Virginia Water Central

Virginia Water Resources Research Center Blacksburg, Virginia June 1998

A New Newsletter Name, But the Same Commitment to Quality

Since I became director of the Virginia Water Resources Research Center in 1996, I have often been asked, "Do you plan to publish *Water News* again?" The previous newsletter was of high-quality, but it was expensive; in 1994, tight budgets forced the abandonment of this popular product. This inaugural issue of *Water Central*, however, signals the Water Center's commitment to offer once again a regular source of water-related information for readers statewide.

In a September 1996 survey, 1300 former *Water News* readers told us what they would like in a new newsletter. A majority wanted news of recent research, a synopsis of important water-related news, and legislative and regulatory updates; about 25 percent requested a conference and meeting calendar, and a forum for policy debates; and over 50 percent wanted electronic access to the newsletter.

Based on this survey and our own judgments, *Water Central* contains these elements:
Feature articles—perspectives on current water-related issues;
Cartoons—original art that captures the theme of the feature articles;
Science Behind the News—scientific information related to a current issue;
In and Out of the News—summaries of water-related news that received relatively little media coverage;
Notices—miscellaneous events, publications, etc., plus news from the Water Center;
The Learning Resource Page(s)—helping readers find and use water information; and
You Get the Last Word—a mail-in space for readers to evaluate the newsletter.

Published bimonthly, *Water Central* usually will be eight pages (occasionally 12 or 16 pages, as in this special issue).

One goal for *Water Central* is to complement, but not compete with, information available on the World Wide Web. With the tremendous growth in Web-based information and in access to the Web, keeping up with water-related news is only a few clicks away, *if* you know where to look. The Water Center is using this technology to produce the "Daily News Update" on the Water Center's Web site (**www.vwrrc.vt.edu/vwrrc/vwrrc.htm**). Each day we search a group of newspapers, identify articles on water and environmental topics in Virginia and nearby states, and link the articles to a page on our site. *Water Central* reviews this page daily for feature-article topics and other ideas. If you're a Web user, we encourage you to try this popular service.

Like the Water Center itself, *Water Central* is intended to serve Virginia's citizens—*that means you!* After you examine this issue, please let us know what you like, dislike, or would like to see added. We are committed to changing *Water Central* as needed to serve our readers. Please help us make this newsletter useful and well-used.

Getting *Water Central* Electronically

An electronic copy is available sooner, saves printing and mailing costs, and reduces

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solid waste. If you have access to e-mail and the Internet, simply send your e-mail address to water @vt.edu. You will receive e-mail announcing the publication of each new issue and the Web address where the new issue can be found. *Unless we hear from you otherwise, you will continue to receive a paper copy.*

Alive and Well at the Water Center

When I became director of the Water Center two years ago, our state and federal budget support had seriously eroded. Fortunately, however, continuing support from Virginia Tech enabled us to persevere. State and federal support is now increasing, and we have secured several new grants.

With this financial support, the Water Center has been busy and productive. We have newly appointed advisory panels to help us stay attuned to our various constituencies. We are providing research and information to state agencies to help them serve the Commonwealth. We have hosted several conferences, expanded our support for students, updated several Water Center publications, and established our Web-based Daily News Update.

We plan to do even more. We seek to be a water-science information "broker," bridging the gap between water-information users and information providers, especially universities' faculty. Since 1965, the Water Center has anticipated Virginia's ever-changing water-resource challenges, and it has managed research and technology-transfer projects in response to those challenges. Here are some ways that today's Water Center is responding to current challenges.

- *Southwest Virginia Drinking Water Initiative.* An estimated 4.5 percent of Virginia households lack complete plumbing systems, and thousands of other households have water sources of questionable reliability or safety. In cooperation with local and state officials, the Water Center has disseminated information on affordable technologies for reliable drinking water in remote Southwest Virginia communities. A project next year will assess a method to monitor small, widely separated water systems from a single location, as a means for reducing water-system management costs.
- *Technical Advice for Water-quality Monitoring.* The Water Center assisted the Department of Environmental Quality in convening an Academic Advisory Committee, whose members—from universities across the state—will deliver a comprehensive report on water-quality monitoring and assessment to DEQ in Summer 1998.
- *Assessing Water-pollution Control Methods.* The Water Center is supporting research to improve computer tools that assess water-pollution control methods (for example, riparian-buffer designs).
- *Watershed Effluent Allowance Trading.* In response to interest from the executive branch and from the General Assembly, the Water Center is organizing discussions on "watershed effluent allowance trading" for water-quality management. Our partner in this effort is the Institute for Environmental Negotiation at the University of Virginia. If you are interested in learning more about this concept, please contact us for our 16-page introductory booklet on the topic.

By these and other efforts, the Water Center is continuing its 33-year tradition of service to the Commonwealth.

—Leonard Shabman, director of the Virginia Water Resources Research Center

FEATURE ARTICLE

1998 General Assembly Legislation Related to Water

The Virginia General Assembly held its regular session from January 14 to March 17, then reconvened April 22-23 to respond to the governor's vetoes. A special session on April 23-24 passed the budget along with car-tax and school-construction-grant legislation. During the regular session, 2152 bills were considered (939 passing, 651 failing, and 562 carried over until 1999), along with 730 joint resolutions (580 passing, 115 failing, and 36 carried over).

Among all this legislative action were nearly 100 water-related bills and joint resolutions. This article presents, first, sources and suggestions for tracking General Assembly action related to water, and second, short summaries of water-related bills in the 1998 session. The August issue of *Water Central* will have a follow-up article on what appears to be the most significant water-related legislation.

