

# The REAL Team: A Cooperative Student Training Program in Rapid Ecological Assessment

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**B**iology educators increasingly recognize that students learn concepts most successfully through a combination of hands-on experience, cooperative problem solving, and independent study (Batchelder and Root 1994, Thorley and Gregory 1994, Herreid 1998). Students who are exploring careers in the biological sciences can experience the daily practice of professionals through a burgeoning number of internships, which are usually separate from their course work. However, academic programs that integrate service learning with formal classroom study are relatively uncommon in the biological sciences, except in certain health or pre-medical curricula (Kelly 1995), agricultural extension programs (Rilla and Ponzio 1994), and environmental studies departments (Kaufman and Zeigler 1993, Touval and Dietz 1994, Ward and Zotlowski 1999).

We describe one such program in which rigorous course work at the University of Connecticut prepared a group of students for a subsequent 10-week summer internship at a non-profit institution, the Connecticut chapter of The Nature Conservancy (TNC). Called the REAL Team, for rapid ecological assessment of the landscape, this program trained students in both broad ecological concepts and specific taxonomic skills, knowledge that they could then apply to their work with a conservation organization. Instead of crowding an internship and classroom instruction into a single semester, the program spanned a spring semester of academic study and a subsequent summer-long appointment to a professional project. We found that this program offers many educational benefits to students, strengthens cooperation between academic and professional institutions, and provides an adaptable model for the development of similar programs elsewhere.

In recent reviews, service-learning programs that have evolved within university curricula have been critically examined for the ways in which these ambitious projects fos-

ter both professional and academic learning. Students benefit from service-learning projects in many ways: directly applying classroom concepts to real-world problems, observing professional role models, developing a sense of place by contributing to their local community, honing teamwork skills, and adopting efficient time management in meeting deadlines (Dillon and Van Riper 1993). However, ambitious projects also carry the risk of failure for students and faculty coordinators and can entail substantial supervision on the part of both the academic and extramural partners. A semester of 16 weeks or less is a very brief time in which to identify an appropriately scaled project; establish and maintain smooth collaboration among students and their host agency; and deliver a tangible product that meets the needs of the educator, agency, and students (Hornig 1999). The host agency must evaluate the net worth of the work the students produce with respect to the time invested by its own employees in assisting students with their project. In addition, such a program can be sustained only if it is an integral part of the departmental curriculum and supported by the academic partner's infrastructure with sufficient budget allocations for the appropriate courses (Korfmacher 1999).

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The REAL Team program exemplifies many of these advantages and challenges. For example, having the internship phase follow the classroom experience requires a long-term commitment from students, but it reduces some of the time pressure that single-semester service-learning courses face. The program currently serves a small number of students, but it reaches out to a larger cohort, including students who may perform better in the field than in the classroom. The REAL Team itself requires a substantial time investment from both the university and the sponsoring agency, TNC. In addition, funding for the pilot year came from an initial investment by TNC. However, the program has the demonstrated capacity to attract extramural grant support (a grant to fund its second year was received after the pilot year). It is possible, therefore, to engage new staff in subsequent years to oversee and ensure continuity in the project.

The REAL Team program was conceived as a means of demonstrating to students the utility of courses grounded in field work and covering basic taxonomy and natural history concepts. Integrative, field-based courses are increasingly rare in university settings, particularly in biology departments that stress laboratory methodologies (Noss 1997). Many contemporary ecology curricula emphasize theory and laboratory experimentation as the means to inculcate undergraduates in basic ecological principles, at the expense of encouraging students to develop observation skills in the field. Such emphases reflect the limitations imposed by winter during the academic year in some regions; the brevity of the semester; and a perceived programmatic need, in some cases, to establish apparent disciplinary rigor through laboratory-based science models (Orr 1993, Garwin 1995). However, students of biology (and conservation biology in particular) lack opportunities to hone their field skills as well as their capacities for “cooperation, initiative, communication, responsibility, flexibility, and innovation” (Touval and Dietz 1994). Such fluency with interpreting the present condition of landscapes is arguably a vital prerequisite to ecological literacy (Orr 1992).

