Mapping Points, Lines, or Polygons: Which data representation works best for my project?
California Invasive Plant Council Symposium
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Leader: Jason Casanova
Panelists: John Knapp, Ingrid Hogle, Steve Schoenig, and Jason Giessow
Note taker: Lynn Sweet

This year's mapping workgroup session will examine the ever-present question, "What data representation(s) should one use when collecting data for an invasive plant monitoring/management program?" Inquiries that frequently arise in mapping include: What data representation works best in my situation? What are the pros and cons of each representation? In what situations should I use multiple representations? Are there guidelines or resources available to assist me in choosing a method? After I select a representation to implement, what BMPs (Best Mapping Practices) or data collection techniques apply to that particular representation?

A panel of experts will present a brief synopsis of their monitoring program, representations they use frequently, and BMPs they utilize to collect those representations. A majority of the meeting will be an open discussion where participants will be able to share their own experiences (pros and cons) with data representations. Those participants that are new to mapping will have the opportunity to ask questions relative to their own situations and use the group Q&A session as a "help desk" to jump start their own mapping efforts.

Jason Casanova gave an introduction to mapping. Most attendees seemed to need pointers on a current mapping project, rather than input on planning a new one. Panelists gave an overview of mapping projects they work on and the thought process behind selecting an appropriate data representation.

Giessow: Polygons work best for his projects because he deals with a limited amount of species and many of them are large form (easily identifiable from aerial photographs). He maps stands by digitizing directly on a tablet PC. This method works well for generating control cost estimates for grants. Working top-down you can look at the overall cost for a watershed and scheduling of work. One example where polygons did not work for him was Artichoke thistle. Polygon data was collected initially. After control, he chose to collect point data rather than mapping polygons with excessively small cover classes (e.g. 0.01%). Nowadays he also takes points when tracking Arundo retreatments.

Hogle: In the Spartina mapping project, they use points, lines and polygons depending on what is most efficient. Lines are useful when the infestation is walkable and linear. The line is walked and recorded, and width beyond the line is estimated and attached to the data along with a cover class. One problem is that it can be hard to update older data with new information. You can update the whole feature as "treated" or "untreated." If you go back to an older spot but the feature doesn't match the ground, it can be hard to decide whether to expand the existing feature to cover it, make a new feature, etc. You can get into splitting hairs.

They use ArcPad and now have a method of either copying and pasting a feature or changing it to a line, etc. The decision about what to do depends on the scale of mapping and the overall goal. A new system they also use is grid-based. They estimate cover % within cells of a grid. Although this is not their preferred method, it works for non-straightforward distributions of plants.

Knapp: They map multiple species. On Catalina, they mapped 72 species. This involved hiking, 600 miles of transects in about a year. They used points and lines for infestations along roads and drains (with width and density). Following this, they used a helicopter to survey 55 weeds on Santa Cruz, all from the air, due to the difficult terrain. They used lines and points to get baseline data, and collected area and density for later treatment. A variety of methods works best for treatment and/or monitoring for the future. They reduced damage and disturbance using the helicopter and improve visual accuracy.

General Considerations and Hints

Giessow: Large plants in the field can be seen on aerial photographs, and on the former Microsoft GoLive site. You can get 2' oblique data from all cardinal directions. Polygons on the ground may be 15% off but it is a start for seeing distribution landscape-scale. They also have a Brassica project along roads. The goal was a Rapid Watershed Inventory for a WMA.

Hogle: Cover class is important. They have a system for taking both cover class and "treatment cover" class. This is due to the non-equivalence between how much ground is covered by a plant (%) and how much area needs to be sprayed. For example, an area on the ground with 5 feet diameter may have only 20% of the ground physically covered by a weed, but since the cover extends evenly over the whole 5-foot circle, that is 100% treatment class. To find the treatment area, multiply the gross area (e.g. 5 feet) by the treatment cover class (100%) to get area. This is essential for knowing how much herbicide to return with, for example. Information about information is important.

What scale is your project? Consider breaking up the area into squares, record what is present there, and then map obvious problem areas as points also within that grid. That way you have your bases covered. Where you have mapped and where you did not cover is also important- or else no one will know if the weed was absent there or just not mapped.

Schoenig: The California Weed Mapping Handbook is a resource for mappers: http://cain.ice.ucdavis.edu/weedhandbook . (The California Weed Mapping Handbook is the product of collaboration between CDFA, CDFG, CalEPPC, USFS, and CAIN). Consider in your project which weeds you would like to include. 700 weeds is a lot, so consider doing a few, as in Cal-IPC-listed plants, or things you would like to eradicate. Also, how extensive is your infestation?

