Science and Civics: Sustaining Wildlife

Student Pages

Project WILD®

Curriculum Guide for Grades 9–12

Pre-assessment Scenario

Pre-Assessment Scenario

NAME: _____ DATE:_____

TO BUILD OR NOT TO BUILD

The town has a big decision to make in the next few weeks. The old McGurk estate, abandoned more than 50 years ago, has been taken over by the town for back taxes. The 30-acre property has several buildings in poor repair, including a large mansion, a barn, and a five-car garage. The grounds once included tennis courts and level lawns for games such as croquet. The once-beautiful gardens and farm fields are now overgrown with brush and weeds. A small stream that runs across the property is clogged with debris. The question facing the town is what to do with this property.

The residents have different ideas for a solution. One group of residents wants to have the buildings and grounds restored and converted into a public recreation center. Another group likes the idea of a recreation area, but wants the buildings razed to convert the entire property into open space. Still others want the property sold to the highest bidder for development in a way that meets a community need.

Your challenge is to decide what you would like to see happen. Describe (1) what information should be included in a formal proposal and (2) what you need to know about the property.

1. Proposal contents (Also, please note any additional information that might be needed):

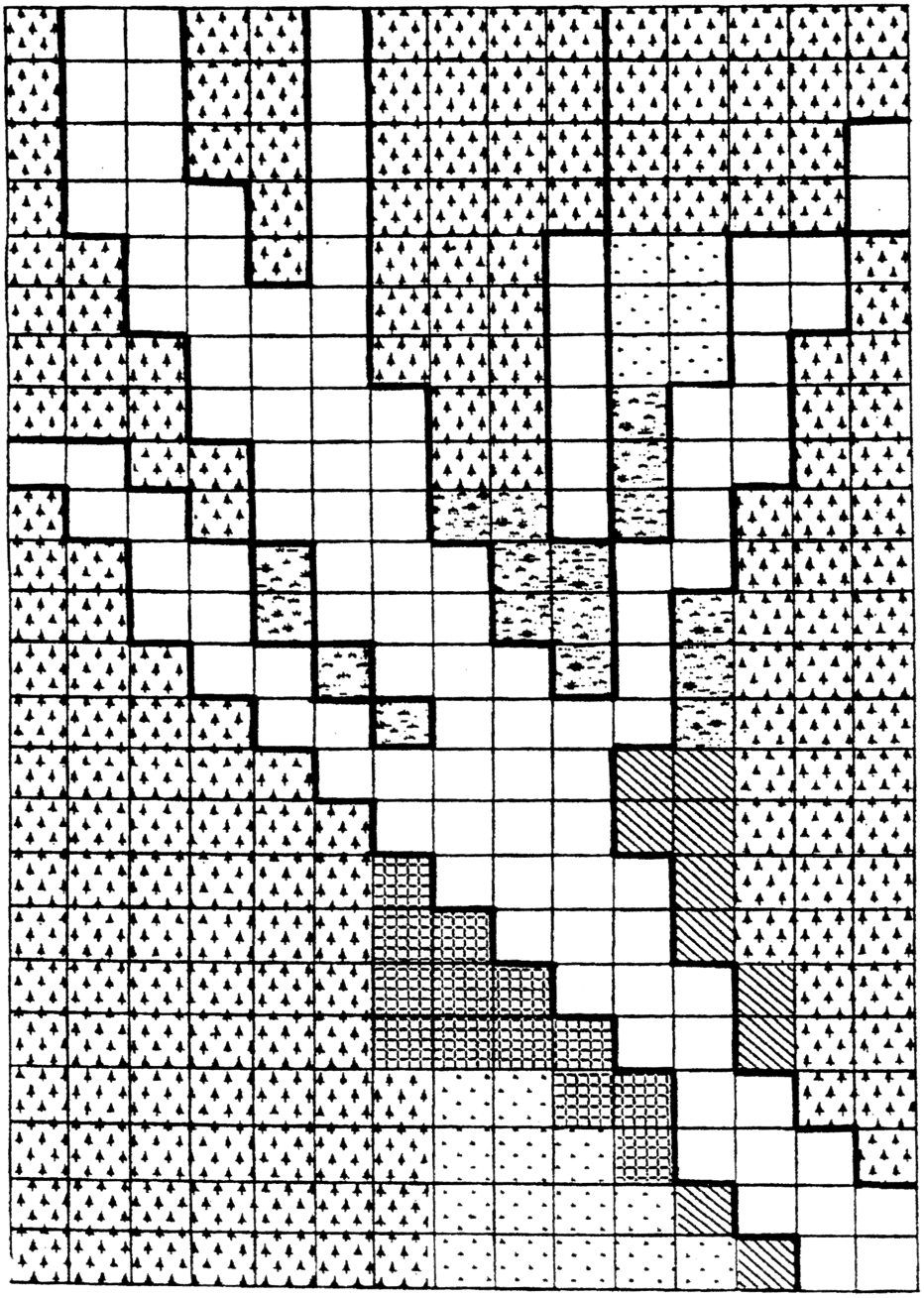
2. Property information needed:

Color Me a Watershed

STUDENT PAGE 1 OF 4

Map A

100 Years Ago

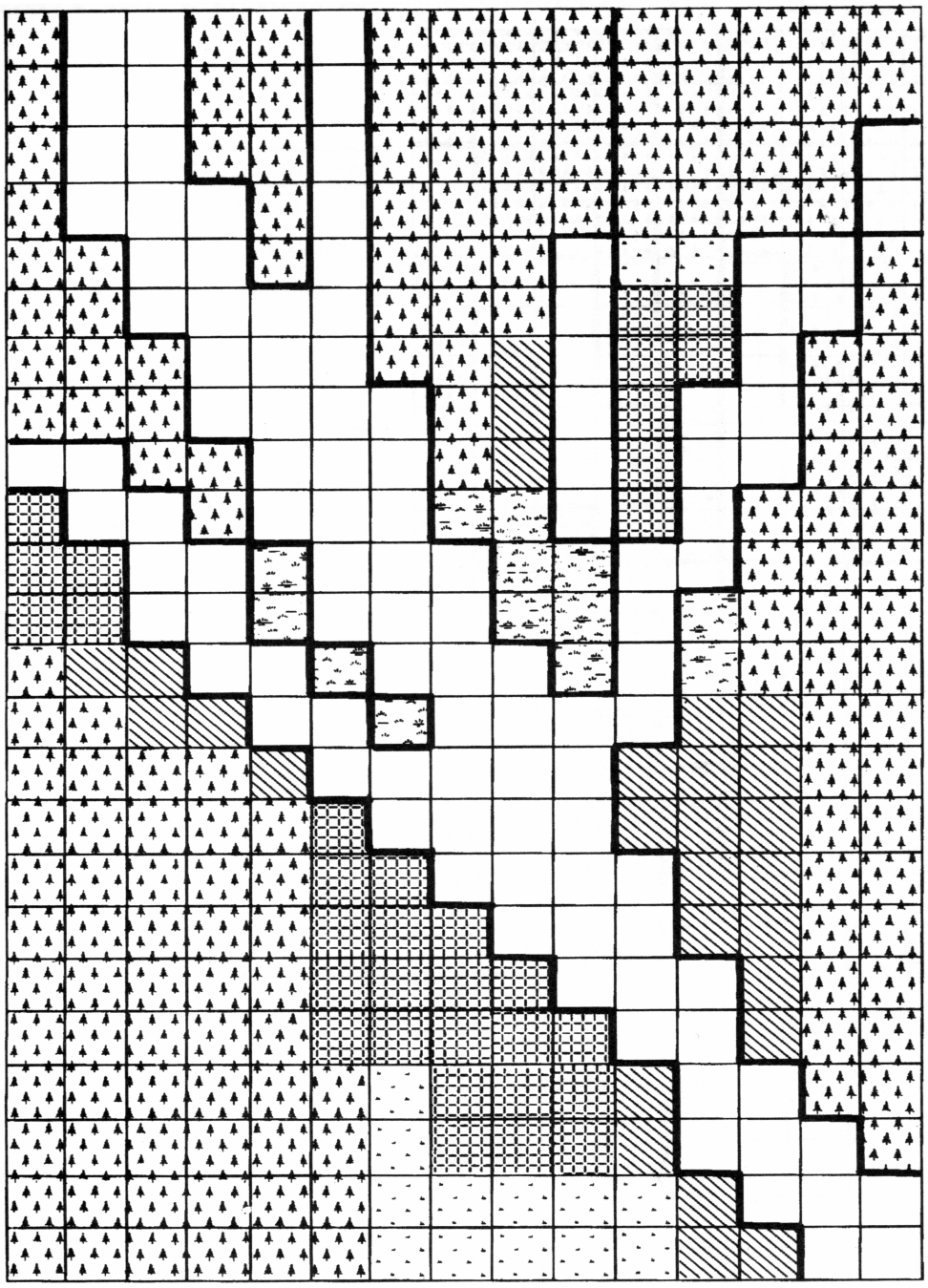


Key

- Agriculture
- Residential
- Wetlands
- Grasslands
- Forest
- Stream

Map B

50 Years Ago



Key

- Agriculture
- Residential
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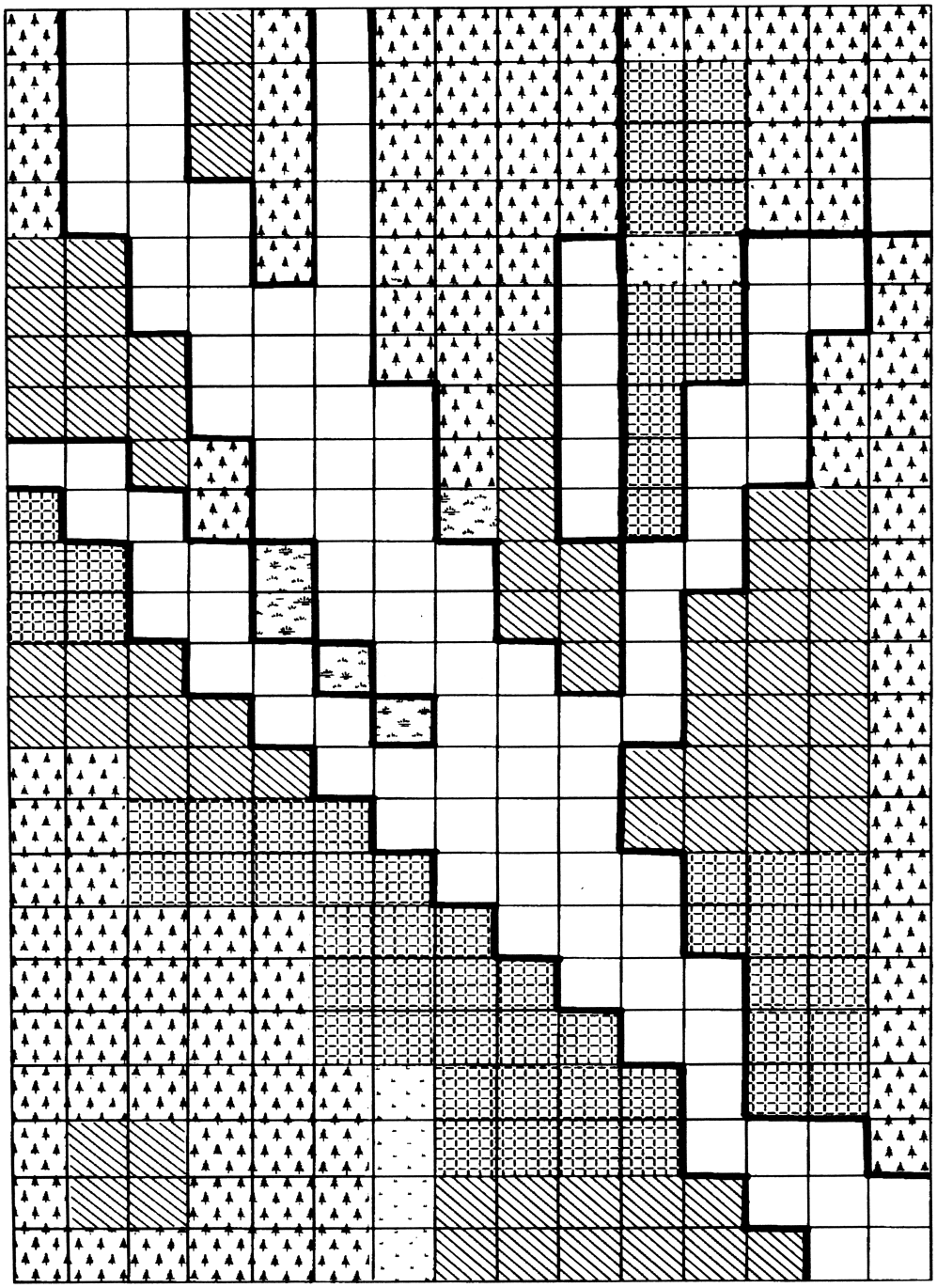
Color Me a Watershed

Map C

Present



Key

- Agriculture
- Residential
- Wetlands
- Grasslands
- Forest
- Stream

Name: _____ Date: _____

Chart for Option 2 AREA OF LAND COVERAGE

	MAP A 100 years ago		MAP B 50 years ago		MAP C Present	
Land coverage	km^2	%	km^2	%	km^2	%
Forest						
Grassland						
Wetland						
Residential						
Agriculture						
Stream						

Chart for Option 3 VOLUME OF RAIN AND VOLUME OF RUNOFF

	MAP A 100 years ago		MAP B 50 years ago		MAP C Present	
Land coverage and % runoff	**volume m^3**	**runoff m^3**	**volume m^3**	**runoff m^3**	**volume m^3**	**runoff m^3**
Forest 20% runoff						
Grassland 10% runoff						
Wetland 5% runoff						
Residential 90% runoff						
Agriculture 30% runoff						
Total runoff						
Total runoff plus stream discharge (5,550,000 m^3)						

Then and Now

STUDENT PAGE 1 OF 5

Glenwood Springs, Colorado 1950

Scale: 1 inch = 1050 feet

(Aerial photos donated by Colorado Aerial Photo Service, Denver.)

Human Related Changes

Type of Change	*Possible Positive Effects to Wildlife*	*Possible Negative Effects to Wildlife*	*Neutral Impacts to Wildlife*
Parking Lots			
Houses			
Roads/Highways			
Shopping Centers			
Dams/Reserviors			
Power Plants			
Oil & Gas Wells			
Railroads			
Mines/Gravel Pits			
Fences			
Airports			
Irrigation Ditches			
Farms/Ranches			
Water Treatment Plants			

Wildlife Species List

For Glenwood Springs and Roaring Fork Valley

(This is not a complete list)

Mammals	Birds
Elk	Mountain Chickadee
Mule Deer	Blue Grouse
Mountain Lion	Dark-eyed Junco
Bobcat	Yellow-rumped Warbler
Coyote	Pigeon
Hoary Bat	Hairy Woodpecker
Black Bear	Raven
Chipmunk	House Finch
Cottontail Rabbit	Red-tailed Hawk
Snowshoe Hare	Golden Eagle
Golden-mantled Ground Squirrel	Bald Eagle
Deer Mouse	Canada Goose
Woodrat	Mallard
Red Fox	Great Blue Heron
Pine Squirrel	Broad-tailed Hummingbird
Colorado Chipmunk	Grey Jay
Porcupine	Cooper's Hawk
Ermine	Magpie

TEMPLATE FOR GRID TRANSPARENCY

Scale 1 inch = 1050 feet; 1 square (1/2 inch) = 275,625 square feet

1 square = about 6 acres

Then and Now

Glenwood Springs, Colorado 1996

Scale: 1 inch = 1050 feet

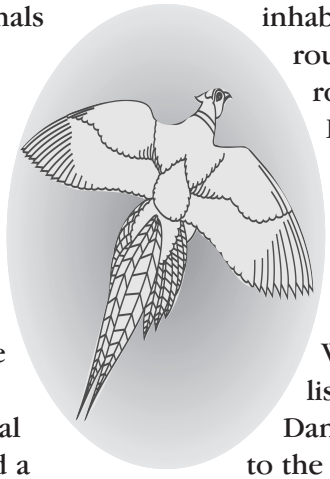
(Aerial photos donated by Colorado Aerial Photo Service, Denver.)

ECOLOGY BEGINS AT HOME

By Sara Stein

When my husband, Marty, and I bought our land, it was in just that stage of regrowth from pasture to forest that is among the most productive ecosystem on Earth. It was thicketed with brambles, bushes, vines, and grasses that supported a large and varied animal population. Our footsteps stirred up flights of grouse, grasshoppers that rose on rattling wings, and panicky rabbits. Frogs of assorted size and voice croaked loudly by the pond. A woodchuck family lived below a large boulder; a fox had its den nearby.

But we are gardeners, and gardeners clear brush and brambles, plant beds of flowers, and cut long grass to lawn. Within only a few summers of straightening up, we managed to degrade or destroy the habitat of most of the animals that previously had lived there.



The most dramatic sign that we were doing something wrong was the disappearance of pheasants. In those early days, we had planted a hedge of currants whose brilliant berries were enjoyed by a mother and father pheasant and all their little chicks. The distance from hedge to unmowed, tall grass cover was about 20 feet—a critical distance it seems, for when we mowed a broader strip the pheasants no longer felt safe from predators. They were cut off from the berries as though by an invisible fence. The more we extended the lawn, the fewer pheasants we saw, and finally we realized that there were none.

