

medical scientists were \$54,260 in research and testing laboratories and \$41,010 in hospitals in 1999.

According to the National Association of Colleges and Employers, beginning salary offers in 2000 averaged \$29,235 a year for bachelor's degree recipients in biological science, \$35,667 for master's degree recipients, and \$42,744 for doctoral degree recipients.

In the Federal Government in 2001, general biological scientists in nonsupervisory, supervisory, and managerial positions earned an average salary of \$61,236; microbiologists, \$67,835; ecologists, \$61,936; physiologists, \$78,366; and geneticists, \$72,510.

Related Occupations

Many other occupations deal with living organisms and require a level of training similar to that of biological and medical scientists. These include agricultural and food scientists, and conservation scientists and foresters, as well as health occupations such as physicians and surgeons, dentists, and veterinarians.

Sources of Additional Information

For information on careers in the biological sciences, contact:

► American Institute of Biological Sciences, Suite 200, 1444 I St. NW., Washington, DC 20005. Internet: <http://www.aibs.org>

For information on careers in physiology, contact:

► American Physiological Society, Education Office, 9650 Rockville Pike, Bethesda, MD 20814. Internet: <http://www.the-aps.org>

For information on careers in biochemistry or biological sciences, contact:

► Federation of American Societies for Experimental Biology, 9650 Rockville Pike, Bethesda, MD 20814. Internet: <http://www.faseb.org>

For a brochure entitled *Is a Career in the Pharmaceutical Sciences Right for Me?*, contact:

► American Association of Pharmaceutical Scientists (AAPS), 2107 Wilson Blvd., Suite #700, Arlington, VA 22201. Internet: <http://www.aaps.org/sciaffairs/careerinp.htm>

For information on careers in microbiology, contact:

► American Society for Microbiology, Office of Education and Training—Career Information, 1325 Massachusetts Ave. NW., Washington, DC 20005. Internet: <http://www.asmsusa.org>

Information on obtaining a biological or medical scientist position with the Federal Government is available from the Office of Personnel Management (OPM) through a telephone-based system. Consult your telephone directory under U.S. Government for a local number or call (912) 757-3000; Federal Relay Service: (800) 877-8339. The first number is not tollfree, and charges may result. Information also is available from the OPM Internet site: <http://www.usajobs.opm.gov>.

Conservation Scientists and Foresters

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Significant Points

- Nearly 3 out of 4 work for Federal, State, or local governments.
- A bachelor's degree in forestry, range management, or a related field is the minimum educational requirement.
- Projected average employment growth will stem from continuing emphasis on environmental protection and responsible land management.

Nature of the Work

Forests and range lands supply wood products, livestock forage, minerals, and water; serve as sites for recreational activities; and provide habitats for wildlife. Conservation scientists and foresters manage, develop, use, and help to protect these and other natural resources.

Foresters manage forested lands for a variety of purposes. Those working in private industry may manage company forestland or procure timber from private landowners. Company forests are usually managed to produce a sustainable supply of wood for company mills. Procurement foresters contact local forest owners and gain permission to take inventory of the type, amount, and location of all standing timber on the property, a process known as timber cruising. Foresters then appraise the timber's worth, negotiate its purchase, and draw up a contract for procurement. Next, they subcontract with loggers or pulpwood cutters for tree removal, aid in road layout, and maintain close contact with the subcontractor's workers and the landowner to ensure that the work meets the landowner's requirements, as well as Federal, State, and local environmental specifications. Forestry consultants often act as agents for the forest owner, performing these duties and negotiating timber sales with industrial procurement foresters.

Throughout the forest management and procurement processes, foresters consider the economics as well as the environmental impact on natural resources. To do this, they determine how best to conserve wildlife habitats, creek beds, water quality, and soil stability and how best to comply with environmental regulations. Foresters must balance the desire to conserve forested ecosystems for future generations with the need to use forest resources for recreational or economic purposes.

