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Cultural Significance of Pacific Fruit Bats (Pteropus) to the Chamorro People of Guam

Conservation Implications

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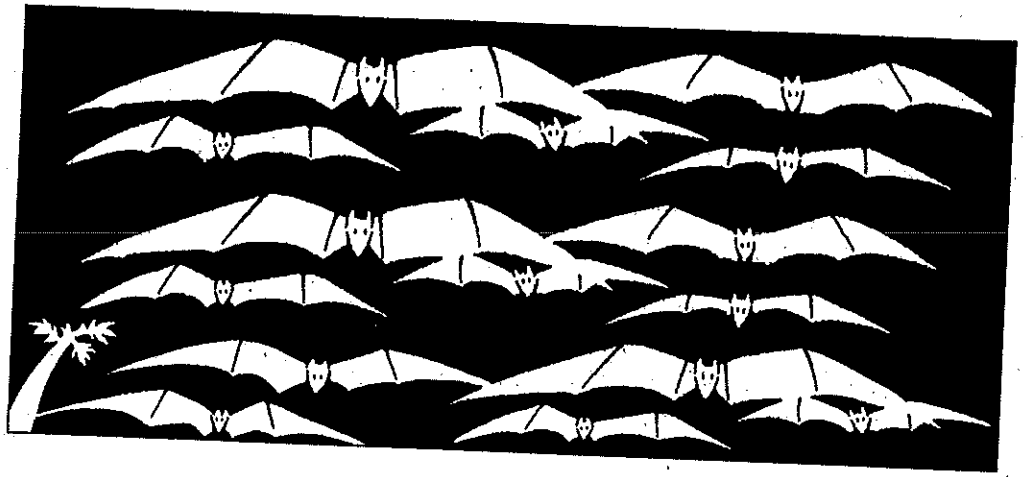

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PART I: BACKGROUND

INTRODUCTION AND LITERATURE REVIEW

It has become increasingly apparent in recent years that for conservation to be effective it must not depend solely on science and regulation as instruments of information and change. Political, economic, and social factors are critical forces in natural resource degradation and scarcity, and ignorance of these factors compromises the effectiveness of many otherwise sound conservation efforts. Science and regulation alone may positively impact habitat recovery or species survival, but an expanded vision of the problem at hand can greatly improve long-term prospects. An integrated approach to natural resource conservation, therefore, requires an understanding of the multiple driving forces behind resource loss. Increasingly, conservationists are looking beyond science to understand human perceptions, political influences, economic forces, and other societal factors.

Fruit bat (*Pteropus* spp.) conservation in the Pacific region offers an illustrative example of this concept. The Mariana fruit bat (*Pteropus mariannus mariannus*), a subspecies endemic to the Marianas archipelago, has been favored traditionally as a "delicacy" among the Chamorros, the indigenous people of the Mariana Islands. Heavy market pressures in Guam over the past several decades have contributed to an ever-widening circle of declining fruit bat populations across the region, with Guam's own populations having been in trouble since World War II. These declining populations have stimulated scientific research and extensive lobbying efforts, which have resulted in more effective protective legislation regionally and globally (Wiles et al. 1989, Bräutigam and Elmqvist 1990, Wiles 1990a), as well as in increased interaction between interested parties. A good example of this was the Pacific Island Flying Fox Conference, held in Hawaii in February, 1990, and hosted by Bat Conservation International. At this conference, wildlife managers from the Pacific islands, scientists, and conservationists came together to address issues relevant to conservation of the region's fruit bats. A broad range of topics were presented, from biology to population status to protective policies to education (Wilson and Graham 1992). In addition, recent trade figures suggest that new international trade regulations and their intensified enforcement on Guam appear to have slowed the trade significantly (Wiles 1991b). pers. comm.

However, the market demand itself has not been addressed, and the threat remains that poaching and smuggling of bats from nearby islands will increase to supply the market. To influence demand effectively on a long-term basis, conservationists must understand it better. This will require greater attention to the concerns and interests of the people with whom the market originates. There has been little Chamorro involvement to date in fruit bat conservation. Conservation initiatives ideally should be locally inspired, guided, and managed, with the active participation at all levels by Guam's indigenous inhabitants (approximately half of the island's populace). This project represents an attempt to identify local concerns among the Chamorros of Guam-their attitudes toward fruit bats, other species of wildlife, and the environment in general-so that these concerns may be integrated into conservation initiatives. It is hoped that this approach will stimulate increased Chamorro participation in Guam's conservation programs.

This report is designed to be easily used by readers with various levels of familiarity with Guam and fruit bat conservation. It is divided into five major sections. Part I provides background information on Guam's physical setting and its human and nonhuman inhabitants. A brief review of *Pteropus* ecology, biology, and conservation status is provided. In Part II, the methodology for

various stages of the project are described and results presented. Only data from certain questions, selected as the most useful to the overall aims of this project, are presented and discussed in this and the subsequent section. However, additional data are presented in absolute and relative form in the appendices for further information to the reader. Part III provides a summary of results, a discussion of their importance and meaning, and suggested measures that might help to create greater conservation awareness among Chamorros and other inhabitants of Guam. The final two segments of this report provide references and appendices.

Guam

Flora and Fauna

The Marianas archipelago consists of two political units: the Commonwealth of the Northern Mariana Islands (CNMI), and the unincorporated U.S. territory of Guam. At approximately 554 km^2 (214 mi^2), Guam is the largest and southernmost of the archipelago's islands, which extend from approximately 13°N to 21°N latitude and 144°E to 147°E longitude in the western Pacific. Guam's northern half consists almost exclusively of coralline limestone plateau, about 90 to 180 ms above sea level. Southern Guam is hilly (some 400 ms at the highest point) and based largely in volcanic material (Stone 1970). Permanent streams exist only in southern Guam. In the north, water percolates through the porous limestone to an underground freshwater lens (Stone 1970), the island's primary source of fresh water.

Guam's climate is relatively uniform throughout the year. Rainfall averages about 2,200 mm (86.6 in) annually (Stone 1970). Prevailing winds from the east bring relatively severe typhoons every 15 to 20 years, while "extraordinarily" severe storms with winds of up to 200kn (230 mph) may occur perhaps once in a century (Stone 1970).

Much of southern Guam is covered with swordgrass (*Miscanthus*, *Dimeria*, and *Phragmites*). This savanna ecosystem appears to have been created and maintained by fires and by the overgrazing of introduced ungulates (Stone 1970). The northern part of the island supports denser and more diverse vegetation, referred to as "typhoon forest" and typified by representatives of the genera *Artocarpus*, *Ficus*, and *Pandanus*, among others (Stone 1970).

Other habitats include: ravine forest, with species of *Ficus*, *Hibiscus*, and *Pandanus* (southern Guam); marshes, with *Cyperus*, *Phragmites*, and *Scirpus* (southern and central Guam); mangroves; strand vegetation; argillaceous limestone vegetation; and coconut (*Cocos*) groves (Stone 1970, Jenkins 1983). Additional genera typically found in the northern plateau include *Bikkia*, *Casuarina*, *Cynometra*, *Neisosperma*, and *Scaevola*, and northern cliff lines are dominated by *Pisonia* and *Pandanus* (Jenkins 1983). *Leucaena*, planted by the U.S. military after World War II for reforestation, pervades the island (Jenkins 1983).

Guam's vascular flora, including introduced species, total approximately 930 species (Stone 1970). Only about 37% are native, and nearly 70% of the native species are Marianas endemics (Stone 1970). Three species are listed as endangered on the Guam Endangered Species List: *Cyathea lunulata*, *Heritiera longipetiolata*, and *Serianthes nelsoni*. *S. nelsoni* is also listed on the U.S.

Endangered Species List; just two trees (one discovered in 1991) remain on the island (Wiles 1990b, Wiles 1991a).

The only indigenous mammals known to have existed on Guam have been bats: two megachiropterans, the Mariana fruit bat (*Pteropus mariannus*) and the little Mariana fruit bat (*Pteropus tokudae*) (both of which are discussed later in this report), and a microchiropteran species, the sheath-tailed bat (*Emballonura semicaudata*). *E. semicaudata* was recorded in the Marianas in 1895 and 1905; the last specimen collected was taken from the CNMI in 1932 (Lemke 1986a). Stephenson (1971) describes a discovery after descending more than 18 m into a cave in the village of Talofofo in 1936. The floor of the cave was "covered with several feet of bat dung, accumulated since prehistoric times." He observes (p. 11): "Standing in silence, we could hear the high-pitched squeaks of hundreds of bats, like as many canaries singing at once, only very faint." These may have been *E. semicaudata*. This species was added to Guam's Endangered Species List in 1982. In 1984, when fewer than 10 sheath-tailed bats were found on Aguijan, it was the first record of this species on Guam since 1972 (Wiles 1992). pers. comm., and only the second verifiable record of sheath-tailed bats in the Marianas in more than 50 years (Lemke 1987).

Historically, the resident avifauna of Guam consisted of 18 indigenous species (Savidge 1987). Most of the forest species were common to abundant throughout the island. In recent decades, however, Guam's avian populations have plummeted, primarily due to the predatory brown tree snake (*Boiga irregularis*) (Savidge 1984), an introduced species that probably came to Guam from New Guinea. Fifteen indigenous bird species are now listed as "endangered" on Guam's Endangered Species List, and 10 on the U.S. Endangered Species List (Table 1).

Table 1. Endangered and threatened birds of Guam.

- ● Mariana mallard (*Anas platyrhynchos oustaleti*) (possibly extinct on Guam)
- ● Micronesian megapode (*Megapodius laperouse*) (extinct on Guam)
- ● Guam rail (*Rallus owstoni*)
- ● Mariana gallinule (*Gallinula chloropus guami*)
- ○ Mariana fruit dove (*Ptinilopus roseicapilla*) (possibly extinct on Guam)
- ○ White-throated ground dove (*Gallicolumba x. xanthonura*)
- ● Vanikoro swiftlet (*Aerodramus vanikorensis bartschi*)
- ● Micronesian kingfisher (*Halcyon cinnamomina cinnamomina*)
- ● Mariana crow (*Corvus kubaryi*)
- ● Nightingale reed-warbler (*Acrocephalus luscinia*) (extinct on Guam)
- ○ Rufous fantail (*Rhipidura rufifrons uraniae*) (may be extinct)
- ● Guam flycatcher (*Myiagra freycineti*) (may be extinct)
- ○ Micronesian starling (*Aplonis opaca guami*)
- ○ Cardinal honeyeater (*Myzomela cardinalis saffordi*) (may be extinct on Guam)
- ● Bridled white-eye (*Zosterops c. conspicillatus*) (may be extinct)

○ = Guam Endangered Species List
● = Guam and U.S. Endangered Species Lists

Source: Guam Department of Aquatic and Wildlife Resources, n.d.

Most of the remnant populations of endangered birds on Guam are restricted to the northernmost sections of the island (Jenkins 1983, Savidge 1984, Savidge 1987). Other native resident avifauna include the yellow bittern (*Ixobrychus sinensis*), Pacific reef heron (*Egretta sacra*), brown booby (*Sula leucogaster*), white-tailed tropicbird (*Phaethon lepturus*), white terns (*Gygis alba*), and the brown noddy (*Anous stolidus*) (Jenkins 1983). Introduced species include the Philippine turtle dove (*Stroptopelia bitorquata*) and the Chinese painted quail (*Coturnix chinensis*), both from the Philippines; the black francolin (*Francolinus francolinus*), introduced as a game species from southeast Asia in the 1960s; the black drongo (*Dicrurus macrocercus*), introduced to Rota (from Taiwan) by the Japanese in 1935; the chestnut mannikin (*Lonchura malacca jagori*), initially brought to the island as a cagebird; and the rock dove (*Columba livia*) (Jenkins 1983, Savidge 1987).

In addition to birds and the snake, other fauna introduced to Guam include the monitor lizard (*Varanus indicus*), three species of rat (*Rattus exulans*, *R. norvegicus*, and *R. rattus*), sambar deer (*Cervus unicolor*), pig (*Sus scrofa*), and Asiatic water buffalo (*Bubalus bubalis*) (Savidge 1984).

Human inhabitants

Guam's first human inhabitants are thought to have arrived from southeast Asia approximately 3,000 years B.C. These early Chamorros appear to have subsisted mostly through fishing and agriculture, which they supplemented by hunting and gathering (Carano and Sanchez 1964, Bunge and Cooke 1984).

When Ferdinand Magellan arrived on Guam in 1521, Chamorros in the Marianas may have numbered 50,000 to 100,000 (Bunge and Cooke 1984). Guam was claimed by Spain in 1565 and colonized by the Jesuits in 1668 (USDOI 1986). Disease and war against the Spanish took its toll on Guam's indigenous population; only 2,000 to 5,000 Chamorros survived on the island by the beginning of the 17th century (Thompson 1941, Bunge and Cooke 1984, USDOI 1986).

The Spanish had two main purposes on Guam: to guard the galleon route to the Philippines and to Catholicize the islanders (Underwood n.d.). During this period, agriculture in the form of "ranching" was introduced by the Spanish. Islanders from Saipan and Tinian were translocated to Rota and Guam. Those on Guam were concentrated in a few villages, and a pattern of traveling back and forth between ranch and village began that has continued to recent times. Other influences on the traditional Chamorro culture during Spanish control came from the Philippines and Mexico, affecting the islanders' diet, clothing, and recreational activities (Underwood n.d.).

As Spain's global power declined, Guam became increasingly isolated. At the conclusion of the Spanish-American War, in December 1898, Guam passed to U.S. control. The island remained under U.S. naval administration until World War II, when Japan seized and occupied Guam for several years. Guam was recaptured from the Japanese by U.S. forces in 1944.

Guam became self-governing under the Organic Act of 1950. The official languages are English and, as of 1974, Chamorro. (After the war and prior to 1974, U.S. policy officially forbade the speaking of the Chamorro language.) Guam's human population grew at a rate of 2.2% in the 1970s, and its urban populations increased from 26% to 40% (Bunge and Cooke 1984). Although in 1982 and 1987 plebiscites the people of Guam chose commonwealth status with the United States, this

change in status has not taken place. The Government of Guam (1988a) identified Guam's 1980 population of 106,000 as approximately 45% Chamorro, 25% white, and 21% Philippino. Guam's population had reached about 133,000 by 1990 (U.S. Bureau of the Census 1990).