Gradually, we learned to see the land through the eyes of other animals. We had thought to make the place spacious by clearing it. But remove a ground bird's cover or a butterfly's flower, and you have erased its space. The less variety of habitat the landscape offers, the less space there is for the creatures that once lived there. When all is simplified, even the expanse the size of a golf course becomes just a hole in the world.

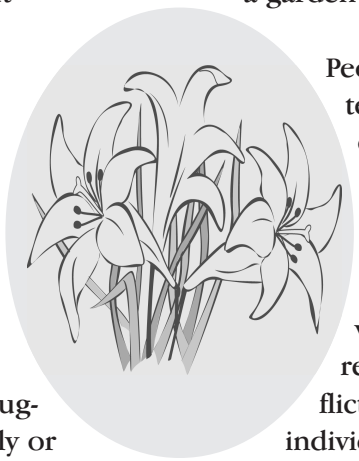
Suburbia already has more holes than a slice of imported Swiss, and the routes along solid ground are becoming more and more difficult for animals to negotiate. America's clean, spare landscaping has devastated our ecology. The relentless spread of suburbia's neat yards and gardens has caused local extinctions of such important predators as foxes and has dangerously reduced the habitat of many birds. Our landscape tradition threatens fragile species with total extinction—orchids that rely on a single pollinator, butterflies that require a specific host plant, songbirds that inhabit deep woods, and turtles whose routes to breeding sites are interrupted by roads or obliterated by drainage projects. Entire communities of plants and insects have been wiped out.

The extent of the loss became clear to me when I read According to Season—a collection of nature columns by Mrs. William Starr Dana—that was first published in 1894. The farmland that Mrs. Dana saw on her forays from New York City to the surrounding countryside bore no resemblance to the land I see today. "The pink azalea," she wrote, "grows in great tangles in the wet meadows, where in June blue flags still lift their stately heads along the water courses, and the blossoms of the blue-eyed grass are now so large and abundant that they seem to float like a flood of color on the tops of the long grasses." Her walks took her along waysides "whitened with

Ecology Begins at Home

the large flowers of the lovely summer anemone." In spring she found the morning air "alive with the happy tinkle" of bobolinks. In summer she waded "knee-deep among the myriad erect stems of meadow lilies."

I became increasingly disturbed as she wound down the year by rhapsodizing about autumn "when September lines the roadsides of New England with the purple of the aster, and flights its mantle of goldenrod over her hills, and fills her hollows with the pink drifts of the Joe-pye-weed or the intense red-purple of iron-weed."



This is not the way it is now in autumn. If I were to rhapsodize, I would have to sing a song of ugly mugwort. I have never seen a meadow lily or heard a bobolink. Where a hundred years ago Mrs. Dana might have found the former pond here "bright with the great blue lobelia," I found a single specimen of *Lobelia siphilitica*. Vines draping thickets now are honeysuckle, not clematis. Blooms purpling damp hollows are loosestrife, not ironweed. Flowers whitening roadsides are Queen Anne's lace, not anemones. These replacements of our native flowers are all alien species and all weeds.

Already in my childhood, Mrs. Dana's floral tapestries of orchids, lilies, irises, and gentians had grown threadbare beneath invasions of exotics. Since then, I have watched as remnant meadows and incipient woods became overrun with *Rosa multiflora*, a pernicious thorn carelessly imported in this century as an ornamental, as too were Japanese honeysuckle, Oriental bittersweet, purple loosestrife, and kudzu vine—all species that have rapidly stamped out our native vegetation. The richness of an ecosystem is reckoned in the coinage of diversity, and these aliens, by suppressing the total number of species, have drastically impoverished the land. Still, that wild mess of aliens that Marty and I cleared away was richer than the cultivated plantings which at first replaced it, for few ecosystem are quite as poor as a garden in the suburbs.

People don't think of the little land they tend as an ecosystem, perhaps because our properties are so remarkably poor in species that not even grasshoppers remain. Diversity of species is a form of safety in numbers—not numbers of individuals, but numbers of ways in which each individual's prodigious reproductive power is modulated by conflicts of interest among all the kinds of individuals with which it shares the land. The more species there are, the less likely it is that any one of them will get out of hand, and—just as true—the less likely that any one of them will suffer unduly. But look down the block; peer along the rows of yards; drive the neighborhood. There are lawns (lots of individuals, but very few species). There are foundation plantings (count the kinds—yew, yew again, more yew, a rhododendron). And ground covers (pachysandra, maybe juniper). Count the kinds of trees; 10 fingers will do. Count the aphids on the roses; the digits of all the neighborhood's inhabitants are not enough. Look in vain for the ladybugs to eat them.

I am neither a romantic nor an altruist. I let grass grow for grouse, preserve dry-stone walls for toads, leave logs rotting in the woods for centipedes. I do this less because it's the decent thing to do rather than because it's the necessary thing to do. Each kind of microbe, animal, and plant possesses some minute portion of the know-how

Ecology Begins at Home

that makes the whole Earth work. The loss of a species deletes some portion of organic intelligence and leaves the land more stupid. Gardeners who clear a wild plot, as we did, can easily notice its diminishing IQ because immediately the land needs planting, feeding, watering, cultivating, and pest control, whereas before it knew how to manage all these things itself.

The degradation of our land is not someone else's problem. Our back yards are not far away, like the rain forest, or steeped in conflict like the spotted owl. We—you and I and everyone who has a yard of any size—own a big chunk of this country. Suburban development has wrought habitat destruction on a grand scale. As these tracts expand, they increasingly squeeze the remaining natural ecosystem, fragment them, and sever corridors by which plants and animals might refill the voids we have created. To reverse this process—to reconnect as many plant and animal species as we can to rebuild lively and intelligent suburban ecosystem—requires a new kind of garden. But what kind? Benign neglect would not be restorative, not with the weeds we have let loose waiting to take over.

Certainly we cannot restore the land to its original state: hemlock forest, sand barren, cedar swamp, or tallgrass prairie. We cannot advise Arizonans to plan their gardens around saguaro cacti that take 30 years to reach chest height, or insist that Kansans let their prairie yards be trampled annually by bison, or persuade Californians that canyon fires are ecologically refreshing.

Nor can we look to our own agricultural past for examples. Part of the predicament we are in was caused by rapacious farming practices that left the land denuded of its forests and prairies, and the soil dry, eroded, and infertile.

Starting in the 1920s, European settlers systematically clear-cut the forest that had maintained the land in abundance and diversity for 10,000 years. The destruction of the northern conifer forest and prairie grassland was even more rapid and complete than had been the felling of New England.

We can, however, set aside a portion of our yards to plant, if not altogether naturally, then at least in a way not alien to the theoretical ecosystem we inhabit. We have a rare opportunity: Land that is now suburban is for the first time in centuries under no pressure to produce corn or cattle, and so it can recover. It can be encouraged to control its own pests, maintain its own soil, conserve its own water, support its own animals, and altogether mind its business with minimal interference.

The first step Marty and I took was timid; we added fruiting shrubs in island beds close to the house. They were quickly noted by migrating birds, and we were emboldened. We joined these small gardens to one another with additional plantings, and brought them toward outlying woodland via thickets, groves and hedgerows. We improved the woods, replanted the pond, and finally wove the whole together with native grass and wildflowers. The project is by no means finished, but the changes we have made so far are working: Berries feed birds as surely as stonewalls shelter chipmunks.

These changes are less apparent to the human eye than in the perception of other animals. The land is still landscaped, the gardens are intact, but less is mowed, the choice of plants is different, and thickets have replaced some previously open beds. Although there are fewer flower borders, there are flowers everywhere all year except in winter when there are berries, holly red and inky black, and grasses, bronze and gold. Meadowlarks

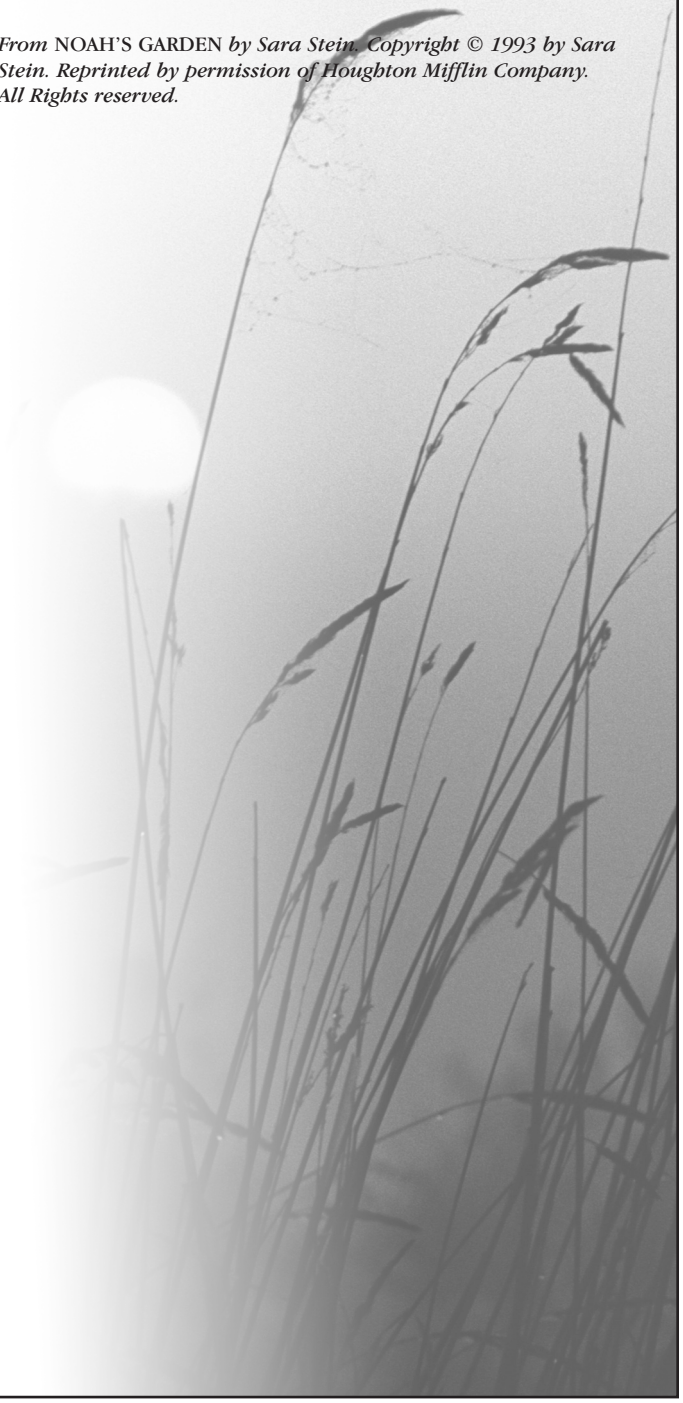
Ecology Begins at Home

and bluebirds have returned. I have not yet learned to identify all the butterflies.

Although our property is large, these plantings would fit anywhere, a hedgerow instead of a hedge, a meadow instead of a lawn, a wooded grove below a specimen shade tree. Our lots are really larger than we know. A friend of mine, who lives on an eighth-acre lot in a tract development, filled a rear corner with pocket woods as richly tiered as a full-scale forest. He edged the woods with serviceberries and currants, hawthorns and hazelnuts—good foods for songbirds and small mammals—and combined many other fruitful shrubs into hedgerows that run along the side yards and front of the street. There are beds of native grasses and wildflowers, a meadow of sedges and rushes surrounding a small pool, and even a tiny bog complete with ferns and skunk cabbage. The moist areas are fed by a stream that flows across a tiny lawn. The entire landscape takes up half the lot, a sixteenth of an acre, yet includes three types of ecosystem: woodland, wetland, grassland.

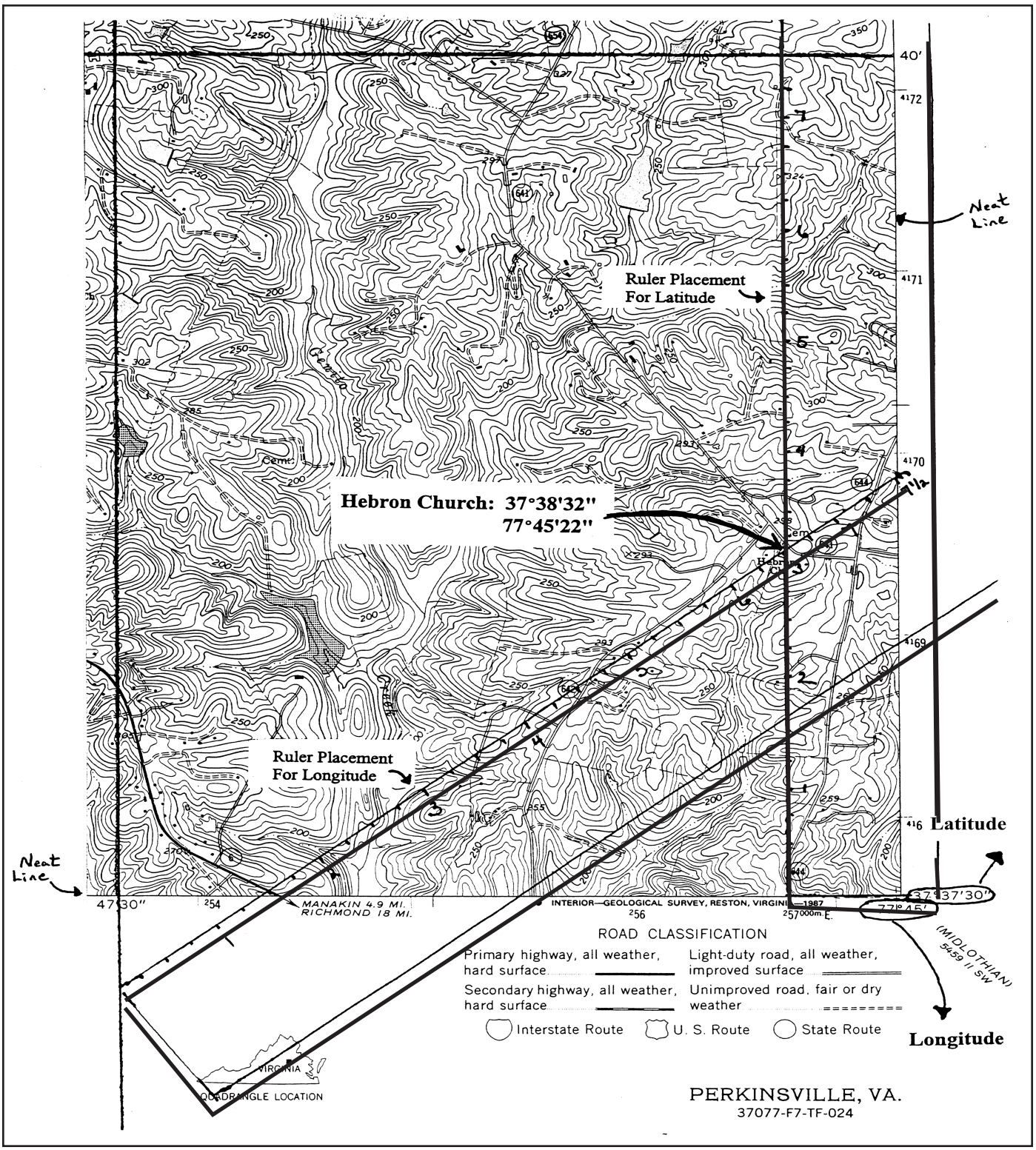
Imagine if the suburban landscape were similarly returned to productivity, to sheltering chipmunks and feeding dragonflies. Take the rectangle of land; reproduce it 20 times; lay the reproductions out in rows; place the rows back to back. See the pattern that emerges: a mosaic of small woodlots edged with thickets, connected by hedgerows, and dotted with flowering meadows. Were the larger landscape of suburbia to be reshaped in this way, as much as half the acreage could be returned to former inhabitants.

It took at least 50 years to erase what Mrs. Dana saw. It will take another 50 years or more to create something again worth seeing. The ecological history of suburbia has yet to be written, and I would like to see it unfold toward a future worthy of another Mrs. Dana.



Getting Acquainted

STUDENT PAGE 1 OF 1



Characteristics and Functions of the Legislative Branch

Descriptors	Federal	State	Local: County	Local: City
Leaders and Other Members				
How Receive Job				
Qualifications for Office				
Term of Office (# of years)				
Cabinets or Executive Departments				
Functions and Powers				
Responsibilities to the Environment				

Structure Review

STUDENT PAGE 2 OF 3

Characteristics and Functions of the Judicial Branch

Descriptors	Federal			State				Local
	Supreme	Appellate	District	Circuit	District	Special Appeals	Appellate	
Component of Court System								
Title of Leader								
How Receive Job								
Term of Office								
Removal Policy								
Functions and Powers (Jurisdiction)								
Cases Reflecting Environmental Concerns								

Characteristics and Functions of the Executive Branch

Descriptors	Federal	State	Local	
			County	City
Leaders and Other Members				
How Receive Job				
Qualifications for Office				
Term of Office (# of years)				
Cabinets or Executive Departments				
Functions and Powers				
Responsibilities to the Environment				

The Law: Before and After

Setting the Stage for the Endangered Species Act

During the 1700s and 1800s, more and more people settled across the North American continent. The natural landscape was quickly and substantially changed from forest and prairie to human communities with houses, farms, and industries. Towns and cities replaced natural areas. People used wildlife to supply food, clothing, and other household items. Few regulations governed hunting and land use. As development continued, pressure on wildlife intensified.

