Virginia Water Central

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FEATURE ARTICLE

Inside Virginia's State Budget for Water

Each year *Virginia Water Central* solicits opinions from Virginia General Assembly participants and observers as to that year's most significant water-related bills. Every year so far, at least one respondent has suggested that, rather than any particular water-related bill, the annual passage or amending of the state's *budget* has the biggest impact on water in Virginia.

"[It's the] state budget!!" Delegate Robert Bloxom (R-1st) insisted in a *Water Central* survey about important legislation in the 2000 General Assembly. In a recent telephone interview, he reasserted his belief that the budget determines the direction of water quality and policy more than any other legislation. "Particularly in the unusual session we just experienced [the 2001 regular session]," he said, "you can see how the budget can make things work or almost come to a complete halt."

Water Central decided, therefore, to explore in some detail the Virginia state budget, in order to answer two questions:

1.) How much money does the state spend on water-related issues?
2.) How is the spending allocated?

[**Ed. note**: The next issue of *Water Central* will feature an inventory of, and opinions on, water-related legislation in the 2001 General Assembly.]

The Budget Process in Brief

The state budget is drafted on a two-year, or biennial, basis, but the legislature meets near the start of each calendar year to revise and amend the spending plan for the approaching **fiscal year** (FY), which begins

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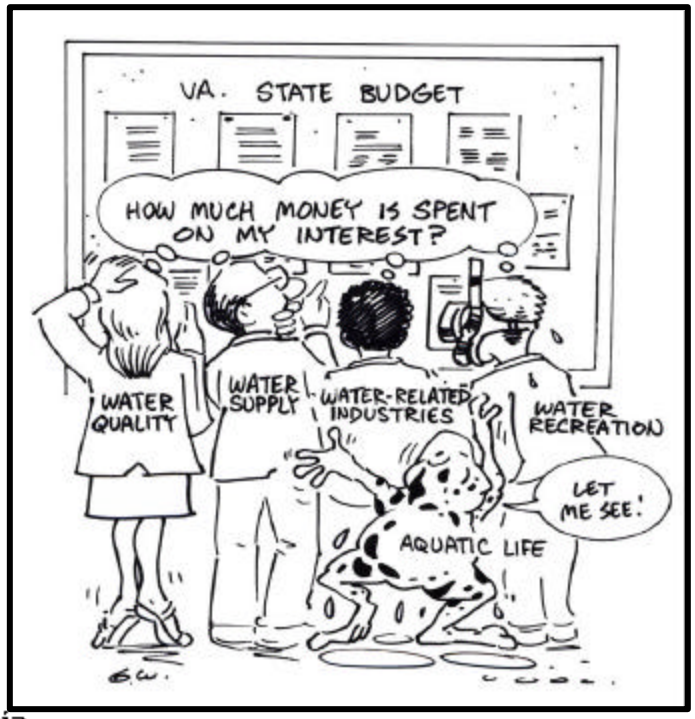

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on the first of each July. Much of the business of any session comes down to striking compromises that bring into accord the proposed budgets, or budget amendments, by both houses of the legislature and the governor. Ultimately, a final budget bill is passed and approved by the governor.

In the 2001 General Assembly's regular session, however, the governor and the legislature failed to agree on an amended budget for FY 2002 (July 1, 2001—June 30, 2002). Consequently, the state reverts to the last approved budget, the one passed in 2000 to allocate spending for FY's 2001 and 2002.

Partial Analysis of State Water Spending Done in 1999

In 1999, the state Department of Planning and Budget (DPB) conducted a study into Virginia's spending on environmental issues for Fiscal Year 2000. Their list identified $99.6 million spent that year on the following water-related issues: drinking-water quality; fish and wildlife protection; marine and coastal management; surface-water quality; and water-resource management. This amount constituted about 0.5 percent of the state's budget of $21.4 billion in that fiscal year.

But that wasn't the complete story on water-related spending, then or now. For instance, the DPB study did not include the state's appropriations for ports or for other water-related commerce and transportation, for water conservation, or for water and marine research and education. So we sought a more comprehensive picture by examining the FY 2002 budget talking to budget experts in the administration.

Start with the Agencies

"We have a lot of [state agencies]," said Marty Farber, senior research associate with the Division of Legislative Services in Richmond. That's a bit of an understatement; there are nearly a hundred agencies in the executive branch alone. But Mr. Farber nonetheless felt the best way to determine the state's spending on water concerns would be to consider which of these many executive agencies are most likely to handle water-related issues. He suggested the agencies listed in Table 1 (below), a list

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Table 1. Virginia Executive Agencies Most Involved with Water Resources.

Agency	Major Water-related Activities
Chesapeake Bay Local Assistance Department	Assists localities in the Bay's watershed in protecting water quality through land-use decisions.
Conservation and Recreation	Manages state parks and preserves; assists in soil and water conservation efforts, dam safety, and resource planning; administers grants for non-point source pollution reduction.
Environmental Quality	Enforces federal Clean Water Act; oversees waste management issues and wastewater treatment; administers grants for point-source pollution reduction.
Forestry	Manages use of land and waters within state forests.
Game and Inland Fisheries	Regulates fishing, boating, and hunting.
Health	Responsible for water supply engineering and shellfish sanitation.
Housing and Community Development	Provides loans and grants for indoor plumbing rehabilitations.
Institute of Marine Science	Conducts research and education on marine life and habitats.
Marine Resources Commission	Manages marine fishery and habitat resources.
Mines, Minerals, and Energy	Oversees mine safety, other regulations, and reclamations; responsible for protection of groundwater and surface water near mines.
Port Authority	Regulates and assists commercial shipping and boating.

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later concurred with by Neil Menkes, a natural resources budget analyst for the Senate Finance Committee. "If you start with these," Mr. Farber said, "and examine their individual budgets, you can get a very good idea as to how much of the state's money is applied to water efforts each year."[1]

Within Agencies, Look for Water Programs

The 535-page document that directs the state's appropriations and spending for the 2000-2002 biennium is known as Chapter 1073 of House Bill 30, which was passed on May 19, 2000, as the last piece of budgetary business in that General Assembly. [2] Chapter 1073 identifies how much money each state agency was appropriated for Fiscal Years 2001 and 2002. Going further, the state's guide to the budget's **program codes** makes it possible to identify within some agency appropriations money that has been earmarked for water-related spending.[3] Table 2 (page 4) lists the FY2002 appropriations for water-related programs for four of the agencies listed in Table 1.

Another four of the agencies listed in Table 1 are completely focused on water-related issues, so it was unnecessary to dissect their budgets by program codes to identify water-related spending. These agencies' FY2002 budgets, all of which we consider water-related, are as follows:

Marine Resources Commission	$14,372,403
Chesapeake Bay Local Assistance	$2,628,411
Institute of Marine Science	$30,947,325
Port Authority	$46,765,930
Total	**$94,714,069**

One remaining agency from Table 1, VDGIF, is something of a special case. While it's clear this department's mandate encompasses more than strictly water-related issues there are no sub-programs within the appropriation it receives to show how the appropriation is divided between efforts directed at fish and those directed at terrestrial wildlife. But because the department's activities affect the state's waters and its *watersheds*, we have also included its total appropriation of $46,560,196 in our estimate.[4]

Considering all the water-related figures cited here (from Table 2 and those identified in this section), as well as a $10,000 appropriation for one agency—the State Water Commission—in the legislative branch, it's possible to conclude that for Fiscal Year 2002, Virginia appropriated approximately **$288.9 million** to support water-related programs. This figure represents about 1.2 percent of the $24 billion state budget for that year.

