

## Science and Culture in a Curriculum for Tribal Environmental Management: The TENRM Program at the Northwest Indian College

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This paper discusses an innovative, interdisciplinary two-year environmental studies program funded by the National Science Foundation (NSF).<sup>1</sup> The authors describe the program—its origins, foundation principles, curriculum, assessment, and recruitment—discuss student participation and achievements, and summarize the long-term prospects of the program. This article was prepared during the program's second NSF-funding cycle.

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The program, titled Tribal Environmental and Natural Resources Management (TENRM), began in the fall of 1998 at the Northwest Indian College located on the Lummi Indian Reservation near Bellingham, Washington. Its second funding cycle ends in 2003. The grants for the program are awarded through the Advanced Technological Education Program of the National Science Foundation. The grants fund administrative and faculty salaries, field trips, faculty training in learning community, pedagogy and attendance at conferences, guest lecturers, annual evaluations of the program, and some teaching-aid equipment.

#### THE ORIGINS OF TENRM

The TENRM program began as a response to the great need for technical and interdisciplinary training for Native Americans. This need is reflected in the lack of Native American personnel in tribal fisheries and natural resources programs. In the Pacific Northwest's Puget Sound region, for example, there are twenty-two tribes, each with three to twelve biologists. None of these specialists is Native American. Higher education and job-training programs are desperately needed, as rates of unemployment continue to rise, often exceeding 50 percent within communities.

The federal Indian Self-Determination and Educational Assistance Act of 1975 (25 USC 450 et seq.) authorizes Indian tribes to assume control over the operation of many programs and spend the same federal funds the agencies would otherwise use. The Lummi Indian Nation, for one, has gone through the self-governance review and self-assessment management process, and now operates many of its programs with funds disbursed directly to the tribe rather than through the Bureau of Indian Affairs, the Indian Health Service, and other agencies. The 1975 law also gives tribes opportunities to rank environmental management of water, air, land, and biotic entities in budget and management plans. The Indian Mineral Development Act of 1982 (25 USC Secs. 2101-8) provides federal assistance to Indian tribes in developing and marketing mineral resources, another advance in Indian control over tribal resources. Of great recent importance to tribes is the 1988 Gaming Regulatory Act (25 USC 2701 et seq.), which establishes a comprehensive scheme for gaming, including high-stakes bingo, on Indian lands. This law has resulted in financial gains for many tribes with surplus funds used for environmental management.

These laws and the requirements of some federal environmental statutes, such as the Clean Water Act and The Comprehensive Environmental Response, Compensation, and Liability Act (Superfund), have resulted in the need for trained tribal members to manage environmental and resources programs. For example, Section 301 of the Clean Water Act provides funds for tribes to protect water resources from contamination. As a consequence of this provision of the Clean Water Act, many tribes have established water resources divisions in their planning or natural resources departments. Also, the US Environmental Protection Agency established a policy for the administration of environmental programs on Indian reservations, which calls for

working with tribes on a government-to-government basis, recognizing tribes as the primary authority on environmental matters, assisting tribes with cooperative programs with states and local governments, and according tribes legal authority on par with states in environmental regulation.

These added jurisdictional responsibilities have prompted tribes to become all the more mindful of the meager technical training available in environmental studies such as terrestrial and marine ecology; regulation; land use; Indian environmental history; and the chemistry of pollutants in air, water, and land. Tribes are often dependent on the knowledge, perspectives, and interests of non-Natives to look out for their interests.

A small proportion of these specialists are tribal employees; others are part-time or full-time consultants. Many of these technicians and professionals hold the view that the only viable model of economic development is that of the free-market economy, a position often in conflict with many tribal precepts and long-held beliefs. Some of the tribal lands and waters have been logged and fished beyond their capacity to restock naturally, and streams, marine waters, and lands maybe polluted.

Tribes are in a dilemma: their dependence on non-Native expertise is often frustrating and clouded in the mystique of Western science and technology, which purports to provide solutions based on "exact" scientific knowledge that often hides political assumptions and agendas. At the same time, a growing number of young Native Americans desire undergraduate and graduate education as their exposure to knowledge of environmental issues and processes increases in the computer age.

There are several other Indian colleges besides Northwest Indian College (NWIC) with natural resources curricula designed for Indian people: D-Q University at Davis, California; College of Menominee Nation in Keshena, Wisconsin; and Haskell Indian Nations University in Lawrence, Kansas. Northern Arizona University in Flagstaff, Arizona, and Humboldt State University in Arcata, California offer four-year natural resources programs for Indian people.

Several years ago, the California Indian Forest and Fire Management Council, a consortium of fourteen tribes, and the Bureau of Indian Affairs (BIA), Sacramento Area Office, Forestry Branch saw the need for education in natural resources and identified it as an important goal. Acting on this need, the BIA office in Sacramento in 1994 executed a contract between its Forestry Branch and the University of California, Cooperative Extension. The object of the contract was to develop a curriculum for ecosystem science and management for Indians in natural resources management.<sup>2</sup> One of the goals of the curriculum was to integrate Indian ecological knowledge, a goal similar to that of the TENRM program at NWIC.