By the turn of the 20th century, many wildlife populations in the United States were on the decline. Some were already at the point of extinction. By 1917, the Carolina parakeet, the great auk, the Florida red wolf, the heath hen, the passenger pigeon, and the sea mink were extinct.

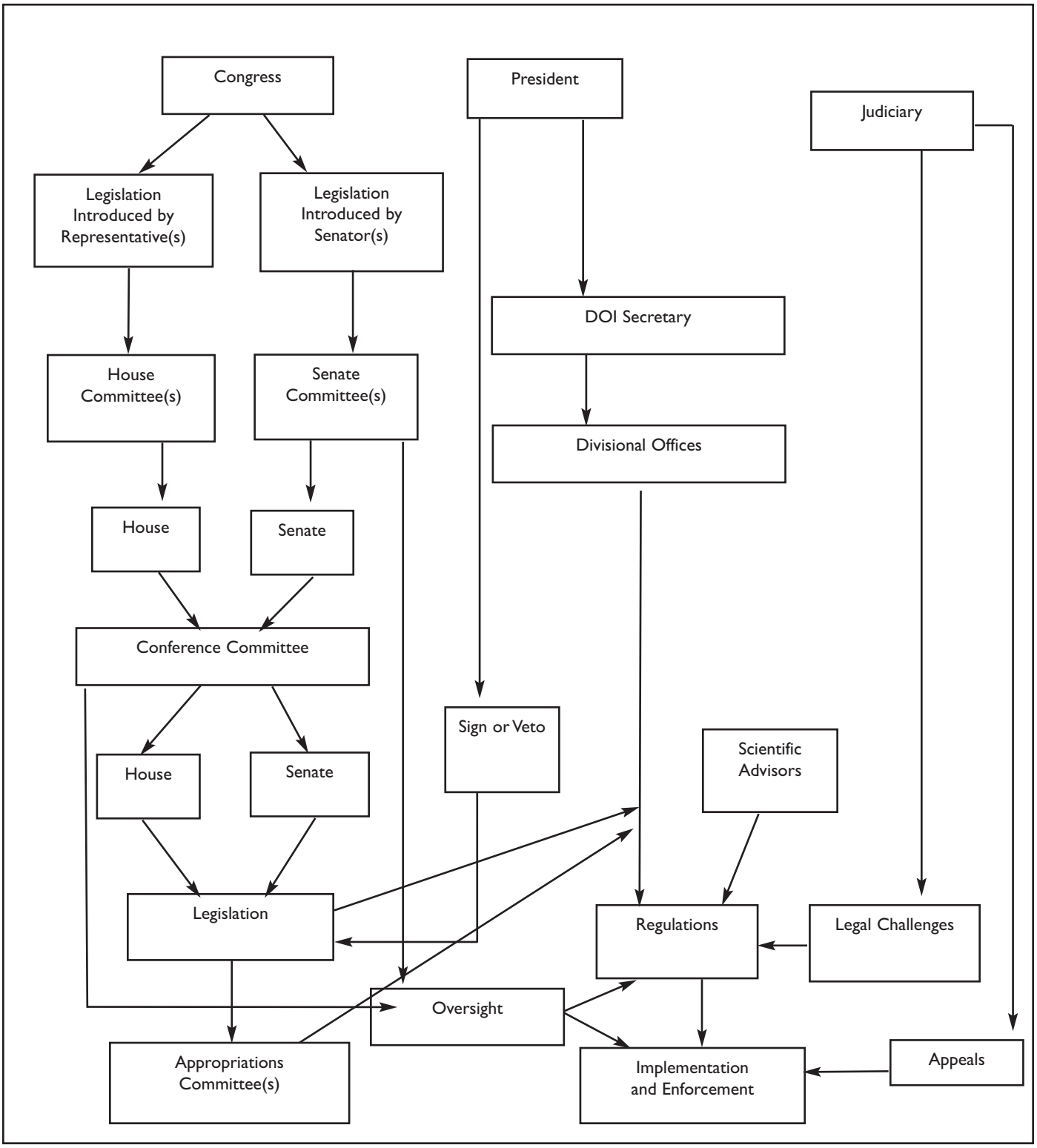
Other species, once fairly common, had become scarce. Only a few herds remained of the American bison, a native species that once roamed the prairies in large numbers. Because feathers of the great egret were valued in the fashion industry to adorn women's hats, the numbers of those birds became so low that extinction appeared to be inevitable. The beaver, elk, timber wolf, and white-tailed deer were rare or extirpated from some eastern states, such as Pennsylvania.

Passenger pigeon populations were reduced from millions to one last survivor within a few short years. In 1878, the last large nesting site for the passenger pigeon was found in the state of Michigan. Million of pigeons once nested in more than 100,000 acres of forest. By 1914, Martha, the last passenger pigeon on Earth, died in a Cincinnati zoo.

Eventually, people started to recognize that the land, once plentiful in wildlife and other natural resources, was being depleted. The very livelihood of many settlers was in jeopardy. This awareness gave conservationists the public support they needed to push for legislation to conserve wildlife and the environment.

Give Wildlife a Break

STUDENT PAGE 1 OF 1



Synopsis of the Endangered Species Act of 1973
(NOTE: Sections not applicable to this lesson have been omitted.)

U.S. Code
Title 16–Conservation
Chap. 35–Endangered Species

1531: Congressional Findings and Declaration of Purpose

A. Findings

Various species of fish, wildlife, and plants have become extinct. Others are in danger of extinction because of economic growth and development without adequate concern and conservation.

These species of fish, wildlife, and plants are of value to the nation and its people.

The United States has pledged itself to the international community to conserve these various species in accordance with

- ☆ Migratory Bird Treaties with Canada and Mexico
- ☆ Migratory and Endangered Bird Treaty with Japan
- ☆ Convention on Nature Protection and Wildlife Preservation in the Western Hemisphere
- ☆ International Convention for the Northwest Atlantic Fisheries
- ☆ International Convention for the High Seas Fisheries of the North Pacific Ocean
- ☆ Convention on International Trade in Endangered Species of Wild Fauna and Flora

Congress encourages the states and other interested parties with financial assistance and other incentives to establish conservation programs that meet international standards.

B. Purposes

The purposes of this act are to provide for conservation of ecosystems on which threatened and endangered species depend, to provide a program for the preservation of threatened and endangered species, and to take appropriate steps to achieve the purposes of the above treaties and conventions.

NOTE: If the information that follows shows a skip in sequence, that item was skipped because it was not applicable.

C. Policy

All federal departments and agencies seek to conserve threatened and endangered species and cooperate with state and local agencies to resolve water resource issues along with conservation of endangered species.

1533: Determination of Endangered Species and Threatened Species

A. General

1. The Secretary of the Interior determines if a species is endangered because of (a) habitat loss; (b) overuse of species for commercial, recreational, scientific, or educational purposes; (c) disease or predation; (d) inadequate regulation; (e) other natural or manmade factors affecting its existence.
2. The Secretary of Commerce, when given responsibility for a species, makes recommendations to the Secretary of the Interior to list the species as threatened or endangered, or to remove it from such listing, as appropriate. The Secretary of the Interior cannot change the status of a species without a recommendation from the Secretary of Commerce.

B. Basis for Determination

1. The Secretary of the Interior, when a species is listed, designates its habitat as critical. This designation may be reversed, based on scientific data and considerations of economic and other relevant effects.
2. a. When a petition is received to list a species as endangered or threatened, the Secretary of the Interior has 90 days to gather information about the species and to publish in the *Federal Register* findings that are based on scientific or commercial information.

b. Then the Secretary of the Interior has 12 months to determine whether or not the action (listing of the species as threatened or endangered) is warranted or, if warranted, whether other proposals may take precedence and then to publish this determination in the *Federal Register*.
c. A negative finding is subject to judicial review.

3. The same procedures are followed for a petition to designate a critical habitat.
5. When the Secretary of the Interior proposes a regulation to protect endangered or threatened species or their critical habitats,
   a. Within 90 days, notice of the proposed regulation including the full text must be published in the *Federal Register* and sent to state agencies where the species is found.
   b. The Secretary must notify foreign nations where the species occurs.
   c. The Secretary also must notify professional scientific organizations, as appropriate.
   d. The Secretary must publish a general summary of the regulation in the general newspapers for the areas where the species occurs.
   e. The Secretary holds public hearings if requested within 45 days of the notice.
6. a.Within one year of publication of the general notice, the Secretary of the Interior either publishes the final regulation in the *Federal Register* or publishes a notice that the year is extended or a notice that the proposed regulation is withdrawn.
   b. The Secretary may extend the one-year period for not more than six months if substantial disagreement with the regulation is found. If the proposed regulation is withdrawn, the decision to withdraw is subject to judicial review. The Secretary cannot propose a regulation that was withdrawn without sufficient new information to support it. The final determination is published in the *Federal Register*.
   c. Final regulations applying to a threatened or endangered species listing and regulations applying to critical habitat are published at the same time unless a prompt endangered species listing is essential for the species survival. If critical habitat has not been determined, the period for researching it may be extended for up to one year. Then the Secretary must publish a final regulation based on available data.
7. The Secretary can issue an emergency regulation without following the procedures above, but the Secretary
   a. must publish detailed reasons that the regulation is necessary and
   b. give notice to the state agency in each state where the species occurs. The emergency regulations cease to have force after 240 days unless the rule-making procedures have been complied with.
8. Publication of the final regulation includes a summary of data on which the regulation is based, plus a brief description and evaluation of activities that adversely affect habitat.

Give Wildlife a Break

C. Lists

1. The Secretary of the Interior publishes in the *Federal Register* a list of all species determined by that Secretary or by the Secretary of Commerce to be endangered or threatened. The list uses scientific and common names and specifies over what part of its range each species is threatened or endangered, plus specifying critical habitat within that range.
2. The Secretary revises the lists from time to time. At least every five years, a review of all species listed is done to determine whether any species should (a) be removed from the list, (b) be changed in status from endangered to threatened, (c) be changed in status from threatened to endangered.

D. Protective Regulations

The Secretary issues protective regulations for threatened species, as deemed necessary.

E. Similarity of Appearance Cases

The Secretary may treat as endangered any species that so closely resembles an endangered species that it would be difficult to tell them apart, adding to the threat to the endangered species.

F. Recovery Plans

1. The Secretary develops and implements plans for the conservation and survival of endangered and threatened species, especially those in conflict with construction, development projects, or other economic activity.
2. The Secretary may use the services of appropriate public and private agencies, institutions, and individuals in developing such plans.
3. The Secretary must report every two years to the Committee on Environment and Public Works of the Senate and to the Committee on the Merchant Marine and Fisheries of the House of Representatives on the status of recovery plans for all listed species, with public notice of the report provided and with review and comments solicited.

G. Monitoring

1. The Secretary, in cooperation with the states, develops a system to monitor for not less an five years the status of all species that have recovered and been removed from the list.
2. The Secretary acts promptly to prevent risk to the well-being of any such recovered species.

H. Agency Guidelines
The Secretary publishes guidelines for agencies in the *Federal Register*, including but not limited to:
1. Procedures for recording and disposition of petitions
2. Criteria for making findings
3. A ranking system to identify species that need priority review
4. A system for developing and implementing recovery plans on a priority basis

Notices of publication of the guidelines must be sent to states and other appropriate agencies, with opportunity to comment in writing on the guidelines.

I. If a state disagrees with the proposed regulations or guidelines and the Secretary issues final regulations in conflict with the state's comments, the Secretary submits written justification for failure to adopt regulations consistent with the state's comments.

1534: Land Acquisition

A. To carry out programs to conserve fish, wildlife, and plants, the appropriate Secretary (Interior or Agriculture) has authority under the Fish and Wildlife Act of 1956, the Fish and Wildlife Coordination Act, and the Migratory Bird Conservation Act to acquire lands or waters by purchase, donation, or otherwise.

B. Funds made available under the Land and Water Conservation Fund Act of 1965 may be used to acquire lands, waters, or interest therein.

1535: Cooperation with the States

A. The Secretary will cooperate with the states to the maximum extent possible.

B. Management agreements, cooperative agreements, terms and conditions are listed.

D. Financial support to the states
1.The Secretary is authorized to allocate funds to states through a respective state agency.
2.The federal share is not to exceed 75 percent of costs. The share may increase to 90 percent when two or more states collaborate to protect listed species and critical habitat.

H. This section authorizes the Secretary to make regulations.

I. Under appropriations, a cooperative conservation fund is established for endangered species and will be administered by the Secretary of the Interior.

Give Wildlife a Break

1536: Interagency Cooperation

This section defines the responsibilities of all federal agencies for wildlife conservation and regulates interagency cooperation.

A. A federal agency proposing a project that may affect a threatened or endangered species must seek consultation with the Secretary of the Interior and other interested constituencies.
B. Time limits for the results of interagency consultation are set. The Secretary is required to provide (1) a written statement of the Secretary's opinion of any proposal and (2) a summary of the information on which it is based to the appropriate federal agency and to the applicant for a listing, plus suggesting alternatives, if needed.
C. It is the federal agency's responsibility to conduct with 180 days a biological assessment to identify any endangered or threatened species likely to be affected by its proposed project.
D. A federal agency cannot commit resources to a proposed project during the consultation period.
E. An Endangered Species Committee is established to review applications for exemptions and make recommendations to the Secretary.
F. The Secretary must set forth regulations for the federal agency within 90 days of a consultation.
G-L. These sections discuss kinds of exemptions and rules that apply to those making applications for exemption.
M. This section discusses citizen suits.
N. This section discusses judicial review.
O-P. These sections discuss more exemptions.

1537: International Cooperation

This section provides for funds to support conservation programs in other countries and for personnel to assist programs. It also defines cooperative agreements and cooperative investigation and research. The Secretary is designated as the Authority for Management and for Science to implement Convention agreements, which will be carried out through the U.S. Fish and Wildlife Service.

1538: Prohibited Acts

A. General
1. It is unlawful for any person in a U.S. jurisdiction to do the following:

a. to import or export threatened or endangered species
b. to take any such species within the United States
c. to take any such species on the high seas
d. to possess, sell, deliver, carry, transport, or ship by any means any species taken in violation of b or c
e. The same prohibitions apply for foreign trade
f. to sell or offer for sale any species taken in violation of b or c
g. to violate any regulation pertaining to endangered or threatened species of fish or wildlife
(1) The same prohibitions apply to threatened or endangered plant species.
(2) The above prohibitions do not apply to captive species except if they are used commercially.
(3) The prohibitions apply to any species protected by a Convention.
(4) It is unlawful to import or export fish or wildlife, except fisheries products.
(5) Restrictions apply to African elephant ivory, whether raw or worked.
(6) Certain ports are designated for legal import to simplify monitoring of these prohibitions.
(7) It is unlawful to commit, solicit another to commit, or cause to be committed any violations listed in this section.

1539: Exceptions in Issuing or Revoking Permits

A. Exceptions are not allowed for commercial activities.
B. This restriction does not apply to native Alaskans such as Indian, Aleut, or Eskimo populations residing in Alaska. The Secretary may prescribe regulations affecting their use of resources. The sale in the United States of products such as whale oil or scrimshaw on the bone or teeth of marine mammals is limited.
C. This section does not exonerate anyone in violation of provisions in section 1538 above.

1540: Penalties and Enforcement

A. Civil penalties vary from $500 per violation up to $50,000 or one year in prison for each violation.
B. Notice and a hearing are required before a penalty can be applied.
C. Any violator's federal hunting or fishing permits are suspended for one year.
D. Acting in good faith to protect one's self, family member, or other individual from attack by a wild animal is an exemption.

Give Wildlife a Break

E. A reward can be given to any person whose information leads to the arrest or criminal conviction of a violator in an amount to be determined by the Secretary, with provision for up to $500,000. Enforcement is the responsibility of the Secretary of the Treasury, the Coast Guard, or judges of the Superior Courts. Search and seizure is authorized, with forfeiture of species and equipment taken to the United States.

1541: Endangered Plants

The Smithsonian Institution is authorized to review species of plants that are or may be threatened or endangered, to review methods of conserving them, and to report to Congress within one year after December 28, 1973, with recommendations for legislation.

1542: Authorization of Appropriations

The following amounts are specified to carry out the functions and responsibilities of the Endangered Species Act: up to $41,500,000 in 1992 for the Department of the Interior; up to $6,750,000 in 1992 for the Department of Commerce, up to $2,600,000 in 1992 for the Department of Agriculture, an appropriation of $600,000 per year to the Secretary of the Interior for the Endangered Species Committee, and an appropriation of $400,000 per year to the Department of the Interior for Convention implementation.

1543: Marine Mammal Act of 1972

The Endangered Species Act does not take precedence, with exceptions.

1544: Annual Cost Analysis

By January 15 each year, the Fish and Wildlife Service conducts an annual cost analysis, and the Secretary of the Interior submits a report to Congress covering the preceding fiscal year. The accounting is on a species-by-species basis of all expenses for endangered or threatened species and their habitats of both federal and state agencies.

Concerns about the Endangered Species Act (ESA)

Some conservationists are concerned about the following weaknesses they perceive in the law: narrow focus, loopholes, and timing.

Narrow Focus

Too many endangered species exist for them to be successfully dealt with one at a time. It has cost about $4 million per species to achieve complete recovery. Rough estimates indicate that it would cost $4.6 billion over 10 years to provide for recovery of all listed and candidate species to the level where they could be removed from the list. This amount is about eight times the amount that U.S. Fish and Wildlife Service (USFWS) has in its budget (about $63 million per year).