Through a process called regeneration, foresters also supervise the planting and growing of new trees. They choose and prepare the site, using controlled burning, bulldozers, or herbicides to clear weeds, brush, and logging debris. They advise on the type, number, and placement of trees to be planted. Foresters then monitor the seedlings to ensure healthy growth and to determine the best time for harvesting. If they detect signs of disease or harmful insects, they consult with forest pest management specialists to decide on the best course of treatment. Foresters who work for Federal and State governments manage public forests and parks and work with private landowners to protect and manage forest land outside of the public domain. They may also design campgrounds and recreation areas.

Foresters use a number of tools to perform their jobs. Clinometers measure the height, diameter tapes measure the diameter, and increment borers and bark gauges measure the growth of trees so that timber volumes can be computed and growth rates estimated. Photogrammetry and remote sensing (aerial photographs and other imagery taken from airplanes and satellites) often are used for mapping large forest areas and for detecting widespread trends of forest and land use. Computers are used extensively, both in the office and in the field, for the storage, retrieval, and analysis of information required to manage the forest land and its resources.

Range managers, also called *range conservationists*, *range ecologists*, or *range scientists*, study, manage, improve, and protect range lands to maximize their use without damaging the environment. Range lands cover about 1 billion acres of the United States, mostly in western States and Alaska. They contain many natural resources, including grass and shrubs for animal grazing, wildlife habitats, water from vast watersheds, recreation facilities, and valuable mineral and energy resources. Range managers help ranchers attain optimum livestock production by determining the number and kind of animals to graze, the grazing system to use, and the best season for grazing. At the same time, however, they maintain soil



Conservation scientists and foresters determine how to best conserve wildlife habitats, water quality, and soil stability in order to protect the ecosystem.

stability and vegetation for other uses such as wildlife habitats and outdoor recreation. They also plan and implement revegetation of disturbed sites.

Soil conservationists provide technical assistance to farmers, ranchers, forest managers, State and local agencies, and others concerned with the conservation of soil, water, and related natural resources. They develop programs designed to make the most productive use of land without damaging it. Soil conservationists visit areas with erosion problems, find the source of the problem, and help landowners and managers develop management practices to combat it.

Foresters and conservation scientists often specialize in one area, such as forest resource management, urban forestry, wood technology, or forest economics.

Working Conditions

Working conditions vary considerably. Although some of the work is solitary, foresters and conservation scientists also deal regularly with landowners, loggers, forestry technicians and aides, farmers, ranchers, government officials, special interest groups, and the public in general. Some foresters and conservation scientists work regular hours in offices or labs. Others may split their time between field work and office work, while independent consultants and especially new, less experienced workers spend the majority of their time outdoors overseeing or participating in hands-on work.

The work can be physically demanding. Some foresters and conservation scientists work outdoors in all types of weather, sometimes in isolated areas. Other foresters may need to walk long distances through densely wooded land to carry out their work. Foresters also may work long hours fighting fires. Conservation scientists often are called in to prevent erosion after a forest fire, and they provide emergency help after floods, mudslides, and tropical storms.

Employment

Conservation scientists and foresters held about 29,000 jobs in 2000. Nearly 4 out of 10 workers were employed by the Federal Government, many in the U.S. Department of Agriculture (USDA). Foresters were concentrated in the USDA's Forest Service; soil conservationists in the USDA's Natural Resource Conservation Service. Most range managers worked in the Department of the Interior's Bureau of Land Management, the USDA's Natural Resource

Conservation Service or Forest Service. About 1 out of 4 conservation scientists and foresters worked for State governments, and nearly 1 out of 10 worked for local governments. The remainder worked in private industry, mainly in research and testing services, the forestry industry, and logging and lumber companies and sawmills. Some were self-employed as consultants for private landowners, Federal and State governments, and forestry-related businesses.

Although conservation scientists and foresters work in every State, employment of foresters is concentrated in the western and southeastern States, where many national and private forests and parks, and most of the lumber and pulpwood-producing forests, are located. Range managers work almost entirely in the western States, where most of the rangeland is located. Soil conservationists, on the other hand, are employed in almost every county in the country.

