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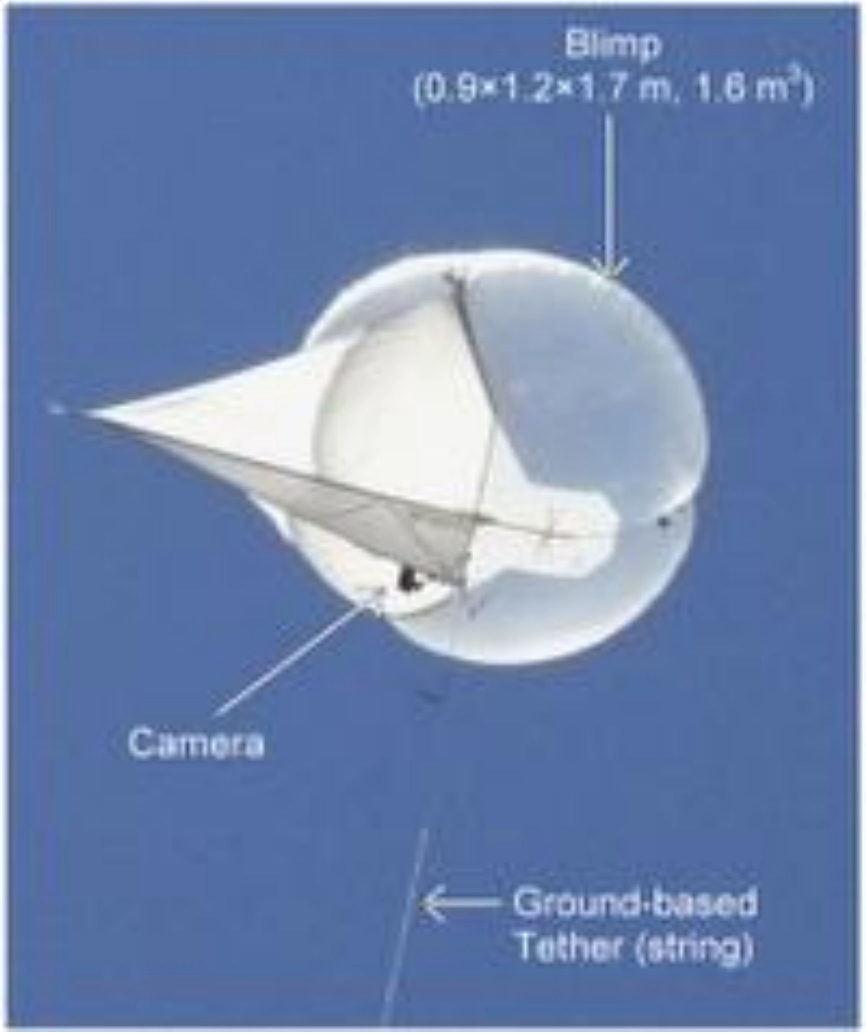
Low-Altitude Blimps (Poor Man's Aerial Photography)

A picture is worth a thousand words. Aerial photography is invaluable for providing context for any measurements taken at a site (e.g. topography, sample locations, etc). It can also be a primary source of data from which numerous classifications or digitized linework (e.g. waters edge, habitat units, vegetation outlines) can be derived. Although free aerial imagery is available from a variety of sources for many localities, it is often low resolution (i.e. < 50 cm), out of date, and not good enough to resolve many habitat features in riparian areas. Professionally acquired imagery from fixed-wing aircraft is an alternative to get you down to the 10 cm to 25 cm resolution range, but typically has a minimum price-tag of $7000 - $10,000 for a flight. The ET AL Lab has been using low-altitude blimps to acquire high resolution (typically 3 to 10 cm) imagery of short river reaches (typically 200 m to 2 km). This page explains the basics for those wanting to know how it works or for the more adventurous wishing to give it a try themselves. Read Vericat et al (2008) at the bottom of the page for more details.

Example of repeat imagery one month apart from Wheaton (2008) showing the impact of a large flood on a small reach of river.
It would have been difficult to commission professional flights quickly enough to capture this event. (Click on Image for Larger View)



How it Works:

The blimp is pretty simple. It uses lighter than air gas (i.e. helium) and has a kite-like design, such that when you walk with it tethered to your kite reel it tracks reasonably well. The blimp has a simple attachment for a digital camera to screw on to and face down toward the ground. We put the camera on an intervelometer (to take pictures ever X seconds) and raise the blimp to an altitude that provides the desired trade off between spatial coverage (typically between 50 m and 250 m). The images can be georeferenced provided that at least six well distributed ground control targets with known coordinates are visible in each image. The images can be mosaicked to provide a complete coverage of a study area.

What you Need:

- A **blimp**. We use a 2.0 cubic meter Allsopp Skyshot Helikite. They are made in the UK by Sandy Allsopp and work pretty well (but will set you back upwards of $3000). You could pretty easily make your own, but then there is the time involved in doing that. If you are going to fly your blimp at altitudes greater than 2000 feet above sea-level, make sure you get the 2.0 cubic meter blimp and not the 1.6 cubic meter blimp. With the camera, the 1.6 cubic meter is pretty much neutrally buoyant here in Logan, Utah. Other larger blimps are available from Allsopp and other vendors (e.g. Above and Beyond Advertising; actually cheaper), which have larger payloads. Note that helium is not cheap and larger payloads mean higher volumes (we typically can get two complete inflations out of one tall canister).

- A **kite reel** and 300 m of line. We use a Crankmaster wooden reel.

- A **light-weight digital camer**a w/ an intervelometer (we use a Ricoh CX-3; but Cannon's also have models that work; most other non-SLRs do not have intervelometers). You need an intervelometer because there is no remote control so you just set it to take pictures every 5 or 10 seconds and throw away the bad ones. Alternatively, in the past we've used the high-tech method of an eraser head and rubber-band.

