River Almanac

An Information Sharing Bulletin of the
Long Term Resource Monitoring Program

Biological Resources Division
U.S. Geological Survey

Visit by top Washington officials underscores importance of Long Term Resource Monitoring Program

by Mark Wenger

"The Long Term Resource Monitoring Program will continue to be a high priority of my office," stated Assistant Secretary of the Army H. Martin Lancaster during a September 9 visit to the Environmental Management Technical Center (EMTC).

Lancaster oversees civil works for the Army Corps of Engineers. He is also responsible for funding and oversight of the Long Term Resource Monitoring Program (LTRMP). He was joined on the tour by Wisconsin Third District Congressman Steve Gunderson and Minnesota First District Congressman Gil Gutnecht.

Lancaster was invited on behalf of Congressman Gunderson, a key figure in the creation of the Upper Mississippi River LTRMP. The purpose of the visit was to provide the Assistant Secretary with a first-hand look at Environmental Management Program riverine wetland projects and LTRMP scientific programs. The visit included a news conference, a working luncheon attended by many support organizations, and a tour of habitat rehabilitation projects in Lake Onalaska.

After the visit, Lancaster said he was impressed by the work being done by state cooperators and LTRMP staff. He was also impressed by how these partnerships have improved cooperation and reduced duplication of services. ❐

Assistant Secretary of the Army for Civil Works H. Martin Lancaster (c), Wisconsin Third District Congressman Steve Gunderson (l), and Minnesota First District Congressman Gil Gutnecht (r) discuss the Upper Mississippi River Long Term Resource Monitoring Program with local news media.

Welcome to the U.S. Geological Survey

The following memorandum was provided to all National Biological Service employees by U.S. Geological Survey Director Gordon Eaton on September 19, 1996.

Welcome to your new home in the U.S. Geological Survey! We're delighted you're here! It has been a long and complicated process, and I suspect that everyone is glad to have it settled at last. With the transfer of the Minerals Information team from the former Bureau of Mines this past winter, and now the addition of you folks as the Biological Resources Division, we can finally say that the foundation for a new USGS has been laid, and all of the pieces are in place for the comprehensive integration of physical and biological science within the Department of the Interior.

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Selected abstracts of Long Term Resource Monitoring Program study efforts

Developing a current vegetation map of the Upper Mississippi Basin from Landsat Thematic Mapper satellite imagery and geographic information system data

Fitzpatrick, D. J., P. Joria, and F. D'Erchia. 1996. Poster presented at the Twenty-Eighth Annual Meeting of the Mississippi River Research Consortium, La Crosse, Wisconsin, April 25-26, 1996.

The Upper Midwest Gap Analysis Program is developing a current vegetation map of the region that includes Illinois, Iowa, Michigan, Minnesota, and Wisconsin. An innovative methodology developed at the Universities of Minnesota and Wisconsin takes maximum advantage of existing ancillary GIS databases to facilitate multispectral classification of Landsat Thematic Mapper imagery. Multidate satellite images are stratified first by Ecological Classification System Subsections and then by National Wetlands Inventory classes before being subject to analyst-guided clustering routines for signature identification. The objective is to produce a relatively uniform vegetation classification to The Nature Conservancy/UNESCO alliance level, across the entire region

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River Almanac
An Information Sharing Bulletin of the
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Biological Resources Division
U.S. Geological Survey

River Almanac is an authorized publication of the U.S. Department of the Interior, published periodically by the Environmental Management Technical Center to provide an ongoing exchange of information between the EMTC and other Long Term Resource Monitoring Program participants and the general public.

Robert L. Delaney - Center Director
Norman W. Hildrum - *Almanac* Coordinator
Terry D'Erchia - Editor
Mark Wenger - Assistant Editor

The Environmental Management Technical Center is a U.S. Geological Survey facility located in Onalaska, Wisconsin, USA. The Technical Center manages the Long Term Resource Monitoring Program (LTRMP), which is the largest river-related inventory and monitoring, research, spatial analysis, and information sharing program in the United States.

