

T-12 P-1

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Illinois Mussel Database: Maintenance & Enhancement

NEED

Freshwater mussels are among the most threatened aquatic organisms in North America (Williams, et al, 1993). In Illinois, a variety of threats, including industrial pollution, siltation, stream modification, exotic invasives (e.g., zebra mussels), loss of host fish species, and other perturbations are having significant negative impacts on mussel assemblages. Cummings and Mayer (1997) suggested that approximately 20% of all Illinois mussel species have been extirpated. Moreover, 16 species are listed as state endangered, and of these, five are federally endangered. An additional eight species are listed as state-threatened (Title 17 Part 1010; Illinois List of Endangered and Threatened Fauna, September 2004).

The Illinois Natural History Survey (INHS) has been collecting data on mussel distributions in Illinois and the region for a century, with all records being supported by vouchered specimens. It maintains one of the largest and best-curated mussel collections in all of North America, with its many specimens being the only reliable source of information on historical distributions.

Illinois Department of Natural Resources (IDNR) field biologists, distributed across several divisions, have been collecting semi-quantitative mussel data for a decade. These biologists have developed close ties with Mr. Kevin Cummings, the INHS Mollusk Collection curator, having been exposed to many hours of instruction on mussel identification and biology. Both agencies recognize the need to share these data to provide a comprehensive data management system for mussel conservation in Illinois.

The IDNR has been working diligently on Illinois' Comprehensive Wildlife Conservation Plan (CWCP, <http://dnr.state.il.us/orc/wildliferesources/theplan/>). The IDNR and the INHS, under the T-3P project, have constructed tools to capture, store, and spatially display Illinois mussel data. A schematic of data acquisition, flow, quality assurance/control timing, and data display is presented in Fig. 1. Under the terms of contract T-3P, a Microsoft Access, desktop, database was built to capture IDNR semi-quantitative mussel data in a "distributed" network. This approach was chosen because many of the field offices still use phone-based internet service providers, which would make for an unreliable, web-based data entry system. This desktop model includes four basic modules: Habitat Assessment and Location, Community (species found, the number of individuals, live, dead, relict, etc.), Mussel Condition Index (MCI, calculates an index of condition based on the mussel assemblage), and Demographics (individual specimen lengths and characteristics). The tables that support the modules are relational, using site, species, and event codes as keys (Fig. 2). Quality control measures (drop down lists, check boxes, input masks, etc.) have been put into place to prevent errors. This product has been beta-tested and found to meet the needs of the IDNR field staff. However, the database has not yet been populated, a task that will occur during the 2005 field season.

Another major task in T-3P was to construct a web-GIS tool for viewing combined IDNR and INHS species location data. Sponsors may test the product at <http://spatial.inhs.uiuc.edu/maps/working/viewer.htm> logging in with the Username=mussel and Password=ill*moll (lower case). Searchable fields include origin (INHS, IDNR, and other museums), catalogue number, genus/species, water body, major Illinois drainages, the 25 "Biological Significant Streams Basins", common location, county, month/day/year, collectors, and number of specimens of live, dead, and voucher status.

Additional funds are sought to expand functionality and provide for maintenance of the work that was completed under T-3P. Briefly, enhancement includes building a web-based search module to create fact sheets, construction of automatically generated length and age class frequency histograms, and 3) construction of automatically generated "Element of Occurrence Records" (EORs, records of imperiled species or diverse communities). Maintenance includes centralization of 2005 IDNR data, quality control of these data, integration of new and modified IDNR and INHS data, and maintenance of the web-GIS module.

The addition of automated analyses of population demographics will be of great usefulness to field biologists and watershed managers. Knowing the distribution of mussel sizes by species will allow managers to know if a population is reproducing or is becoming senescent, suggesting that management may be necessary. The construction of a web-based system for IDNR biologists to search the data via their dial-up service is much less problematic than is data entry over such a connection and negates the need to send large updates to biologist and other users.

Fig. 1 demonstrates the general data flow and maintenance that is necessary to keep this system running. Multiple files must be gathered from field biologists, compiled into a single file, quality assured, and combined with INHS collections data into a single comprehensive database for use in mapping and query. While a single system will be produced, users will be able to query for either semi-quantitative IDNR data, or INHS collections data, or both. Compilation of the database will require much preparation, data cleanup, and discussion with field biologists by our database manager. In addition, troubleshooting of the desktop system and maintenance of the SQL database is expected.