- An **easily accessible field site** (i.e not to far from vehicle) that has an unobstructed flight path you can walk (i.e. no powerlines, not too many trees, etc.). Although the blimp is light, the targets can add up and the helium canister is not something you'll be lugging around in a backpack. As such, unless you can walk the blimp in to a site fully-inflated, this won't work to well for remote settings.

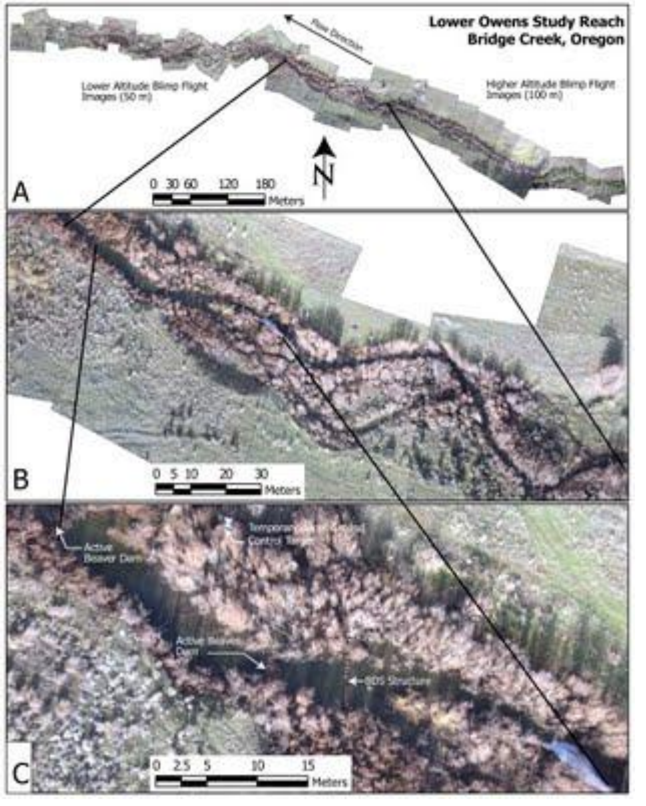
- A **2 person crew** (one to fly blimp & one to stand roughly underneath blimp as to help navigate)

- **Ground Control Targets** (between 30 and 100; depends on how much area you want to cover and how far between images). 1 m x 1 m targets seem to work best for a range of flight heights although we sometimes use 0.5 m x 0.5 m. We just paint numbers and/or letters on them so they are identifiable from the images and to the person pulling in target coordinates. If you want to go cheap and disposable, a roll of heavy duty garbage bags, some duct tape, and some turf pins works well. We use rubber targets now that are heavy enough they don't need to be pinned or weighted down to keep from blowing away (see here for whats needed to make your own). Lots of things can work so long as you can see it from the sky. The target layout plan is critical. It should be organized and logical and needs to be executed such that every image has at least five to six targets well distributed throughout the photo (more is better).

- A **survey-grade GPS or Total Station** to acquire coordinates of ground control targets (just survey the center of the target)

- **Software for georeferencing images**. We use ArcGIS w/ Georeferencing Toolbar or ERDAS Imagine for georefercing images (See Vericat et al. (2008))

An Example Product:



An example of georeferenced blimp imagery acquired in [Bridge Creek](), Oregon. (Click on Image for Larger View)

Some Rules of Thumb:

Many folks get pretty excited about the simplicity of the blimp systems and given the obvious utility of aerial photographs want to use blimps to get images for all their sites. There is an economy of scale involved, such that the blimp makes sense (if you have all the equipment and manpower) for shorter reaches and smaller surveys. However, if you're getting above 2-4 km of river, traditional professionally commissioned flights from fixed-wing aircraft or drones (e.g. AggieAir Flying Circus) are probably more economical and provide a better product. The reasons for this are because even with cheap labor, the time adds up:

- 3 to 6 hours per site (upto 1 km reach length) in the field
    - 15-20 minutes to assemble the Blimp and inflate
    - 1-3 hours to lay out 50+ ground control targets and survey in (more time if you need more targets, need multiple total station setups, or need to collect targets and repeat as you traverse)
    - 5- 10 minutes to unreel kite to reach appropriate altitude (triple if you need to check resolution of images and reel back in then back out)
    - 10-30 minutes for two passes of site with blimp (more if you want to fly at multiple altitudes and/or check your work and find you need to redo it
    - 5-10 minutes to reel kite back in (each time)
    - 30-60 minutes to collect ground control targets
    - 10-20 minutes to deflate blimp and
- 15 minutes to an hour per photo to georeference (typically 0.5 day to 1 day per site of post processing)

We call this poor man's aerial photography, because of how simple the setup is and how easy it is to deploy. Students and field technicians can be trained relatively quickly, but it is important that they experience the entire workflow from site layout to finished product to ensure good quality control. However, to be perfectly honest this isn't the cheapest thing to acquire or operate. The blimp itself is in the neighborhood of $3200, the camera is a $300, and helium ranges between $40 and $90 a canister. You also need to have access to and experience with survey grade GPS or total-station equipment and georeferencing software. If you've got all these things (and cheap labor), this method makes a lot of sense. However, there will be many applications where commissioning a professional flight makes the most sense. None-the-less another fun toy in the toolbox that works like a charm in the right circumstances.

Relevant References:

Vericat, D, Brasington, J, Wheaton, JM and Cowie, M. 2008. Accuracy Assessment of Aerial Photographs Acquired using Lighter-Than-Air Blimps: Low-Cost Tools for Monitoring Fluvial Systems. River Research and Applications. DOI: 10.1002/rra.1198.