The Long Term Resource Monitoring Program for the Upper Mississippi River System was authorized under the Water Resources Development Act of 1986 as an element of the Environmental Management Program. The mission of the LTRMP is to provide river managers with information for maintaining the Upper Mississippi River System as a sustainable large river ecosystem given its multiple-use character.

The LTRMP is a cooperative effort of the U.S. Geological Survey, the U.S. Army Corps of Engineers, and the States of Illinois, Iowa, Minnesota, Missouri, and Wisconsin.

Questions or comments may be directed to the EMTC, ***River Almanac*** Staff, 575 Lester Avenue, Onalaska, WI 54650-8552, Telephone: 608/783-7550, Fax: 608/783-8058.

River Almanac is also available on the World Wide Web (*http://www.emtc.nbs.gov/).*

Opinions expressed in this bulletin do not necessarily reflect the position of the U.S. Department of the Interior or any LTRMP participant.

Mention of trade names or commercial products does not constitute endorsement or recommendation for use by the Department of the Interior.

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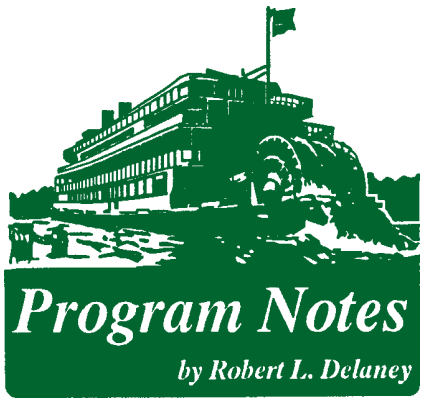

On October 1, the Environmental Management Technical Center and management of the Upper Mississippi River System Long Term Resource Monitoring Program officially became part of the new Biological Resources Division within the U.S. Geological Survey.

We at the Center have long been an advocate for this merger with the Survey and are quite pleased with our new home. Many Center activities involve physical and biological scientists working together to predict Upper Mississippi River status and trends as well as defining the causes of the observed trends. The main reason for the merger of our old home, the National Biological Service, into the U.S. Geological Survey was to provide for a comprehensive integration of the physical and biological sciences within the Department of the Interior. We have worked closely with the Survey on many Upper Mississippi River projects over the past several years and look forward to expanding these productive relationships in the future as part of the "new" U.S. Geological Survey.

We recently jointly developed a proposal for integrating science at the basin level for the Mississippi River System. The potential efficiencies and scientific productivity resulting from this effort are exciting to anticipate. An even more important aspect of our merger, though, is the promise it holds for enhancing our ability to provide sound science for better management of Mississippi River resources. ❐

Welcome *from page 1*

As some of you may know, over the past several months my staff and I have visited three of the 16 NBS Science Centers and met with people from two of the Cooperative Research Units in the field. We have been utterly fascinated by the variety and excellence of the research being conducted there. Over the coming months, we look forward to continuing these visits and further increasing our awareness and understanding of the outstanding contributions that you are making to our Nation's well-being.

I am also pleased at the number of collaborative projects and activities that are already underway or will begin soon. For example, studies in the Chesapeake Bay Program are incorporating the full range of our disciplines–biology, geography, geology, and hydrology–and this fall the Ecosystem Program will solicit proposals for a new ecosystem study area in which BRD can be a full partner from the beginning. In addition, the National Water Quality Assessment Program in the Water Resources Division has included significant cooperative work with NBS on questions that are crucial to the environmental and economic health of our Nation, such as the work on endocrine disruptors that are contaminating our water and impacting our wildlife.

These are just a few of the complex issues facing our society today, issues that demand experts from many different disciplines working together to create meaningful and lasting solutions.

It has been a year of challenge and change for everyone, old and new USGS employees, alike. Some of the changes have been trying, but now it is time to put the past squarely behind us and focus on our future. America's abundant water, biological, land, energy, and mineral resources provide the foundation for much of our Nation's wealth and the well-being and enjoyment of its citizens. We are now uniquely able to provide the knowledge and understanding needed for thoughtful stewardship and sustainable use of these resources to ensure the health, prosperity, and quality of life of current and future generations of Americans.