For political reasons, the act has been used primarily to protect the "charismatic megafauna," even if only a population or subspecies is under threat. In 1991, more than half of the dollars spent were used on 7 of 639 listed taxa; all 7 were subspecies or populations. At the same time, many full species of invertebrates or plants were left without protection. Together, 270 plants and 9 invertebrates received 5 percent of total funding. Previous Secretary of the Interior Manuel Lujan questioned whether subspecies should be listed.

Loopholes

One legal loophole available to listing agencies is to declare a listing "warranted but precluded." This loophole allows an agency to postpone action on species that deserve protected status yet are not in imminent danger of extinction so the agency can focus first on other critically imperiled species. Environmental groups have sued the USFWS for using this provision in the case of the lynx, which is abundant in Canada but is endangered in the United States. The Interior Department agreed to protect the species under a settlement reached in February 1998.

Timing

The ESA approach might be viewed as an "emergency room" approach. Species are not given protection until their numbers are reduced to the extent that they are already on their way to extinction. The number of individuals left at the time of listing has been about 1,000 for animals and about 100 for plants. When species have declined this far, recovery is very difficult, is not guaranteed, and is very expensive.

Federal Players Chart

POSITION	1966	1969	1973
President	Lyndon Johnson	Richard Nixon	Richard Nixon
Vice President	Hubert Humphrey	Spiro Agnew	Gerald Ford
Interior	Stewart Udall	Walter Hickel	Rogers Morton
Treasury	Henry Fowler	David Kennedy	George Schultz
Defense	Robert McNamara	Melvin Laird	James Schlesinger
Attorney General	Nicholas Katzenbach	John Mitchell	Elliott Richardson
Agriculture	Orville Freeman	Clifford Hardin	Earl Butz
Commerce	John Connor	Maurice Stans	Frederick Dent
Labor	W. Willard Wirtz	George Shultz	Peter Brennen
Health, Education, and Welfare	John Gardner	Robert Finch	Caspar Weinberger
Housing and Urban Development	Robert Weaver	George Romney	James Lynn
Transportation	Alan Boyd	John Volpe	Claude Brinegar
State	Dean Rusk	William Rogers	Henry Kissinger

Presidential Prerogatives

Teddy Roosevelt: One of the First Modern Environmentalists

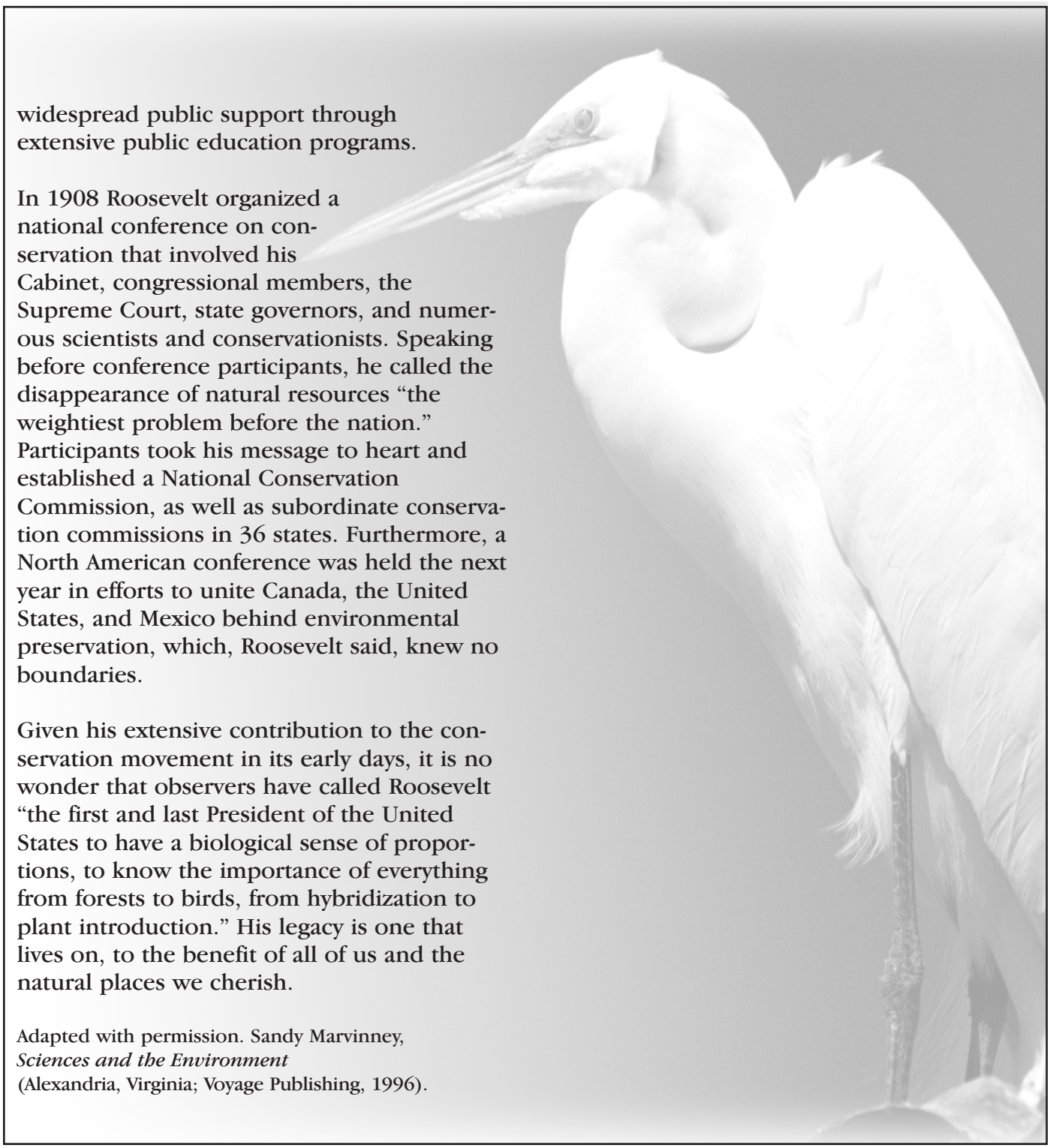
When we think of conservation and ecological preservation, we think of the contentious issues in the headlines today: the disappearance of rainforests, the loss of biodiversity, habitat depletion. Those issues have spearheaded global activism in an age when we wonder if we are reaping the costs of irreversible havoc [we have wreaked] on our planet and the environment.

The seeds of conservationism were actually planted long ago, and an important steward of our natural environment who helped ensure the germination of those seeds was U.S. President Theodore Roosevelt. Roosevelt is, perhaps, most often remembered for his trust busting, rough riding and big game hunting, but he also applied his lifelong interest in wildlife and wild places to the development of strategies for the preservation and management of natural resources.

Roosevelt first recorded his ecological interest when, at age nine, he wrote in great detail about wildlife observations made "in the field" and created the "Roosevelt Natural History Museum," where he displayed his collection of items such as bird nests, insects, minerals, and shells. Later, when he began his political career, his interest translated into more visible activism.

In 1881 Roosevelt was elected to the New York State Assembly, and in 1888 he founded a preservationist organization known as the Boone and Crockett Club, which focused on preserving big game habitats. In the 1890s, as Governor of New York, Roosevelt helped jump-start an interest in monitoring sewage treatment and effluent discharge from pulp mills and tanneries.

When he reached the presidency of the United States, Roosevelt used his authority to rally the government behind successful management of the nation's natural resources. He supported efforts to reclaim and preserve western lands, and he stressed the importance of reorganizing the government bureaus responsible for managing the forest reserves. He created the U.S. Forest Service, added significant acreage to the forest reserves, set aside land containing treasures such as mineral deposits and water resources, established the first federal wildlife refuge to protect Florida's egret population, and created five new national parks. While some of his initiatives were contested by the logging industry and others, Roosevelt won



widespread public support through extensive public education programs.

In 1908 Roosevelt organized a national conference on conservation that involved his Cabinet, congressional members, the Supreme Court, state governors, and numerous scientists and conservationists. Speaking before conference participants, he called the disappearance of natural resources "the weightiest problem before the nation." Participants took his message to heart and established a National Conservation Commission, as well as subordinate conservation commissions in 36 states. Furthermore, a North American conference was held the next year in efforts to unite Canada, the United States, and Mexico behind environmental preservation, which, Roosevelt said, knew no boundaries.

Given his extensive contribution to the conservation movement in its early days, it is no wonder that observers have called Roosevelt "the first and last President of the United States to have a biological sense of proportions, to know the importance of everything from forests to birds, from hybridization to plant introduction." His legacy is one that lives on, to the benefit of all of us and the natural places we cherish.

Adapted with permission. Sandy Marvinney, *Sciences and the Environment* (Alexandria, Virginia; Voyage Publishing, 1996).

Presidential Prerogatives

TR's Legacy: The Environment

The Roosevelt Museum of Natural History opened its doors in 1867. Among its first specimens was the skull of a seal that had washed up in New York Harbor and that had been begged from its owner by the museum's founder, 8-year-old Theodore Roosevelt Jr. Frail, myopic "Teddy," as he was known to his family, seemed an unlikely naturalist. But it was his mind, not his body, that made Roosevelt's precocious entry into the world of natural history anything but child's play. Inquisitive and single-minded, he would pursue his interests in nature relentlessly for the rest of his life, a pursuit that would affect America's wild places for decades beyond his death.

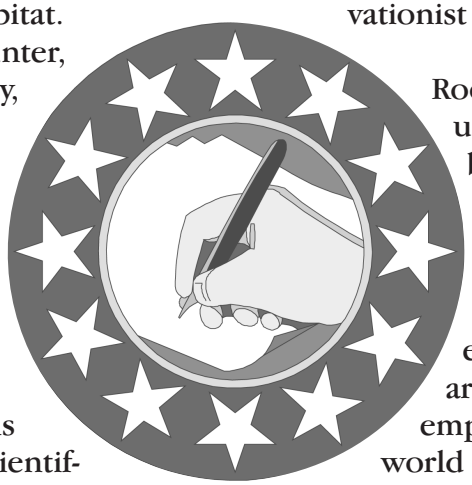
Fueled by Theodore's curiosity, the Roosevelt museum grew. Teddy collected everything within his reach and range of vision, and he begged friends and family to bring him any specimens they found. He even paid other children to collect specimens for him. Yet he generously shared his collection. In 1871, he donated several specimens to another fledgling museum, the American Museum of Natural History, which had been co-founded by his father.

The following year, having obtained spectacles to correct his vision and a shotgun to aid in capturing specimens, Theodore traveled with his family to Egypt and Syria, where he collected numerous birds. By then a skilled taxidermist, he skinned and mounted the birds himself. If young Roosevelt's collection methods seemed bloody and cruel, he merely followed the accepted practices of the leading naturalists of the time. Killing was the only way to make extremely accurate observations about the physical characteristics of unfamiliar animals.

Written in a childish hand, the notebooks in which young Roosevelt logged his studies reflected the zeal with which he pursued nature. They contained complete descriptions of the animals collected, including size, sex, place and date collected, habits, and even stomach contents. In Vienna, where the family traveled after leaving Egypt, Roosevelt turned his hotel room into a virtual zoological laboratory, much to the dismay of the cousin who shared his lodgings. At Harvard, where he studied natural history, Roosevelt similarly outfitted his off-campus apartment and continued collecting. In 1882, after being elected to the New York State Legislature, Roosevelt donated the bulk of the Roosevelt Museum of Natural History to the Smithsonian Institution. But his interest in the outdoors did not end with his museum's closing.

By the mid-1800s, many of the people closest to nature had come to realize that the wilderness could suffer only so much exploitation.

Hunters, miners, and timber cutters threatened not only individual species, but also entire ecosystems. Fortunately, forward-thinking sportsmen began to organize for the conservation of game and game habitat. Theodore Roosevelt, an avid hunter, joined the fight. Not surprisingly, the organization he helped to found would be among the most influential.



Roosevelt and editor George Bird Grinnell of *Forest and Stream* magazine founded the Boone and Crockett (B & C) Club in 1887. In the pages of his magazine, Grinnell called for scientific forest management, clean water, and restricted use of natural resources, ideas considered quite radical by most Americans. Under Roosevelt and Grinnell, the B & C would support those concepts, promoting not only the enjoyment of hunting, but also the study and preservation of game animals and their habitats.

Perhaps none of the club's efforts was more significant than one of its earliest: the battle for Yellowstone. While Yellowstone had been officially designated a national park, the designation included no provision for its protection from commercial exploitation. When mining and railroad interests threatened to seriously damage the park, B & C rose to the defense. With editorials, speaking engagements, and furious lobbying among Washington's rich and powerful, B & C succeeded. In 1894, President Grover Cleveland signed a bill protecting Yellowstone. While that action alone might have been enough to enshrine Theodore Roosevelt as a friend to nature, it represented only a fraction of what he would do to preserve the natural world. Roosevelt's career as a politician and conservationist had only begun.

Roosevelt the President is almost universally remembered for his brash foreign policy. Yet Roosevelt the naturalist also lived in the White House. During his tenure, with the same type of bullishness as he exhibited in the international arena, he established a natural empire the like of which the world had never seen.

In March 1903, Roosevelt visited Pelican Island in Florida, a nesting ground for numerous shorebirds. At the time, demand for plumes for women's hats had decimated shorebird populations, and Roosevelt was well aware of the danger of massive extinction. With the stroke of his presidential pen, Roosevelt created Pelican Island Bird Reservation. This was the first, but by far not the last, time Roosevelt would use such power. Before he left office, he would create 50 more such refuges.

While his eye for beauty and his love of nature for nature's sake helped to drive Roosevelt's conservation efforts, they were motivated by practicality as well. Influenced by early wise-use advocates such as Gifford Pinchot, Roosevelt believed that nature existed to benefit humanity. In a conserved wilderness, timber could be harvested, sport could be had, and water could be taken to irrigate

Presidential Prerogatives

farmland. All of those benefits would be lost if the wilderness were destroyed.

Acting on those beliefs, Roosevelt established the federal Reclamation Service in 1902. The agency, through the use of dams and irrigation, created arable land in areas that had been too dry to farm. Eventually, the Reclamation Service brought millions of acres of farmland into service. In 1905, Roosevelt created the Bureau of Forestry, with Gifford Pinchot as chief forester. Pinchot believed that timberlands should be managed scientifically, with selected trees harvested and others left to grow, so that rain would not cause excessive soil erosion, runoff, flooding, or water pollution. The timbermen found this idea incompatible with their pocketbooks, and they protested vigorously to their representatives in Washington. Bowing to industry pressure, Congress attached a rider to an agricultural appropriations bill that Roosevelt could not avoid signing. The rider limited the President's abilities to set aside western forest lands for preservation. Roosevelt responded with characteristic panache; before approving the bill, he signed 16 million additional acres of western forest into federal protection. The timbermen howled louder, but Roosevelt had trumped them again.

Year by year, act by act, proclamation by proclamation, Roosevelt built his natural empire. In Alaska, he created the Tongass and the Chugach forest reserves. In Hawaii, he set several small islands aside as the Hawaiian Islands Bird Reservation. Everywhere, it seemed, TR added acreage: Mount Olympus, Washington; Lake Malheur, Oregon; Culebra Island, Puerto Rico; Mosquito Inlet, Florida; and perhaps his greatest achievement, Grand Canyon National Monument, Arizona. "I hope you will not have a building of any kind, not a

summer cottage, a hotel, or anything else, to mar the wonderful grandeur, sublimity, the great loneliness and beauty of the canyon," Roosevelt said at a speech at the Grand Canyon in 1903. Under the auspices of the Antiquities Act, he signed the Grand Canyon National Monument into being on January 11, 1908. It was the 11th such monument he had created to date. He would create 18 in all, among them Montezuma Castle, Arizona; Gila Cliff Dwelling, New Mexico; Devil's Tower, Wyoming; and Muir Woods, California.

No mention of Roosevelt the conservationist would be complete that did not include his friend John Muir. Though Muir, who favored keeping forest lands completely intact, often disagreed with Roosevelt on policy matters, they remained allies and admirers. It was during a memorable camping trip in Yosemite that Muir pressed Roosevelt to add Yosemite Valley and the Mariposa sequoia grove to Yosemite National Park. Roosevelt willingly complied.

When Roosevelt left office in 1909, his thoughts again turned to nature. Under the auspices of the Smithsonian Institution, he led an expedition to Africa to collect specimens. Roosevelt and company bagged 512 animals, keeping about 24 and giving the rest to the Smithsonian, the American Museum of Natural History in New York, and the San Francisco Museum. Although his days of pursuit had nearly ended, he would have one more adventure: as he said, "One more chance to be a boy."In 1913, Roosevelt took his last major trek into the wilderness, this time to the Amazon on an expedition sponsored by the American Museum of Natural History. He and his companions traveled more than 1,000 miles on the previously uncharted Rio da Duvida (River of Doubt), collecting 3,000 specimens. During the voyage, Roosevelt sustained a leg injury that became badly infected, and he contracted a tropical fever. This trip marked the beginning of decline for the relentless naturalist, who died on January 6, 1919, without having regained his health.