In a period when all scientists, especially ecologists, are increasingly exhorted to communicate the general significance of their research and its ramifications for policy (Jacobson and Jacobson 1997, Norton 1998), programs that integrate course work with meaningful, sustained professional service to policymaking agencies must evolve. Work with conservation organizations demands that students be able to communicate their findings clearly and rapidly to a variety of audiences. This practice reinforces their learning of basic concepts and enhances their future credibility as scientists (Moore 1992, Giblin and Pagen 1998).

### ***Conceptualizing the program and forging cooperation***

The REAL Team program was developed by the staff of the Connecticut chapter of TNC and the faculty of the University of Connecticut's Department of Ecology and Evolutionary Biology (EEB) in 1997–1998. We designed the program

to simultaneously enhance TNC's ability to assess the conservation significance of land parcels and educate students in general principles of conservation biology and decision-making. The small staffs at TNC and its information-gathering partner, the Natural Diversity Database (NDDDB) of Connecticut's Department of Environmental Protection, are limited in their capacity to complete extended field surveys in response to the dozens of inquiries about land conservation options they receive annually. Through many discussions, a potential solution emerged: to teach advanced undergraduates and graduate students with demonstrated interests in natural history and conservation biology to survey sites rapidly and to make critical information available to both TNC and NDDDB. Data gathering would be augmented, while students would gain valuable theoretical grounding in ecology through course work, as well as practical and professional experience through an internship.

We derived information and composed general goals for the program from the experience of other service-learning programs throughout the country (Howard 1993, Kraft and Swadener 1994, Connors 1998). The program designers borrowed certain elements of its format from course curricula at the University of Maryland (Touval and Dietz 1994), the University of Vermont's Field Naturalist master's program, and the University of California at Irvine (MacMillen and Powell 1997), as well as rapid-assessment training materials currently used by the Smithsonian Institution, the American Museum of Natural History, and Conservation International.

During 1998, a formal proposal was developed, and this plan was refined through meetings among cooperating partners and members of the Connecticut Biodiversity Forum, a consortium of conservation professionals. A memorandum of understanding delineating goals, responsibilities, and a schedule for the project was signed and approved by the three cooperating parties. The TNC budget required to run the program ranged from \$16,000 in 1999 to \$25,000 (provided by an extramural grant) in 2000.

### ***Recruiting and selecting students***

During the fall semester of 1998, a flyer and application form were circulated by members of the EEB faculty among advanced undergraduate and graduate students who were enrolled in courses in relevant departments. Faculty members were also encouraged to individually identify promising students for REAL Team positions and to encourage them to apply. Applications were received and reviewed by faculty members and TNC staff in early December, and students were interviewed by the EEB faculty. Students were carefully selected on the basis of their demonstrated motivation and enthusiasm for the 6 months of work that the program required. Evidence of successful independent work was an important criterion, in certain cases outweighing grade point average or specific field expertise. Offers were extended to five undergraduate and recently graduated students; four students eventually completed the 1999 program (the fifth had conflicting summer thesis research responsibilities). In the summer of