The NWIC is one of thirty-three tribal colleges in the United States. The college awards associate of arts and sciences and associate of technical arts degrees. Most tribal colleges have not developed closely allied curricula with universities, although this is changing. A case in point is the TENRM program, which is designed to give students experience and background to either graduate as technical experts or to transfer to a four-year university or college environmental studies program.

Recognizing that Native Americans have been educationally underserved and have the lowest representation in the sciences of all ethnic groups in the United States, and that tribal governments are assuming broader responsibilities in resources management, the major purpose of the NSF grants is to improve training for Native Americans, especially in resource science and management. NSF provides most of the funds for TENRM, including funds for equipment, internships, and a college recruiter. NSF grants for the TENRM program have run a total of five years, with the first grant covering the curriculum years of 1998 to 2000, and the second from 2001 to 2003. By 2003, NSF and NWIC will have supported three full cohorts of TENRM students for their two-year associate of arts and sciences degree.

To insure that the curriculum would be useful and pertinent to tribes, the first director of TENRM first conducted a needs assessment. He studied environmental and resources curricula that were available to Indian students. He also used data from a questionnaire he prepared and administered to eighty environmental professionals who worked for or with tribes and who had attended a 1997 conference in Anchorage, Alaska, sponsored by the US Environmental Protection Agency. The questionnaire was administered to learn more about the kinds of background and training students should have to work in tribal, federal, and state environmental and natural resources management agencies.<sup>3</sup>

The TENRM curriculum is coordinated with Huxley College of the Environment's two-year, upper-division, undergraduate program at Western Washington University in Bellingham, Washington, Fairhaven College, a four-year liberal arts college also at Western Washington University, and the Evergreen State College in Olympia, Washington, another four-year liberal arts college. Students who complete the TENRM program are qualified for entry into four-year college and university degree programs in the physical and social sciences. The TENRM program has formal partnerships with the Lummi nation, the US Environmental Protection Agency, the US Forest Service, the US Department of Energy, and the Partnership for Environmental Technology Education. An advisory board for TENRM meets semiannually. It is composed of nine members: two members from the Lummi Indian Business Council, the two deans from Huxley College and Fairhaven College, a professor from the Evergreen State College, a representative from the Washington Center for Improving the Quality of Undergraduate Education (an innovative educational organization at the Evergreen State College), one retired professor who was a former provost at Cornell University, and two Native American officials from federal agencies (the US Environmental Protection Agency and the US Forest Service).

The first-year students are a cohort, a group of students who enroll in and attend concurrent classes during the two-year TENRM program. Students who need to leave the program temporarily can reenter the program either by joining their own cohort or a subsequent cohort.<sup>4</sup> Upon completion of their program, they receive an associate of arts and sciences degree, which will qualify them to work as technical staff for their tribes or to transfer into four-year environmental studies, or, with additional work, environmental science and other degree programs. The first cohort, which began in 1998, was com-

prised of nineteen students. Students represented ten tribes in Washington, Alaska, California, and New York. The second cohort consists of twelve students and represents ten tribes in five states. One of these students is Afro-American. The program is open to students of all backgrounds and cultures, but its focus is on Native Americans.

#### FOUNDATION PRINCIPLES<sup>5</sup>

The entire TENRM program is built on a foundation of three fundamental principles. These principles have guided every stage of the design of the program and the changes made to adapt it to the experience gained.

##### **First Principle: Co-articulation of Tribal and Western Knowledge**

The program aims to assist students to co-articulate the knowledge and the perspectives of both tribal and non-tribal science. The validity of each is respected, and the differences and similarities between them are recognized. Tribal natural resources managers and environmental specialists need both realms of knowledge and science, and the TENRM program is designed to provide the necessary knowledge of Western science, within the context of tribal culture and knowledge. It also is intended to broaden students' tribal cultural knowledge with speakers and academic materials in Indian and Alaska Native science and resources management fields.

##### **Second Principle: Non-Abandonment Policy**

From the beginning, a basic TENRM working policy and philosophy has been that all students enrolled in the program are strongly supported to continue with the program. However, through the first program academic year, the faculty struggled with attendance and varying performance levels of students (familiar issues at other academic institutions, as well), and how to deal with students who were struggling academically while still being fair to students doing well. Late in the first year, the faculty adopted an explicit policy—and underlying philosophy—of non-abandonment.