> The man should have youth and strength who seeks adventure in the wide, waste spaces of the earth, in the marshes, and among the vast mountain masses, in the northern forests, amid the steaming jungles of the tropics, or on the desert of sand or of snow. He must long greatly for the lonely winds that blow across the wilderness, and for sunrise and sunset over the rim of the empty world.
> –Theodore Roosevelt

"TR's Legacy, The Environment" from The AMERICAN EXPERIENCE web site for "TR, the Story of Theodore Roosevelt," at *pbs.org/wgbh/amex/tr/envir.html*

A Brief History of the Tellico Dam Project

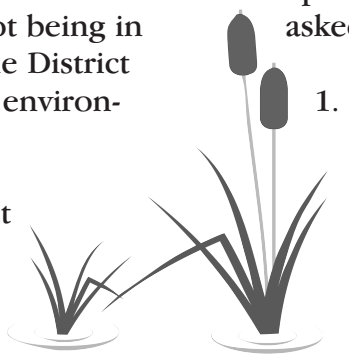
In 1967, the Tennessee Valley Authority (TVA) received funding from Congress to construct a dam on the Little Tennessee River. The purpose was to stimulate shoreline development, generate electricity for 20,000 homes, provide for flat-water recreation and flood control, and generally improve economic conditions. The project was called the Tellico Dam and Reservoir Project. This project was vigorously opposed by local citizens and national environmental groups.

Before the Endangered Species Act became law in 1973, a tangle of lawsuits and administrative proceedings delayed progress on the proposed dam. Citizen groups and national environmental agencies claimed that the project did not conform to the requirements of the National Environmental Policy Act (NEPA) of 1969 and obtained a court injunction that stopped construction. TVA developed a series of environmental impact statements that were rejected by the District Court as not being in compliance with NEPA. In 1973, the District Court determined that TVA's latest environmental impact statement did comply with NEPA and dissolved the injunction. Work on the project was resumed.

Four months later, Congress passed the Endangered Species Act of 1973. The snail darter's existence in the Little Tennessee River became the focus of efforts to halt construction of the Tellico Dam. This 3-inch fish occupied the attention of the TVA, the U.S. Department of the Interior, environmental organizations, and concerned citizens for several years. In January 1975, a petition by those who wanted to stop construction of the dam asked the Secretary of the Interior to list the snail darter as an endangered species. On October 8, 1975, after considering comments from various interest groups, including TVA and the state of Tennessee, the Secretary agreed that the snail darter was endangered and listed the species as such.

The TVA maintained that relocating the snail darter to another habitat was the only available alternative. TVA searched for possible sites and experimented with moving a group of snail darters to the Hiwassee River nearby. The Secretary of the Interior was not satisfied with the results of those efforts.

Consequently, the dispute was brought to the Supreme Court in 1978. The Court was asked to resolve two questions:



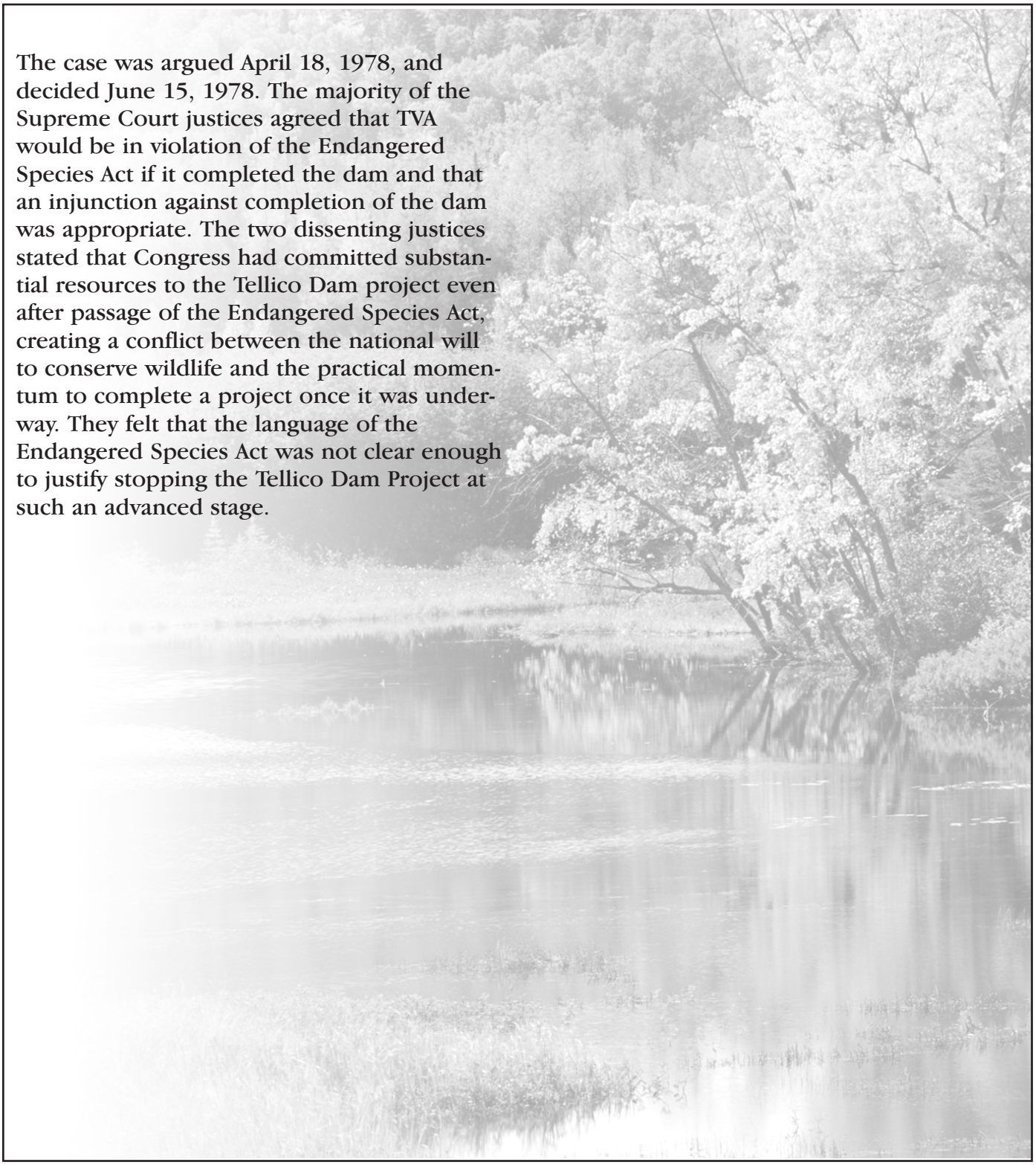
1. Does the Endangered Species Act of 1973 require a court to stop the operation of a nearly completed federal dam, authorized before the act, when operation of the dam would eradicate an endangered species?

2. Do congressional appropriations for the dam after 1973 imply a repeal of the Endangered Species Act, at least with regard to this particular dam?

Testing the Law: *TVA vs. Hill*

STUDENT PAGE 2 OF 2

The case was argued April 18, 1978, and decided June 15, 1978. The majority of the Supreme Court justices agreed that TVA would be in violation of the Endangered Species Act if it completed the dam and that an injunction against completion of the dam was appropriate. The two dissenting justices stated that Congress had committed substantial resources to the Tellico Dam project even after passage of the Endangered Species Act, creating a conflict between the national will to conserve wildlife and the practical momentum to complete a project once it was underway. They felt that the language of the Endangered Species Act was not clear enough to justify stopping the Tellico Dam Project at such an advanced stage.



Excerpts of the Supreme Court Justices' Opinions on the *TVA vs. Hill* Case

U.S. Supreme Court
TVA vs. Hill, 437 U.S. 153 (1998)

Tennessee Valley Authority vs. Hill et al.
Certiori to the United States Court of Appeals for the Sixth Circuit
No. 76–1701
Argued April 1978
Decided June 15, 1978

Mr. Chief Justice Burger delivered the opinion of the Court:

The questions presented in this case are (a) whether the Endangered Species Act of 1973 requires a court to enjoin the operation of a virtually completed federal dam–which has been authorized prior to 1973–when, pursuant to authority vested in him by Congress, the Secretary of the Interior has determined that operation of the dam would eradicate an endangered species; and (b) whether continued congressional appropriations for the dam after 1973 constituted an implied repeal of the Endangered Species Act, at least as to the particular dam.

The Little Tennessee Valley originates in the mountains of northern Georgia and flows through the national forest lands of North Carolina into Tennessee, where it converges with the Big Tennessee River near Knoxville.

In this area of the Little Tennessee River, the Tennessee Valley Authority, a wholly owned public corporation of the United States, began constructing the Tellico Dam and Reservoir Project in 1967, shortly after Congress appropriated initial funds for its development. Tellico is a multipurpose regional development project designed principally to stimulate shoreline development, generate sufficient electric current to heat 20,000 homes, and provide flat-water recreation and flood control, as well as improve economic conditions.

Although Congress has appropriated monies for Tellico every year since 1967, progress was delayed, and ultimately stopped, by a tangle of lawsuits and administrative proceedings. Local citizens and national conservation groups brought suit in the District Court, claiming that the project did not conform to the requirements of the National Environmental Policy Act of 1969. The injunction remained in effect until late 1973, when the District Court concluded that TVA's final environmental impact statement for Tellico was in compliance with the law.

A few months prior to the District Court's decision dissolving the NEPA injunction, a discovery

Testing the Law: *TVA vs. Hill*

was made in the waters of the Little Tennessee, which would profoundly affect the Tellico Project. Exploring the area around Coytee Springs, which is about 7 miles from the mouth of the river, a University of Tennessee ichthyologist, Dr. David A. Etnier, found a previously unknown species of perch, the snail darter, or *Percina (Imostoma) tanasi.* This 3-inch, tannish-colored fish, [437 U.S. 153, 159] whose numbers are estimated to be in the range of 10,000 to 15,000, would soon engage the attention of environmentalists, the TVA, [and] the Department of the Interior and [would] provide an additional basis to halt construction of the dam.

The moving force behind the snail darter's sudden fame came some 4 months after its discovery, when the Congress passed the Endangered Species Act of 1973 (Act), 87 Stat. 884, 16 U.S.C. 1531 et seq. (1976 ed.). This legislation, among other things, authorizes the Secretary of the Interior to declare a species of animal "endangered" [437 U.S. 153, 1601] and to identify the "critical habitat" of these creatures. When a species or its habitat is so listed, the following portion of the Act–relevant here–becomes effective.

In January 1975, the respondents in this case and others petitioned the Secretary of Interior to list the snail darter as an endangered species. After receiving comments from various interested parties, including TVA and the State of Tennessee, the Secretary formally listed the snail darter as an endangered species on October 8, 1975. In so acting, it was noted that "the snail darter is a living entity which is genetically distinct and reproductively isolated from other fishes" [40 Fed. Reg. 47505]. Most important for the purposes of this case, it was noted that the snail darter apparently lives only in that portion of the Little Tennessee River which would be completely inundated by the reservoir created as a consequence of the Tellico Dam's completion.

TVA consistently took the position that the only available alternative was to attempt relocating the snail darter population to another suitable location. TVA conducted a search of alternative sites that might sustain the fish, culminating in the experimental transplantation of a number of snail darters to the nearby Hiwassee River. However, the Secretary of the Interior was not satisfied with the results of these efforts, finding that TVA had presented "little evidence that they have carefully studied the Hiwassee to determine whether or not" there were "biological and other factors in this river that [would] negate a successful transplant."

We begin with the premise that operation of the Tellico Dam will either eradicate the known population of the snail darters or destroy their critical habitat. Petitioner does not now seriously dispute this fact. In any event, under 4 (a) (1) [437 U.S. 153, 172] of the Act, 87 Stat. 886, 16 U.S.C. 1533 (a) (1) (1976 ed.), the Secretary of the Interior is vested with exclusive authority to determine whether a species such as the snail darter is "endangered" or "threatened" and to ascertain the factors which have led to such a precarious existence. By 4 (d), Congress has authorized–indeed commanded–the Secretary to "issue such regulations as he deems necessary and advisable to provide for the conservation of such species." Doubtless petitioner would pre-

fer not to have these regulations on the books, but there is no suggestion that the Secretary exceeded his authority or abused his discretion in issuing the regulations. Indeed, no judicial review of the Secretary's determinations has ever been sought and hence the validity of his actions [is] not open to review in this court.

Starting from the above premise, two questions are presented: (a) [W]ould TVA be in violation of the Act if it completed and operated the Tellico Dam as planned? (b) [I]f TVA's actions would offend the Act, is an injunction the appropriate remedy for the violation? For the reasons stated hereinafter, we hold that both questions must be answered in the affirmative.

A. It may seem curious to some that the survival of a relatively small number of 3-inch fish among all the countless millions of species extant would require the permanent halting of a virtually completed dam for which Congress has expended more than $100 million. The paradox is not minimized by the fact that Congress continued to appropriate large sums of public money for the project, even after Congressional Appropriations Committees were apprised of its apparent impact upon the survival of the snail darter. We conclude, however, that the explicit provisions of the Endangered Species Act require precisely that result.

B. Having determined that there is an irreconcilable conflict between operation of the Tellico Dam and the explicit provisions of the Endangered Species Act, we must now consider what remedy, if any, is appropriate. It is correct, of course, that a federal judge sitting as a chancellor is not mechanically obligated to grant an injunction of every violation of law. This Court made plain in *Hecht Co. vs. Bowles,* 321 U.S. 321, 329 (1944), that [a grant of jurisdiction to issue compliance orders hardly suggests an absolute duty to do so under any and all circumstances.] As a general matter, it may be said, "Since all or almost all equitable remedies are discretionary, the balancing of equities and hardships is appropriate in almost any case as a guide to the chancellor's discretion."

Mr. Justice Powell, with whom Mr. Justice Blackmun joins, dissenting:

The Court today holds that the Endangered Species Act requires a federal court, for the purpose of protecting an endangered species or its habitat, to enjoin permanently the operation of any federal project, whether completed or substantially completed. This decision casts a long shadow over the operation of even the most important projects, serving vital needs of society and national defense, whenever it is determined that continued operation would threaten extinction of an endangered species or its habitat. This result is said to be required by the "plain intent of Congress" as well as by the language of the statute.

The Senate Committee on Appropriations did not view the Endangered Species Act as "prohibiting the completion of the Tellico project at its advanced stage," and it directed "that this project

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be completed as promptly as possible in the public interest." The appropriations bill was passed by Congress and approved by the President.

"Where a project is on-going and substantial resources have been expended, the conflict between national incentives to conserve living things and the pragmatic momentum to complete the project on schedule is most incisive." Today the Court, like the Court of Appeals below, adopts a reading of the Act that gives it a retroactive effect and disregards 12 years of consistently expressed congressional intent to complete the Tellico Project. With all due respect, I view this result as an extreme example of a literalist construction, not required by the language of the Act and adopted without regard to its manifest purpose. Moreover, it ignores established canons of statutory construction.

Powell agreed that it can be viewed as a textbook example of fuzzy language, which can be read according to the "eye of the beholder." The critical words direct all federal agencies to take "such action [as may be] necessary to insure that actions authorized, funded, or carried out by them do not jeopardize the continued existence of ... endangered species ..."

The critical word is "actions" and its meaning is far from plain. In terms of planning and executing various activities, it seems evident that the "actions" referred to are not all actions that an agency can ever take, but rather actions that the agency is deciding whether to authorize, to fund, or to carry out.

The Senate Committee on Appropriations did "not view the Endangered Species Act as prohibiting the completion of the Tellico project at its advanced stage," and it directed "that this project be completed as promptly as possible in the public interest." The appropriations bill was passed by Congress and approved by the President.

"Where a project is on-going and substantial resources have already been expended, the conflict between national incentives to conserve living things and the pragmatic momentum to complete the project on schedule is most incisive."

Mr. Justice Rehnquist, dissenting:

In the light of my Brother Powell's dissenting opinion, I am far less convinced than the Court that the Endangered Species Act of 1973, 16 U.S.C. 1531 et seq. (1976 ed), was intended to prohibit the completion of the Tellico Dam. But the very difficulty and doubtfulness of the correct answer to this legal question convinces me that the Act did not prohibit the District Court from refusing, in the exercise of its traditional equitable powers, to enjoin petitioner from completing the Dam.

Ma Baker's Little Acre
by John D. Loudermilk

Chorus:
Now a little old lady by the name of Ma Baker
Lived out of town on one square acre,
In a little white house with a picket fence all around.
She had a kind and gentle way
Till the day the T.V.A.
Tried to make Ma Baker sell her little acre of ground.

They showed her a map of how the river ran
And a sketch of a brand new dam,
But Ma Baker wouldn't sell her little acre of land.
She said, "Pa left this to me sonny
And I wouldn't sell for love nor money."
No sir, Ma Baker's gonna keep her little acre of land.

Now, the next time they came, they brought the sheriff,
And found Ma a-rockin' in an old porch chair,
Just a-knittin' and a-rockin' out in the evening sun.
She told them that they'd best to wait
And not step through the picket gate,
And on Ma's lap they saw Pa's old shot gun.

Now out in the middle of the brand-new lake,
Is a little island of one square acre,
But Ma Baker's just as happy as she can be;
She can't swim but she can float,
And catch big bass from her motor boat,
And when the wind ain't blowin' too much, she can water ski.
And Ma Baker still owns her little acre of land.

