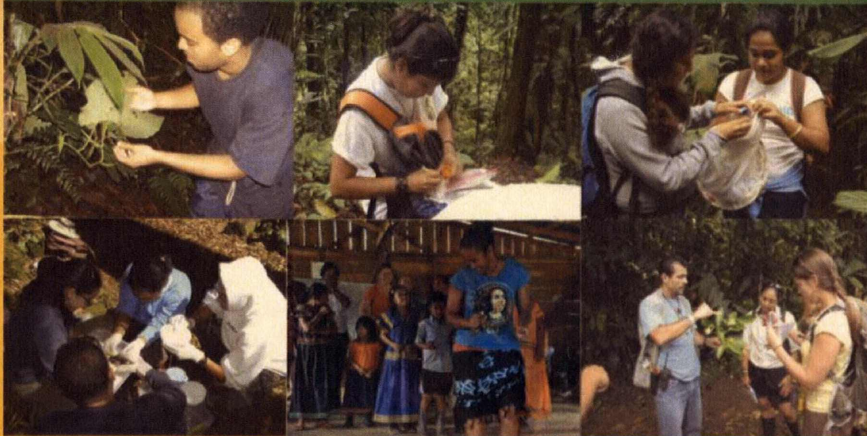




Organization for
Tropical Studies

NAPIRE

NATIVE AMERICAN AND
PACIFIC ISLANDERS
RESEARCH EXPERIENCE



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PREFACE

The OTS Native American and Pacific Islanders Research Experience program (NAPIRE) began with a conversation between one of our program officers and Dr. A. James Hicks, Director of the Louis Stokes Alliance for Minority Participation at the U.S. National Science Foundation. They were on a coffee break at a conference on best practices for recruiting and retaining underrepresented groups in ecology and the environmental sciences. In discussing the difficulties in attracting Native Americans and Pacific Islander undergraduate students to the STEM fields and the success OTS was experiencing in recruiting African American and Hispanic American undergraduates into its field-based, mentored-research program in Costa Rica, the idea was raised between the two of them to try a targeted one-year pilot program funded by LSAMP.



NAPIRE 2009 Capturing insects, Chandra Ledgesog right.



NAPIRE 2011 Rhiana Jones sifts through the leaf litter for invertebrates.

nor their own professions in the same way. Indeed the NAPIRE program has also transformed Organization for Tropical Studies. In large part thanks to the program, our organization has fundamentally rethought how we recruit, train, and retain young scientists from underrepresented groups.

Thus, in 2005 the NAPIRE program was born; seven years later with more than 100 Native American and Pacific Islander students having passed through the program, students experiencing tropical biology first hand, learning to conduct group and individual research projects, sharing ideas and cultures with each other and with indigenous peoples of Central America, the program has been as a tremendous success. As the NAPIRE program has grown and matured, the one word that we keep hearing is "transformational." The Native American and Pacific Islanders that spend a summer doing a research-experience in Costa Rica never again look at science

nor their own professions in the same way. Indeed the NAPIRE program has also transformed Organization for Tropical Studies. In large part thanks to the program, our organization has fundamentally rethought how we recruit, train, and retain young scientists from underrepresented groups.

Dr. Elizabeth C. Losos
 President and CEO
 Organization for Tropical Studies





TABLE OF CONTENTS

Preface	3	Program completion	18
Table of contents	4	Academic credit and recognition	18
Introduction	5	Improved academic performance	19
Who are the NAPIRE students?	7	Post program career trajectory	20
Ethnicity	7	Networking	21
Gender	8	How else does NAPIRE impact science and scientists?	23
Age	8	NAPIRE research-mentors	23
Grade point average	9	NAPIRE home-mentors	24
College majors	9	NAPIRE home-institutions	24
What is the NAPIRE program?	10	LSAMP institutions	26
Scientific method, research design, statistical analysis	10	NAPIRE impact in Costa Rica	26
Ecological field-research experience	11	Impacts of NAPIRE on the academic community	27
Communication skills	12	Conclusion and Summary	29
Other life and professional skills	14	Literature cited	29
World citizenship	14	Appendix 1: Research papers by NAPIRE students	31
What is the impact of NAPIRE on students?	16		
Student appraisal of NAPIRE impact	16		



INTRODUCTION

In 2005, the Organization for Tropical Studies joined forces with the National Science Foundation's Louis Stokes Alliance for Minority Participation (LSAMP) to foster diversity in the ecological workforce via career expanding research opportunities for underrepresented minorities. The first step was to include LSAMP students in the already functioning Research Experience for Undergraduates (REU). But OTS also chose to develop a new undergraduate research experience, NAPIRE (Native Americans and Pacific Islanders Research Experience), designed especially for these two undergraduate groups significantly underrepresented in sciences careers. In addition to completing a research project like the other OTS REU, NAPIRE students would also be introduced to some of the environmental and social issues facing Central American Indigenous People during visits and exchanges with Costa Rican Indians. Since its conception, 113 students have participated in seven NAPIRE summer programs and one pilot mini-program.

The global ramifications to humans and the environment of current ecological issues have increased the urgency for trained ecologists to be diverse in their thinking and capable of conceiving innovative solutions. Serious environmental problems, such as global warming, species extinction, and deforestation, are especially complex in their scope and need to be addressed with interdisciplinary

approaches. Increasing the diversity of perspectives and vision about environmental issues and ecological phenomenon will positively impact the inventory of possible solutions to environmental problems. Insuring diversity in ecological sciences requires the preparation of new generations of scientists coming from all types of backgrounds. Native Americans and Pacific Islanders, although often closely linked to and dependent upon their natural resources, are significantly underrepresented in science.

By designing and implementing the NAPIRE program, OTS conceived a formula to stimulate more young scientists from these ethnicities to consider these environmental issues and envision a career in ecological research. These young people are the future hope of their tribal and island governments and, thus, could be direct participants in the environmental solutions for their communities tomorrow.

2006 NAPIRE student

I can honestly say that the trip has definitely been one of the best experiences I've had. It has shown me different avenues to take in the future, and has encouraged me to pursue graduate studies.

Annalee Herrera,
University of Washington





The OTS approach to capacity building encourages exploration by students into scientific fields that previously may have been less familiar to them. Introduction to new fields of study is central to broadening the career horizon of a student with an interest in science; he or she must be shown the variety of ways his or her interest in biology can lead to a career path other than medicine.

OTS strives to offer an academic, hands-on, research experience; which is increasingly expected of students by Ph.D. programs in STEM. Graduate admissions committees consider such experiences as indicators for future success in graduate school. Undergraduate research experiences may help students gain acceptance to graduate programs and give the scientific experience needed to move directly from an undergraduate program to the Ph.D. (OTS, 2007). Students who have conducted research independently, from conceptual design to data collection and analysis to presentation of results, are more likely to be accepted at "top-quality" graduate schools and Ph.D. programs (NSF 2006).

OTS graduates with their hands-on research experience have a distinct advantage over their peers.

In an increasingly global world, it is critically important that U.S. students have international experiences and develop international capabilities in the early stages of their career (NSF 2002). The benefits of study abroad programs are multiple; the most important of these is an improved self-esteem and self-

confidence (Nash 1976; Carsello and Creaser 1976; Orndorff 2002). Additionally, there is an increased openness to diversity, coupled with more cultural awareness (Wortman 2002; Dwyer 2004; Ismail et al. 2006).