The policy means, basically, that the faculty and administration will do everything they reasonably can to support students in completing the program. The faculty and administration will not abandon students. The policy does not mean that standards will be lowered for students who are struggling. It means, rather, that the program will not take any formal action to remove them from the program if the students fail to attend class or complete their course credits on schedule. They will be welcomed back to class and assisted to complete missed work. The non-abandonment policy is consistent with an overall philosophy of non-coercion, and internal- and community-based loci of motivation. As external evaluator Joan LaFrance has written,

[the policy] emerged from the recognition that students at NWIC lead complicated lives. This was not news to the faculty based at

NWIC. However, the cohort approach had allowed the faculty to form a sense of community with students in ways that had not happened when teaching regular courses. This contact contributed to developing a fuller understanding of the barriers to learning in the lives of many students. Through the depth of contact created in the learning community, faculty became more aware of the barriers and challenges reservation students encounter navigating everyday life. Perhaps this awareness influenced the decision to reject more bureaucratic approaches to attendance policies in favor of the 'non-abandonment' philosophy.<sup>6</sup>

### **Third Principle: Developmental Education**

To succeed with its basic mission of preparing Indian and Alaska Native students for tribal natural resources management and environmental work, the program must build from the starting point of incoming students' level of knowledge and preparation. Academic skills among beginning students are generally weak, and much of the first quarter must be devoted to strengthening computational and writing skills.

However, students also often bring personal experience of natural resources work environments, which helps provide a base on which to build and develop a higher level of education. Students may be weak in standard academic skills, but their practical experience is often a strength in their learning. Their experience also supports the program's overall purpose of co-articulating tribal and Western knowledge.

### **THE CURRICULUM<sup>7</sup>**

After conducting extensive research on environmental curricula for Indian students, the six core faculty members of TENRM prepared the following eight curriculum goals: (1) understand Native American cultures, beliefs, values, knowledge, histories, treaties, and governments in resources management and environmental protection (Native American elders and Native American scholars would assist in teaching these subjects); (2) understand resource management techniques and environmental processes, measurement, and impact assessment, mitigation, and restoration; (3) understand the relationships among tribes, the federal government, states, and counties in resources management and protection; (4) use a flexible curriculum with interdisciplinary team-teaching, field trips and visits, student team projects, and guest speakers; (5) study the processes involved in the functions of ecosystems; (6) understand major environmental federal, state, county, and tribal policies, laws, and regulations; (7) provide a curriculum that accommodates changes in teaching and learning techniques as deemed necessary by administrators, faculty, students, and staff; and (8) tutor students as frequently as possible to foster maximum student and faculty interaction, and to facilitate learning. The curriculum is unique in several respects. It is thematic, interdisci-

plinary, and team-taught. It emphasizes group learning, team projects, peer assistance and camaraderie, and group seminars, field trips, and internships.

Five theoretical assumptions guide the design and delivery of the TENRM program. The first is that an interdisciplinary curriculum most closely reflects Native American teaching and learning. Thus, the six-quarter TENRM program is based on the premise that tribal environmental management is multidisciplinary. An integrated program of core courses combines the content of natural sciences, political science, public policy, and management with cultural experience and support. For example, in addition to learning about biology, students learn how life sciences relate to Indian culture, mathematics, physical sciences, and the environment.

The second theoretical assumption is based on Native values with an emphasis on the interdependence of individuals across the community of learners. Students, as well as faculty, enter the program as a cohort, working closely to support each other as learners and achieve an identity as a community. Experts have identified traits common to a successful community regardless of size, purpose, and scope of a group—interdependency, informality, traditions, celebration, coming together after tragedy, embracing the spiritual, modeling and teaching character and moral education, taking responsibility, and identifying group members who can act as guides or problem solvers. The TENRM program includes all these traits to some extent.

The third theoretical assumption is predicated on Native values and learning styles and the integration of Native American tribal, cultural, historical, and political interests and experiences into each of the core classes. The relational core curriculum corresponds to indigenous philosophies that focus on active connections within the natural world rather than separate compartments of knowledge.

The fourth assumption relates explicitly to cultural lenses. Students are encouraged to develop their own cultural lenses to assess curriculum content and relevant issues in various fields of study, and in so doing practice personal and tribal self-determination.

The fifth and final assumption involves the interinstitutional working relationship between NWIC and Western Washington University. This relationship eases students into a four-year curriculum with close support from the university.

The theoretical assumptions and the implementation of them in the TENRM program have three desired results for students and faculty: to develop critical and integrative skills, to be a people, and to provide tribal people with basic skills to manage and preserve their cultural and natural resources. Auxiliary goals are to maintain academic standards and ensure retention of students; to help them make connections between Indian ideas about nature and the place of humans in it; and to understand the epistemological differences between Western sciences and Native American knowledge of nature.

Initially, six core faculty<sup>8</sup> were involved in planning the curriculum, four of whom were full-time faculty at the Northwest Indian College. One of these was a biologist, one a chemist, the third a mathematician and computer specialist, and the fourth, a Lummi nation member, an anthropologist and

Lummi cultural specialist. The other two faculty members were professors of environmental physical and social sciences at Huxley College of the Environment, Western Washington University. These six faculty worked during 1997–1998 developing the curriculum, attending workshops on learning communities, and studying curriculum of other Native American programs in resources management.

