



Balloon Based Oil Spill Surveillance

W. Scott Pegau¹ and Brian Green²

1. Oil Spill Recovery Institute, wspgou@pwssc.org, 907-424-5800

2. Alaska Clean Seas, Offshore@alaskacleanseas.org



Abstract:

Spill response vessels are currently guided by aircraft over flights and ability of the crew to see oil on the water. The aerial component can be limited by weather, daylight, and fuel capacity. Autonomous aircraft could provide a broader aerial operating window, but obtaining permits to fly the vehicles has been difficult. We present another approach to providing continuous aerial observations for spill response vessels. This approach is based on using a visible and infrared surveillance camera below a tethered balloon.

This approach has simple permitting requirements: if deployed more than five miles from an airport and below 500 feet a permit is not required. It can remain airborne continuously. It transmits images to the mother ship and surrounding vessels. The cameras can be controlled by the mother ship. And it provides a means to view a large area around a vessel.

We present a description of a system and results from field testing in Alaska. The system tested used off-the-shelf components. Several balloons and cameras are available that are appropriate for this type of work. We are not promoting any one system, just the concept for providing aerial surveillance from a balloon instead of aircraft.

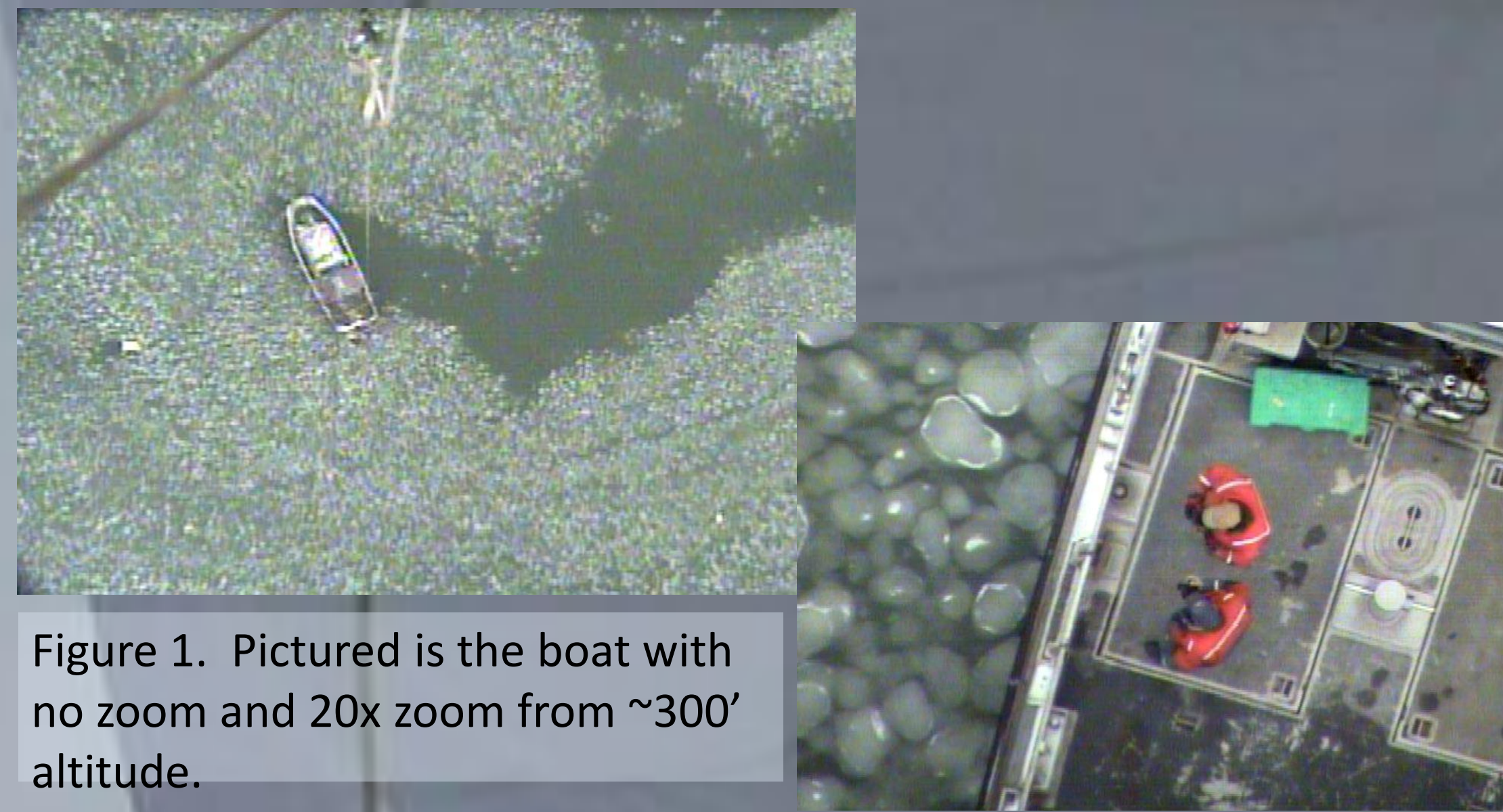


Figure 1. Pictured is the boat with no zoom and 20x zoom from ~300' altitude.

Background:

In 2008 The Oil Spill Recovery Institute and Alliance for coastal technologies sponsored a workshop to identify hydrocarbon detection needs in the marine environment.

Results from that workshop can be found at

<http://www.pws-osri.org/publications/Hydrocarbon%20Sensors.pdf>.

Subsequent U.S. Coast Guard regulations requiring aerial surveillance pushed the need to test new systems. We looked for a system that was easy to operate, relatively inexpensive, has long endurance, and is easy to permit.

This led us to testing a balloon-based surveillance system that incorporates visible and thermal IR imaging systems (Fig 1).

System:

There are multiple systems available. We tested a SkyDoc™ aerostat model 18 Two-ply balloon and a Latitude Engineering Paracam that includes a CloudCap TASE Duo visible/IR camera system (Fig 2.).

The balloon is 15 feet in diameter and filled using 5 bottles of helium (970 cu ft). Minimum lift is 22.4 lb at still wind. It is rated to 90 mph winds, although the winch and tether may be the limiting factors since it gains lift with wind speed. We have not tested the endurance of the system, however expected helium loss rate is 1-5% per week. The manufacturer does not provide a maximum altitude, but 500' is the limit before a permit is required.