Posey (2003) found a positive association between participation in a study abroad program and graduation rates and grade point averages. In addition, international educational experiences may positively influence student decisions to pursue post-graduate degrees (McMillan and Opem 2004). With the OTS approach, the combination of an international experience with hands on research experience may increase a student's competitiveness in the academic and employment arenas.

NAPIRE 2007 student

"The NAPIRE program has certainly impacted my academic career. The scientific experiences, the field work, and the experience of working with other people in an international setting helped prepare me for undergraduate research, for work after graduation, for graduate school, and for other international research endeavors. I reference my experiences in NAPIRE almost any time I apply for a major fellowship or grant".

Jeremy Crawford, Duke University,
current graduate school University
of California, Berkeley



WHO ARE THE NAPIRE STUDENTS?

Students are recruited each fall and winter for participation in the NAPIRE summer experience. They come from institutions across the United States and the Pacific islands that have historical agreements with the United States (ex Protectorates). Most public educational institutions are reminded yearly about this opportunity but particular emphasis is given to recruiting applicants from Tribal Schools and other institutions known to have substantial Native American and Pacific Islander student populations.

Each fall, potential NAPIRE students are recruited using virtual notifications, personal contact at universities and community colleges, and recruitment booths set up at the national conferences of Society for Advancement of Chicanos and Native Americans in Science (SACNAS) and American Indian Science and Engineering Society (AISES). However, the most effective recruitment tool is the local LSAMP coordinators and program managers at the various institutions.

One hundred and seven students have been accepted by the NAPIRE summer program, and six students in the pilot mini-NAPIRE (two weeks) tested in 2008 during the middle of the semester.

ETHNICITY

More than half (54%) of the 113 past NAPIRE participants were Native Americans, while 36%

claim a Pacific Islander heritage (See Figure 1). Only 10% were students identifying with other ethnicities, including four students listing themselves as multiracial, two Hispanics, two whites and two people who did not identify their ethnic affinities (Figure 2).

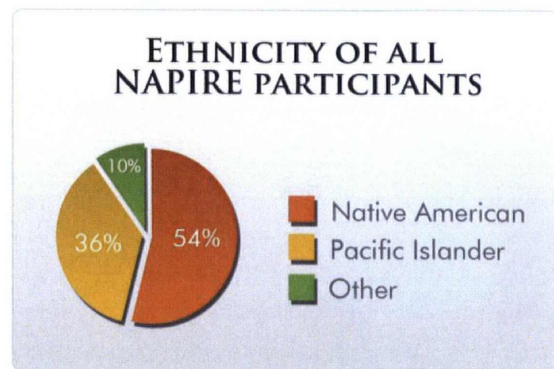


Figure 1 Ethnic identity of all 113 students participating in NAPIRE programs

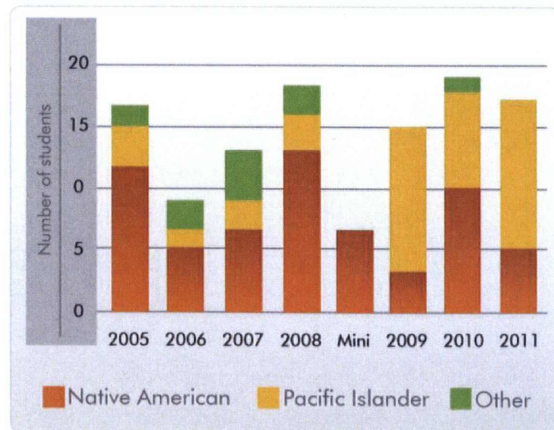


Figure 2 Self-declared ethnic identity of NAPIRE participants as compared across years





Through the years, OTS has improved its ability to attract Pacific Islander students to the NAPIRE program. In fact, in recent years there have been more Pacific Islanders applying than Native Americans (Figure 2). Nevertheless, Pacific Islander students have yet to add up to half of the total NAPIRE participants. More effective recruiting is reflected also in the decreasing proportion of NAPIRE participants that are not from targeted populations.

GENDER

The majority of NAPIRE students are female, which mirrors application rates. The participation rate is 1.9 females to every male. Some years it has not been possible to attract male students; for example, in 2006 the program had no males and only two attended in 2009. This is the same trend found in other OTS courses and in study abroad generally. This trend is very noticeable for Native Americans and for Pacific Islanders, as can be seen in table 1. Without considering 2006 and 2009 when there was particularly low male attendance, the rate was still 1.5 females to every male student participating.

AGE

The NAPIRE program is designed to supplement college studies and amplify career opportunities and choices for Native American and Pacific Islander undergraduates. As such, the program accepts sophomores, juniors or first-semester seniors.

Even so, NAPIRE students were generally older at the start of their REU program than the majority of graduating college students (Table 2). They averaged 23.6 years in age (standard deviation = 5.1; max = 54; min = 18), an age when most students have graduated already and started their careers. Many of our older students actually had abandoned college for a time before continuing their studies.

In most years, the older students were female, although in 2008, three male students were older than 30 (See Figure 3).

The six female students that were over thirty had all returned to school after raising a family. If the students over thirty were removed as outliers, the average age of participating females (22.5) was not significantly different than the average age of males (22.1 years).

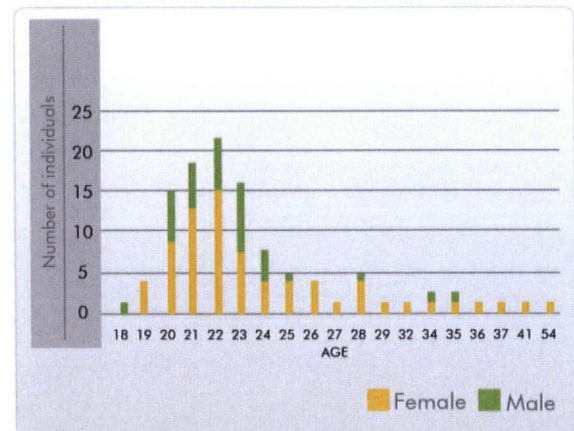


Figure 3 Age and gender profiles of NAPIRE Summer course participants



GRADE POINT AVERAGE

Unlike some other undergraduate research experiences, students are accepted with lower Grade Point Averages (GPA).

If the program were to accept only those with a higher than a 3.0 GPA, a full 31 % of the students would not have had the opportunity.

NAPIRE year	Females	Males	Average Age	Average GPA	Range of GPA
2005	8	8	24.5		
2006	9		21.8	3.18	2.7-4.0
2007	8	5	21.9	3.14	2.5-3.6
2008	12	6	26.2	3.32	2.5-4.0
2009	13	2	22.9	3.05	2.1-3.88
2010	13	6	22.5	3.11	2.2-3.7
2011	9	8	24.6	3.31	2.4-3.7
Totals	72	36	23.6	3.20	2.2-4.0

Table 1 Average age and GPA of NAPIRE participants

COLLEGE MAJORS

NAPIRE students come from a variety of declared majors (See Table 2). A full 26% were Biology and Biological Science majors (includes Chemistry, Zoology, Cell and Molecular Biology, Botany, Life Science, Natural Science). Another 20% were in Environmental Sciences and Natural Resource Programs (Conservation, Environmental Science and Evolution, Ecology and Evolutionary Science). Resource Management students (Wildlife, Soils, Hydrology, Forestry etc.) filled 11 % of the past NAPIRE positions. Ninety percent of NAPIRE students come from STEM Majors. The proportion of STEM majors to non-STEM majors, excluding the students whose majors are unknown (17), is 9 to 1 (81:9). The Marine Science students were all Pacific Islanders, as were the three Liberal Arts students, who came from two-year colleges in the Islands.