The staff conducted recruitment campaigns in local high schools and community colleges in Washington, Alaska, Oregon, and Idaho until September 1998. With only about ten students committed to the program as late as early September, the TENRM staff and faculty decided a crash recruitment program was needed. They and several persons hired to assist them set up two recruitment tables on the Lummi Reservation at grocery stores where most of the on-reservation Lummi and other Native Americans shop. This effort went on for several days. The effort proved fruitful with an additional thirteen initially registered for the program—ultimately the initial cohort would number nineteen.

In planning the curriculum, it was difficult for the faculty, despite their extensive experience with Indian communities, to decide on the meaning of Native American content and perspective. One of the faculty—a Lummi person, born and raised on the Lummi Indian Reservation and a full-time faculty member at NWIC with a master of arts degree in anthropology from Western Washington University—methodically, patiently, and eloquently spoke of the ideas and philosophy she thought would serve the program well. She, in effect, provided much of the cultural content of the two-year, six-quarter program.

The program consists of six multiredit blocks with at least ten credits of integrated theme-based material. Thus, each quarter is organized around a theme or environmental resource—To Be the Eagle's View, Water, Land, Ocean, Finding a Balance, and Project.<sup>9</sup> The last two quarters, Finding a Balance and Project, provide capstone experiences in the form of group project work and extended field trips. Faculty coordinators conduct weekly seminars with students to review the curriculum and afford opportunities for students to talk about the subjects and draw parallels between the separate disciplines.

The Native American historical and cultural instruction is given in a less didactic fashion than one expects from typical academic disciplines. Subtle connections and meanings are drawn in a circular way, with each subject revisited as new ones are brought up so that students gradually begin to see the worldview of the Pacific Northwest and Native people.

Faculty coordinators and teachers are paired to maximize interdisciplinary teaching and learning. Sixty of the ninety credits required for the associate of arts and sciences degree are taken as a cohort and are provided by team-taught, interdisciplinary classes; the remaining thirty credits consist of separate NWIC classes.

Much of the curriculum relates to Indian governments and resources, although federal, state, and local governments also are covered. These governments are studied for their structure, powers, and influence on Native American polities.

TENRM also encourages the perspective of examining mainstream and Native science for similarities and differences. The rationale for this is the



view that major changes in science are highlighting, and converging with, indigenous ways of understanding the structure and function of the universe. Traditional indigenous knowledge, or Native science, which recognizes the intimate relationship among all things, has always taken a holistic healing approach to environmental problems. Western scientists are looking in this new direction to address environmental problems.

This positive trend is not limited to environmental science. There also is a general shift from a science of specialization that reduces facts into seemingly unrelated parcels to a science that recognizes the more realistic complex adaptive systems and subsystems of knowledge practiced by people long before the arrival of Europeans to the Western Hemisphere. Scientists are merging traditional disciplines, such as biology, ecology, chemistry, biochemistry, molecular genetics, geology, primatology, mathematics, and physics into "meta" domains of understanding to develop a more realistic description of the universe. One compelling example is the frame shift from "geology" to Earth System Science, which views the earth as a single interacting system. This emerging complexity provides the base upon which science education in Indian Country should be built, just as science education will be built elsewhere by those at the leading edge of change.

### **The Two-Year Curriculum**

The Native American instructors and visiting scholars who visit the program play a decisive role in ensuring that Native points of view are established in the curriculum. In the first quarter, complex systems theory is used to introduce systemic understanding and holistic approaches to earth sciences. Students who need assistance in mathematics and English are tutored by some of the NWIC staff and others hired to supplement the project curriculum. The NSF grants provide funds for hiring experts in geology and microeconomics. These specialists assist with curriculum development and give some of the lectures, and in certain cases teach a segment of a given quarter. Students also take classes in successful learning and studying. All six core faculty meet each week to discuss the program to try to ensure its high quality and to strengthen student retention.

Throughout the two academic years of a cohort, students and faculty regularly take field trips to observe and receive instruction on: fish hatchery management; cultural resources management programs; tribal, federal, state, county, and municipal government natural resources management programs; management of water supplies; watersheds; wetlands; agricultural land; fisheries, forests, and wildlife; endangered and threatened species; and industrial pollution control. Each field experience is supplemented with class lectures and exercises. Trips are taken to the Lummi nation's fish hatcheries. Students also visit Arlecho Creek in the Nooksack River watershed where the Lummi nation has a stand of old-growth evergreens set aside for ceremonial and other cultural purposes. Field visits (as opposed to more academic field trips) also are taken to Semiahmoo Spit on the shores of the Puget Sound, a sacred place of great cultural significance to the Lummi nation.