Keeping Up with the Lawmakers

Printed legislative publications—bills, journals, and other official documents—can be purchased through the Legislative Publication Subscription Service. For information or requests, write to Division of Legislative Automated Systems, Legislative Bill Room, P.O. Box 654, Richmond, VA 23218, or call (804) 786-1895. Internet users can locate this information at the following Web address:
legis.state.va.us/services.htm.

Access to the Internet makes tracking legislation easy. The Legislative Information System (**leg1.state.va.us**) provides a page for every bill introduced in the last four sessions, listing the patron, a summary, links to the full text of the bill, and a complete record of action on the bill. Bills are indexed by subject, number, and committee. For more information on the Legislative Information System, call or write the Division of Legislative Automated Systems at the phone or address listed above.

When the General Assembly is not in session, the House and Senate Committee Operations offices will, upon request, mail notices of legislative studies and of committee meetings on carry-over legislation. For information about this service, contact the House Committee Operations Office, P. O. Box 406, Richmond, VA 23218, phone (804) 698-1540; or the Senate Committee Operations Office, P. O. Box 396, Richmond, VA 23219, phone (804) 698-7450.

For information about Virginia state government generally, the Virginia state Web site (**www.state.va.us**), is full of contact information for elected officials and state agencies, on-line versions of government publications, and lists of other available publications.

Various organizations publish reviews of General Assembly actions. *Water Central* was able to confirm two related to water specifically:
Bay Journal, from the Alliance for the Chesapeake Bay, phone (717) 428-2819, had a legislative review in its June 1998 issue; and

Virginia Waterlines, from the Southeast Rural Community Assistance Project, phone (540) 345-1184, planned to publish a legislative wrap-up soon after the General Assembly session concluded for the year.

More generally, during General Assembly sessions the Virginia Association of Counties (VACO) publishes a weekly legislative update, available by mail for $75 a year. Past updates and other publications are available at VACO's Web site (**www.institute.virginia.edu/vaco**). Readers without Internet access can contact VACO at 1001 E. Broad St., Suite LL 20, Richmond, VA 23219-1928; phone (804) 788-6652.

Water in the 1998 Session

(The source for the following information was the Legislative Information System, described above.)

By our count, the 1998 General Assembly considered 97 bills or joint resolutions related to water.[1] (Hereafter, we will use "bills" to include both bills and joint resolutions.) To identify bills related to water, we used the Legislative Information System's subject index, looking first under two categories: "Waters of the State, Ports and Harbors" and "Water and Sewer Systems." Of the 97 bills listed below, 73 were in one of these two categories. We then found 24 other pertinent bills under these categories: Conservation; Fisheries and Habitat of Tidal Waters; and Game, Inland Fisheries and Boating.[2]

Because General Assembly committees are key to any legislation, it's helpful to know what committees tend to consider legislation on a given subject. The water-related bills in 1998 were allocated to committees as follows:

House of Delegates

Appropriations:	3
Chesapeake and Tributaries	23
Conserv. and Nat. Res.	40
Corporations, Ins. and Banking	3
Counties, Cities, and Towns	9
Courts of Justice	2
Finance	4
General Laws	1
Mining and Mineral Resources	2
Rules	5
Transportation	5

No water-related bills
Agriculture; Claims; Education; Health, Welfare and Institutions; Interstate Cooperation; Labor and Commerce; Militia and Police; Privileges and Elections; Science and Technology.

Senate

Agric., Conserv. and Nat. Res.	46
Commerce and Labor	3
Courts of Justice	3
Finance	5
Local Government	9
Privileges and Elections	1
Rules	8
Transportation	2

No water-related bills
Education and Health; General Laws.

The rest of this article presents very brief summaries of water-related legislation in 1998, based on information from the Legislative Information System. The bills are grouped first by whether they passed, failed, or were carried over, then by Legislative Information System category. For details of any bill, please refer to sources listed earlier in this article.

[1] We excluded from our list some bills—probably less than five—that were in some way related to water but that were too narrow for the purpose of this article (for example, a bill regarding special license plates for a bass anglers group).

[2] The following categories used by the Legislative Information System also can be expected to have some water-related bills (but we found no *additional* bills in these categories for this session): Dangerous or Hazardous Substances or Chemicals; Drainage, Soil Conservation, Sanitation, and Public Facilities Districts; Education; Energy Conservation and Resources; Mines and Mining; Public Service Companies; Science and Technology; and Waste Disposal.

A Survey of Water-related Legislation in the 1998 Virginia General Assembly

Abbreviations used are as follows: HB = House bill (that is, introduced in the House first); HJ = House Joint Resolution; SB = Senate bill; SJ = Senate Joint Resolution; SCC = State Corporation Commission; VA DEQ = Virginia Department of Environmental Quality; VMRC = Virginia Marine Resources Commission; and *etc.* = other provisions not noted, due to space.

Passed

Waters of the State, Ports and Harbors

HB 547 Appomattox River; portion a scenic river: Extends from five to 6.2 miles the portion of the river included in the Virginia Scenic Rivers System. Identical to **SB 106** (also passed).

HB 615 Petroleum Storage Tank Fund: Makes several changes to the regulations guiding use of this fund for reimbursement of costs incurred for oil cleanup.

HB 620 Discharges of oil; recovery of costs: Affects the defenses allowed in liability cases for oil discharges.

HB 626 Local penalty powers in Chesapeake Bay Preservation Areas: Authorizes penalties in local Chesapeake Bay water-quality ordinances. Identical to **SB 354** (also passed).

HB 716 Containment and cleanup of oil spills: Alters the definition of "containment and cleanup" in the relevant section of the Virginia *Code*.

