

## HUNTING AND KILLING PLANTS FOR SCIENCE

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### Introduction

Carnivorous plants provide many possibilities for research—for examples, we can investigate issues like the details of their evolution, how they migrated across the continents, and what their futures may look like in the context of our changing climate. The primary data to fuel these speculations is a solid knowledge of the current distributions of carnivorous plants. So, it is important to discover as many of their populations as possible, and to check in on them time to time to monitor their health. This is not an easy task, as the plants are often found in obscure, difficult to reach locations.

As a scientist, my primary interest is in assessing the current distributions of carnivorous plants in the western states of the USA. I enjoy working with old, sketchy, or otherwise incomplete information, and by combining those leads with modern resources and my own expertise, I am often able to track down previously detected carnivorous plant sites, and also find new, undocumented locations.

### Preparatory Work

Carnivorous plant enthusiasts often read field trip reports by plant explorers, such as myself, and wonder how we figure out where carnivorous plants might live. Let me be clear about this—it is not easy, and it takes a tremendous amount of work—much of it is done before we even head outdoors!

I learn of possible sites from many sources. Biologist friends might tell me about something they saw during their own fieldwork. I might find site information on internet compendia of images or biological assessments. Old books, papers, and herbarium specimens may include passing references to potential sites. All these things can alert me to the possible presence of a place worthy of investigation.

Once I have a lead for a plant site, the next step involves trying to narrow down the likely locations, as much as I can. (I couldn't even begin to count the number of times I've looked for places referred to only as "Grass Lake" or "Lily pad marsh.") Mapping tools such as Google Earth are enormously helpful in examining aerial imagery. Combining those tools with topographic maps and reference works listing place names can often narrow down likely options even more. Eventually, I usually identify a cluster of sites that must be investigated.

Now for planning the trip... I carefully gather GPS points for each site I want to visit, and then study maps to try to develop several approaches, each of which gets me as close as possible to the target points. The reason I plan multiple routes is that, while one road may look great from aerial maps, it may be in fact impassable. It might enter private property and be posted against trespassing. Storms, earthquakes, or fires might have resulted in mudslides, rockslides, or washouts. Downed trees might block my passage. The list is nearly endless—once while botanizing on tribal lands in Arizona, many roads were closed to non-tribal visitors because of sacred events. Another time, a friend of mine, driving on a public road in a remote area in California notorious for *Cannabis* plan-

tations, was stopped by heavily armed, sketchy civilians who told her that the road was private, and she had better turn around. She did.

Also—and this is a step that cannot be skipped—it is critical to determine who or what agency has ownership or management of the land. I am amazed when people don't seem to understand that every square meter of the USA is owned or managed by someone. You have to contact the appropriate people involved, and be ready to deal with possibly being told that access is simply not allowed, or otherwise restricted.

Once all this is done, I can finally put gas into the car.

### Hitting the Road

The first attempt to visit a site is often just a reconnaissance trip in which I try to get as close to a site as I can. Sometimes I'll do these trips in late winter, when the site might still be under snow (if it is at high elevation), but at least I can see if the approach is possible. If I am hugely lucky, I might be able to drive right up to the site on my first visit, although this is rare. More typically, I might be able to get to within a few km of my target destination. Trails to target locations are rare, so I usually have to bushwhack the final approach.

For those unfamiliar with bushwhacking, it is vastly different from trail hiking. It can be extremely time consuming and exhausting. If your path takes you into a forest blowdown (where fallen trees lay on top of each other like matchsticks), or dense forest, or mucky swamp, every step can be an effort. In such situations a GPS alone becomes useless because it is so easy to get turned around. A compass is critical—and make sure it is not one that depends upon a battery! Sometimes the route, which seemed so trivial at home on Google Earth, turns out to be impossible. All you need is a sheer cliff only 3 meters tall, or a stream roaring with spring snow melt, or an illegal *Cannabis* plantation, to be turned back. What looked like a grassy field in aerial photographs may turn out to be flooded, muck-filled wetlands.

Add to this the fact that you are in a wildlife situation—you must keep your eyes open for any number of hazards along the way, such as surprised animals, plants with lacerating surfaces, and dangerous footing. Once, on a narrow path navigating the walls of a cliff in Montana I found my way blocked by a stubborn mountain goat—unwilling to be knocked off the cliff to my death, I had to turn back—even though I had hiked more than 12 km to reach that point! The most dangerous hazard of all is other humans that might have their own agenda that might not fall within the realms of legality.

Sometimes, sites are simply unreachable with the time and resources you might have. A few years ago, I was planning a visit to a mountain site, just to find that my desired site was in a wilderness area that would take at least a few days backpacking each way to reach—and all within active grizzly bear territory. Not my cup of tea...

### Arrival!

Reaching a destination for the first time is always exciting. If the site is small, it may not take much time at all to either locate the plants, or to determine that habitat degradation has resulted in the death of all the carnivorous plants that might have once been present. On the other hand, if the potential site is large, it might take hours (or even multiple trips) to scour the entire area to find plants. For example, I surveyed a site in Idaho—a wetland valley about 1 km × 1 km, with a complicated matrix of ponds, waterflows, and small forested patches—and it took several hours of

crisscrossing over difficult terrain before I finally found a very small microsite supporting populations of *Drosera anglica* and *Utricularia minor*.