Uncertainties Exist

At least two complications reduce the accuracy of the water-resource spending figure cited above ($288.9 million). For one thing, this estimate doesn't include any water-related appropriations for two of the agencies in Table 1—the Department of Forestry (DOF) and the Department of Mines, Minerals, and Energy (DMME). For another, some programs administered listed in Table 1 are not *exclusively* water-related.

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[1] We chose not to include higher-education spending on water-related education, research, and public service, as it would be quite difficult to sort out water-related efforts within those areas.

[2] The entire budget document is available at state depository libraries. Portions of it can be examined on-line at leg2.state.va.us/MoneyWeb.NSF/sb2001.

[3] An accounting change in the 1980s made tracking appropriations by subject a bit easier. Rather than awarding money to agencies and allowing them to spend it according to their own priorities, the budget allocated money by *programs* (such as water quality, air quality, land conservation, etc.). Each program has a three-digit code; within each code may be sub-programs, to which two more digits are attached.

[4] This amount includes $5,172,000 of capital expenses for fish hatchery improvements. This was the only agency on our list with water-related capital expenses for FY 2002.

Table 2. FY2002 Appropriations for Water-related Programs in Four Virginia Agencies.

Department of Environmental Quality	
Chemical Emergency Response	$75,154
Chesapeake Bay Quality and Habitat Monitoring	$2,246,924
Chesapeake Bay Quality Assessments	$4,399,505
Coastal Resources Management	$1,253,201
Construction Assistance	$33,562,126
Discharge Inspections	$3,940,131
Discharge Pre-treatment	$217,382
Discharger Permit Assistance	$3,347,169
Environmental Education	$239,549
Environmental Emergency Response	$55,479
Financial Aid for Coastal Resource Management	$1,818,853
Financial Aid for Environmental Resource Management	$2,702,479
Financial Assistance for Water Quality	$677,163
Groundwater Management	$633,344
Interagency & Intergovernmental Coordination	$183,687
Interstate Management	$136,930
Oil Spill Discharge Response	$1,744,318
Policy and Program Development	$248,166
Pollution Prevention	$902,264
Surface Water Investigations	$622,055
Underground Storage Tank Regulation	$20,241,213
Waste Disposal Site Remediation	$1,440,920
Wastewater Treatment Plant Operations	$177,539
Water Discharge Permits	$3,946,319
Water Quality Control Construction Assistance	$939,345
Water Quality Planning	$873,480
Water Quality Research	$605,323
Water Resources Enforcement	$1,353,337
Water Supply Planning	$57,754
Total	**$88,641,109**
Conservation and Recreation	
Assistance to Soil and Water Conservation Districts	$4,725,440
Dam Safety	$362,621
Flood Plain Management	$642,518
Natural Heritage Resources	$3,314,027
Nutrient Management	$223,650
Shoreline Management	$426,796
Statewide Non-point Pollution Control	$8,772,286
Urban Non-point Pollution Control	$1,085,594
Total	**$19,552,932**
Health	
Financial Assistance for Water Supply Monitoring	$24,860,000
Sewage and Wastewater Regulation	$1,957,955
Shellfish Sanitation	$1,770,229
Water Supply Engineering	$7,832,387
Total	**$36,420,571**
Housing and Community Development	
Indoor Plumbing Assistance	$3,030,000
Total	**$3,030,000**
Four Agencies Total	**$147,644,612**

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The two following subsections explore these complications.

Why Two Agencies Didn't Make the Cut

The DOF appropriation for FY 2002 is $24.9 million. DOF devotes some of that money to water-related activities, such as erosion control in state forests and wetlands protection, but there are no *specific* water-related programs for these expenditures. As explained by the department's budget director, Jim Bowen, these efforts simply make up a part of the regular duties DOF personnel perform in support of the state's forests, and are given no special distinction in the agency's budget. Consequently, Mr. Bowen could not attach a specific percentage of his budget to water-related activities.

The situation at DMME is similar. As part of its responsibility for mine regulation and mine-reclamation enforcement, this agency has a direct role in monitoring and preventing contamination of surface and groundwater. But there are no line items for this aspect of its duties in the $29-million appropriation it is to receive in FY 2002.

For these reasons, and because water resources are not the *primary* focus of these two agencies, we did not include *any* portion of their budgets in our estimate of water-related spending. Doing otherwise would have involved either guessing about the percentage of total appropriations the agencies devote to water-related efforts (something even knowledgeable staffers were unwilling to do), or categorizing their *total* budgets as water-related. Either approach would skew the estimate dramatically.

And Why Some Programs Did

A similar problem exists, though to a lesser degree, within some line-item programs that clearly involve water resources. For example, the Natural Heritage program administers and protects nature and wildlife preserves. Some of those preserves are aquatic and some are not, but there's no distinction in the program's $3 million appropriation between aquatic areas and terrestrial areas.

At least ten programs within the Department of Conservation and Recreation or the Department of Environmental Quality similarly apply state funds to water-related activities while also targeting land conservation, preservation of historic homes and sites, forest conservation, and other measures. We chose to include the full appropriations for these programs in our estimate, acknowledging that doing so added a possible source of overestimation to our final calculation of water-related spending.

Conclusion

Using the Virginia's official budget as a guide, it's possible to identify $288.9 million in appropriations in FY 2002 for issues including water quality, water conservation, water used for recreation, water as a medium for transport and commerce, marine and shoreline protection, aquatic-life study and preservation, and water-related research and education. This represents 1.2 percent of the state's total appropriations for the fiscal year. This estimate does not include all water-related appropriations, because some agency budgets are not set up to separate water-related expenditures, and some programs within agencies similarly devote money without distinction between activities that are water-related and those that are not.

This effort to identify water-related appropriations in the state budget is a first step toward understanding how the budget affects water-related issues in Virginia. With this guide for tracing a high percentage of water-related spending, one could begin to explore such spending from year to year, as well as determine how Virginia's water-related spending compares to that in other states. We hope to continue such explorations in future issues of *Water Central.*

–By David Mudd

Water Central thanks budget analysts at the Virginia Department of Planning and Budget, Division of Legislative Services, and Virginia Tech for their assistance with this article.

SCIENCE BEHIND THE NEWS

Out of the Water, But Not Forever

In the wordless, beautifully drawn children's book *Tuesday*[5], nightfall finds frogs rising from the water on lily pads, leaving behind astounded fish and turtles as the frogs fly toward town. The frogs chase birds and a dog, make capes from sheets hanging out to dry, channel-surf as an elderly lady sleeps in front of her television, and in general make mischief all around before splashing back into the pond at daybreak. On Main Street on Wednesday morning, they leave a trail of lily pads and a befuddled police detective searching for clues.

Sadly, or perhaps thankfully, real-life frogs don't fly on lily pads or by any other means. But this book *does* capture two truths about frogs as well as toads and salamanders, the animals known collectively as **amphibians**. First, amphibians may leave water at some times, but most have to return eventually, at least to breed. Second, because amphibians are especially sensitive to environmental conditions around them, they provide clues about water quality and other conditions of the areas they inhabit. In fact, declining amphibian **populations** and the occurrence of deformed individuals are clues scientists have been pondering since at least the 1970s, with greatly increased attention in the news since the late 1990s. (For more on the attention amphibians have been getting, please see "Who's Talking…" on page 11).

When temperatures in Virginia warm during March and April, the loud and lyrical calls of Spring Peeper frogs begin. This year, they signaled that it was time for *Water Central* to explore tadpoles, toads, bullfrogs, chorus frogs, waterdogs, and the other animals that spend part of their lives on land and part in the water—and not just on Tuesdays.