HB 779 Property conveyance; lands in James River: Allows the VMRC to convey certain lands to Chesterfield County.

HB 807 Clean Water Farm Award Program; created: A program by the Chesapeake Bay Local Assistance Board to recognize farms using nutrient-management plans.

HB 816 Regulation of water transport of wastes: Requires the Waste Management Board to develop regulation of solid and medical wastes on state waters. Identical to **SB 657** (also passed). See related bill **HB 818** (carried over)

HB 817 Personal watercraft; ordinance enforcement: Empowers law-enforcement officers to enforce local ordinances regulating personal watercraft (i.e., "jet-skis").

HB 903 Definition of no wake: Defines "no wake" as operation of a vessel at the slowest possible speed required to maintain steering and headway.

HB 904 Boating; no wake speed: Makes it unlawful to operate a motorboat above "no wake" speed within a certain distance of various structures or people in the water (*etc*).

HB 905 Personal watercraft rentals: Requires people who rent or lease personal watercraft to provide certain information to the renter about operating procedures.

HB 972 Concrete plant water discharge general permits: Makes the required general permit for stormwater or process water applicable both to permanent and to portable plants (*etc.*).

HB 991 Confined animal feeding operations: Has various provisions modifying the general permit process covering these operations. Identical to **SB 661** (also passed).

HB 1027 Operation of personal watercraft; penalty: Sets limits on allowable speed of personal watercraft within certain distances from shore or structures.

HB 1209 Potomac River Compact: Makes provisions in Virginia's version of the compact conform to technical changes made by Maryland in 1996 and 1997.

HB 1244 Definition of coastal primary sand dune: Excludes from this definition sand deposited for beach replenishment.

HB 1295 Boating; reckless operation of a personal watercraft: Defines "personal watercraft" and describes activities to be considered a misdemeanor "public nuisance."

HB 1380 Age for operation of a motorboat; penalty: Sets at 16 the legal age to operate a motorboat.

HB 1381 Motorboat safety training: Requires personal-watercraft rental agents to complete a boating safety course, *etc.*

HB 1419 Wetlands and riparian buffers; taxation: Allows local governments to exempt from real-property taxation certain wetlands and riparian buffers; *etc.*

HJ 118 Citizen water monitoring volunteers: Encourages relevant state-agency cooperation with citizen water-quality monitors. Very similar to **HJ 159** (also passed).

HJ 236 Study; water resources: Requests State Water Commission to study ways of making best use of state water resources.

HJ 283 Study; submerged aquatic vegetation: Requests the Virginia delegation to the Chesapeake Bay Commission to study ways to protect submerged aquatic vegetation.
SB 56 Craney Island; construction of additional marine terminal: Authorizes study of the eastward expansion of the island and a possible additional terminal (this island is part of Portsmouth).
SB 328 Smith Mountain Lake; no-discharge zone for boat sewage: Directs Water Control Board to seek federal approval to designate the lake as a no-discharge zone for boat sewage.
SB 335 Chesapeake Bay Bridge and Tunnel Commission: Changes procedures for appointing members of the Commission after July 1, 1998. Same as **HB 692**, which failed.
SB 483 Oil release report and notification: Requires VA DEQ to compile a list of the locations of oil releases; *etc.*
SB 487 Powers of the Virginia Resources Authority: Gives the Authority power to establish a credit enhancement surety bond program; *etc.*
SB 598 Rappahannock River Basin Commission: Provides for establishment of the commission, to provide guidance on natural resources of the basin (no regulatory powers).
SB 621 Peninsula Ports Authority: Adds additional localities to the Authority and adds representation of those localities to the Authority's Commission.
SJ 171 Study; economic incentives for shipbuilding industry: Establishes a joint subcommittee to study economic incentives for shipbuilding, ship repair, and shipping.
SJ 187 Study; dredging of Rudee Inlet: Directs Senate Finance and House Appropriations to study funding options to continue dredging this inlet in Virginia Beach.

Water and Sewer Systems
HB 339 Lien for water and sewer charges: Adds Orange County to localities allowed to provide that taxes or charges for water or sewer service shall be a lien on the real estate served.
HB 448 Credit for excessive water or sewer charges: Allows for partial credit for water and sewer charges where high usage was due to unintentional causes.
HB 501 Sewer services; Town of Front Royal: Allows Front Royal to provide sewer to industrial and commercial users outside its boundaries and collect compensation.
HB 502 Water; Town of Front Royal: Allows Front Royal to provide water supplies to industrial and commercial users outside its boundaries and collect compensation.
HB 912 Gray and rain water use guidelines: Directs state Health Department to develop guidelines for, and promote (with VA DEQ), the use of gray water and rain water.
HB 1042 Local water supply systems: Provides that local water rates shall be fair and reasonable and payable as directed by the locality.
HB 1133 Distribution of coal and gas road improvement tax for water projects: Removes requirement that all water supplies in a locality be included in plans for funding water projects from this tax.
HB 1220 Coalbed methane well operations; water supply replacement: Requires replacement of water supplies contaminated or interrupted by these operations when within a certain distance; *etc.*
SB 249 Lien for water and sewer charges; City of Fairfax: Adds Fairfax to localities allowed to provide that water or sewer charges shall be a lien on the real estate served.