If I detect plants, and I have appropriate permission (or permits) to collect plants, I start counting... I follow a 1-in-20 collection rule, meaning that I will only collect a specimen if there are at least 20 plants present. Usually, this is not a limitation, as carnivorous plants typically grow in large numbers, but on occasion this is an important consideration. Sometimes I will collect more plants than I need for my own herbarium, if I intend to give specimens to another institution. I do this especially if I want to thank an organization or agency that gave me permission to work at the site, or that provided information that was useful to me in locating the site.

When I collect plants, I make sure the specimens are typical of the population—I do not collect the largest plant, or the smallest, or clumpiest, or whatever. I select typical specimens—if possible with flowers, etc. I carefully wash soil from the roots or stems and place the specimen carefully in the carrying container I have with me. I also record appropriate data such as GPS coordinates, and photograph any other plants that might have caught my interest. Those who are familiar with my presence on social media know that sometimes I will capture some video for later posting on line. I hope that the video I produce may contribute to the public understanding of how our wild lands are valuable in a natural state and are not just resources to be exploited and destroyed.

### Pressing and Preparing the Specimens

A critical tool for field botanists is a field press (Fig. 1). Usually, I keep my press in the car—it is too massive and bulky to take on the trail. Furthermore, it is usually filled with specimens from earlier in the season that I do not want to damage.

Back at the car, I place my specimens in the press. Collections are arranged between sheets of newspaper, which are then sandwiched between sheets of blotter paper—and as appropriate—sheets of cardboard. Each specimen is also accompanied by a slip of paper recording data such as species name, collection date, location, etc. The press is closed, then squeezed tightly and the specimen is allowed to dry. In my arid conditions, this is not difficult, but when I am botanizing in humid environments mold can be a problem if you aren't careful. Particularly wet collections, such as *Utricularia*, should be towel dried before being placed in the press. I have discovered that collections of sticky or mucilaginous plants like *Drosera* and *Utricularia* should be accessed after a day and moved to fresh newspaper—otherwise they often become permanently attached to the newspaper. Ultimately, the specimens usually stay in my press for several months.

Many months later, usually during the winter when my field season is mostly over, I pull the specimens out of the press and prepare them for preservation (Fig. 2). This re-



Figure 1: An exploded view of an herbarium press. At left, the wooden frame, straps, and cardboard dividers; bottom right, newspapers; top right, blotter paper.



Figure 2: Gluing completely dried specimens onto herbarium paper.



Figure 3: *Drosera* specimens weighed down with coins, as the mounting glue sets.

horticultural interest (for example, *Darlingtonia californica* f. *viridiflora*), I have tried to work with the appropriate authorities to introduce the plants into horticultural circles.

quires special materials. The sheets of paper that the specimens will be mounted on are acid-free, and of archival quality. The adhesive is water-soluble, archival glue. Even the labels I use to annotate the specimens are acid-free.

The specimens are arranged on the sheets in a way that displays the plant's characteristics—for example, both sides of the leaves, as appropriate. I also like to place the plants in a way that evokes the way the plants grow in the wild—if it is a *Utricularia* with horizontal green shoots and descending bladder-bearing stolons, I mount them accordingly. There is a certain beauty to properly presented specimens.

Gluing the plants is a tedious process but must be done carefully. I use coins to weigh them down as the glue dries (Fig. 3). Finally, I add a label that includes information about the collection—plant name, geographic data, collection date, collector's name and collection number, etc. (Fig. 4)

Voila!

I am occasionally asked by hobbyists why I do not collect plants for live collections. I do not because I almost never see plants that have truly notable characteristics, and most of the plants I am collecting are already well-established in collections. Furthermore, the undeniable antagonistic relationship between horticulturists and land managers—while much improved when compared to years past—still complicates the good will I require from agency staff, in order to conduct my research. The very few times I have found plants of horticultural interest



Figure 4: Finished, annotated herbarium specimens.

### Storage

I hold a researcher position at the University of California (Davis) Center for Plant Diversity, so that is where I store the bulk of my collections. Occasionally, as noted above, I will collect for other institutions as well. The Center for Plant Diversity has a fantastic herbarium, where the specimens are stored in cabinets in refrigerated conditions (Fig. 5). When I submit specimens to the herbarium, they are first frozen for several days to kill any insects that might spend the decades feasting upon invaluable herbarium specimens. Once in the herbarium, the specimens are kept in clean rooms, and if they are ever loaned out to other institutions, they are refrozen before being stored back in the collection.

It is always humbling to look at my specimens in herbaria. The plants I have collected will far outlive me—they are the scientific legacy I will leave behind. Indeed, I have used herbarium speci-



Figure 5: Herbarium cabinets on wheels (left). These can be moved back and forth to access the collections they contain (right).

mens many decades old, and in the same way I hope that my research can aid those who follow. I know that many of the sites I visit will not support carnivorous plants in the future, but at least this way future researchers will have irrefutable evidence that plants were there, in the past. My specimens are time travelers.

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