The Study of Vegetation Inventory Methods for NatureMapping®: a Citizen Science Based Program

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In this research project, vegetation inventory methods were studied to determine a suitable protocol for use in NatureMapping®: a citizen science based program. NatureMapping® was developed at the University of Washington and is a training program for average citizens to identify, locate and inventory vegetation. NatureMapping® allows ecologists and other scientists to locate appropriate sites for further research. Fauna is the principle aspect which is being inventoried whereas this work aims at adding a flora component. Currently, only Iowa's NatureMapping® program employs a vegetative protocol, but only as an invasive plant species inventory. The amount of inventory methods existing is extensive and many can be complex, especially for citizens of various educational backgrounds. Thus, inventory methods were narrowed down to three choices: line transects, circle and point quadrants. These methods were tested in four areas (lowland savanna; woodland transition area; highland woodland; and dense shrubland) at Beaver Creek Reserve in Fall Creek, Wisconsin. Six study sites were delineated: two in the lowland savanna as well as the woodland transition area and one study site in each of the highland woodland and dense shrubland habitats. Within these study areas, the three vegetation inventory methods were conducted.

Purpose of Study

States currently NatureMapping® are inventorying primarily mammals, amphibians, birds, fish, reptiles and mollusks. Some NatureMapping® programs are getting closer to including vegetation inventories such as invasive species counts through Iowa State University Extension that works with Iowa's NatureMapping® program. However, this is limited to inventorying invasive species such as garlic mustard (*Alliaria petiolata*), bush honeysuckle (*Rhamnus cathartica*), tartarian buckthorn (*Lonicera tartarica*) and multiflora rose (*Rosa multiflora*) (Iowa State 2002). No other NatureMapping® program is inventorying vegetation. In fact setting a standard for inventorying vegetation is a long standing question, "The need for quantitative records has made it necessary to give serious consideration to the methods of sampling." (Kent and Coker 1992). Even such organizations as the United States Geological Survey are conducting studies to set a standard methodology for vegetation analysis (USGS 2000). The purpose of this study is to identify a vegetation inventory method suitable for NatureMapping®. The requirements for choosing an appropriate vegetation inventory method for NatureMapping® needs to be uncomplicated for participants, but at the same time yield accurate scientific data for future researchers and natural resource management agencies. To be uncomplicated the set-up time and material required should be minimal. Scientific data must be conducted in such a manner that is consistent with each NatureMapper.

The underlying purpose of this study is to increase awareness of the importance of vegetation. Vegetation is a significant component within the environment by being a primary producer, source of habitat and as a physical representation of an ecosystem (Kent and Coker 1992). With these three roles in mind they, "show the central importance of vegetation to ecology and demonstrate the need for methods to assist with description and analysis" (Kent and Coker 1992). The inventory method that will be utilized needs to have a simplified component, a great deal of the methods that exist were ruled out such as grids, plotless sampling (Kent and Coker 1992) and nested quadrats (Oosting 1948). Many of these methods are more complicated, rigorous and time consuming.

History of NatureMapping®

NatureMapping® started at the University of Washington in response to the Washington Gap Analysis Project (WAGAP). The Gap Analysis Project is the scientific means of identifying to what extent species and their habitats are or are not being protected by environmental policies and laws. The goal of GAP is to identify species and their habitats that are underrepresented in the conservation sector in an attempt to protect biodiversity. The Gap Analysis Project believes that not only do endangered species need to have protection and be monitored but that common species need that attention as well (National Gap Analysis Program). One problem with this is land ownership of gap lands is varied. The gaps could be private land, parks, Native American Indian reservations, etc. It is the goal of gap analysis to fill in these gaps by having the owners of these properties inventory the biota on their land.

The Washington Gap Analysis Project (WAGAP) organized groups to begin inventorying biota in the areas lacking data collection. These groups included local, state and federal natural resource agencies, conservation groups, corporate landowners and Indian nations. In time the WAGAP noticed that the project of inventorying local habitat gaps was more extensive and expensive than anticipated. In response, Washington state sought out another route to inventory the flora and fauna. In 1990, during the same time Washington was looking for a solution, Washington state mandated environmental education for grades K-12. In 1993, Washington Gap Analysis and Washington Cooperative Fish and Wildlife Research unit piloted a project that involved teachers in collecting local biotic data for a statewide biological database. The purpose of this database is for researchers and natural resource managers to locate areas in need of protection, conservation and/or more in-depth research.