Conservation
HB 648 Stormwater management, fees; exempts cemeteries: Allows localities to exempt cemeteries from local stormwater management fees.
HB 1425 Property tax exemption for erosion control improvements: Allows localities to make partially tax-exempt real estate improved for erosion control; *etc.*

Fisheries and Habitat of Tidal Waters
HB 656 Placing food in peeler crab pots: Allows VMRC to develop regulations for placing food for male crabs in peeler pots.
HB 992 Oyster inspection tax: Extends from June 30, 1998, to June 30, 2000, the date that the oyster inspection tax becomes effective.
HB 993 Marine Resources Commission; sale of gear licenses and permits: Allows VMRC to issue gear licenses or fishing permits to state's island residents.
HB 1264 Marine Resources Commission; membership: Requires that one of the nine members of VMRC represent sport fishing industry or recreational fishers.

Game, Inland Fisheries and Boating

HB 535 Local regulation of motorboat distance: Allows Lake Anna localities to require motorboats to remain below planing speed within 50 feet of shore or docks; *etc.*

HB 576 Insuring personal watercraft rentals: Allows localities to establish standards for insurance coverage for businesses that rent personal watercraft.

HB 1353 Liability insurance; private pleasure watercraft: Requires insurers to offer, along with liability policies for such watercraft, optional uninsured operator coverage.

HJ 174 Study; mandatory boating education: Establishes a joint subcommittee to study costs and benefits of a mandatory boating-safety course for motorboat operators.

SB 458 Boating while under the influence: Requires Department of Motor Vehicles to maintain accessible records of people convicted of operating a boat while intoxicated; *etc.*

Failed

Waters of the State, Ports and Harbors

HB 503 Sewage sludge land application: Would have prohibited application of sludge containing any untreated human waste, or issuance of permits for application of sludge, without written consent of affected property holders.

HB 605 Flood prevention; Town of Grundy: Would have required Town of Grundy to gain referendum approval prior to constructing flood-control structures.

HB 887 Advisory referendum; King William reservoir: Would have provided for a referendum in November 1998 on whether the reservoir should be built in the county.

HB 974 Removal of non-conforming structures from state waters: Would have required removal of such structures, regardless of payment of a monetary penalty.

HB 1138 National pollutant discharge elimination permits; penalties (passed but vetoed): Would have clarified use of civil penalties under the Virginia Coal Surface Mining and Reclamation Act to enhance conservation and recreation in the coal counties.

HB 1334 Confined swine-feeding operations: Would have put a moratorium, with certain exceptions, on permitting and construction of such operations until July 1, 2000.

HB 1394 Water permit fees: Would have increased the maximum allowable charge for the processing of various water permits. See related bill **SB 597** (carried over).

HJ 188 Study; animal-waste management in Chesapeake Bay watershed: Would have set up a subcommittee to study animal-waste management in the Bay watershed.

Water and Sewer Systems

HB 956 Small water or sewer public utilities; rate changes: Would have required *individual*, written requests from customers of such utilities to the SCC for public hearings on rate changes. Same as **SB 294** (also failed). See related bills **HJ 207** (also failed) and **HB 739** (carried over).

HJ 207 Study; small water or sewer public utilities, rate changes: Would have set up a subcommittee to evaluate current procedures for rate changes by such utilities. See related **HB 956** (also failed) and **HB 739** (carried over).

SB 253 Water and sewer connections; applicable in York County: Would have allowed York County to require water and sewer connections in certain cases.

SB 403 Private water and sewer systems: Would have required an owner of a system with more than 15 connections to have an escrow account for repairs and maintenance.

Fisheries and Habitat of Tidal Waters

HB 684 Saltwater recreational fishing licenses: Would have removed the seaside exemption from the requirement to have a saltwater recreational fishing license.

HB 691 Marine Resources Commission: Would have changed the position of Commissioner of Marine Resources to Director of the agency; *etc.*

Carried over until 1999

Waters of the State, Ports and Harbors

HB 473 Water Quality Improvement Fund; utilization of: Would expand the eligible uses of the Water Quality Improvement Fund; *etc.* Similar to **HB 814** (also carried over). See related bill **SB 49** (also carried over).

HB 818 Prohibition on water transport of wastes: Would prohibit transport of solid and medical wastes by vessel on state waters (to the extent consistent with the U.S. Constitution). Same as **SB 656** (also carried over). See related bill **HB 816** (passed).
HB 823 Chesapeake Bay Byway Program; created: Would set up a special transportation program for the area along Route 3 between Route 301 and Route 14; *etc.*
HB 1207 Poultry-waste management in Chesapeake Bay watershed: Would require the Water Control Board to set up a poultry-waste regulatory program for the Bay watershed.
HB 1348 Shipbuilding industry tax credit: Would create two credits against employee income tax withholding payments if a qualified shipbuilder makes contributions for a "certified carrier platform integration center"; *etc.* Same as **SB 706**, which failed.
SB 49 Geographic eligibility for Water Quality Improvement Grants: Would clarify that grants from this fund may be made throughout the Chesapeake Bay watershed even if the funded project is not in an area with a completed tributary plan.
SB 582 Wetlands mitigation banks: Would allow use of wetlands mitigation bank credits as compensation for adverse impacts to wetlands; *etc.*
SB 597 Water permit fees: Would require the Water Control Board to recover eventually the total costs of administering the water permit program through the imposition of annual fees on water permits; *etc.* See related bill **HB 1394** (failed).

Water and Sewer Systems
HB 739 Small water or sewer public utilities; rate changes: Would prohibit rate increases or similar changes prior to public hearings and approval by the SCC; *etc.* See related bills **HB 956** and **HJ 207** (both failed).

Conservation
HB 1089 Water Quality Improvement Act point source grants: Would remove restriction that such grants first go to installation of biological nutrient removal at publicly owned sewage treatment plants; *etc.*
SB 492 Water Quality Improvement Grants for education: Would add education efforts to the potential uses of nonpoint source pollution grants from this fund.