**Table 1. Syllabus for field methods course at University of Connecticut.**

Schedule	Classes meet weekly for 2 hours, beginning in February, with a 2-week field program in May and one full-day and two half-day field trips on selected weekends in April.
Prerequisites	Graduate or upper division undergraduate status and consent of instructor are required and at least one prior course in general ecology is recommended.
Books and readings	Sutherland (1996); Jorgensen (1978).
Assessment	Group inventory project (during field component), an individual project of choice (during field component), problem assignments, and class participation.
Specific topics covered during the semester	
<ul style="list-style-type: none"> <li>• Landscape perspectives in ecology, ecological inventories, and conservation.</li> <li>• Introduction to the use of geographic information systems (GIS) and software tutorial.</li> <li>• Introduction to the use of global positioning systems, mapping, and orienteering.</li> <li>• Principles of rapid biotic inventory and the use of database tools: sampling and statistical issues.</li> <li>• The plant perspective in the landscape: plants as indicators, plant collection and identification.</li> <li>• Ecosystem geography and classification of ecosystem regions, plant communities, and biogeography in the Northeast.</li> <li>• Overview of environmental factors affecting species and community distribution patterns: climate, land-use patterns, historical factors, biotic factors (including invasive species).</li> <li>• Overview of regional bedrock and surficial geology (field trip): effects on species and community patterns.</li> <li>• Overview of soil classification and soil attributes at the landscape level (field trip).</li> <li>• Vegetation reconnaissance, sampling, natural community classification, and inventory methods (field trip).</li> <li>• Community ordination and introduction to software.</li> </ul>	
Objectives of intensive field component during May	
<ul style="list-style-type: none"> <li>• Field orientation to the landscape of northwest Connecticut and the Berkshire region.</li> <li>• Lecture overviews and field orientations on sampling vertebrate and invertebrate taxa (including arthropods, amphibians and reptiles, birds, and small mammals): trapping, direct counts, mark-and-recapture method, indirect methods.</li> <li>• Practice conducting ecological reconnaissance, biotic site surveys (focusing primarily on plants), landscape-level transects (including both more complete inventories and reconnaissance), evening lectures, analyses, group presentations.</li> <li>• Individual student projects with analysis and presentations to peers.</li> </ul>	

2000, three new students (including one from another institution) and one returning participant from the previous year composed the REAL Team.

### **Three-part training of students**

REAL Team training during the spring of 1999 consisted of three complementary curricula. First, REAL Team students enrolled (along with other students) in an upper-level

undergraduate course on ecological field methods, which involved classroom instruction and a 2-week intensive field module (Table 1). The course emphasized ecological landscape analysis, introduced theories of biogeography, and elucidated factors and processes that influence the distribution and abundance of species and ecological communities. Plant-based systems were the primary focus of the course, but through guest lectures, demonstrations, and individual projects, other taxa and perspectives were incorporated. Students also read primary literature on conservation biology and ecology. The course culminated in a 2-week field module that exposed students to a range of Connecticut environments.

Second, students enrolled in a for-credit independent study that consisted of a series of introductory workshops offered by TNC and NDDB staff. In this module, they learned methods for broadly characterizing landscape heterogeneity and biological diversity at sites in Connecticut. These independent-study sessions included an orientation to the conservation mission and work of TNC in Connecticut and an introduction to the types of activities students would carry out during the upcoming summer. Staff from NDDB also acquainted students with the activities and methods of the agency, gave them an extensive overview of NDDB inventorying priorities, and provided a detailed introduction to the use of standard data forms.

Third, each of the four students chose a different taxonomic group on which to focus during the semester: plants, reptiles/amphibians, insects, and birds/mammals. Students spent this apprenticeship time with faculty, staff, and graduate student mentors who had expertise in the flora and fauna of Connecticut. During this time, they learned how to sample and identify key rare taxa within these focal groups using methods appropriate to the taxa. Students later relied on these mentors for knowledge and advice to help them with their field work, especially early in the summer. Subsequent interviews revealed that students viewed mentors as critical to their intellectual development, as has been noted in other scientific disciplines (Kennedy and Mohai 1987, Widnall 1988, Tobias 1990).

Thus, by the time students commenced their internships, they had received comprehensive training in ecological theory and taxonomy, as well as more vocational education in specific field skills needed to assess the condition and conservation significance of land parcels. Although the spring semester was geared to preparing the students for their internship, the training phase of the program surpassed more narrow vocational and technical curricula in breadth.

## Summer 1999 internship

The first step in structuring the REAL Team internship activities was to identify and schedule the sites to be inventoried. TNC identified a set of eight sites and distributed maps to REAL Team members in early May 1999. Thus, students could orient themselves and consult geographic information systems (GIS) and other data prior to initiating the summer's work, which commenced on 7 June and ended on 4 August 1999. On the first day of reconnaissance at a new site, students would be accompanied by a professional biologist (generally a staff member or affiliate of TNC or NDDDB) who checked the accuracy of their work; thereafter, they worked independently as a team, receiving occasional advice on sampling from their faculty mentors.

