APPENDICES

Mississippi River Internet Sites of Interest .....A - 2
Activities that can be adapted for the Mississippi River .....A - 3
Examples of Homemade Sampling Equipment
Temperature.....A - 5
Transparency (Secchi Disc) .....A - 7
Volume of Water (Flow and Velocity) .....A - 11
References for more Information .....A - 15
Bibliography of Books about the Mississippi River .....A - 18
Fact Sheets for Animals Included in Activities
Blanding's Turtle.....A - 21
Bald Eagle.....A - 24
Canvasback.....A - 28
Bluegill.....A - 32
Potential Mississippi River Information Contacts .....A - 38

A FEW OF THE INTERNET SITES REGARDING THE MISSISSIPPI RIVER AND OTHER TOPICS (Also use links from these pages)

(Updated 2008)

INTERNET SITE NAME	INTERNET ADDRESS
EXCELLENT STARTING POINTS	
NIC - Navigation Information Connection	http://www2.mvr.usace.army.mil/nic2/default.cfm
Upper Midwest Environmental Sciences Center	www.umesc.usgs.gov/
MAPS	
Color Landform Atlas of the United States	fermi.jhuapl.edu/states/states.html
ORGANIZATIONS	
The Waterways Journal	http://www.waterwaysjournal.net/
Upper Mississippi River Conservation Committee	http://mississippi-river.com/umrcc/
PLANTS AND ANIMALS	
Welcome to the PLANTS National Database	http://plants.usda.gov/
ENVIRONMENTAL EDUCATION SITES	
EE Link – National Assoc. for Environmental Ed.	http://eelink.net/
Environmental Education U.S. EPA Region 5	http://www.epa.gov/region5/enved/index.html
EPA's Surf Your Watershed	http://cfpup.epa.gov/surf/
ESRI – GIS and Mapping	http://www.esri.com/industries/k-12/index.html
Mississippi River Headwaters Board	http://mississippiheadwaters.org/
Nonpoint Source Pollution	http://www.epa.gov/OWOW/NPS/kids/
River of Song	http://www.pbs.org/riverofsong/
Rivers of Life Welcome	http://cgee.hamline.edu/rivers/
WI Association for Environmental Education	http://www.uwsp.edu/cnr/waee
UWEX water resources and environment in Wisconsin	http://clean-water.uwex.edu/
Wisconsin Center for Environmental Education Home Page	http://www.uwsp.edu/cnr/wcee/
Ideas Wisconsin (Search: Mississippi River)	http://www.ideas.wisconsin.edu/
MISC	
Archaeology Mississippi Valley Archaeology Center	http://perth.uwlax.edu/mvac/
Big River, Upper Mississippi news, stories and more	http://www.big-river.com/
Wisconsin Department of Natural Resources	http://www.dnr.state.wi.us/

Activities Which can be Adapted for the Mississippi River

Project *WILD* and Aquatic *WILD*

Aqua Words
Students brainstorm water words, make word trees with those words and write poetic statements about water.
Grades K-4
Awareness and Appreciation

Water Plant Art
Students create artwork from pressed aquatic plants.
Grades K-12
Awareness and Appreciation

Riparian Retreat
Awareness of riparian zone is created through the use of a simulated field trip and art work.
Grades 6-12
Diversity of Values

Water Canaries
Students investigate a stream or a pond using sampling techniques.
Grades 4-12
Diversity of Values

Fashion a Fish
Students design a variety of fish adapted for various aquatic habitats.
Grades K-12
Ecological Principles

Net Gain, Net Effect
Students conduct a simulation to explore the evolution of fishing and the effects of changing technology on fish populations.
Grades 3-6
Management and Conservation

Where have all the Salmon Gone?
Students graph and interpret actual fish population data in relation to historical events.
Grades 6-12
Management and Conservation

Watered Down History
Students investigate the history of a chosen waterway through standard reference sources as well as taped personal interview and public records, where available, and then display their findings in a mural.
Grades 4-8
Culture and Wildlife

Aquatic Times
Students investigate, write and produce a newspaper that features aquatic information and issues.
Grades 1-12
Trends, Issues and Consequences

Dragonfly Pond
Students create a collage of human land-use activities around an imaginary pond.
Grades 4-12
Responsible Human Action

Plastic Jellyfish
Students monitor the plastic waste production in their own households, research its effect on freshwater and marine life, and propose various ways to lessen the problem.
Grades K-12
Responsible Human Action

Something's Fishy Here
Students read and discuss a story, inventing their own endings that lead to environmental action in their community.
Grades 2-8
Responsible Human Action

Examples of Homemade Sampling Equipment

DETERMINING WATER TEMPERATURES (STREAM)

Background

Environmental temperature is an important regulator of life processes. It is one of the important factors that determines the distribution of organisms. Water temperature is especially important because most aquatic organisms are cold-blooded, meaning their temperature is about the same as that of their water habitat. Many aquatic organisms can survive only within certain narrow temperature ranges.

TEMPERATURE RANGES (APPROXIMATE) REQUIRED FOR GROWTH OF CERTAIN ORGANISMS:

Temperature		**Examples of Life**
Greater than 68° (warm water)		Much plant life, many fish diseases. Most bass, crappie, bluegill, carp, catfish, caddis fly.
Less than 68° (cold water)	Upper Range (55-68°)	Some plant life, some fish diseases. Salmon, trout, stone fly, mayfly, caddis fly, water beetles, striders.
	Lower Range (Less than 55°)	Trout, caddis fly, stone fly, mayfly

Objectives

To measure and record water temperature in a stream and explain existing life.

Materials Needed

One thermometer
Yardstick

Procedure

1. Thermometer should be shaded from direct rays of the sun.
2. Bulb of thermometer should be completely immersed in water and left in water for one minute.
3. Reading should be taken while bulb remains in water.
4. If possible, take several readings every six inches from the surface of water to bottom. Average the readings at each depth to get a reliable measurement of temperature.

Note: A flow of water from an outside source, such as a pipe or ditch, may influence the temperature of the water you are studying.

Interpretation

Water has the capacity to store vast amounts of heat. Changes in water temperature take place gradually. Three to five times as much energy is used in heating a gram of water 1° C as would be used in heating a gram of soil the same amount. Thus, changes in water temperature from day to night, as well as season to season, are relatively small. This is a matter of great importance to aquatic life that cannot cope with sudden, drastic temperature ranges. Within the tolerated range, however, death may still occur if sudden temperature change occurs.

Questions/Discussion

1. Using the data and temperature chart above, determine what type of life may be present.
2. Can you think why one temperature reading is sufficient for a fast-moving stream?
3. Why is surface water generally the warmest?
4. What is the reason for not removing the thermometer from water when reading it?

Credit

Take from: Iowa Assist's Local Ecology Project-Water and the Pittsburgh District US Army Corps of Engineers' Water Resources-Interpretive Lesson Plans

TRANSPARENCY (TURBIDITY)

Background

Water transparency determines the depth of light penetration and gives an indication of the amount of suspended matter in the water. Transparency is measured with a Secchi disc or an inexpensive homemade version.

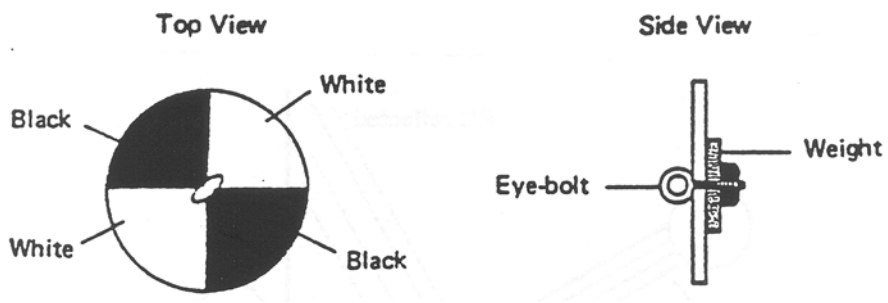
Objective

To measure and determine the amount of light penetration in the water.

Materials Needed

One Secchi disc
One calibrated cord

Improvising: Use a metal pot lid, acrylic plastic, or plywood.
The disc diameter must be 20 cm. (8 inches).
Paint disc black and white as follows:



Disc may need to be weighted so it hangs straight in the water or place on a pole if measuring transparency in flowing water.

Procedure

1. Attach the disc to the calibrated cord and lower it into the water.
2. Lower the disc until it just disappears from view, and record the depth.
3. Then lift the disc and record the depth at which it reappears.
4. The average of the readings is the limit of visibility.

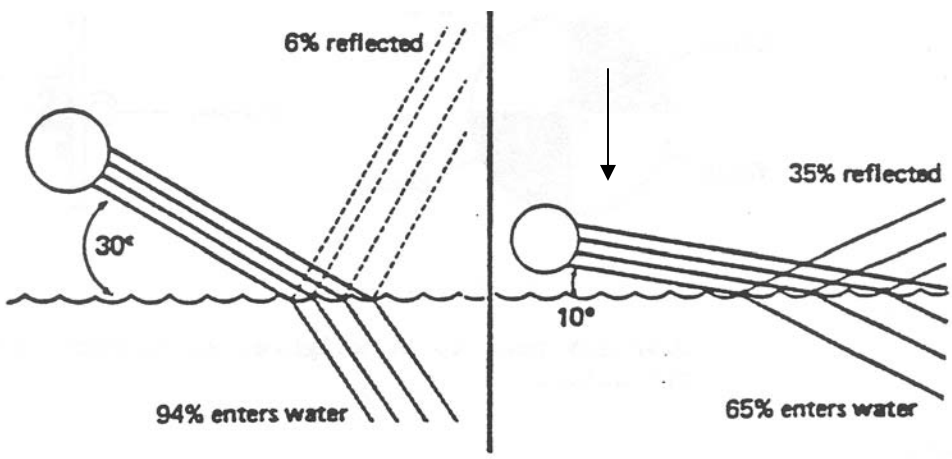
Note: Standard conditions for taking readings are overhead sun, no clouds, and minimum waves or ripples. Readings should be taken from the shady side of the boat

or dock. If you take readings under other conditions, record these conditions so these influences can be considered when reviewing the data.

Comparisons can be made at various locations in the pond and at intervals throughout the year, before and after heavy rain, snow, or freeze, etc.

Interpretation

Energy captured from sunlight through photosynthesis of green plants powers all living systems. Aquatic organisms depend on the amount of the sun's energy available within their habitat, just as land organisms do. Not all light falling on a water surface penetrates the water. The proportion reflected depends upon the angle at which the light strikes the surface. At a 30° angle from horizontal only about 6 percent is reflected, while at 10°, 35 percent is reflected. Thus, much more light enters a body of water during the middle of the day than in early morning or evening.



Much of the light that is absorbed by water is converted into heat. Therefore, the depth to which light penetrates can have an important effect on the temperature of a body of water. In water that is not clear, most light will be absorbed near the surface; the surface temperature will tend to be higher than in clearer water where light is absorbed over a greater depth.

Biologists often speak of the productivity of a body of water or area of land. Productivity refers to the amount of living materials that the water or land can support. For example, a forest is usually more productive than a desert.

Light penetration in water can be limited by large numbers of tiny living organisms or by nonliving materials such as sand or silt. Secchi disc readings can give an indication of the productivity of a body of water. In very productive waters, light penetration will be

limited by the presence of billions of tiny living organisms. The depth to which one can see a Secchi disc will be much more limited than in less productive waters having fewer organisms. Clear water is an indication of low biological productivity. A water of low productivity is a poor water, biologically speaking, but is a clean water and desirable as a water supply or for recreational use. A productive water may be either a nuisance to man or it may be highly desirable. Foul odors and weed-choked waterways are usually branded a nuisance; however, bumper crops of bass, catfish or sunfish may be the result and are highly desirable.

Differences will occur throughout the year, especially in spring and fall due to "blooms" of organisms. Predominant species in a "bloom" may change every two weeks, causing turbidity changes, too.

Secchi Disc Reading	**Inferences**
0" - 6"	Most productive waters Minimum oxygen from photosynthesis Maximum algae growth
6 " - 12"	↕
12" – 24"	
Greater than 24"	Least productive waters Maximum oxygen from photosynthesis Maximum algae growth

Remember that light penetration can also be blocked by nonliving material. Thus, it is important to know what kind of suspended material is present before deciding what Secchi disc data mean.

Questions/Discussion

1. What is the reason for using a black and white disc as opposed to one of another color? Try changing colors – does it make a difference?

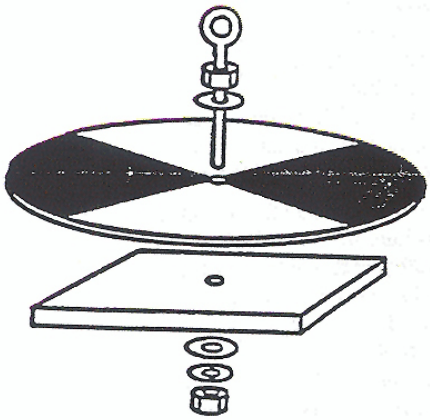
MAKE YOUR OWN SECCHI DISC!

Here are two ways you can make your own secchi disc:

Constructing a Secchi Disc (Version I) (adapted from the *Volunteer Monitor*, Vol. 3, No.1)

Secchi discs can be made out of many materials on hand. Generally, they are constructed out of steel (1/8" thick), Plexiglas (1/4") or marine plywood (1/4" - 1/2"). The lighter materials must be weighted down with washers or weights. Steel and wood discs must be painted on all sides. Plexiglas can be purchased in white opaque and the surface must be roughed with fine sandpaper and the disc warmed before painting, Flat enamel paint works best in most cases. The disks should be 20 cm (8 inches) in diameter and have a 3/8" hole in the center to accommodate an eyebolt.

Assemble discs with the eyebolt (5/16" diameter). Use flat washers between the disc and nut, and between the steel plate and locking washer. Use 5/16" nuts at the top of the eyebolt, and to bolt the steel plate onto the disk (*see diagram*).



Constructing a Secchi Disc (Version II)

(adapted from the *TVA Water Quality Series Booklet 2: Homemade Sampling Equipment*)

A simple homemade Secchi disc can be easy to make by following the directions below:

MATERIALS

1 circular stiff plastic lid, flattened pie plate, piece of plywood or other material (20 cm in diameter)
Empty pen housing or metal casing
Scissors
Drill with 1/2 or 3/8 inch bit
50-ft nylon rope
Yardstick
Electrical or duck tape
Rock or other weighting device
Black and white enamel paints
Paint brushes

DIRECTIONS

1. Cut lid, pie plate, or plywood into a circle, 20 cm (8 inch) in diameter.
2. Paint the circular piece in black and white quarters as shown.
3. Drill a hole in the center of the disk and insert the pen housing or metal casing. The fit should be snug.
4. Draw the rope through the casing and tie it to the rock or other weighting device as shown.
5. Use the yardstick to mark off 1-foot increments on the nylon rope. Wrap the tape around the rope to mark the 1 foot increments.

References:

http://humboldt.kent.edu/~carlson/secchi.html
http://www.detlakes.k12.mn.us/www/waterwatch/secchi.html
http://www.epa.gov/OWOW/volunteer/vm_index.html

Ely, Eleanor, ed. *Volunteer Monitor: The National Newsletter of Volunteer Water Quality Monitoring.* San Francisco, CA. (Vol. 3, No.1).

Betz, Carolyn Rumery (Revised by Jo Temte and Celeste Moen, 4/6/92). *Self-Help Lake Monitoring Handbook.* Wisconsin Department Of Natural Resources Lake Management Program. 1993. [PUBL WR-251 90]

Towne, Chari and Lowell Klessig. 1992. *Adopt-A-Lake Project: A Resource Guide for Leaders.* UWEX-UWSP: Stevens Point, WI.

Tennessee Valley Authority. *TVA Water Quality Series Booklet 2: Homemade Sampling Equipment* (Booklet Pepared for Use with TVA's Teacher/Student Water Quality Monitoring Network).

VOLUME OF FLOW (CUBIC FEET PER SECOND)

Background

IT is sometimes quite incredible how large the volume of water is that can flow past you. This activity outlines a method of calculating this figure for a river or stream.

Volume of flow influences many factors such as dissolved oxygen concentration, carbon dioxide concentration, and temperature. It also has an effect on the numbers and kinds of organisms in that area.

Objective

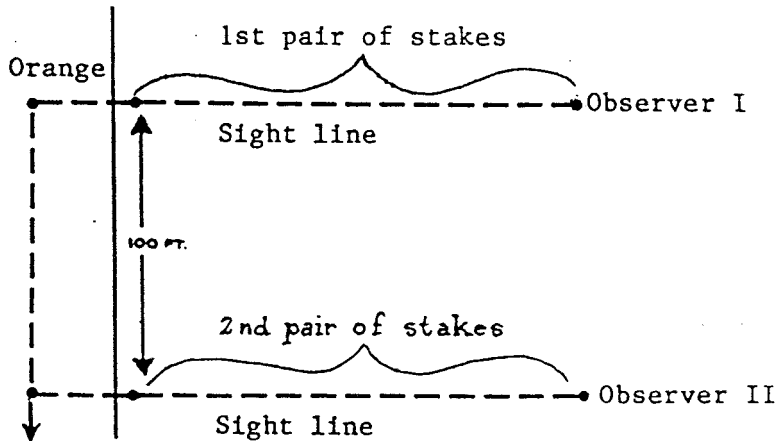
To measure and determine the volume of flow in a specific area of a river or stream.

Materials Needed

Watch with second hand or stopwatch
Orange or lemon
Tape measure
4 stakes

Procedures

1. Measure and mark 100 ft. distance along a straight section of a stream. Pairs of stakes on parallel lines should be set up on the bank.



2. Place the orange upstream of the first pair of stakes so that the orange will reach the rate of flow of the stream by the time it passes the first observer. Orange should be free floating and placed where flow rate seems greatest. Orange should move

perpendicular to the two parallel sight lines. Also try to obtain data in a location shielded from the wind.

3. Record the number of seconds it takes to float downstream between the stakes. Divide the 100 ft. distance by the total seconds it took the orange to float between the stakes. Repeat steps 2-3 two more times. Average the three readings.

4. Find the average wide of the stream by measuring the width of the stream in three places within the 100 ft. area and averaging the results.

5. Find the average depth of your section of the stream by measuring the depth of the stream in a straight line in three places and averaging the results.

6. To compute the rate of volume or volume of flow in cubic feet per second use the formula: R = VWDA

   R = rate of flow
   V = velocity (Step 3)
   W = width (Step 4)
   D = depth (Step 5)
   A = streambed constant

   (The value of A is 0.8 if the streambed is composed of rubble or gravel and 0.9 if the streambed is quite smooth – sand, mud, silt, or bedrock.)

<u>Interpretation</u>

A cubic foot of water is the water in a container one foot wide, one foot high, and one foot long, and contains 7.48 gallons. In order to find out how many people could live from the water in this stream, complete the following calculations:

_____	X	_____	=	_____
Stream flow in cu. ft. per sec.		Gallons in 1 cu. ft. of water		Gallons of water per second

_____	X	_____	=	_____
Gallons per second		Sec. in minute		Gallons of water per minute

_____	X	_____	=	_____	+	_____	=	_____
Gallons of water per min.		No. of minutes in a day		Total gal. water per day		Amount of water one person uses per day		Total no. people who could live from water in this stream

*The average person uses about 200 gallons of water a day for home use. This does not reflect each person's share of water used for industrial, public services, and commercial uses.

An important characteristic of streams is the volume of flow. It controls many other factors of lesser importance. Factors such as oxygen content, water temperature, composition of streambed, amount of food available, and pollution level are all influenced by the speed and volume of the water. All these factors directly affect the types and numbers of plant and animal species which exist, that is, the productivity.

In slow-moving streams, species of plants and animals may be similar to those in a pond. Animals for slow-moving streams usually require less oxygen. Examples of animals found in slow-moving streams are: suckers, water striders, and turtles. Fast-moving streams with better oxygen levels can support animals like trout and the larvae of caddis fly.

Questions/Discussion

1. If you measure the volume of flow for the same stream in a very wide section and in a very narrow section, will the two volumes differ?

2. What would be the reason for the use of the streambed constant?

3. Is the rate of flow affected by the geology of the stream?

4. How does velocity affect dissolved oxygen content?

5. What are some ways stream organisms have adapted to life in rapidly flowing water?

6. How can people reduce the amount of water they use every day?

7. How many people use the stream as a water source? Is it being overused?

8. Should water consumption be regulated in places where there are shortages?

ALTERNATIVE ACTIVITIES

Observing Bottom Currents

Observe bottom current by placing small rounded pebbles (or marbles, beads, etc.) into the stream. What size and weight of particle is moving downstream? Compare straight with curved portions of the stream; wide with narrow; flat with steep; upland with lowland. Relate the observations to the actual stream bottom particles.

Study Surface Current Action

A dye, such as food coloring, which will not harm the ecology can be used to study surface current action. Concentrated dye is placed on the water and the rate of diffusion (spreading) is observed as the color spreads and may disappear (dilution). Look for areas where the coloring accumulates or concentrates. Biologists and water quality specialists use this technique to measure the flow patterns of water in areas with very little current velocities – velocities which are difficult to measure with even the most sensitive equipment. However, dye studies cannot be used estimate the flow of water in a stream because of the many different factors which could interfere with it's travel (wind, eddies, etc.)

References for More Information

***Monitoring the Miss**:*

Meade, R. H. Contaminants in the Mississippi River, 1987-92. U.S. Geological Survey Circular 1133, Denver, CO. 1995.

Project Wild. Aquatic Project Wild--Aquatic Education Activity Guide. Western Regional Environmental Education Council, Inc., 1992.

Project Wild. Project Wild Activity Guide. Western Regional Environmental Education Council, Inc., 1992.

Robinson, A., and R. Marks. Restoring the Big River--A Clean Water Act Blueprint for the Mississippi. Izaak Walton League of America and Natural Resources Defense Council, 1994.

Steingraeber, Mark T., et al. "Polychlorinated Biphenyl Congeners in Emergent Mayflies from the Upper Mississippi River." Environmental Science & Technology. 1994, **28** (4), 707-714.

Sullivan, John F. A Review of the PCB Contaminant Problem of the Upper Mississippi River System. Wisconsin Department of Natural Resources, 1988.

Sullivan, J., D. Stoltenberg, S. Manoyan, J. Huang, R. Zdanowicz, W. Redmon. Upper Mississippi River Water Quality Assessment. Upper Mississippi River Conservation Committee, Rock Island, IL. 2002.

Weiner, James G., et al. (ed.) Contaminants in the Upper Mississippi River--Proceedings of the 15th Annual Meeting of the Mississippi River Research Consortium. Boston: Butterworth Publishers, 1984.

Wisconsin Department of Natural Resources. Wisconsin Water Quality Assessment Report to Congress 1994. Publ-WR254-94-REV. Wisconsin Department of Natural Resources, 1994.

Messin in the Mud:

Project Wild. Aquatic Project Wild--Aquatic Education Activity Guide. Western Regional Environmental Education Council, Inc., 1992.

Robinson, A., and R. Marks. Restoring the Big River--A Clean Water Act Blueprint for the Mississippi. Izaak Walton League of America and Natural Resources Defense Council, 1994.

Sullivan, John F. Water Quality Characteristics and Trends in the Main Channel of the Upper Mississippi River: A Review of Wisconsin's Ambient Water Quality Monitoring Program (1977-87). Wisconsin Department of Natural Resources, 1989.

Upper Mississippi River Basin Association. How Clean is the Mississippi River? Bulletin. 415 Hamm Building, 408 St Peter Street, St Paul, Mn.

Upper Mississippi River Basin Association. Sediment: Clogging the Lifelines of the Upper Mississippi River System. Pamphlet. 415 Hamm Building, 408 St Peter Street, St Paul, Mn.

Weiner, James G., et al. (ed.) Contaminants in the Upper Mississippi River--Proceedings of the 15th Annual Meeting of the Mississippi River Research Consortium. Boston: Butterworth Publishers, 1984.

Wisconsin Department of Natural Resources. Wisconsin Water Quality Assessment Report to Congress 1994. Publ-WR254-94-REV. Wisconsin Department of Natural Resources, 1994.

Migration Headache:

1. Contact the Wisconsin DNR for more information on waterfowl. Fact sheets are available for the following species: mallard, blue-wing teal, redhead, canvasback, wood duck, trumpeter swan and Canada goose. Wetland information available includes a magazine supplement, "Wetlands, Wonderlands," with a poster "A Wetland Year." In addition, the DNR has information on the Stewardship Program and wildlife areas. Please write to:

Educational Programs
Bureau of Information and Education
Department of Natural Resources
P.O. Box 7921
Madison, WI 53707

2. Books: (note: numerous books are available, this is just a small sample)

Bellrose, Frank C. Ducks, Geese and Swans of North America. Harrisburg, PA: Stackpole Books.

Gooders, John and Trevor Boyer. Ducks of North America and the Northern Hemisphere. New York: Facts on File Publications. 1986.

Heintzelman, Donald S. North American Ducks, Geese and Swans. New York: Winchester Press. 1978.
Hoshing, Eric. Wildfowl. New York: Facts on File. 1985.

Johnson, Phyllis. A Guide to the Field Identification of Birds of the Horicon marsh. Wisconsin: Marsh Haven Nature Center. W6431 Sunset Road Juneau, WI 53039. 1986.

Lincoln, Frederick C. Migration of Birds. Circular 16. U.S. Fish and Wildlife Service/U.S. Department of the Interior. 1979.

Line, Les and Kimball L. Garret and Kenn Kaufman. The Audubon Society Book of Water Birds. New York: Harry N. Abrams, Inc. 1987.

Mackenzie, John P. S. Birds in Peril. Boston: Houghton-Mifflin Co. 1977.

3. Wisconsin Wetland Inventory Maps: The Wisconsin Geologic and Natural History Survey can send you paper copies of aerial photographs with wetlands outlined on them. Each wetland will have a letter and number indicating its type. Call or write the survey to determine what maps will cover the area you want to visit. You'll need to provide information on township, range and section. The cost: $2.00 per map. Orders must be prepaid. Wisconsin Geologic and Natural History Survey/Map Sales, 3817 Mineral Point Rd., Madison WI 53705. (608) 263-7389.

4. The following organizations may also have useful information:

U.S. Fish and Wildlife Service Twin Cities Regional Office (Region 3) Federal Building, Fort Snelling Twin Cities, MN 55111	The Nature Conservancy 333 W. Mifflin St. Suite 107 Madison, WI 53703	Wisconsin Wetlands Association 111 King Street Madison, WI 53703
International Crane Foundation E-11376 Shady Lane Road Baraboo, WI 53913-9778	Ducks Unlimited 1 Waterfowl Way Long Grove, IL 60047	Wetlands for Wildlife, Inc. Box 344 West Bend, WI 53095

Turtle Hurdles

A slide and cassette program entitle “Let’s Talk Turtles”, #518, is available through the Minnesota DNR’s film loan service. It may be obtained by writing to:

MN DNR Bureau of I & E
500 Lafayette Rd.
St. Paul, MN 55155-4046
or by phoning: (612) 296-0899

“Turtles in Minnesota” a brochure produced by the Bell Museum of Natural History, 10 Church St. SE, Mpls., MN 55455.

Minnesota Endangered Flora and Fauna, Coffin and Pfanmuller, eds., available through most libraries.

Bibliography of Books about the Mississippi River

Adult and or High School Literature

Anfinson, John. 2003. The River We Have Wrought. University of Minnesota Press. Political and social history of the Upper Mississippi from the time of early European exploration (1823) through the completion of a navigable channel and a system of locks and dams (1940).

Carlander, Harriet B. 1954. History of Fish and Fishing in the Upper Mississippi River. Upper Mississippi River Conservation Committee.

Eyden, Pamela et al. 1996. Big River Reader : an Anthology of Stories about the Upper Mississippi, from the First Four Years of Big River. Winona, Minnesota.

Fredrick, J.L. 2004. Cursed by the Wind. Joel Lovstad Publishing. (In July 1890, the riverboat, *Sea Wing,* steamed across Lake Pepin only to be destroyed by a swift tornado. This fictional rendition of an historical event is told from the perspective a 13-year old boy.)

Havighurst, Walter. 2003. Voices on the River, The Story of the Mississippi Waterway. University of Minnesota Press. The book gathers memories of a wide variety of Mississippi River characters, mixing fact and colorful stories. Originally published 1964.

Hoops, R.A. River of Grain: The Evolution of Commercial Navigation on the Upper Mississippi River. Send to: Publication Distribution, Room 245, 30 N. Murray St., Madison, WI 53715.

Leopold, Aldo. 1966. A Sand County Almanac With Essays on Conservation from Round River. Ballantine Books. A must read for all natural resource enthusiasts. Journey with Leopold as he observes the natural resources abound him through the seasons.

Madson, John. 1985. Up on the River: An Upper Mississippi River Chronicle. Nick Lyons Books (Schocken Books). Collection of short stories about the people and wildlife on the Upper Mississippi River.

Meade, Robert H. 1995. Contaminants in the Mississippi River, 1987-92. U. S. Geological Survey.

Merrick, George B. 2001. Old Times on the Upper Mississippi: The Recollections of a Steamboat Pilot from 1845 to 1863. University of Minnesota Press. Merrick chronicles the panorama of steamboat life in the mid-1800s. Originally published in the early 1900s.

Merritt, Raymond H. 1979. Creativity, Conflict & Controversy: A History of the St. Paul District U. S. Army Corps of Engineers. U.S. Army Corps of Engineers.

Neuzil, Mark, Henry Bosse, Merry A. Foresta. 2002. Views on the Mississippi: The Photographs of Henry Peter Bosse. University of Minnesota Press. Photos taken in the late 1800's. Includes descriptions of each photo.

Robinson, A. and R. Marks. 1994. Restoring the Big River: A Clean Water Act Blueprint for the Mississipp. Izaak Walton League of America. A call to action for improving the Mississippi River's habitats and watershed.

Russell, Charles Edward. 2001. A-Rafting on the Mississip. University of Minnesota Press. History of transporting logs harvested from Northern Minnesota and Wisconsin down the Mississippi in the late 1800's.

Severin, Timothy. 2002. Explorers of the Mississippi. University of Minnesota Press. Spirited stories of heroes and scoundrels who explored the River. Orriginally published 1968.

Stumm, Robert. 1997. A postcard Journey Along the Upper Mississippi. Templegate Publishers. Postcards dating from 1905-1920 provide a historic travelogue down the Mississippi. Short narratives accompany each postcard.

Technical Papers

Lubinski, K., J. Wiener and N. Bhomik. September 1995. Regulated Rivers Research & Management. Wiley Publishers.

Lubinski, K., J. Wiener and N Bhomik. October 1995. Regulated Rivers Research & Management. Wiley Publishers

Miller, J. Etal. 1995. BioScience: Ecology of Large River. American Institute of Biological Sciences.

Children's Literature

Baker, Sanna Anderson. 1996. Mississippi Going North. Albert Whitman and Company. Describes the sights that can be seen canoeing north from the headwaters of the Mississippi River through the remote natural settings. (elementary)

Browne, Michael Dennis. 2004 Give Her the River. Atheneum Books for Young Readers. A father dreams of all the things he will give his young daughter. He decides a river captures his feelings for her best. (elementary – high school).

Chrustowski, Rick. 2006. Turtle Crossing. Henry Holt Publishing. Follows the life of a painted turtle. (elementary)

Dunphy, Madelin. 1996. Here is the Wetland. Hyperion Books for Children. Cumulative approach to describe wetland ecology. Similar in format to "The House that Jack Built." (elementary)

Fredrick, J. L. 2004. Cursed by the Wind. Joel Lovstad Publishing. In July 1890, the river boat Sea Wing steamed across Lake Pepin only to be destroyed by a swift tornado. This fictional rendition of an historical event is told from the perspective of a 13 year old boy. (upper elementary – high school)

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Fact Sheets for Animals Included in Activities

Blanding's Turtle
(Emydoidea blandingii)

Turtles are an important link to the past history of life on earth. It is believed that turtles have survived for millions of years as inhabitants of our planet; however today, here in Wisconsin, many turtle species are being threatened. One such species is the timid, gentle Blanding's turtle.

Legal Status in U.S.: Unprotected
Legal Status in Wisconsin: Threatened
Length: 8 to 10 inches
Weight: Up to 3 pounds
Range in Wisconsin: Throughout the state except the
extreme north-central counties.

Description
Distribution and Habitats
Life History
Current Status
Excerpt from the Animal Guide

Description

Named after its discoverer, the Blanding's turtle is medium-sized. It can be easily identified by the bright yellow underside of its neck. Its head, tail, and limbs are blue-black, while the underside of its shell (or plastron) is yellow, with brown or black splotches, and is hinged. Its upper shell (or carapace) is usually black speckled with yellow, or horn colored and mottled with brown. The young are patterned differently from adults; their shells help them blend in with their surrounding environment. The hinge of the Blanding's turtle's plastron is not functional until the turtle is 3 to 5 years old. Before this age its yellow throat markings are not apparent. The function of the yellow chin is unknown (perhaps it has something to do with mating). Males are larger than females, have longer tails, and their plastrons are concave for mating. The hinged plastron allows the turtle to close the front half of the shell tightly, protecting the soft flesh of its head, neck, and legs from predators. Due to this behavior, this species is sometimes referred to as the "semi-box turtle."

Distribution and Habitat

The original range of the Blanding's turtle extended from southern Ontario and northwestern Pennsylvania in the East, through Ohio, Indiana, Michigan, Illinois, Wisconsin, and southern Minnesota and is found in Nebraska, Iowa, and extreme northeastern Missouri in the West.
In Wisconsin, Blanding's turtles live throughout the state with the exception of the extreme north-central counties. They are most concentrated in the vast marshes along the Wisconsin River in Wood, Juneau, Adams, and Iowa counties. While Blanding's turtles live primarily in marshes and the shallow bays of lakes, they also can be found in shallow, slow-moving rivers, streams, and some northern bogs.
A map outlining Pre-1977 and 1997 to Present Distribution is available.

Life History

The Blanding's turtle is semi-aquatic. It prefers open, grassy marshes containing shallow water, but it will, on occasion, move to ground adjacent to water to forage or bask in the sun. While in the water, it feeds on crustaceans, snails, insects, frogs, and fishes. Crayfish appear to be a preferred food when available. When on land, however, it consumes earthworms, slugs, grasses, berries, and succulent vegetation. The Blanding's turtle is unique because, unlike most turtles, it can swallow food both in and out of the water. During the winter, it hibernates by burying itself in the silt on the bottom of the pond, bay, or river it inhabits which reduces its chances of freezing.

Blanding's turtles require 15 to 20 years to mature. Mating usually occurs in the water during early spring. After fertilization, females will bask in the sun with their heads and legs fully extended. This warming behavior, called thermoregulation, speeds the development of their eggs enabling them to be laid sooner. This gives the eggs a better chance of hatching before the autumn frost. This, in turn, allows the hatchlings to grow before hibernating, giving the immature turtles a greater chance of surviving the winter. About one-half of the female population breeds annually. Like all turtles, they must lay their eggs on land and prefer a patch of sandy ground for nesting. They will travel up to one and a half miles from water to nest, and they usually return to the same nesting site each year. They typically lay their eggs during the late afternoon or after dusk. Once they deposit the eggs in the ground, the mothers return to the water, and the sun's warmth is used to incubate the nested eggs. The clutch may contain from 3 to 17 elliptical eggs. Between 65 and 90 days pass before they hatch.

The nests, however, are not safe. Subject to predation by birds and small mammals such as crows, skunks and raccoons, many eggs are lost in the first 24 hours of incubation. Those that do hatch are in danger of additional predation and highway mortality as they travel to their aquatic habitat. Hatchlings are about one and a quarter inches long and range from dark gray to greenish in color. Little is known about the habits of the young. They appear to be very secretive, foraging exclusively in aquatic habitats which are densely vegetated. Once they are about 6 inches long they can be seen basking and foraging more easily and often.

Even fully grown the Blanding's turtle is one of nature's most timid creatures. Due to their shyness, they must be approached very delicately if they are to be observed. If disturbed on land, the Blanding's turtle will pull itself tightly into its shell. If it is basking in an aquatic environment, it may quickly dive and remain hidden in the watery depths if it senses danger. It will remain at the bottom for 20 to 30 minutes at a stretch before again peeking carefully above water. Though shy, the Blanding's turtle is also exceedingly gentle and will very rarely attempt to bite.

Current Status

Maintaining both its aquatic and terrestrial environments is critical to the survival of the Blanding's turtle. Its population in parts of Wisconsin has become limited as natural wetlands are drained in preparation for suburban development or for conversion to soil adequate for farming. These practices dramatically affect the local turtle population by shrinking and fragmenting its habitat. In addition, the introduction of new roads with increased traffic results in the accidental killing of Blanding's turtles as their shells cannot withstand the weight of an automobile. A road presents a major hazard if its placement requires the turtles to cross it to either lay their eggs or to reach their non-aquatic foraging grounds. Wet-lands — with adjacent territory — provide the stable environment needed for the well-being of the Blanding's turtle. Without this stable environment, the future of this and many other species is threatened.

Excerpt from ***THE ENDANGERED AND THREATENED VERTEBRATE SPECIES OF WISCONSIN***

Status: State Threatened (1979).

Occurrence: Found throughout most of Wisconsin except for the mature hardwood forests region of the northern counties. A map outlining Pre-1977 and 1997 to Present Distribution is available.

Aid to ID: Medium sized semiaquatic turtle characterized by a long neck and a bright yellow throat, a distinct plastron (bottom shell) hinge, and a smooth carapace (top shell). Head, tail and limbs are blue-black or brown, the plastron is blue-black or brown and yellow, and the carapace is usually black speckled with yellow. Males are larger than females, have longer tails, and have concave plastrons. Hatchlings are dark gray or greenish and have a tail that nearly equals the carapace length.

Habitat: Prefer shallow and deep marshes, the shallow bays of lakes and reservoirs, shallow, slow moving streams and rivers, and backwater sloughs with soft bottoms and aquatic vegetation. Rarely found in northern forested regions, fast moving rivers or northern bogs.

Food Habits: Forage in water and on land. Omnivorous diet includes: crustaceans, snails, insects, frogs, crayfish, earthworms, slugs, grasses and berries.

Natural History:

Active: Diurnally April to November. Will frequently leave water to forage in open, wetland fringe communities.

Hibernation: November to April in mud or debris on bottom in deeper water ponds and streams.

Reproduction: Mate in early spring and fall, usually in water. Females lay clutches of 6-15 (avg. 10) eggs beginning in June during late afternoon or at dusk. Use sandy, open, upland sites up to 1.5 miles from water. Eggs hatch in 65-90 days. Sexually mature in 14-20 years. Females breed every other year.

Management Considerations: Threatened by habitat loss and fragmentation due to draining of wetlands, heavy nest predation, highway mortality, and low nesting frequency. Predator exclosures may effectively reduce predation where nesting is concentrated. Barriers along roadways have proven effective in reducing adult turtle mortality.

Information compiled from publications ER-529 92REV and ER-091.

Top of page || Endangered Resources || E/T List
Mammals, Birds, Reptiles & Amphibians and Fish List

Home || Search || Feedback || What's New

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Wisconsin
Department of Natural Resources

Home | Search | Feedback | What's New

Bald Eagle
(*Haliaeetus leucocephalus*)

Legal status in U.S.: Threatened
Legal status in WI: delisted
1991 numbers in WI: 900
Length: female 34-43 inches male 30-35 inches
Wingspan: 7 feet
Weight: 8-14 pounds

Description
Food
Breeding Biology
Distribution
History in Wisconsin
Current Status in Wisconsin
Research and Management
What You Can Do
Further Reading
Endangered Resources Reports

Description
Bald eagles are well-known as our national symbol. The adult eagle's most distinctive characteristic, its white head, is described by both its common name, "bald," and scientific name, "*leucocephalus*," which means "white head." An adult bald eagle's white head and tail contrast strikingly with its dark-brown body. Its large bill, feet and eyes are yellow.
Immature bald eagles are harder to identify. They are dark-brown with only spatterings of white on the underwings and tail. Head and tail feathers don't turn white until the birds are four or five years old. Immature eagles' feet are yellow, but unlike the adults, their bills and eyes are brown. Thus, it is easy to confuse immature bald eagles with large hawks or golden eagles. Bird identification guides describe ways to tell these birds apart.

Food
Bald eagles feed primarily on fish. In Wisconsin, the most important species are suckers, northern pike, muskellunge and bullheads. Eagles scavenge dead fish along shorelines and capture live ones with their feet. Their talons are strong and sharp, good for grasping prey. Occasionally, eagles eat waterbirds or mammals. Often these are carrion, like roadkilled deer.

Breeding Biology
Bald eagles are sexually mature when four or five years old. A courting male and female will engage in aerial displays (soaring, chases, dives, siderolls) that are thought to help cement the bond between them.

During the breeding season, bald eagles establish and defend territories. Mated adults usually return to the same breeding territory each year. Thus, a newly mated pair must find a territory that is unoccupied. If one member of a pair dies, the other will remate. The territory must have a suitable nesting site (4 large tree) and be near water with an adequate supply of fish. Eagles also require isolated areas, for they are easily disturbed by human activities.

In February or March, Wisconsin bald eagles begin building a nest or repairing one they built a pervious year. They usually build in a tall tree, often a live white pine. Nests are made of large sticks and other vegetation, the sticks forming the shell and more flexible greens lining the inside platform. The average nest is four feet in diameter and three feet deep. Eagles will build more than one nest in their territory, although they use only one each breeding season. If the pair reuses an old nest, they add new materials to it. A nest may become so big and heavy that it makes the tree susceptible to breakage during storms. Sometimes the entire nest will blow down.

The female eagle usually lays two white, three-inch long eggs in late March or early April. Both adults incubate the eggs starting when the first one is laid. The first egg hatches about 40 days later. Both parents feed the downy white chicks. They carry fish back to the nest, tear off bits with their beaks and place the food in the chicks' beaks. Eggs and chicks are vulnerable to the effects of severe weather and predation from great horned owls, ravens and raccoons. Many chicks don't survive the first year.

When three months old, the young eagles are able to fly. They exercise their wings and soon leave the nest. For several weeks, they stay near the nest site and the adults as they become familiar with the area and how to find food.

Distribution

Bald eagles live only in North America. Historically, they inhabited the entire continent wherever there were adequate nest sites and an abundant supply of fish. However, due to human activities, bald eagle populations have declined dramatically throughout most of the species' range. While small numbers of eagles presently nest in many regions of North America, the largest breeding populations are in Alaska and Canada. In Wisconsin, bald eagles nest along the shores of inland lakes and rivers. Their largest breeding concentrations are in the northern third of the state.

Bald eagle distribution varies with the seasons. In southern states, eagle breeding and wintering range can be the same. Eagles that breed in northern states, however, move south as northern waters freeze. They often congregate and share communal roosts and feeding grounds. While biologists don't know where Wisconsin's bald eagles overwinter, they suspect the birds move south where there is open water, concentrating along the Mississippi and Lower Wisconsin rivers.

History in Wisconsin

Until the 1800s, bald eagles bred throughout Wisconsin. As the state was settled, eagle populations began to decline. Habitat disturbance and destruction, and shooting of eagles were major causes. With the passage of the Migratory Bird Treaty in 1916 and the Bald Eagle Protection Act in 1940, it became illegal to shoot bald eagles. But enforcement of the law was weak. By 1950, eagles no longer existed in the southern two-thirds of Wisconsin.

Eagle populations remained stable in northern Wisconsin until the 1950s, when use of pesticides like DDT became common. Pesticides accumulated in animals that fed high on the food chain (like eagles, which eat fish). High pesticide levels caused physiological changes in eagles that had serious impacts: eggshells became thin and broke under the weight of incubating adults and parenting behavior changed. The bottom line was that eagles were unsuccessful at rearing chicks. They were unable to produce enough young to offset adult mortality, and the population plummeted.

In 1972, bald eagles were placed on the Wisconsin Endangered Species List. The same year, the federal government banned the use of DDT and other organochlorine pesticides in the U.S. But eagle populations were slow to recover. The number of bald eagles breeding in Wisconsin has gradually increased from 82 pairs in 1970 to 414 in 1991.

Other factors still cause bald eagle mortality. Wisconsin's eagles are sometimes caught in trap set for other animals, shot illegally by misinformed people who dislike birds of prey, electrocuted when they perch on power lines or poisoned by lead ingested when they eat waterfowl that have lead shot pellets in their bodies. Recent passage of a Wisconsin law banning use of lead shot should help reduce the problem of lead poisoning. Habitat destruction and disturbance also remain major problems for bald eagles.

Current Status in Wisconsin

Bald eagles were placed on the Federal Endangered Species list in 1973. However, since Wisconsin's eagle population is higher and more stable than that of most other states, the federal government listed Wisconsin's eagles as "threatened" in 1978. Bald eagles are protected by both state and federal laws. Violators face penalties of up to $20,000 in fines and/or 1-5 years in prison.

In 1991, 414 active territories were located. The recovery goal (360) was exceeded. The eagle's state status was upgraded to "threatened" in 1989. Eagles will still receive the same protection as other listed species.

Research and Management

Since 1963, the U.S. Forest Service has made annual surveys of bald eagles on federal forest lands in Wisconsin. Other annual surveys by the National Audubon Society (1967-1973), the U.S. Fish and Wildlife Service (1973-1978), the Wisconsin DNR (1978 to present) and the National Wildlife Federation (1979 to present) have provided information on the status and distribution of bald eagles in Wisconsin.

In 1986, a Bald Eagle Recovery Plan was approved by the DNR. The plan's main objective is to increase the self-sustaining population of bald eagles in Wisconsin to 360 breeding pairs by the year 2000 with an average annual productivity of at least 1.2 young per occupied nest. The goal has been reached through work to study current population and habitat status; determine the population and habitat required to achieve recovery; protect, enhance and increase bald eagle populations and habitats; and establish communication and education networks to coordinate recovery efforts.

What You Can Do

Wisconsin citizens can help the BER in its efforts to increase the population of bald eagles in our state. The BER encourages citizens to become informed about Wisconsin's bald eagles and get involved in eagle recovery work by: reporting active nest locations to the BER; avoiding bald eagle nests during the breeding season (February 15-August 1); volunteering to participate in the winter bald eagle survey; discouraging illegal and unethical shooting of eagles; and adopting an eagle nest.

Further Reading

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Sindelar, C. R. 1983
Bald eagles amongst the Apostle Islands and adjacent mainland shore: historical records, current status and brief recommendations.
Wis. Dept. Nat. Resour. Mimeo. 50 pp.

Endangered Resources Reports

To order any of these reports, please use the order form or email your request to BER. See also Bird-related Reports.

l - Eckstein, R. G., C. A. Sindelar and D. L. Evans l983.
Bald eagle and osprey population status, nesting biology, and management in Wisconsin
4 pp.
6 - Sindelar, C. and R. Jurewicz l983
Status and management of bald eagle in l983 6 pp.
l4 - Sindelar, C., R. Jurewicz and C. Gieck l984
Status and management of bald eagle in l984 l7 pp.

l8 - Sindelar, C., R. Jurewicz and C. Gieck l985
Wisconsin bald eagle breeding survey, l985 22 pp.
24 - Gieck, C. M. l986
Wisconsin bald eagle recovery plan 44 pp.
29 - Sindelar, C., R. Jurewicz and C. Gieck. l986
Wisconsin bald eagle breeding survey, l986 l6 pp.
30 - Sindelar, C., R. R. Jurewicz and C. Gieck. l987
Wisconsin bald eagle breeding survey, l987 30 pp.
48 - Gieck, C. M. l988
Wisconsin bald eagle breeding survey - l988 34 pp.
52 - Gieck, C. l989
Artificial structures for eagles, osprey and American kestrels in Wisconsin 32 pp.
62 - Gieck, C. and Sindelar, C. 1989
Wisconsin Bald Eagle and Osprey Breeding Surveys, 1989 15 pp.
70 - Gieck, C., Eckstein, R., Tesky, L., Stubenvoll, S., Linderud, D., Meyer, M. 1990
WI Bald Eagle and Osprey Breeding Surveys 20 pp.
78 - Gieck, Eckstein, Tesky, Stubenvoll, Linderud, Meyer, Nelson and Martell. 1991
Wisconsin Bald Eagle and Osprey Surveys - 1991 19 pp.
82 - Gieck, Charlene 1992
Region 3 Winter Eagle Roost Research, 1990-91 48 pp.
94 - Gieck, Eckstein, Tesky, Stubenvoll, Linderud, Nelson, Meyer, and Ishmael. 1992
Wisconsin Bald Eagle and Osprey Surveys - 1992 27 pp.

You Can Help Protect Wisconsin's Bald Eagles! By becoming a bald eagle nest sponsor you help continue the important work of monitoring and managing our eagle population. Individuals, clubs, schools and other groups can become bald eagle "foster parents" by contributing a $100 per year adoption fee. All contributions are used specifically for bald eagle management and educational activities such as aerial surveys, rescue and rehabilitation of sick or orphaned young, educational materials for schools and work with private landowners to protect nest trees. Over the course of the year, sponsors receive an adoption certificate, a report on the current year's management activities and surveys, and a photograph of young eaglets in a nest. If you would like to get involved, call us at (608) 266-7012, write to: Adopt An Eagle Nest Program Bureau of Endangered Resources P.O. Box 7921 Madison, WI 53707 or check out the AEN web site.

Information compiled from publications ER-501 and ER-091.

Top of page || Endangered Resources || E/T List
Mammals, Birds, Reptiles & Amphibians and Fish List

Home || Search || Feedback || What's New

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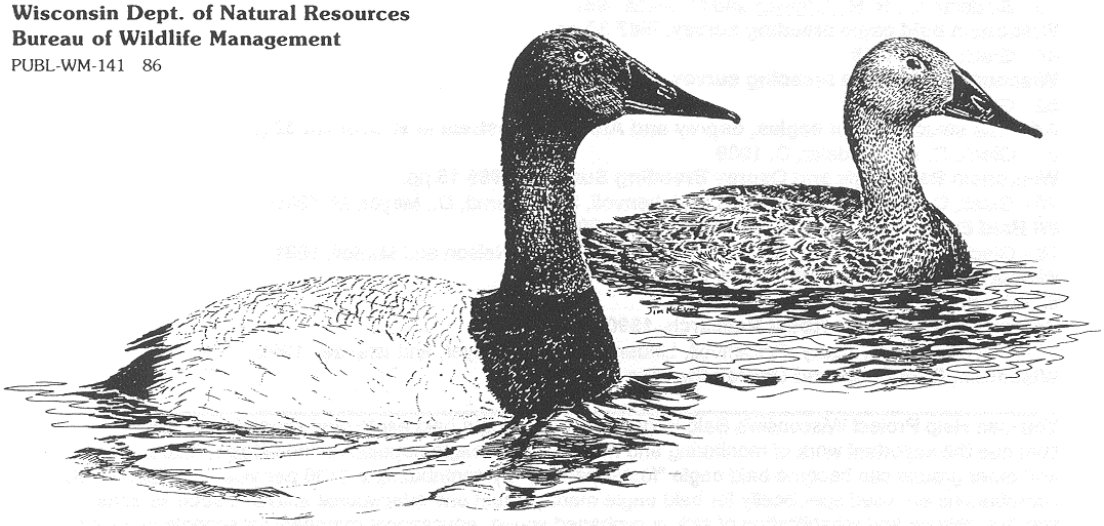
The Canvasback

(Aythya vallisneria)

By Sherry Wise

Wisconsin Dept. of Natural Resources
Bureau of Wildlife Management
PUBL-WM-141 86



Description

Canvasbacks, also called "cans", are highly prized game birds and are easily recognized by their large size, rapid flight, and characteristic long, V-shaped flocks. They measure 19-22 inches in length, nearly equal to mallards, but weigh more, averaging 2½-3 pounds.

Male and female canvasbacks differ in their plumage patterns, except for a short time in the late summer and early fall when males resemble females, wearing their drab "eclipse" plumage. While in breeding plumage, males are more brightly colored than females.

The male has a distinct, chestnut-red head and neck, with a 2-3 inch wide band of black encircling the upper body just below the neck. The wings and back are nearly white. The female has darker, more grayish wings and back and her head is buffy brown, shading into a darker brown chest. In both sexes, the rump and tail are black and the wing patch or "speculum" is pearly gray.

Both the male and female canvasback have a unique wedge-shaped head, sloping upward from the tip of the long, black bill. This distinctive profile distinguishes cans from redheads, which appear to have rounder heads and shorter bills. Also, male canvasbacks appear lighter on the wings and back in comparison to redheads which are grayish. Cans have longer, stouter necks than other species of diving ducks.

In flight, canvasbacks are probably the fastest of all ducks, reaching speeds of over 70 miles per hour. Their long, V-shaped flocks are often equal in size to those of Canada geese, but the cans' long pointed wings and sloping profiles distinguish them.

Silent except during courtship, the male canvasback's cooing courtship call may frequently be heard during the spring. Females sometimes make a quack similar to that of mallards and, when alarmed, utter a high-pitched, screaming "croak".

Reproduction

Canvasbacks begin their courtship behavior of "pair bonding" while still on wintering grounds, and continue after arriving on breeding grounds in late April or early May. During courtship, male cans (drakes) use several aquatic displays to attract a female (hen). These displays include "head-throwing" and dove-like cooing calls. Once the pair has mated, they separate from the flocks and search for a small, shallow pond on which to rest.

The female canvasback usually builds her nest over water, in a stand of bulrushes, cattails or sometimes flooded grasses or sedges. Preferred nest sites are often 10-15 yards from areas of open water, in vegetation that is 1-4 feet tall. In building the nest, the hen weaves dead grasses and other vegetation into a bowl-shaped form and lines it with her own pearly gray down.

Often, in areas of dense canvasback populations, hens lay their eggs in the nests of other waterfowl, including redheads and other canvasbacks. This parasitism results in lower nesting success for parasitized broods.

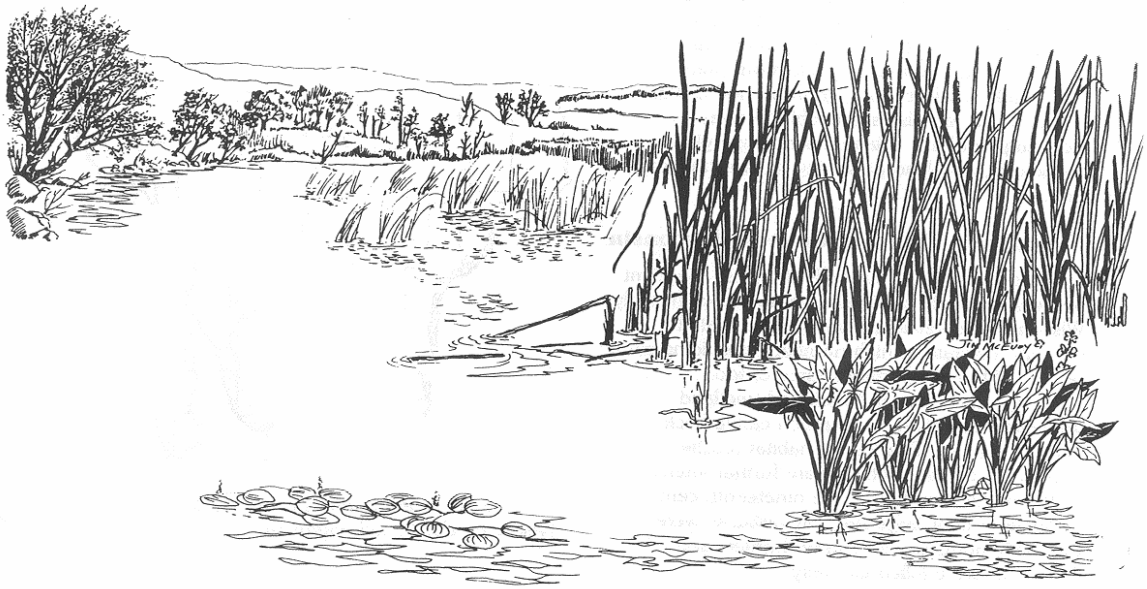
In nonparasitized nests, cans lay an average of 9-11 grayish-olive eggs. The hen incubates her eggs for about 24 days, rarely leaving her nest. During this period of incubation, the drake begins his post-breeding molt and leaves his mate to search for a secluded area in which to molt.

Following hatching, the female canvasback takes her ducklings to open water in a larger lake or pond. The young begin to grow their first feathers after about 3½ weeks and are able to fly by 8-9 weeks. Sometimes, though, the hen begins to molt before her young can fly and she abandons the brood before they fledge. Canvasbacks are sexually mature at one year, but many females may not breed their first year if habitat conditions are poor.

Food

Wild celery *(Vallisneria spiralis)* was once considered a favorite food of canvasbacks and gave the can its scientific name *(Aythya vallisneria)*. Depletion of wild celery, however, has caused the cans to use other foods. About 80 percent of their diet consists of plant matter, including pondweed, wild celery, arrowhead, and seeds of grasses and bulrushes. During the fall, especially, canvasbacks feed extensively on these aquatic plants, sometimes diving to a depth of 20-25 feet to reach them.

The other 20 percent of the can's diet is made up of animal matter like small fish, mollusks, and aquatic insects. During the summer, females and their broods feed almost entirely on animal life. The hen guides her brood from pothole to pothole, never spending more than seven days in one area. Next to pintails, canvasback broods are the most mobile of all duck broods.



Habits and Habitat

The canvasback is a migrating duck, with separate breeding and wintering areas. Most of the canvasbacks which pass through Wisconsin breed in the prairie pothole regions of Canada and Alaska. They begin to leave these breeding grounds in late September and October, reaching the wintering areas around Chesapeke Bay in late November. The cans fly north again as water opens up, beginning in February, and arrive again at the prairies in mid-April.

Preferred breeding habitat for canvasbacks is characterized by a large diversity of potholes. These shallow ponds, usually less than one acre in area and encircled by cattails and bulrushes, are used for nesting. Brood ponds are slightly larger. For feeding, resting and courting, however, cans require larger and deeper permanent ponds. The availability of such ponds determines the home range for canvasbacks and these activity areas can exceed 1,300 acres. Although activity centers of pairs may overlap, cans are usually quite territorial, requiring large areas for individual pairs.

Optimum wintering habitat consists of fresh and salt water bays and lagoons which support abundant growth of underwater grasses and invertebrates. Availability of these sites is decreasing, and competition for wintering grounds may cause canvasbacks to disperse to new areas.

In addition to loss of wintering habitat, the canvasback's breeding territory has also been threatened. These losses have caused declines in canvasback populations. Hunting, has also accounted for much of the mortality in this species. Natural mortality results from predation by fox, skunk, mink, coyote, great horned owl and hawks. Cans are also susceptible to diseases including botulism, avian cholera, aspergillosis, coccidiosis, and lead poisoning from eating lead shot.

History and Current Status in Wisconsin

The canvasback is currently the least abundant of the extensively distributed game ducks. In early Wisconsin, however, canvasbacks migrated through the state in high numbers, providing early settlers with an important source of food.

As agriculture began to expand, wetland drainage was initiated and much canvasback habitat was lost. This loss of habitat resulted in population declines which were further intensified by the market hunting of the nineteenth century. Because of their large size, canvasbacks were especially popular with market hunters and thousands were killed annually.

When the legal interstate sale of game ended in 1900, canvasback populations began to recover. However, the drought period of the 1930's presented an even more serious threat to cans. Extensive loss of wetlands again caused numbers to decline and, in the 1960's a second period of very unfavorable breeding conditions resulted in hunting restrictions.

Recently, cans have begun to make a comeback, largely because of state and federal programs established to preserve wetland areas. Sources of revenue like the Federal Duck Stamp and the Pittman-Robertson Act (a tax on arms and ammunition) enable refuges to be established and support other types of habitat preservation.

Currently, about 200,000 canvasbacks pass through Wisconsin on a major migration route. Lake Onalaska, north of LaCrosse, is a major concentration point (Fig. 1), with cans beginning to arrive the third week of October. They reach peak numbers on this lake around the first week of November and begin departing for three different wintering sites over the next two weeks. The main population goes to Chesapeke Bay, Maryland.

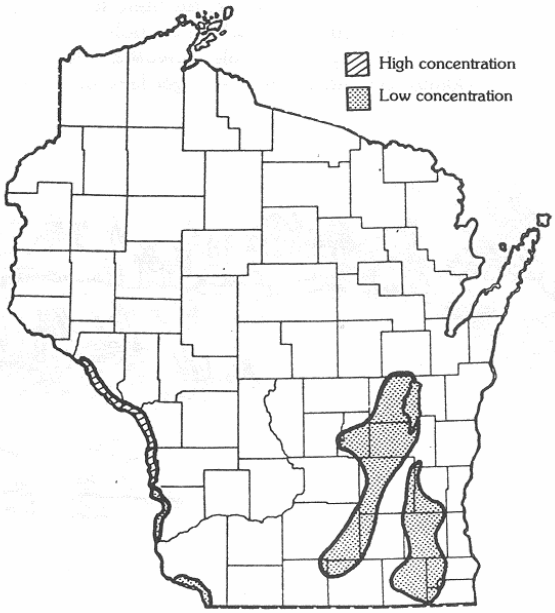


Figure 1. Concentration of canvasbacks in Wisconsin during fall migration.

Management

Duck management in Wisconsin has a long history. Initially, exclusive hunting clubs "managed" large marshes and lakes using habitat manipulation and bag limit restrictions. Regulations limiting shooting by time and place started in 1870, and a license to hunt was initiated in 1899.

In 1972, a restrictive hunting season for canvasbacks was established as a result of their declining numbers. Important concentration areas and high-harvest counties for cans were closed during the hunting season. In addition, Wisconsin's regulations set daily and possession limits on the number of cans harvested. (One canvasback is equivalent to one day's bag limit). Other rules also regulate decoys, blinds, and other aspects of the hunt. All of these regulations are designed to limit the harvest so that a sufficient number of canvasbacks return to the breeding grounds each year.

Wisconsin's migratory duck season usually opens October 1 and continues for 40 days. The state is zoned into 2 parts (north and south). Because of continental declines, the hunting of canvasbacks has been prohibited statewide since 1986.

Besides hunting, many opportunities exist for photographing, studying and watching canvasbacks. Areas like Lake Onalaska, where huge flocks of cans gather, are visited by many people each year.

Because canvasback populations are threatened by habitat loss, careful habitat management is very important. With the initiation of the Wisconsin Waterfowl Stamp in 1978, money is now available to establish resting and feeding areas on state-owned property. And, of course, wetland preservation and management are the key to all management efforts. For canvasbacks, both breeding and wintering grounds have been threatened, and habitat preservation in both areas is critical if the can is to flourish.

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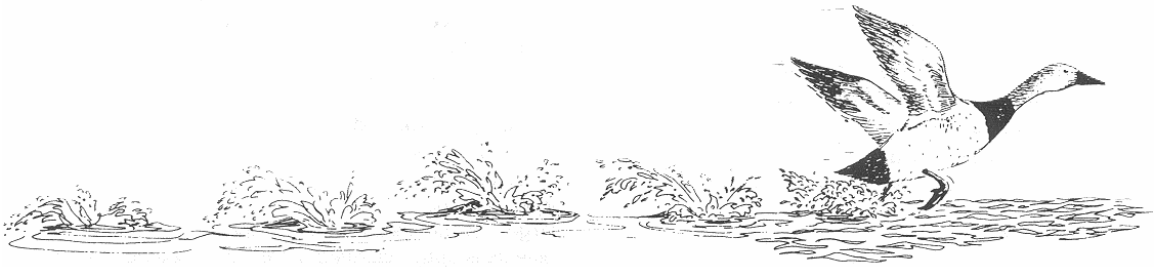
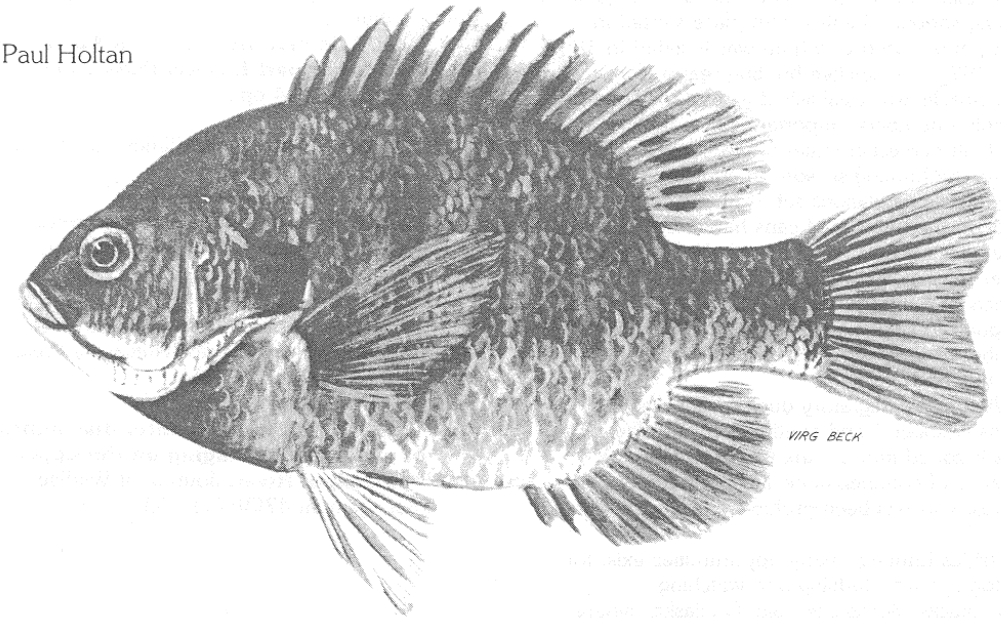


BLUEGILL

(Lepomis macrochirus)

By Paul Holtan



Common Names
Bluegill, bluegill sunfish, northern bluegill sunfish, common bluegill, blue sunfish, bream, blue bream, bluegill bream

Wisconsin Department of Natural Resources
Bureau of Fisheries Management

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"...the fight does not begin until the fish finds that it is hooked, but from then on the fight is of the most vigorous kind, and is kept up to the end with a persistency and viciousness that make the bluegill 'the gamest of all fishes for its size' "

— David Jordan and Barton Evermann
American Food & Game Fishes, 1905

A scrappy little fighter and an excellent eating fish, the bluegill is probably one of the most popular sport fish in Wisconsin; it is certainly one of the most abundant. Bluegills occur in most state waters from midsize streams to almost all ponds, lakes and [illegible] many lakes, bluegills are more plentiful than any other species of fish. For the angler, however, the ability for bluegills to thrive and multiply is a mixed blessing: while there are a lot of them around to fish for, bluegills can easily overpopulate a lake, especially a small one, resulting in **stunted** fish (shortened growth due to overpopulation).

Bluegills are just under half as deep as they are long, and they are very narrow, with even the largest of the species under 1-inch thick. The bluegill is aptly classified a panfish. Looking at one from the side, it is compressed, almost disc-shaped, like a frying pan (Fig. 1). The panfish shape is fitting, since that is precisely where most anglers intend on putting the bluegills they catch. White, flaky bluegill flesh is very low in fat, with a clean, crisp flavor.

As tasty as bluegills are to eat, that is not the only reason they are a popular sport fish. The same deep, narrow shape that makes bluegills ideally suited for the pan is responsible for their reputation as spunky contenders at the end of a line. Although the species averages only 5 to 7 inches in length, a bluegill will turn its broad side to an angler after being hooked, swimming at right angles and putting up a stubborn fight.

This combination of fight and flavor has helped make the "gamest of fishes for its size" a favorite among Wisconsin anglers.

Identification

An iridescent blue color on the lower portion of both the jaw and **operculum** (gill cover) give the bluegill its common name. Trying to identify the species by color, though, can be unreliable. Bluegills take on different hues depending on factors like age and sex of the fish, type of water, and the season of the year. Darker water yields darker bluegills with olive to black backs that get lighter toward a yellowish belly. Clearer water produces bluegills with blue-green backs giving way to white bellies. Males have brighter colors than females, especially during breeding, when they may have orange to rusty-red breasts, although immature males have white breasts.

Bluegills have five to nine dark, vertical bands running down their sides. The bands get lighter as they go down the side, disappearing near the belly.

The bluntly-pointed bluegill head has a small mouth that slants down into the jaw, not quite reaching as far back as the large, dark eye. The two spiny-ray **dorsal** (back) fins on the bluegill are continuous, so they appear as one fin. The front dorsal fin has 10 **spines** (stiff, sharp fin supports) and the rear dorsal fin has 10 to 12 **rays** (flexible, divided fin supports). Another distinguishing characteristic of the bluegill is a prominent dusky round spot on the rear dorsal fin. A similar spot sometimes develops on the **anal** (bottom, rear) fin. The **caudal** (tail) fin has a shallow fork and rounded tips. Bluegills have **ctenoid scales** (scales with a row or rows of small teeth on the exposed edge) covering their bodies, including the head and gill covers.

The bluegill is in the sunfish family (*Centrarchidae*) which also includes largemouth bass, smallmouth bass, rock bass, crappie, pumpkinseed and other sunfishes. Bluegills and pumpkinseeds are very similar and occasionally crossbreed. The two species can be distinguished by their flexible black "ear flaps" on the back edge of the operculum. Bluegills have solid black ear flaps while pumpkinseeds have a distinctive scarlet spot on their black ear flaps (Figs. 1 and 2).

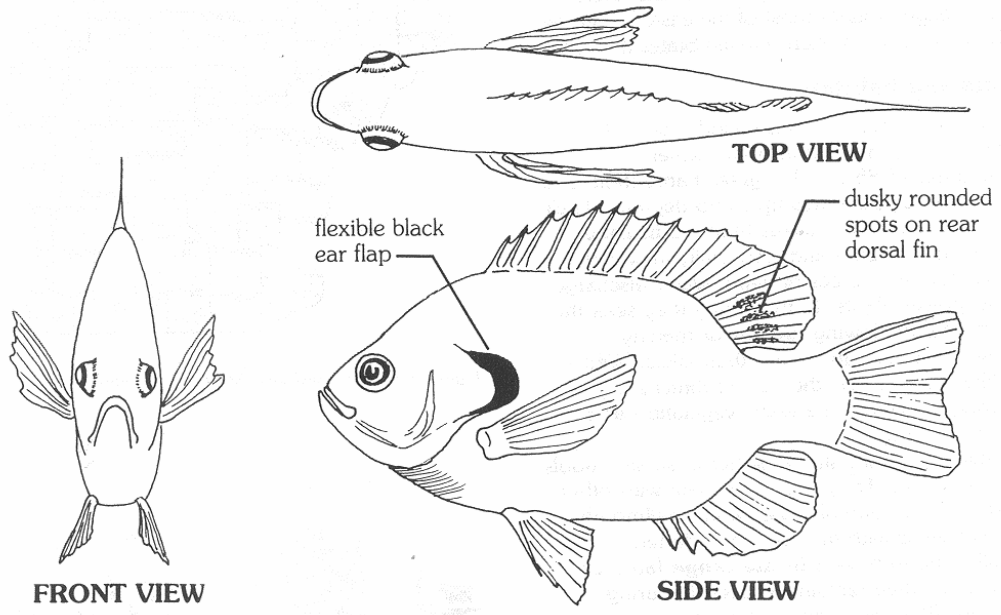


Figure 1. The shape of the bluegill resembles a pan. Thus it is called a panfish.

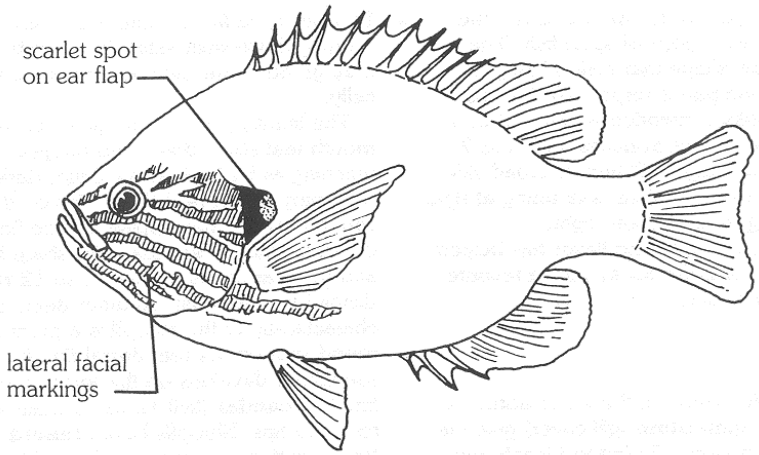


Figure 2. The pumpkinseed is a panfish that resembles the bluegill. (For additional information about the pumpkinseed, see the Pumpkinseed fact sheet).

Distribution

A warmwater species, bluegills are at the northern most edge of their range in Wisconsin. Originally bluegills were not present in the Lake Superior drainage basin of northern Wisconsin but stocking programs have extended their range to include the entire state. Bluegills prefer quiet water so they are primarily a lake species, although they do live in wider, slow-moving streams and rivers.

Their range includes most of the eastern, central, southern and southwestern United States (Fig. 3).

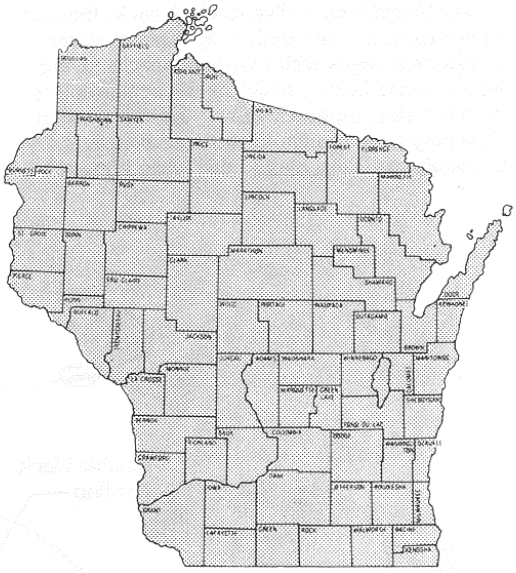
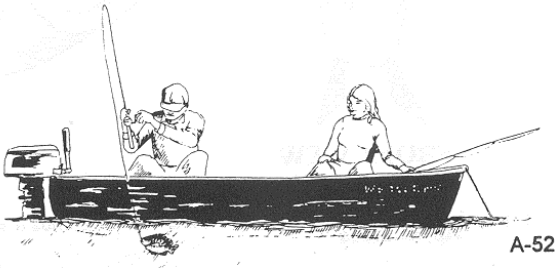


Figure 3. Generalized distribution of bluegill in Wisconsin.

Habits and habitats

Some like it hot, and this includes bluegills. These heat-craving sunfish prefer water temperatures of 85 to 88 degrees Fahrenheit, and can tolerate temperatures up to 95 degrees. Their quest for warm water makes them particularly fond of shallow lakes and, especially in winter, attracts them to sources of warm-water discharge, such as power plants. In the spring they seek the warmth of slow-flowing streams or marshy channels that heat up sooner than lakes. While they like warm water, they avoid direct sun, preferring the cover of aquatic vegetation and submerged brush.

Bluegills generally stay together in small schools of 10 to 20 fish. They will congregate with other sunfish, such as pumpkinseed and smallmouth bass, as well as with minnows and darters. Bluegills tend to have a **home range** (an area within which they remain), especially during spawning. Bluegills removed from their normal haunts and released in another area have been observed swimming around as if looking for familiar landmarks.



Though their small mouths limit bluegills to small food, they still enjoy a diverse diet that includes algae, aquatic vegetation, zooplankton, insect larvae, insects, fish eggs and, occasionally, minnows and small fish. Bluegills are sight-feeders, moving around and grazing on anything that catches their eye. They don't have **canines** (large conical, sharply-pointed teeth), relying instead on brushlike bands of small teeth to nibble at food and long **gill rakers** (comblike structures in the gills) to capture and filter smaller free-floating food out of water. In late June and early July when mayflies and other insects are emerging and swimming on lake surfaces, bluegills will go to the surface and suck insects in, creating a "popping" sound that can be heard out of the water.

Bluegills feed primarily at dawn and dusk, though they will feed throughout the day. Feeding patterns vary greatly with the season as bluegills feed on whatever is available. During the summer when food is abundant bluegills may consume up to 35 percent of their own body weight weekly. In winter that rate can drop to 1 percent. Bluegills follow a daily migratory pattern that tends to bring them closer to shore at night and into open water during the day.

As **fingerlings** (small, immature fish) bluegills fall prey to a wide variety of species including northern pike, muskellunge, largemouth bass, yellow perch, crappie and even adult bluegills. However, by the time they are 2 to 3 years old they have grown too large for all but largemouth bass; northern pike and muskellunge. Beyond that age, their deep bodies help spare them from the jaws of even large predators.

Bluegills are intolerant of low oxygen levels and are among the first to die off from **winterkill** conditions (lack of oxygen in water under frozen lakes).

Life cycle

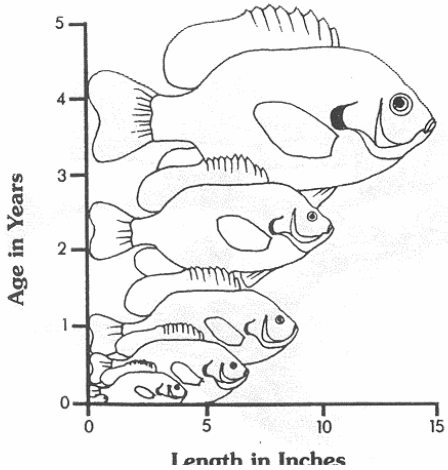
Bluegills have elaborate reproductive behavior. Spawning begins with males moving into shallow waters in late spring, when the water temperature approaches 67 degrees Fahrenheit, to claim spawning grounds. Like other sunfish, bluegills build nests in which they deposit and fertilize eggs. The gregarious nature that has bluegills swimming in schools carries over to nest building. Males normally build nests in colonies in shallow sand or gravel beds. While the colonies can include up to 40 or 50 nests, each male vigorously defends his nests from competing male sunfish. Using its caudal tail like a broom, a male bluegill will sweep back and forth — holding its **pectoral** (side) fins straight out and pushing them forward to counter the forward locomotion of the caudal sweep — clearing away loose sand and gravel. Occasionally they will use their snouts to dislodge stubborn obstacles. These meticulous nest-builders keep up the sweeping action until they have excavated a saucer-shaped depression that is between 2 to 6 inches deep and up to a foot in diameter. When completed, the nest resembles an ancient, weathered crater — like those on the moon's surface. To the angler, the nests may look like groups of light spots on dark lake bottoms.

Females arrive after the nest is built and males greet them with energetic displays, called rim circling, in which they repeatedly swim in circles around their nests. They speed up as females approach, attempting to attract them into the nest. When a female enters a nest both fish swim around in circles within the nest until they come to a rest at a right angle with their bellies touching. The female then releases some eggs and the male releases some **milt** (sperm). A female may deposit eggs in more than one nest, and more than one female may use the same nest.

Figure 4 - Bluegills nest in colonies

Spawning peaks in June and may continue into August, although it normally ceases when water temperatures exceed 80 degrees Fahrenheit. Females can produce up to 25,000 or more eggs, though the average is probably closer to 12,000. Egg production increases with a female's age and size. Under normal weather conditions and optimum temperatures, eggs hatch in two to five days. One nest may produce up to 18,000 **fry** (newly hatched fish) that are about an inch long, though they grow rapidly. While females leave the nest immediately after spawning, males can truly be described as doting fathers. They tend the eggs, fanning them with their caudal fins to keep them aerated and free of debris. The protective father may even stay with the fry, guarding them for several days.

Bluegills grow the most in the first five years of life, though growth rates can vary depending on many factors, such as lake size and average water temperature. Under favorable conditions, bluegills reach an average length of 6-8 ounces. With excellent conditions, bluegills may grow to 9 inches and weigh from 12 ounces up to 1 pound. In lakes with stunted populations, bluegills may grow no larger than 4.5 inches and weigh only 2.5 ounces. The largest bluegill ever caught was a 15-inch, 4-pound, 12-ounce monster taken from Ketona Lake in Alabama in 1950. The Wisconsin record is a 2-pound, 6-ounce bluegill taken in 1982 from Iron Lake in Bayfield County. Bluegills rarely live over 10 years (Fig. 6).



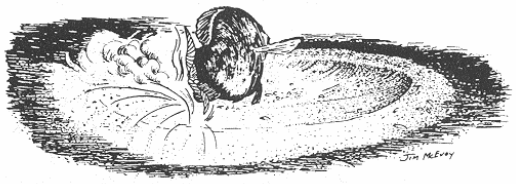


Figure 5. The male bluegill fans the sand and gravel with its tail to make its nest.

Fishing for bluegills

No matter where you are in Wisconsin, you don't have to travel far to fish bluegill. Nor do you need special equipment or bait. With the exception of fast-moving streams, most bodies of water that support fish will contain bluegills. And bluegills are curious fish that seem to want to taste anything in front of them; they have even been known to nibble on swimmers' toes. At one time, cane poles long enough to reach the shallow spawning beds from shore were popular for bluegill fishing. Today, most anglers fish with light-weight rods and reels. During the summer, anglers will likely have the best luck fishing from a boat in water between 5 and 15 feet deep. Although worms are probably the most common bait, bluegills are not fussy and will bite at almost any small bait like insects, insect larvae or other invertebrates. Because of their small mouths, anglers should use small hooks (Fig. 7). Bluegills suck in their prey rather than striking at it, so a bobber helps signal a bite. Setting the hook at the first sign of a bite is usually successful as long as the bait and hook are small. Be prepared for a fight, though, as soon as the bluegill realizes it is hooked.

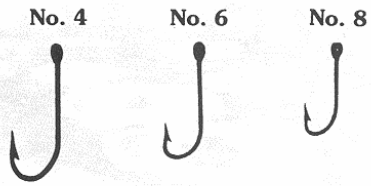


Figure 7. Small hooks are best for catching bluegills. Shown here are the actual size of a type of small hook.

Fly-fishing for bluegills with either a wet or dry fly is at its best during insect hatches in late spring and early summer. During the winter, ice anglers usually have the best fishing among the weeds in deeper water. Ice anglers use short, light jig poles, light-weight line and small tear-shaped jigs. The small hooks are usually baited with grubs, which are the larvae of flying insects (Fig. 8).

Bluegills fall under the panfish category of Wisconsin fishing regulations, with no size limit and a liberal bag limit. Check current Guide to Wisconsin Hook and Line Fishing Regulations for more information.

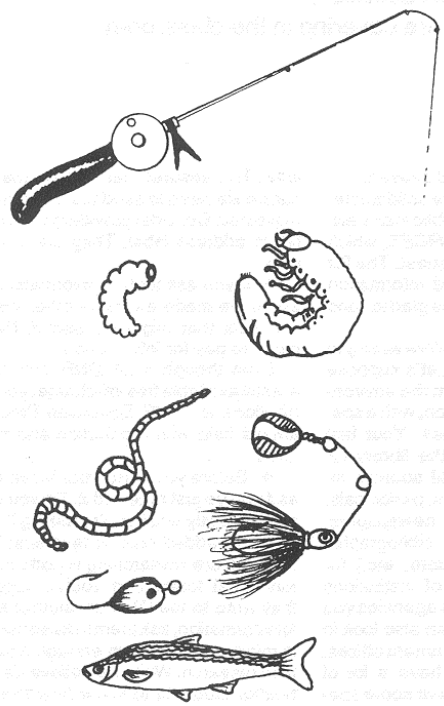


Figure 8. Jig poles are used for ice-fishing for bluegills. Grubs are an excellent bait.

Management

Bluegill overpopulation, especially in small bodies of water that lack predator fish, often leads to stunted populations. Fish managers have experimented with different techniques to reduce bluegill populations, and in turn, increase fish size. Stocking predator fish in lakes with a stunted bluegill population has some success, but even stunted bluegills can be too large for predator fish if they are stocked as fingerlings. Establishing predator populations in lakes that have experienced winterkill or that have been treated to remove stunted populations is more successful at preventing panfish populations from becoming stunted. Chemical treatment is highly effective but it eliminates all fish, including predators, and requires expensive restocking efforts.

A more recent technique is to draw down lakes before they freeze. This practice can: create winterkill conditions, reducing stunted populations; concentrate bluegills in the remaining water, making it easier for predators to prey on them; and freeze out aquatic vegetation that provides bluegills shelter from predators during the summer. Lake drawdowns usually require landowner agreement and can only take place where the water level is easily controlled.

Environmental concerns

Stunted bluegill populations often occur in lakes that have abundant amounts of aquatic vegetation. The vegetation not only provides basic food sources for bluegills, the dense cover makes it difficult for predator fish to prey on them. Harvesting or chemically treating vegetation is costly and provides only a temporary remedy. A more long-term approach to controlling aquatic plant growth is to limit the nutrients that flow into lakes and rivers from sewage effluent, leaking septic systems and agricultural and lawn fertilizers.

Because bluegills are low on the aquatic food chain, have a low fat content and live relatively short lives, they do not accumulate toxic chemicals or metals in their flesh to the extent that larger, longer-living predator fish do.

Additional reading

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Phillips (Gary L.), Schmid (William D.) and Underhill (James C.), **Fishes of the Minnesota Region**, University of Minnesota Press, 1982

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Potential Mississippi River Information Contacts

The following article provides a series of guidelines people should consider whenever asking for information from an agency. The same guidelines apply when trying to find a speaker. It is helpful to inform potential speakers with:

- a clear description of what you would like them to talk about,
- how long they will speak,
- audience size,
- areas available for the presentation (classroom, gym, outside),
- age of audience
- if you plan to do pre and post presentation activities,
- how their presentation fits with what you are covering in the classroom.

Doing Your Homework

Dear DNR: My class is currently doing a unit on the environment. Please send all the free information you have on this topic. Thank you, Quik Info

Dear Quik,

Letters like your are both encouraging and frustrating. We're always happy to hear from you. It's great to know you want to keep informed on environmental issues. But based on your request, it's difficult to supply you with the best information. Here's why, along with some tips for getting the information you need…

Your request is too general. The DNR has hundreds of publications about environmental topics from Angler education to Zebra mussels. Letters asking for "Everything you have on…" are impossible to answer and leave us feeling we've done a poor job in responding to your request.

Try to narrow your topic by focusing on a specific subject. If we have to guess what you want, we send you publications you can't use. When you're specific, we can send you just what you may need, making us all better conservationists. We save on the cost of paper, printing, postage, and people-power, and prevent unnecessary generation of more solid waste.

Feel free to ask for our publications list, Natural Resources RESOURCES, which may help you focus your request. The list provides titles available and information on how to order them. We'd be glad to send you a copy.

Do your homework before writing to an agency for information. Let's suppose you narrowed your topic from the environment to wetlands conservation, with a specific focus on sandhill cranes. Your first step should be to look in the library for information sources. Typical sources include encyclopedias, atlases, periodicals, card catalogs, field guides, newspapers, and microfilm. Take down bibliographic information (author, title, date, ect.) for each source. Make notes of institutions and government and private agencies you may wish to contact. You can also look in the phone book under government offices.

Even though you now have a lot of information, you may still have some specific questions about wetlands conservation. Your next step is to write to an agency. But do not rely solely on a request for information for all your research. It may be inadequate, inappropriate, or received too late for your report.

Include you grade level and type of information needed—general factsheets, statistics, charts, legal information, illustrations, or scientific research reports.

Please plan more lead time for your request. We'll do our best to get you the information quickly, but it may not reach you in time to help with your unit right now.

Be sure to include your return address not only on the envelope, but on your letter. This ensures that we have the information we need to send the materials you requested. Consider providing a preprinted return address label. They are always a help.

If you ask for free information, also ask to be made aware of other low-cost materials that might be useful. Be prepared to pay for information.

Even though most DNR publications are still available free-of-charge, your contributions to "DNR Education Programs" always help with production and mailing costs.

Before you send your letter, read it as if you've just received it. Do you understand exactly what you're asking?

An added note to teachers: If your students are researching reports on environmental topics and you've suggested they write to the DNR or another agency for information, ask them to keep the above in mind and give them enough time to dotheir research. While we believe it's important for students to know how to write to agencies for information, we are best able to respond to one letter from each class, instead of 25 individual letters from a class.

When you're done with your project, don't throw away the materials. Share them with others—teachers, parents, students---or donate them to your library.

We look forward to hearing from you. Please feel free to write or call us at: DNR Education Programs, P. O. Box 7921 Madison, WI 53707, 608-266-5334

--Adapted from articles in: Pennsylvania Game News and Fishing for Information, Virginia Sea Grant Marina Advisory Services.

EE News Spring '9??