Fisheries and Habitat of Tidal Waters
HB 579 Oyster and clam aquaculture: Would ensure riparian landowners in Virginia Beach a 50-foot zone (from mean low water) for oyster and clam aquaculture; *etc.*
HB 598 Fishery regulations: Would require that all VMRC fishery regulations, except emergency regulations, remain effective for one year, without amendments.
HB 671 Fishery Resource Grant Program; created: Would establish grants for commercial equipment, environmental studies, marine aquaculture, or seafood technology; *etc.*
SB 392 Restrictions on taking crabs: Would require any size and catch restrictions to be identical for peeler and soft crabs.
SB 393 Gray trout; management: Would require any regulation of the commercial gray trout fishery to apply the same catch limit to every method of catch.
SB 395 Restrictions on crab dredging: Would prohibit crab dredging on Sundays; *etc.*

Game, Inland Fisheries and Boating
HB 40 Hunting and fishing license fee adjustments: Would authorize an increase in the costs of basic hunting and fishing licenses, tied to inflation; *etc.*
HB 160 Personal watercraft; age increased for operation: Would increase from 14 to 16 the minimum age to operate a personal watercraft.
HB 765 Boating; life jackets for children: Would require a child 12 years of age or younger to wear a personal flotation device while in a motorboat; *etc.*

Joseph Manfre contributed to this article. Joe, a 1998 graduate of Virginia Tech, was an intern at the Water Center during the Spring 1998 semester.

SCIENCE BEHIND THE NEWS

Pfiesteria or Not, There's Always Algae

In late summer and fall 1997, news media serving Virginia, Maryland, and North Carolina were having to use a little bit of Latin—*Pfiesteria piscicida*. News articles were reporting that toxins from this microscopic organism were the chief suspect in fish kills in these states and in unusual illnesses in humans. The *Pfiesteria* story continues in the news—such as "Effects of *Pfiesteria* to be studied/ Virginia earmarks $7.7 million over two years," *Richmond Times-Dispatch*, May 7, 1998—because scientists and public health officials fear that potentially toxic forms of *Pfiesteria* are lurking in the sediments of Chesapeake Bay tributaries.

Pfiesteria is only one type of the thousands of different organisms known as **algae**. While only time and scientific testing will reveal whether Virginia's waters will contain toxic forms of *Pfiesteria* this summer, there is no doubt that those waters will contain hundreds of other kinds of algae. This article offers an introduction to this group of organisms, whose impact matches their great numbers and diversity more than it does their often-microscopic size.

Some Algae Basics

What do the terms "pond scum" and "seaweed" call to mind? How about "mermaid's wine goblet" and "watersilk"? These and many other names have been used for different kinds of algae. Such names hint at the diversity of algae and at the many ways that humans use or are affected by algae. But they don't say much about what algae really are.

According to a 1989 phycology[1] textbook, an alga (the singular form of "algae") is an organism *with* chlorophyll (the pigment plants use to capture energy from sunlight during photosynthesis); *without* roots, leaves, or stems; and *without* a sterile (non-reproductive) covering around its reproductive cells (in contrast to flowering plants, for example, where female reproductive cells are contained within an ovary, the part of a flower that develops into a fruit). Within the confines of this difficult definition are a wide variety of organisms.

Depending on the species, algae live as single cells; as single cells grouped into colonies that form filaments or other structures; or as multi-cellular forms. A single water body can contain a huge number of individuals of a single-celled alga. On the other hand, multi-cellular brown algae known as kelps can be several hundred feet long.

As a group, algae live practically everywhere. Algae live in two basic ways: suspended in water as **phytoplankton**; or attached to some surface on land or in water, including rocks, trees, buildings, plants, and even such animals as snapping turtles, alligators, and sloths.

There are approximately 40,000 species of algae worldwide, and new species are continually being identified. No one reference indicates how many species exist in Virginia. A 1984 guide to freshwater algae in North Carolina lists approximately 2000 species for that state; Virginia, with its similar geography and climate, should have a comparable number. Some partial counts for Virginia waters are available, however: In

[1] Phycology, from the Greek word for seaweed, is the study of algae.

Mountain Lake in Giles County, over 300 species have been recorded since 1930; 174 species of attached, marine algae were reported for Virginia in 1978; and over 700 species of phytoplankton were reported in 1994 for the Chesapeake Bay.

Scientists classify algae into groups of species that share basic characteristics; the largest and most general groups of algae are known as **divisions**[2]. The seven following divisions are among the most important groups, and they include the algae that one is most likely to encounter in nature, in commercial products, or in the news.

Greens—The largest algal division, with approximately 7500 species, in fresh water, brackish water[3], salt water, and on land. An example you might have seen in school is *Spirogyra*, with its spiral-shaped green chloroplasts visible under a microscope.

Golden-browns, including Diatoms[4]—Approximately 6000 species, primarily microscopic, in fresh water, brackish water, salt water, and on land. Most algae in this division (over 5600 species) are diatoms. Diatoms in a stream will often cause a slimy, brownish coating on rocks.

Blue-greens—Approximately 1500 species, in fresh water, brackish water, salt water, and on land. Some scientists classify these organisms as "Cyanobacteria," primarily because their cell structure is more similar to bacteria than to other algae.

Dinoflagellates—More than 3000 species, in fresh water, brackish water, and salt water. *Pfiesteria* is a dinoflagellate.

Euglenoids—More than 750 species, in fresh water, brackish water, salt water, and on land. *Euglena*, a common subject of study in high school and college biology courses, is in this group.

Browns—1500 to 2000 species, all multicellular and found mostly in brackish water and salt water.