[5] David Wiesner, *Tuesday* (New York: Clarion Books, 1991).

Amphibian Groups and Biology

Amphibians, having appeared about 350 million years ago according to the fossil record, were the first **vertebrates** to evolve into land-dwelling organisms. Today there are approximately 4,600 species, classified into three main groups, or orders: *frogs and toads*; *salamanders*; and *caecilians* (the latter are tropical, limbless, burrowing species; no species are found in Virginia). Worldwide, frogs and toads are the largest and most diverse amphibian group, with approximately 10 times the numbers of frog/toad species as salamander species. In Virginia, though, there are twice as many salamander species as frog/toad species (see the following chart).

Number of Amphibian Species

	World	Virginia
Frogs/Toads	approx. 4100	25
Salamanders	approx. 415	49
Caecilians	approx. 165	0
Total	approx. 4600	74

Sources: F. H. Pough *et al.* , *Herpetology*, 1998; J. C. Mitchell and K. K. Reay, *Atlas of Amphibians and Reptiles in Virginia*, 1999.

All amphibians have a moist, smooth, *water-permeable skin*, and all are *"cold-blooded"* (more correctly referred to as **ectothermic**). *Most* amphibians have a life cycle that includes both an aquatic and a terrestrial phase. Beyond these common characteristics, amphibians exhibit great variation in their body structure and size, behavior, and ecological relationships. Let's look in a bit more detail at three key aspects of amphibian biology.

Skin Impact on Water and Oxygen

Water readily passes through amphibians' thin, moist skin. In fact, amphibians do not drink water, as they absorb it readily from their freshwater surroundings.

On the other hand, amphibians readily *lose* water through their skin if their surroundings are too dry. Some amphibians are able to tolerate a good deal of dehydration. For example, the semi-aquatic Northern Leopard Frog can tolerate a 36-percent body-weight loss of water, and the terrestrial Southern Toad, a 43-percent loss.[6] But typically amphibians use behavior to prevent losing too much water. To preserve water, amphibians stay close to water or stay in secluded, humid spots, and they are most active at night. Use of burrows is another water-conserving behavior; some amphibians dig their own, while others occupy those dug by other animals.

Staying moist is also necessary for amphibians to get adequate *oxygen.* Much of amphibian breathing occurs across their skin, which must be kept moist to allow oxygen to pass through the skin into the body. As a group, amphibians can breathe through skin, gills, lungs, and mouth cavity. Some species have gills *and* lungs (both more-or-less functional), while other species have *no* lungs or gills as adults; the largest family of salamanders, for example, have no lungs. In species with no lungs or gills, as much as 90 percent of gas exchange is through the skin.

A Red-spotted Newt, a salamander species found in most Virginia counties. ©2001 Kenneth J. Stein, Ph.D.; used with permission.

Temperature Relations

The biochemical reactions that sustain living things require certain temperatures to occur. While animals (and other living things) obviously can tolerate a range of temperatures, different species do so in different ways.

As noted above, amphibians, unlike birds and mammals but like all other animals, are **ectothermic** (also referred to, somewhat misleadingly, as "cold-blooded)". This means that their body temperature follows closely the environmental temperature, and that they have no (or very little) physiological or chemical way to maintain a constant body temperature. Birds and mammals are **endothermic**, meaning they use energy from food to maintain a relatively constant body temperature (the actual range depends on the species).

Rather than using energy from food to maintain a constant temperature, amphibians and other ectotherms become inactive when temperatures are too high or too low. This makes ectotherms efficient in using the energy in their food for growth (rather than losing it as heat). For example, a 1980 study indicated that the Red-backed Salamander converts 48 percent of the energy in its food to body mass; the average for a group of 19 species of birds and mammals was 1.4 percent.[7]

[6] R. W. Hill, *Comparative Physiology of Animals* (New York: Harper & Row, 1976), p. 204.

[7] F. H. Pough, *et al.*, *Herpetology* (Upper Saddle River, N.J.: Prentice Hall, 1998), p. 15.

The challenges of being an ectotherm occur when temperatures are too hot or too cold. During hot weather, amphibians must seek out cool and moist areas and become relatively inactive (in a dormant state called *aestivation*). As temperatures cool below the animals' preferred range, amphibians may remain active but be sluggish; this can makes them more vulnerable to predators and less efficient at capturing their own prey. In very cold weather, amphibians seek refuge in areas of high humidity and temperatures above freezing, and again become inactive (in a state of *hibernation*). Depending on the species, places of winter refuge include the bottoms of ponds or other water bodies; under logs, leaves, or other debris on the land surface; or holes or crevices in the soil below the depth of freezing.

Life Cycles

Within amphibians as a group, reproductive cycles show great variety, with three main variations: egg-laying (either in water or not) followed by development involving a transitional aquatic larvae; egg-laying (either in water or not), followed by development to adult with no transitional larval form; and live birth of larvae or tiny adult forms.[8] Overall, the most common reproductive mode is the one involving a free-living, aquatic, larval form and **metamorphosis** from egg to larva to subadult to adult (a subadult has the same body form as an adult but is not yet capable of sexual reproduction).

In the typical pattern of amphibian metamorphosis, the change in body form from larva to adult results from *many* biochemical and physiological changes throughout the entire larval body. The following chart (next column) compares certain features *generally* seen in amphibian larvae vs. adults.

The timing and pattern of metamorphosis is inherent in an amphibian's tissues, but the right biochemical conditions

General amphibian larva	**General amphibian adult**
Fully aquatic	Semi-aquatic or terrestrial
Vegetarian	Carnivorous
Well-developed gills	Well-developed lungs
Long tail	No tail
No eyelids	Eyelids
Teeth and intestine suited for consuming and digesting plant material	Teeth and intestine suited for consuming and digesting animal material
Excretion of ammonia as primary nitrogen-waste product	Excretion of urea as primary nitrogen-waste product

Source: N. J. Berrill and Gerald Karp, *Development*, 1976.

are needed for the development to proceed normally. One key aspect is the hormone *thyroxin*, specific levels of which are needed at specific times. If thyroxin levels are not correct—as can happen, for example, if the animal does not get sufficient iodine—normal developmental processes go astray, and deformities can result in the adult amphibian. Other factors, such as chemicals and radiation, can alter development as well. Ultraviolet radiation, for example, has been shown experimentally to cause an extra hand to form during regeneration of a limb.[9]

Each amphibian species has its own pattern of mating. Frog and toad males gather at breeding time (usually spring) and generate "choruses" to attract females; the females identify males of their own species by the calls. Salamanders, however, do not call, so they must use vision and smell to find mates. Fertilization of eggs typically occurs outside of the female's body (external fertilization), and fertilized and deposited eggs lack a shell. This makes it necessary for amphibians to breed in wet or moist places, as the unprotected eggs would dry out

[8] All three main groups of amphibians include both egg-laying and live-bearing species, but all North American amphibians lay eggs. In many frog species worldwide, there is no aquatic larval stage.

[9] Amphibians can regenerate body parts (as can fish, but not reptiles, birds, or mammals). Regeneration of limbs, the tail, the snout, and even eyes is possible, occurring more readily when the animal is young or small.