As a 117-year old Federal science agency with an international reputation of integrity, credibility, and respect, we are genuinely delighted to welcome you as new members of our professional family. ❐

Senate confirms Major General Joe N. Ballard as 49th Chief of Engineers

On September 20, 1996, the United States Senate confirmed Major General Joe N. Ballard as the Army's 49th Chief of Engineers and Commanding General of the U. S. Army Corps of Engineers and his promotion to lieutenant general. An Assumption of Command is scheduled for October 1. He will take command from Maj. Gen. Pat M. Stevens IV, who has been serving as the Acting Chief of Engineers since Lt. Gen. Arthur E. Williams' retirement in June. General Ballard is currently the chief of staff, United States Army Training and Doctrine Command, Fort Monroe, Virginia, a position he has held since July 1995.

Maj. Gen. Ballard was born in Meeker, Louisiana. In 1965, he graduated from Southern University A&M College, Baton Rouge, Louisiana, with a bachelor's degree in Electrical Engineering and was commissioned into the Corps of Engineers. In addition to his master's degree in Engineering Management from the University of Missouri, he is a graduate of the Engineer Officer Basic and Advanced Courses, the Army Command and General Staff College, and the Army War College. He is a registered professional engineer in civil engineering. ❐

Several speakers discuss the importance of the Long Term Resouce Monitoring Program during a September 9 luncheon for H. Martin Lancaster, Assistant Secretary of the Army for Civil Works. Top row, left to right: Marc Schultz, La Crosse Conservation Alliance; Maryann Sumi, Wisconsin Department of Natural Resources; Holly Stoerker, Upper Mississippi River Basin Association. Bottom row, left to right: Dewey Wagner, Operating Engineers for the State of Wisconsin-Local 139; Gil Gutnecht, Minnesota First District Congressman and Robert L. Delaney, Environmental Management Technical Center Director.

EMTC to provide access to related scientific study information via World Wide Web and Internet

by Linda E. Leake

The Environmental Management Technical Center is developing an inventory of biological, physical, and spatial data relating to the Upper Mississippi River System (UMRS). Access will be provided to river scientists, managers, and educators, who will share information about datasets they believe will benefit other UMRS resource managers and decision makers. Information will be captured through a simple online dataset inventory form. This dataset inventory will be available to scientists, resource managers, and the general public via the EMTC HomePage: **http://www.emtc.nbs.gov/http_data/data_set_inventory/dsetinv.html**

"There is quite a bit of scientific information relating to the Upper Mississippi River System that researchers may want to share with others," said Norman Hildrum, EMTC Director of Information and Technology Services. "I hope this service will stimulate significant interest in sharing common data."

Scientists, managers, and educators interested in providing information about their data can access the EMTC Data Set Inventory and enter their information. Questions about this process may be directed to Linda Leake at 608/783-7550 Ext. 13. ❐

Historical monitoring of benthic macroinvertebrates on the Upper Mississippi River System

by Jennifer Sauer

Monitoring of benthic macroinvertebrates on the Upper Mississippi River System (UMRS) has a rich history. Mayflies (Ephemeridae) and fingernail clams (Sphaeriidae) have been studied pre- and post-impoundment (Wiebe 1927, Fremling 1964, Carlander et al. 1967, Eckblad and Lehtinen 1991). The Long Term Resource Monitoring Program (LTRMP) macroinvertebrate component began monitoring selected benthic macroinvertebrates in 1992. Sampling is based on a stratified random design of about 125 sites per study area (see figure); however, a select number of sites are based on historical locations—areas where benthic samples were collected previously.

