

**GRANT REPORT**  
**2005 IPFW SUMMER GRANT FOR INSTRUCTIONAL DEVELOPMENT**

**Development of IPFW Biology Department 'Multi-Use' Plant Ecology Laboratory Exercises**

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***Overview:***

Last Summer, I received an Instructional Development grant to develop curricular materials for use in plant ecology instruction at IPFW. The impetus for the proposal was related to the interest of the biology department in expanding the number and diversity of plant biology courses for our majors. As a new faculty in the department, and one of only two with formal plant science training, I was expected to contribute at least one upper level plant biology course to the curriculum. Traditionally, plant physiology has filled this niche; however, in recent years the course has attracted limited enrollment and the rationale for the course was weakened when the biology core curriculum was re-designed to include a strong plant physiology component.

Instead of resurrecting the plant physiology course, I made a strategic decision to offer field botany (Biology 595), starting in the Fall of 2005, under the expectation that the course would draw enrollment both from biology graduate students involved in conservation-related research and from junior or senior-level undergraduates interested in a field lab experience. However, in the context of discussions with the department chair I realized that there were several additional niches for plant ecology in the biology curriculum, particularly at the non-major level. A course on the natural history of Indiana had been under consideration within the department for several years, and is scheduled to be taught starting in the Fall of 2006. In addition, the possibility existed for developing a non-majors field botany course, with an ethnobotany or economic botany emphases.

The premise behind the grant was that much of the legwork involved in the development of plant ecology-based labs is similar regardless of the specific course focus or target audience (major or non-major, lower or upper level). In particular, the processes of field site selection and characterization were identified as time consuming and potentially limiting steps common to the development of many plant ecology-based labs. The grant also posited that lab exercises relating

to fundamental plant ecology themes; such as plant succession, vegetation sampling and analysis, plant identification, plant collection and sample preservation, etc., could be more or less directly shared between courses, or at least with limited enough modification, that it would of benefit to the department to have a “bank” of common-use plant ecology lab exercises. The grant proposed to deliver products on both ‘fronts’, with the first three to four weeks of the grant period being used for field site evaluation and the remaining two to three weeks being used for the preparation of lab exercises. The grant was expected to take six weeks of full-time work and to be completed by the end of the Summer.

In retrospect, the grant was overly ambitious and also a bit naive. My lack of formal training in plant ecology and related disciplines (soil science, plant taxonomy, geology, etc.) contributed to the problem in that I significantly underestimated that amount of time required for the thorough and meaningful evaluation of field sites. The preparation of floristic inventories, and databases of plant images, was particularly time-consuming and remains an ongoing effort. Prompt completion of the grant was also complicated by my concurrent work on field botany course development. I had trouble separating the grant work from my course work and did not feel a strong impetus to complete the grant on schedule since the projects were complimentary. In addition, research obligations prevented me from focusing exclusively on the grant for most of the first half of the Summer.

In addition, as my work on the grant continued into the Fall, I began to question my assumptions about the degree to which pre-formulated lab exercises would be used by other faculty in the department. Had I overestimated how much content that was conserved between plant ecology courses as a group? Also, were there practical or ethical issues related to the transferability of the exercises that I had not fully considered at the point of grant submission? A particular concern was that differences between faculty in training, teaching philosophy, or pedagogy would limit curricular sharing of the type envisioned. If my own personal experience is a useful guide, I have generally appreciated the opportunity to talk with other instructors about their courses, but have not been willing to directly adopt their teaching materials (lab exercises, Power points, etc) for use in my courses.

Ultimately, I decided that a better grant product in terms its level of utility to other instructors in the department, would be a series information packets, termed ‘plant community profiles’, for field sites of high teaching value on the IPFW campus. The profiles would include site maps and location data, overviews of the types and quality of plant communities present, and suggested teaching uses; floristic inventories and accompanying photodatabases of plant images,

compilations of landscape data (topographic maps, soil surveys, etc.), and land use records (if available). The decision to limit the scope of the project to the campus was considered essential to maximize the utility of the grant products to other IPFW faculty.

Although the campus, obviously, does not contain examples of all major plant community types for the state, it contains a rich variety of wetlands, associated with the St. Joseph River. The campus also boasts a diverse collection of woodlots, ranging from less than one acre to nearly 20 acres in size, that collectively harbor a large percentage of the native tree and shrub flora of the state. Other plant ecology resources include a mitigated wetland, 'erosion control' plantings, and 'old field' successional environments; all of which are of significant teaching value. In addition, the ease of access and of the securing permission for sampling or experimentation was considered sufficient to offset for the lack community diversity compared with that that could have been achieved by surveying field sites over a broader region.