Integrative seminars are conducted during weeks when there are no field trips. These give students opportunities to analyze the course material, to test their logic and degree of comprehension, to question the faculty on the accuracy of information and the ways class materials are presented, and to emphasize knowledge and principles. The seminars are conducted by the faculty responsible for the quarter's curriculum, and allow the faculty to exchange ideas with the students regarding teaching and learning in the program.

Some quarters, students keep journals to explore Native American concepts and worldviews, make connections and recognize differences between Indian worldviews and Western sciences, allow for interpretation between readings and lectures, and record student progress in understanding concepts and processes. These journals are edited and commented on by the faculty. The journals are a primary means of integrating knowledge and concepts.

In subsequent quarters, emphasis is placed on the cultural and economic importance of particular natural resources, such as water. Faculty relate Indian myths to explain how water is conceived in the origin of the cosmos and living beings; the connections between freshwater and ocean systems; the hydrological cycle; aquatic systems (lakes, rivers, wetlands); and analysis of water quality. This quarter also introduces Indian treaties with the United States government; environmental laws and regulations; tribal, federal, state, county, and municipal jurisdictions; and water rights. Students begin working in teams to study conflicts over water rights, applying principles of mathematics and ecology to wastewater treatment and analysis. They also take humanities and other technical courses outside of TENRM classes.

The last quarter of the first year focuses on the cultural and economic importance of land; the role and applications of treaties and Indian sovereignty in land rights and land use; and the effects of land use on soils, landforms, terrestrial life forms, and human settlements. Students study and apply some aspects of forestry, agriculture, microeconomics, geology, mapping, remote sensing, Global Positioning Systems, and Geographical Information Systems to the circumstances of the Pacific Northwest Indian tribes. These activities satisfy requirements for mathematics, political science, and geography.

The first quarter of the second year focuses on the role of the Pacific Ocean in aboriginal and contemporary Indian life, laws, traits, and histories; the ocean's biological, chemical, and shoreline processes; and contemporary human impacts on ocean resources. Students also take three credits of microeconomics for their general college and university requirements. The faculty supplement the standard microeconomics course with subjects specific to tribal governmental economics: quantitative and inflation-adjusted estimates of values and prices of Indian resources such as timber, fish, hard-rock minerals, land, water, and others; cost of equipment and staffing resources departments, such as information machines, software, furnishings, wages, benefits, training, conferences, workshops, and other costs; federal and tribal budgeting processes, and budget proposals; congressional allocations; demographic effects on resource demands; corporate-tribal joint ventures in resources use; tribal investments and investment portfolios; role of taxes (value-added,

excise, and others) in resources planning; household budgeting; and, leases, sales, rents, and bonuses in resources contracts.

In political science, which comprises three credits, course material covers subjects that are additions to the general requirements for political science in the associate of arts and sciences degree program. The faculty, and guest speakers from tribal departments, and state and county agencies, provide training and knowledge in how tribal, federal, state, county, and municipal laws, codes, ordinances, and regulations are established; ways to monitor regulatory performance; the relationship between statutes and regulations and codes; ways in which statutes, regulations, codes, ordinances, and resolutions are amended; the connections among tribal, federal, state, county, and municipal governments in budgeting, law enforcement, game management, and other activities and resources; the use of memoranda of agreement, memoranda of understanding, concurrent jurisdiction, cross-deputizing, cooperative agreements (such as the Timber, Fish and Wildlife Agreement in Washington State), joint councils and commissions, and scientific and other professional organizations; unique tribal opportunities and problems in resources management; the structure, function, and processes in tribal government operations; and the history of the relationships between tribes and the federal government. Students continue to study chemistry, keep journals, and use computers to model fisheries.

The last two quarters focus on application of knowledge, processes, techniques, and concepts. The fifth quarter, "Making Connections, Finding a Balance," focuses on: understanding the connections between cultural values and expectations, economic development, and environmental protection; knowing the types of information needed and steps required to do an environmental analysis; learning to prepare and defend a project proposal; and learning how to work in teams. Students are taught technical and grant writing, argumentation, economic and watershed analysis, budgeting, environmental impact analysis, and statistics.

In the sixth and final quarter, "Project: Bringing It All Together," students apply their knowledge to the project proposed in the previous quarter. They work in teams, prepare resumes, apply for positions on the teams, and prepare cover letters expressing their motivation and interest in the projects and noting their qualifications. Since teamwork is common in environmental professions because of the need for interdisciplinary approaches to environmental issues, it also is an important part of the TENRM program. Several students comprise each team and each team conceives a project and conducts a public meeting for personnel in the Lummi nation's resources and planning departments and other interested parties, presenting their findings and making recommendations to reduce and avoid adverse environmental and social effects of proposed and existing actions. Students defend their recommendations logically, factually, and on the basis of their feasibility. Each team receives a summary grade for team performance and about half of each student's grade is based on a written report.