Within 18 months, 320 teachers were participating in adding to a database that researchers could use. The combined effort of the Washington Gap Analysis Project, the Washington Cooperative Fish and Wildlife Department and Washington's environmental education reform created a statewide program to inventory state habitat information. When other states discovered Washington's new environmental educational project they wanted to know how Washington began their inventory program. This interest began a program called the Student and Volunteer Education program (S.A.V.E.), but in 1995 the West Coast Office of Defenders of Wildlife became a participant and renamed S.A.V.E to NatureMapping® (Dvornich 2000, 61).

Process of NatureMapping®

All ages and educational backgrounds can participate in NatureMapping®. Each registered NatureMapper receives training before being allowed to add to the states database. This training allows NatureMappers to receive consistent information on the procedures of the Program. Training consists of learning to read topographic maps; how to use internet sources, record data and identification guides. Training varies for each state because different NatureMapping® criteria exist for every state. For example, some states use Universal Transverse Mercator map coordinates, hectares or interactive web-based point and click map systems. Each person can determine where they will NatureMap such as backyards, parks, nature trails or while driving along a highway. The time and duration spent NatureMapping® can vary depending on personal preference. The site can be revisited every day or just once a year. The observation duration could be as brief as reporting a road kill.

NatureMapping® benefits include: improving relationship between natural resource regulatory agencies and the public, providing an inexpensive way for agencies to inventory flora and fauna, identifying areas that need further research, creating opportunities for teachers to incorporate environmental education into curriculum and connecting citizens to their environment.

Study Site

The study area is Beaver Creek Reserve in Fall Creek, Wisconsin (Figure 1). This study area is ideal because it contains diverse habitats and accessible walking trails. Beaver Creek Reserve is a 360 acre environmental education center open to the public. With this in mind study sites were located approximately 5 meters (m) from the walking trails to avoid human disturbance.

Four habitat areas (lowland savanna; woodland transition; highland woodland; and dense shrubland) were selected based on differing ecologies to test if certain inventory methods worked more effectively in differing habitats.
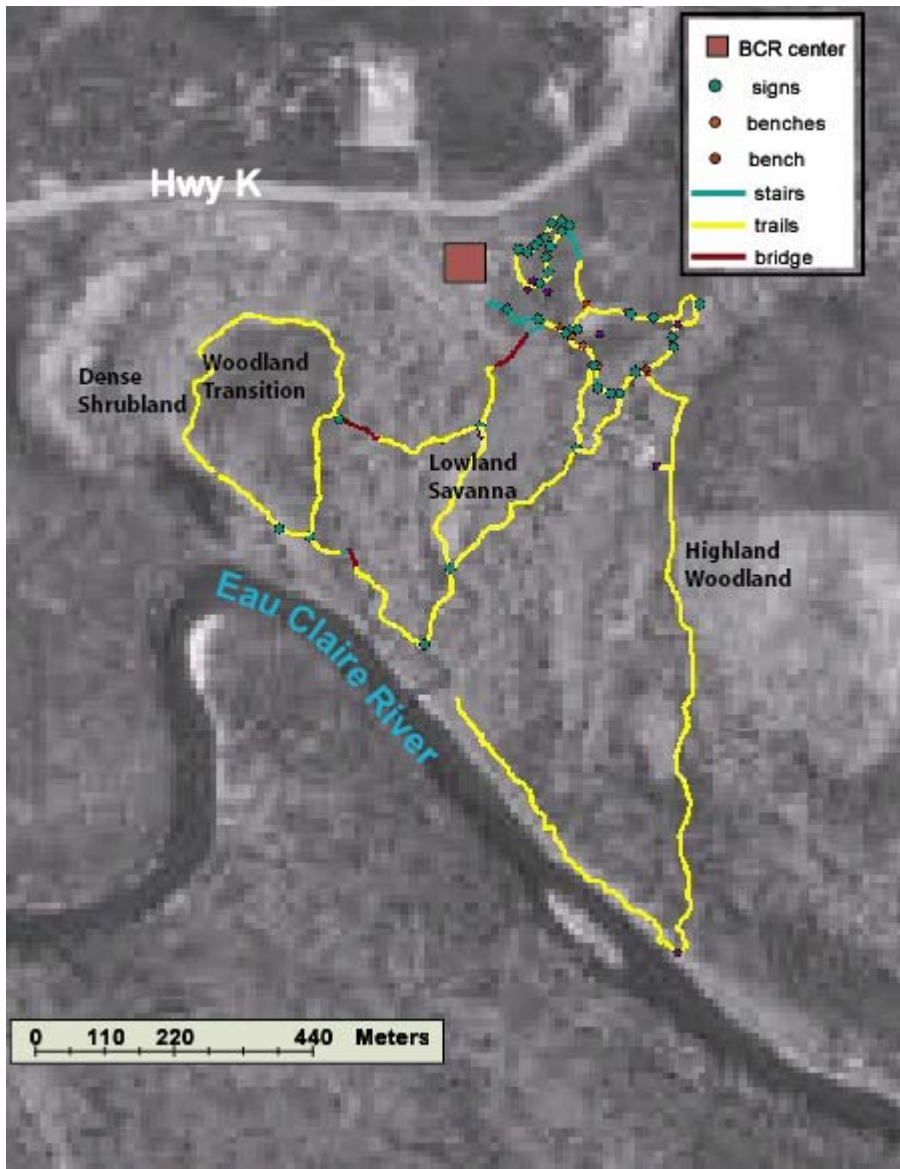
Figure 1. Aerial photo of Beaver Creek Reserve. Trails were mapped using a Trimble Pro XR.