Aside from their use by biology faculty, the plant community profiles are expected to be useful for geology or environmental conservation instruction, especially for courses with a focus on wetland conservation or delineation. Since plants are a primary source of food and habitat for animals, and are easy to survey as a consequence of their sessile nature, they have traditionally played a primary role in ecological classification and habitat restoration efforts. For example, in the context of wetland conservation efforts, floristic data is used not only for wetland delineation and classification, and also for the assessment of wetland 'quality' and for the certification of mitigated (constructed) wetlands. Mechanically, the use of floristic data for the classification and evaluation of ecological communities is simple, but requires basic plant identification skills. However, with nearly 3,000 plant species in the state, plant identification is frequently a daunting challenge even for trained plant taxonomists. With this in mind the inclusion of full floristic inventories and corresponding photodatabases was considered a key component of the field site evaluation process. In addition, photodatabases were also expected to be useful for the preparation of student study guides in field botany.

Over the long run, the plant community profiles may also be useful even beyond the IPFW community. In this context, potential 'consumers' include ecology/field biology faculty at other colleges or universities in the region lacking direct access to an equivalent set of plant communities, with the Similarly, AP biology instructors at Fort Wayne area high schools may be interested in using the plant communities for demonstrations or field trips. The potential also exists for collaborations with the IPFW grounds department, which has a long-standing interest

in the documentation and maintenance of campus natural areas, combined with their use as vehicles for community outreach.

### ***Execution and Methodology:***

Early in the Summer I met with Janet Kelly, Director of Special Projects for the Grounds Department, to tour campus natural areas on the west side of the St. Joseph River. I was already familiar most of the major plant communities on the “main” IPFW campus, having arranged a similar meeting with Janet in the Fall of 2003, in the context of preparing a demonstration-based plant ecology lab for Introductory Plant Biology (Biology 108). In both cases, Janet provided me with basic information on the history of each natural area, initial floristic data (if available), and on future development plans, if any, for each area. Shortly after this meeting, I selected six communities for further evaluation; two lagoons off the St. Joseph River, a remnant ‘oxbow’ wetland, a mitigated (constructed) wetland, the largest woodlot on campus (Sugar Woods), and an “old field” environment, with community profiles being prepared for each of the six.

I immediately began to survey the sites and to prepare plant lists. However, at this point in the project I knew few plants by sight and several of the plant identification guidebooks that I had ordered for use in field botany had not yet arrived, so I resorted to taking digital photographs of the plants in lieu of direct identification. I had purchased a digital camera in the Spring and considered photography preferable to the preparation of herbarium specimens since it was non-destructive and less cumbersome with a camera was easier to carry into the field than a plant press. In addition, this approach offered an additional efficiency since the photographs could ultimately be incorporated into the community profiles

Even after, the plant identification guidebooks arrived, the process of preparing plant inventories remained challenging and representing the single most time-consuming aspect of the grant. Conclusive plant identification typically requires the use of multiple taxonomic keys, with specific traits being evaluated varying between keys, followed by verification with reference to full taxonomic descriptions and comparison against botanical image databases (photographs and line drawings). For difficult plant taxa, hours, or even days, may be required to identify a single specimen. In addition, for some of the largest families and genera of plants in the state; i.e., grasses, sedges, and asters, conclusive identification involves the evaluation of sets of traits that are largely novel to the taxa in question, and also frequently requires the learning of a specialist vocabulary.

With a basic knowledge of the defining characteristics of the major plant families in the state the identification process becomes somewhat abbreviated and more efficient, but even so, conclusive identification frequently requires the evaluation of floral or fruit structures. However, since most plants flower only at very specific times during the growing season, the preparation of complete floristic inventories requires that field sites are visited at regular intervals, typically every two to three weeks over the course of the entire growing season (May-November). In addition, even for plants that can be identified with a high degree of certainty in a vegetative (sterile) condition, the evaluation of flowering and/or fruiting specimens is required for the preparation of herbarium specimens, and for photographic documentation of the reproductive structures for teaching purposes.

I returned to the campus plant communities at multiple times during the Summer to identify new flowering specimens. However, since I did not start the floristic surveys until June, most of the plants that had flowered in the Spring were available only in a sterile condition or were completely absent from the aboveground plant communities, as is typical for 'spring ephemeral' herbs, that confine their entire period of shoot growth to the Spring and early Summer, with the plants persisting as tubers, rhizomes, or other subterranean structures for the remainder of the growing season. In addition, the number of times I was able to visit to each field site was limited since I was simultaneously evaluating off campus field sites, representing a wider range of plant community types, for possible use in the field botany labs.

