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Author(s): Berry J. Brosi, Michael J. Balick, Robert Wolkow, Roberta Lee, Mark Kostka, William Raynor, Robert Gallen, Ally Raynor, Pelihter Raynor and Dana Lee Ling

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# Cultural Erosion and Biodiversity: Canoe-Making Knowledge in Pohnpei, Micronesia

BERRY J. BROSI,\*†† MICHAEL J. BALICK,\* ROBERT WOLKOW,† ROBERTA LEE,‡  
MARK KOSTKA,§ WILLIAM RAYNOR,§ ROBERT GALLAN,§ ALLY RAYNOR,§  
PELIHTER RAYNOR,§ AND DANA LEE LING\*\*

\*Institute of Economic Botany, The New York Botanical Garden, Bronx, NY 10458, U.S.A.

†Columbia University, Center for Environmental Research and Conservation, New York, NY 10027, U.S.A.

‡Beth Israel Continuum Center for Health and Healing, New York, NY 10016, U.S.A.

§The Nature Conservancy, P.O. Box 216, Kolonia, Pohnpei 96941, Federated States of Micronesia

\*\*College of Micronesia—FSM, P.O. Box 159 Kolonia, Pohnpei 96941, Federated States of Micronesia

**Abstract:** *Erosion of traditional knowledge and practice is a serious and accelerating problem, but quantitative work on traditional knowledge loss and its importance to biodiversity conservation is lacking. We investigated traditional knowledge of canoe making, a skill heavily dependent on plant biodiversity, on Pohnpei, Federated States of Micronesia, through a survey of 180 island residents. Our results showed that there has been an intergenerational erosion of canoe-making skills. Given current trends, the present generation of Pohnpeiians may be the last to retain any knowledge of this traditional craft. We also identified several correlates of knowledge loss—including Western educational level and occupation—that highlight potential avenues for skill conservation via governments, traditional leadership, and schools. These institutions could intervene to emphasize traditional knowledge, which would reinforce institutional contexts in which traditional knowledge and practice is valued. The heightened awareness of the value of biodiversity that is linked to traditional knowledge is key to biological conservation on Pohnpei and can help support local conservation programs.*

**Keywords:** conservation, quantitative survey, traditional knowledge, traditional skills

Erosión Cultural y Biodiversidad: Conocimiento sobre la Manufactura de Canoas en Pohnpei, Micronesia

**Resumen:** *La erosión del conocimiento y práctica tradicional es un problema serio y en aceleración, pero se carece de trabajo cuantitativo sobre la pérdida de conocimiento tradicional y su importancia para la biodiversidad. Investigamos el conocimiento tradicional sobre la manufactura de canoas, un oficio estrechamente dependiente de la biodiversidad de plantas, en Pohnpei, Estados Federados de Micronesia, mediante una encuesta a 180 residentes de la isla. Nuestros resultados mostraron que ha habido una erosión intergeneracional de las habilidades para la manufactura de canoas. Con las tendencias actuales, puede que la generación presente de Pohnpeiianos sea la última en retener cualquier conocimiento de esta artesanía tradicional. También identificamos varias correlaciones de la pérdida de conocimiento—incluyendo nivel educativo y ocupación Occidentales—que ponen de relieve potenciales avenidas para la conservación del oficio por medio de gobiernos, liderazgo tradicional y escuelas. Estas instituciones podrían intervenir para enfatizar el conocimiento tradicional, que podría reforzar los contextos institucionales en los que se valoran el conocimiento y prácticas tradicionales. El incremento de la percepción del valor de la biodiversidad que está ligada al conocimiento*

††Current address: Center for Conservation Biology, Department of Biological Sciences, Stanford University, 385 Serra Mall, Stanford, CA 94305, U.S.A., email [bbrosi@stanford.edu](mailto:bbrosi@stanford.edu)

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*tradicional es clave para la conservación biológica en Pohnpei y puede ayudar a apoyar programas locales de conservación.*

**Palabras Clave:** conocimiento tradicional, conservación, encuesta cuantitativa, oficios tradicionales

## Introduction

As globalization continues to homogenize human society, erosion of traditional knowledge is becoming a serious problem. This loss of traditional knowledge has implications not only for cultural preservation, but also for the conservation of biological diversity (e.g., Maffi 1998; Liu et al. 2002; Nabhan et al. 2002) and the potential development of economic products (e.g., medicines; Cox & Balick 1994).

At the request of the Pohnpei Council of Traditional Leaders, we quantitatively assessed the changes in a biodiversity-based traditional practice—the complex and culturally important skill of canoe making—on Pohnpei in the Eastern Caroline Islands, Federated States of Micronesia. We also sought to identify groups of people and trends associated with particularly high and low levels of traditional knowledge loss to identify avenues for the conservation of canoe-building skills (e.g., Ghimire et al. 2004). This work involved Pohnpeians in every aspect, from planning through implementation and analysis.

A pilot study documented canoe making as the most rapidly eroding of five plant-based skills on Pohnpei (Lee et al. 2001). To examine more fully the temporal trends in traditional canoe-making knowledge, we constructed a survey instrument that was more detailed than that used in the pilot study and administered it to a larger and more representative sample of Pohnpeians. The survey had two major foci: to quantitatively assess whether canoe-making knowledge is eroding on Pohnpei and to identify social factors that may influence trends in knowledge transmission.

## Methods

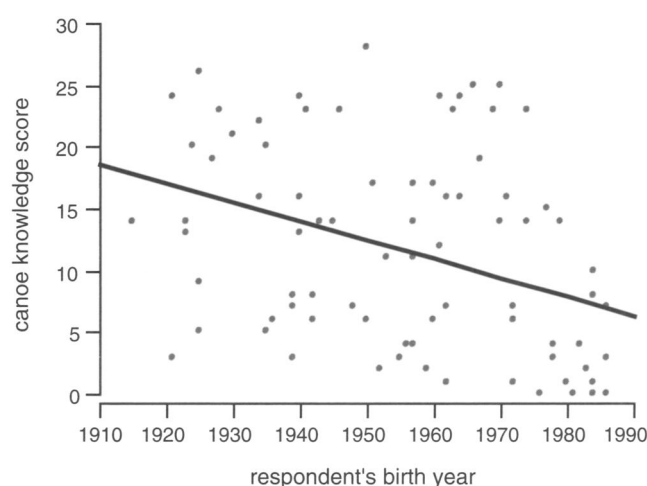
The survey instrument contained 72 categorical and open-ended questions, including sections on demographic information, canoe-building knowledge, patterns of canoe use, and possible correlates of canoe-making knowledge. An interdisciplinary panel of scientists with field experience in Pohnpei and local residents substantially improved earlier survey drafts. We administered the survey to identify potential interventions for conserving traditional knowledge in Pohnpei. Bilingual Pohnpeians (M.K., R.G., and A.R.) administered the survey in the Pohnpeian language in July 2001. Each respondent was briefed on the purpose and nature of the work, assured anonymity, and provided oral consent prior to administra-

tion of the survey. We interviewed 180 people (approximately 0.5% of the island's population) that were stratified by gender, age, and island municipality. We report only male responses ( $n = 90$ ) for the bulk of our analyses because traditionally only men build canoes.

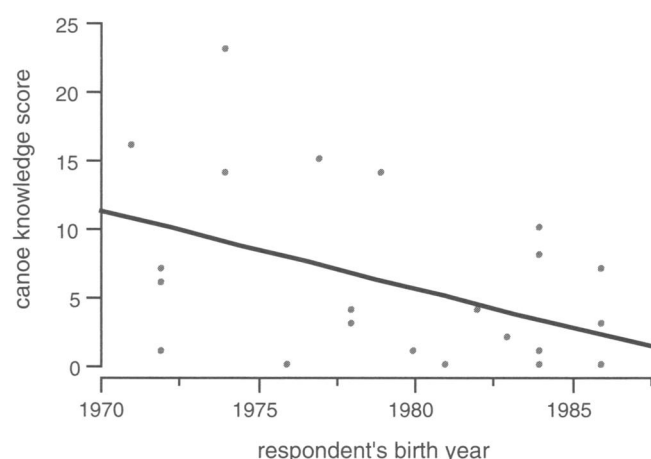
Due to correlations in survey data, we collapsed canoe-knowledge responses (number of canoes built, canoe ownership, number of canoe varieties known, number of plants used in canoe construction known) into a linear canoe-knowledge index, in which greater knowledge corresponded with higher scores. As a check, we compared results in all statistical tests with the first axis of a principal components analysis (PCA) derived from the same variables, which returned the same patterns in all cases. We analyzed our data with Kruskal-Wallis tests (due to non-normality of data), linear regressions, and chi-square tests, all in JMP 5 (SAS Institute, Cary, North Carolina).

## Results

Traditional canoe knowledge declined in Pohnpei. Canoe knowledge differed significantly among generational age classes ( $<30$ ,  $30-60$ , and  $60+$  years of age; Kruskal-Wallis  $H_{2,82} = 18.26$ ,  $p < 0.0001$ ), declining from the oldest to the youngest generation. Canoe knowledge also continuously declined with a respondent's birth year ( $F_{82} = 12.8$ ,  $p = 0.006$ ,  $r^2 = 0.14$ , Fig. 1). Evaluated separately, there



**Figure 1.** Canoe-knowledge score as a function of respondent's birth date (linear regression  $p = 0.006$ ,  $r^2 = 0.14$ ).



**Figure 2.** Canoe-knowledge score as a function of respondent's birth date for the youngest generation (respondents 30 or younger; linear regression,  $p = 0.007$ ,  $r^2 = 0.44$ ).

was no relationship between the over-60 and 30–60 age classes; however, for the <30 age class, canoe knowledge significantly declined with birth year ( $F_{23} = 5.63$ ,  $p = 0.027$ ,  $r^2 = 0.20$ , Fig. 2), which supports our hypothesis that canoe knowledge is declining most rapidly in the youngest generation. Among members of the youngest age class, only 27.8% had participated in building at least one canoe, whereas 70.3% of the oldest generation and 66.7% of middle-aged respondents had built canoes ( $\chi^2_2 = 6.63$ ,  $p = 0.03$ ). Moreover, several respondents between the ages of 15 and 30 had a canoe-knowledge index score of zero, whereas all respondents above the age of 30 scored positively on the canoe-knowledge index.

Geographically static respondents (those who had lived in the same place as their extended family for most or all of their lives) evaluated on a 4-point scale had marginally higher levels of canoe knowledge than those who moved more ( $H_4 = 8.05$ ,  $p = 0.045$ ). Canoe scores from respondents living in the most rural municipalities did not differ significantly from those in more populous ones ( $H_1 = 0.82$ ,  $p = 0.37$ ). The number of times a respondent traveled off the island also had no effect on his canoe score ( $H_4 = 0.63$ ,  $p = 0.89$ ). Respondents involved in canoe racing had much higher canoe-knowledge scores than their counterparts who did not race canoes, for both men and women ( $H_1 > 16$ ,  $p \ll 0.0001$  in both cases).

Education and occupation were significantly related to canoe-knowledge scores. The more formal Western education a respondent had, the lower he was likely to score on the canoe-knowledge index ( $H_2 = 18.75$ ,  $p \ll 0.0001$ ). Occupation had a similarly strong effect: respondents in nonindustrial professions (farming and fishing) had significantly higher canoe-knowledge scores than their counterparts ( $H_1 = 13.24$ ,  $p < 0.0001$ ). Government employment was not related to canoe score ( $H_1 = 0.40$ ,  $p =$

0.53), but when only middle-aged respondents were considered, the effect was significant ( $H_1 = 5.02$ ,  $p = 0.025$ ), in large part because traditional knowledge was generally high in the oldest generation and low in the youngest. Respondents with family members in governmental jobs also scored significantly lower than their counterparts (excluding respondents with government jobs;  $H_1 = 13.24$ ,  $p = 0.0003$ ).

## Discussion

We found evidence of declining canoe knowledge on Pohnpei, and at current rates of knowledge loss, canoe-making skills could disappear within a generation. Respondents with less formal education, nonindustrial professions, and those involved in canoe racing had higher levels of canoe knowledge than other sectors of the population.

Ragone et al. (2004) found a similarly strong relationship between age class and mean number of breadfruit cultivars reported in Samoa and documented an inverse relationship between knowledge of breadfruit and quantity of formal education, showing strong parallels with our findings. In contrast to our results, however, Ragone et al. (2004) found that residents of more traditional villages are able to list a greater number of cultivars than residents of less traditional villages. We did not find a relationship between municipality and canoe knowledge. Pohnpei, however, is both much smaller and more homogeneous than Samoa, and there are essentially no “traditional” villages left there. Our data on geographic fidelity lend support to the idea that people rooted in one place—as traditional Samoans are also likely to be—are more likely to acquire and maintain traditional knowledge and practice.

It is possible that our results on knowledge erosion are an artifact of the complexities of canoe making, the skills of which take a long time to learn completely. If this were true, younger people would generally have lower levels of canoe knowledge than older people, even in the absence of skill erosion. The nature of canoe building, combined with aspects of our data, however, support the hypothesis that these trends are truly due to knowledge erosion as opposed to gradual accumulation. Foremost, canoe building is not traditionally an age-restricted or secretive activity. A typical Pohnpeian man would learn this skill by watching and participating in boat construction beginning at a very young age (M.K., W.R., and R.G., personal observation). Given this, if knowledge were not declining, we would have found statistically even proportions of people in each age group who: (1) had participated in canoe construction and (2) who had at least some minimal knowledge of canoe construction. We found the opposite in both cases. This supports our conclusion that the age-based decline in canoe knowledge is due at least partially



to knowledge erosion, instead of purely due to the complexity of the skill.

Traditional knowledge is not a static entity for any set of skills in any culture, and people often change their techniques when easier methods become available. The wholesale and rapid loss of an entire set of traditional knowledge, however, is clearly different than gradual cultural evolution. It is possible that in the next several years, if no interventions are undertaken, the current generation of Pohnpeian children will never develop the skills needed to construct traditional canoes and thus will be unable to pass the practice on to their descendants. This trend is being driven by globalization (e.g., Benz et al. 2000), exacerbated by escalating Micronesian dependence on U.S. Government aid, which has led to high (approx. 20%) levels of government employment. This and other economic factors have increased the opportunity cost of acquiring and maintaining canoe-building skills, meaning that spending time learning how to operate and maintain outboard-motor-driven fiberglass boats is socially and economically more adaptive than learning traditional canoe making. U.S. Government funding and the future availability and price of gasoline are volatile, however. If either changes, the economic balance between paddle canoes and fiberglass outboards could shift. For example, in a 2005 trip to Pohnpei, one of us (M.B.) spoke to a fisher who stated that the increases in the price of gasoline (approx. US\$3.50/gallon at the time) meant that he no longer fished outside the reef; thus, his catch was reduced. If sudden additional increases in energy prices were to happen, say, in 20 years—after many of the most knowledgeable canoe makers have died—it could result in significant adversity for the people of Pohnpei.

Canoe making is a strongly biodiversity-dependent skill set, requiring a diverse and specific group of plants to construct the various parts of the canoe. Respondents in our survey identified at least 27 species of plants—both wild harvested and cultivated—used in the construction of canoes on Pohnpei. These ranged from *Artocarpus altilis* and *Ceiba pentandra* for hulls, to *Ixora casei* for the upright portion of the outrigger, to *Atuna racemosa* for production of a varnish to cover the canoe. This diversity of botanical raw materials used in the construction of Ponapean canoes is similar to that reported by Banack and Cox (1987) in Fiji and that presented in the classic work on Pacific Island canoe construction, *Canoes of Oceania* (Haddon & Hornell 1975).

On Pohnpei the management and harvest of plants for canoe building helps in maintaining respect for the value of biodiversity. Without an appreciation of the importance of specific plants in canoe making, another local incentive for wilderness conservation would disappear. Yet, this one example can be multiplied by the hundreds of other biodiversity-dependent traditional practices on Pohnpei—including production and harvest of plants for food, fiber, construction materials, and

ethnomedicines—that are fading rapidly. Traditional leaders have told us that without respect for Pohnpeian culture, there can be no respect for the environment and thus the biodiversity and ecosystems it contains. The bond between people, culture, and the environment is central to traditional Pohnpeian life.

Garabaldi and Turner (2004) proposed the use of the phrase *cultural keystone species* to describe species that have a key role in “defining cultural identity,” based on Paine’s (1969) keystone species concept. Cultural keystone species are taxa of great utility to an individual culture, independent of their ecological dominance, whose disappearance would have damaging cascade effects on the culture. Perhaps specialized traditional practices of great importance to local cultures, such as canoe making, deserve similar recognition in some contexts. Such essential skills and practices, if vital to sustaining other cultural activities, could be considered cultural keystone *practices*. Cultural keystone practices, like canoe making, are likely to be complex and evolve over long periods of time and, as in this case, depend on a broad range of local materials derived from nature—further establishing the importance of conserving the local environment and managing its resources in a sustainable manner.

To help preserve canoe-making knowledge, our results suggest that a successful intervention would include emphasis in three different areas: education, government, and canoe racing, which would reinforce institutional contexts in which traditional knowledge and practice is valued (Ghimire et al. 2004). Canoe knowledge decreased as formal education increased among Pohnpeians, thus likely affecting those islanders most likely to be leaders in government, business, and education. Thus, a natural first step would be to incorporate traditional knowledge, including canoe making, into school curricula in Pohnpei. Although this effort is perhaps best started in early childhood, a separate educational program for government workers could help improve awareness and support of traditional knowledge among the island’s decision makers. Two of us (D.L. with help from M.B.) have initiated an ethnobotany course at the National Campus of the College of Micronesia that teaches plant-based traditional knowledge through lectures and practical experience, which provides cultural support and academic training. Community education outside the formal classroom is also a key element of supporting the continued practice of traditional knowledge. The Pohnpei Ethnobotany Project has taken steps toward this goal by producing a series of articles on traditional use of plants for the local newspaper, *The Kaseleblie Press*. This type of cultural support is essential to maintaining an understanding and perception of the value of traditional knowledge.

Encouraging canoe racing, already an official sport in the Micronesian Games (a type of regional Olympics) could be another effective intervention in saving canoe knowledge, especially because it gives people an

incentive to learn to build and maintain traditional canoes. Racing leagues could be set up or altered such that the canoes utilized would have to be built by the participants, perhaps with a restricted amount of nontraditional building materials. Presently, traditional leaders are encouraging canoe racing as a source of village, municipal, and island pride.

Other arguments aside, the human race is more impoverished with the loss of any set of traditional knowledge, and especially so in the face of the homogenizing force of globalization. Because of the immense scale of traditional knowledge erosion in virtually all areas of the globe, we invite other researchers, conservationists, and development workers to assess the loss of traditional knowledge and practices, identify areas for interventions, and help make those interventions happen in the areas where they work. Efforts at strengthening awareness of the link between culture and the environment can be very helpful in supporting local conservation programs, and important for personal, community, and environmental well-being around the world.

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