The projects help prepare students for further higher education and employment. The faculty realize that students learn technical skills with

greater facility and interest if they apply them to tangible local issues based on field studies, field observations, and collaboration with persons, professional and otherwise, who work directly on the issues. The student projects further satisfy credits in speech, English, and statistics.

Further, the students have opportunities to work as interns with tribal or other governments, private companies, or nonprofit organizations, to enhance their education and improve their knowledge of on-the-job work. Although acquiring technical skills is fundamentally important in environmental management, the faculty recognizes that it is as important that the students should be able to ask the right questions and suggest integrative solutions to specific problems. Thus, paid internships are available during the summer for academic credits with tribes, federal agencies, and other institutions. Students have served as interns with the Washington State Department of Ecology, Montana State University, the US National Aeronautics and Space Administration, the Nooksack Salmon Enhancement Associations in Whatcom County, the Native American Fish and Wildlife Society, the University of Washington, the Lummi Indian Business Council, and the Lummi Department of Natural Resources.

Student interns are supervised while performing challenging work, contributing to the host organizations, and preparing a report helpful to their employer and the community, as well as reporting on their work in a seminar in the first week of fall quarter. The report is part of each student's credentials for further academic advancement, other internships, and jobs. The internships are tied to university internship programs throughout the country. Several students have been hired by the organizations for which they served as interns. For example, a student who worked for the Lummi nation's Natural Resources Department is now a full-time employee of the Planning Department, with time off for completion of a bachelor of arts degree in environmental planning at Western Washington University. A second TENRM student served as an intern for the Lummi nation's Cultural Resources Department and is now employed full-time by the department with allowance for time to complete a bachelor of arts degree in environmental policy at Western Washington University.

TENRM guest speakers include Native American lawyers, federal agency employees, tribal officials, scholars, and educators. They also provide a focal point for all college and Lummi High School forums. Their presentations and seminars have served as major intellectual activities at NWIC since the beginning of TENRM. They provide student, staff, faculty, and others in the Lummi community the opportunity to discuss diverse subjects. These important topics include, among others: the similarities and differences between Native American forms of knowledge and science, and Western science; the rights of Native and non-Native peoples on Indian reservations; the evolution of policies of the US Forest Service on land management and forests; the regulatory work conducted by the National Marine Fisheries Service on the protection of endangered species of salmonid; and Native American traditional knowledge and ecological restoration techniques. Elder Native Americans from the Lummi reservations speak on Native American languages, botany, spiritual beliefs, and history.

Several noted scholars have been guest speakers: Gregory Cajete, author of several books on American Indian knowledge and science; Leroy Little Bear, former dean of the Native American Indian Studies Program at Harvard University; Daniel Wildcat, co-director of the Haskell Environmental Research Studies program; Robin Kimerer, botanist (traditional sustainable harvest practices), Cornell University; Ray Pierotti, University of Kansas and Haskell Indian Nations University; Simon Levin, biologist, Princeton University; Peter Kareiva, National Marine Fisheries Service, Salmon Recovery Team, Seattle, Washington; and Susan Williams, attorney, Lummi nation.

#### ASSESSMENT

In a learning environment such as TENRM, it is difficult to use traditional means of assessment since students may be absent for extended periods of time due to personal or family needs, cultural traditions, or school service functions.

Students may, in fact, only complete partial credit for coursework. Further, it may take them substantially more than two years to finish the program. For these reasons, the faculty has eliminated punitive measures for low attendance and late work (i.e., lowering the grade), and, instead, encouraged community support for completion of competencies and coherence within the community. This is in line with a primary goal of the program: "to be a people."

To put this approach into operation, two changes in student assessment are required: first, giving up the usual obsession with seat time (attendance) in favor of assessing proficiencies gained by completing work within and outside the classroom; and, second, being more creative in measuring the student's performance—for example, calculating a student's grade point average on the basis of credits completed rather than credits attempted.

How is such proficiency to be measured and assessed? What the students have learned can be (and was) measured by conventional testing—in written and oral formats, specific and comprehensive, and on a regular basis, as well as by observing how the students work together and how they teach each other complex material.

This approach emphasizes practical learning and proficiency and gives less importance to precisely measurable outcomes, and thus represents one difference between TENRM and many Euro-American models of education. The TENRM program emphasizes practical competency—an ability to synthesize and to solve complex real-world problems. Important measures of success in our program included whether or not the student: stayed grounded in cultural values; maintained self-respect and a healthy sense of self within the context of community throughout the program; was able to use critical and integrative abilities to problem solve and imagine creative solutions; and made substantial improvement in writing, reading comprehension, speaking, and computational abilities. Finally, because students differ greatly in their backgrounds and interests, it also is necessary to individualize the yardstick of measurement for each student.