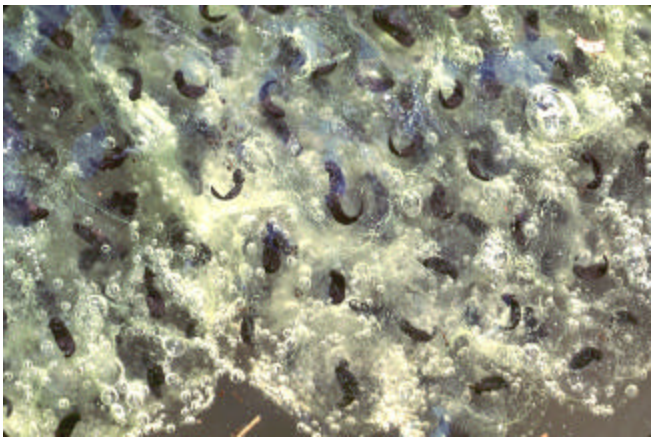
otherwise; moreover, in species with aquatic larvae, the eggs must be laid either *in* water or where larvae can quickly *reach* water.

Frogs and toads may lay eggs in still water, flowing water, tree holes, water-filled depressions, nests on ground, rocks, leaves over water, the female's back, or the male's legs. Salamanders may lay eggs in still water, flowing water, nests on the ground, or nests in trees. Some amphibians lay their eggs in clumps, others in strings, and still others singly. Many frog and toad species' eggs have colors that help the eggs absorb light and warm faster, speeding development (which depends on temperature). The number of eggs ranges from 1 to 30,000 among frog and toad species, but salamanders lay at most a few hundred eggs.

Generally eggs are abandoned, but some salamanders—Hellbenders, for example—guard eggs aggressively.[10] On the other hand, Hellbenders will also eat some eggs, apparently as an exchange for the energy required to protect them.

Some Aspects of Amphibian Ecology

Amphibians as a group are preyed upon by fish, reptiles, birds, and mammals. Some amphibians, too, prey on other amphibians, including members of their own species.[11] They are protected somewhat by having a slippery body, by being small and inconspicuous (usually), and by making visual displays (such as puffing up their throat) or loud sounds to try to intimidate predators. A noteworthy amphibian defense is the poisonous skin of some species, poisonous enough to kill or sicken many animals as well as humans. (Consequently, it is important to wash your hands after handling amphibians. Also, for the amphibians' benefit, moisten your hands before handling amphibians, so as not to remove any of the animals' protective moisture.)



A Wood Frog egg mass, with tadpoles preparing to leave the mass. ©2001 Kenneth J. Stein, Ph.D.; used with permission.

Adult amphibians typically eat insects and other small invertebrates, although in some species the adults are plant-eaters (and larvae typically eat plants). This gives amphibians an important role in the *flow of energy* through ecosystems. They can make use of small prey that is not as readily available or is not adequate for large reptiles, birds, or mammals. As mentioned above (page 7), amphibians are efficient at converting the food they consume into amphibian body mass; in doing so, they take animals too small for larger predators to consume and "convert them into [amphibian-size] packages that birds and mammals can consume."[12]

Besides their roles in natural systems, amphibians are useful to humans in several other ways, including the following:
- they are consumed as human food;
- they have diverse and potent skin toxins of interest to pharmacological research;
- the relatively large eggs of several amphibians have been very useful to the study of developmental biology; and
- salamanders' "heat-shock proteins"—chemicals that enable them to withstand a rapid temperature increase, such as when they emerge from shade to a sunny location—have been studied for information applicable to medicine, including cancer research.

[10] No Virginia frog species show parental care of eggs, but frog species in some other parts of the world do.

[11] Cannibalism in amphibians typically involves adults eating larvae or eggs, or larvae eating smaller larvae or eggs. It can be widespread when food is limited, such as in a temporary pond.

[12] Pough, *et al.*, *Herpetology*, 1998, p. 16.

Amphibians in Virginia

Where would you look to find amphibians in Virginia? Here are several possibilities: in rivers; along pond and lake margins; in freshwater or brackish wetlands; along streams; in temporary pools; in rock crevices on mountains; in caves, tunnels, and mines; and, of course, in your back yard or garden! The two photos to the right show examples of amphibian habitat in Virginia.

Virginia's diverse geography[13] provides habitats to support a relatively high number of amphibian species. Because amphibians are ectotherms, and because their skin is water-permeable, an area's temperature and moisture greatly influence the suitability of habitat for amphibians. Average annual temperature decreases with elevation, so average temperature tends to decrease from east to west across Virginia. As for moisture, the Shenandoah Valley is generally the driest region (over 33 inches of precipitation per year), while Lee County is the wettest (over 49 inches per year).

These factors, combined with ecological relationships with other species (including humans), determine where in Virginia amphibians live (their **distribution**). Some species—for example, the American Bullfrog—are found in nearly every county in the state. Other species, such as the Alleghany Mountain Dusky Salamander, are found in several counties but only in the western part of Virginia. Still others are found in only a very few locations; the Shovel-nosed Salamander, for example, is known only from Mt. Rogers and Whitetop Mountain in southwestern Virginia.

Virginia has several rare, endangered, or threatened amphibian species; the box to the right lists those species. The main threats to these species are habitat *loss* (such as through development or wetland draining), habitat *fragmentation* (such as dividing areas by roadways); and habitat *modification* by pollution, excessive sediments, etc.

Continued after box on page 11

[13] Virginia has five distinct geographic areas: Coastal Plain, Piedmont, Blue Ridge, Valley and Ridge area, and Cumberland Plateau.

Amphibian habitat at Pandapas Pond, Montgomery County, Va.

Rare, Endangered, and Threatened Amphibians in Virginia

On federal endangered species list
Shenandoah Salamander

On federal threatened species list
Mabee's Salamander

On Virginia endangered species list
Eastern Tiger Salamander

On Virginia threatened species list
Barking Treefrog

Of "special concern"* in Virginia
Oak Toad
Cow Knob (or White-spotted) Salamander
Hellbender (a salamander)
Mole Salamander
Peaks of Otter Salamander
Pigmy Salamander
Shovel-nosed Salamander
Weller's Salamander

*"Special Concern" in not a legal category, as "threatened" and "endangered" are.

Source: Virginia Department of Conservation and Recreation/Division of Natural Heritage Web-site, March 23, 2001.

Who's Talking about Amphibians

1998

•"[S]choolchildren discovered grossly deformed frogs in [a Minnesota pond in the summer of 1995…. Frogs with [deformities] have been found throughout Minnesota,…Vermont, Oregon, and Delaware…Such deformities have been under study in Quebec…by the Canadian Wildlife Service since 1992."— William Souder, "A Possible Leap Forward on Amphibian Abnormalities," *Washington Post*, March 16, 1998, p. A3.

•"**Herpetologists** with 30 years of field experience are reporting that many frogs and toads are simply disappearing from large parts of their former range." In response, the Declining Amphibian Populations Task Force (DAPTF) was formed in 1991. It now has over 3000 members in 90 countries.—Julie Griffin, "Amphibian Decline: Monitors Search for Answers," *Volunteer Monitor*, Vol. 10, No. 1 (Spring 1998).

•The Michigan Department of Natural Resources started conducting an annual frog and toad survey in 1996. "Frogs and toads are our watchdogs," said a volunteer monitor. "[Frogs are] a pretty good environmental indicator. They're sort of a biological sponge," said Michigan State University herpetologist James Harding.—Malcolm Johnson, "Frog Survey Gives Pollution Clues," *Associated Press*, May 17, 1998.

1999

•"Increased public awareness of declining populations, habitat loss, environmental pollution, and passage of the federal Endangered Species Act and the Virginia Endangered Species Act have focused attention on the state's native species [of amphibians and reptiles]."—Joseph Mitchell and Karen Reay, *Atlas of Amphibians and Reptiles in Virginia*, 1999.

2000

•An analysis of 936 amphibian populations worldwide showed "relatively rapid declines [globally] from the late 1950s/early 1960s to the late 1960s, followed by a reduced rate of decline [but still dropping] to the present." In North American, populations declined during the 1960s and from the 1970s to the late 1990s. Out of all the populations , 56.6 percent were declining.—Jeff E. Houlahan *et al.*, "Quantitative Evidence for Global Amphibian Population Declines," *Nature*, Vol. 404 (April 13, 2000), pp. 752-755.

•The U. S. Fish and Wildlife Service began a study in 2000 of frog-deformity rates at 43 national wildlife refuges in 31 states. They introduced the project at the Patuxent Research Refuge in Laurel, Md., where ponds sampled in 1999 had "higher than normal rates of deformed frogs" (it was 5 percent). "It's probably normal to have about one or two percent of frogs deformed…[but some refuges] have had rates as high as 17 percent."—Fern Shen, "Why is This Frog Worried?" *Washington Post*, Aug. 8, 2000, "KidsPost" section.

Continued from page 10

Unlike with some other groups of animals or with plants, there are not many established populations of *non-native* amphibians in Virginia. Individuals of some species (the Cuban Treefrog, for example) are sometimes imported on horticultural plants, but they usually can't survive here. It is illegal to release such animals into the wild.

Conclusion

Whit Gibbons and James Sweeney, writing in a recent issue of the *National Wetlands Newsletter*,[14] note several reasons why people "care about amphibians." The following three reasons stand out as especially compelling and well-put:

•Amphibians are "beautiful, mysterious, fascinating animals prominent in the history, religion, and mythology of many cultures…."

•They are "inhabitants of wetlands and terrestrial habitats with diverse and complex roles in nutrient cycling, seed dispersal, and as predator and prey" [including as predators on mosquitoes and other pests to humans].

•They are "heralds of environmental health…."

Amphibians live, usually inconspicuously, all around us, as well as in places where most people will never go and could not survive—deserts on the one hand, northern Alaska on the other. Their

[14] "Partnering for Herpetofauna Conservation—the PARC Approach," *National Wetlands Newsletter*, Sept.-Oct. 2000, p. 3.

inconspicuous habits have helped them survive for millions of years, but their complex life cycles—involving both land and water habitats—make them vulnerable to a number of modern-day threats. News reports over the past few years show a growing awareness of these diverse and interesting animals and their status. But to enhance *your own* awareness, put aside the news, go to a wet area, and listen for a frog "chorus."

—By Alan Raflo

Water Central thanks Carola Haas, Virginia Tech Department of Fisheries and Wildlife Science, for her assistance with this article; and Kenneth Stein, Conservation Management Institute at Virginia Tech, for permission to use his photographs.

Definitions for Words in Bold

•**Distribution**—when applied to a biology, this refers to the pattern of occurrence of the species or population. The geographic area in which the species or population is distributed is known as the **range**.

•**Ectotherm/endotherm**—terms synonymous with the more common but misleading terms "cold-blooded" and "warm-blooded," respectively. **Ectotherms** depend on the external environment to provide body heat; their body temperature fluctuates with external conditions. **Endotherms** generate body heat from their food and maintain a relatively constant body temperature.

•**Herpetologist**—one who studies amphibians and reptiles, from a Greek word verb meaning "to creep." Amphibians and reptiles collectively are often referred to as "**herps**."

•**Metamorphosis**—a dramatic but predictable change in body form and habits as an animal progresses from an egg to adult.

•**Population**—the individuals of a certain species within a particular area. For example, one can refer to the population of American Toads in a single backyard garden, in a given Virginia county, in all of Virginia, and so forth.

•**Vertebrate**—a member of the group of animals that have a backbone; this group includes fishes, amphibians, reptiles, birds, and mammals.

Scientific Names of Amphibians Mentioned

(* indicates *not* found in the wild in Virginia)

Frogs

American Bullfrog—*Rana catesbeiana*
Barking Treefrog—*Hyla gratiosa*
*Cuban Treefrog—*Osteopilu septentrionalis*
*Northern Leopard Frog—*Rana pipiens*
Spring Peeper—*Pseudacris crucifer*
Wood Frog—*Rana sylvatica*

Toads

American Toad—*Bufo americanus*
Oak Toad—*Bufo quercicus*
Southern Toad—*Bufo terrestris*

Salamanders

Alleghany Mountain Dusky Salamander—*Desmognathus ochrophaeus*
Cow Knob Salamander—*Plethodon punctatus*
Eastern Tiger salamander—*Ambystoma tigrinum tigrinum*
Hellbender—*Cryptobranchus alleganiensis*
Mabee's Salamander—*Ambystoma mabeei*
Mole Salamander—*Ambystoma talpoideum*
Peaks of Otter Salamander—*Plethodon hubrichti*
Pigmy Salamander—*Desmognathus wrighti*
Red-backed Salamander—*Plethodon cinereus*
Red-spotted Newt—*Notophthalmus viridescens viridescens*
Shenandoah Salamander—*Plethodon shenandoah*
Shovel-nosed Salamander—*Desmognathus marmoratus*
Spotted Salamander—*Ambystoma maculatum*
Weller's Salamander—*Plethodon welleri*

Hmmm…I wonder if any of those reporters know how "Hellbenders" got their name?

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Mitchell, Joseph C. "Amphibians and Reptiles." Pages 411—476 in *Virginia's Endangered Species*, Karen Terwilliger, ed. Richmond: Va. Dept. of Game and Inland Fisheries, 1991. Distributor: McDonald and Woodward, Granville, Ohio, (800) 233-8787.

Mitchell, Joseph C. and Karen K. Reay. *Atlas of Amphibians and Reptiles in Virginia*. Richmond: Va. Dept. of Game and Inland Fisheries, 1999.

For More Information

U. S. Geological Survey

•The USGS runs the North American Reporting Center for Amphibian Malformations. (800) 238-9801; www.npwrc.usgs.gov/narcam/index.htm.

•Frogwatch USA is an educational, long-term frog and toad monitoring program. Frogwatch USA Coordinator; Patuxent Wildlife Research Center, USGS—Biological Resources Div., 12100 Beech Forest Road; Laurel, MD 20708-4038; (301) 497-5819; e-mail: frogwatch@usgs.gov; www.mp2-pwrc.usgs.gov/frogwatch/index.htm.

Virginia Herpetological Society.

This group pursues education, research, and conservation related to amphibians and reptiles. VHS Secretary/Treasurer, Dept. of Biology, Liberty Univ., 1971 Univ. Blvd., Lynchburg, VA 24502; e-mail: vhsociety@mindspring.com; vhsociety.home.mindspring.com.

Va. Dept. of Game and Inland Fisheries

The regulatory agency for amphibians in Virginia. Game regulations applicable to amphibians are summarized in Mitchell and Reay, pp. 23-24 (reference listed above). The regulations themselves are available on-line at www.dgif.state.va.us/fishing/regs/section7.html.

Related Museum Exhibit

"Shake, Slither, and Swim" is a Va. Museum of Natural History exhibit on reptiles and amphibians. The exhibit runs from April 27—October 7 in Martinsville. For more information, phone (540) 666-8800; www.vmnh.org.

TEACHING WATER

Especially for Virginia's K-12 teachers

This Issue and the Virginia Standards of Learning

Below are suggested Virginia Standards of Learning (SOLs) supported by this issue's Feature, Science, and For the Record sections. Abbreviations: BIO=biology; C/T=computer technology; ES=earth science; LS=life science.

Feature Article—Water in the State Budget
Science SOLs: 6.11, ES.7.
Social Studies SOLs: 7.4, 12.8.