Reds—More than 5000 species, most of which are marine, occurring usually in warmer ocean waters; some occur in fresh or brackish water.

How Are Algae Important?

"Notwithstanding their extreme minuteness, it is evident, from their vast abundance, that [certain algae] have some important offices to perform in the economy of nature..."

Writing this in 1841, Jacob W. Bailey (1811-1857)—considered the first scientist to study algae in Virginia—had enough information and insight to anticipate algae's ecological importance. Today, we understand much better algae's vital ecological roles, especially in aquatic systems[5], but we have also found many economic and scientific uses for algae.

Algae's Economic and Scientific Uses

Although you won't see it mentioned in the news very often, numerous practical uses exist for algae and materials derived from algae. A 1990 book on applied phycology reveals the scope of uses: Its 22 papers describe uses of algae ranging from fertilizer to dental care to high-performance papers. Five important types of uses follow.

Human food. One source indicates that more than 70 species of marine algae are used as food, mostly in Asia. One type of blue-green, *Spirulina*, is a staple food in some countries, while, in the United States, it is sold as dried tablets in natural-foods stores.

Extracts. Agar, derived from certain types of red algae, is used as a laboratory culture medium. Algin, derived from the cell walls of many brown algae, has many uses as an agent that regulates water within substances (for example, to thicken or stabilize them). This and other properties

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[2] A division is analogous to a phylum for animals. For example, humans are in the phylum of chordates, which also includes fish, amphibians, reptiles, birds, and other mammals.

[3] Brackish water has a level of saltiness between fresh water and salt water.

[4] Scientists disagree on exactly how many algal divisions there are (anywhere from 9 to 15 are recognized). For example, some scientists split the golden-brown algae into several divisions.

[5] On land, one important but inconspicuous role is performed by certain algae that combine with certain fungi to form **lichens**, which can colonize rocks and help begin soil formation.

make algin useful in food, paper, textiles, pharmaceuticals, cosmetics, industrial uses, and brewing. Carrageenan, also from red algae, has uses similar to algin.

Diatomaceous earth. This versatile material comes from the silicon-based cell walls of diatoms. When diatoms die, these resistant walls can accumulate in deep layers. The resulting lightweight, durable material is used in filters, polishes, reflective paint for road signs, and other products.

Scientific value. Because algae take up little space, are relatively easy to grow, and reproduce rapidly, they have been valuable in research of such topics as photosynthesis, cell division, and the effects of aquatic toxins. In the study of the history of lakes and other water bodies (known as paleolimnology), resistant diatom cell walls in sediments are clues to past conditions, such as climate and the relative level of nutrients in the water.

Wastewater treatment. In wastewater oxidation or stabilization ponds, oxygen generated by algae supports bacteria that break down organic wastes. Algae can also help remove nutrients from wastewater.

Impacts of Algae in Aquatic Systems

Food Chain. During photosynthesis, algae convert energy in sunlight to energy in a chemical form usable by animals as food. As a result, algae are often the basis of the food chain in a water body. Algae are eaten by a variety of animals, including zooplankton (floating microscopic animals) and certain kinds of snails, insects, tadpoles, fish, and ducks. Algae-eaters are in turn eaten by larger animals, including eventually those important to humans for food, recreation, or other uses.

Different animals prefer different kinds of algae. If the number or kinds of algae in a water body change—in response to changes in light, nutrients, temperature, or other factors—some animals may not have the kind of food they need. The effects may be seen through the entire food chain. This can result in headlines such as "Bait fish declining in state's waters/Food chain failure may be to blame" (*Richmond Times-Dispatch*—Web edition, March 30, 1998).

Oxygen. Also during photosynthesis, algae produce oxygen from carbon dioxide and water. Aquatic organisms use oxygen dissolved in water. The amount of dissolved oxygen in water can change significantly, depending on several factors: the temperature of the water (cold water can hold more dissolved oxygen that warm water); how much the water mixes with air; how much oxygen is being produced (by plants and algae); and how much is being *used*, especially by bacteria and other organisms that break down dead organisms. Depending on the amount of algae in a water body, the algae can be crucial to this balance between oxygen production and use.

Nutrients. While organisms that carry out photosynthesis can make their own energy supply from sunlight, they cannot grow and develop properly without a variety of materials known collectively as nutrients. Algae absorb nutrients into their cells from the surrounding water. Algae, therefore, play a key role in nutrient cycling between the non-living and the living parts of an ecosystem.

An organism's growth can be limited if an essential nutrient is in relatively short supply. Aquatic habitats where algae grow often have a short supply of nitrogen or phosphorus, relative to other factors the algae need to grow (such as light, adequate temperature, and other nutrients).[6] If nutrients are added in this situation, algal growth in the habitat can increase, often dramatically in what is known as a "bloom." Marine blooms near coastal areas occur occasionally, while freshwater blooms often occur seasonally.

As algae in a bloom grow, they will produce oxygen, but they will also use oxygen. During the day, more oxygen will be produced than used, but at night, the reverse will be true. Moreover, when a large mass of algae dies and settles to the bottom, bacteria use up a lot of oxygen breaking down the dead algae.

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[6] Many species of blue-greens can use the gaseous nitrogen in the atmosphere, rather than only nitrogen dissolved in water, and so are not limited by the level of nitrogen in the water.

The usual result of an algal bloom, then, is to reduce oxygen available to fish, shellfish, etc., especially at night, at lower depths, and at higher temperatures. Blooms in response to excessive nutrients may also result in toxins, bad taste and odor of drinking water, and poor boating and fishing. The potential for algal blooms is one major factor behind headlines such as "Maryland among states seeking federal manure waste controls" (AP story, April 3, 1998).