List of Stakeholders Involved in a Land-Use Project

A community was divided over the issue of how to convert a decommissioned military base to private use. The following stakeholders were involved in the dispute:

- ☆ Town Manager, who favored mixed uses, including open spaces, mixed-income housing, and significant commercial development for tax relief
- ☆ Planning Board member, who gave priority to private housing development
- ☆ Planning Board member, who gave priority to mixed commercial uses
- ☆ Planning Board member, who gave priority to conservation and open space
- ☆ Conservation Commission members, who are local citizens responsible for monitoring development that affects waterways, wildlife, and habitats
- ☆ State Department of Economic Development, which is responsible for attracting business and jobs to the state
- ☆ State Department of Natural Resources, which is responsible for preservation of open space and wildlife habitats
- ☆ School Board members, who are looking for a site for a new high school with space for athletic fields and natural areas for outdoor classrooms
- ☆ Private citizens, who have a mix of interests and priorities

Stakeholder Analysis Chart

Stakeholders	Characteristics			
	Values	Position on Problem	Role in Community	Actions on Environment
Individuals				
Environmental Organizations				
Government				
Business				

Stakeholder Interaction Chart

Problem Solvers	Motivators			
	Individuals	Environmental Organizations	Government	Business
Individuals				
Environmental Organizations				
Government				
Business				

Problem Solvers are those who can take action to address environmental problems and who are prompted by the actions of the motivators.

Motivators are those whose actions generate interest and support.

Where Does Water Run?

Sheet 1: Velocity

Stream

Trial	Seconds
1	_____
2	_____
3	_____
Average Time	_____
Distance Used	_____

Culvert/Two-Ended Pipe

Trial	Seconds
1	_____
2	_____
3	_____
Average Time	_____
Distance Used	_____

Mean Velocity = Average Time X Distance Used

Mean Velocity _____ m/sec

Mean Velocity _____ m/sec

Adjusted Mean Velocity = Mean Velocity X Bottom Constant (see box at bottom)

One-Ended Pipe (Optional)

	Trial 1	Trial 2	Trial 3
Initial Flow Meter Reading	_____	_____	_____
Final Flow Meter Reading	_____	_____	_____
Difference	_____	_____	_____
Time	_____	_____	_____
Velocity	_____ m/sec	_____ m/sec	_____ m/sec

Mean Velocity = Sum of three trial velocities divided by 3

Mean Velocity _____ m/sec

Adjusted Mean Velocity = Mean Velocity X Bottom Constant (see box at bottom)

Adjusted Mean Velocity _____ m/sec

Bottom Constants
- 1.0 for smooth
- 0.9 for sandy/muddy
- 0.8 for gravel/rock

Water Discharge Calculations

Sheet 2: Cross Sectional Area

Streams and Culverts

Upper End					Lower End				
Subsection Depth (m)	X	Subsection Width (m)	=	Subsection Area (m^2)	Subsection Depth (m)	X	Subsection Width (m)	=	Subsection Area (m^2)

Total Upper Area = _____ m^2 Total Lower Area = _____ m^2

Average Cross Sectional Area of Water = (Total Upper Area + Total Lower Area) divided by 2 = _____ m^2

All Pipes

Diameter of pipe = _____ m

Radius of pipe = _____ m

Cross–sectional area of pipe = πr^2 [or (3.14) X radius X radius] = _____ m^2

Percent of pipe containing water = _____ % ➡ Decimal Fraction Equivalent = _____

Cross Sectional Area of Water =

Cross sectional area of pipe X Decimal fraction of water pipe = _____ m^2

Discharge Rates

For all types of systems

Discharge Rate = Cross–Sectional Area of Water (above) X Adjusted Mean Velocity (from sheet 1)

Discharge rate for stream = _____ m^2 X _____ m/sec= _____ m^3/sec

Discharge rate for human-made system =_____ m^2 X _____ m/sec =_____ m^3/sec

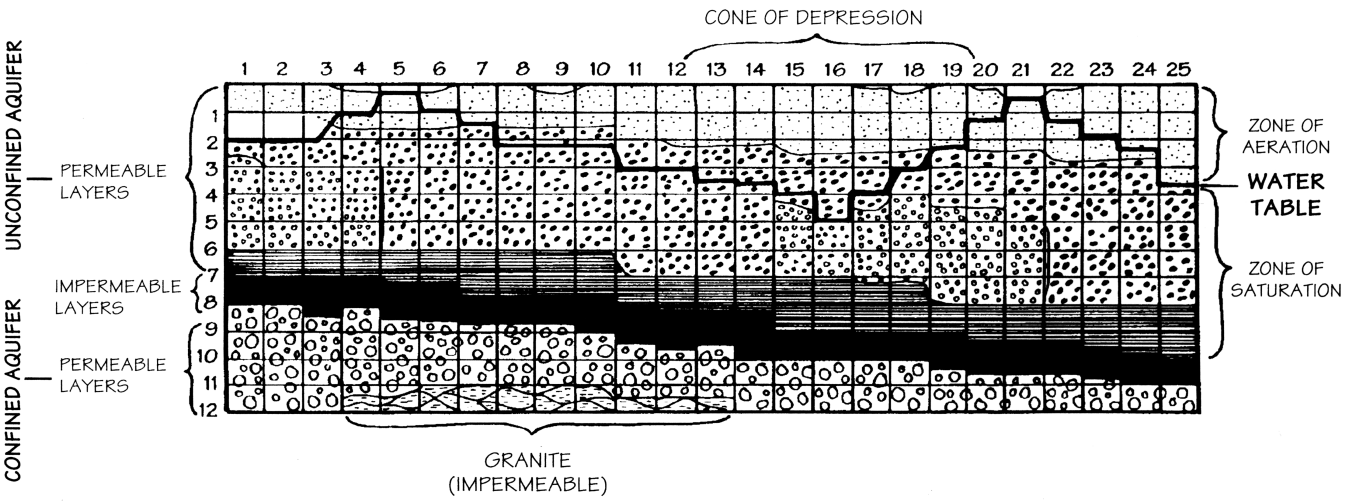
Can Water Get Through This?

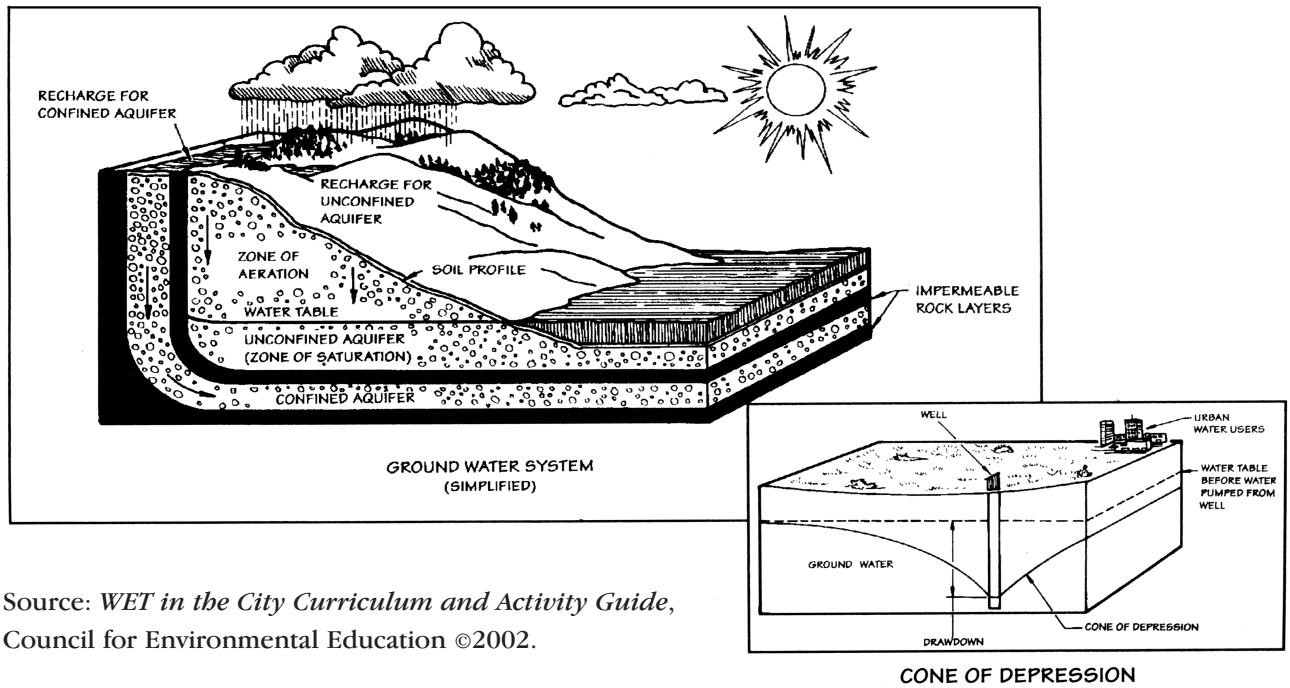
Well Log Data Chart

Well No.	Land Use Type	Water Table	Fine Sand	Medium Sand	Coarse Sand	Sand-stone	Clay Layer	Gravel Layer	Granite
		KEY Note: numbers in vertical columns are in inches							
1	farmland	2	0 - 1	1 - 2 1/2	2 1/2 - 6	6 - 7	7 - 8	8 - 12	—
2	farmland	2	0 - 1	1 - 3	3 - 6	6 - 7	7 - 8	8 - 12	—
3	farmland	2	0 - 1 1/2	1 1/2 - 3	3 - 6	6 - 7	7 - 8 1/2	8 1/2 - 12	—
4	wetland	1	1/4 - 1 1/2	1 1/2 - 3	3 - 6	6 - 7	7 - 8 1/4	8 1/4 - 11 1/2	11 1/2 - 12
5	wetland	1/4	1/2 - 1 1/2	1 1/2 - 6	—	6 - 7 1/4	7 1/4 - 8 1/4	8 1/4 - 11 1/2	11 1/2 - 12
6	wetland	1	1/4 - 1 3/4	1 3/4 - 6	—	6 - 7 1/4	7 1/4 - 8 1/2	8 1/2 - 11	11 - 12
7	farmland	1 3/4	0 - 1 3/4	1 3/4 - 6	—	6 - 7 3/4	7 3/4 - 8 3/4	8 3/4 - 11	11 - 12
8	farmland	2 1/2	0 - 1 3/4	1 3/4 - 6	—	6 - 7 3/4	7 3/4 - 8 3/4	8 3/4 - 11	11 - 12
9	landfill	2 1/2	3/4 - 1 3/4	1 3/4 - 6	—	6 - 7 3/4	7 3/4 - 8 3/4	8 3/4 - 11	11 - 12
10	industry	2 1/2	0 - 1 3/4	1 3/4 - 6	—	6 - 7 3/4	7 3/4 - 9	9 - 11	11 - 12
11	industry	3	0 - 2	2 - 7	—	7 - 8	8 - 9 1/4	9 1/4 - 11 1/2	11 1/2 - 12
12	urban area	3	0 - 2 1/4	2 1/4 - 7	—	7 - 8 1/4	8 1/4 - 9 1/2	9 1/2 - 11 1/2	11 1/2 - 12
13	urban area	3 1/2	0 - 2 1/4	2 1/4 - 7	—	7 - 8 1/4	8 1/4 - 9 1/2	9 1/2 - 11 1/2	11 1/2 - 12
14	urban area	3 3/4	0 - 2 1/4	2 1/4 - 7	—	7 - 8 1/2	8 1/2 - 9 3/4	9 3/4 - 11 1/2	11 1/2 - 12
15	urban area	4	0 - 2 3/4	2 3/4 - 4 1/2	4 1/2 - 7	7 - 9	9 - 9 3/4	9 3/4 - 12	—
16	urban area	5	0 - 2 3/4	2 3/4 - 4 1/2	4 1/2 - 7	7 - 9	9 - 9 3/4	9 3/4 - 12	—
17	farmland	4	0 - 2 3/4	2 3/4 - 4 1/2	4 1/2 - 7 1/2	7 1/2 - 9	9 - 10	10 - 12	—
18	wastewater treatment plant	3	1/4 - 2 1/2	2 1/2 - 4	4 - 7 1/2	7 1/2 - 9	9 - 10	10 - 12	—
19	farmland	2 1/2	0 - 2 1/4	2 1/4 - 4 1/2	4 1/2 - 8	8 - 9	9 - 10 1/4	10 1/4 - 12	—
20	river	1 1/2	1/4 - 2 1/2	2 1/2 - 4 1/2	4 1/2 - 8	8 - 9 1/4	9 1/4 - 10 1/2	10 1/2 - 12	—
21	river	1/2	1 - 2 1/2	2 1/2 - 5	5 - 8	8 - 9 1/4	9 1/4 - 10 1/2	10 1/2 - 12	—
22	river	1 1/2	1/4 - 3	3 - 8	—	8 - 9 1/4	9 1/4 - 10 1/2	10 1/2 - 12	—
23	national park	2	0 - 3	3 - 8	—	8 - 9 1/2	9 1/2 - 10 3/4	10 3/4 - 12	—
24	national park	3 1/4	0 - 2 3/4	2 3/4 - 8	—	8 - 9 3/4	9 3/4 - 11	11 - 12	—
25	national park	3 3/4	0 - 3	3 - 8	—	8 - 10	10 - 11 1/4	11 1/4 - 12	—

Can Water Get Through This?

WELL LOG GROUND WATER CHART (CROSS SECTION)





CONE OF DEPRESSION

Source: *WET in the City Curriculum and Activity Guide*, Council for Environmental Education ©2002.

Layering the Soil

Soils Data Sheet

Fill out a sheet for each identified horizon

Horizon _____ ***Location*** _____

Depth of Horizon _____ ***cm***

Structure Type(s) _____ (See diagram below.)

Color

Dominant _____

Subdominant _____

Consistence _____

Texture Type (by feel) _____

Particle Size Distribution:

Sand (after 12 min.) _____ ml _____ %

Silt (after 24 hrs.) _____ ml _____ %

Clay (by subtraction) _____ ml _____ %

Chart Texture Type _____

Carbonates Present

Yes _____ No _____

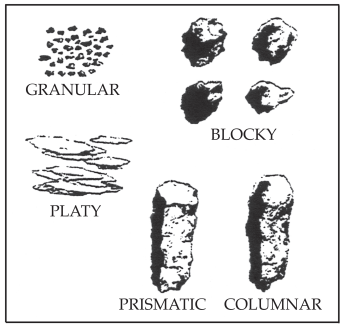
pH _____

Nutrient Levels:

Nitrogen (N) _____

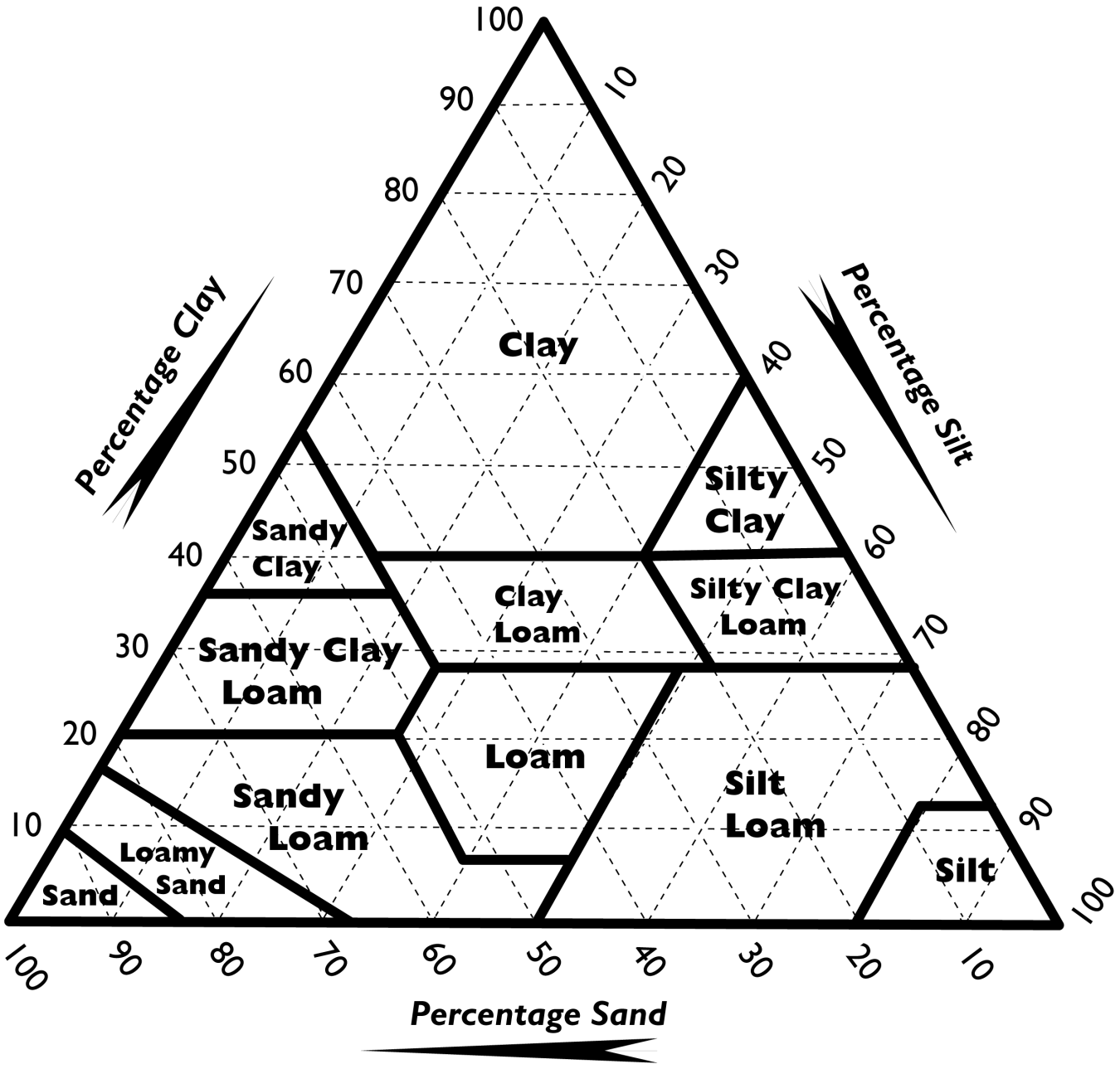
Phosphorus (P) _____

Potassium (K) _____



Choices of Soil Structure

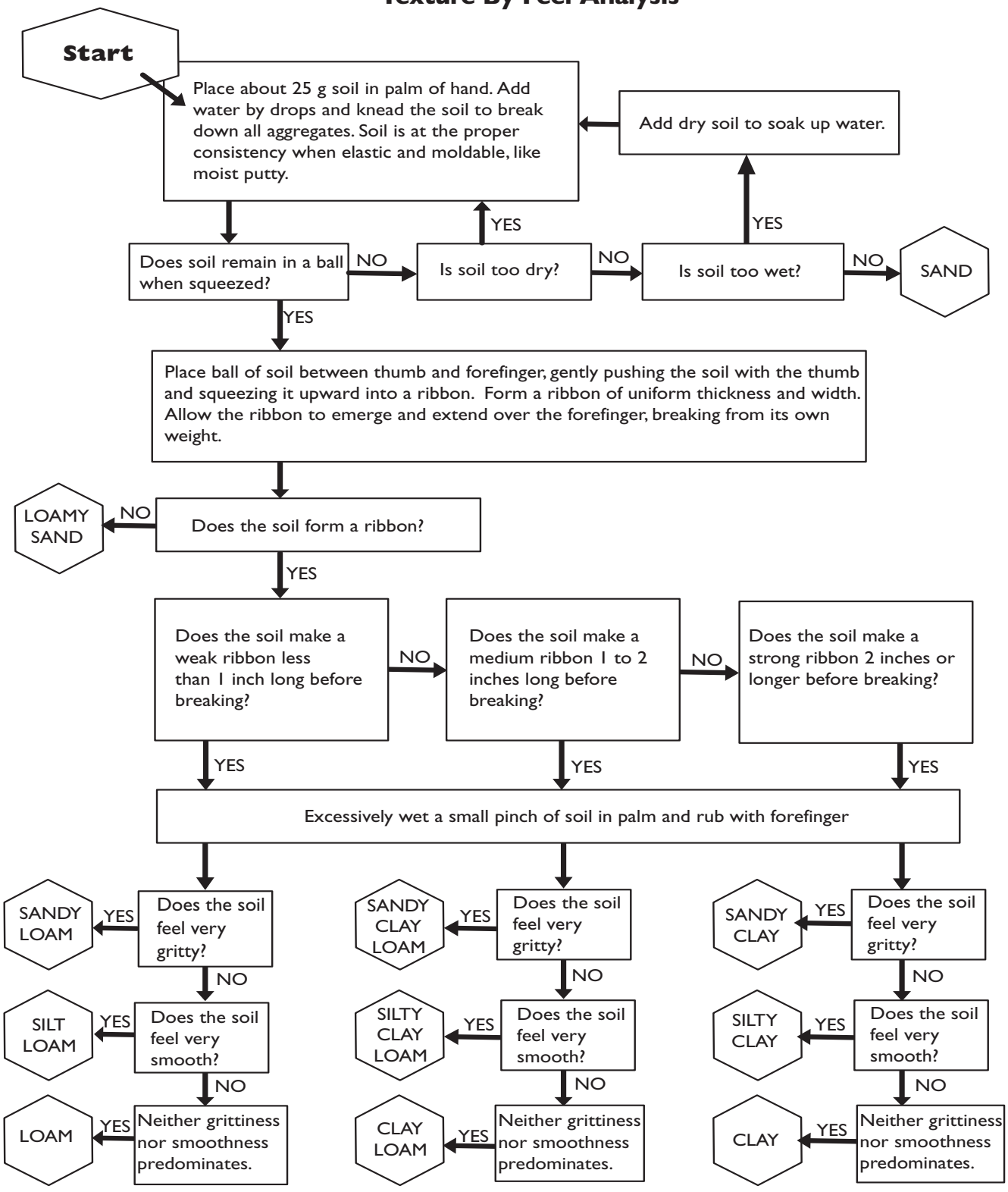
Textural Triangle



Layering the Soil

STUDENT PAGE 3 OF 3

Texture By Feel Analysis

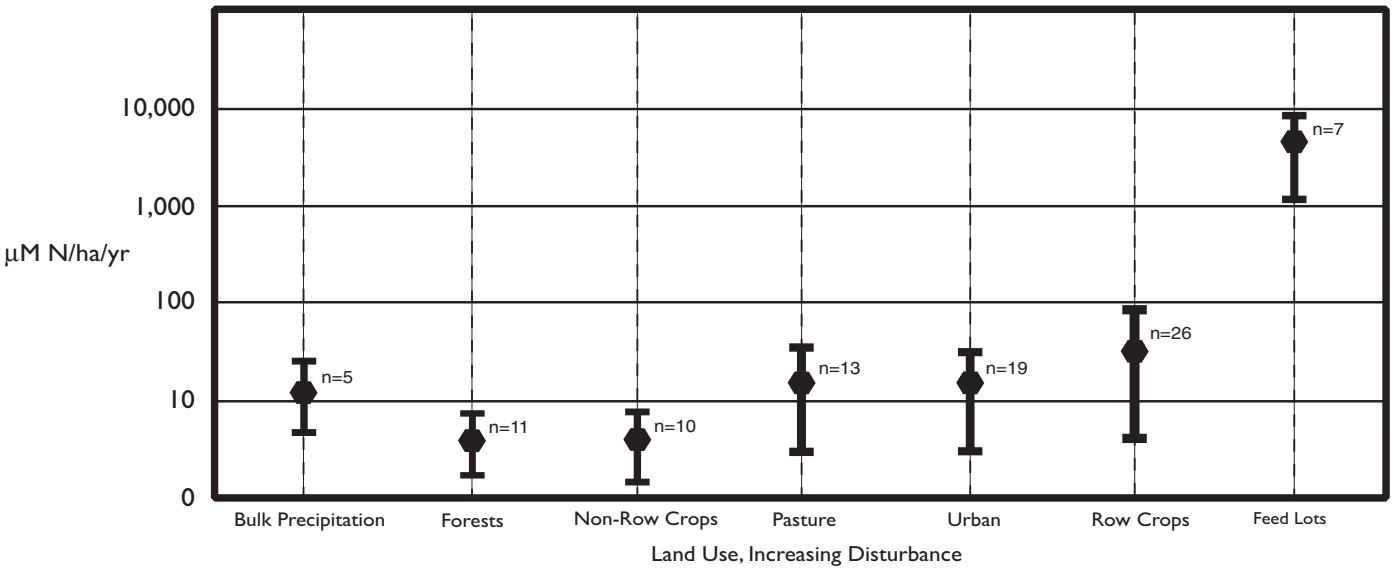


Feeding the Soil

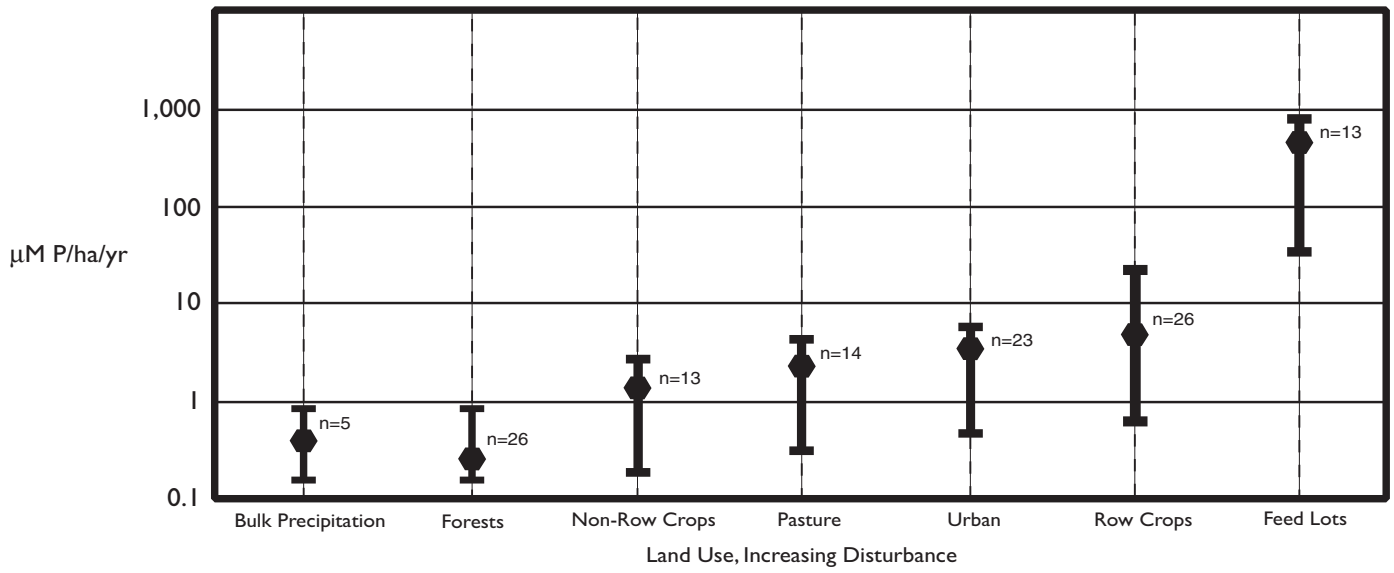
STUDENT PAGE 1 OF 2

Graph 1

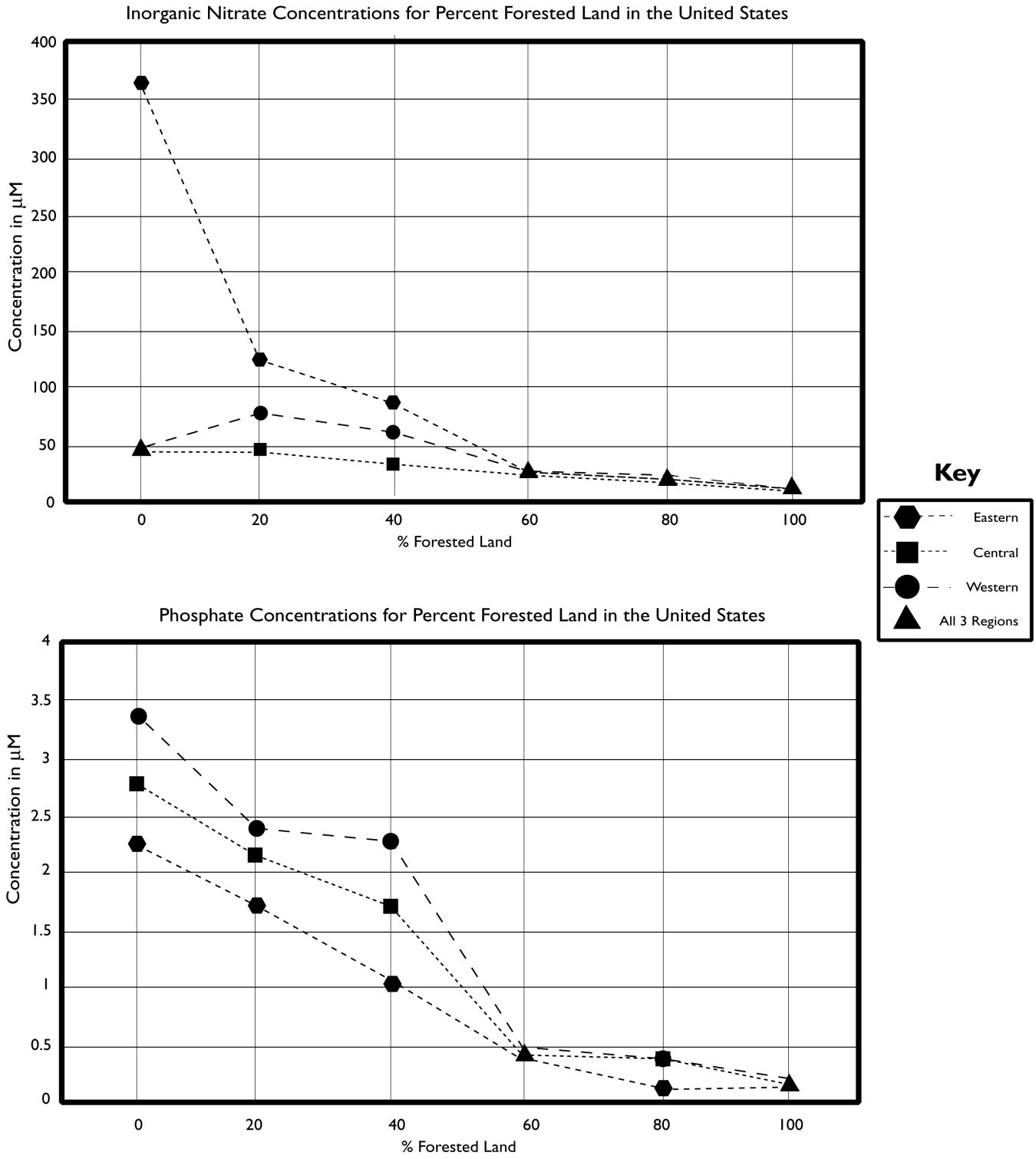
Land Use Yields for Nitrogen



Land Use Yields for Phosphorus



Graph 2

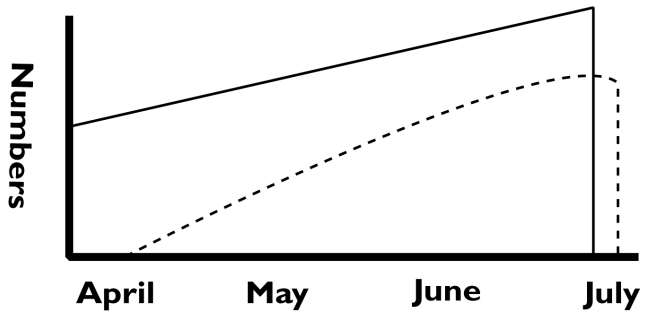

Inorganic Nitrate Concentrations for Percent Forested Land in the United States
Concentration in µM
400
350
300
250
200
150
100
50
0
0
20
40
60
80
100
% Forested Land
Key
Eastern
Central
Western
All 3 Regions
Phosphate Concentrations for Percent Forested Land in the United States
Concentration in µM
4
3.5
3
2.5
2
1.5
1
0.5
0
0
20
40
60
80
100
% Forested Land

Limits to Living Here

Graph A

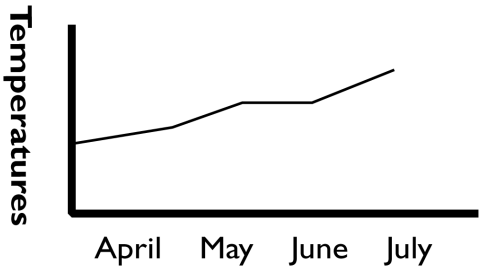
Number of ground squirrels ——————

Number of prairie falcons - - - - - - - - - - - - - - -



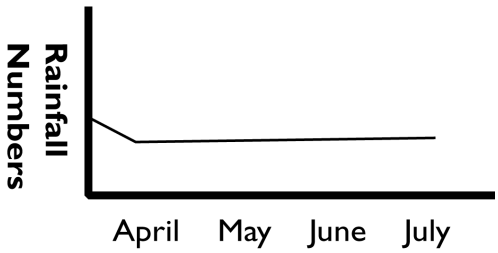
Graph B

Average Temperature



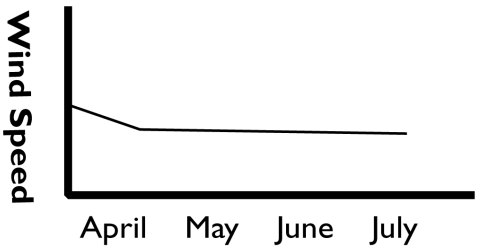
Graph C

Average Rainfall



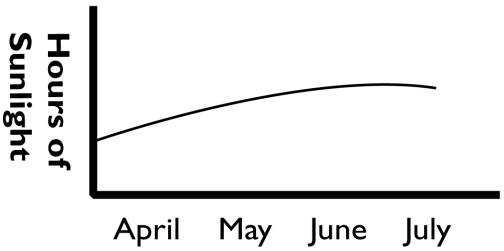
Graph D

Average Wind Speed



Graph E

Average Hours of Sunlight



Population Estimation Calculations

Date: _____ Site: _____

Optional:
Map Grid #: _____
Latitude: _____
Longitude: _____

Species: _____

Number of Organisms in Sample: _____

Sample Volume: _____cm^3

Thickness of Horizon

Upper Boundary Depth: _____cm

Lower Boundary Depth: _____cm

Thickness: _____cm

Horizon Volume:_____cm^3

Sample Fraction: Sample Volume ÷ Horizon Volume = _____

Estimated Number of Organisms per Square Meter:
Number of Organisms ÷ Sample Fraction = _____

Optional:
Estimated Number of Organisms on Site: _____

Who Lives in Soil?

Descriptions of Organisms

Bacteria

One of the most important soil organism groups is bacteria. Their modes of living enable them to fill a variety of ecological roles, include these:

☆ Photosynthetic. These bacteria can live only to the depth that light penetrates, which is the top few centimeters.

☆ Chemosynthetic. These bacteria do not require light and are present throughout the soil. They oxidize inorganic nitrogen and sulfur compounds, and they use the released energy for their metabolism.