Rapid assessment protocols, per the needs of TNC, placed more emphasis on qualitatively characterizing broad patterns of diversity, especially physical topography, prior land use, and general plant community types. This initial reconnaissance was designed to provide TNC with a preliminary snapshot (in written and photographic form) of areas they would not otherwise have had sufficient time or personnel to survey themselves. Particularly useful models for survey in this regard were those of Burnett and colleagues (1998) and Nichols and colleagues (1998), which stress the utility of indices of geomorphic heterogeneity for estimating potential biotic diversity. Instead of providing an exhaustive list of all species (which was not feasible in any case, given limited sampling time relative to flowering and emergence times of organisms), the REAL Team provided an initial summary of the conservation significance and management issues associated with each parcel of land, as well as suggestions for where additional, more comprehensive surveys should be performed.

The 1999 REAL Team students devised their own field data form on which to record observations made in the field, adapted from field forms used by NDDDB in Connecticut. The 2000 REAL Team modified this original form to take more systematic data on the types of natural plant communities, including wetlands, present at the site. These were identified by the predominant plant species and delineated by keys provided by NDDDB. In both years, students recorded data on all vertebrates, birds, and insects observed during the site visit. Such rapid assessment methods, involving natural community identification (Alpert and Kagan 1998) as well as observation of individual species, are used widely by biologists performing fieldwork for TNC, land trusts, and other conservation organizations throughout North America. Thus, the methods employed here can be readily adapted to work with other employers and other projects by REAL Team graduates. We also expect that this consistency in data collection will contribute to a growing data set for systematic biotic inventory in Connecticut, permitting biologists to determine links between landscape characteristics and the distribution of both rare and common species in the state (Debinski and Humphrey 1997). Although the focus of the inventory was not

specifically on identifying rare species, several were sighted and one new state record was found.

In general, the 1999 REAL Team spent 1 day per week assembling GIS data layers and maps before the site visit, 2–10 days at the site, and 1 day at the University of Connecticut vouchering and identifying specimens and transcribing field data for a final report. In the second year, TNC asked students to focus on a smaller number (five) of larger sites, spending more field days per site to compile observational data.

A written report on each site was then assembled by the REAL Team, with specific tasks rotating among students. One student was primarily responsible for assembling GIS data layers, downloaded from the University of Connecticut's Map and Geographic Information Center, which displayed digital hydrography, land use, road locations, soil types, surficial deposits, and elevational topography for each site. The sampling path taken by the team during their surveys was superimposed on a topographic map so that surveys could be replicated at a later date. The REAL Team members also compiled computerized lists of species encountered at the site, along with a concise narrative that described predominant landscape features and issues of conservation importance to TNC. REAL Team members were especially adept at linking species occurrences with discussions of their habitat requirements in relation to the natural communities present at each site. Each report culminated with a section summarizing the conservation significance and recommendations for protection and management activities. REAL Team reports have in both years provided a useful baseline for future surveys and decisionmaking at TNC.

In August 1999, REAL Team students summarized the summer's accomplishments for TNC staff and board members, EEB faculty, and NDDDB in a slide-show presentation and question-and-answer session. The students were also presented with certificates of participation signed by all parties.

## Assessment of the internship program

It was critical after the 1999 pilot phase to develop a sense from TNC, NDDDB, EEB, and the students of the program's efficacy and of where improvements should be made. First, a meeting was held in August among all participants to discuss the outcome and future of the program. Second, a questionnaire covering all aspects of the training and the internship was distributed to the participating students to solicit their input on the program. Students both wrote comprehensive answers and were individually interviewed when clarification was needed. All parties spoke of the value of the REAL Team and called for its continued support and expansion. Students offered detailed suggestions for improvement, which included focusing on a few large sites, tightening travel schedules, easing logistics for using field and laboratory equipment, and communicating expectations (about survey data and final report format) more clearly at the outset. Students concurred that the intensive exposure to field biology had strengthened their commitment to science and conservation careers. Of the seven students enrolled in the 1999 and 2000 REAL Teams, two are in graduate degree programs in conservation biology; one is in

veterinary school; one team member, who participated in both years (affording a measure of continuity), works professionally in biological inventory; and the remaining students are completing undergraduate majors in biological or environmental sciences. Thus, the program was of educational and professional value to the students. The REAL Team program also benefited TNC and NDDDB practically by providing consistent and informative surveys that augment their conservation efforts. According to scientists from both TNC and EEB, it also strengthened their intellectual partnership with each other.