Light. The amount of phytoplankton in a standing or slowly-moving water body affects water clarity. It also affects how much light reaches submerged, rooted plants, which are often important habitat and food sources for fish and other animals. One measurement used to gauge the health of the Chesapeake Bay, for example, is the extent of submerged aquatic vegetation—referred to as SAV's or bay "grasses."

Toxins. As has become well-known from news stories about *Pfiesteria*, some algae can produce substances toxic to other organisms. Only some 50-60 species of algae produce toxins, however; most of these are dinoflagellates, along with three principal toxin-producers among the blue-greens and several marine diatoms.

Toxin production is often associated with an algal bloom. Not all blooms are toxic, however, either in marine or freshwater systems. When toxins *are* produced, they may poison fish, shellfish, farm animals, and potentially humans. In general, humans are exposed to toxins through contact with affected water or by eating animals that have eaten the toxin-producing algae.[7]

Scientists do not completely understand how toxic blooms begin, and the task is complicated by the relatively complex life cycles of some species. But three factors have been identified as necessary for a bloom (that may or may not be toxic) to occur: a "seed" population of algal cells; a suitable chemical environment, including the level of nutrients; and suitable water conditions for concentrating nutrients and organisms in an area.

In the case of *Pfiesteria*-like organisms, it is believed that chemical cues from fish can stimulate certain life-cycle stages to produce toxins. The toxins can debilitate the fish and cause lesions, allowing the dinoflagellates to ingest sloughed-off tissue from the fish.

A Last Look at "Pond Scum"

If you travel to a lake, stream, or other water body this summer, you will probably encounter algae, perhaps as an annoyingly large, floating patch of "pond scum." Other than for its ability to annoy, the pond scum probably won't command much respect. But there's more to that pond scum than meets the naked eye. Unseen within the green slime are several powerful traits:

- *diversity* of species, structures, and life cycles;
- within this diversity, a collective t*olerance of varied environmental conditions*;
- *important ecosystem roles*, affecting fundamental processes and materials; and
- the *capacity to grow and multiply* rapidly under the right conditions.

These traits of a single patch of pond scum are true many times over for the thousands of kinds of algae worldwide. They are basic, underlying reasons why we find algae everywhere, including in the news.

—Alan Raflo, Water Central editor

Water Central thanks phycologists Harold Marshall and Bruce Parker, and botanist Nancy Mignone, for reviewing and assisting with this article.

Further Reading on the World Wide Web

The Algae Home Page of the Smithsonian Institution/National Museum of Natural History has an excellent introduction to algae, along with lots of detail on various aspects of algae (**nmnhwww.si.edu/botany/projects/algae/**).

"The Scientific Method, Fish Health and *Pfiesteria*" discusses how Robert Koch's

[7] *Pfiesteria* researchers in North Carolina have found that humans can be exposed to these organisms' toxins through water and through the air. Exposure to *Pfiesteria* by eating seafood has as yet been neither documented nor ruled out.

postulates—formulated in bacterial studies in the 1800's—must be followed to determine if fish kills are due to *Pfiesteria* or to some other cause (on the University of Maryland's "Fish Health in the Chesapeake Bay" page: **www.som1.ab.umd.edu/AquaticPath/fishhealth/koch.html**).

"The Cambridge Consensus" is the collective opinion of scientists, convened by the University of Maryland in October 1997, on toxic dinoflagellates, *Pfiesteria*, and the role of nutrients (**www.mdsg.umd.edu/fishhealth/pfiesteria/index.html**).

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IN AND *OUT OF* THE NEWS

Newsworthy items you may have missed

•The **Virginia Marine Resources Commission** approved a system that lets commercial fishermen buy and sell rights to harvest **striped bass** from state waters. The "individual transferable quota" or ITQ, system went into effect February 21, 1998. The program does not apply to recreational anglers, who still have a limit of two fish per person per day. The program is intended to ease disputes between commercial and recreational fishing that developed as striped bass populations have recovered. (*Virginian-Pilot*, November 26, 1997)

•Construction of a $1.4-million **fish ladder on the James River**, delayed in early spring due to flooding, was expected to be completed by June. The ladder—around Bosher's Dam, the last obstacle for migratory fish between the ocean and Lynchburg—will allow shad and river herring to reach the river at Lynchburg for the first time in almost 200 years. (*Richmond Times-Dispatch*, March 26)

•The Virginia Department of Health lifted an eight-year advisory against eating bottom-feeding fish from the **Blackwater and Nottoway rivers**, near Franklin. The advisory was due to high dioxin levels, attributed to releases from the Union Camp paper mill. Union Camp has reduced its dioxin releases by changing its paper-bleaching process to use ozone instead of chlorine (dioxin is a by-product of the chlorine-bleaching process). (*Richmond Times-Dispatch*, March 28)

•The **Virginia crab harvest** increased for the third consecutive year, to 39 million pounds. A 34-year low of 23 million pounds occurred in 1992. (*Richmond Times-Dispatch*, March 27) Meanwhile, this year's "spat set"—the **number of baby oysters**—

in parts of the Chesapeake Bay is perhaps the highest in the last 30 years. (*Baltimore Sun*, May 12)

•A California study linked drinking-water levels of **trihalomethanes** (THM's) above 75 parts per billion (ppb) with increased risk of miscarriage risk for pregnant women in their first trimester. The findings led to a health alert for pregnant women in Chesapeake, where weekly THM readings have been above the 75-ppb level. The city provides weekly updates on THM levels, and on how to remove THM's from tap water, on its Water Quality Hotline. (*Virginian-Pilot*, April 25)