Documentation and Absence Data

Knapp: Also important for mappers is a breadcrumb trail (the GPS can record where you went in addition to the plant location points you record). This gives a better record of thoroughness. Also you can accurately say what land was covered for a report or grant. It also helps to make sure the workers don't overlap.

Hogle: The boundary of the inventoried area as well as absence data within that area is not trivial. Though it can be time-consuming; it is important. Have your data-gatherers draw where they went that day on a map or aerial photo. Have them record what they saw and didn't see. If you're mapping using binoculars, you need to use another method since breadcrumbs track where you actually went. This is where you can use a software or printed "Tracking Grid" to check off areas that are done. Check them off as "done" or "not done" at the end of the day.

Q & A Group Session

Question: In Yosemite, they have problems with getting enough satellites visible to have good precision. They would like polygons to derive area of infestation. How do you decide between a polygon and a point, when the desired resolution is to map a 10m-patch.

- **Hogle:** In training workers, it's helpful for them to picture their car, and use this as a known gauge of size and distance.
- **Knapp:** People can estimate better looking downward than upward.
- **Giessow:** It can be a problem of reference, like, for instance, the moon on a horizon looks bigger than it does high in the sky. This is not a problem of atmospheric distortion; it's literally a problem with perspective and reference that makes it appear bigger when it is not.
- **Suggestion:** Take a large number of points in a reference spot and have the GPS average them to give one accurate point with which to gauge accuracy of data as a whole on that survey.
- **Hogle:** What if your estimates are off? Do a power analysis to see how much error is tolerable for your project. Put simply, if you're looking for a significant 5% reduction, 5% error is too much. If you're looking for a 70% reduction, that error may be OK. You can also just flag the perimeter of the patch physically to see changes.
- **Schoenig:** Ask yourself if you need this level of accuracy. What accuracy do you need to reach your goals? You could instead pick certain patches as monitoring patches and measure them with higher accuracy, as representative of the whole project. Then just map the others. Basically do a subset of areas well and use those to gauge progress. But the question remains- do you need this level of precision?
- **Knapp:** Sometimes you have to track eradication success, and then after that, surveillance mode may be less effort-intense.

- **Giessow:** Sometimes higher resolution is used to map, for example, endangered plants, like orchids. In this case you might GPS *each* orchid. If it's bigger, you

could use a grid or just a polygon. Sometimes you can spend as much effort in mapping as you would to kill the weeds.

Question: If I'm mapping invasive grass in redwoods in a program to reimburse homeowners for control of slender false brome, their reimbursement is based on acreage. What mapping methods would work best to help me track treatment in this case?

- **Hogle:** You can use "Treatment Percent" in this case. What % of what area do you have to physically apply herbicide to?
- **Giessow**: You could also track treatment area using the capacity of the backpack sprayer and the rate. However, in this case, retreatments of the same area might show less "treatment area" because less herbicide might be used on a large area of scattered resprouts. In general, this might work given accuracy of ID and little overspray.
- **Schoenig:** In our CDFA program, we've eradicated 5,000 populations of 1-1000 acres. We calculated our net acreage controlled based on usage. If eradication is the goal, sometimes you can break up a large unit into smaller parts.
- **Giessow:** It also helps to know how much chemical you've applied over how much land (especially important when using imazipyr). Eradication can take a long time. When contractors are bidding on a project, they need to know the size of the trees (i.e. diameter and breast height, area, size and age class).
- **Hogle:** Acreage should be explicitly defined. Net acres or patches?
- **Giessow:** Some numbers aren't accurate, so it's important to record percent cover and overall area of a stand. Remember that vegetation mapping is not the same protocol as invasive species mapping
- **Knapp:** On Santa Cruz we used 100ft between populations to delineate separate populations. This was just based on utility. This is how we differentiated patches. "Patch differentiation" is the threshold distance at which you consider two patches to be unique. This number can vary by project, goal, species, etc., but needs to be explicitly defined.

Audience Comment: Another issue is turnover in projects. Sometimes you inherit data, so metadata, and other relevant information is important to document.

Knapp: On projects sometimes you change your protocol in stages. For instance, you take point data to map the overall distribution of the populations to guide staff. Then when you go back to actually treat, you do a thorough survey and take down more detailed information.

Hogle: Points are simpler to maintain than polygons. You can use a tablet to re-digitize in the field with good imagery. Sometimes you can redraw the polygons on aerials. Another issue is that tablets may be heavy and dim in the field.

Attendees

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