Proposed modifications to the schedule and structure of training were implemented in the 2000 REAL Team program. For example, later students benefited from access to samples of previous reports produced by the previous REAL Team. Thus, the nature of the work and the products expected by TNC were clearer to interns at the outset. TNC also selected the sites to be surveyed earlier in the year, so that preparatory GIS and lab work could commence earlier. REAL Team members had a more concrete sense of scope, schedule, and location of the summer's work, and they could compare notes earlier with faculty mentors about the types of organisms they should specifically search for at each site. During field work, REAL Team members coordinated their sampling schedules to census more effectively organisms that are active at different times of day. TNC also received a grant from the Carolyn Foundation to augment student stipends the second year.

Realistically, the longevity of the REAL Team program, like other service-learning curricula, depends upon sustained student interest, vigorous recruitment of students by faculty members and by their peers, and a department infrastructure that allows instructors time to participate in a novel and somewhat unconventional curriculum. This program proceeded for 2 years because EEB faculty demonstrated a substantial commitment to mentoring students and to cooperating with an extramural agency (the format for future iterations is being discussed). The faculty must view this type of program as an integral step in providing the best training for students and must actively promote it when discussing planning with university administrators. Faculty members also benefit if students who have participated in service learning return to the university better equipped to perform high-quality independent research. If the program is seen only as an interesting exercise that is tangential to the immediate academic mission, interest will soon wane because the demands on faculty time are many.

Likewise, former student participants, who are among the toughest critics of novel academic programs, must actively recruit their peers to sustain the program from year to year. The available pool of applicants can grow only as students promote the experience with each other and as they teach each other the concepts and techniques they have learned (Trombulak 1995). Each year we individually selected students from a small applicant pool of graduate and undergraduate students who had demonstrated interests (but not necessarily

previous experience) in ecology, taxonomy, and conservation. Because some of the REAL Team students who were less successful in traditional classroom settings proved to be exemplary field biologists who adhered to rigorous professional standards and deadlines, the REAL Team program afforded a unique, previously untapped cadre of students an opportunity to enter the biological sciences and to discover abilities that are not expressed in the classroom. Although it is a promising vehicle for recruiting new types of students into biology careers, the REAL Team in its current format is a highly individualized program designed for a group of students who can function well as a team.

This program also could be maintained through the host agency because it raised the necessary funds to pay student stipends. Funding clearly is available to support cooperative enterprises between nonprofit organizations and academe, as the need and the benefits of this type of collaboration are so readily apparent. TNC also dedicated some of the work time of its staff and recruited other affiliated biologists to accompany the students in the field early in the summer. This type of investment on the part of the host agency must be weighed critically against the usefulness of the resulting product from the students.

Can this model be translated to other institutions? The most likely institutions to adopt a program of this nature are colleges and universities with faculty members who have research interests in conservation biology, natural resources management, or environmental studies and who may already have expertise in the ecology and natural history of their region. A group of neighboring colleges can also cooperate to recruit and train students. An established local conservation organization with a tangible need for student assistance must then work closely with the academic institution to develop appropriate curricula and internship experiences. Finally, students must find the opportunities genuinely valuable. Advanced undergraduates and first-year graduate students are the logical participants. We contend that such a model, in which targeted course work is immediately followed by an internship and which is evaluated and iteratively improved each year by all parties, could be developed between university and extramural partners for training a new generation of conservation biologists, as well as students from a broad range of subdisciplines of the biological sciences.

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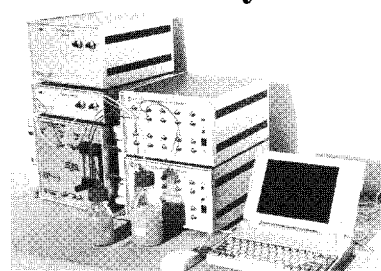
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