Major	Total
Biology*	28
Environmental Science and Natural Resources*	21
Resource Management*	12
Health*	8
Marine Science*	5
Anthropology, Social Sciences, Indigenous studies	4
Liberal Arts	3
Agriculture*	2
Engineering*	2
Geography*	2
Business	1
Computer Science*	1
Government	1
Unknown	17

Table 2 Frequency of declared majors of NAPIRE summer participants * STEM major



WHAT IS THE NAPIRE PROGRAM?

The NAPIRE program was designed with Native American and Pacific Islander undergraduates in mind. The eight-week program brings 15-17 students to Costa Rica, where during the first two weeks they participate in lectures, site visits and hands-on activities to learn about the Neotropics, ecology, and the scientific method. Throughout the last six weeks, they are individually guided by an experienced field ecologist to design and carry out their own field-research project. They finish the summer by documenting their results with a scientific paper and oral presentation. The impacts of NAPIRE on the students, institutions, and the general public are described in the following section.



NAPIRE 2009 students measuring the pH of Phytotelms

The NAPIRE program differs from typical on-campus experiences in that the activities are tailored to take full advantage of the unique resources available at each field site, as well

as the knowledge each student brings to the program. We employ the OTS educational model with the NAPIRE program, which is a hands-on learning style that has been adapted and perfected by OTS for each of its field programs for almost 50 years. This pedagogical model works particularly well with OTS undergraduate research experiences, all of which target students from underrepresented groups. As with other OTS REU students, the typical NAPIRE students have had little or no exposure to hands on research in the field.

The NAPIRE experience gives students the opportunity to design and complete their own research, while they are guided closely by a hands-on research mentor. Many undergraduate research experiences place interns into pre-designed and set activities as a part of a larger research program. But in NAPIRE, students are mentored directly and individually, with no more than three students per mentor. Students and mentors also have the opportunity to get to know each other casually, as everyone lives and works in the same facility (OTS Las Cruces Biological Station) for the six weeks of the research program. Students also can converse with other researchers and graduate students and are exposed to an active research culture at the OTS biological stations.



SCIENTIFIC METHOD, RESEARCH DESIGN, STATISTICAL ANALYSIS

NAPIRE students are immersed in scientific investigation for two months at OTS Las Cruces Biological Station and Wilson Botanical Garden, Coto Brus, Costa Rica. The program starts with lectures and workshops that introduce the scientific method and research terminology, such as variables, precision, and validity. The program then moves on to an introduction of descriptive statistics and basic distribution curves. At this point, students develop testable hypotheses with their research mentors. They work very hard to incorporate random sampling into their research design, although due to inexperience, forest complexity, and limited time and funds, this may not always be achievable. Students are instructed to describe in their final papers any limitations and assumptions to the statistical tests.

In addition to designing their own research project, NAPIRE students are exposed to other ecological and social research. Invited lecturers give symposiums, workshops, and hands-on exercises in research methods and results. Visiting scholars present their work while explaining the theories, thought processes, and problems involved with their research. Students can discuss their research design with other students, mentors, and OTS staff, all of whom have unique training and experiences that add richness to a students' understanding of ecological research.

ECOLOGICAL FIELD RESEARCH EXPERIENCE

The introduction to field-research by the NAPIRE program is made considerably more interesting because the OTS stations facilitate access to protected primary tropical and montane forests and easily viewed and abundant biodiversity.

Though living at a tropical station, students have access to sophisticated equipment, a library, and laboratories to support data collection in the field – not to mention comfortable accommodations and delicious cuisine. The stations have emergency procedures and equipment, and OTS staff are trained in first-aid procedures.

NAPIRE 2011 student

"I will definitely use the research methods and skills I learned for future research. Approaching biological science ethically, learning to write a scientific paper properly, thinking about experimental design and knowledge from other scientists are all things that are useful for me in building a scientific career."

Kyla Winthers-Barcelona,
California State University,
Humboldt





Students are instructed in risk management, especially in proper footwear against poisonous snakes, an environmental risk which many of our Pacific Islanders students have never experienced. Moreover, the biological station is ten minutes away from a major public hospital, part of Costa Rica's excellent medical system. A flight between the nearby town of San Vito and the best hospitals of the city of San José would take less than an hour.

Completing field-research requires a person to have or acquire organizational skills. Organizational skills are needed from the initial stages of planning what, where and when a student will conduct his or her research all the way through the packing up of field equipment, collecting of data, and organizing results. Time management is a huge component of field-research and though some students may have to learn the hard way, they have a good opportunity to learn first-hand how much time is involved in all the phases of field-work.



NAPIRE 2010, Christopher Goldsmith, Dr. Tahay Jones and Tara Hammer discuss field research method in the Rio Java at Las Cruces.

Real life lessons in logistics are important to foster more efficient planning, a major

component in future academic success and STEM careers.

NAPIRE research mentors accompany their students to the field during the design process. Later students are on their own, unless they specifically request help. Mentors guide students to take and organize their field-notes. The combined experience of mentors and coordinators each summer typically totals more than 100 years of field-experience. All of this help is available to the NAPIRE students.

Students are encouraged to take advantage of their access to this wealth of experience to improve their research design.

COMMUNICATION SKILLS

Good communication skills are critical to success in the sciences. Although many types of communication are used throughout the summer, NAPIRE students specifically receive training in scientific communication, written and oral. Effective communication to colleagues is a skill that can be learned and, thus, NAPIRE promotes practice with criticism and guidance. Learning to balance criticism and using it to improve communication is crucial to the growth of every scientist.

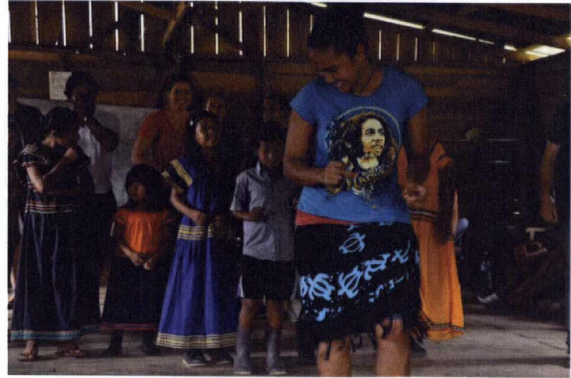
The vast majority of scientific communication is written. For this reason the NAPIRE program encourages students to start working on their final paper when they begin their research. By starting the writing process early, students improve the overall organization of their research, and this could aid them in streamlining their methods and increasing their efficiency. Scientific writing can be challenging



to all scientists and especially to young aspiring scientists. For this reason, the NAPIRE program puts special emphasis on promoting extensive and early writing, with continual feedback to help boost student's confidence in their writing.

Writing a scientific paper requires the application of critical thinking. NAPIRE students are encouraged to search for scientific literature to develop their hypotheses and help interpret their results. When the NAPIRE 2011 students were asked about how many scientific journals they commonly consult prior to their arrival in Costa Rica, 90% of them listed no journals. By the end of the course; all of these students indicated that had used from 1 to 5 scientific journals during the summer. Reading scientific literature can help improve writing, but it also permits a student to strengthen the quality of his or her arguments, and the analysis and interpretation of his or her results. Learning to describe creatively the basic ideas behind one's research, and using proper citations, is accelerated by examples of literature, by practice, and by guidance.