Science Article—Amphibians
Science SOLs: 1.5, 2.4, 3.4, 3.6, 3.10, 4.5, 4.8, 5.5, 6.9, LS.5, LS.7, LS.8, LS.9, LS.11, LS.12, BIO.5, BIO.7, BIO.8, BIO.9.

For the Record:
Groundwater Information Sources
Computer Technology SOLs: C/T5.3, C/T8.4.

Science SOLs: 4.8, 6.11, ES.7, ES.9.
Social Studies SOLs: 10.9, 11.15.

IN AND *OUT OF* THE NEWS

Newsworthy Items You May Have Missed

The following summaries are based on information in the source(s) indicated at the end of each item. Selection of this issue's items ended April 3, 2001. Unless otherwise noted, all localities mentioned are in Virginia.

In Virginia…

•The **Hampton Roads Sanitation District (HRSD) and BP-Amoco kicked off a new water-conservation effort** last December. Under their agreement, HRSD pumps 500,000 gallons/day of "reclaimed wastewater" from the York River Wastewater Treatment Plant to the oil company's Yorktown refinery, to be used as coolant. This effort is a first in Virginia. It will reduce the amount of wastewater HRSD discharges to the York River, and BP-Amoco will pay less for the wastewater than they would for an equal amount of drinking-quality water.

In another water-conservation effort in that area of the state, the James City Service Authority (JCSA) is launching an effort to reduce summer peak demands for water. JCSA is the largest water system in the state solely dependent on groundwater. It hopes to reduce summer demand spikes—which are sometimes 50 percent higher than average daily usage rates—with a Water Conservation Education and Information Campaign, Irrigation Association certification programs for landscape professionals, water-conserving landscaping demonstrations at the JSCA office grounds, and water-management training workshops for commercial and multi-residential users. (*Update, Regional Raw Water Study Group*, Winter 2000/2001)

•The **Kim-Stan Landfill in Alleghany County, closed in 1990, is not a hazard to humans** in the area, according to a draft report by the federal Agency for Toxic Substances and Disease Registry. The agency, which is part of the U. S. Department of Health and Human Services, detected chemicals in surface water, soil, and sediment but not in concentrations considered threatening to humans. It also found contamination in groundwater beneath the landfill, but the water is not used for drinking or other domestic purposes, so it too was ruled out as a hazard. The report, which is available at the Clifton Forge Public Library and the Lancaster Community College Library, recommends more sampling of water, soil, and gaseous emissions at the site. The U. S. Environmental Protection Agency (EPA) is to release more data later this year on contaminants at the site, which was placed on the National Priorities List of Superfund sites in 1999. (*Roanoke Times*, 1/9/01)

•**About 41 percent of state-monitored rivers and streams are impaired**—that is, fail to meet one or more state water-quality standards—the Virginia Department of Environmental Quality (DEQ) reported early in the year. That compares to an almost equal percentage of impaired streams and rivers across the nation, and is felt by DEQ to be a more accurate representation than reported in years past. (*Richmond Times-Dispatch*, 1/22/01)

Meanwhile, the DEQ has prepared a **cost estimate for cleaning impaired rivers and streams in the state**. In a report submitted to the Virginia General Assembly in February, the agency estimated that over the next decade it will cost about $60 million for planning, and $300 for implementation, for 648 plans (Total Maximum Daily Loads, or TMDLs) to clean up some 600 impaired stream segments (stretching nearly 4000 miles). (*Richmond Times-Dispatch*, 2/8/01)

•The town council of **Tangier Island** (pop. approximately 700) has reached agreement with the DEQ on **a set of pollution-control measures**. The measures are intended to solve several long-standing problems: the island's wastewater treatment plant has been pumping poorly-treated water into the Chesapeake Bay; its incinerator doesn't meet clean air standards; and residents have been dumping large trash items in the island's marshes. Tangier has agreed to begin remedying these problems by increasing utility fees on residents and by turning management of its sewer and incinerator systems to a private firm, Maryland Environmental Services, Inc. The state is to help fund the changes with a grant of $125,000 from the Virginia Environmental Emergency Response Fund. The Virginia Water Control Board, and perhaps other agencies, must first approve the agreement. (*Richmond Times-Dispatch*, 1/26/01)

•On January 24, the **Maryland Department of Environment (MDE) issued a permit for Fairfax County to extend a water-intake pipe** farther into the Potomac River. MDE took the action, however, only because of a court order, and Maryland officials plan to appeal that order. Fairfax officials have said they wanted the extension only because water taken from deeper in the river is cleaner, but Maryland Governor Parris Glendening and other state officials have suggested the fast-growing Virginia county wants more water to serve development. (*Richmond Times-Dispatch*, 1/26/01)

•The **number of registered boats and other watercraft in Virginia is rising while the number of boat-related accidents and fatalities is dropping**. There were 240,317 registered boats in the state in 2000, with 179 reported accidents resulting in 17 deaths. In 1999, with nearly 2000 fewer boats registered, 200 accidents were reported, with 21 deaths. The most significant decrease in accidents and fatalities has been in the personal-watercraft category, with 40 reported accidents last year compared to 90 in 1997. (*Roanoke Times*, 2/16/01)

•Considering a **case against Smithfield Foods by the state Water Control Board**, the Virginia Supreme Court ruled in March that Virginia cannot recover penalties from Clean Water Act violators when the U. S. EPA has already fined the same violator for the same infraction. The ruling is expected to have national implications, because it is apparently the first time a state court has made such a ruling. (*Inside EPA Water Policy Report*, 3/12/01)

•In an **effort to rebuild the state's depleted oyster population**, the Virginia Marine Resources Commission (VMRC) has asked the U. S. Army Corps of Engineers for permission to dredge millions of bushels of ancient oyster shells from beds in the Elizabeth and James rivers. The old shells will be used to construct reefs for seeding young oysters into the Rappahannock, Elizabeth, and Bank rivers, as well as Tangier and Pocomoke sounds. The VMRC wants to relocate as many as 35 million bushels of the shells over the next five years. The oyster beds to be dredged support very few living oysters: in some areas, disease-causing organisms are present; in other areas, encroachment of fresh water makes the areas inhospitable to oysters. (*Richmond Times-Dispatch*, 3/14/01)

…and Outside of Virginia

•An October report by the World Resources Institute stated that "**four out of every 10 people [around the world] live in river basins that are experiencing water scarcity**." In addition, the report claims that many of the world's freshwater systems are seriously degraded in their capacity to support human, animal, and plant life. The report, "Pilot Analysis of Global Ecosystems: Freshwater Systems," can be viewed on-line at www.wri.org/wri/wr2000 (click on "Freshwater Systems"). (*National Wetlands Newsletter*, Nov.-Dec. 2000)

•In January, the U. S. Supreme Court ruled that **the Clean Water Act does not give the EPA or the Army Corps of Engineers authority over all bodies of water in the United States**. As a result of a lawsuit against the Corps by the Solid Waste Agency of Northern Cook County (in the Chicago area), the court ruled the Corps' jurisdiction over "navigable waters" does not apply to *isolated* waters (including wetlands) that are not navigable. In the case, the waste authority sought to develop a landfill site where several drainage sites had essentially evolved into wetland habitat for migratory birds; area environmentalists had sought to protect the habitat. (*Inside EPA Weekly Report*, 1/10/01)

•On January 12, the U. S. Food and Drug Administration (FDA) and the EPA jointly issued **advisories on mercury in commercially available as well as non-commercial fish**. The FDA recommended that pregnant or nursing women and young children not eat shark, swordfish, king mackerel, or tilefish, and that they eat no more than an average of 12 ounces of other fish per week. The EPA recommends that pregnant or nursing women limit to six ounces (cooked fish) per week their consumption of freshwater fish caught by subsistence or recreational fishers; young children should consume no more than two ounces per week. For more information about mercury in seafood, phone the FDA toll-free at (888) 723-3366; or visit their Web-site at www.cfsan.fda.gov. Information on the EPA advisory is available on-line at www.epa.gov/ost/fish. (Sources for this item are the two Web-sites mentioned, April 2001)

In a related story close to Virginia, state officials say **mercury is the leading cause of fish advisories in North Carolina**. In fact, the state was the first on the East Coast to issue a warning about eating too much king mackerel. (*Raleigh News-Observer*, 1/22/01)

•**The American Water Works Association Research Foundation announced in January the awarding of 48 project grants for 2001**. Nearly $11 million was given to projects in **six disciplines**: reducing microbial risk in drinking water; protecting consumers from chemicals in drinking water; improving water quality and water-system management for utilities; improving water-delivery infrastructure; informing consumers about the science and technology of drinking-water supply and protection; and ensuring access to and wise use of water resources. (*AWWA Mainstream*, February 2001)

Another sample of what's happening in water research comes from a recent list of projects supported by the **National Research Council's Water Science and Technology Board**. Some of the topics being addressed are these: the scientific basis for the Total Maximum Daily Load (TMDL) approach to water-pollution reduction; toxins and pathogens in biosolid fertilizers; restoration of the Everglades; drinking-water contaminants; environmental remediation at U. S. Navy facilities; the Missouri River ecosystem; privatization of water services; functions of riparian zones; and mitigating wetland losses. (*WSTB Newsletter*, Jan.-Feb. 2001)

•It's known that **North Carolina** is home to more than **770 closed landfills.** What's not known is **what condition many of those landfills are in**, nor exactly where many of them are. It also isn't known how many may be contributing to groundwater contamination, though officials suspect it's a high percentage because many operated before requirements (for liners and other measures) were in place to prevent contamination. The state has begun an effort to catalogue the sites and eliminate contamination hazards if possible. Landfills are "officially blamed" for 58 groundwater-contamination incidents, but that number underestimates the problem, according to the state's groundwater section chief. (*Charlotte Observer*, 2/5/01)

•**Many observers expect the new Congress to allow appropriations for major water infrastructure initiatives this year**. Two influential interest groups disagree about the potential billions of new spending. The Water Infrastructure Network (WIN), made up of local government groups, water-treatment and water-supply interests, and environmentalists, has recommended that Congress authorize $57 billion for infrastructure spending over five years. On the other hand, the H20 Coalition, consisting of the National Association of Water Companies, water- and wastewater-equipment producers, and the National Council for Public/Private Partnerships, agrees that much of the country's water infrastructure has problems but says the price is too much for the government to pay on its own. It has recommended alternative sources of funding. (*Inside EPA Water Policy Report*, 2/12/01)

•A recommendation has been made by researchers at East Carolina University that a **bi-state panel be formed to manage the Waccamaw River basin in North Carolina and South Carolina**. The researchers' report, still under review by the North Carolina Division of Water Resources, concludes that the area is under increasing pressure from development that is taxing the water table, and that logging activity in the Green Swamp—a vital contributor to the river's flow—is draining the shallow parts of the swamp and filling the deeper parts with sediment. (*Wilmington Star*, 2/25/01)

•A recent study by the University of North Carolina suggested it may be **more important to enforce more fully existing laws regulating erosion and run-off controls at construction sites than to pass more restrictive rulings**. Researchers found that water-quality degradation was "significantly impacted by enforcement activities" at construction sites along tested streams in the state, while at sites where restrictions were stronger but enforcement was lax, water quality suffered. This finding suggests implementation of EPA's "Phase II" stormwater regulations of small construction sites and sewer systems, set for next year, may have limited impact because enforcement personnel nationwide are already stretched. (*Inside EPA Water Policy Report*, 2/26/01) [**Ed. note:** For more on stormwater issues, please see the Feature Article in the February 2000 *Water Central*.]

•**The Army Corps of Engineers chose to suspend a $60-million study of potential construction projects on the Mississippi River** after an independent review by the National Academy of Sciences (NAS) concluded there were serious problems with projections and methods in the study. The report praised the Corps for improving its economic models, but it criticized it for overestimating barge traffic on the Mississippi, using inaccurate assumptions, paying too little attention to environmental concerns, and ignoring non-structural methods (such as scheduling changes) to relieve barge congestion. (*Washington Post*, 3/1/01)

•The Chesapeake Bay gets most of the attention, but Maryland is also concerned about its other bays. The state Department of Natural Resources has announced plans for a **survey this summer to determine the health of Chincoteague, Sinepuxent, Isle of Wight, and Assawoman bays**. Officials say they are concerned about encroaching development and heavy agricultural use in areas adjacent to the bays, and they want to get a sense of water quality and marine life in each bay as a first step in developing plans to stabilize their health. (*Baltimore Sun*, 3/15/01)

•In a November 2000 report, the North Carolina Marine Resources Commission (NCMRC) asserted that **if all proposed efforts to replenish the state's beaches were implemented, they would pose a "real and significant threat" to coastline and marine resources**. Pumping sand to rebuild small stretches of beach has been a regular practice for decades, but there are serious plans now for large-scale rebuilding of shorelines along nearly 120 miles of the state's 300-mile coast. This beach rebuilding would both reduce threats of shoreline erosion to existing beachfront developments and pave the way for additional development. But it worries some biologists and fish and wildlife officials who believe many marine animals living along the state's shores depend on conditions found on narrow beaches—conditions that are altered or eliminated by beach replenishment. They content that marine life is also further affected by altered circumstances at sites where sand is dredged for transport to shorelines. The NCMRC is urging state officials to review all proposed projects. (*Winston-Salem Journal,* 3/15/01)

•Just when you may have gotten accustomed to TMDLs, along comes **another somewhat neglected aspect of the national Clean Water Act (CWA): antidegredation**. The CWA requires that state water-quality programs have three main elements: designated uses for water bodies; numerical measurements for regulating pollutant discharges; and an anti-degradation policy to protect existing water quality and uses. But over 20 states have no antidegradation policy in place, and the U. S. EPA is concerned that there may be increased litigation regarding this policy, similar to the many lawsuits over TMDLs in recent years.

West Virginia is one arena where antidegradation is currently being debated. The state's Division of Environmental Protection has proposed one antidegradation plan; a consortium of industries has proposed another. Some environmental activists, such as the West Virginia Rivers Coalition, contend that neither plan may do enough to protect water quality, and the Rivers Coalition may sue the EPA if the West Virginia legislation passes a policy that the group considers too lenient. (*Inside EPA Water Policy Report*, 3/26/01

•As has been widely reported, the EPA was ordered by the Bush Administration to suspend implementation of a **stricter standard for arsenic in drinking water**. The stricter standard of 10 parts per billion (ppb) was to replace the current 50-ppb level, which was set in the 1940s. The final regulation, having been through a contentious review process over several years, was published in the *Federal Register* on January 22, 2001. The White House delayed the rule's implementation for an initial 60 days (through March 22). On March 20, EPA Director Christine Todd Whitman delayed its implementation for an additional 60 days. During this period, the agency is expected to begin the formal process of withdrawing the regulation for further review. The 50-ppb standard likely would remain in place during such a review. (Washington Post, 3/21/01; and *Inside EPA Water Policy Report*, 3/26/01)

—By David Mudd

CORRECTION FROM THE PREVIOUS ISSUE OF *WATER CENTRAL*

The Feature Article cartoon (page 1) in the January 2001 issue had the words "Disinfection" and "Infiltration" reversed. The correct cartoon is printed here:

N O T I C E S

On the Public Calendar

•**May 24**—Virginia Pollution Prevention Advisory Committee. DEQ Piedmont Regional Office, Richmond, 10 a.m. For more information contact Sharon Baxter, e-mail: skbaxter@deq.state.va.us; or by phone at the DEQ central office in Richmond toll-free in Virginia, (800) 592-5482.

•**June 6**—State Water Control Board. General Assembly Building, Richmond, 9 a.m. For more information contact Cindy Berndt, e-mail: cmberndt@deq.state.va.us; or by phone at the DEQ central office (see number above).

Directory of River/Watershed Groups

River Network offers a CD-ROM with a searchable database of over 3,500 river and watershed conservation groups in the United States. The directory is also available at www.rivernetwork.org. For more information, contact River Network at 520 SW Sixth Ave., Ste. 1130, Portland, OR 97204-1535; (503) 241-3506; e-mail: info@rivernetwork.org.

Canoe Through Rivers and History

The Mattaponi and Pamunkey Rivers Association is selling a canoe-trail guide for these two tributaries to the York River. The guide, consisting of five maps on waterproof paper, covers history, recreation, natural features, and tidal information. For more information, or to purchase the maps, contact MPRA, P. O. Box 242, Manquin, VA 23106; (804) 769-0841.

Upcoming Conferences

•**Seventh National Watershed Conference**, sponsored by the National Watershed Coalition, May 20—23, Richmond. For more information, contact John Peterson, (703) 455-6886; e-mail: jwpeterson@erols.com.

•**Lake and Pond Management Workshop**, sponsored by Virginia Cooperative Extension (VCE), May 30, Virginia Beach. For more information, contact the VCE in Virginia Beach, (703) 427-4769.

•**Forest Road Stream Crossings**, sponsored by the Virginia Tech Dept. of Forestry, June 1, Blacksburg. For more information, contact Michael Aust, (540) 231-4523; e-mail: waust@vt.edu; Web-site: www.conted.vt.edu/strmxing.htm.

At the Water Center

For more information about any item below, call the Water Center at (540) 231-5624; e-mail: water@vt.edu; or visit www.vwrrc.vt.edu

•**New Video for Loan**: Lake Sampling Techniques, produced by Massachusetts Water Watch Partnership, 1998; 15 minutes. Shows procedures for sampling lake depth, temperature, Secchi depth, nutrients, and chlorophyll, and shows chlorophyll-filtering process. The data collection forms shown are specific to Massachusetts, but the sampling techniques are applicable elsewhere.

•**Research in Progress**: Len Shabman is serving as an adviser to a congressionally mandated study of the science behind the Total Maximum Daily Load (TMDL) process. A committee appointed by the Water Science and Technology Board of the National Academy of Sciences (NAS) is conducting the study. The report will be issued by June 2001.

•**Research Paper**: "The Role of Water Resources Institutes in Information Dissemination: The Virginia Water Information and Technology Transfer Web Site," by Jane Walker and Tamim Younos. Presented at the Third Water Information Summit in Miami, Nov. 2000. The paper is available on-line at www.waterweb.org/wis3/pub-paper.ihtml.

•**Research Paper**: "A Service-Learning Program and its Role in Watershed Management," by Jane walker, Tamim Younos, and Alan Raflo. In *Integrating Universities' Knowledge and Student Service-Learning into Community-Based Watershed Management Programs*, C. Lewicki and T. Younos, eds., Water Resources Update No. 119, Universities Council on Water Resources, 2001. Article reprints are available from the Water Center; the entire booklet is available from the Universities Council, e-mail: ucowr@siu.edu.

•**Grant Received:** "Capacity Development and Restructuring of Small Water Systems." The goals of this study are to develop the concept of *cooperative* for the technical and fiscal management of small drinking-water systems, and to demonstrate the concept in a Virginia locality. Funded through the Va. Dept. of Health. For more information, contact Tamim Younos at (540) 231-8039; e-mail: tyounos@vt.edu.

FOR THE RECORD
Sources for Selected Water Resources Topics

Groundwater Information Sources

(Please see the February 1999 issue of Water Central, p. 15, for a previous article identifying sources of groundwater information.)

Virginia Ground Water Protection Steering Committee (GWPSC)

The GWPSC is a good starting point for general information or for sources of more specific data. The staff contact person is Mary Ann Massie, Va. Department of Environmental Quality, (804) 698-4042; e-mail: mamassie@deq.state.va.us; Web-site: www.deq.state.va.us/gwpsc/home.html.

The GWPSC's *2000 Annual Report* includes information on Virginia's Aquifer Susceptibility Study, a Virginia Beach groundwater assessment, and on other topics.

U. S. Geological Survey (USGS)

The USGS gathers and makes publicly available a great deal of water-related information, including groundwater information. The **headquarters** and **Eastern Regional office** are located USGS National Center, 12201 Sunrise Valley Drive, Reston, VA 20192; (703) 648-4000; Web-site: www.usgs.gov. The USGS' **Virginia District Office** is located at 1730 East Parham Road, Richmond, 23228; (804) 261-2600; e-mail: dc_va@usgs.gov; Web-site: water.usgs.gov/wid/html/va.html.

The USGS's **Office of Groundwater Programs** provides information on the location, extent, and characteristics of the nation's major aquifers. The Office publishes *The Ground Water Atlas of the United States*. Contact this at (703) 648-5001; e-mail: ogw_webmaster@usgs.gov; or Web-site: water.usgs.gov/ogw/.

The USGS's **National Water Information Center** has a toll-free phone number for water information requests: (888) ASK-USGS (275-8747); information requests also accepted by e-mail: h2oinfo@usgs.gov.

The **National Water Quality Assessment Program (NAWQA)** assesses water quality of surface water and groundwater in 51 representative areas of the United States. The results from each area are reported in compact, well-written and well-illustrated "circulars"; the two circulars covering areas of Virginia are the Albemarle-Pamilico Drainage Basin (# 1157) and the Potomac River Basin (# 1166). To request these or other NAWQA reports, contact the NAWQA Program Chief at the USGS headquarters address listed above. The Web-site for NAWQA reports is water.usgs.gov/nawqa/.

The USGS publishes **annual *Water Resources Data* reports** for each state. The Virginia report includes groundwater data from a limited number of well sites. This report is available at many libraries; for your own copy, contact the USGS Virginia District Office at the address or phone number listed above.

Groundwater Report to Congress

In October 1999, the U. S. Environmental Protection Agency (EPA) produced this compilation of national information on groundwater uses, characteristics, quality, and management. It is available on-line at www.epa.gov/safewater/Pubs/index.html (at this page, enter the title in the "Search" function). For a printed copy, contact the EPA Office of Water (4606), 1200 Pennsylvania Avenue, NW, Washington, D.C. 20460; (202) 260-2090. Request publication EPA-816-R-99-016.

Karst Waters Institute

This non-profit organization seeks to improve understanding of the geological and groundwater areas known as "karst" (commonly found in western Virginia). The organization's Web-site, www.karstwaters.org/, has a searchable **database of animals that live in groundwater-related habitats**. Contact the institute at P. O. Box 537, Charles Town WV 25414; (304) 725-1211.

Upcoming "For the Record" Schedule

2001

Issue 17 – Coastal/Marine Resources Information
Issue 18 – Drinking-water Information
Issue 19 – Water-quality Information
Issue 20 – Water-quantity and Hydrologic Information

2002

Issue 21 – Following the Va. Gen. Assembly
Issue 22 – Weather and Climate

Schedule subject to change

Virginia Water Central

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