The camera has full pan and tilt control with a visible zoom of 20X and thermal IR zoom of 2X. This system has a 50°-2.5° half width field of view. The camera is wirelessly controlled from a computer and deck station on the vessel. It transmits its signal wirelessly back to the mother ship and surrounding vessels. It is powered by a battery with an expected duration of 24 hours. There is an option for using a wire to transmit power and signal to and from the camera.



Figure 2. Pictured from right to left are the balloon deployed for transit on the Alaska Clean Seas vessel Harrison Bay, the camera system in its mount, the deck unit for communicating with the camera, and the controller with computer.

Problem: Providing 24 hour aerial surveillance during a spill

Solution: Balloon based aerial surveillance

Testing:

The system was deployed from a 48' boat (Fig 2.) and a flatbed truck (Fig 3.). The purpose of the tests were to determine the capabilities of the system and help establish the equipment and personnel requirements. Winds were generally <15 knots during launch and retrieval. The balloon was at ~300' altitude from the boat and 150' from the truck. On land we poured warm water beside and under snow to test the IR camera system.



Figure 3. Pictured is the balloon and camera being deployed from the truck. The pictures at the top are a visible and IR set of pictures from ~150 with 2x zoom of two areas with warm water and a cone, a person, and a truck. Note that where the water run under the snow it is still seen in the IR image. The balloon was transported inflated and tied to the framework at the back of the truck.

Desired modifications:

- A dedicated and strong winch.
- Greater IR zoom
- Improved camera securing system
- A tether with electrical wires for long deployment

All of these modifications are available, just not part of the system we tested.

Lessons learned:

The balloon gains lift with wind speed so it is difficult to recover at higher wind speeds.

A high volume air supply is desirable when testing for leaks. A vacuum is useful for deflating the balloon.

Conclusions:

- The system was fairly simple for personnel with limited training to assemble and deploy from various platforms. Although there are capabilities of the system that we were not able to figure out in the field.
- It showed promise for providing low-cost (<\$100,000), continuous surveillance on a 24/7 basis. Most of the cost is associated with the camera.
- Several small modifications have been identified to improve the system. The recommended changes are possible with off the shelf components.
- The system requires a strong winch and dedicated docking system for operating in higher wind state.
- The balloon system may be able to fly other types of sensors than the one described here. Our interest was in determining how much was to be gained by increasing the height of the observation, not in determining the best type of observations to make.

Acknowledgements: We thank the many people at Alaska Clean Seas and Cook Inlet Spill Prevention and Response Inc. for their efforts in testing this system.