NAPIRE students do a minimum of three oral presentations during the summer. They begin by developing power point presentations with the results of their group research projects. Then they give presentations on their proposed individual research and, again, at the conclusion of the program with the final results. In a workshop, they are given tips to improve the organization, style, and content of their presentations. The oral presentations are a very important aspect of the NAPIRE



NAPIRE 2011, Sharing a popular dance from Palau, the chicken dance to the Ngöbe Indians.

program, underscored by the fact that the students must give their presentations in front of senior scientists as well as their fellow students. Students are encouraged to work hard on their presentations, and in NAPIRE 2011, the final presentations were "broadcast" through a group video call on Skype, making them available "live" to family, friends, and home mentors.

Throughout the eight-week program, NAPIRE uses video as a tool for students to critique their own presentations. The NAPIRE 2010 students had the opportunity to participate in the professional production of the NAPIRE recruitment film, gaining experience in front of a camera by expressing the impact of NAPIRE on their future careers (<http://ots.ac.cr/napire>). Through the years, video cameras have become more accessible, and some NAPIRE students have learned to make video collages of their experience, a skill that could be useful for developing public information campaigns and conservation efforts.



OTHER LIFE AND PROFESSIONAL SKILLS

The bombardment of new people, experiences, food, and scientific concepts can be challenging for any undergraduate. For Native Americans and Pacific Islanders, it can be even overwhelming. It takes real courage to leave your island home and go half way around the world to a place you had barely heard of previously. Most of the NAPIRE students have very little travel experience before flying to Costa Rica and most had not traveled to a new place by themselves. Then there can be an overwhelming bombardment of new people, experiences, food, and scientific concepts. Students that complete NAPIRE feel a sense of satisfaction for their perseverance.

Native Americans and Pacific Islanders are very close to their families. This makes their two-month absence from their loved ones even more difficult. Ninety percent of the NAPIRE students attend a college close to home. Before NAPIRE almost no student had ever experienced separation from their loved ones of such duration. Homesickness is a real and universal problem which can have debilitating effects. Of the three students that chose to leave early, homesickness was the principle cause. Channeling homesickness into hard work is a solution chosen by many of the NAPIRE students to alleviate the symptoms. By the end of the program they and their family are proud of their results.

Having the opportunity to have long conversations with 10 to 15 different Ph.D. professionals during the summer is an

NAPIRE 2010 Research Mentor

"The NAPIRE experience has definitely helped guide my mentoring of undergraduates and given me an opportunity to suggest to students a wonderful undergraduate research opportunity."

Dr. Kristin Conway-Gomez,
California Polytechnic University,
Pomona

opportunity most undergraduates never have. In this program NAPIRE students get to know researchers personally; these professors are no longer on an academic pedestal; they have become accessible role models. Being appreciated by your role model helps the NAPIRE students understand that they, too, have the potential to excel in higher education. As the summer progresses they begin their transformation from student to colleague, a very necessary step for professional advancement and graduate school in STEM degrees.

WORLD CITIZENSHIP

Exposure to other ways of thinking is a critical part of scientific formation; indeed, this is the basic reasoning behind the peer-review process. Students are invited to this program as Native Americans and Pacific Islanders; but this is not a uniform group, it is actually very culturally diverse. Each of the island homes of the students has its own culture. Equally, each



NAPIRE 2010 student, Nikki Tully, measuring water quality in the Ngöbe village.

of the North American and Native Alaskan tribes has a different language and customs, and a different cosmivision. The diversity of student’s ethnic origins makes an excellent opportunity for learning about other viewpoints, natural resources, and even traditional research methods. Broadening a professional’s viewpoint can help them become more integrated scientists.

For this very reason, NSF has pointed out that, given globalization, it is critically important that U.S. students develop international capabilities in the early stages of their career (NSF 2002). By bringing students to Costa Rica, they are extracted from their familiar surroundings and challenged to learn how to survive with different rules. Functioning in a world where communication is limited by language barriers

builds character and understanding how others must organize their livelihoods, and education can increase understanding of critical sustainable development issues.

NAPIRE students visit various Costa Rican indigenous communities during their summer experience. They have the opportunity to learn about indigenous livelihoods, agricultural crops, medicine and medicinal plants, and the real problems the Central American indigenous peoples and their ancestors face.

Even though these discussions are translated, the Native American and Pacific Islander students can identify immediately with the experiences of these communities. The NAPIRE students observe the living conditions, bad roads, and lack of potable water and compare them to conditions in their own communities.



NAPIRE 2011 students participate in circle dance of Bribri people



WHAT IS THE IMPACT OF NAPIRE ON STUDENTS?

STUDENT APPRAISAL OF NAPIRE IMPACT

Each year NAPIRE students evaluate the program by filling out a questionnaire. These evaluations, demonstrate to the OTS staff that NAPIRE participants agree that participating in NAPIRE contributed to their science career. Students were asked to score their agreement with the following statement on a Likert scale:

“This program contributed positively to my interest in a career in science”.

NAPIRE 2011 student

“I learned to deal with criticism and become more understanding of different personalities and this will help with future interaction within the scientific community”.

Katharine Stewart,
Northeastern State University,
Oklahoma

Students marked 1 for the lowest agreement and 5 as the highest. On average over a six-year period, students were in agreement with this statement, as the tabulated results show, they averaged 4.46 (STDV 0.37, n =72) on the Likert scale.

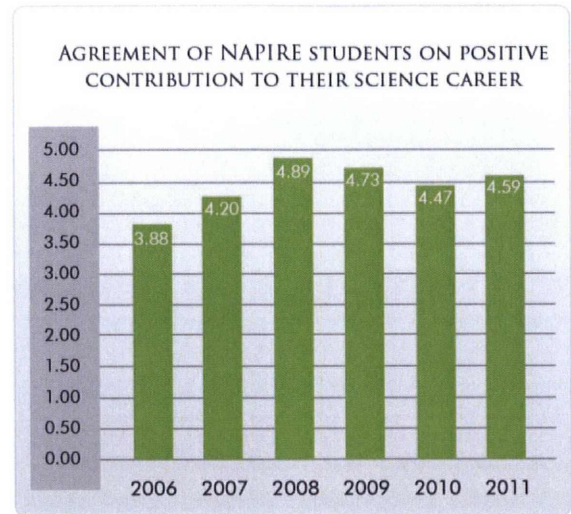


Figure 4 NAPIRE student agreement with positive impact of NAPIRE on careers

NAPIRE 2011 students were asked to assess their own gains in scientific capacity from the program. Once again using a Likert scale of 1-5, but where 5 indicated highest agreement, students were asked to appraise their gains in a variety of skills which scientists use constantly.

93% of the 16 respondents said that their experience in NAPIRE had confirmed their interest in their field of study, 80% said that it prepared them for advanced courses or thesis work, and 87% stated that the NAPIRE experience prepared them for graduate school.



Students finishing NAPIRE 2011 reported well to great gains, in the skills, tools, and thought processes involved in scientific research (See Table 3).

Overall, the students scored good gains (average=4.02 STDV =0.26) on all elements queried. The lowest gains were perceived to be in topics related to statistical design, analysis, and interpretation, however none of these was significantly less, and the average lies between “some gain” and “good gain”.

Identifying Neotropical Organisms was a skill for which students expressed less confidence in their gains (avg= 3.69, STDV =0.95), but again this difference was not significantly lower than other gains.