The woodland transition site (Figure 2) was named as such based on the fact that the 100 m^2 circle encompassed an herbaceous area as well as the edge of a wooded area.

Figure 2. Woodland Transition

Figure 3. Lowland Savanna

The lowland savanna area (Figue 3) was named as such because it was located on the lower portion of Beaver Creek Reserve. Figure 6 illustrates the topography of the Reserve. The 100 m^2 circle contained herbaceous plants and small shrubs only. A forest is located around this area but within the 100 m^2 circle the forested area was intentionally omitted.

Figure 4. Highland Woodland

The Highland Woodland habitat (Figure 4) was located on higher portion of Beaver Creek Reserve. This area is dominated by Pine and Oak trees as well as shrubs.

The dense shrubland habitat (Figure 5) was located on the lower portion of the Reserve and contains herbaceous plants scattered throughout an area of thick shrubs.
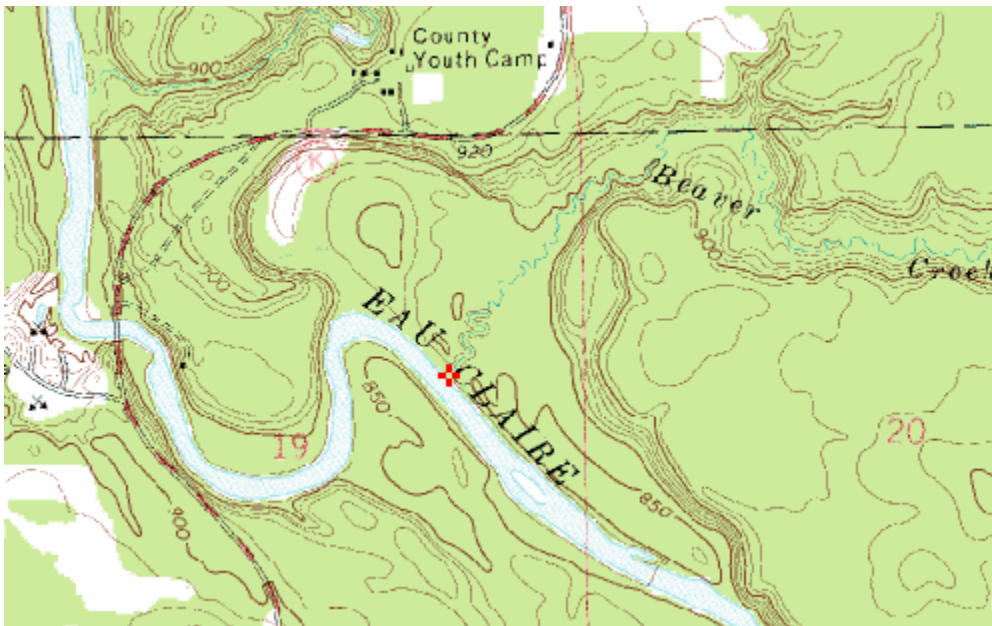
Figure 5. Dense Shrubland

Figure 6. Topographic map of Beaver Creek Reserve (Topozone.com).