### RECRUITMENT

In Indian Country, student recruitment is often the most challenging task in the development of a postsecondary degree program. To recruit students, college faculty and staff attended events at Lummi and other reservations, including powwows.<sup>10</sup> The college's program brochure was mailed to various tribes and schools. It advertises an integrated curriculum and collaborative learning, two approaches that are appropriate to Native American learning styles. The publication also emphasizes hands-on learning, a strong tribal orientation, and real-world experiences in field trips, projects, and internships. The NWIC also has a website for TENRM recruitment, which was developed for the second cohort.

Although staff sent recruiting material to prospective Indian students and advertised the program through radio and tribal and other newspapers, the most effective method was, and continues to be, word of mouth. The most rewarding and effective activity was one in which staff set up a table with brochures and application packets in two local Lummi Indian Reservation general stores. Community members, trained by program managers to talk about the program and the opportunities it presented, were given small stipends for their efforts. After only three days, this approach resulted in a dramatic increase in applicants. This technique also was used for the recruitment of the second cohort of students in late summer 2000.

### EVALUATION

A Native American professional curriculum program evaluator has prepared assessments of TENRM annually since 1999. The evaluator assesses, among other things, student performance and retention, and compiles student evaluations of the development of the program.<sup>11</sup>

A variety of personal circumstances can make staying in college difficult for students, such as family responsibilities, legal and financial problems, chemical dependencies, domestic abuse, lack of self-confidence, and coming to terms with one's place in American society as a Native American. Also, two students in the first cohort passed away. For these and other reasons, retention in many Native American educational programs often is low. To counter this, faculty and staff placed greater emphasis on preparedness in recruiting the second cohort and for this reason, and others, the retention rates improved. A Native American retention specialist and faculty member joined the program in the spring of 2000, to good effect.

A simple measure of student retention is the number of students who enroll and complete each quarter. Nineteen students enrolled in the first quarter of the first TENRM program in fall 1998.<sup>12</sup> Ten (53 percent) still were enrolled in the last quarter of their two-year program, most of whom were older students, married with children. Six of these ten received their diplomas from NWIC, and all six entered a university (five at Western Washington University and one at the University of Washington in Seattle). Four received full scholarships (The David and Lucile Packard Foundation and Morris K. Udall) to Huxley College of the Environment, and one received a Gates Millennium Scholarship for academic work for the completion of a doctorate

at the University of Washington. Two of the remaining ten were working toward completion of their associate of arts in sciences degree a year later.

In the second cohort's first quarter (fall 2000), eleven students enrolled, thirteen enrolled for the second quarter, and ten enrolled for the third quarter. One of the students who left between the second and third quarter had severe health problems; when these are addressed, he may return to the program. The other students who failed to complete the third quarter are young males, one of whom was initially a member of the first TENRM cohort. The retention rate in the first year of the second cohort was 77 percent based on the figure that ten of the thirteen recruits enrolled in the first two quarters, compared with roughly half of the first cohort after their first year. Thus, most students who initially enrolled were still active in the program at the end of the first instructional year. Of the active students, 90 percent had completed more than half of the required credits in the first year. During the summer of the second year, six students finished incomplete work.<sup>13</sup>

The first cohort of students gave high ratings to the integrated curriculum, team-teaching, and cohort structure. They cited many specific experiences and aspects of the program of particular value to them such as mastering some computer programs; feeling a sense of unity among the variety of students in the cohort; being instructed one-on-one; becoming self-confident; gaining hands-on experiences in projects and field work; and improving their writing skills. The pace of the program and the challenge of integrating subjects frustrated some of the students. Students offered several recommendations for improving TENRM, particularly in assistance with financial aid and making the program more coherent. These recommendations were followed by the faculty and staff and applied to the second cohort.

### PROSPECTS

In terms of long-term prospects, two of the goals of the second cycle of funding were to adapt and expand the TENRM program to include a yearly cohort and to build toward program sustainability through increased college funding and external partnerships. The TENRM faculty and staff will continue to work with tribal colleges, universities, governmental agencies, and other organizations to assist them in infusing tribal knowledge and perspectives into mainstream science. In this way, the TENRM faculty hopes the project will make a long-term significant contribution to Indian and conventional education. To this end, the faculty prepared a curriculum guide (available at <http://www.nwic.edu/tenrm>) and video (available from NWIC) on the program for wide distribution and to further accomplish program goals.

Institutionalization of the TENRM approach at Northwest Indian College was built into the effort from its inception. Initially, the new curriculum was to be offered only at the main campus, but plans are underway to broaden the offerings through distance learning and at remote sites. Although the cohort approach to teaching and learning is very time-consuming for faculty, the college is looking toward applying it and the team-teaching approach in other courses not presently part of the TENRM program. In an effort to create a

self-sustaining program, the college is seeking additional partnership agreements. Already funding has been secured for a five-year initiative to establish learning communities in all programs at the college.