NAPIRE gives the opportunity for students to gain recognition for their hard work and to be proud of what they accomplish. As budding scientists they receive personal attention by experienced scientists assigned to mentor them.

5= Great gains. 4= good gains. 3= some gains. 2 = little gain. and 1 = no gain	Average	STDV
Asking interesting questions about ecological phenomena that could be answered with data	4.06	0.93
Forming hypotheses and outlining predictions	4.38	0.72
Collecting data in the field	4.50	0.52
Figuring out the next step in a research project	3.94	1.06
Identifying limitations of research methods and designs	3.93	0.88
Understanding the theory and concepts guiding my research project	4.27	0.88
Understanding the connections among scientific disciplines	4.27	0.88
Understanding the relevance of research to my coursework	4.13	1.25
Identifying Neotropical organisms	3.69	0.95
Writing scientific reports or papers	4.25	0.77
Making scientific oral presentations	4.00	0.82
Determining what type of data to collect to test a hypothesis	3.94	1.12
Explaining my research to people outside of my field	4.25	0.93
Keeping data organized in a field notebook and on the computer	4.13	1.09
Using statistical programs to analyze data	3.31	1.62
Creating professional statistical figures (graphs)	3.69	1.40
Understanding and critically reading journal articles	4.13	1.09
Accurately interpreting the results from statistical tests and applying it to big picture theory and concepts	3.81	1.05
Conducting scientific literature searches	4.00	1.10
Managing my time during a research project	4.13	0.89
Problem-solving in project design and concept	3.88	0.96

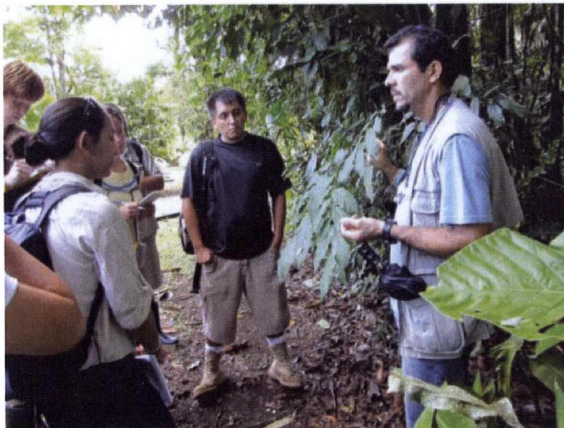
Table 3 NAPIRE 2011 Student self assessment of gains (n= 16)





NAPIRE students are challenged to learn scientific research procedures, the use of data collection equipment, and most of all, how to read scientific literature. Some of the students use the opportunity to obtain academic credits for their efforts. Research-mentors have helped students to publish and to create posters for presentation at research meetings. All this hard work translates into higher academic performance when the student returns to their institution.

The exposure to the scientific research is only part of the growth opportunity available to students during the NAPIRE internship. Throughout the summer students are required to live very closely with others having different backgrounds, beliefs, and behaviors. Tolerance is a necessary tool for career advancement in most cases and sharing bunk rooms, computer space, equipment, and just about everything else, provides a novel opportunity to learn tolerance.



NAPIRE 2010 Botany lecture at La Selva Biological Station

Other emotional growth, such as increased self-esteem, more confidence, greater independence, continuity, and persistence is fostered by the majority of the NAPIRE activities. In recent NAPIRE courses, the participants have had frequent (weekly) lectures and discussions on ethics in science, including discussions about the Green Revolution and global climate change.

PROGRAM COMPLETION

Completion of the student research paper is a major achievement, typically well beyond any prior academic effort of most NAPIRE students. See the Appendix for a list of the 97 research papers prepared by NAPIRE students.

Of the 107 summer students, ten did not finish the program by completing research papers (9%). Most of the reasons that students left the program early were expressed as personal and family-oriented problems (five students), although on two occasions students had to be sent home for disciplinary reasons. Another three students gave no reason for not turning in their final paper. All six students participating in the mini-NAPIRE completed their projects and are in the process of publishing their results with their mentor Dr. Doug Eifler.

Since 2006 the NAPIRE research papers have been collated into a yearly course book made available online on the OTS web page:

http://ots.ac.cr/index.php?option=com_content&task=view&id=305&Itemid=446.



ACADEMIC CREDIT AND RECOGNITION

At least twelve students (about 10%) have used their NAPIRE research experience to receive school internship credits or as a senior thesis. This percentage actually may be higher if one includes presentations and results presented as class work. About half of the 25% of the students that reported had made one or more presentations of their NAPIRE data. Eleven students have presented their research at National Meetings of SACNAS (Society for the Advancement of Chicanos and Native Americans in Science) and six at AISES (American Indian Science and Engineering Society). Other students have participated in regional AISES and SACNAS meetings, as well as regional AMP and AIHEC (American Indian Higher Education Consortium) research conferences, with their NAPIRE research results. Two NAPIRE alumni have won awards at the National AISES Conference, Jeremy Rude (NAPIRE 2009) took first place in undergraduate oral presentations, and Lisa Kapono (NAPIRE 2009) tied for third place in undergraduate poster presentations. Two NAPIRE alumni have received SEED fellowships from the Ecological Society of America.

Since 2006, all students that finished the NAPIRE summer program (97) have published their NAPIRE research results online. This will give them an advantage when applying for other opportunities or graduate school. Some (12) of the research results produced during NAPIRE have been published elsewhere, either via online publications (two), or with mentors (five), and some are still being prepared for



NAPIRE 2009 Kalyn Knaeble identifying invertebrates

publication (five). All six mini-NAPIRE students were invited for other summer internships in STEM; one of these returned to the tropics, and the group continues to prepare their three manuscripts for publication.

IMPROVED ACADEMIC PERFORMANCE

The NAPIRE course is scientifically rigorous. During the first two weeks students receive intense theoretical and hands-on instruction about tropical ecology. This period is geared towards helping the student understand the baseline concepts they will need for construction of their research question. The stimulating environment of the OTS biological stations offers students an impressive array of biodiversity, as well as access to world-class investigators who demonstrate their own long-term research projects. NAPIRE students come from a variety of backgrounds, experiences, and academic exposure, and, thus, lecturers and research-mentors can be challenged to teach at multiple levels, especially in terms of technical language and statistics. However, this also induces the research-mentor to use one-on-one guidance methods and to treat



each student individually. This helps every student see that they can achieve as much as they are willing to work. Some students take an improved work-ethic back to the university, according to some home-mentors.

Students also may make advances in technological capacity during NAPIRE. Most students learn to use Global Positioning Systems (GPS) to mark a location, and those students with previous classes in Global Information Systems (GIS) can build upon that knowledge by applying it in their individual research project.

NAPIRE 2009 student

"The other REU I participated in started the fire in me to do research, but the NAPIRE experience poured gasoline on it."

Chandra Legdesog,
Chaminade University of Honolulu

Each OTS site has a meteorological station which allows students to immediately correlate their findings to weather conditions.

Some students come with less computer experience than others. However every year students bring more expertise, and many students are more computer savvy than the mentors and OTS staff. However, arriving students may be limited in computer data analysis and statistics, or in formatting their written document. Students also gain

considerable experience during the course using PowerPoint to prepare their presentations. Exposure to ecological data analysis tools reinforces their use and application in other courses and could help a student feel more assured when applying for a related job.