Citizen Scientist Participation

Within this study two citizens participated in testing the three inventory methods in the lowland savanna habitat. They had no prior experience or knowledge of vegetation identification or inventory methods. They were given instructions on how to carry out the vegetation inventory methods and to identify plant species. Since the volunteers lacked

knowledge of plant names they were instructed to give their own descriptive name of the plant. In doing this they were able to obtain a count of vegetation diversity. At the same time, I inventoried vegetation within their plots in order to compare data. The bar graphs (Figure 5-8) contain the data of the participants with the comparable data to the immediate left labeled Lowland Savanna.

Methods

Circle quadrates, line transects and point quadrates were the three vegetation inventory methods used to inventory vegetation at Beaver Creek Reserve. The three inventory methods were applied at each study site. The circle quadrate was set up first then the line transect and point quadrates were set up within the circle quadrate. This insured that the three inventory methods were conducted on the same vegetation plot.

Circle quadrates had a 10 m radius and an area of 314 m^2. All plant species within the circle were counted once. For example, if plant A was seen three times within the circle then it was counted once. The benefit of this method is that the circles size encompasses larger vegetation such as trees and shrubs. For this method the volunteers stated that the circle quadrate was overwhelming because there was an excessive amount of area and they had difficulty deciding where to begin.

The line transect method had a 10 m. long transect and at every two meters a flag was placed which became a point (6 points total). For each point a circle was indicated around the point with a radius of half a meter and an area of 4.71 m^2. Vegetation species were counted once at each point. For example, if plant A was located in the first and second circles, both were recorded. This method is useful for seeing any vegetation patterns that exist in the environment. By looking at the data one could see the abundance of a species. For example if plant A is recorded for each point than one could see that plant A has a high abundance. If plant B is only recorded once than there is a low abundance along that line. The large circle quadrate doesn't allow for this data, unless the observer records a percent of the species in the circle. However, percentage estimates are highly subjective as everyone has a different view of what percentage of a plant exists within a given area.

Point quadrates are very similar to the points on the line transect. They are 2 m apart, 6 total and have a radius of 0.5 and an area of 4.71 m^2. The only difference is that they aren't placed on a line but rather placed every 2 m. If plant A is found in the first and second circle they are both recorded. The benefit to this method is that randomness becomes a factor in statistical calculations. The problem with randomness is that clustering can result, so an accurate picture of the diversity is not as visible.

Results

To identify a suitable vegetation inventory method for NatureMapping® graphs were constructed illustrating the number of plants and number of species inventoried in each habitat using the three vegetation inventory methods.

Figure 7 and 8 illustrate the number of plants counted and species at each site using the three inventory methods. The line transect and point quadrate methods yielded the highest number of total plants. The 100 m^2 circle obtained the highest number of
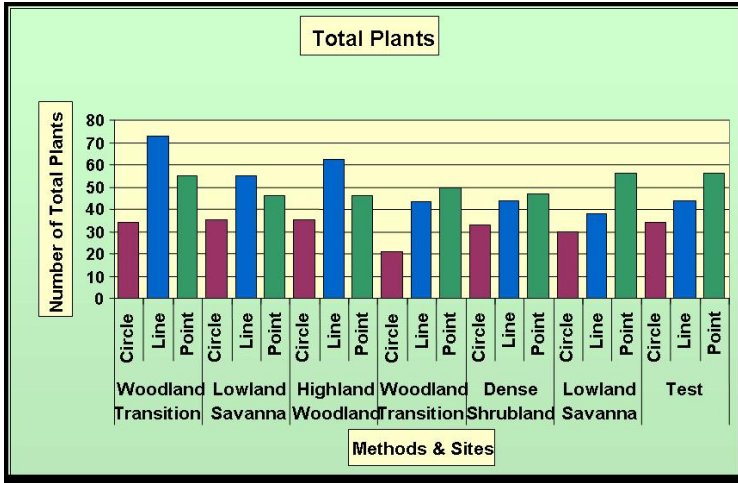
species most likely due to the fact of greater area.

