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From Data to Ducks

By Robb Macleod, Ducks Unlimited

If a picture is worth a thousand words, then an accurate spatial database could be worth thousands of ducks. That is exactly what Ducks

Unlimited, Inc. (DU) is trying to accomplish with Great Lakes Habitat Evaluation Network (HEN). DU is a non-profit organization that conserves, restores, and manages wetlands and associated habitats for North America's waterfowl. These habitats also benefit other wildlife and people.

DU accomplishes its mission using a science-based approach that utilizes biologists, engineers, researchers, and GIS professionals. In July of 1984, DU's need for information to help with its planning and habitat restoration in the Prairie Pothole region (parts of Minnesota, North and South Dakota, and Montana in the U.S. and parts of Manitoba, Saskatchewan, and Alberta in Canada) led to its investment in a GIS program. The initial GIS project was to map over 300,000 square miles (777 000 km²) of the Prairie Pothole region!

It is this same drive toward using a scientific approach to habitat restoration and protection that has led DU toward developing Great Lakes HEN. Established in 1998, the Great Lakes/Atlantic Regional Office of Ducks Unlimited used the currently available scientific and geographic information to develop Ecosystem Initiatives for its region. However, it was soon apparent that there was a lack of information for this region at a landscape or ecosystem level. Many state and county government agencies have generated a great deal of geo-spatial information, but it very rarely crosses state boundaries in a seamless fashion. In addition, there was very little waterfowl data for the region, especially in the Great Lakes where over 76% of the mallards found in the Great Lakes are also hatched and raised in the Great Lakes.

Great Lakes HEN is like the seat of a three-legged stool. The three legs that are the foundation of the stool are: research, geo-spatial data, and user feedback and interaction. Three years ago, DU, along with numerous state and federal agencies and private foundations, began the Great Lakes Mallard Study. The information that is gathered and analyzed from this study will be the biological foundation, or

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WHO'S DOING WHAT IN GIS AND SPATIAL TECHNOLOGY



CITY OF HOLLAND BOARD OF PUBLIC WORKS

- Population: 89,855
- Service Area: 92 Sq. Miles (238.28 km²)
- Number of Parcels: 26570
- Electric Lines: 420.7 Miles (677.05 km)
- Water Line: 221.5 Miles (356.47 km)
- Sewer Line: 166.2 Miles (267.47 km)
- Number of Staff: 9 IT (2 of which are GIS)
- Annual Budget: \$684,000 for IT (\$170,000 of which is for GIS)

PROGRAM STATUS

The Holland Board of Public Works (BPW) started looking for a GIS in 1989. The BPW set up a committee with the City of Holland to evaluate different systems. This committee chose ESRI ArcInfo for the City/BPW GIS program. The reason the committee selected ArcInfo was that they felt this program would be the best GIS package to meet the long-term needs of the BPW and the City. The GIS project remained administratively within the BPW for funding reasons. While choosing the software, Aerometric was hired to do the orthophotos. The orthophotos were done at 1:1200 (1" = 100') and were set to

the Michigan State Plane Coordinate System to build the City's landbase. The landbase includes: quarter section index, rights of way centerlines, rights of way, building footprints, building addresses, lots, lot numbers, parcels, parcel numbers, street names, hydrology, railroad, and light and power poles.

In 1991, the BPW hired Plangraphics of Frankfort, KY to be their consultant. Plangraphics wrote the Request for Proposal (RFP) for converting the BPW's paper maps to electronic form. Greenhorne and O'Mara, Inc. of Greenbelt, MD was hired to do the BPW conversion. They converted all electric, water, sewer, and parcel maps. During the conversion, all record maps were frozen. No changes were added to the maps until the conversion of an area was completed.

While the conversion was being done, the BPW created two new positions: GIS Supervisor and GIS Technician. Also, personnel were temporarily reassigned to help with the conversion from other departments. Today, the GIS staff is part of the new IT Department, which currently has a staff of nine.

The Electric Department joined the GIS effort on July 1, 1996. This became possible when the BPW's GIS programmer developed a program called ZAP, an editing program created to make ArcInfo Workstation more user-friendly. After this date, the Electric Engineering Department was required to do all their work orders on the GIS using ZAP. When the Electric Engineering Technician adds work orders, the GIS is updated that evening, and all users can see the change the next day.

In the early years, the goal of the Electric Engineering Department was to improve the data's accuracy. To support this, the BPW hired Burns and McDonald of Kansas City, MO. Following a pilot, the BPW partnered with Burns and McDonald during the field collection process, which helped both parties achieve a successful completion of the project in 14 months and under budget. As a result, the BPW now has the orthophoto-verified location of all meters, transformers, protective devices, risers, poles, streetlights, and wires in ArcInfo format.

The Electric Engineering Department continues to improve the accuracy of the GIS data. One way it improves the accuracy of the primary lines is using other programs for analysis. One of these programs is called Synergee. This program shows the

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research leg, for HEN (see <http://www.ducks.org/conservation/Projects/GreatLakesAtlantic/MallardTrax/index.asp> for more information on the Great Lakes Mallard Study). The second leg, geo-spatial information, is split into two groups. The first group is the condition of the current landscape and the second group is the potential of the current landscape to be restored. The third leg, user feedback and interaction, will be programmed into the Great Lakes HEN application

If research is the duck, then the geo-spatial information is the flyway. The biological foundation being developed in the Mallard Study tells us a lot about the birds, but without the knowledge of the current and potential landscape, the ability to affect waterfowl populations greatly decreases. Therefore, a complete, seamless dataset for Wisconsin, Illinois, Michigan, Indiana, and Ohio needed to be assembled. Geo-spatial data for the current landscape consisted of: base layers, land cover, wetlands, conservation and recreation lands, mallard distribution, and mallard production. The potential landscape will be developed from a soil moisture index and analysis of the land cover and wetlands data sets.

The base layers for Great Lakes HEN (hydrology, transportation, and administrative) are all abundantly available but are in various formats, scales and projections. For this project, we standardized on 1:24,000 scale data and Albers Equal Area projection. The statewide data was edge-matched with neighboring states and merged into a single, seamless data set. However, there were still problems with some of the base layers between states. DU has plans for updating this layer as better data becomes available.

Detailed land cover data sets are available for all five states in the Great Lakes HEN project area. However, classification schemes and projections were all different between states. The first step was to develop a consistent classification scheme and crosswalk (mapping all of the different classification schemes into a single consistent classification) for all five states. For example, the WisLand land cover for Wisconsin had four types of wetland shrub (lowland shrub, broad-leaved deciduous lowland shrub, broad-leaved evergreen deciduous lowland shrub, and needle-leaved lowland shrub). The other state land cover data sets only had one wetland shrub class. Therefore, in the final Great Lakes land cover data set, the four wetland shrub classes in the WisLand land cover had to be "mapped"

or reclassified to a single wetland shrub class to be consistent with the other states. Once this process was completed, the individual state land cover data sets were projected to Albers Equal Area projection and mosaicked.

If the devil's in the details, he was certainly hanging around the wetlands an awful lot! The wetlands layer was the most problematic layer to put together. The U.S. Fish and Wildlife Service's National Wetlands Inventory (NWI) was used as the basis for this layer. Unfortunately, NWI does not exist in Wisconsin or in about two-thirds of Ohio. Luckily, both of these states have their own wetlands inventory programs. As in the Great Lakes land cover data sets, the Wisconsin and Ohio wetlands inventory had different classification schemes than the NWI data. The NWI classification scheme was chosen for the Great Lakes wetlands layer so both the Wisconsin and Ohio wetlands inventory had to be crosswalked or "mapped" to the NWI classification scheme. Once the Wisconsin and Ohio data was mapped to the NWI classification scheme, each statewide wetland data set was converted to raster format and projected to Albers Equal Area projection. The statewide raster images were then mosaicked for seamless coverage of the five states. DU is currently looking into methods for updating this wetlands layer, as much of this information is now outdated.

The Conservation and Recreation Lands (CARL) layer is a combination of public and private lands that are being used for conservation and recreational purposes. This data set was put together from local, state, and federal agencies as well as private lands and easements from local and national conservation organizations. Once again, these layers were mosaicked and projected to produce a seamless dataset.

DU, in conjunction with the Michigan Department of Natural Resources and Wisconsin Department of Natural Resources, are developing a mallard distribution layer for the five states. This layer is derived from aerial waterfowl surveys and the Great Lakes Wetlands layer mentioned above. The number of mallards from the surveys is related to the wetland class by means of a statistical equation. This equation is then applied to the study area using the seamless Great Lakes Wetlands layer. A draft version of the mallard distribution layer is currently completed, with final results expected in early 2004. The mallard productivity layer (where the mallard broods have the best chance for survival) is currently being created from the

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Electric Engineering Technician where the primary electric lines are not joined correctly. The BPW purchased Synergee from Advantica Stoner, of Carlisle, PA in 1991.

While the Electric Engineering Department was improving the quality of the GIS electric data, the Customer Service Department was changing their Customer Service program from an in-house program to a commercial one. Using this new program, the IT Department was able to join the customer information to the electric meters and present the result in ArcView.

The Fiber Department was created in 1992, when they built a fiber optic ring around the City for internal use. In 1999, external customers were connected to the fiber optic system. SPEEDY, a modification of ZAP, was created for the Fiber Department so that hand sketches could be input. With SPEEDY, the fiber technicians can view the fibers in the BPW Service Area. They are able to get information on the fiber cable, route, devices, sizes, counts, footages, ownership, and other administrative details.

The Water/Wastewater Service Department (W/Ww) received FLUSH in the mid-1990s, so the W/Ww could manage its GIS data. FLUSH, like ZAP, is an editing program created to make ArcInfo Workstation user friendly. Several years ago the W/Ww acquired a program called Azetca for work management. Azetca uses GIS data to create work orders. The BPW's GIS programmer worked directly with Azetca to make the program functional for the BPW.

NEW PROGRAMS AND ACTIVITIES

Today, the Electric Department uses the GIS data daily. Some of the ways it's used include creating work orders, service orders for meter installs, viewing data via truck-based laptops, load analysis, determination of phasing on electric lines, transformer loading, miles of lines, number of customers on a circuit, GIS electric data quality control reports, and many other uses. The BPW is in the contract stage for an Outage Management System program from Utility Automation Integrators, Incorporated, (UAI) of Huntsville, AL. The implementation of the program is to start as soon as the contracts are signed, along with integrating of SCADA (SCADA is electronic monitoring of substations and other devices) and the GIS electric data. Currently the BPW is also in Phase 1 of the implementation of an Automatic Meter Reading installation for electric and water, with all phases to be completed in 2005. Other futures plans of the Electric

Department are to replace ZAP with UA Field from UAI, add UA FM from UAI, and convert to ArcGIS 8.3 from ESRI.

Recently, the Fiber Department found a program named OSP InSight Pro (OSP) from Advance Fiber Optics of Salt Lake City, UT. OSP is integrated with ArcGIS 8.3 and will be replacing SPEEDY. The Fiber Department is currently inputting all fiber records into OSP along with all equipment information. Other future goals for the Fiber Department are to add terminations, customer data for those on the fiber system, electronics, routing, and applications for fiber to the home.

Having completed the conversion of wastewater main lines, valves, hydrants, and manholes during the major conversion project in the early 1990s, the W/Ww is now inputting their water and wastewater service line information. The W/Ww uses ArcView daily for analyzing mains, hydrants, valves, manholes and water services line data, and uses Azetca for work management, cost of projects, and work histories. The Water Engineering Department uses WaterCAD for their system hydraulic modeling. The W/Ww is looking into the possibility to put all plan records on CD and create a way to get all information from one source though the GIS.

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results of the Mallard Study.

The previously described layers all deal with the current landscape, but for restoration purposes, areas with a potential for restoration also need to be identified. Most conservation programs enroll farmlands of low productivity due to very hydric soil conditions. Identifying hydric soils (soils seasonally or permanently saturated with water) would be fairly straightforward if digital county level soils information existed for all five states. As a surrogate for hydric soils, DU created a Soil Moisture Index (SMI) from Landsat ETM+ imagery. A collection of 43 springtime images were used to classify the five states from very dry soils to very wet soils. The SMI will be completed in January 2004.

Now the fun begins! Using the first leg of the stool, we now have a better understanding of the biological aspects from the Mallard Study. With the second leg, we have a complete image of what the landscape looks like and where there is potential for restoration projects. Great Lakes HEN will incorporate these two legs to develop focus areas and "hot" spots for restoration and protection that will guide our efforts along with other conservation organizations. However, the stool will not stand on its own without the third leg, user feedback and interaction. The user (field biologist) should be able to use and interact with Great Lakes HEN. For example, if the ideal is restoring 40 acres (16.19 ha) of wetland and 20 acres (8.09 ha) of grassland on a given area of land, but the landowner only wants to restore 30 acres (12.14 ha) of wetland and 10 acres (4.05 ha) of grassland, how does that affect bird numbers and productivity? If the effect is low, the biologist can go ahead with the restoration. If the effect is large, there is good reason to convince the landowner to restore the whole area.

Finally, this accurate spatial database will only be worth thousands of ducks if the data is available to a wide and diverse user group. All data sets that DU creates in this project are available to the public. However, some of the data that will be used in Great Lakes HEN are proprietary from other organizations and will have to be obtained from the originating organization. For more information on this project, look for the Great Lakes HEN link on <http://gis.ducks.org> in early 2004.

Like all projects of this nature, it would not be possible without a long list of cooperators. Organizations that have helped in

the data development and Great Lakes HEN are: Herbert H. and Grace A. Dow Foundation, U.S. EPA GLNPO, Saginaw Bay WIN, U.S. Fish and Wildlife Service, Michigan Department of Natural Resources, and Wisconsin Department of Natural Resources. For cooperators on the Great Lakes Mallard Study, please see the link listed above for the Mallard Study.

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*Preliminary Results of the Mallard Distribution Layer
(darker areas equal greater number of mallards)*



Soil Moisture Index (darker areas equal wetter soils)

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