Mr. Kevin Cummings (INHS) served as principal investigator for the current T-3P grant which is due to expire soon. Expertise is being added on the new SWG'04 proposal by including Dr. R. Edward DeWalt (also of the INHS) as co-principal investigator. Dr. DeWalt is an aquatic entomologist with experience in biodiversity informatics development. Mr. Cummings will continue to provide technical guidance regarding mussel biology and taxonomy, curation of IDNR vouchers, and will conduct quality assurance/control procedures on 2005 data. Dr. DeWalt will oversee the data management portion of the SWG'04 mussel proposal.

The IDNR anticipates that many management entities will use this data source. Several mussel species have been identified in Illinois' CWCP as "Species in Greatest Need of Conservation". Addressing the many threats to these species requires a thorough understanding of their population and habitats. Consolidation of Illinois mussel data will enhance our ability to address these concerns. The IDNR uses similar data in their screening process of potential industrial and residential development across the state. This product will provide important tools such as interactive GIS and robust query capabilities for internal IDNR use. IDNR Natural Heritage will also use these data to help protect imperiled species and in their efforts to define and protect natural areas. The Illinois Environmental Protection Agency would also have use for these data in their wastewater permitting process. Illinois' many watershed based partnerships, The Nature Conservancy, and the Prairie Rivers network may also be invited to use these data in a limited, judicious way, although the details of their use of sensitive data have not yet been worked out.

OBJECTIVES

1. Build a web-based system to query the integrated database, build site fact sheets, provide Excel downloads, produce length/age-frequency histograms by species, site, and date combinations.
2. Program automated Element of Occurrence Records (EOR) for reporting findings of Illinois and federally imperiled mussels and high MCI values to IDNR Natural Heritage Division.
3. Maintain and support database and web GIS software, including data and software updates,

quality control/assurance, troubleshooting, and modifications as requested by IDNR biologists or the Ad hoc Mussel Committee.

EXPECTED RESULTS OR BENEFITS

The major benefit to a web-based query tool is that there is only one version of data from which biologists search for information. Another is that these data can be updated on a more frequent rate, yet the data manager would not have to send copies of the data to every user when minor changes take place. Field biologists would be tempted to analyze demographics using their own small data set. With the web module, they can pull data for multiple species, sites and dates simultaneously, building a wider context from which to draw conclusions. Our hope is that dial-ups will soon be a thing of the past, allowing for us to enter data directly from the web. Until all biologists have fast networks, this web search module will provide access to the most up-to-date version of the database.

Automating the creation of Element of Occurrence Records will improve completeness of reports and provide digital files that Natural Heritage can modify and import into Biotics4. While we envision most EORs being forwarded to Natural Heritage on an annual basis, we realize that some circumstances will force biologists to send these in soon after data collection.

APPROACH

Project Leaders and Staff. Co-principal investigators from the INHS include Dr. R. Edward DeWalt and Mr. Kevin Cummings. Dr. DeWalt will supervise Mr. Edward Z. Chen, a skilled database manager with much experience in the design and implementation of Access and SQL databases. Mr. Chen built the current desktop, Access database. Web programming will be conducted by Mr. Quoc Le Bao. Mr. Bao has programmed many of the web modules found in the Critical Trends Assessment Program on-line data module (see, <http://ctap.inhs.uiuc.edu/data/data.asp>). Mr. Cummings is heavily involved in the conceptual design of new modules and in quality control of data coming into the project. Mr. David Day will serve as project coordinator from the IDNR.

Contact information:

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Build a Web-Based System to Query the Integrated Database. An SQL database has been constructed that houses existing IDNR and INHS data. We propose to build a web-based module that will allow for the submission of sophisticated queries to the integrated SQL database. The result will be the dynamic construction of species lists, site fact sheets, graphics, and more. Active Server Page (ASP), a web protocol that permits direct queries of databases, will be used to construct the dynamically created formats.

Users will be able to choose from several geographic, date, and other criteria to produce fact sheets. Contents of fact sheets will identify the site specifically, provide species richness and MCI values graphed against the state and watershed averages, number of imperiled species, and a species list with numbers of individuals and their statuses (live, dead, relict, state or federal

imperilment). Other types of fact sheets will produce species demographic data for a site.