POST PROGRAM CAREER TRAJECTORY

The NAPIRE program demonstrates what is required in ecological field research. It gives students firsthand knowledge of all the ups and downs, the boring periods, the uncomfortable conditions, and the wonderful "ah ha!" moments of discovery and completion. For most of the Native American students, this is a first exposure to the diversity of a tropical environment, and, although the Pacific Islands are tropical, most of the students from there have never experienced such diversity. Knowing what to expect and one's own physical capability and resistance levels can help clarify career choices. Field research is not for everyone, and finding this out early in one's career is important. The research-mentors and OTS professional staffs often serve as *ad hoc* career counselors. Since the trajectory of each of the professionals has been different, the program can showcase a variety of career paths. Some of the mentors were traditional students, going straight into their graduate studies after college. Others finished their bachelors degree and then took time off to work (or volunteer for the Peace Corps), before returning to graduate school later in life. Some completed their doctorates with full fellowships, while others worked their way through school. This variety of circumstances



lived by the research-mentors and OTS staff can show students that there are multiple options and routes to professionalize.

Between the research-mentors and the two-week introduction, the students have been exposed to a variety of ecological methods and equipment. Knowing how to use these tools can increase ones employment options and instill self-confidence. Exposure to a variety of techniques can help students decide what discipline is best for them.

After completing the NAPIRE experience, students are expected to return to their academic institution where they will continue their studies until they graduate. Of the approximately 75% of students who responded to OTS post-program survey, 52% graduated and 41% were still in school. Three others left school before graduation and, unfortunately, one of these students has passed away. No students reported changing their major upon returning from NAPIRE. Eighteen students came to NAPIRE from two-year colleges, of these seven have graduated with their Associates Degree, and four of these continued on to four-year colleges, from where two already have graduated. Of the remaining five participants who received Associate Degrees after participating in NAPIRE, three are working in STEM jobs, one is in Law Enforcement for Tribal government, and one is unaccounted for in our survey.

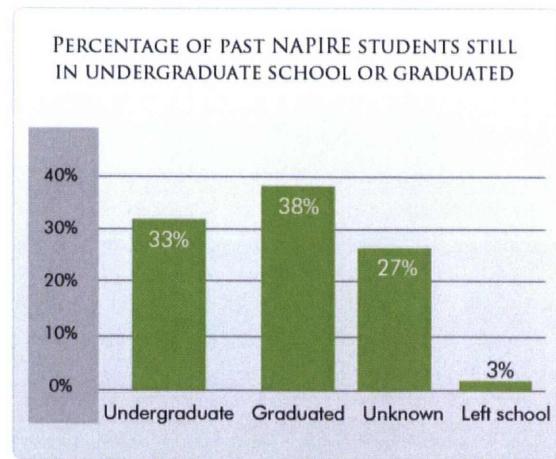


Figure 5 Percentage of NAPIRE students still in undergraduate school or graduated

Of the 14 community college students who responded to queries, nine, or 64%, are still in STEM careers, either in jobs or continuing their university studies.

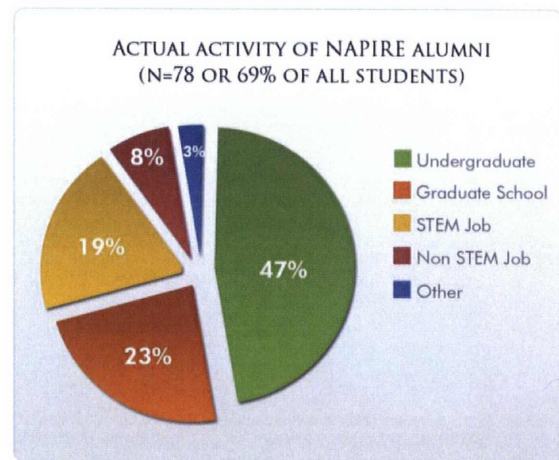


Figure 6 Present activity of 78 of 113 past NAPIRE students



Of the 78 NAPIRE students who have reported on their present activities, a majority (67) are currently in STEM careers, either in school or in the workplace (Figure 7).

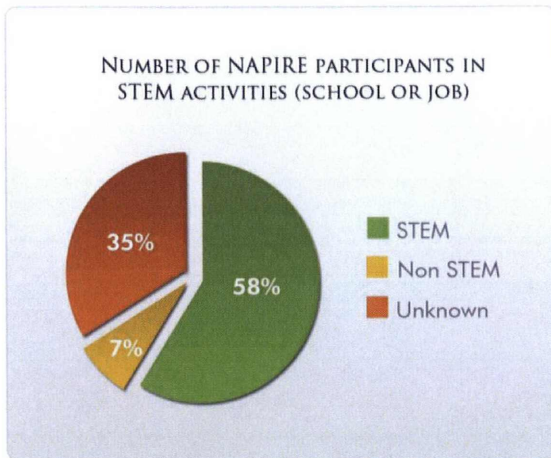


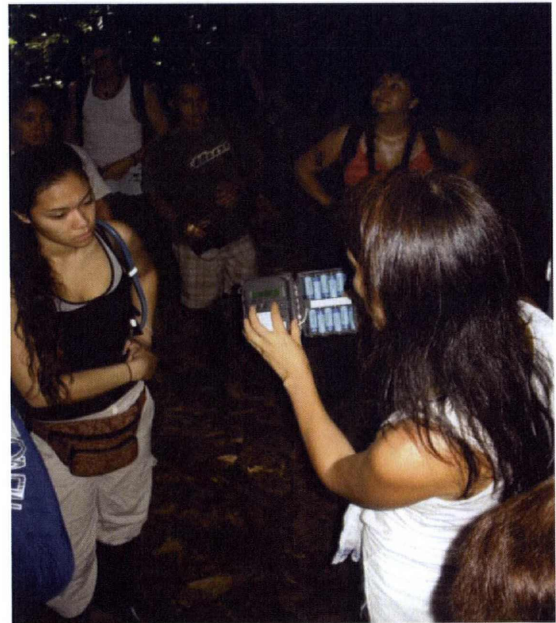
Figure 7 NAPIRE students that are still in STEM careers.

NETWORKING

An extra benefit gleaned during NAPIRE participation are the contacts. Students meet and can get to know personally at least ten Ph.D. professionals that do not come from the student's home-institution. Students also begin to build a cohort of colleagues from their fellow students, and some will become lifelong friends. By developing partnerships and alliances early in their career, students can make more efficient use of all potential resources, including formal and informal educational and career placement services. The more professional contacts a student has at graduation, the more likely he or she is of hearing about a job or other career opportunity.

Contacts with professionals from institutions other than one's own can increase student career opportunities.

Students that take full advantage of the NAPIRE experience by working hard and completing a good research project will find themselves with multiple offers for letters of recommendation. Two of our students have even been offered graduate positions through their research-mentor. Almost all research mentors and NAPIRE coordinators have produced letters of recommendation for students, and most mentors reported maintaining contact with the majority of their past students, meaning that this "recommendation benefit" may be requested at a future date.



NAPIRE 2011 Johana Hurtado shows a camera trap



Sometimes it is difficult for students from big university campuses to obtain personal letters of recommendation from professors that actually know them well enough to write a good letter. The professional relationships built during the NAPIRE program can help open doors to new opportunities.

Networking with students and mentors has grown and “modernized” since the first NAPIRE program in 2005.

NAPIRE 2010 student

“Napire has impacted my career by giving me my first opportunity to partake in research. Not only did I complete a research project, but I designed the project with the help of my mentor. This has impacted me by making me more interested in research related careers and future research internships.”

Nicole Kenote,
Colorado State University



NAPIRE 2011 student, Hayden Hedman, uses video to document male-male aggression in frogs

Since the NAPIRE 2008 class, students have kept in touch via their Facebook pages. In 2011 students created their own, open, Facebook group “NAPIRE OTS 2011.”

<http://www.facebook.com/groups/191412860907509/>.

On this page, NAPIRE students, staff, and mentors share pictures, as well as ask for and give moral support for life challenges. New communication technology, such as Skype, permits students to keep in regular contact with fellow NAPIRE participants at a fraction of the cost of traditional phones. Students are also using SMS to stay in contact.



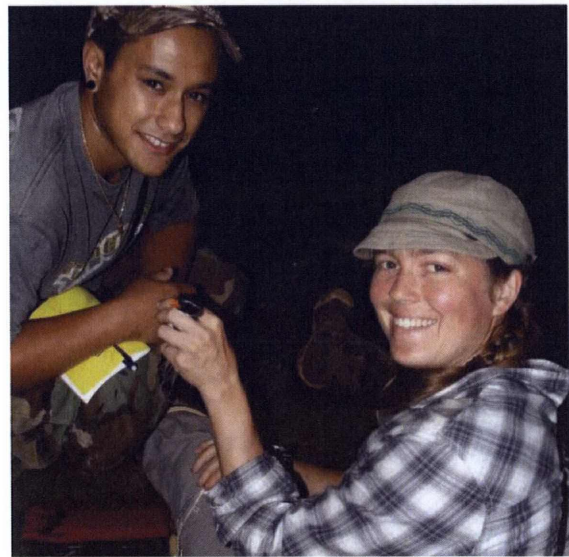
HOW ELSE DOES NAPIRE IMPACT SCIENCE AND SCIENTISTS?

The NAPIRE program impacts more than just the participating students. The mentors have the opportunity to continue and expand their research opportunities. Research-mentors and home-mentors are exposed to new places, environments, and cultures, strengthening their abilities as advisors to undergraduates. Home-mentors, their institutions, and AMP's benefit by increasing the amplitude of summer internship choices for their students, especially for those who still are exploring their options. And finally, the academic world benefits from the documentation of the research results that the students produce to complete the NAPIRE program.

NAPIRE RESEARCH MENTORS

Thirty-two ecological researchers have participated in the NAPIRE program as research-mentors to NAPIRE students. The average number of years a research-mentor participates is 1.44 (STDV 0.62, $n=32$), showing that the majority of volunteers repeat the task. The average number of students mentored by each professional is 2.71 (STDV 1.47), and 3 professionals have 7 mentored students in 3 years of participation each. Mentors say they return because of the challenge, the lifetime contacts, and the chance to be a formative part of a deserving young person's future. Almost all of the research-mentors have contacted participants in the program since their experience, and most have written letters of recommendation for them. Since good

mentoring for underrepresented minorities includes assisting students in finding career paths, guidance by research-mentors contributes to establishing and maintaining a diverse academic environment (George *et al.* 2001). Mentors can feel good about having this important role in a student's life.



Joshua Pang Ching and Dr. Jamie Cornelius take measurements on the orange billed sparrow. NAPIRE 2011

NAPIRE offers an opportunity for beginning or established Ph.D. professionals to continue with their research venue or even design a new one. The Las Cruces Biological Station gives access to various primary, fragmented, and restored habitats at different elevations, all within a day's walk of a comfortable living arrangement. Research-mentors can benefit from having willing student to uncover trends and collect data for long-term research



programs. Mentors have reported benefitting from published papers from NAPIRE research.

NAPIRE HOME-MENTORS

Home-mentors or on-campus-mentors fill a very important role for NAPIRE. It is the home-mentor who needs to advise the NAPIRE coordinators of an applicant's limitations and experience. The home-mentor also is important in guiding their accepted students through the paperwork and passport procurement. The home-mentor needs to be available throughout the summer to mediate if problems arise and give moral support to a homesick student. Recently home-mentors have been invited to the final presentations live, via Skype. Responding to home-mentor requests, the program now sends all proposals and final documents to them for their evaluation. Many of the NAPIRE alumni are encouraged to present their research results at their home-institutions.

In order to expand the home-mentors understanding of the target students, NAPIRE in recent years has organized a workshop in Costa Rica. The expressed purpose of these workshops is to promote communication between home-mentors, research-mentors, and OTS staff, and, as result, the event has been very useful for understanding NAPIRE students. The NAPIRE workshop has been the first international travel for some home-mentors.

The workshop also serves to introduce the home-mentor to the NAPIRE program. Home-mentors can experience first-hand the living conditions, food, and insects, thus, enabling

them to give accurate advice to their students. During the visit to the station they see wildlife and plants that most of them have never seen outside of a zoo or botanical garden. A visit to a local supermarket gives them the opportunity to know what can and cannot be obtained, thus, improving their ability to guide the students they send to the summer NAPIRE program.



Recording songs as part of a research project during NAPIRE 2009

At the workshop home-mentors can exchange experiences with other invitees and increase their own knowledge. These contacts can be an important part of future networking, and, in fact, many of home-mentors already know each other. Home-mentors also are taken to the Brunka Indigenous community to give them a chance to expand their home-view.

NAPIRE HOME INSTITUTIONS

Students were accepted from 47 institutions from all over the United States and the Pacific Islands. Most schools were four-year colleges, only 10 were community-college level (21%).





Table 4 Home Institutions and AMPs of NAPIRE students

LSAMP Institutions			Students
All Nations			
	Haskell Indian Nations University		6
	Salish Kootenai		4
	Sitting Bull College		4
	Southwestern Polytechnic Institute	Indian	4
	University of Montana		1
All Nations and Wisconsin AMP			
	College of the Menominee Nation		3
CAMP			
	California Polytechnic University		1
	CSU San Bernadino		1
	Humboldt State University		6
	San Jose State University		1
Colorado State University AMP			
	Colorado State University		3
	Fort Lewis College		4
	Trinidad State Junior College		1
	University of Colorado Boulder		1
Islands of Opportunity			
	American Samoa Community College		3
	Chaminade University of Honolulu		2
	Kapi'olani Community College		2
	Leeward Community College		1
	Northern Marianas College		1
	Palau Community College		3
	University of Guam		6
	University of Hawaii		2
	University of Hawaii at Hilo		13
	University of Hawaii at Manoa		10
Michigan LSAMP			
	University of Michigan		1

LSAMP Institutions		Students
New Mexico AMP		
	New Mexico State University	2
New Mexico AMP WAESO		
	University of New Mexico, Main Campus	1
North Carolina AMP		
	University of North Carolina-Pembroke	2
North East		
	University of Rhode Island	1
North Star STEM		
	Macalester College	1
Ohio Science and Engineering Alliance		
	Ohio State University	1
OK LSAMP		
	Northeastern State University	1
	Oklahoma State University	1
	University of Oklahoma Stillwater	2
Pacific AMP		
	University of Alaska-Anchorage	2
Pacific AMP & Pacific Northwest AMP		
	University of Washington	1
Pacific Northwest AMP		
	Washington State University	1
The Upstate Alliance		
	Cornell University	1
Western Alliance to Expand Student Opportunities		
	University of Arizona	1
	University of Nevada Las Vegas	1
Non LSAMP		
	Black Hills State University	1
	Duke University	1
	Hotchkiss	1
	Leech Lake Tribal College	2
	Northern Arizona University	2
	University of Vermont	2



LSAMP INSTITUTIONS

The NAPIRE program offers opportunities to students from any LSAMP-affiliated school, thus, increasing the diversity of experience-based opportunities the AMPS can offer their students. By offering greater diversity in scientific internships, students can gain broader exposure to a variety of disciplines in science. To date, 17 LSAMP alliances have sent students to NAPIRE.

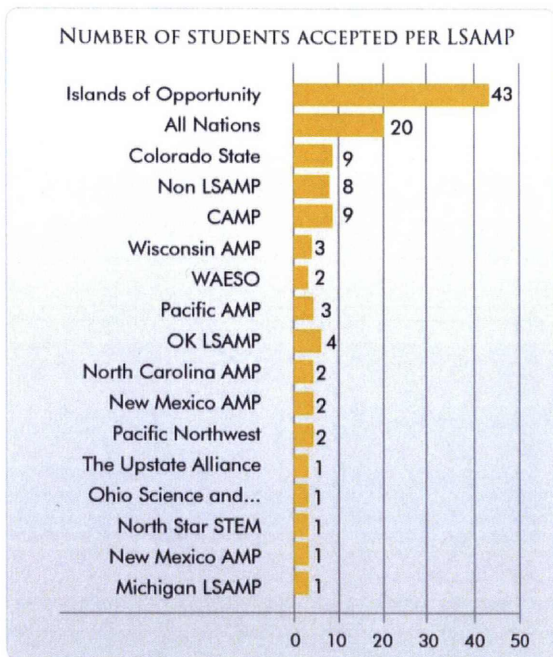


Figure 8 Frequency of students from different LSAMP alliances

NAPIRE IMPACT IN COSTA RICA

The OTS biological stations are maintained through funds received for hosting courses and other events. Prior to the NAPIRE program, the Las Cruces Biological Station was under-utilized. The funds obtained from housing the NAPIRE students, the research-mentors and

their family members plus NAPIRE staff, has increased station usage and helped to attract and promote further research interest at the station by virtue of the many visiting mentors over the year.

The NAPIRE students themselves also contribute to the income of Costa Rica. They pay foreign visitor use-fees for every day they are in Costa Rican National Parks, private reserves, or when they visit museums. At every stop made, students buy snacks, sodas and other personal supplies at convenience stores, supermarkets, and local shops. While at Las Cruces, students make numerous trips to the nearby town of San Vito to stock up on their particular treats or needs. Making a run to town for pizza or milkshakes is a favorite free time activity. This may not seem like a lot, but if every student leaves only a third of their stipend in Costa Rica, it means that at least \$20,000 is spent in Costa Rica by NAPIRE students.



NAPIRE 2011 Adel Nez learns how the Brunka women weave their textiles



Cultural exchanges between NAPIRE students and Costa Rican Indigenous communities also can have a financial impact on a community. When the Program visits the Talamanca Bribri students stay at their training center and hire Bribri guides to show their culture, agriculture, and chocolate production. This puts money directly into the economy of the community. Students buy almost all the beautiful folk art that the indigenous artisans have to show them. In one visit to the Brunka community, it was calculated that at least \$2,500 was spent by the NAPIRE group purchasing local artwork. A visit from NAPIRE doesn't just mean seeing a cultural presentation, it also can mean good sales, depending on the handiwork the host community has on hand.

In recent years the NAPIRE students have been organizing a cultural presentation with songs, dances, and other cultural manifestations from their homes. Local students love this opportunity to see and hear people from another part of the world, with a culture very distinct from what they know. The receptivity of NAPIRE's cultural "gift" has grown every year and is becoming a part of some local schools activities.

IMPACTS OF NAPIRE ON THE ACADEMIC COMMUNITY

There have been 76 research projects, some having multiple authors (See Appendix 1), and about 11 short faculty-led group research projects. Three papers are still in preparation from the Mini NAPIRE.

All data is available online to the scientific community thanks to NSF, OTS, and the NAPIRE students.

The information gathered is a continuum of tropical ecology themes, forest restoration being the most conspicuous research focus in NAPIRE with eleven papers produced. This is due to the long-term restoration efforts and research in Las Cruces area.

The restored areas have the necessary historical information to make it possible to take measurements or observations in known-age stands. The birds, amphibians, reptiles, and mammals at Las Cruces have been popular research subjects, as well as the freshwater invertebrates and water systems.

NAPIRE 2006 student

"Costa Rica is one place I will never forget... I believe we came together in the group for reasons far greater than who we are as humans. Thank you for letting me stay there, it was the most difficult experience - emotionally. But my family told me they feel that I have gotten much stronger, they know me better than I know myself".

Sarah Kissoon,
Haskell Indian Nations University



NAPIRE papers on different topics	No.
Forest Restoration	11
Birds	9
Amphibians and reptiles	9
Freshwater System	6
Mammals	6
Plant-Animal Interactions	6
Freshwater Invertebrates	5
Ants	4
Phytophagous	4
Soils	3
Tropical Succession	3
Bio-Control	2
Health	2
Human Ecology	2
Water Quality	4
Geomorphology	1
Invertebrates	1
Malacology	1
Total	79

Table 5 Topics of NAPIRE student research papers

The human ecology, health, water quality research projects have produced information that is very important to the Ngöbe Indian territory near Las Cruces. The water quality results helped the Coto Brus County Health Services pinpoint contaminated water sources.



NAPIRE 2011 Students learn about moth and butterfly pupas at La Selva Biological Station

The same health services agency used results from NAPIRE research to demonstrate to their central office that they also need to be concerned about veterinary care of the animals kept by the Ngöbe Indigenous People because they are reservoirs of intestinal parasites and other diseases.



NAPIRE 2010 Examining a squirrel for ectoparasites in the Las Cruces laboratory

One health study done by NAPIRE has helped them convince administrators in the capital of San José that Gastric Cancer is more prevalent in Coto Brus region surrounding Las Cruces than anywhere else in Costa Rica. Still another research project helped document improvements in infant mortality as a result of more culturally sensitive actions from the county health workers. It is fair to say that the research by the Native American and Pacific Islanders of the NAPIRE program have catalyzed positive changes for the local Ngöbe community.





CONCLUSION

Underrepresented groups can be discouraged from careers in ecology and environmental science by a scarcity of role models and a lack of knowledge about the culture and idiom of science and the academy. Mentoring can be one of the most effective tools in helping to attract, nurture and encourage students to persist (American Society for Mechanical Engineers 2006).

Participation in the NAPIRE program gives an advantage to alumni in these ways:

- Deciding whether they will pursue a career in ecology, or stay in STEM.
- Individual guidance from an experienced researcher, who can later become an important contact for future opportunities in the sciences.
- Familiarity with a wide variety of field methods, tools and equipment and research projects.
- An independent research project, final paper, and presentation completed.
- Opportunity for personal and emotional growth, especially in self confidence.
- Knowledge about Costa Rican Indigenous people, their customs, history and present reality.
- Emersion in an international experience in a foreign language speaking country.



NAPIRE 2009 class with Dr. James Hicks, who came to hear their research presentations in Las Cruces, Costa Rica.



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- Kapono, L. 2009, Cultural Effects of Habitat Fragmentation on the Song Bird *Arremon aurantirostris* (Orange Billed Sparrow) in Coto Brus, Costa Rica.
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