Training, Other Qualifications, and Advancement

A bachelor's degree in forestry is the minimum educational requirement for professional careers in forestry. In the Federal Government, a combination of experience and appropriate education occasionally may substitute for a 4-year forestry degree, but job competition makes this difficult.

Sixteen States have mandatory licensing or voluntary registration requirements that a forester must meet in order to acquire the title "professional forester" and practice forestry in the State. Licensing or registration requirements vary by State, but usually entail completing a 4-year degree in forestry and a minimum period of training, and passing an exam.

Foresters who wish to perform specialized research or teach should have an advanced degree, preferably a Ph.D.

Most land-grant colleges and universities offer bachelor's or higher degrees in forestry; about 100 of these programs are accredited by the Society of American Foresters. Curriculums stress science, mathematics, communications skills, and computer science, as well as technical forestry subjects. Courses in forest economics and business administration supplement the student's scientific and technical knowledge. Forestry curriculums increasingly include courses on best management practices, wetland analysis, water and soil quality, and wildlife conservation, in response to the growing focus on protecting forested lands during timber harvesting operations. Prospective foresters should have a strong grasp of policy issues and of increasingly numerous and complex environmental regulations, which affect many forestry-related activities. Many colleges require students to complete a field session either in a camp operated by the college or in a cooperative work-study program with a Federal or State agency or private industry. All schools encourage students to take summer jobs that provide experience in forestry or conservation work.

A bachelor's degree in range management or range science is the usual minimum educational requirement for range managers; graduate degrees usually are required for teaching and research positions. In 2000, about 40 colleges and universities offered degrees in range management or range science or in a closely related discipline with a range management or range science option. A number of other schools offered some courses in range management or range science. Specialized range management courses combine plant, animal, and soil sciences with principles of ecology and resource management. Desirable electives include economics, forestry, hydrology, agronomy, wildlife, animal husbandry, computer science, and recreation.

Very few colleges and universities offer degrees in soil conservation. Most soil conservationists have degrees in environmental studies, agronomy, general agriculture, hydrology, or crop or soil science; a few have degrees in related fields such as wildlife biology, forestry, and range management. Programs of study usually include

30 semester hours in natural resources or agriculture, including at least 3 hours in soil science.

In addition to meeting the demands of forestry and conservation research and analysis, foresters and conservation scientists generally must enjoy working outdoors, be physically hardy, and be willing to move to where the jobs are. They also must work well with people and have good communications skills.

Recent forestry and range management graduates usually work under the supervision of experienced foresters or range managers. After gaining experience, they may advance to more responsible positions. In the Federal Government, most entry-level foresters work in forest resource management. An experienced Federal forester may supervise a ranger district, and may advance to forest supervisor, to regional forester, or to a top administrative position in the national headquarters. In private industry, foresters start by learning the practical and administrative aspects of the business and acquiring comprehensive technical training. They are then introduced to contract writing, timber harvesting, and decisionmaking. Some foresters work their way up to top managerial positions within their companies. Foresters in management usually leave the field-work behind, spending more of their time in an office, working with teams to develop management plans and supervising others. After gaining several years of experience, some foresters may become consulting foresters, working alone or with one or several partners. They contract with State or local governments, private landowners, private industry, or other forestry consulting groups.

Soil conservationists usually begin working within one county or conservation district and, with experience, may advance to the area, State, regional, or national level. Also, soil conservationists can transfer to related occupations such as farm or ranch management advisor or land appraiser.

Job Outlook

Employment of conservation scientists and foresters is expected to grow more slowly than the average for all occupations through 2010. Growth should be strongest in State and local governments and in research and testing services, where demand will be spurred by a continuing emphasis on environmental protection and responsible land management. Job opportunities are expected to be best for soil conservationists and other conservation scientists as government regulations, such as those regarding the management of stormwater and coastlines, have created demand for persons knowledgeable about runoff and erosion on farms and in cities and suburbs. Soil and water quality experts also will be needed as States attempt to improve water quality by preventing pollution by agricultural producers and industrial plants.