Long Term Resource Monitoring Program study reaches for macroinverterate sampling

Historical site locations were selected from various reports by universities (e.g., master of science theses) and State or Federal organizations. For example, the Pool 8 historical sites were obtained from graduate work done by Elstad (1977) and the Pool 4 sites were obtained from an Environmental Impact Assessment Study done by Fremling (1973) for the St. Paul District Corps of Engineers. The number of historical sites differs in each study reach, ranging from 4 in Pool 4 to 26 in La Grange Pool. Although historical sites are not used in the statistical analysis of the stratified random sampling sites, they give us an idea of how dynamic macroinvertebrate densities can be from year to year. For example, a historical site in Lake Pepin, Pool 4, was reported to have zero mayflies and 77 fingernail clams per square meter in 1973. The same results were found in 1992 sampling. However, mayfly and fingernail clam densities changed in samples taken in three subsequent years. For the period of 1993-1995, mayfly densities of 0 m^{-2}, 0 m^{-2}, and 327 m^{-2}, respectively, were observed. Fingernail clam densities for this same period were 154 m^{-2}, 0 m^{-2}, and 231m^{-2}, respectively. One of the greatest fluctuations in fingernail clam densities was in La Grange Pool. In Paloumpis and Starrett's 1960 study they found about 24,610 m^{-2} , whereas less than 30 m^{-2} were found in 1992, 1993, 1994, and 1995. With such a short time period available to us, trends in benthic macroinvertebrate (mayfly and fingernail clam) densities are difficult to discern. This is why the LTRMP is so integral to understanding the biology of select macroinvertebrates in the UMRBS. Not only will the data collected provide a baseline for future reference on the distribution and abundance of benthic macroinvertebrates, but also provide data for other analyses (e.g., synthesis among LTRMP components).

References

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Paloumpis, A. A. and W. C. Starrett. 1960. An ecological study of benthic organisms in three Illinois River Flood Plain Lakes. The American Midland Naturalist 64(2):406-435.

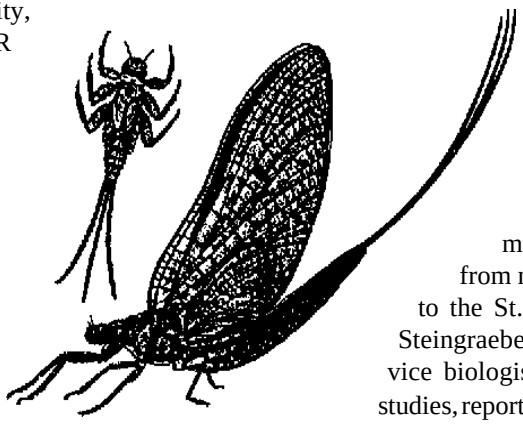
Wiebe, A. H. 1927. Biological survey of the upper Mississippi River with special reference to pollution. Bulletin of the U.S. Bureau of Fisheries 43:137-167. ❐

Mayfly studies track pollution in the Upper Mississippi River

by Terry Dukerschein

While many view mayflies as smelly nuisances that crunch underfoot, local researchers have learned much about pollution in the Upper Mississippi River (UMR) ecosystem by studying these aquatic insects.

If mayflies are present in large numbers in a river system, it usually means sewage pollution is under control. Large quantities of sewage, agricultural runoff, and other gross organic pollutants use up dissolved oxygen and release ammonia in the process of decomposition. These conditions may kill mayflies and other sensitive aquatic organisms. According to surveys done by Dr. Cal Fremling, biology professor emeritus at Winona State University, mayflies occurred along much of the UMR earlier in this century. But as pollution from large unregulated sewage discharges and agricultural runoff increased, mayflies became increasingly scarce or absent in the UMR throughout most of the Twin Cities area and downstream through Lake Pepin. It was only in 1986, after Clean Water Act requirements had prompted greatly improved sewage treatment throughout the Twin Cities metropolitan area, that mayflies were able to recolonize suitable habitats in that stretch of the river.



The resurgance of mayfly populations has been noted by several researchers. Steve DeLain of the Lake City, Minnesota, Field Station said, "Long Term Resource Monitoring Program (LTRMP) data indicate that mayflies have held their own in the Lake Pepin area since annual LTRMP monitoring for mayfly nymphs began in 1992." This observation was confirmed by Jennie Sauer, a biologist with the Biological Resources Division of the U.S. Geological Survey, "Overall numbers of mayflies sampled can vary from year to year in the six LTRMP sampling areas along the UMR and Illinois River, but they are well within the ranges reported by past studies."

Although concerns about sewage discharges have lessened as a result of improved waste treatment practices, persistent toxic pollutants such as certain metals (mercury, lead, and cadmium) and organochlorine compounds (DDT, PCB) were discharged for many years and remain a concern. The metals have been associated with birth defects and certain blood, brain, and kidney ailments. Exposure to some organochlorines has been associated with skin and liver disorders, birth defects, cancer, and hormone disruption. These pollutants tend to attach to tiny floating particles of soil or other debris that travel downstream and eventually settle out in areas of slow water, creating hot spots of contaminated bottom sediment many miles downstream from their discharge site.

Existing as winged adults for only 2-3 days and neither eating nor drinking at this stage, mayflies mate, deposit eggs in the river, and die. Eggs hatch in about 12 days and the tiny, shrimp-like nymphs burrow into the river bottom and emerge as adults the following year. If mayfly nymphs burrow, feed, and grow in areas that happen to be contaminated with persistent pollutants, they can accumulate toxins throughout their 1-year life cycle.

Because many fish, diving ducks, and songbirds can eat large quantities of mayflies, some of these toxins may potentially be transferred up aquatic and terrestrial food chains and become biomagnified (concentrated in the larger, longer-lived organisms such as humans).

Since 1988, several related Federal and State studies have assessed contamination in mayflies and sediments in the UMR from near its headwaters in Minnesota to the St. Louis, Missouri, area. Mark Steingraeber, a U.S. Fish and Wildlife Service biologist involved with several of the studies, reported, "Mayflies collected near large metropolitan areas (Twin Cities, Quad Cities, St. Louis) are typically the most contaminated, with patterns of either sudden or gradual decreases occurring downstream. For example, in the late 1980s, PCBs apparently discharged from the Twin Cities area were still being accumulated by mayflies as far away as 230 miles downstream."

Based on his most recent mayfly work (including the sediment work by John Sullivan of the Wisconsin Department of Natural Resources and investigations by other river researchers from agencies such as the National Biological Service and the U. S. Geological Survey), Steingraeber summarized, "It appears that the Great Flood of 1993 covered some of the more contaminated areas in the UMR with cleaner sediments."

Another interesting preliminary finding in Steingraeber's most recent mayfly study indicates that mayfly nymphs collected near Galena, Illinois, contain sediments contaminated with lead in their digestive tracts. "Lead was formerly mined near Galena. Much lower levels of lead in emergent mayflies collected from this area indicate lead is not accumulated by adult mayflies. This is good news for local songbirds that feed on this insect after it emerges from the water. However, more work will be necessary to determine whether area fish accumulate lead from the contaminated sediment present in the digestive tract of the nymphs that they eat," Steingraeber said. ❐

Abstracts from page 2

Short-term changes in the submersed aquatic vegetation of Lawrence Lake in Pool 8, Upper Mississippi River System

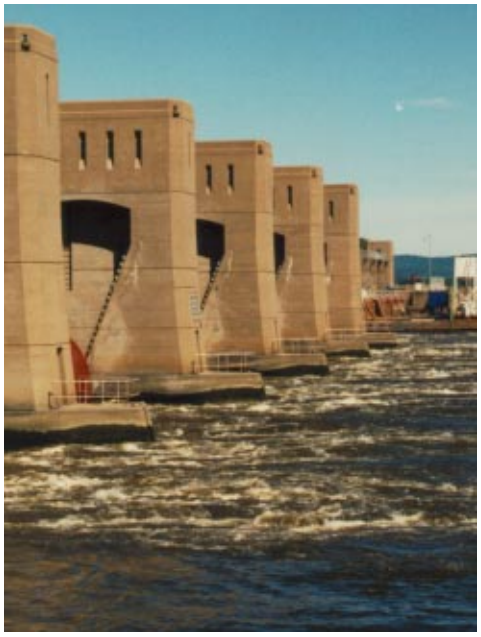
Langrehr, H. 1996. Poster presented at the Twenty-Eighth Annual Meeting of the Mississippi River Research Consortium, La Crosse, Wisconsin, April 25-26, 1996.

Submersed aquatic vegetation is an important habitat component of the Upper Mississippi River System (UMRS). Lawrence Lake, a contiguous backwater in Pool 8, UMRS, has been sampled for submersed aquatic vegetation from 1991 to 1995 by the Long Term Resource Monitoring Program (LTRMP). The LTRMP was initiated to monitor long-term trends in fish, water quality, invertebrates, and vegetation in selected pools of the UMRS. Ten transects were sampled in Lawrence Lake each year. Spring 1991 sampling showed *Ceratophyllum demersum* L. (coontail) occurring in 76% of the sampled sites. By August, however, submersed aquatic vegetation occurred in only 4% of the sites, while *C. demersum* L. occurred in 0.5%. Water quality data collected by the LTRMP indicated elevated turbidity readings for the month of June, possibly limiting light availability. August sampling from 1992 through 1995 showed a recovery in submersed aquatic vegetation; greater than 50% of sampling sites were vegetated. *Potamogeton pectinatus* L. (sago pondweed) and *P. crispus* L. (curly pondweed) were the dominant species in 1992, possibly because of cooler water temperatures. Species dominance shifted again in 1993 and 1994 to *C. demersum* L. and *Myriophyllum spicatum* L. (Eurasian watermilfoil). *Ceratophyllum demersum* L. was again dominant in 1995. *Myriophyllum spicatum* L., however, showed a decline in 1995 while *P. pectinatus* L. increased in frequency. The information collected indicates that both frequency and dominance of submersed aquatic species can change rapidly from year to year. ❐

Historical water elevation and discharge data

by Joe Wlosinski

Water surface elevations and discharge affect all other components listed in the Long Term Resource Monitoring Program Operating Plan, including floodplain elevation, water quality, vegetation, sediment composition, macroinvertebrates, fish, and wildlife. Assuming that the bottom geometry remains constant, river discharge is usually estimated from water surface elevations because these two variables are directly related in uncontrolled rivers. However, this relationship is violated at many of the stations within the Upper Mississippi River System (UMRS) because of a series of 36 lock and dams. For this reason, separate databases are maintained for water surface elevation and discharge.



Water surface elevation and discharge data are not collected by the LTRMP but are obtained from other agencies mandated to collect this information. Water surface elevation data within the UMRS are collected by three district offices of the U.S. Army Corps of Engineers: St. Paul, Rock Island, and St. Louis. Discharge data are collected by the U.S. Geological Survey (USGS) by four State offices: Minnesota, Illinois, Iowa, and Missouri. Both of these agencies have most of the historical record for both variables in electronic form, and those data were obtained by the EMTC. Data are available from as early as 1861, although data collection at most stations was initiated after 1930. The databases developed by the LTRMP contain only data from stations located within the Environmental Management Program, which encompasses the navigable portions of the Mississippi, St. Croix, and Illinois Rivers. Both the Corps and the USGS are now distributing data over the Internet.

The historical water surface elevation database at the EMTC contains data from 160 locations on the UMRS, with 135 stations currently active. The discharge database contains data from 21 locations on the UMRS, of which 14 stations are currently active. Variables in each database include a station code, the year and day of collection, and either water elevation (in feet above sea level) or discharge (in cubic feet per second). The EMTC databases include one value per day, although additional data may have been collected and are available from the Corps or the USGS.

Data are available to Program partners using the EMTC web site (http://www.emtc.nbs.gov), the anonymous ftp (file transfer protocol) at ftp://ftp.emtc.nbs.gov/ltrmp_data, or by telephone or E-mail request to Dave Hansen (608/783-7550, extension 704 or dhansen@emtc.nbs.gov). Several "off-the-shelf" programs are also available for use with both datasets. These include descriptive statistics, plots, exceedence frequencies, and predicted water surfaces by pool at various exceedence frequencies. The data have been used for numerous studies, including Habitat Rehabilitation and Enhancement Projects, studying drought and flood frequencies, planning moist soil units, relating biological variables to physical factors, and planning alternative water level management options. ❐

New Reports

The following reports were recently completed and have been distributed to Program partners. LTRMP reports are available through the National Technical Information Service, 5285 Port Royal Road, Springfield, Virginia 22161 (800/553-6847 or 703/487-4650).

Burkhardt, R. W., and S. Gutreuter. 1995. *Improving electrofishing catch consistency by standardizing power.* North American Journal of Fisheries Management 15:375-381. Reprinted by the National Biological Service, Environmental Management Technical Center, Onalaska, Wisconsin, May 1996. LTRMP 96-R004. 7 pp. (NTIS #PB96-183355)

Fischer, J. R., and T. O. Claflin. 1995. *Declines in aquatic vegetation in Navigation Pool No. 8, Upper Mississippi River, between 1975 and 1991.* Regulated Rivers: Research & Management 11:157–165. Reprinted by the National Biological Service, Environmental Management Technical Center, Onalaska, Wisconsin, July 1996. LTRMP 96-R005. 9 pp.

Hrabik, R. 1996. *Taxonomic and distributional status of* Notropis volucellus *and* Notropis wickliffi *in the Mississippi River drainage: A literature review.* National Biological Service, Environmental Management Technical Center, Onalaska, Wisconsin, July 1996. LTRMP 96-S001. 15 pp.

Owens, T., and D. McConville. 1996. *Geospatial Application: Estimating the spatial accuracy of coordinates collected using the Global Positioning System.* National Biological Service, Environmental Management Technical Center, Onalaska, Wisconsin, April 1996. LTRMP 96-T002. 13 pp. + Appendix.

Rogers, S. J. 1994. *Preliminary evaluation of submersed macrophyte changes in the Upper Mississippi River.* Lake and Reservoir Management 10(1):35-38. Reprinted by the National Biological Service, Environmental Management Technical Center, Onalaska, Wisconsin, June 1996. LTRMP 96-R007. 4 pp.

Tucker, J. K., and E. R. Atwood. 1995. *Contiguous backwater lakes as possible refugia for unionid mussels in areas of heavy zebra mussel* (Dreissena polymorpha)*colonization.* Journal of Freshwater Ecology 10(1):43-47. Reprinted by the National Biological Service, Environmental Management Technical Center, Onalaska, Wisconsin, April 1996. LTRMP 96-R003. 5 pp. (NTIS #PB96-176326)

Tucker, J. K., F. J. Janzen, G. L. Paukstis, R. J. Maher, C. H. Theiling, and J. B. Hatcher. 1996. *Five articles on the eastern box turtle, the red-eared turtle, and the three-toed box turtle.* Reprinted by the National Biological Service, Environmental Management Technical Center, Onalaska, Wisconsin, June 1996. LTRMP 96-R006.

Dr. Dennis Fenn named first Chief Biologist of U.S. Geological Survey

On October 1, 1996, Dr. Dennis B. Fenn was named as first Chief Biologist of the Biological Resources Division (BRD), U.S. Geological Survey. The BRD, formerly the National Biological Service (NBS), will provide scientific research and technologies necessary for the sound management of the nation's biological resources.

Dr. Fenn has a B.S. degree from the University of Arizona and Masters and Ph.D. degrees in soil chemistry and chemistry, respectively, from Michigan State University. Since 1978 he has supervised ecological and biological research in the National Park Service and the NBS. Dr. Fenn assisted in the formation of the NBS and has since served as the Western Regional Director, and more recently as the Deputy Director. ❐

Meetings of Interest

Upper Mississippi River Geospatial Workshop - La Crosse, Wisconsin, *November 18-20, 1996.* This informal workshop is for users of geospatial technologies such as geographic information systems (GIS), remote sensing technologies, and the Global Positioning System. For more information contact Tom Owens, EMTC, 575 Lester Avenue, Onalaska, WI 54650. Phone: 608/783-7550, ext. 20. Fax: 608/783-8058.

ARC/INFO training, Environmental Management Technical Center, Onalaska, Wisconsin, November 5-7, 1996, February 4-6, 1997, and May 5-7, 1997. For more information, contact Doug Olsen, EMTC, 575 Lester Avenue, Onalaska, WI 54650. Phone: 608/783-7550, ext. 17. Fax: 608/783-8058.

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