However, on a positive note, I was able to continue to evaluate the campus sites into the Fall when visits to most of the off campus sites were no longer feasible. For many of the most important plant families in the state (aster, mine, figwort, grass, etc.), fall flowering is common and continued plant identification was possible. In addition, tree and shrub identification, which is generally possible with sterile specimens as a consequence of the greater number of vegetative traits expressed by trees in comparison with herbs, and the more limited species diversity, with only 101 native tree species in the state, also continued to be feasible. Visitation into the early Winter, following leaf fall and herb and dieback, facilitated photographic documentation of the physiography (e.g., landforms, surface topography, etc.) of the communities.

A secondary challenge associated with the floristic surveys related to the organization and labeling of the digital photographs. In total, more than 1500 photographs were taken for the six campus plant communities selected for evaluation. Some of the pictures were overviews of the communities (topography, aspect, etc.), but most were of individual plants. In addition, for most plants, multiple photographs, showing a range of diagnostic features (leaf, stem, flower,

etc.) were typically taken. By default the photographs were assigned numeric file names by the camera, with the images being numbered sequentially and organized into folders by date. This file naming system facilitated the matching of photographs and field notes; however, to be of general utility the image files needed to be renamed to indicate the species shown. Using the full species name was not desirable since the length of the file names interfered with the viewing of thumbnail images of the files. Ultimately, each file was assigned a standard abbreviation based on the species name and within each species the photographs were numbered sequentially.

In comparison with the floristic inventories and photodatabases, the compilation of landscape data was more a straightforward, and less time-consuming process. An initial time investment was required to locate sources of landscape data (i.e., websites of satellite imagery data, topographic maps, soil surveys, and relevant Indiana Geological Survey publications, etc.), but once the necessary materials had been secured they were easy to use and data extraction was a largely mechanical process.

### ***Products and Applications:***

For each of the plant communities evaluated the following products were prepared: floristic inventories, photodatabases of plant images, and compilations of landscape data. In addition, brief written overviews were prepared emphasizing noteworthy or unique features of the plant communities and possible teaching uses. The completed materials have been added to my IPFW webpage (<http://users.ipfw.edu/BoselaM/community-profiles>), for viewing or downloading

The floristic inventories were prepared as Excel files. Aside from basic nomenclatural data, species abundance estimates, site location data (when relevant), and species abbreviations, as used for image labeling, are also provided. In addition, annotations are provided to indicate species of exotic (non-native) origin. The landscape data, prepared single Powerpoint files for each site, includes campus 'locator maps', aerial photographs and satellite images downloaded from the Internet, scans from topographic maps and soils surveys for the sites, photographs showing the overall aspect and layout of the communities as viewed from the ground, written descriptions of the soil types present, geographic coordinates and elevational data. The written overviews prepared for each community are also included with the Powerpoint files of landscape data. The plant images (photodatabases) are available as web photo galleries prepared using Adobe Photoshop.

Since the community profiles were completed at the end of the semester and have not been advertised within the IPFW community, there has been little opportunity for their adoption and use by other IPFW faculty. However, I was able to use the photodatabases in the context of teaching field botany this past Fall. For example, the Sugar Woods photodatabase was used to prepare a tree identification 'guidebook' for use in a tree sampling lab conducted in the woodlot (Appendix A). Images from the photodatabases were also used to create study guides for the course exams (Appendix B). To assess whether these materials had been helpful I anonymously surveyed students, with ten of 13 students responding. Seven of ten students indicated that they had used the plant study guides and had found them helpful for exam preparation. Similarly, eight of ten students indicated that the tree identification guides prepared for use in the sampling lab had been helpful, with five of eight volunteering that they preferred the guidebooks were more useful than the 'Trees of Indiana' publication that served as one of the course 'textbooks'.

The plant community profiles will also be used next Fall in association with the instruction of a course on the Natural History of Indiana taught by my wife (Alicia Bosela). However, to encourage even greater use of the materials, I will make an informal presentation describing the community profiles at a biology faculty meeting in the Spring. In addition, over the Summer, I am also planning to meet individually with faculty from other departments that I would anticipate as having an interest in and/or uses for the community profiles both to promote my work and seek their input and constructive criticisms. The possibility also exists for collaborations with the grounds department (see 'Remaining Work', below).

### ***Remaining Work and Continuation***

For all of the sites evaluated, the floristic inventories are incomplete. Since I did not begin work on the grant until the middle of the Summer, plants that had flowered early in the growing season are absent from the plant inventories. In addition, for each site there are a small handful of plants where the identifications are tentative, being based primarily on the evaluation of image data, and should be confirmed with fresh specimens this Summer. Similarly, for several difficult genera (*Aster*, *Solidago*, *Juncus*, etc.) the plants surveyed were not initially keyed to species level and remain to be conclusively identified.