☆ Heterotrophic. These bacteria also do not require light and are present throughout the soil. Most bacteria get their energy as either saprophytes (living on dead organisms) or parasites (living on living organisms). To obtain their energy, a number of them reduce organic compounds to inorganic carbon dioxide, water, ammonium, and nitrate ions.

Most bacteria are aerobic and can be found wherever there is enough oxygen, including at all depths in well-aerated soil. Anaerobic bacteria, which obtain their energy from glycolysis, can live only where oxygen is absent. Facultative anaerobes do not require oxygen; thus they can live where oxygen is present or absent.

The bacteria of the nitrogen cycle are important for all life because they help make nitrate (the only form of nitrogen that plants can use) available to the plants. Nitrogen fixation (conversion of atmospheric nitrogen to nitrate) is carried on by symbiotic bacteria that live on the roots of plants, particularly leguminous ones (*Rhizobium*, the symbiont of legumes, is the best-known example), and by the free-living *Azotobacter* and *Clostridium*. Nitrification (conversion of ammonium ions to nitrate) is usually facilitated by *Nitrosomonas* and *Nitrobacterium*. Another step in the nitrogen cycle is the reduction of nitrogen compounds to atmospheric nitrogen, or denitrification. This step is conducted mainly by *Pseudomonas.*

Other common soil bacteria are aerobic *Bacillus* and *Streptomyces. Bacillus* is a common rod-shaped bacterium. The filamentous *Streptomyces*, which resembles fungi, produces by-products with antibiotic properties (i.e., streptomycin). It is also responsible for the earthy odor of soil.

Algae

Soil algae belong to the blue-green (*Cyanophyta*) and green (*Chlorophyta*) algal groups, and they live in water droplets in the soil. Both are photosynthetic and therefore are confined to the upper layers of the soil.

Protozoa

Although these organisms live in water, they are not dependent on light. They are heterotrophs that usually feed on bacteria.

Fungi

All fungi are heterotrophic organisms. They obtain their nutrients by secreting digestive enzymes into the tissues of the organisms on which they feed and then by absorbing the

digested products. Bacteria, fungi, and slime molds are the most important organisms of decay. (Slime molds are not true molds, but have some fungal properties and some animal-like ones. They are best classified as a fungus-like protist.)

An important fungal type is the *Mycorrhizae*, a mutualistic fungi that envelopes the roots of trees, especially conifers, beeches, and oaks. Their hyphae grow into the roots and out into the soil. Digestive products are passed into the tree's system, which benefits the entire tree.

Nematodes
Roundworms are free-living, successful soil inhabitants that are tiny, even microscopic. They fall into two groups: (1) the fast-moving worms that feed on microorganisms and (2) the sluggish, herbivorous ones. The latter use a sharp stylet to pierce roots and withdraw tissue fluids. Plants often react by forming root galls, and severe attacks may kill the plant.

Earthworms
Earthworms are important animals because their activity channels, aerates, mixes, and fertilizes the soil. They ingest soil as they tunnel through, digesting and absorbing microbes and debris, and eliminating soil, undigested materials, and metabolites as castings. They inhabit the lower, moist layers of soil.

Snails and Slugs
Snails and slugs are herbivorous mollusks that live on the surface of the soil. They are slow-moving animals that glide along on a film of slime, ripping off and ingesting fragments of leaves and detrius as they go. The difference between the two mollusks is that snails have shells and slugs do not.

Arachnids
Arachnids have two body parts (cephalothorax and abdomen) and four pairs of legs, and they consume only liquid food. Soil arachnids include these:

☆ Pseudoscorpions. Predators of insects, these animals resemble scorpions but are smaller and lack a stinger.

☆ Mites. Some of these tiny creatures are herbivorous, while others are plant or animal parasites.

☆ Spiders. Carnivorous spiders use a variety of tactics including webs, traps, ambush, and chase to catch their insect prey. They paralyze the insects by an injection of digestive enzymes. When digestion is complete, the spider sucks its prey's body dry.

Sow Bugs
Sow bugs (also called pillbugs or wood lice) are one of the few terrestrial crustaceans. Living in moist soil under rocks or other objects, these small animals are scavengers, feeding on decaying vegetation. When disturbed, they curl up into balls.

Centipedes and Millipedes
Although they look similar, these two animals belong to two different arthropod classes and have quite different modes of life. On the one hand, centipedes have one pair of legs on each body segment and are fast-moving. They prey on insects, worms, and slugs, which they paralyze by injection. On the other hand,

Who Lives in Soil?

millipedes have two pairs of legs per body segment. They are sluggish scavengers, remaining quietly under rocks, fallen leaves, or other objects.

Insects

Insects have three body parts (head, thorax, and abdomen) and three pairs of legs. Insects are the largest and most successful group of animals on Earth and live in a wide variety of habitats where they fill a variety of ecological roles:

☆ Ants. Ants also tunnel in the soil, aerating and fertilizing it as they go. They are herbivores, carnivores, and scavengers and are more advanced than termites. Ants have a system of social castes (queen, workers, drones) and an elaborate communication system that enables them to follow a trail. They also manage colonies of aphids as a source of food.

☆ Beetles. Belonging to the largest group of animals, ground beetles are fast-moving predators of other insects.

☆ Earwigs. These herbivores and scavengers chew vegetation, both living and decaying. Their distinguishing characteristic is a pair of projecting forcep-like structures on the end of their abdomen.

☆ Grubs. These larval beetles are commonly found in soil.

☆ Springtails. These primitive insects are small and wingless, and they subsist on decaying vegetation. Their name comes from their means of locomotion. The last abdominal segment terminates in an extension that is tucked under the body. When this extension is released, the animal bounces forward suddenly.

☆ Termites. Termites belong to a social organization, or colony. Soil termites construct tunnels through soil or through wood, eating as they go, similar to earthworms. Their digestion requires the help of mutualistic protozoa.

Mammals

Burrowing moles, mice, gophers, prairie dogs, and woodchucks aerate and fertilize the soil on a grander scale than do the small invertebrates. Moles have well-developed adaptations for digging; they spend their lives underground eating larvae, earthworms, and other soil organisms. Because the other rodents are herbivorous and are not as well adapted for digging as moles are, they tend to spend more time above ground. Although these animals may be observed at the field site, they will not be collected or handled in this activity for safety reasons.

Description of Collection Equipment

The equipment needed to obtain soil organisms can be purchased from biological supply companies or made with ordinary materials. Construction directions follow.

Baermann Funnel

The Baermann Funnel is used to separate nematodes from the soil.

To make one,

1. Obtain a large funnel. Any narrow-necked, broad-shouldered plastic container (for cleaning products, for example) can be converted into a funnel.

2. Attach a piece of tubing to the stem of the funnel, and close it with a pinchcock.

3. Put a fine sieve at the base of the funnel to block large particles from entering the tubing. Nylon window screening (1/16-inch mesh) makes a good sieve.

4. Rest the funnel in a support ring.

5. Place a soil sample (in a cheesecloth bag) on top of the sieve in the funnel.

To use the funnel,

1. With the pinchcock closed, pour warm water slowly over the soil. When the soil is saturated, water will drip down the stem of the funnel, washing the nematodes down with it.
2. Allow the apparatus to remain in place in the lab for about 24 hours. Open the pinchcock, and drain several millimeters of liquid into a vial or dish for study.

Berlese Funnel

This apparatus is used to separate small arthropods from the soil.

To make one,

1. Obtain a large funnel with a wide stem and a 1/4-inch mesh shelf across the middle. A funnel used to drain crankcase oil (available in hardware, automotive, and discount stores) works well.

2. Rest the funnel on a large jar or a support ring with another jar below it.

3. Fill the jar half full of 70 percent isopropyl alcohol.

4. Position a lamp above the funnel. (25–40 watt bulb)

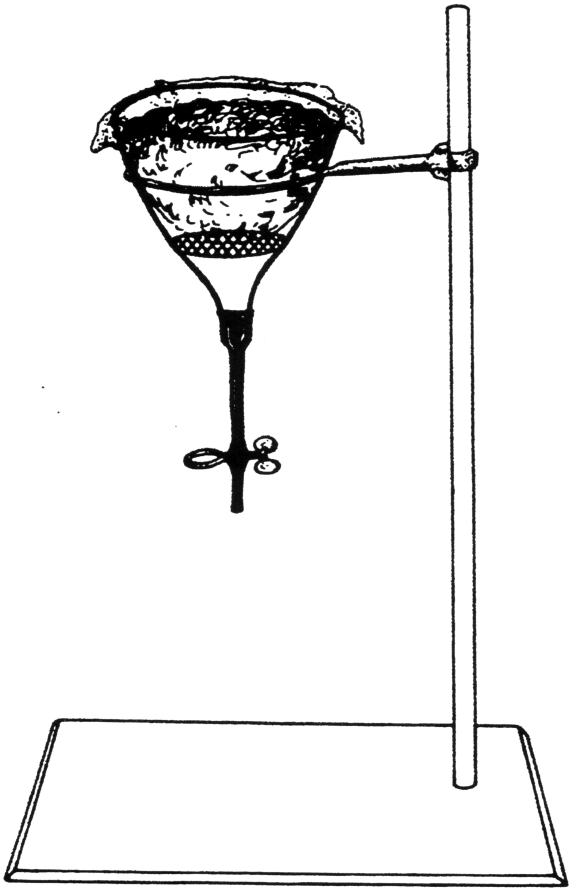
To operate the Berlese Funnel,

1. Place a soil sample on the mesh shelf of the funnel.

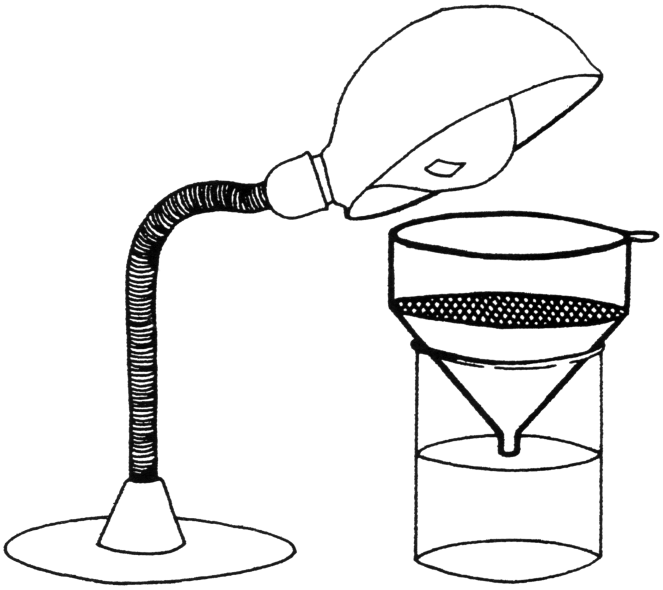
2. Turn the light on, and adjust the height of the lamp so it is not too close to the soil.

3. Wait overnight for the animals to collect in the jar. The soil animals that are adapted to

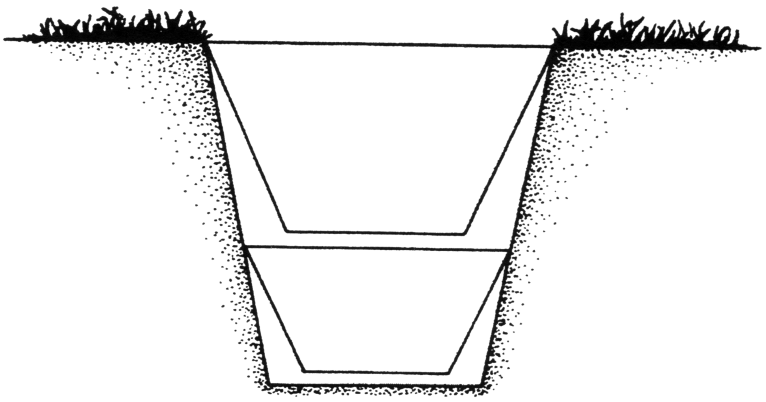
What Lives in Soil?



a. Baermann Funnel (soil nematodes)



b. Berlese Funnel (soil arthropods)



c. Pitfall Trap (fast-moving, surface arthropods)

the cool and dark environment will move down and away from the light, falling into the jar below.

4. Pour them into a shallow dish to examine.

Traps

A pitfall trap is a device that is sunk into the ground and catches small, fast-moving animals, such as ground beetles and centipedes, that walk across the surface. The trap consists of a buried container with a wide-mouthed funnel hanging from the container's rim. The funnel directs falling arthropods into the bottom of the trap but will not let them escape back up the sides.

To make one,

1. Use a disposable, plastic beverage glass with sloping sides to make the funnel. Cut off the bottom of the glass, and you have the funnel.

2. Place the funnel into any wide-mouth jar that will support it all the way around the rim.

3. Place the traps where humans will not step on or be tripped by them. Bury the container in the ground up to the rim. Roofing is not necessary, but it does camouflage the trap. If used, roofing should be simply sticks and leaves and should not alter the habitat climate beneath it.

To operate a pitfall trap,

1. Place bits of fruit or meat to attract arthropods into the trap.

2. Check the trap the next day.

3. Try to return animals to their habitat, if possible. Killing agents usually aren't necessary, but if escape proves a problem while the trap is being removed, you can add a small amount of detergent solution or mineral oil to the jar.

A potato trap is used to catch sow bugs.

To make one,

1. Hollow out the inside of a potato with an apple corer or knife.

2. Place the potato in a sheltered, moist area and cover lightly with leaves.

3. Check the trap the next day.

A Place for Every Living Thing

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Wildlife Diversity
Sample Sheet Data

Observers: _____ Date: _____

Time: _____ Weather: _____

Habitat Description:

Grid #	Number of Animals	Wildlife Species Seen, Heard/Sign	Description of the Location

Summary

Total number of wildlife found: _____ Number of different species found: _____

Number of wildlife for each species as follows:

Developed by T. Alberici, PA Game Commission

Plant Diversity
Sample Sheet Data

Inventory Team: _____ Site #_____

Date:_____ Time:_____ Weather: _____

Habitat Description:

Grid #	Number of Plants	Vegetation Species	Location (over story, under story, shrub, ground)

Summary

Total number of plants found: _____ Number of different species found: _____

Number of plants for each species as follows:

Developed by T. Alberici, PA Game Commission

How To Evaluate Habitats

Inventory Checklist

Name: _____ Date: _____

Site: _____ Location: _____

Part A. Natural History

Wildlife species: _____

Description of animal: _____

Specific needs of animal:

Food:

Water:

Space:

Shelter (all types; nesting, wintering, storage, resting and protection):

Air (oxygen concentration for aquatic animals):

Part B. Habitat Characteristics

Habitat type: (circle all applicable)

Agricultural field
Buildings, lots of mowed lawns, some trees
Buildings, scattered trees, little or no lawns
Business area
Forest
Houses, few trees, and little lawns
Houses, many trees, mowed lawns
Lake
Mixed field, shrub
Mixed field, shrub, some trees
Mixed forest
Neighborhood
Park
Pond
River
School yard
Shrub with some trees
Stream
Wetland
Other: _____

Description of the habitat:

Briefly describe the habitat:

Major vegetation:

Wildlife known to be on site:

Part C. Habitat Component Rating

Food:

Does this site provide food for this animal?
If yes, list foods found on site:

Are foods limited to one or more seasons?
Which seasons?

Rate Food from 1 to 10* ☐

Shelter: Animals require different types of shelter. Place a "yes" next to those shelter types your animal require, then decide if this site meets the needs for the animal. If yes, list possible places where the animal may find this shelter on your site.

Shelter Type	*Needed by Animal?*	*Found on Site?*	*Locations (be specific)*
Breeding or nesting			
Nursery			
Roosting or resting			
Hibernating			
Protection			
Other			

Rate Shelter from 1 to 10* ☐

Water:

Does this site provide adequate water?
If yes, list sources:

Rate Water from 1 to 10* ☐

Air (for aquatic animals):

Does this animal have a sufficient oxygen supply?
If yes, give concentration:

Rate Air from 1 to 10* ☐

Space:

Does this site provide adequate space?
Explain:

Rate Space from 1 to 10* ☐

[10 is excellent quality; 1 is poor quality]

How to Evaluate Habitats

Part D. Human Compatibility

Human Compatibility:

Are there many activities by people on this site?
If yes, list:

Are these activities compatible with this animal inhabiting this site?

Rate Human Compatibility from 1 to 10* ☐

Part E. Management

What is the total rating for this animal at this site? _____

Based on this habitat evaluation, could this animal live on this site? _____ Why or why not?

Do you know whether the animal lives on this site? _____ If it does not, why not?

Can this site be easily improved for this animal? _____ If yes, how?

[10 is excellent quality; 1 is poor quality]

Planning to Act

STUDENT PAGE 1 OF 1

Task List for *Planning to Act*

_____
_____
_____
_____

Team Members

Describe the problem your project will address.

What is the goal of your project?

Why is this goal important? (refer to Habitat Evaluation findings).

Describe your strategy for reaching your goal.

List your specific objectives.

What are the probable starting and ending dates of your project?

List the tasks needed to accomplish each objective.
For each task, include:
- ***Time frame***
- ***Who will be responsible***
- ***Supplies and equipment needed***
- ***Any funding requirements***

Make a list of people and organizations that may be able to help with their expertise, special skills, useful information or other assistance.

List ideas for publicity and generating support for your project.

How will you know if your project is successful? Describe measures of success in relation to your stated goal and objectives.

Comments: