pay extra attention to the o-ring seals, where tiny grains can become lodged, around the thrusters where sea grass and other filamentous organic matter can become entangled, and inside motor bells where material is hard to detect.
- After each dive, perform the same visual inspection, returning any organic matter to its place of origin.
- Inspect shoes, clothing, and any gear to confirm that no organic material will be transmitted between sites.

Step 3 — Freshwater soak prior to beginning an expedition and freshwater rinse at the conclusion of each dive



- ROV operators should soak MicroROVs in freshwater for 24 hours prior to transport between different geographic regions.
- Rinse ROVs in clean, fresh water following each dive. This will help remove salt and minimize corrosion of critical components as well as protect against invasive species.
- Fresh water is lethal to many marine species, including microscopic organisms that cannot be detected during visual inspection.
- Don't transport rinse water between sites.
- Having fun in a pool or freshwater tank is a great way to ensure a thorough rinse.

Step 4 — Bleach soak before transporting robots between sites or preparing for long term storage



- ROVs should be thoroughly washed using a weak bleach solution or other readily available sanitizing agent.
- This will kill many microbial and viral vectors that could be transported between sites.
- A dilute bleach solution (7.75 mL household bleach per liter of water) for no more than 15 minutes will not damage o-rings or other delicate components.

Step 5 — Minimize transport between ecosystems



- The most effective method of avoiding species introduction is to limit the geographic and ecologic range of each robot.
- Robots dedicated to specific ecosystems can eliminate the possibility of invasive transport.
- Users can minimize the amount of transport between ecosystems by planning their expeditions such that all dives in a specific site are completed contiguously, with the fewest possible transitions between geographically or biologically distinct regions.
- When robots must be carried internationally, users should declare their ROVs at customs checkpoints and provide an opportunity for host nations to implement their own disinfectant procedures.