Fewer opportunities for conservation scientists and foresters are expected in the Federal Government, partly due to budgetary constraints. Also, Federal land management agencies, such as the Forest Service, have de-emphasized their timber programs and increasingly focused on wildlife, recreation, and sustaining ecosystems, thereby increasing demand for other life and social scientists relative to foresters. However, a large number of foresters are expected to retire or leave the Government for other reasons, resulting in many job openings between 2000 and 2010. In addition, a small number of new jobs will result from the need for range and soil conservationists to provide technical assistance to owners of grazing land through the Natural Resource Conservation Service.

Reductions in timber harvesting on public lands, most of which are located in the Northwest and California, also will dampen job growth for private industry foresters in these regions. Opportunities will be better for foresters in the Southeast, where much forested land is privately owned. Rising demand for timber on private lands will increase the need for forest management plans that maximize

production while sustaining the ecosystem for future growth. Salaried foresters working for private industry—such as paper companies, sawmills, and pulp wood mills—and consulting foresters will be needed to provide technical assistance and management plans to landowners.

Research and testing firms have increased their hiring of conservation scientists and foresters in recent years in response to demand for professionals to prepare environmental impact statements and erosion and sediment control plans, monitor water quality near logging sites, and advise on tree harvesting practices required by Federal, State, or local regulations. Hiring in these firms should continue during the 2000-10 period, though at a slower rate than over the last 10 years.

Earnings

Median annual earnings of conservation scientists in 2000 were \$47,140. The middle 50 percent earned between \$37,610 and \$56,040. The lowest 10 percent earned less than \$30,240, and the highest 10 percent earned more than \$68,300.

Median annual earnings of foresters in 2000 were \$43,640. The middle 50 percent earned between \$34,760 and \$53,740. The lowest 10 percent earned less than \$27,330, and the highest 10 percent earned more than \$65,960.

In 2001, most bachelor's degree graduates entering the Federal Government as foresters, range managers, or soil conservationists started at \$23,776 or \$30,035, depending on academic achievement. Those with a master's degree could start at \$30,035 or \$42,783. Holders of doctorates could start at \$52,162 or, in research positions, at \$61,451. Beginning salaries were slightly higher in selected areas where the prevailing local pay level was higher. In 2001, the average Federal salary for foresters in nonsupervisory, supervisory, and managerial positions was \$55,006; for soil conservationists, \$53,591; for rangeland managers, \$50,715, and for forest products technologists, \$71,572. According to the National Association of Colleges and Employers, graduates with a bachelor's degree in conservation and renewable natural resources received an average starting salary offer of \$28,571 in 2001.

In private industry, starting salaries for students with a bachelor's degree were comparable with starting salaries in the Federal Government, but starting salaries in State and local governments were usually lower.

Conservation scientists and foresters who work for Federal, State, and local governments and large private firms generally receive more generous benefits than do those working for smaller firms.

Related Occupations

Conservation scientists and foresters manage, develop, and protect natural resources. Other workers with similar responsibilities include agricultural engineers; environmental engineers; agricultural and food scientists; biological scientists; environmental scientists and geoscientists; and farmers, ranchers, and agricultural managers.

Sources of Additional Information

For information about the forestry profession and lists of schools offering education in forestry, send a self-addressed, stamped business envelope to:

► Society of American Foresters, 5400 Grosvenor Lane, Bethesda, MD 20814. Internet: <http://www.safnet.org>

For information about career opportunities in forestry in the Federal Government, contact:

► Chief, U.S. Forest Service, U.S. Department of Agriculture, P.O. Box 96090, Washington, DC 20090-6090. Internet: <http://www.fs.fed.us>

Information about a career as a range manager, as well as a list of schools offering training, is available from:

► Society for Range Management, 445 Union Blvd., Suite 230, Lakewood, CO 80228-1259. Internet: <http://srm.org>