Program Automated Element of Occurrence Records. Key to getting sensitive mussel data into the hands of those who use it is the printing of EORs. With a large number of people sampling streams, there could be quite a lot of records for mussels. Currently, there is a bottleneck at the IDNR Natural Heritage for processing EORs. By the time this information gets into Natural Heritage databases, records may have been keyed up to three times. This generates errors and steals precious time. The IDNR/INHS propose to program the SQL mussel database to automatically recognize imperiled species and MCI values ≥ 10 and build an EOR module that prints forms and exports electronic documents, emailing them directly to the Natural Heritage data manager. These functions would be conducted after quality control/assurance procedures confirmed mussel records for a given year (see next Approach section for timing).

Maintain and Support the Mussel Database and Web-GIS Software. This system is complex and requires the periodic attention of database managers, web programmers, and GIS specialists. The IDNR and INHS have established a timetable for new development and key features of maintenance and support. Major support functions include data and software updates, quality control/assurance, troubleshooting, and modifications as requested by IDNR biologists or the Ad hoc Mussel Committee.

Timetable. The IDNR/INHS wish to begin work on 1 April 2005 and end 30 June 2006 (Table 1). Crafting a more detailed vision for enhancement of the current product will involve meeting with the Adhoc Mussel Committee sometime in April or May. Work would then commence on the new database and web modules in May or June. Field biologists will collect 2005 mussel data from June through September. The desktop databases can be loaded on laptop computers for direct entry in the field, but this will probably not be the norm. Therefore, the months of October and November have been slated for data entry. Another meeting of the Adhoc Committee will take place in September and their suggestions will be used to modify web and data modules throughout the fall.

In late fall, populated files from the several distributed desktop databases and voucher specimens will be sent to the INHS. In December, the INHS data manager will combine these into one file. A fourth meeting of the Adhoc Committee will take place in December 2005 or early January 2006 to review programming changes and to determine if the schedule is being met. At this time, Mr. Cummings will begin QA/QC procedures, which may last into April, depending upon his schedule. A third meeting with the Adhoc Committee in March, 2006 will review the final version of the web and database modules and evaluate the remaining tasks on the contract. The newest version of the integrated database will be ready for use by sometime in May. Drafting of the final report will take place in May and will be reviewed in early June, 2006 meeting of the Adhoc Mussel Committee. A final draft of the report will be delivered the end of June.

Budget. The INHS and IDNR will conduct this work for a total of \$48,130 (see Table 2 for detailed accounting). An INHS database programmer (Mr. Edward Z. Chen) at will be employed 50% rate for 10.25 months at a cost of \$23,339. Fringe benefits are charged at 32.37% of salary for a total of \$7,555. A web programmer, Mr. Quoc Le Bao, will be employed at an hourly rate of \$14 for two months, full time for \$4,480. The fringe benefits rate for him is 9.44% for a total of \$423. Contractual services, in the form of software licenses and specimen identification, amount to \$3,000 and supplies such as media and paper and curatorial items (label paper, jars, alcohol, specimen boxes, etc.) cost \$1,311. Facilities and Administrative cost at the University of Illinois is currently set at 20% for federal pass through dollars, amounting to \$8,022.

The INHS is providing match of in-kind services equivalent to 25% of project costs. This is

accomplished through a claim of 3.44% contributed effort for Dr. DeWalt's and Mr. Cummings' time in salaries, fringe benefits, and facilities and administrative costs, (charged at 44.3% of salaries plus fringe benefits), and un-recovered facilities and administration costs on project costs (20% vs 44.3% or \$9,746). Including match, a grand total of \$64,172 will be used to fund this project for one year.

Project Evaluation: Most products from this work will be in the form of integrated databases and web modules for searching for mussel data. Additional measures of accomplishment will be the maintenance of the data accumulation, integration, quality assurance, and update schedule. Co-principal investigators will demonstrate progress to the Adhoc Mussel Committee and other IDNR employees in September and December 2005 and March and June 2006. If development is not on schedule, then remedies will be explored to return to schedule.

COMPLIANCE

The proposed work will comply with all federal regulations. No federally or state listed live mussels will be sacrificed during this work, although dead and relict shell will be collected as voucher of historic location for the species. Information about the locations of imperiled species will be dealt with securely, with access to these records being protected by user identifications and passwords.