In addition, the level of photographic documentation is highly variable between plant communities. Knowing that I would use Sugar Woods for a sampling lab in field botany, the degree of surveying and photographic documentation was much more extensive here than for any of

the other plant communities. More than 800 photos were taken for the woodlot, compared with only 40-50 photos each for the old field and the oxbow wetland. The degree of visitation was also equally as variable; i.e., the oxbow wetland and old field were visited only once or twice during the entire growing season, compared with 6-10 visits to the Sugar Woods. In addition, the Sugar Woods was the only campus plant community where a consistent attempt was made to photograph every plant species present. For most of the other sites, species that had previously photographed in the context of surveying off-campus field sites for field botany lab development were often not photographed a second time. However, these photographs from the off-campus field sites have not yet been assigned species names and integrated with the photodatabases prepared for the IPFW communities.

A second priority area for future work related to the grant would involve issues related to the online presentation and ease of use of the community profiles. Some of the improvements envisioned would be technologically simple and 'easy' to implement, such as an elaboration of the floristic inventories to include location data for each plant species, with "locations" within field sites being distinguished based on differences in physiography (landform, or microhabitat) and geographic position (North, South, etc.) coupled with maps for each community showing the different locations recognized each site. In addition, annotations (comments) could be added to the Excel files indicating the distinguishing characteristics for each species; however, this would be a time-consuming proposition and could be substituted by references, or possibly links, to online plant taxonomic databases.

Other improvements of a more technological nature would require collaboration with other IPFW faculty or staff with expertise in web design, possibly as part of a second, related instructional development grant. Some of the issues that require attention are relatively minor, such as problems with image orientation and viewing size. Similarly, the user interface could be improved by replacing the 'links' table with a campus map, that could be used to open separate webpages for each plant community, with the webpages providing both written and photographic overviews of the particular plant community and links to the corresponding community data sets (floristic inventories, landscape data, etc.). Other issues that need to be addressed are a bit more challenging. For example, the current photodatabases are not searchable. However, it would be highly desirable if the images could be searched both by the species and traits (floral, leaf, etc.) shown. Another goal would involve integrating the photodatabases and floristic inventories such that the photos could be assessed from 'within' the inventories.

Aside from improvements to the current plant community profiles outline above, I am also interested in establishing collaborations with the IPFW Grounds Department, which has a long-standing interest in the documentation and maintenance of campus natural areas, combined with their use as vehicles for community outreach. For example, the grounds department has prepared inventories and maps of the entire population of planted trees and shrubs on campus, facilitating their use by arboriculture (tree identification) classes, and also by high school and grade school students working on 'leaf collection' assignments. More recently, the Grounds Department has developed a 'Native Trees of Indiana Walk' that includes natural or planted specimens of all 101 tree species native to state. Additionally, the Grounds Department has expressed an interest in developing a second interpretive walk in conjunction with the extensive development that is planned for the west side of the campus. Although the theme of the new walk has not been determined if the focus is on natural communities, as anticipated, the plant community profiles that I have prepared would be especially valuable resources. In addition, there also is a possibility for direct collaboration. For example, many of the topics that I developed in the Sugar Woods sampling lab for field botany could be incorporated in an interpretive walk emphasizing forest tree dynamics and diversity.

Provided that additional funding is secured, other goals would include an expansion of the project to include all major natural areas on campus. Aside from the six plant communities evaluated to date, there are also two additional lagoons off the St. Joseph River including a very large, but highly degraded lagoon, at the mouth of Stoney Run Creek on the west side of campus and several fairly large tracts of bottomland forest/hardwood swamp, again as a component of the floodplains on the western edge of river. There are also two additional upland woodlots of putative significant ecological value: Aquarius Park, located on main campus adjacent to the Friends of IPFW pavilion, a the larger woodlot located east of Stellhorn Road between the new student dormitories to the north and the TV station to the south. Other smaller, but interesting, plant communities include shrubby wetland communities associated with an abandoned feeder canal for the Erie Canal system that bisects the McKay soccer complex and "erosion control" plantings at the mouth of the drainage that supplies that lagoons on the eastern side of the river. Aside from their functionality, the erosion control plantings, which employ large numbers of grasses as a consequence of their soil stabilization properties include representatives of several of the most ecologically important grass species in the state and thus are useful for plant taxonomy instruction.

In addition, over a longer time frame, it may also be possible to expand the project to include plant communities at the IPFW biology research station on Crooked Lake in Whitley County, or in the Fort Wayne metropolitan area more generally. Through doing so it would be possible to include examples of all major plant communities for the region with the exception of bogs and open (active) sand dunes which represent two of the rarest and most northern-limited plant communities in the state. Although the surveying component of the initial grant took longer than anticipated, as indicated under the 'Execution and Methodology' section, above), a continuation and expansion of this project would ultimately allow for some of this initial time investment to be recouped. In addition, there is an aspect of positive feedback involved; i.e., provided that a minimum learning threshold has been achieved, for each new plant species learned and each new community surveyed the process of performing additional surveys becomes that quicker and easier.