Figure 1. Bar graph of total plants inventoried using the three vegetation inventory method in each habitat.
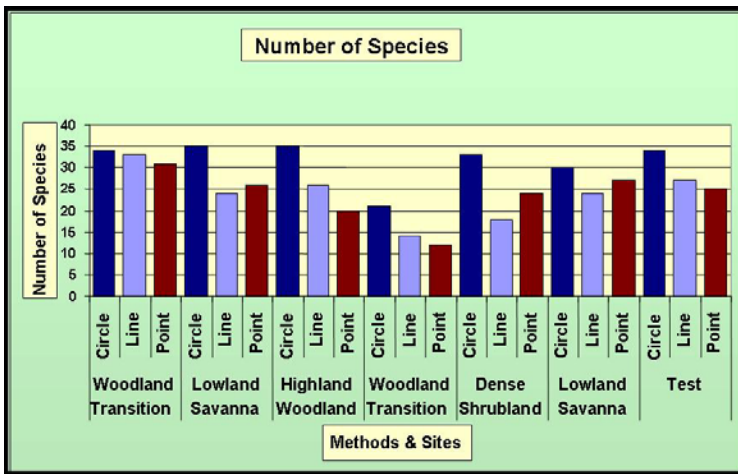

Figure 2. Bar graph of number of species inventoried using the three vegetation inventory method in each habitat.

Figure 9 and 10 demonstrate the number of total plants and species per square meter that were collected using the three inventory methods at each study site. The method that worked best for obtaining total plants and species per square meter was the line transect and point quadrant method. These methods have less area however one plant species could be counted numerous times along the transect due to the 6 circle quadrates.
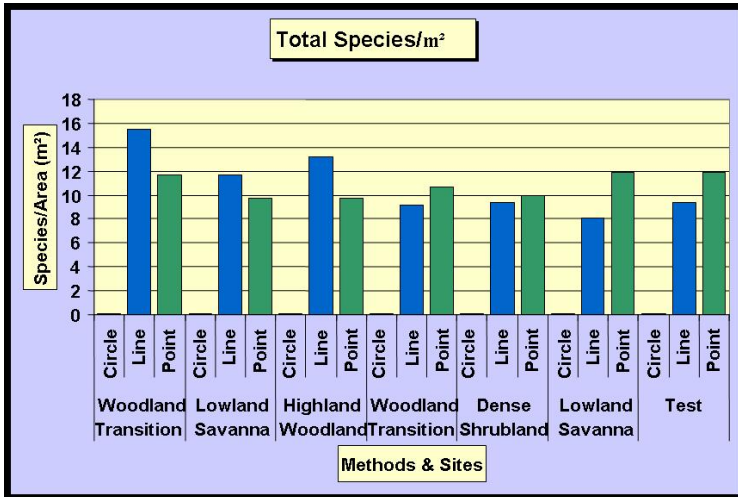
Figure 3. Bar graph of total plants inventoried divided by area using the three vegetation inventory methods in each habitat.
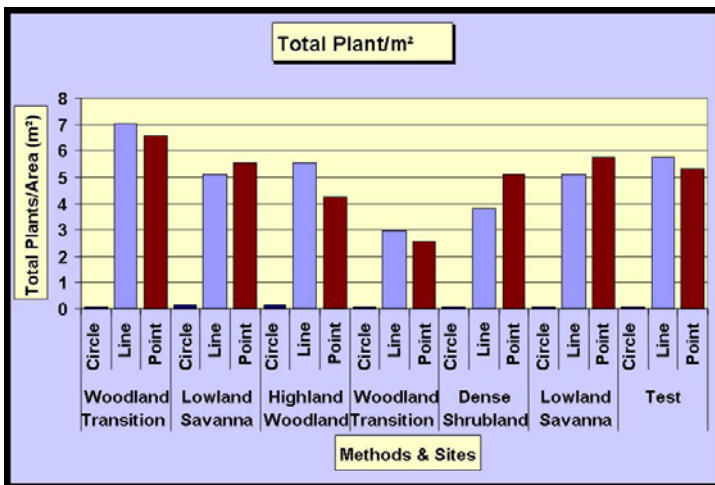

Figure 4. Bar graph of number of species inventoried divided by area using the three vegetation inventory methods in the each habitat.

Conclusion

The research suggests that the line transect method is the most appropriate vegetation inventory method to be utilized in a lowland savanna, woodland transition, highland woodland and dense shrubland. The line transect method is proposed due to the fact that transitions in habitat can be examined within the data. Circle quadrates are overwhelming for citizens with little vegetation identification experience. Random point quadrates create clustered data. The line transect requires minimal materials consisting of one 10 m long string or tape measure and 6 flags.

Future studies in determining a vegetation identification method could examine different factors such as size of the line transect and testing other methods in varying habitats. Additional research could involve testing the line transects by increasing the length and size of the circles along the line. Further research could involve a citizen scientist study in which the citizens test the various inventory methods in determining usability. More habitats could be examined such as tropical rainforest, desert and grassland to determine if various habitats need different vegetation inventory protocols.

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