Literature Cited

- Cummings, K. S. 1991. The Aquatic Mollusca of Illinois, pp. 428-438 in: Page, L. M., and M. R. Jeffords eds. Our living heritage: the biological resources of Illinois. Illinois Natural History Survey Bulletin 34: 357-477.
- Williams, J.D., M.L. Warren, Jr., K.S. Cummings, J.L. Harris, and R.J. Neves. 1993. Conservation status of freshwater mussels of the United States and Canada. Fisheries 18(9):6-22.

SEE FIGURE #1 BELOW

**IDNR
Distributed MS
Access,**

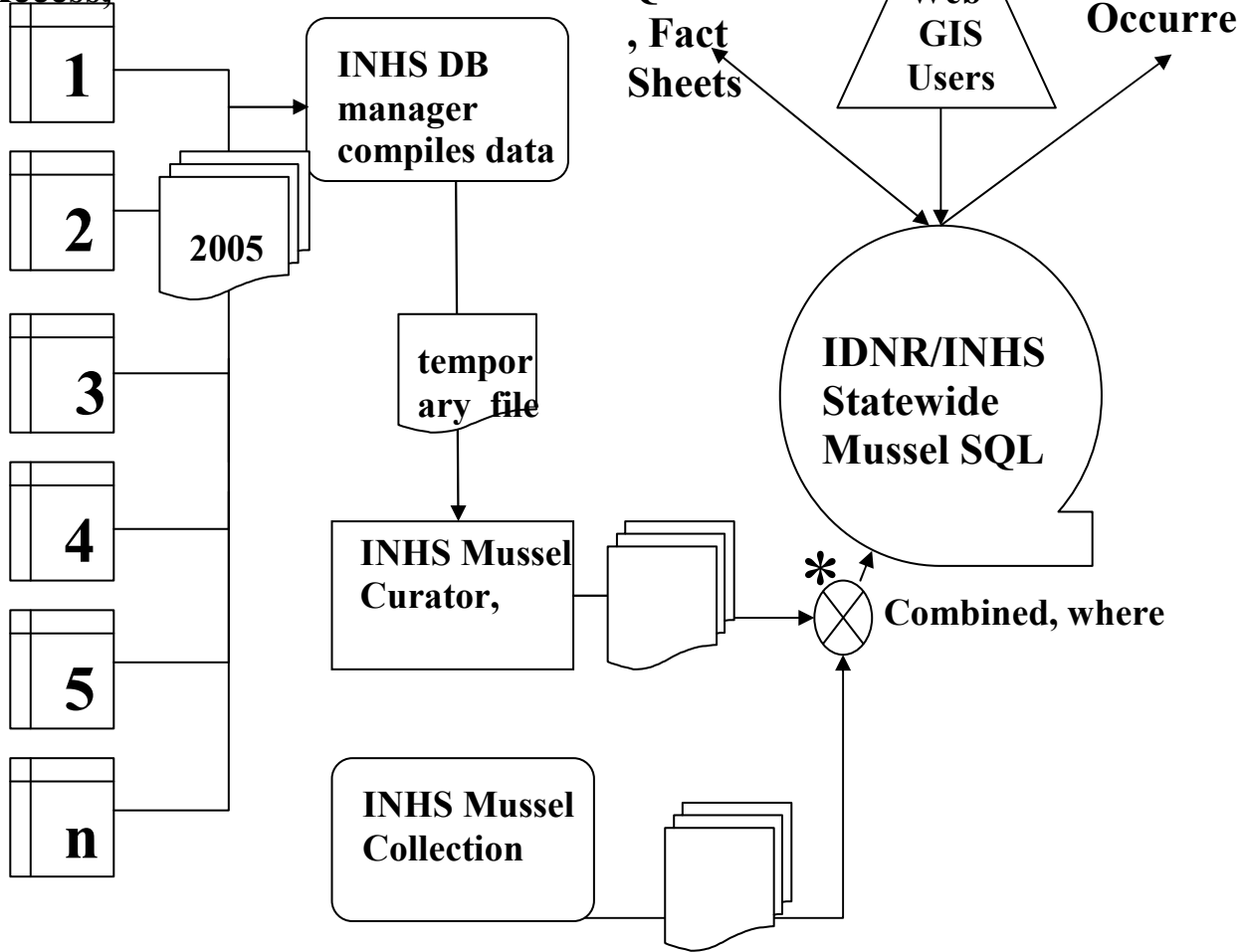


Fig. 1. IDNR/INHS Statewide Mussel Database and Information Management System. *Indicates those task to be completed in this proposal