#### SUMMARY

This paper has described the need for more training in the environmental physical and social sciences for Native Americans. It also explains the origin, structure, content, implementation, and evaluation of an innovative, two-year college curriculum funded by the National Science Foundation in environmental resources management at the Northwest Indian College on the Lummi Indian Reservation near Bellingham, Washington, which operates under the name of the Tribal Environmental and Natural Resources Management (TENRM) program. The program is in the middle of a second NSF funding cycle, the first of which began in 1998. The NWIC faculty and staff expect to continue TENRM after 2003, when NSF funding ends, with additional external funding and in-house resources at Northwest Indian College. The students in TENRM are organized into two-year cohorts that maintain strong ties of identity, mutual support, and teamwork. TENRM emphasizes Native American ways of knowing, Indian identity, pride, and service to one's tribal community. Foundational principles include co-articulation of tribal and western knowledge, a non-abandonment policy, and developmental education.

The program is team taught, with extensive tutoring, a retention specialist, and a strong focus on helping students stay in the program. Students complete paid internships between their first and second years in the program. They also conduct applied projects on local environmental and resource issues at the end of their second year, close to the completion of their associate of arts in sciences degree. Thus they are prepared for entry into a tribal workforce or into a four-year baccalaureate program.

The program is strongly linked with various institutions through partnerships with the Lummi nation, several Washington State universities, and federal and state agencies, some of which also participate in an advisory board. Assessment focuses on the credits completed rather than attempted and on individualizing the yardstick of measurement for each student. Student retention is high compared with other Indian and community colleges. For the second cohort, two-thirds of the students who initially enrolled were still active in the program at the end of the first instructional year.

TENRM was about to begin educating its third cohort of students when this paper was in preparation. The prospects for the program are excellent as the TENRM model of learning, in whole or in part, is dispersed to other departments in NWIC, as well as other Indian and non-Indian colleges. These institutions can adopt all or parts of the model as has been disseminated in professional meetings, a curriculum guide, and video.



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### NOTES

1. National Science Foundation Nos. DUE-9752076 and DUE-0053303.
2. This curriculum is outlined in Richard R. Harris and Randi Cox, "Curriculum on Ecology and Natural Resource Management for Indian Natural Resource Workers." *American Indian Culture and Research Journal* 21, number 3 (1997): 33-48.
3. Dan Burns, "Northwest Indian College Environmental Technology Project Results of the Needs Survey" (Bellingham: Northwest Indian College, January 1998). On file, Office of the dean of science and mathematics, the Northwest Indian College.
4. Gigi Berardi, Dan Burns, Phil Duran, Roberto Gonzalez-Plaza, Sharon Kinley, Lynn Robbins, Ted Williams, and Wayne Woods, "Principles and Adaptation of the Tribal Environmental and Natural Resources Management (TENRM) Model for Tribal Colleges" (2001), 101. Copies are available from the Offices of the dean, science and mathematics division of Northwest Indian College and Huxley College of the Environment, Western Washington University; or, by visiting <<http://www.nwie.edu.term>>.
5. Ibid. This brief section is drawn from the TENRM curriculum guide.
6. Joan La France, "Final Evaluation Report—1999–2000 Program Year. Tribal Environmental and National Resources Management" (Bellingham, Washington: Northwest Indian College, 2000), 44. On file, Office of the dean of science and mathematics, the Northwest Indian College.
7. The curriculum also is based on the "learning community" model. This approach places students in a supportive cohort of peers that participate in the same classes and off-campus activities. The cohort model closely mirrors Indian community values and ideals, particularly in terms of sharing wealth (in this case, educational), for in Indian and Alaska Native communities, the individual works to honor those who have gone before her or him. The students attend welcoming activities two days before classes begin. They meet with the faculty, staff, students and administrators, and attend luncheons and a dinner with faculty, staff, and some of the members of the TENRM advisory committee. TENRM students are guided in community learning and consensus-building by a specialist in conflict resolution, a Pacific Northwest Native American woman hired as a contractor for TENRM, and a faculty member who is a specialist in student counseling.
8. Gigi Berardi, Dan Burns, Roberto Gonzalez-Plaza, Sharon Kinley, Lynn Robbins, and Ted Williams, "Principles and Adaptation of the Tribal Environmental and Natural Resources Management (TENRM) Model for Tribal Colleges."

9. Berardi, et al. "Principles and Adaption of TENRM."
10. Ibid.
11. La France, Joan. "Interim Evaluation—Program Year 2000–2001: Tribal Environmental and Natural Resources Management II, Northwest Indian College" (unpublished paper prepared for the National Science Foundation, American Indian Technology and Science program and the Northwest Indian College, Bellingham, Washington, Summer 2001).
12. One member of the first cohort died in winter of her second year in the program. She had had the highest grade point average in the class.
13. Ibid.