•By helping build its own water system, a Tazewell County community qualified for funds from the Virginia Department of Housing and Community Development's **Self-help Virginia Program**. The program can provide water and sewer funds to communities that cannot get a community development block grant. To receive a Self-help grant, communities must provide work that amounts to 40 percent of the project cost. The staff contact for this program is Winfred Brown at (804) 371-7076. (*Richlands News-Press*, May 19; and Mr. Brown at Housing and Community Development, June 3)

•Prince William County will receive a **$50,300 federal grant** to assess water quality in portions of **Bull Run and Cedar Run**. The streams were identified as ``impaired'' in the state's 1996 report to the U.S. Environmental Protection Agency, with some sections exceeding bacterial and nitrogen standards. The money, matched locally with $33,000, will pay for testing by George Mason University and the Occoquan Laboratory to identify sources of contamination. (*Prince William Journal*, May 28, and *Washington Post*, May 31)

—Compiled by Joseph Manfre

N O T I C E S

•***Virginia Regulatory Update***, published monthly by the Department of Environmental Quality (DEQ), summarizes regulations currently being considered by DEQ and its citizen boards. According to the May 1998 issue, water regulations are currently under consideration on the following topics:

Discharge general permits for ready-mix concrete, nonmetallic mineral mining, and storm water from construction and from industrial activity;

Proposed repeal of Water Quality Management Plans as regulations;

Water Quality Management Plans for Roanoke River, Upper Roanoke River Subarea, and Smith-Dan Subarea;

Surface Water Management Areas on the Shenandoah, North, and James rivers;

Groundwater withdrawals; and

Financial responsibility for aboveground and underground storage tanks.

For information about these regulations, or to receive the *Update*, call (800) 592-5482. The *Update* is also available at the DEQ Web site (**www.deq.state.va.us**).

•**At the Water Center**, five new publications are available:

Proceedings of the Karst-Water Environment Symposium (October 30-31, 1997, in Roanoke), 154 pp.;

A Guide to Virginia's Ground Water (revised version of *A Groundwater Primer for Virginians*, 1984), 30 pp.;

A Guide to Protecting Virginia's Valuable Resource: Ground Water (revised version of *Threats to Virginia's Groundwater*, 1988), 42 pp.;

Protecting Virginia's Ground Water, brochure and poster;

Evaluation of Rooftop Rainfall Collection-Cistern Storage Systems in Southwest Virginia, 41 pp.

Virginia residents may receive one free copy of these publications, while supply lasts, by calling the Water Center at (540) 231-5624, writing to 10 Sandy Hall (0444), Blacksburg, VA 24061; or sending e-mail to water@vt.edu.

THE LEARNING RESOURCES PAGE

For the Record

Sources for selected public-interest topics

Tracking Federal Legislation and EPA Regulations

The Library of Congress website (**www.loc.gov**) is an on-line gateway to a vast amount of legislative information. One valuable link from this site is to "Thomas" (**thomas.loc.gov**), a searchable archive of complete bill texts, sponsors, and floor action for the past four Congresses, as well as on-line versions of historical documents and descriptions of legislative processes.

"In Congress" (**www.incongress.com**) is an on-line issues forum available free to the general public, but for a fee to "advocates." Free subscriptions to the site include access to position papers on issues before Congress, information on various "hot topics," and contact information for legislators, officials, and government staff. Paid, advocate subscriptions allow users to upload information and submit comments. All users can create a "personal profile" describing the issues that interest them most; "In Congress" will then e-mail users when new information about these issues becomes available. For more information, including cost of advocates' subscriptions, write The InForum Group, LLC, 818 Connecticut Avenue, N.W., Suite 1010, Washington DC 20006; or phone (202) 293-1447.

Water Policy Report is a biweekly newsletter on water-related legislative action as well as studies, reviews, and regulations originating from the U. S. Environmental Protection Agency. Yearly subscriptions cost $565 in the United States and Canada and $615 elsewhere. Contact Inside Washington Publishers, P. O. Box 7167, Ben Franklin Station, Washington DC 20044; or call (800) 424-9068.

—Compiled by Joseph Manfre

***FOR THE RECORD* SCHEDULE**

1998

This issue – Tracking Federal Legislation and EPA Regulations

August – Finding Drinking Water Information

October – Finding Water Quality Information and Data

December – Finding Hydrologic, Weather, and Climate Information and Data

1999

February – Tracking Virginia General Assembly Legislation

April – Following State Water Regulatory Processes

Schedule subject to change

Teaching Water

Especially for Virginia's K-12 teachers

Water Central will use this space to list the Virginia Standards of Learning—in science and social studies—for which articles in the issue have relevant information. We will also include, whenever we can, other information, activities, or resources of particular interest to teachers or their students.

This issue and the Virginia Standards of Learning

(ES = earth science, LS = Life science, and BIO = biology).

"1998 General Assembly"
Science: 6.11, LS.12, ES.9, ES.11
Social Studies: 7.4, 12.6, 12.8, 12.13

"Pfiesteria or Not…"
Science: 1.5, 2.5, 3.5, 3.6, 3.10, 4.5, 4.8, 5.6, 6.9, 6.11, LS.3, LS.4, LS.6, LS.7, LS.9, LS.11, LS.12, BIO.4, BIO.5, BIO.9

"For the Record"
Social Studies: 7.4, 11.14, 12.6, 12.8, 12.10, 12.13, 12.16

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Please answer the following questions to let us know whether the newsletter is meeting your needs. Please mail this page to the Water Center address listed in the box to the left, or e-mail your responses to water @vt.edu. Thank you.

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