Tourism has become Guam's leading industry in recent years (Government of Guam 1988b). By 1988, the 10-year average annual increase for tourism was 8.8%; that year, the island received over 585,000 visitors (a 20% increase over the previous year). More than 800,000 tourists were expected in 1990, and 1,000,000 in 1991. Marine recreation and golf were two of the major areas of growth in 1988 (behind shopping complexes). That year, at least five hotels were built or expanded upon; seven new golf courses were projected, to add to the three existing facilities. Approximately 85% of the tourists in 1987 and 1988 arrived from Japan, where Guam is considered the 10th most desirable vacation spot (Government of Guam 1988b). In fact, it may be cheaper for a Tokyo businessman to buy a condominium unit in Guam and fly there for golf weekends than to join a country club in Japan (Monmaney 1990). The most recent trend on Guam, however, appears to be a slowing of the rate of development, possibly due to recently troubled economy in Japan (Wiles 1992). pers. comm. Whether or not this trend is temporary remains to be seen.

Throughout the past several centuries, the Chamorro culture has clearly experienced many changes. However, as Dr. Robert Underwood of the University of Guam notes (n.d.) "Culture is learned and it is adaptive." Underwood emphasizes that, despite the introduction of various cultural patterns, the belief system of the Chamorro people has remained relatively intact.

Pteropus

Taxonomy and Distribution

Old World fruit bats are placed in the global order Chiroptera, in their own suborder (Megachiroptera) and family (Pteropodidae). There is some contention that the fruit-eating bats of the paleotropics are more closely related to primates than to other bat families (Pettigrew 1986). The family Pteropodidae, which accounts for nearly 18% (174 species) of all bats, occurs in the paleotropics and subtropics: in Africa, southern Asia to Australia, and the western Pacific (Corbet and Hill 1980).

Approximately 80% of the pteropodids, including the genus *Pteropus*, belong to the subfamily Pteropodinae. The 57 species of *Pteropus* are found in Madagascar, Southeast Asia, northern Australia, and among the islands of the Indian and Pacific oceans (Corbet and Hill 1980). Forty-seven of these species occur in the Pacific, east of the Indian Ocean (USFWS 1989).

As a region, Southeast Asia supports the highest densities and diversities of fruit-eating bats, most likely due to higher between-site, or between-island, diversities (Fleming et. al. 1987). The distributions of nearly all *Pteropus* species (96.5%) include or are restricted to islands. Given this distribution, it is no surprise that the genus supports very high levels of endemism: 61% are confined to single islands or small island groups, and only seven species occur on continental land masses. Distribution for many species is limited: 67% are restricted to land areas of under 50,000 km^2, 39% to land areas under 10,000 km^2, and 23% to land areas under 1,000 km^2 (USFWS 1989, Bräutigam and Elmqvist 1990).

Northern Marianas Populations

The little Mariana fruit bat (*P. tokudae*), a species endemic to Guam, was apparently never abundant there and has not been seen since the 1960s (Perez 1972, Wheeler and Aguon 1978, Wiles 1987a). While it is listed as "endangered" on the U.S. and Guam Endangered Species Lists, it is thought to be extinct. In addition to the Marianas archipelago, the range of the Mariana fruit bat (*P. mariannus*) includes the Republic of Palau, some of the Caroline Islands, and the Ryukyu Islands (Corbet and Hill 1980). Two subspecies of *P. mariannus* have been described for the Marianas: *P. m. mariannus* (endemic to the archipelago) and *P. m. paganensis* from the island of Pagan. The latter designation has been questioned by Wiles et al. (1989), who suggests that insufficient breeding isolation has existed between the bats of Pagan and those of neighboring Mariana islands. In the mid-1980s, the total population of *P. mariannus* in the Marianas was estimated to be 8,700 to 9,000, mostly concentrated on the nine northernmost islands (Wiles et al. 1989).

Declines of fruit bats in the Marianas have been recorded since the 1960s. According to unpublished data, the first census on Guam indicated a population of no more than 3,000 in 1958 (Wheeler and Aguon 1978, Wiles 1987a). Although colonies of 100 to 500 individuals were commonly observed in most of the relatively undisturbed forests of Guam during the 1960s, diminishing populations were noted on an annual basis throughout the decade and into the 1970s (Perez 1972, Wheeler and Aguon 1978, Wiles 1987a). By that time, as few as 50 to 100 individuals may have remained on the island (Wheeler and Aguon 1978, Ralph and Sakai 1979). In the early 1980s, numbers appear to have increased, probably as a result of immigration from the neighboring island of Rota (Wiles et al. 1989, Wiles and Glass 1990). Yet, by the middle of the decade, the population dropped again; current estimates place *P. mariannus* at approximately 400 to 500 individuals on Guam (Wiles et al. 1992).

By two to three decades ago, Guam's fruit bats had become confined to the island's more inaccessible and unpopulated segments in the interior, as well as the steep northern cliff lines (Perez 1972). The current remnant population is largely restricted to the latter (Wiles et al. 1989), and much of this land is under the control of the U.S. military. *P. mariannus* is protected by local legislation throughout the Northern Marianas (Wiles 1990c). Guam's population of *P. m. mariannus* was listed as "endangered" under the U.S. Endangered Species Act in 1984, and the populations of Rota, Aguijan, Tinian, and Saipan may be listed sometime in the future (Wiles 1990c).

Rota was thought to support several hundred bats by the late 1970s (Wheeler 1980). In the early-to mid-1980s, however, three of the island's four major colonies declined (Lemke 1986b). In 1983 the population was estimated at only 1,500 to 2,000 individuals; it is now estimated at approximately 1,000 to 1,500 individuals (Wiles 1992). pers. comm.

Surveys in the late 1970s and early 1980s provided estimates of fewer than 50 individuals on the islands of Saipan, Tinian, Aguijan, and Farallon de Medinilla (Wheeler 1980, Wiles et al. 1989). Currently, the bats of Guam and Rota (about 14% to 17% of the archipelago's total population) appear to be genetically isolated from bats in the northern Marianas (Wiles et al. 1989). The rugged islands north of Farallon de Medinilla are largely uninhabited and, due to remoteness and inaccessibility, receive only occasional human contact (Wiles et al. 1989). With the exceptions of Maug, Sarigan, and Farallon de Pajaros, which support little or no fruit bat habitat, these northern islands (Asuncion, Agrihan, Pagan, Alamagan, Guguan, and Anatahan) appear to support fairly stable populations of bats. The largest of these, Anatahan, Pagan, and Agrihan, host a total of

approximately 6,500 fruit bats, amounting to 72% to 75% of the entire archipelago population (Wiles et al. 1989).

Population densities in the Marianas appear to be correlated with hunting pressure (Wiles et al. 1989), which in turn appears to be a function of ruggedness of terrain and proximity to or presence of human populations (Lemke, unpub. data, cited in Wiles et al. 1989).

Biology

Pteropodids, generally larger than their neotropical relatives, may reach as much as 1,500 g (3.3 lbs) with wingspans of 170 cm (5.7 ft) (Nowak and Paradiso 1983). Perez (1972) measured a number of *P. mariannus* killed by hunters in Guam and found that the average weights for adult males and females were 513 g (1.1 lbs) and 423 g (0.9 lbs), respectively. (One Guam bat shot by a hunter in 1966 purportedly weighed about 2 pounds and had a wingspan of 45.5 in) [Anon. 1966]. *P. tokudae* appears to have been smaller than *P. mariannus*, the only measured specimen weighing in at 152 g (5.4 oz) [Perez 1972].

Pteropus's longevity in the wild is not known. One captive fruit bat lived for 17 years, but the record for a *Pteropus* is a *P. giganteus* individual that lived at least 31 years in captivity (Nowak and Paradiso 1983). While some pteropodids appear to have well-defined mating seasons (Marshall 1947, Thomas and Marshall 1984), the bats of Guam do not show such a distinction (Perez 1972, Wiles 1987b). *Pteropus m. mariannus* females appear to reach sexual maturity at approximately 18 months to 2 years of age (Wheeler and Aguon 1978, Wiles 1991b). pers. comm., giving birth to one young per year (Wheeler and Aguon 1978).

Primarily canopy and forest-edge feeders (Fleming et al. 1987), megachiropterans are known to feed on the flowers, leaves, and fruits, in particular, of at least 188 plant genera in 64 families (Marshall 1983, 1985). Fruits in the pteropodid diet are usually low in fats and protein and high in water and carbohydrates (Fleming et al. 1987). *Pteropus* has been found to utilize the flowers of 26 different plant genera in 14 families, the leaves of 3 genera in 3 families, and the fruits of 64 genera in 32 families, for a total of 89 plant genera used in 44 families. The most important families are the Palmae (16 genera used by *Pteropus*), Anacardiaceae (10 genera), and Sapotacaceae (8 genera) (Marshall 1985). Fruits are generally consumed when ripe to overripe, although there are some exceptions (e.g., *Cocos*) (Marshall 1985).

Pteropodids generally ingest only the juice and pulp of the fruit. Most seeds, as well as the fibrous parts, are voided or dropped, although in some instances (e.g., *Ficus*, *Piper*, or *Solanum*) small seeds may pass through the digestive tract (Jones 1972, Cox 1983, Marshall 1983, 1985, Ash 1987). Megachiropterans may fly considerable distances to forage, taking advantage of the fruiting and flowering periods of different plants (Bruner and Pratt 1979, Marshall 1983). In certain instances, these movements have a seasonal nature (Marshall 1983, Nelson 1965).

The preferred foods for *P. mariannus* in the Marianas include the blossoms of the kapok tree *(Ceiba pentandra)*, screw pine fruits (*Pandanus* spp.), breadfruits (*Artocarpus* spp.), papayas (*Carica papaya*), the sap of young coconut blossoms (*Cocos nucifera*), custard apples (*Annona reticulata*), and gulos (*Cynometra ramiflora*) (Perez 1972, Wheeler and Aguon 1978, Bruner and Pratt 1979). Other

favorites include *Cycas circinalis*, *Mammea odorata*, and *Terminalia catappa* (Wiles 1987b); foraging on *Aglaia mariannensis*, *Ficus prolixa*, and *Hibiscus tiliaceus* has also been noted (Wheeler and Aguon 1978).

Social behavior within Pteropodidae varies considerably. Some species roost singly or in pairs, while others are more gregarious and may form large, noisy colonies, even in the hundreds of thousands (Jones 1972, Wodzicki and Felten 1975, Bruner and Pratt 1979, Cox 1983, 1984b, Heaney and Heideman 1987, Jolly et al. 1984). *Pteropus mariannus* is gregarious; historically, roosts of as many as 1,000 bats were noted on Guam (Wheeler and Aguon 1978). During Guam's bat population crash in the mid-1970s, however, the largest group noted by Wheeler and Aguon (1978) was 15 individuals. Currently, most of the bats on Guam live in a single colony (Wiles et al. 1989, Wiles (1990d). pers. comm.

Those genera, including *Pteropus*, that roost communally appear to have a high degree of roost-site fidelity (Marshall 1983). Most fruit bats on Guam disperse from their roost soon after sunset, but they have been found to be very active in the early morning as well (Wheeler and Aguon 1978, Wiles et al. 1989). Interisland movements of the Marianas fruit bats, including between the islands of Rota and Guam, have long been observed but are not well documented (Perez 1972, Wiles et al. 1989, Wiles and Glass 1990). Wiles et al. (1989) note that although such dispersals may be triggered naturally by overpopulation, seasonal variations in food supplies, or dispersal of young in at least one instance a large flight from Rota to Guam was caused by hunting at a colony site on Rota.

Threats

Hunting of pteropodids for food and sometimes medicinal purposes is known to have occurred in the Cook Islands (Wodzicki and Felten 1980), the Federated States of Micronesia (Rainey 1990). pers. comm., Indonesia, and Malaysia (mostly by ethnic Chinese) (Fujita and Tuttle 1988), Madagascar (Jolly et al. 1984), Mauritius and Reunion (Cheke and Dahl 1981), the Philippines (Cox 1984a, Conklin 1990 pers. comm.), and Samoa (Cox 1983), among others. Traditional methods for catching or killing pteropodids vary depending on the culture. Methods include hanging nets around fruiting or flowering trees or on a colony's foraging route, as in Indonesia, Malaysia, and the Philippines (Fujita and Tuttle 1988, Conklin 1990). pers. comm.; stringing ropes with fish hooks around food trees to entangle the foraging bats, as in Indonesia and Malaysia (Fujita and Tuttle 1988); or snagging them with burr-covered wands (*Harpagophyton*, *Uncarina*) or thorny vines (*Alyxia*) as in Madagascar (Jolly et el. 1984) and Samoa (Cox 1983).

During the course of this project, the preferred hunting method on Guam, prior to the widespread use of firearms, was described by numerous individuals as follows: A hunter would construct a small platform high in a tree through which bats were known to pass on nightly foraging patterns. On a moonlit night, the hunter would perch in the tree with a long-handled hoop net, swinging it at bats as they passed by. The hunter might have a helper on the ground below who could remove the bats from the net as they were caught. Additionally, young boys would shoot bats out of trees with slingshots, sometimes selectively shooting for the tastier males.

On Guam, Thompson (1941) noted before World War II that fruit bats were a "rare delicacy," and were expensive on the market--too expensive, apparently, to serve at large gatherings.

She stated that the bats were shot or caught with nets at night but that the demand always exceeded the supply.

Overhunting appears to have been the major cause for the decline in Marianas fruit bat populations (Perez 1972, Wheeler and Aguon 1978, Wheeler 1980, Lemke 1986, Wiles et al. 1989). After World War II, the proliferation of available firearms replaced the more traditional hunting methods, and harvests grew. As local fruit bat populations declined, the market was supplied by bats from other Marianas islands and, ultimately, other island groups. Guam imported nearly 200,500 bats from 1975 through 1988, including more than 99,000 since 1975 from the island of Palau alone (Wiles and Payne 1986, USFWS 1989). Documented sources of fruit bat imports include the Commonwealth of the Northern Marianas, the Federated States of Micronesia, Indonesia, Papua New Guinea, the Philippines, the Republic of Palau, and Samoa (American and Western) (Wiles and Payne 1986, USFWS 1989). With a permanent U.S. Fish and Wildlife Service wildlife inspector now stationed on Guam, imports of *Pteropus* have dwindled; approximately 7,000 were imported in 1991, virtually all from Palau (Wiles 1992). pers. comm.

Poaching remains a threat to the Mariana fruit bat. Although Guam's remaining colony lives on isolated and protected federal military lands, any poaching incident may pose a serious threat to the small colony. An estimated 25 to 30 bats were taken by poachers in late July 1991, representing approximately 10% of Guam's population (Evans 1991, Thompson 1991, Wiles 1991). pers. comm. While this was the first such incident in several years, and it received a significant amount of concerned attention from the press, it indicates the determination of some individuals to obtain fruit bats.

Tourists on Guam do not contribute significantly to the demand, although fruit bat has been served in restaurants in the past (Mallo 1976). Prices reported in Guam for imported bats in the 1970s ranged from $5 to $25 (Perez 1972, Wheeler and Aguon 1978, Bruner and Pratt 1979). Palauan bats were being imported to Guam as early as 1971, selling in Tamuning for $5.65 per 5 lbs (Anon. 1971). In the course of this project, no bats were observed being offered for commercial sale.

In addition to hunting, other threats to fruit bat populations in the Marianas and elsewhere include land clearing and development, typhoons, disease, and introduced predators. Perez (1972) noted that "changes in the island's landscape" were responsible for the gradual decline in Guam's bat population, and Wheeler and Aguon (1978) also placed some of the blame for Guam's declines on land clearing and other human activities such as coconut crab trapping and fruit collection. Typhoons, in addition to any direct harm they may cause to fruit bats, often strip the vegetation clean of leaves and fruits. As a result, bats suffer from starvation or are forced to forage on the ground where they become more vulnerable to predators, including humans (Wheeler and Aguon 1978, Wheeler 1980, Wiles 1987a, Wiles et al. 1989, Daschbach 1990, Flannery 1990, Rainey 1990). pers. comm.

In the past decade, disease has been implicated in the dramatic decline of bat populations in the Admiralty Islands and the Solomon Islands (Flannery 1990). Although it is unlikely that Guam's bats have been significantly impacted by disease (Wheeler and Aguon 1978), their low numbers and colonial behavior make them particularly vulnerable to this threat.

Fruit bats have few, if any, serious natural predators (Marshall 1983, USFWS 1989). The black drongo has been observed harassing fruit bats on Guam, but this alien species has probably had no serious impact on fruit bat populations (Perez 1972, Wheeler and Aguon 1978, Bruner and Pratt 1979). On the other hand, the brown tree snake, already implicated in the loss of Guam's avifauna, appears to prey on young fruit bats and may be the cause of poor juvenile recruitment in Guam's remnant population of *P. mariannus* (Wiles et al. 1989, Wiles 1990c). Wiles (1991b). pers. comm. estimates that juvenile mortality currently borders on 100%.

Protection

At the Seventh Meeting of the Parties to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) in October 1989, seven species of *Pteropus* (*P. insularis*, *P. mariannus*, *P. molossinus*, *P. phaeocephalus*, *P. pilosus*, *P. samoensis*, and *P. tonganus*) were added to Appendix I of the convention. The remaining species of *Pteropus* and all species of *Acerodon* were placed on the CITES Appendix II (Bräutigam and Elmqvist 1990). In addition to these international precautions, domestic measures exist providing varying degrees of protection for *Pteropus* either specifically or indirectly (e.g., specific export bans, general hunting bans). Individual islands or nations that provide some form of protection include American and Western Samoa, Australia (state of New South Wales), the Commonwealth of the Northern Marianas, Guam, peninsular Malaysia, the Republic of Palau, Tonga (one roost specifically), the United States, and Yap (Federated States of Micronesia) (USFWS 1989). As already noted, Guam's population of *P. m. mariannus* receives full protection under the U.S. and Guam Endangered Species Acts (and derives additional, albeit indirect, benefit from restrictions on public access to U.S. military land) (Wiles 1987a).

Enforcement of these laws is often difficult, however. For example, because the U.S. Department of the Interior considers trade between Palau and Guam to be domestic, CITES does not apply and shipments to Guam can only be prohibited if the U.S. Lacey Act has been violated. (The Lacey Act prohibits the transport across state lines of wildlife taken against the laws of the state or country of origin.) Enforcement personnel must first ascertain that imported bats have been shot with firearms, in violation of Palauan law, to halt the shipment (Wiles 1990c). On Rota, official support for wildlife law enforcement has been weak, and conservation officers are not authorized to carry firearms (Wiles et al. 1989). Wiles et al. (1989) observed that cultural patterns may form the greatest obstacle to enforcement of wildlife protection laws in the CNMI, where families are often large, kin relationships well maintained, and island communities close-knit. As a result, local agencies may find it difficult to enforce unpopular hunting laws.

PART II: PROJECT IMPLEMENTATION AND FINDINGS

The aim of this study has been to document the attitudes among Guam's Chamorro population toward fruit bats and, more generally, toward their island environment and local conservation and development activities. It is hoped that the information contained in this report can provide a base from which to develop local education and conservation measures. To this end, a broad array of questions were asked of approximately 200 island residents, all Chamorros.

METHODOLOGY

This project was conducted in four stages in 1990: (1) initial questionnaire development (New Haven, Connecticut); (2) questionnaire refinement and survey preparation (Guam); (3) survey implementation (Guam); and (4) data analysis and report write-up (New Haven, Connecticut). The principal investigator consulted with numerous village, nongovernmental, and government leaders throughout the course of the project (Appendix 1) and hired an assistant, Maria Santos Yatar, to help implement the survey.

Questionnaire

The survey questionnaire, designed to be administered in personal interviews, was initially developed in conjunction with Dr. Stephen Kellert of the Yale School of Forestry and Environmental Studies. It was then modified in Guam, with input from individuals knowledgeable about Guam and Chamorro culture. After a pretest was conducted, major adjustments were made to reduce question complexity and questionnaire length. Interview time for the final questionnaire (Appendix 9) ranged from about 13 to 45 minutes, although 20 to 30 minute interviews were most common. Interview length depended largely on the degree of nearby distractions (for example, children, other family members) and the respondent's desire to converse. On several occasions, the principal investigator encountered elderly individuals who felt uncomfortable responding to the survey in the English language. In such cases, the survey was either conducted by the project assistant or aborted.

The questionnaire was designed primarily to reveal information on three aspects of the Chamorros' relationships with fruit bats: their behavior with regard to fruit bats, their attitudes toward the animals, and their familiarity with fruit bat ecology and trade. Secondarily, the survey was expected to examine the larger context for these issues by probing Chamorro attitudes and knowledge regarding the local fauna and environment in general.

Numerous issues currently being debated among residents of Guam, particularly among the Chamorros, may directly or indirectly influence the conservation of fruit bats and other endangered species on the island. Among these issues are the rate of development, appropriate levels of tourism (directly associated with the development question), Chamorro cultural heritage, and overall quality of Guam's environment. While each specific issue was not investigated in detail, certain elements were targeted in the survey when it was thought that they might provide useful insight for later conservation efforts. The initial survey questions (questions 1 through 4) provide a base for later comparison of survey results and are asked first in order to avoid the possibility of influencing the respondent through subsequent questions. These are followed by questions that attempt to reveal

ıus attitudes (questions 5 through 20). General topics targeted in this section of the questionnaire ıde tourism on Guam, the rate of development the island is currently undergoing, and the degree hich respondents value the island's environment and wildlife, particularly the fruit bat.

Questions 21 through 30 investigate the respondent's level of knowledge about fruit bat ›gy and the abundance of wildlife on Guam. These questions are also used in the development of ıowledge scale." Subsequent questions (31 through 47), examine the respondents' behavior with ›ct to fruit bats and to various outdoor activities. Finally, questions 48 through 52 provide basic ›graphics and information on frequently used news media.

ey Implementation

primary focus of this project was to collect information that would aid the long term conservation ıit bats on Guam. As there is no market for fruit bats among the island's non-Chamorro lation, the survey audience consisted of Chamorro residents only. A meeting was held with each ;e mayor before actually surveying a given village, for the purposes of introducing the project, ing the mayor's support, and receiving any advice or information he or she might wish to offer regard to the project. Target numbers for surveys from each of the island's 19 villages were lated in the following manner:

Population estimates for each village were obtained from the government of Guam. As ;e population breakdowns by ethnicity were unavailable at the time, each mayor was asked for an ate for the number of Chamorro residents in his or her village. The resulting total (of estimated ıorro residents by village) was found to be inflated well over the official figure obtained for total ıorro residents on Guam. Since official estimates for total Chamorro residents equaled ›ximately 47% of the total of mayoral estimates, each mayor's estimate was therefore adjusted by ame percentage to arrive at what was hoped to be a more realistic figure, on average, for ıorro residents by village. Adjusted estimates of village Chamorro residents were then measured st total Chamorro residents to estimate a percentage contribution from each village to the island ıorro population. That percentage was weighed against the desired target number of 200 surveys tain a target survey number for each village.

Due to time restraints, much of the survey had to be carried out during the afternoon, and s were often unoccupied. A street was chosen from a map and a target number of homes visited ch street. An attempt was made to cover each village as widely as possible, given the number :veys targeted.

The only limiting factor consciously employed by the interviewers in selecting the individuals erview was age: individuals under the age of 18 were not interviewed. Ideally, interviews were ıcted in private with one individual. However, in some instances, other adults did gather and their views.

Analysis

:AS statistical computer software program was used for analyzing data, primarily using simple

lts were considered significant at the 0.95 confidence level ($P < 0.05$). Response data collected ıuestions 12, 32, and 38 were considered unreliable and were discarded.

A knowledge scale was developed based on nine survey questions that indicated some degree nowledge of wildlife and fruit bats (questions 21 through 30); the highest score possible was 100. rrect" responses received a certain number of points, while "incorrect" responses or lack of onse earned none. A multiple regression analysis and a Duncan's multiple-range test were ɔrmed to compute "knowledge" scores (Appendix 9).

About two-thirds of the interviews were conducted by the principal investigator, most of the ıinder by the project assistant, and a handful in the village of Tamuning were conducted by an tional hired assistant. Anecdotal information was collected through informal discussions and :ings with various individuals.

ıographics of Respondents

c demographic data are provided in Appendix 2. Respondents totaled 206, the majority of which ó) were female. Only 12% of the respondents fell between the ages of 18 and 25 years. Those in the 26-to-35, 36-to-45, and 46-to-55 age ranges each constituted approximately one-fifth of the sample. Respondents over the age of 55 years constituted the single largest age group (27%). ıe figures, when weighed against 1980 census information, indicate that individuals aged 35 years under were probably underrepresented, and those over 35 were probably over-represented. Data ı 1980 compiled by the Government of Guam (1988a:142) show that approximately 45% of the norro population was over the age of 20. Within this population, ages break down as follows: ɾiduals aged 20 to 24 years constituted 18% of the total; 25 to 34 years, 30%; 35 to 44 years, ; 45 to 54 years, 16%, and over 55 years, 17%.

Thirty-six percent of the respondents claimed to have achieved a partial or complete .entary education. Nearly half (45%) had completed high school, 11% had completed two years ɔllege, and fewer than one-tenth (8%) had completed four years of college or more (including uate education).

Not surprisingly, age appears to be a strong factor in terms of level of education achieved 0.001). While 84% of respondents over the age of 55 never completed or went beyond entary school, 80% of those in the 18-to-25-year range had at least completed high school. This obably the result of Guam's post-World War II development and of changing attitudes and lations toward formal education. Many elderly Chamorros noted that the war effectively halted elementary school education: when peace--and school--resumed, these children were needed at ɛ and were unable to return to school.

For the purposes of this project, household income distribution was defined in the following ıer: equal to or below $25,000 annually = "low," $26,000 to $54,000 annually = "middle," $55,000 or more annually = "high." One-half (50%) of the respondents claimed to have an al household income of $25,000 or less, while 40% fit into the category of "middle income" and identified themselves as "high-income" households. There was a significant relationship between ne and age ($P < 0.001$): approximately one-third of each of the high- and middle-income groups

consisted of Chamorros over the age of 46, while nearly two-thirds of the low-income category consisted of respondents in that age category.

Slightly more than one-third of the respondents lived in northern Guam (the villages of Dededo, Tamuning, and Yigo). Nearly one-half inhabited central Guam (Agana, Agana Heights, Asan/Maina, Barrigada, Chalan Pago/Ordot, Mangilao, Mong Mong/Toto/Maite, Piti, Sinajana, and Yona), and the remainder (20%) were from the villages of Agat, Inarajan, Merizo, Santa Rita, Talofofo, and Umatac in the south. These regional frequencies were expected, as the proportion of respondents in each village were calculated to represent total proportion of Chamorro residents in each village.

RESULTS

Appendix 3 provides simple response frequencies for all questions other than those providing basic demographics. Frequencies broken down by selected variables are provided with significance levels in Appendices 4 through 8. Analyses that (*a*) did not yield significant results, (*b*) were found to have problematic data, or (*c*) were not found to be particularly illustrative were not included in these appendices. Appendices 4 through 8 are as follows: (4) analysis by respondent age; (5) analysis by respondent gender; (6) analysis by respondent's educational level; (7) analysis by respondent household income; and (8) analysis by consumption (or nonconsumption) of fruit bat. A summary of results is located in Part III.

Behavior

Consumption of Fruit Bat

Fifty-three percent of the total sample stated that they enjoyed eating fruit bats, referred to locally in Chamorro as *fanihi*. Sixty-one percent of the males and 48% of the females surveyed claimed to eat fruit bat ($P=0.053$). The majority of respondents over 35 years of age ate fruit bat, particularly those over 56 years (85%) ($P=0<0.001$). In contrast, 70% and 78% of those aged 18-to-25 and 26-to-35, respectively, claimed not to eat fruit bat.

Of those respondents who claimed to eat fruit bat, 10% attended college and 50% attended school beyond the elementary level. Respondents who did not eat fruit bat generally had experienced higher levels of formal education: 29% attended college and 80% attended school beyond the elementary level.

Respondents in the high-and middle-income categories showed approximately the same relationship between fruit bat consumers (45%) and nonconsumers (55%). In the low-income category, however, the majority of respondents (62%) claimed to eat fruit bats ($P=0.048$).

Although it was sometimes remarked in conversation that Chamorros in the "south" were most likely to eat fruit bat, the data showed no significant differences in bat consumption by regional distribution ($P=0.500$).

Seventy-seven percent of the respondents who liked to eat fruit bat also claimed that they virtually do not eat it anymore. Approximately 17% claimed to eat it only one or two times per year, 4 percent claimed three to five times per year, and 2 percent claimed five to ten times per year. There appeared to be no significant pattern in rate of consumption by respondent's age, gender, or region.

Nearly 60% of the respondents who enjoyed eating fruit bat fell in the low-income category; however, 90% of this group claimed to eat virtually no more fruit bat, and roughly 5 percent stated they eat it no more than one or two times per year. On the other hand, for middle-income consumers, 59% claimed not to eat fruit bat anymore, and 38% estimated that they eat fruit bat once or twice per year. Of the nine high-income individuals who liked fruit bat, five (55%) claimed not to eat it anymore. Forty-four percent of the respondents who liked to eat fruit bat achieved only an elementary school education; of these, roughly 90% claimed that they do not eat it anymore.

More than half of the respondents (55%) stated that other members of their household do eat fruit bat. Of respondents who like to eat fruit bat, two-thirds have other household members who also eat it. Of respondents who do not eat fruit bat, fewer than half claimed to have other household members who do ($P=0.003$).

Preferences

The majority (61%) of respondents answered that the most important reason for eating fruit bat was the taste. Other answers provided were tradition (16%) and smell (6%).

Overall, 65% of the respondents held the opinion that different species of fruit bats vary in taste. Approximately 70% of those over 35 years of age felt that different species vary in taste, versus 42% of those aged 18 to 35 ($P<0.001$). Roughly 40% of the respondents over 35 years claimed to like all fruit bats, and an equal proportion expressed a distaste for bats from anywhere other than Guam. Although the issue was only raised anecdotally, a number of older Chamorros noted a distinct preference for male bats than for females, apparently due to the stronger smell and taste of the former. This preference was most apparent when respondents discussed the bats on Guam (*Pteropus mariannus*). Older respondents (over 35) were far more opinionated in general on the question of preferences than were younger respondents.

Other Behavioral Considerations

Ninety-three percent of the respondents--strong majorities across all age classes and with no apparent differentiation by gender, income, or education--stated that they enjoyed watching nature programs on television. Camping and reef fishing were the most frequently listed outdoor activities (nearly 60% of the respondents claimed to take part in each), followed by wild plant collecting (45%) and hiking (40%). Hunting, ocean fishing, and water sports were the least frequently cited activities, each claimed by approximately one-fifth of the respondents. Women were more involved in camping, reef fishing, and plant collecting than in other activities listed but were nevertheless significantly less involved in these activities than were men.

There was relatively little difference in participation by age for hunting, camping, reef fishing, and plant collecting, but there were significant differences for hiking and water sports. Not surprisingly, more than half of the hunters and hikers were relatively young, between the ages of 26 and 45 years. The single-largest age group participating in water sports was the youngest (18-to-25 year olds).

Attitudes

Kellert (1980) defines 10 different types of human attitudes toward wildlife, two of which (aesthetic and utilitarian) were specifically targeted by questions in this survey.

The "utilitarian" attitude toward animals is defined by Kellert (1980:35) as the "primary concern for the practical and material value of animals." One question was specifically targeted to reveal this attitude, but it is important to keep in mind than any given individual may harbor a mixture of attitudes that a single question will not fully define. Kellert notes (1980:32):

> These attitudes primarily describe basic perceptions rather than behaviors. Additionally, attitudes should <u>not</u> be identified with individual people--i.e., the attitudes may describe elements of a person's perception, but rarely will all of an individual's actions be explained by just one attitude. Moreover, an individual's attitudes may change over time as the person experiences different life situations. (Emphasis placed by the author.)

The attitude category of "aesthetic" is used here more narrowly than by Kellert. He defines the "aesthetic" attitude toward wildlife as the "primary interest in the artistic and symbolic characteristics of animals" (1980:35). For this study, the definition is limited more to the appearance of the fruit bat; "symbolic" is separated as a distinct category of its own containing two subcategories. These are the "cultural" symbolic value, in which fruit bats are considered an appropriate symbol for the overall Chamorro culture, and the "identity" value, in which actually eating fruit bats is felt by the respondent to be a more personal expression of identity.

<u>Utilitarian</u>

One question specifically examined utilitarian attitudes toward animals by asking whether animals that serve as a food source for humans are more important to respondents than those that do not. The question does not request specific clarification of other values that animals might offer.

Fifty-six percent of the respondents answered that food animals are more important than nonfood animals, while 39% held the opposite view. Nearly three-quarters (72%) of those respondents who liked to eat fruit bats felt that food animals are more important than nonfood animals, as opposed to fewer than half (44%) of those who do not eat fruit bats ($P<0.001$). There was no apparent difference of responses between gender ($P=0.404$), although there was a strong difference between answers given by different age groups ($P=0.004$). The proportion of respondents who recognized food animals as being more important increased steadily as the age of respondents increased. Of the respondents who had attended two years or more of college, fewer than half (45%)

exhibited this utilitarian attitude. In contrast, 54% of those who completed high school felt this way, as did 73% of those who achieved only an elementary education ($P=0.020$).

Respondents were also questioned as to whether they recognized any values for the fruit bat other than as food. Slightly more than half (52%) of those surveyed felt that the fruit bat does offer value other than as food. A higher proportion of male respondents (60%) than females (46%) recognized other values ($P=0.040$). Women were also the least opinionated on this issue: nearly 80% of those who had no opinion were women.

Aesthetic

Respondents were asked to express their feelings about the fruit bat's appearance; respondents who enjoyed the appearance of the animal are here considered to hold an "aesthetic" attitude. Three-quarters (76%) of the respondents felt that fruit bats were "nice to look at." Sixty percent of those who answered thus also said that they like to eat bats ($P<0.001$). There was a marked difference between male and female respondents' attitudes towards the appearance of fruit bats: 93% of the men said that they like the appearance of fruit bats, versus 68% of the women ($P<0.001$).

Respondent's age was expected to be a possibly significant factor in attitudes toward the appearance of fruit bats, but this was not the case. Nor was there a significant relationship between aesthetic attitude and level of education or regional distribution.

Symbolic

Eighty-two percent of the respondents believed that the fruit bat has "cultural" value, while only one-half believed that the fruit bat's "identity" value is important. No significant relationship was found between the consumption of fruit bat and valuing it as an important Chamorro cultural symbol. On the other hand, a strong relationship appeared to exist between the consumption of fruit bat and viewing this activity as important to Chamorro identity ($P<0.001$): three-quarters of those who ascribed identity value to the fruit bat also claimed to enjoy eating it.

There was no significant gender difference in assigning cultural or identity values to the fruit bat. While significant relationships also were not found between age and cultural value, this was not true for age and identity value. Approximately 77% of the respondents over 45 years of age felt that eating fruit bat was important to the Chamorro identity, versus 46% of those under the age of 45 ($P<0.001$).

A strong association appeared to exist between the level of formal education received and the imparting of cultural value to fruit bats ($P<0.001$). Ninety-three percent of those who did not progress beyond an elementary education believed that fruit bats provide a cultural value, versus 63% of the respondents who attended college or beyond.

Attitudes Toward Local Issues

Tourism and Development: Nearly half of the respondents felt that it is not important for Guam to

have a lot of tourism. There was a significant difference in response according to the age of the respondent ($P=0.001$). The youngest respondents (18 to 25 years) showed the strongest reaction in favor of tourism (73%), while those aged 46 to 55 years showed the strongest reaction against it (68%).

When asked whether commercial development on Guam was more important for Chamorros than protecting the island's forests, the responses were strongly negative (76%). Statistically, these results were weakly significant when weighed against the respondent's age ($P=0.052$), but there was no significance in terms of respondent's sex, income distribution, education, or region. Nearly all individuals surveyed (98%) felt that it was important that some parts of the island's forests be completely protected from development.

An overwhelming majority (83%) of respondents felt that new roads or hotels along the coast were not worthwhile if the development occurred at the expense of the coastal reef. This feeling appeared throughout the sample, with no apparent significant pattern by age, gender, or other parameter.

Wildlife Protection: Most respondents (95%) felt that it is important to protect the wildlife of Guam even to the extent of restricting hunting, if necessary. Although this was true for both sexes ($P=0.028$) and among all age classes ($P=0.012$), there was a slightly higher resistance to this idea among respondents over 55 years of age. A slightly smaller percentage of female respondents (92%) than male (99%) held this view ($P=0.028$). All respondents who had experienced two or more years of college supported wildlife protection, versus 88% of respondents who had never completed or gone beyond elementary school ($P=0.011$). There was no significant difference in response between those who claimed to like eating eat fruit bats and those who did not.

Eighty-five percent of the respondents felt that people should stop eating fruit bats if to do otherwise would lead to extinction. There was no difference in response pattern between respondents who claim to enjoy eating fruit bats and those who did not, nor was there such a relationship by age, gender or education.

Nearly 80% of the respondents felt that poachers on Guam should have to face a punishment of a fine or jail. Many felt that while jail itself might be harsh, particularly for first-time offenders, a stiff fine was appropriate. Of those who felt otherwise, there were some who, in conversation, expressed resentment that local people could no longer pursue the activities that they had pursued traditionally. Some individuals mentioned that fines were appropriate if the hunter was caught, implying that the punishment was more for the mistake of getting caught than for the act of poaching itself. While there was no relationship between response and gender, income distribution, or education, significant relationships were indicated with age of respondent ($P=0.021$) and with their tendency to consume fruit bat ($P=0.036$). Respondents between the ages of 26 and 35 years exhibited the strongest unity on this question, with 98% agreeing that fruit bat hunters on Guam should have to pay fines or go to jail. Respondents over the age of 45, while still strongly in favor of such punishment (72%), were proportionately less so than those in the middle age-group (80%). Of the respondents who claimed to consume fruit bat, 74% supported such punishment, versus 86% of those who did not eat fruit bat ($P=0.036$).

Approximately 70% of the respondents felt that, due to their role in creating a market, Chamorros have some responsibility to ensure that fruit bats do not become extinct on other Pacific islands. Slightly more than 20% felt otherwise; in conversation, it was mentioned that to become involved in protecting other islands' fruit bat populations would be interfering. This position was held most strongly by older respondents over 55 years of age (40%). Respondents with more formal education showed a stronger tendency to agree with the concept that Chamorros hold some responsibility for protecting fruit bat populations on other islands.

Knowledge

Cause of Fruit Bat Decline on Guam

Forty-five percent of the respondents laid the primary blame for the fruit bat's decline on Guam on overhunting. Another popular reason cited was snake predation (16%). Development and the associated destruction of habitat, World War II, typhoons, and parasites and disease were also suggested as causal factors. More than half (57%) of the nonconsumers of fruit bat identified overhunting as the overwhelming causal force, and only 8 percent pointed to snake predation. However, of the respondents who claimed to consume fruit bat, approximately one-third (34%) attributed the decline to overhunting and 22% blamed snake predation.

Expressed Knowledge of Fruit Bats

More than half (57%) of the respondents claimed to know little or nothing about fruit bats. The proportion of each age group that claimed to know a lot about fruit bats increased as age increased, however the relationship was not statistically significant, nor was the relationship between respondent's sex and stated knowledge of fruit bats.

The majority of respondents identified the main source of Guam's imported fruit bats as the Republic of Palau. Other than Palau, male respondents tended to attribute the fruit bat supply to other outlying Pacific islands, especially the Federated States of Micronesia. Although 51% of the women also attributed the primary source of bats to Palau, more than twice as many women as men identified the source as other islands in the Marianas archipelago. Nearly one-third of the youngest (18-to-25 years) and oldest (56 years and over) age classes said that they did not know the source of Guam's imported fruit bats.

Due to their heavier involvement in hunting, it was expected that male respondents might show a significantly greater knowledge of fruit bat biology and trade than women. However, only two questions showed any significant difference: (*a*) regarding the legality of hunting fruit bats on Guam, and (*b*) regarding the role fruit bats play in seed dispersal. Other questions including those regarding the number of young, roosting habits (trees versus caves), and numbers of bats imported showed no significant differences in the responses of males and females.

Sixty-eight percent of the respondents were aware that hunting bats on Guam is illegal. Women, on the whole, were less informed about this and about the fruit bat's ecological role than were men. Nearly 80% of the men knew that the hunting of bats is illegal; 6% were unsure. Sixty

percent of the women knew that bat hunting is illegal, with 25% unsure. Thirty-six percent of the women and 18% of the men did not know of the fruit bat's role in seed dispersal.

The respondents ages yielded significant differences in responses in only three of the questions in "knowledge" group, regarding: (*a*) whether or not fruit bats generally prefer ripe fruit; (*b*) how many young the females bear, and (*c*) whether they roost in caves or trees. As the age of respondents increased, so did their apparent awareness of the fruit bat's feeding habits. Only 30% of the 18- to 25-year olds knew that fruit bats generally prefer ripe fruit, most expressing uncertainty over the issue. In contrast, 95% of those over 55 replied correctly. A similar pattern, although not so striking in contrast, was exhibited regarding the number of young a female bat bears each year. Eighty-eight percent of the youngest respondents, versus 36% of those over 56 years, claimed no knowledge on this question. The number of respondents with correct answers generally increased with age.

With regard to fruit bat roosting habits (cave versus trees), there was more variation to the responses. The most correct answers (48%) were provided by the oldest age group (over age 55).

In general, most respondents (61%) believed that fewer than 5,000 bats were imported to Guam every year. Only 9% estimated the figure to be over 5,000 annually. There is also a significant association between age of respondent and estimated quantity of fruit bat imports to Guam. The level of uncertainty among respondents about import quantities increased as the age class increased.

Expressed Knowledge of Guam's Wildlife

One-third of the respondents stated that they knew a lot about Guam's wildlife. A significant relationship was found between the respondent's gender and the expressed level of knowledge of Guam's wildlife ($P<0.001$). Approximately half of the male respondents claimed to be knowledgeable, whereas only one-fifth of the women interviewed felt similarly. A larger proportion of older respondents claimed to be more knowledgeable about Guam's wildlife than did younger respondents ($P=0.04$). In each of the age classes, however, a majority of respondents claimed to know little about the island's wildlife.

Men and women showed significantly different response patterns regarding the abundance of various wildlife on Guam, specifically the Mariana fruit dove, the Micronesian kingfisher, and the exotic Philippine turtle dove. The differences between men's and women's answers were significant for each of these questions. The majority of men and women contended that there are not many of these three species on the island, but women as a group were less familiar with each of these species. Men and women exhibited similar levels of awareness of larger or more highly publicized fauna of the island, such as deer, fruit bats, or the Guam rail, but generally split along gender lines when discussing less public species.

Patterns of response by age are similar to those by gender for this series of questions. Data for the more common animals (for example, deer, carabao, rails) show little difference in response based on respondent's age. However, for fruit doves, turtle doves and kingfishers, there is a consistent trend of increasing familiarity and knowledge with increasing age. Of the 18-to-35 age classes, 73% were unaware of the general abundance of fruit doves on Guam; 72% did not know

about turtle doves, and 84% did not know about kingfishers. These age groups otherwise showed 90% to 99% familiarity with the other species listed. Older respondents, particularly those over 46 years of age, showed much greater familiarity with the doves and kingfisher.

Measured Knowledge Levels

When level of general wildlife knowledge was actually measured by "knowledge scale," men scored significantly higher than did women ($P=0.0001$). There was also a highly significant relationship between the respondent's age and knowledge ($P=0.0001$). Those who scored highest were over 36 years of age. Knowledge results for respondents aged 18 to 25 and those aged 26 to 35 were each significantly lower than those of the successive age group (as indicated statistically by the Duncan's Multiple Range Test) (Appendix 9a).

There was a highly significant association between tendency to eat fruit bat and knowledge of Guam's wildlife ($P=0.0001$), with respondents who do eat fruit bat exhibiting more knowledge than those who do not.

An interesting relationship was found to exist between wildlife knowledge and level of formal education achieved ($P=0.01$). The most knowledge was exhibited not by those respondents with the highest levels of education but by those who never went beyond elementary school. This group was followed, in decreasing order, by those with college or graduate degrees, high school educations, and two years of college.

Respondents who claimed to know a lot about Guam's fruit bats and other wildlife did appear to be more knowledgeable than respondents who claimed to know little or nothing. The results were slightly more significant for those who claimed to know a lot about wildlife in general ($P=0.0002$), than for those who claimed to know a lot about fruit bats specifically ($P=0.003$).

One might expect to find that respondents who hunt would score significantly higher on the knowledge scale and that those who have spent time away from Guam might score lower. In both cases, however, there were no statistically significant differences between the variables. Hunters exhibited only slightly more knowledge than nonhunters, and those who had moved off of Guam at some point in their lives actually scored slightly higher than those who had always lived on Guam.

When age, gender, level of formal education, and tendency to eat fruit bat are measured against knowledge in a multiple regression analysis, the levels of significance for each variable changes (Appendix 9b). Level of formal education and knowledge were shown to have a significant relationship when measured by the Chi-square statistical test, but, once other factors were controlled for, the significance of education as an important variable dropped ($P=0.11$). Similarly, levels of knowledge and consumption of fruit bat showed a highly significant relationship when measured by the Chi-square test ($P=0.0001$), but, when age, gender, and education were controlled for, the results became insignificant ($P=0.21$). Differences in knowledge by age ($P=0.0001$) and gender ($P=0.0001$), however, retained their significance values when analyzed by multiple regression. Age and gender, therefore, appear to be the most influential variables of the four measured through multiple regression.

Respondent Suggestions for Fruit Bat Protection

The single most frequently suggested action (30%) for protecting fruit bats in the region was to stop hunting and eating them. Other suggested measures, in order of frequency of response, were to enforce laws and punish poachers more effectively (16%), control development and protect fruit bat habitat (11%), provide and enforce regulated seasonal hunting (7%), ranch fruit bats (4%), and develop an environmental education program (2%). Additional miscellaneous suggestions (totaling 20% of the response) included conducting more biological research, providing a wildlife center, and allowing fruit bat populations to increase.

The relationship between age of respondent and suggested action measures proved weakly significant ($P=0.054$). The suggestion that hunting and eating of fruit bats be halted was the most numerous response for each age group. Two-thirds (67%) of the suggestions to protect habitat and control development came from Chamorros over 45 years (47% of the sample).

Although one might expect a significant difference in the pattern of response to this question to be given by those who do eat fruit bat and those who do not, there was no such relationship. Nor were there significant differences in the responses by gender or educational level.

A large proportion (68%) of respondents stated that they would attend an educational talk at their community center if the opportunity were available. Within each subset of respondents who do and do not eat fruit bat, the majority said that they would attend an educational meeting at the local community center. However, a far greater majority (80%) of respondents who eat fruit bat said they would attend, versus 62% of those who do not eat fruit bat ($P=0.009$). There were no significant patterns of response for this question by gender, age, or level of education.

A vast majority (87%) of respondents stated that they would be willing to donate $10 to a local group to promote conservation on Guam. There were no apparent relationships between this willingness and age, gender, education, fruit bat consumption, or income distribution. (However, a stated willingness to pay a sum of money for a particular service does not mean that the individual would in fact pay that sum. This question should be considered only as an indication of willingness to pay.)

PART III: INTERPRETATION AND RECOMMENDATIONS

The small oceanic island of Guam is hardly unique in its historical burden of colonialism and ecological devastation. The inherent vulnerability of most island units to cultural and ecological invasion and disturbance sets a stage for intense challenges to natural resource conservation. It is this vulnerability and challenge that make a socially and economically integrated approach to conservation so important on an island such as Guam.

Fruit bat conservation on Guam must be linked to environmental conservation in general to be most effective. Following is a discussion of the meaning of the survey results discussed in Part II and the pertinence of these findings to fruit bat conservation. That discussion is followed by recommendations for informing the public on Guam and for integrating conservation and cultural concerns in order to have the most impact over the long term.

DISCUSSION

Nearly all of the respondents to the questionnaire felt that it was important to protect Guam's wildlife, even to the extent of restricting hunting. This was true of both men, and, in particular, women. A slightly higher degree of resistance to this concept was found among older respondents, which may be related to the fact that it was not many years ago when much of Guam's wildlife was still abundant. In addition, many elderly individuals indicated concern over Guam's loss of self-sufficiency and heavy dependence on imports for food. Not too long ago one could still venture into the forest or out on the reef to collect food, but at present most of Guam's food supply is imported. As one elderly woman queried, "What happens if the ship suddenly stops coming in?"

It has been thought that the demand for fruit bats on Guam might eventually disappear as increasing numbers of younger, less traditional Chamorros fill the population on Guam. The results indicate that significantly larger proportions of older Chamorros than younger Chamorros enjoy eating fruit bats. However, from additional discussions with Chamorros of varying ages, it is clear that some level of demand will continue into the future. Many of the respondents explained that their children and grandchildren like to eat bats. Informal discussions with numerous teenage and younger Chamorros also showed that many were enthusiastic about eating bats. Slightly more than half of the respondents noted that other members of their household liked to eat fruit bat; roughly two-thirds of those who like to eat fruit bat answered similarly ($P=0.003$). This suggests that there is a pattern of eating fruit bats among households.

Although the relationship between consumption of fruit bats and education is statistically significant, age is probably a key hidden factor in the expression of the results. Older Chamorros have a greater preference for eating fruit bats than do younger Chamorros, but it also happens that the educational experience of many older Chamorros was prematurely terminated at the onset of World War II. Therefore, it appears that age is more important in determining fruit bat consumption patterns than education.

Individuals over the age of 46 years most frequently expressed a dislike for bats imported from islands other than the Marianas. This is possibly a result of the fact that these individuals grew up during a period when the local bat (*Pteropus mariannus*) was still relatively abundant. As local supplies dwindled, imports filled the void. Many respondents, particularly the elderly, expressed a

distaste for the imports due to their frequently smaller size, weaker odor, and higher levels of ectoparasites. Respondents often told me that they stopped eating imported bats because, when they were cooked in coconut milk (a common method of preparation), there would be a layer of "bugs" floating on the surface of the liquid. *P. m. mariannus* does not appear to host as high an ectoparasite load as some of the imported species, and respondents frequently referred to the local bat as a "clean" animal. These preferences (in addition to high prices) might also explain why approximately 90% of elderly individuals who said they like to eat fruit bats also claimed that they virtually never eat them anymore. A number of respondents, in discussing local bats, also stated that they prefer males to females, apparently due to the larger size and stronger odor and flavor of the former.

Generally, women on Guam do not appear to be as involved in outdoor activities as men. Approximately half the women surveyed said that they enjoy camping versus 68% of the men. An entire family might drive to the beach, set up camp, and stay for a day or two, or longer. More often the men, but additionally women and children to varying extent, will participate in reef fishing with nets and rods. These outings appear to be generally popular with individuals of all ages, possibly due to the traditional nature of reef fishing itself. Chamorros have relied on their coastlines for sustenance for thousands of years, and nearly 60% of the respondents indicated that they participate in reef fishing.

Another form of outdoor recreation that is based in cultural tradition is plant collecting. Although traditionally the plants collected may have been used for food, medicine, tools, or other purposes, the most common uses appear to be for food and for decorative purposes for fiestas. Not surprisingly, nontraditional recreation, such as jet skiing or scuba diving, is most popular among the young.

Most respondents felt that the fruit bat provides some symbolic value for the Chamorro culture. Some commented that the relationship between the Chamorro people and fruit bats displayed something unique about their culture. Therefore, whether or not an individual likes to eat bats seems to have little relationship with whether one feels that fruit bats could be considered a useful symbol for the Chamorro culture. If a respondent felt that bats would not be a useful cultural symbol, it was usually because he or she, at best, considered them to be insignificant or, at worst, associated the animals with rats, unpleasant odors, or disease. The association between eating fruit bats and their "identity" value, on the other hand, seems to be more personal. For many of those who enjoy eating the bat, the practice apparently provides a means by which they can associate with their cultural heritage.

The fact that a majority of respondents exhibited a utilitarian attitude toward animals was not surprising. Until just a few decades ago, the people of Guam were largely self-sufficient, depending on their ranches, the forest, and the coast for much of their food and other materials. The carabao, or water buffalo, and other domestic animals were sources of transportation, labor, and food. However, according to discussions with a number of islanders, some of the animals used for utilitarian purposes or otherwise eaten were, at times, kept by children as pets. These include carabao, rails, and fruit bats.

The questionnaire was not designed to identify specifically any of the 10 attitude types defined by Kellert other than "utilitarian" and "aesthetic." Nevertheless, it became clear in conversation that other attitudes exhibited toward fruit bats, in particular, represented the humanistic, negativistic, ecologistic, and moralistic values.

A "humanistic" attitude is defined by Kellert (1980) as "primary interest and strong affection for individual animals, principally pets." This attitude was more frequently exhibited toward fruit bats by elderly Chamorros who remembered, as children, having kept fruit bats as pets. These respondents talked of the bats fondly, often telling affectionate and amusing stories of bats sleeping over their beds at night or flying into the house for food once grown and free living.

"Negativistic" attitudes were also exhibited by several respondents. Kellert describes such attitudes as ones in which the main orientation is one of an "active avoidance of animals due to fear or dislike." Upon hearing that the subject of the survey was the fruit bat, the immediate and emphatic response from some individuals (usually younger) was an analogy of fruit bats to rats. For these individuals, the reasons given for their negative feeling toward the fruit bat often were the animal's strong smell and its appearance when dead (lips curled back, tongue extruding). Some of these individuals commented that they had never seen a live fruit bat. There was also the impression that fruit bats are dirty and can transmit disease; this impression may have developed from the existence of ectoparasites on many imported bats or possibly from the perceived similarity of appearance between fruit bats and rats.

Kellert defines an "ecologistic" attitude as one in which the primary concern is for "the environment as a system, for interrelationships between wildlife species and natural habitats." Such attitudes were at times expressed by individuals who noted that fruit bats must have some role in maintaining Guam's forest environment, and were important for that reason alone. Some individuals worried specifically about the loss of forest habitat around Guam and speculated that the bats might be necessary for the continued health of the remaining forest vegetation.

Lastly, some individuals noted in conversation that fruit bats were important in their own right and need not be considered important to humans to have their existence justified. This typifies Kellert's definition of the "moralistic" attitude when he states: "A basic moralistic principle is the fundamental similarity of all animals, each endowed with equivalent rights to existence."

Respondent feelings toward increasing tourism and development on Guam were expected to be closely associated, yet the response with regard to development was much more negative than the response regarding tourism. While much of the development currently taking place on Guam is directly related to tourism, for example, golf course development and hotel construction, discussions with respondents indicated greater tolerance for the tourists in particular than for development in general. A local group, *Protehi I Tano'ta* (Protect Our Land), has developed specifically in response to the rapid development of Guam (Charfauros 1990). During the summer of 1990, at least two other nongovernmental groups were formed: Citizens for Sound Development, in favor of controlled development (Ching 1990), and *Abansa I Isla'Ta* (Improve Our Land), a strongly prodevelopment group (Taitano 1990).

Respondents felt strongly that some of Guam's remaining forests and coastline should be permanently protected from further impact or development. Many individuals viewed jet ski activity, particularly by tourists in certain coral reef flats, as the cause for declining reef productivity. (Savanna fires, construction, and road development have also been implicated in the increasing coastal siltation and subsequent coral mortality off the southwestern coast of Guam [Wiles 1990a]).

Age and gender appear to be influential variables for respondent knowledge (Appendix 9), which helps to explain some of the knowledge results. For instance, respondents who eat fruit bat show a significantly higher knowledge score than those who do not eat fruit bat. Yet the multiple regression analysis indicates that age and gender are more influential variables in determining knowledge levels. As a higher proportion of older respondents than younger enjoy eating fruit bat, it is likely that age, more than the fact that one likes to eat fruit bat, influences the individual's knowledge score. Another relationship that is clarified by the multiple regression analysis is education. Respondent knowledge scores generally decrease as the level of formal education increases; this pattern is also probably influenced by respondent age. Older individuals, whose life styles generally brought them in closer association with fruit bats and the local environment, experienced a shorter period of formal education.

As Guam's native fauna disappear, the level of awareness about these animals among the island's younger Chamorros seems to be declining as well. Many younger respondents were unfamiliar with such birds as the Micronesian kingfisher or the Mariana fruit dove. The Guam rail is a fairly popular bird, however, and efforts to save it from extinction have received some publicity on the island. Other than the rail, the native animal that seemed to be most clearly familiar to younger respondents was the fruit bat. Deer and pigs were well known, probably due to their large sizes, their abundance in certain parts of the island, and to their roles as game species. Carabao, with their close association with the Chamorro until recent years, were also quite well known.

The brown tree snake was extremely well known, and heavily disliked, by the respondents and other residents of Guam. The snake consumes the islanders' chickens and other domestic birds, and there are many instances of snakes entering people's houses. Periodically there are reports of babies in their cribs being bitten by these rear-fanged snakes, whose venom is not strong enough to kill most infants but can cause some harm. An effort sponsored by various members of the business community in the summer of 1990, called "Sweepsnakes," offered a prize of a four-wheel drive pickup truck to the individual who could kill the largest number of snakes during a set period. (The final toll of 1,273 snakes could hardly have had much of an impact on the island's total population.) Other hype associated with the "Sweepsnakes" included snake "trade-ins" for cash from car dealers.

The measure most frequently suggested to help protect fruit bats in the Pacific region was to cease hunting and eating the animals, apparently regardless of whether or not one likes to eat fruit bats. The proportion of respondents suggesting this measure was higher than might have been expected, suggesting a basis for support for conservation efforts. There is also a fair amount of support for stronger enforcement of existing laws and stricter punishment for their violation (especially through leving fines). Several individuals, also in conversation, suggested the possibility of ranching fruit bats. It is generally known that fruit bats are still somewhat common in Palau, relative to the Marianas, and some people seemed to think that this might be a possibility worth exploring in the future.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

Although teenagers and children were not included in this survey, conversations held during the course of the summer provided some cause for concern for the future of Guam's native forests and fauna. Not only was there apparently less knowledge about the island environment among some youth, but there also seemed to be less concern. The drop in demand for fruit bats is a positive sign for the future of the Pacific region's fruit bats, but Guam's own beleaguered flora and fauna need a more organized effort on their behalf among the local population.

At the same time, there appears to be a growing resurgence of interest among Chamorros in their cultural heritage. There was a strong wave of reaction against the proliferating development on the island during the summer of 1990. This was particularly the case when the buried remains of Chamorro ancestors were uncovered in a hotel development project. In addition, a controversy in southern Guam erupted when the mayor of the small quiet village of Merizo proposed a development moratorium, to be in effect until a village master plan was completed. The mayor, Buck Cruz, was strongly criticized for his efforts by much of Guam's business community and other proponents of the current pace of development.

One of the primary issues appears to be one of control: ordinary local people feel that they have little opportunity, or even right, to influence plans developed by wealthy, powerful individuals and families on the island. On the other hand, many citizens often pass on opportunities to become involved (such as public hearings or environmentally related activities). *Protehi I Tano'ta*, the local organization mentioned above, seems to have initiated change in this arena by organizing grassroots efforts in favor of controlled development. In addition, the Marianas Audubon Society (MAS) holds publicized meetings and events throughout the year. Few Chamorros attend or have become members, however. In fact, virtually none of the Chamorros interviewed had ever belonged to an environmental group, although several had joined 4-H as children. A definite opportunity exists for the cultivation of a locally oriented grassroots conservation effort among the Chamorro community on Guam, whether it occurs in the form of a new organization or as an expansion of existing organizations.

Knowledge and culture are additional areas to focus on for further environmental initiatives. Through interviews and numerous conversations, most Chamorros expressed a strong feeling of identity as a Pacific Island people, despite the adoption of many aspects of typical mainstream American society. Although conservation of the fruit bat alone may not be a strong enough issue to encourage citizen involvement, the concept of losing the health of Guam's environment and with it the Chamorro heritage appears to be a mounting concern. During the summer of 1990, at least two candidates for the Guam legislature campaigned on platforms that emphasized the island's need for controlled development and greater environmental protection. Although neither candidate was ultimately elected that year, the fact that these issues were raised signifies change.

With regard to fruit bats, specifically, the indications are mixed. For the *Pteropus* populations elsewhere in the Pacific, recent regulatory and enforcement initiatives appear to be having a strong impact on the trade. During the three months before a temporary U.S. Fish and Wildlife Service (FWS) wildlife inspector arrived on Guam in the summer of 1990, nearly 4,000 fruit bats

were imported to the island. By the end of the summer, imports had dropped to a few hundred (Wiles 1990c). Yet, once there was no longer a federal presence, imports climbed again and some 4,000 bats entered Guam from December 1990 to April 1991 (Wiles 1991b). pers. comm. A permanent federal inspector position has now been established and will hopefully have an even greater, and more permanent, impact on the fruit bat trade.

Yet the demand for fruit bats is not disappearing. Approximately half of the survey respondents claimed to enjoy fruit bats as food, and approximately one-quarter stated that they eat fruit bat at least once a year. A number of individuals spoken to were emphatic in their desire to have access to fruit bats. If enforcement of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) is effective, the mode of fruit bat import might shift to smuggling by boat to fulfill the market demand. Such a shift, while relieving hunting pressure on *Pteropus* populations elsewhere in the Pacific, might increase the pressure on populations in the Marianas. The greatest pressure could occur on Rota, where poachers are currently thought to be taking as much as a couple hundred fruit bats per year (Wiles 1991b). pers. comm. On Guam, the bats are difficult to access by land due to military restrictions and by water due to the rugged coastline. Poaching continues to occur, however, and may be responsible for the loss of 10 to 20 individuals on average each year (Wiles 1991). pers. comm. The 1991 loss of perhaps as many as 30 bats in a single poaching incident supports this concern. If imports continue to shrink, and no significant change occurs in the level of demand, poaching levels might increase.

Biologists from the federal FWS and Guam's Division of Aquatic and Wildlife Resources (DAWR) also continue to investigate snake control methods. Although there is hope that certain sections of the island might be "snake-proofed," it is questionable whether snakes can ever be eradicated from Guam. If the snake is responsible for the extreme levels of juvenile mortality among fruit bats on Guam, as is suspected, and those levels remain relatively unchanged, then the maintenance of a colony on Guam will depend ultimately on immigration from Rota. This relationship between the two islands underscores the need for more effective conservation of fruit bats on Rota.

Recommendations for Local Conservation Activities

A comprehensive conservation effort should be locally based and coordinated with existing initiatives. The following are some possible initiatives aimed primarily at increasing levels of awareness and concern for fruit bats and the environment among Chamorros, as well as other citizens of Guam.

Media

An *environmental education packet* for journalists could be an effective tool in covering a variety of issues. The quality of environmental reporting in Guam's major newspapers could be improved. At times, in the past, Guam's journalists have appeared to have a weak understanding of the environmental issues they have covered. An education packet could include clearly written fact sheets addressing such local issues as marine and freshwater wetland conservation, coral reef protection, species conservation, waste disposal, and pesticide use, among others. The packet could also include more detailed information on various issues and/or a list of useful, relevant publications available locally. A list of local experts on various issues could be compiled to ensure that journalists get the

most informed and current information. The packet could be presented to individual journalists, or to newsrooms, or whatever other method would be considered most effective and appropriate.

To provide an incentive for accurate environmental reporting, an annual *Award for Environmental Journalism* could be presented to a journalist whose work was determined to be consistently accurate and environmentally informative. Such an award might be best presented by a joint governmental/nongovernmental group, both to give the award prestige and to de/politicize it. The development of the award and the criteria to be judged should be made available to news staff, and the designation of a winner should be a public, visible affair. Although many local journalists work on a variety of issues, this initiative might encourage some individuals to develop a more informed base of knowledge for environmental issues.

Exhibits

Exhibits could be developed for placement, either on a permanent or a rotating temporary basis, in public places. A *mall environmental exhibit series* would be effective: the expansive Micronesia Mall would be an ideal place for a rotating series of temporary exhibits, again focusing on pressing local aspects of species and ecosystem conservation, deforestation, coral reef productivity, littering and waste disposal, and conservation of local hydrological systems. The mall is crowded on a daily basis with locals and tourists, and exhibits there would receive a high degree of publicity. These exhibits could tie into the cultural aspects of current island environmental concerns. One example might be reef fishing, a traditional Chamorro activity, and the declining catch due to recent problems of pollution, siltation, or coral collection. The devastated native wildlife of Guam should be an important focus, including but not limited to *Pteropus*. The exhibits should be simple, clear, graphically effective, and factually informative.

At least part of each exhibit could be developed by elementary school children. The involvement of children might help to draw communities into the effort and make the exhibits more personal. This local involvement might also facilitate the obligatory fundraising efforts.

Village Endangered Species Presentations

Each village on Guam has a community center. Although nearly 70% of the survey respondents stated that they would attend a presentation on fruit bat conservation if one was offered at the local community center, some of this response may have been offered out of politeness. Many individuals noted conversationally that, if the presentation consisted only of a talk, they in fact probably would not attend. The possibility of seeing a live fruit bat elicited somewhat more interest, particularly on behalf of their children. The response's indicated the most interest, however, when there was the prospect of seeing not only a live fruit bat but a rail and other endangered native species, as well.

A small traveling presentation that included a nonbreeding rail and a fruit bat (if and when available), if well-publicized, could have some impact within the communities. Other animals, including exotics (for example, a monitor lizard), could be included if available, and their role in (or impact on) local ecosystems described. Such an event should be done initially on a test-run basis, perhaps visiting a different community center on one particular evening each week for one month. Pre-event publicity should be heavy, perhaps including notices in both island newspapers and on

popular radio stations. Nearly three-quarters of the respondents claimed to receive local news by word of mouth, and this more traditional news medium should not be ignored.

Involve Guam's Senior Citizens

Guam's elderly appear to be most familiar with, and knowledgeable about, the island's dwindling wildlife resources. Despite the rapid "Americanization" that has taken place on the island, the island's senior citizens retain a fair amount of respect in the community. Means should be explored by which their knowledge of native wildlife could be passed on to the young, perhaps by visits to schools or involvement in the village endangered species presentations.

Development of a Local Public Television Documentary or Series on Guam's Environment

Ninety-three percent of the respondents interviewed claimed to enjoy watching nature programs on television. Indeed, several interviews took place with nature programs playing on television in the background. Usually, however, these were programs about endangered species in Africa, North America, or some other foreign environment. Television programs should be developed that are oriented specifically to local and regional issues.

DAWR staff developed a series of public awareness announcements, aired for a time on local public TV, that addressed issues ranging from fruit bat conservation to hunter safety. These public service announcements (referred to as "ads" in the survey) were viewed at least once by two-thirds of the respondents. Governmental regulation, however, limits DAWR's efforts to fundraise. This might be an ideal opportunity for a joint governmental/nongovernmental/corporate effort.

Environmental Radio Spot

Approximately 70% of the respondents receive news from the radio, and nearly half of these listen to the "Chamorro" station, KUAM. A brief radio spot could be developed in Chamorro and English on local environmental issues, including endangered species conservation.

Small-Scale, Environmentally, and Culturally-Related Tourist Activities

Many of the tourist activities on Guam are conducted with little regard for the island's environment or cultural past. Typical activities include jet skiing, golf, viewing historic war sites, or visits to *Puntan dos Amantes* (Two Lovers Point) and Latte Stone Park for a quick look and a photograph. Development of coastal areas is a lucrative and tempting way for islanders to utilize family land holdings. One less environmentally damaging way to make land pay, albeit at a more modest level, might be to hold Chamorro dinners on family land, particularly along the coast. Tourist groups could be served traditional Chamorro meals (minus the fruit bat), and other cultural and environmental themes might be integrated into the evening. This could conceivably become a popular activity with foreign tourists. The Chamorro Language Commission might be a source of useful advice as to how to broach such an idea among island landholders.

Environmental Fundraising

Numerous business interests on Guam, both local and foreign, could help provide funding for conservation initiatives. Specific proposals that involve local efforts and have the promise of high visibility may prove to be ultimately successful in encouraging corporate involvement in local conservation. Guam hosts numerous Japanese business interests as well as Japanese tourists, and some of these companies may be worth approaching for funds.

Fruit bat initiatives

DAWR has developed various initiatives in the past, including posters and public service announcements, but generally has been limited by a lack of funds. Items promoting the *fanihi* could be developed to hand out in association with other events, such as village presentations or school visits. Following in the path of the work done on St. Lucia with the native parrot, a local campaign to increase the symbolic value of the fruit bat could involve promotions by local businesses, school activities, etc. Such efforts might be even more effective if they were linked to other local environmental and wildlife issues. The fruit bat's role in helping to maintain the health of Guam's ecological systems should be highlighted, particularly for the less knowledgeable younger Chamorro population.

The impact of Guam's market on the fruit bat populations of other Pacific islands should be emphasized. Seventy percent of the respondents surveyed claimed to feel that Guam's Chamorro population bears some responsibility for the fate of fruit bat populations on other islands. If the Government of Palau were willing, a highly publicized official appeal to the people of Guam might protect Palau's *Pteropus* population.

Integration with Other Organizations

Integration of environmental initiatives with preexisting organizations is essential. These organizations include, but are not limited to, the following:

- *Mayors' Council of Guam.* Although a mayor's approval is not necessarily required for all activities, mayoral support might make the difference in the success or failure of any initiative. Mayors are good sources of information and advice, and it is simple courtesy to keep them informed. The Mayor's Council may be the best approach for island-wide initiatives, but personal calls to individuals is a good idea for village-specific activities.

- *Marianas Audubon Society.* MAS is the oldest and the most environmentally involved of the island groups. It provides hikes, talks, and other activities; publishes a newsletter (*Koko's Call*); and actively participates in public debate on environmentally related issues.

- *Protehi I Tano'ta.* This grassroots organization aims to "ensure that the development of the island of Guam is accomplished in a manner both sound and prudent, and that island development takes into account the desires of the residents of Guam" (*Protehi I Tano'ta* [n.d.). Much of the group's activity focuses on community

community organizing, raising the level of public debate on development issues, and promoting an island-wide master plan to control the rate of development. *Protehi I Tano'ta* is actually an umbrella organization, with both individual and organizational members.

- *Students for Environmental and Social Action (SESA).* This University of Guam student organization developed in early 1990. SESA "strives to promote awareness about environmental and social issues affecting the welfare of our island and its people." Planned activities for the autumn of 1990 included a conference concerning an island master plan for development, and research on golf courses (Tarkong 1990). pers. comm.

- *Government of Guam agencies.* Relevant agencies include the Division of Aquatic and Wildlife Resources, the Department of Parks and Recreation, the Guam Environmental Protection Agency, and the Department of Education.

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PART V: SUPPORTING DATA

APPENDIX 1

Consultations on Guam

The principal investigator consulted with numerous individuals throughout the period of project implementation on Guam, from June 15 through August 1990. All were supportive and helpful, taking time to share their knowledge of many environmental, cultural, and logistical considerations relevant to the project. Those consulted include the following:

Antonio C. Babauta, Mayor, Agat
Vicente C. Bernardo, Mayor, Yona
Dorothy Blas, Assistant to Mayor Raymond S. Laguana, Barrigada
John F. Blas, Mayor, Yigo
Nonito "Nito" C. Blas, Mayor, Mangilao
Mark Charfauros, *Protehi I Tano'ta*
Ignacio "Buck" S. Cruz, Mayor, Merizo
Juan C. Cruz, Mayor, Inarajan
Maria Didasco, Assistant to Mayor Gregorio M. Borja, Santa Rita
Alfredo C. Dungca, Mayor, Tamuning-Tumon
Joseph Flores, Guam Department of Commerce
Isabel S. Haggard, Mayor, Piti
Frances Hudgens, Assistant to Mayor Frank M. Portusach, Agana Heights
Francisco N. Lizama, Mayor, Sinajana
David Lotz, Guam Department of Parks and Recreation
Rufo Lujan, Chief, Division of Aquatic and Wildlife Resources, Guam Department of Agriculture
Tito A. Mantanona, Mayor, Talofofo
Antonio D. Materne, Mayor, Mong Mong-Toto-Maite
Rosa Palomo, Chairman, Chamorro Language Commission
William Paulino, Chamorro Language Studies Division, Guam Department of Education
Jose A. Rivera, Mayor, Dededo
Vicente L. San Nicolas, Mayor, Asan-Maina
Vicente S. San Nicolas, Mayor, Chalan Pago-Ordot
Jeff Shafer, Research Planning and Evaluation, Guam Department of Education
John A. Simpson, Science and Math Consultant, Guam Department of Education
Laura M. Torres Souder, University of Guam
Jo Ann Tarkong, Students for Environmental and Social Action (SESA), University of Guam
Albert T. Topasna, Mayor, Umatac
Robert Underwood, University of Guam
Felix F. Ungacta, Mayor, Agana

APPENDIX 2

Demographics of Respondents

1. **Total number of Chamorro respondents:** 206

2. **Gender of respondents:**

Gender	Frequency	%
Male	85	41
Female	121	59

3. **Age of respondents:**

Age	Frequency	%		
18 - 25 years	24	12	Male:Female	0.50:0.50
26 - 35 years	45	22	(*P*=0.003)	0.38:0.62
36 - 45 years	40	20		0.65:0.35
46 - 55 years	40	20		0.38:0.62
Over 56 years	55	27		0.25:0.75

4. **Village of residence:**

Region	Village	Frequency	%
North:	Dededo	27	13.1
	Tamuning	22	10.7
	Yigo	22	10.7
	(Subtotal)	(71)	(34.5)
Central:	Agana	4	1.9
	Agana Heigts	8	3.9
	Asan/Maina	5	2.4
	Barrigada	30	14.6
	Chalan Pago/Ordot	6	2.9
	Mangilao	13	6.3
	Mong Mong/Toto/Maite	4	1.9
	Piti	5	2.4
	Sinajana	10	4.9
	Yona	8	3.9
	(Subtotal)	(93)	(45.1)
South:	Agat	8	3.9
	Inarajan	4	1.9
	Merizo	5	2.4
	Santa Rita	16	7.8
	Talofofo	6	2.9
	Umatac	3	1.5
	(Subtotal)	(42)	(20.4)

5. **Income distribution** (n=194):

Income (annually, per household)		Frequency	%
High	($55,000 and over)	10	5
Middle	($25,000 - $54,999)	82	42
Low	(under $25,000)	102	53

6. **Income distribution by age** (n=204):

Age	High Inc. Freq.	%	Middle Inc. Freq.	%	Low Inc. Freq.	%
18 - 25 years	3	13	9	37	12	50
26 - 35 years	6	13	23	51	16	36
36 - 45 years	6	15	23	57	11	28
46 - 55 years	1	3	20	50	19	47
Over 56 years	5	9	7	13	43	78
(Total)	(21)	(10)	(82)	(90)	(101)	(50)

P<0.001

7. **Education** (n=205):

Educational level reached	Frequency	%
Elementary school (completed or partial)	73	36
High school (completed)	93	45
College (two years completed)	22	11
College (four years or more completed, including graduate school	17	8

8. **Educational level achieved, by age** (n=204):

Age	Elementary school Freq.	%	High school Freq.	%	Two years college Freq.	%	≥Four years college Freq.	%	
18 - 25	0	0	19	79	5	21	0	0	
26 - 35	4	9	30	67	5	11	6	13	
36 - 45	7	18	20	50	8	20	5	12	
46 - 55	15	38	17	42	4	10	4	10	
Over 55	46	84	7	13	0	0	2	3	
(Total)	(72)	(35)	(93)	(46)	(22)	(11)	(17)	(8)	*P<0.001*

APPENDIX 3

Survey Response Frequencies

i. **Name of interviewer** (n=206):

Interviewer	Frequency	%
Lili Sheeline	124	60.2
Maria Santos Yatar	77	37.4
Lou Weilbacher	5	2.4

1: **How much do you know about Guam's wildlife?** (n=204)

Response	Frequency	%
A lot	65	31.9
Just a little	124	60.8
Nothing	15	7.4

2: **How much do you know about fanihi?** (n=204)

Response	Frequency	%
A lot	66	32.4
Just a little	116	56.9
Nothing	22	10.8

3: **Do you like to eat fanihi?** (n=206)

Response	Frequency	%
Yes	109	52.9
No	96	46.6
DK/NO	1	0.5

4: **Why do you think there are less fanihi now on Guam?** (n=205)

Response	Frequency	%
Hunting/poaching	92	44.9
Snake predation	32	15.6
Development	18	8.8
WWII/typhoons	10	4.9
Parasites/disease	14	6.8
Other	17	8.3
DK/NO	22	10.7

5: **Do you think it's important for Guam to have a lot of tourism?** (n=204)

Response	Frequency	%
Yes	88	43.1
No	98	48.0
DK/NO	18	8.8

6: **Do you think that commercial development on Guam is more important to Chamorros than protecting the jungle?** (n=206)

Response	Frequency	%
Yes	35	17.0
No	157	76.2
DK/NO	14	6.8

7: **Do you think it's important to protect Guam's wildlife, even if that means less hunting?** (n=204)

Response	Frequency	%
Yes	193	94.6
No	7	3.4
DK/NO	4	2.0

8: **Do you think Guam should save some parts of the jungle where there would be no building allowed at all?** (n=206)

Response	Frequency	%
Yes	202	98.1
No	4	1.9

9: **Do you like to watch TV shows about nature?** (n=206)

Response	Frequency	%
Yes	191	92.7
No	13	6.3
DK/NO	2	1.0

10: **Do you think that animals that you eat are more important than animals that you don't eat?** (n=206)

Response	Frequency	%
Yes	115	55.8
No	80	38.8
DK/NO	11	5.3

11: **Do you think it's important to build new roads and hotels on the coast, even if that might hurt the reef?** (n=205)

Response	Frequency	%
Yes	26	12.7
No	170	82.9
DK/NO	9	4.4

13: **Do you think fanihi are nice to look at?** (n=204)

Response	Frequency	%
Yes	154	75.5
No	42	20.6
DK/NO	8	3.9

14: **Do you know people who would shoot a fanihi on Guam, even if it's not allowed?** (n=206)

Response	Frequency	%
Yes	71	34.5
No	126	61.2
DK/NO	9	4.4

15: **Do you think fanihi can be used as a symbol of Chamorro culture?** (n=206)

Response	Frequency	%
Yes	164	79.6
No	35	17.0
DK/NO	7	3.4

16: **Do you think people who illegally hunt Guam's fanihi should have to pay fines or go to jail?** (n=206)

Response	Frequency	%
Yes	161	78.2
No	41	19.9
DK/NO	4	1.9

17: **Do you consider eating fanihi an important part of being Chamorro?** (n=206)

Response	Frequency	%
Yes	101	49.0
No	96	46.6
DK/NO	9	4.4

18: **Do you think fanihi are good for anything other than eating?** (n=206)

Response	Frequency	%
Yes	107	51.9
No	71	34.5
DK/NO	28	13.6

19: **If eating fanihi meant that they were going to disappear from the jungle forever, would you (do you think people should) stop eating them?** (n=206)

Response	Frequency	%
Yes	176	85.4
No	23	11.2
DK/NO	7	3.4

20: **Since Chamorros eat fanihi now from other islands, do you think they should make it their business to help protect those fanihi from dying out also?** (n=204)

Response	Frequency	%
Yes	142	69.6
No	45	22.1
DK/NO	17	8.3

21: **Do you think there are a lot of these animals on Guam?**

Koko (rail)	Frequency	% (n=206)
Yes	10	4.9
No	195	94.7
DK/NO	1	0.5

Fanihi (fruit bats)	Frequency	% (n=205)
Yes	5	2.4
No	196	95.6
DK/NO	4	2.0

Snake	Frequency	% (n=205)
Yes	189	92
No	10	4
DK/NO	6	2

21, continued:

Fruit dove	Frequency	% (n=206)
Yes	12	5.8
No	164	79.6
DK/NO	30	14.6

Turtle dove	Frequency	% (n=206)
Yes	22	10.7
No	149	72.3
DK/NO	35	17.0

Deer	Frequency	% (n=206)
Yes	72	35.0
No	128	62.1
DK/NO	6	2.9

Kingfisher	Frequency	% (n=206)
Yes	9	4.4
No	159	77.2
DK/NO	38	18.4

Carabao (water buffalo)	Frequency	% (n=205)
Yes	95	46.3
No	107	52.2
DK/NO	3	1.5

22: Where do you think the fanihi come from that come to Guam? (n=203)

Response	Frequency	%
Commonwealth of the Northern Marianas	31	15.3
Republic of Palau	109	53.7
Federated States of Micronesia	29	14.3
Other	3	1.5
DK/NO	31	15.3

23: **Is it true that fanihi like fruit best after it ripens?** (n=206)

Response	Frequency	%
Yes	148	71.8
No	7	3.4
DK/NO	51	24.8

24: **Is it legal to hunt fanihi on Guam?** (n=206)

Response	Frequency	%
Yes	32	15.5
No	139	67.5
DK/NO	35	17.0

25: **Is it true that fanihi actually help trees grow in the jungle by spreading seeds?** (n=206)

Response	Frequency	%
Yes	129	62.6
No	18	8.7
DK/NO	59	28.6

26: **Is it true that hunting fanihi on other islands to bring them to Guam is causing them to disappear from other islands?** (n=205)

Response	Frequency	%
Yes	123	60.0
No	32	15.6
DK/NO	50	24.4

27: **Is it true that each mother fanihi has 3 or 4 babies every year?** (n=205)

Response	Frequency	%
Yes	9	4.4
No	46	22.4
DK/NO	150	73.2

28: **Do brown tree snakes eat fanihi?** (n=206)

Response	Frequency	%
Yes	83	40.3
No	27	13.1
DK/NO	96	46.6

29: **Do fanihi sleep in caves during the day?** (n=202)

Response	Frequency	%
Yes	80	39.6
No	67	33.2
DK/NO	55	27.2

30: **How many fanihi do you think Guam imports every year?** (n=205)

Response	Frequency	%
Less than 5,000	125	61.0
5,000 - 10,000	14	6.8
More than 10,000	5	2.4
DK/NO	61	29.8

31: **About how many times each year do you eat fanihi? (Asked only if respondent claims to eat fanihi.)** (n=110)

Response	Frequency	%
0 times	85	77.3
1 time	9	8.2
2 times	10	9.1
3 - 5 times	4	3.6
More than 10 times	2	1.8

33: **Why do you (or others) eat fanihi?** (n=148)

Response	Frequency	%
Taste	90	60.8
Smell	9	6.1
Tradition	24	16.2
Other	16	10.8
DK/NO	9	6.1

34: **Does anyone else in your house eat fanihi?** (n=200)

Response	Frequency	%
Yes	109	54.5
No	90	45.0
DK/NO	1	0.5

35: **Do all kinds of fanihi taste the same?** (n=139)

Response	Frequency	%
Yes	27	19.4
No	90	64.7
DK/NO	22	15.8

36: **Are there some fanihi that you don't like to eat? (Asked only if respondent claims to eat fanihi.)** (n=115)

Response	Frequency	%
No: like all fanihi	43	37.4
Yes: don't like fanihi from off-Guam	43	37.4
Yes: other reasons	16	13.9
DK/NO	13	11.3

37: **Have you ever sent frozen fanihi to people outside of Guam as gifts?** (n=204)

Response	Frequency	%
Yes	3	1.5
No	201	98.5

39: **Do you ever buy fanihi:**

At the grocery store	Frequency	% (n=196)
Yes	52	26.5
No	120	61.2
DK/NO	24	12.2

At the Harmon market	Frequency	% (n=200)
Yes	29	14.6
No	127	64.1
DK/NO	42	21.2

At roadside stands	Frequency	% (n=199)
Yes	53	26.6
No	120	60.3
DK/NO	26	13.1

39, continued:

From house-to-house vendors	Frequency	% (n=199)
Yes	27	13.6
No	150	75.4
DK/NO	22	11.1

40: **What price would be too expensive to buy 1 fanihi?** (n=195)

Response	Frequency	%
No price is too expensive	4	2.1
Over $10	57	29.2
Over $20	56	28.7
Over $30	35	17.9
DK/NO	43	22.1

41: **What can you and other Chamorros do to help protect the fanihi from disappearing on Guam and other islands in the Pacific?** (n=202)

Response	Frequency	%
Stop eating, hunting	61	30.2
Control seasons	15	7.4
Control development, protect habitat	22	10.9
Stricter punishment	32	15.8
Ranch bats	8	4.0
Environmental education	4	2.0
Other	41	20.3
DK/NO	19	9.4

42: **If someone gave a talk on fanihi and their protection at the community center, do you think you would go?** (n=206)

Response	Frequency	%
Yes	140	68.0
No	56	27.2
DK/NO	10	4.9

43: **Would you give $10 each year to a local group if they were doing things to protect Guam's land and coasts?** (n=206)

Response	Frequency	%
Yes	179	86.9
No	21	10.2
DK/NO	6	2.9

44: Do you think it would be useful to go to a Senator for help if you wanted better protection for the jungle on Guam? (n=206)

Response	Frequency	%
Yes	148	71.8
No	51	24.8
DK/NO	7	3.4

45: Do you know who the Division of Aquatic and Wildlife Resources (DAWR) is? (n=206)

Response	Frequency	%
Yes	172	83.5
No	34	16.5

a: Have you ever gone to DAWR to get a hunting or fishing permit? (n=206)

Response	Frequency	%
Yes	23	11.2
No	182	88.3
DK/NO	1	0.5

b: Have you ever seen DAWR advertisements on TV? (n=204)

Response	Frequency	%
Yes	135	66.2
No	67	32.8
DK/NO	2	1.0

c: Have you ever seen or read about DAWR in the news? (n=203)

Response	Frequency	%
Yes	149	73.4
No	53	26.1
DK/NO	1	0.5

d: Do you know anyone who had been arrested by DAWR for hunting illegally? (n=204)

Response	Frequency	%
Yes	55	27.0
No	149	73.0

45, continued:

e: **Have you ever heard anyone from DAWR give a talk on anything (e.g. hunting, fishing)?** (n=206)

Response	Frequency	%
Yes	21	10.2
No	184	89.3
DK/NO	1	0.5

46: **Do you ever:**

Hike	Frequency	%
Yes	81	39.7
No	123	60.3

Hunt	Frequency	%
Yes	38	18.5
No	167	81.5

Camp	Frequency	%
Yes	119	58.0
No	86	42.0

Reef-fish	Frequency	%
Yes	121	58.7
No	85	41.3

Ocean-fish	Frequency	%
Yes	42	20.5
No	163	79.5

Collect plants in jungle	Frequency	%
Yes	93	45.1
No	113	54.9

46, continued:

Do watersports	Frequency	%
Yes	39	18.9
No	167	81.1

47: **Have you been a member of an environmental group?** (n=205)

Response	Frequency	%
Yes	2	1.0
No	203	99.0

If "yes," which group?	Frequency	%
4H Club	2	100.0

48: **How do you find out the news on Guam?** (n=205)

a:

Watch TV	Frequency	%
Yes	182	88.8
No	23	11.2

If yes, which channel?	Frequency	% (n=170)
Channel 6	127	74.7
Channel 10	28	16.5
Other	15	8.8

b:

Listen to radio	Frequency	% (n=205)
Yes	141	68.8
No	64	31.2

If yes, which station?	Frequency	% (n=119)
KUAM	58	48.7
"Hit radio"	41	34.5
K57	10	8.4
Other	10	8.4

c:

Read newspaper	Frequency	% (n=205)
Yes	188	91.7
No	17	8.3

48c, continued:

If yes, which paper?	Frequency	%
Pacific Daily News	166	95.4
Tribune	8	4.6

d: Word-of-mouth	Frequency	%
Yes	138	70.1
No	59	29.9

49 through 51: see Appendix II, p. 40.

52: **Have you always lived on Guam?** (n=205)

Response	Frequency	%
Yes	147	71.7
No	58	28.3

If not, how long were you away? (n=55)

Response	Frequency	%
1 - 5 years	176	85.4
6 - 10 years	17	8.3
11 - 20 years	9	4.4
Over 20 years	4	1.9

APPENDIX 4

Statistics for selected variables analyzed by respondent age

1. How much do you know about Guam's wildlife? (q.1)

Frequency Row %	Know a lot	Know little, nothing	Total	
18-25yrs.	4 18.18	18 81.82	22	
26-35yrs.	9 20.45	35 79.55	44	
36-45yrs.	16 44.44	20 55.56	36	
46-55yrs.	14 37.84	23 62.16	37	
>55yrs.	21 43.75	27 56.25	48	
Total %	64 34.22	123 65.78	187 100.00	(P=0.040)

2. Do you like to eat fanihi? (q.3)

Frequency Row %	Eat	Don't Eat	Total	
18-25yrs.	7 30.43	16 69.57	23	
26-35yrs.	10 22.22	35 77.78	45	
36-45yrs.	21 52.50	19 47.50	40	
46-55yrs.	22 55.00	18 45.00	40	
>55yrs.	47 85.45	8 14.55	55	
Total %	107 52.71	96 47.29	203 100.00	(P<0.000)

3. **Do you think it's important for Guam to have a lot of tourism? (q.5)**

Frequency Row %	Yes	No	Total	
18-25yrs.	16 72.73	6 27.27	22	
26-35yrs.	16 39.02	25 60.98	41	
36-45yrs.	26 68.42	12 31.58	38	
46-55yrs.	12 32.43	25 67.57	37	
>55yrs.	18 39.13	28 60.87	46	
Total %	88 47.83	96 52.17	184 100.00	(*P*=0.001)

4. **Do you think that commercial development on Guam is more important to Chamorros than protecting the jungle? (q.6)**

Frequency Row %	Yes	No	Total	
18-25yrs.	5 23.81	16 76.19	21	
26-35yrs.	2 4.55	42 95.45	44	
36-45yrs.	6 16.22	31 83.78	37	
46-55yrs.	7 18.42	31 81.58	38	
>55yrs.	14 28.00	36 72.00	50	
Total %	34 17.89	156 82.11	190 100.00	(*P*=0.052)

5. **Do you think it's important to protect Guam's wildlife, even if that means less hunting? (q.7)**

Frequency Row %	Yes	No, no op.	Total	
18-25yrs.	24 100.00	0 0.00	24	
26-35yrs.	44 97.78	1 2.22	45	
36-45yrs.	38 97.44	1 2.56	39	
46-55yrs.	39 97.50	1 2.50	40	
>55yrs.	46 85.19	8 14.81	54	
Total %	191 94.55	11 5.45	202 100.00	(*P*=0.012)

6. **Do you think that animals that you eat are more important than animals that you don't eat? (q.10)**

Frequency Row %	Yes	No	Total	
18-25yrs.	10 41.67	14 58.33	24	
26-35yrs.	17 43.59	22 56.41	39	
36-45yrs.	19 50.00	19 50.00	38	
46-55yrs.	27 69.23	12 30.77	39	
>55yrs.	40 75.47	13 24.53	53	
Total %	113 58.55	80 41.45	193 100.00	(*P*=0.004)

7. **Do you think people who illegally hunt Guam's fanihi should have to pay fines or go to jail? (q.16)**

Frequency Row %	Yes	No	Total	
18-25yrs.	19 79.17	5 20.83	24	
26-35yrs.	41 97.62	1 2.38	42	
36-45yrs.	32 80.00	8 20.00	40	
46-55yrs.	29 72.50	11 27.50	40	
>55yrs.	39 72.22	15 27.78	54	
Total %	160 80.00	40 20.00	200 100.00	(*P*=0.021)

8. **Do you consider eating fanihi an important part of being Chamorro? (q.17)**

Frequency Row %	Yes	No	Total	
18-25yrs.	8 33.33	16 66.67	24	
26-35yrs.	10 24.39	31 75.61	41	
36-45yrs.	12 30.00	28 70.00	40	
46-55yrs.	28 73.68	10 26.32	38	
>55yrs.	41 78.85	11 21.15	52	
Total %	99 50.77	96 49.23	195 100.00	(*P*<0.000)

9. Where do you think the fanihi come from that come to Guam? (q.22)

Frequency Row %	CNMI	Palau	FSM	Other	Don't know, no op.	Total
18-25yrs.	3 13.04	10 43.48	2 8.70	1 4.35	7 30.43	23
26-35yrs.	9 20.00	22 48.89	9 20.00	1 2.22	4 8.89	45
36-45yrs.	5 12.50	25 62.50	8 20.00	1 2.50	1 2.50	40
46-55yrs.	6 15.79	27 71.05	3 7.89	0 0.00	2 5.26	38
>55yrs.	8 14.55	24 43.64	6 10.91	0 0.00	17 30.91	55
Total %	31 15.42	108 53.73	28 13.93	3 1.49	31 15.42	201 100.00

(*P*=0.009)

10. Is it true that fanihi like fruit best after it ripens? (q.23)

Frequency Row %	Yes	Don't know, no op.	Total	
18-25yrs.	7 29.17	17 70.83	24	
26-35yrs.	22 48.89	23 51.11	45	
36-45yrs.	29 72.50	11 27.50	40	
46-55yrs.	36 90.00	4 10.00	40	
>55yrs.	52 94.55	3 5.45	55	
Total %	146 71.57	58 28.43	204 100.00	(*P*<0.000)

11. **Is it true that each mother fanihi has 3 or 4 babies every year? (q.27)**

Frequency Row %	Yes	No	Don't know, no op.	Total
18-25yrs.	1 4.17	2 8.33	21 87.50	24
26-35yrs.	2 4.44	3 6.67	40 88.89	45
36-45yrs.	3 7.50	8 20.00	29 72.50	40
46-55yrs.	1 2.50	12 30.00	27 67.50	40
>55yrs.	1 1.85	20 37.04	33 61.11	54
Total %	8 3.94	45 22.17	150 73.89	203 100.00

(P=0.015)

12. **Do fanihi sleep in caves during the day? (q.29)**

Frequency Row %	Yes	No	Don't know, no,op.	Total
18-25yrs.	9 37.50	5 20.83	10 41.67	24
26-35yrs.	24 54.55	8 18.18	12 27.27	44
36-45yrs.	17 42.50	17 42.50	6 15.00	40
46-55yrs.	18 47.37	10 26.32	10 26.32	38
>55yrs.	11 20.37	26 48.15	17 31.48	54
Total %	79 39.50	66 33.00	55 27.50	200 100.00

(P=0.005)

13. **How many fanihi do you think Guam imports every year? (q.30)**

Frequency Row %	<5,000	>5,000	Don't know, no op.	Total	
18-25yrs.	16 66.67	3 12.50	5 20.83	24	
26-35yrs.	28 63.64	7 15.91	9 20.45	44	
36-45yrs.	22 55.00	7 17.50	11 27.50	40	
46-55yrs.	27 67.50	2 5.00	11 27.50	40	
>55yrs.	30 54.55	0 0.00	25 45.45	55	
Total %	123 60.59	19 9.36	61 30.05	203 100.00	(P=0.017)

14. **Do all kinds of fruit bats taste the same? (q.35)**

Frequency Row %	Yes	No	Don't know, no op.	Total	
18-25yrs.	5 45.45	4 36.36	2 18.18	11	
26-35yrs.	2 9.09	10 45.45	10 45.45	22	
36-45yrs.	3 10.34	20 68.97	6 20.69	29	
46-55yrs.	4 15.38	20 76.92	2 7.69	26	
>55yrs.	13 26.00	35 70.00	2 4.00	50	
Total %	27 19.57	89 64.49	22 15.94	138 100.00	(P<0.000)

15. **Are there some fanihi that you don't like to eat? (Asked only if respondent claims to eat fanihi.) (q.36)**

Frequency Row %	Like all bats	Do not like non-Guam bats	Do not like female bats	Do not like (other)	Don't know, no op.	Total
18-25yrs.	1 25.00	0 0.00	0 0.00	0 0.00	3 75.00	4
26-35yrs.	5 35.71	3 21.43	1 7.14	1 7.14	4 28.57	14
36-45yrs.	10 40.00	8 32.00	1 4.00	2 8.00	4 16.00	25
46-55yrs.	9 39.13	12 52.17	0 0.00	2 8.70	0 0.00	23
>55yrs.	18 38.30	18 38.30	0 0.00	9 19.15	2 4.26	47
Total % (*P*=0.005)	43 38.05	41 36.28	2 1.77	14 12.39	13 11.50	113 100.00

16. **What can you and other Chamorros do to help protect the fanihi from disappearing on Guam and other islands in the Pacific? (q.41; continued on following page)**

Frequency Row %	Stop hunting, eating	Control seasons	Control devpm't, protect habitat	Enforce and punish more	Ranch bats
18-25yrs.	7 30.43	1 4.35	2 8.70	4 17.39	1 4.35
26-35yrs.	11 24.44	3 6.67	4 8.89	6 13.33	5 11.11
36-45yrs.	12 31.58	5 13.16	1 2.63	9 23.68	1 2.63
46-55yrs.	14 35.00	6 15.00	7 17.50	4 10.00	1 2.50
>55yrs.	16 29.63	0 0.00	7 12.96	9 16.67	0 0.00
Total %	60 44.12	15 11.03	21 15.44	32 23.53	8 5.88

16. (Q.41) continued:

Frequency Row %	Wildlife center	Environ-mental ed.	Other	Don't know, no op.	Total
18-25yrs.	0 0.00	2 8.70	2 8.70	4 17.39	23
26-35yrs.	1 2.22	1 2.22	9 20.00	5 11.11	45
36-45yrs.	2 5.26	1 2.63	5 13.16	2 5.26	38
46-55yrs.	0 0.00	0 0.00	7 17.50	1 2.50	40
>55yrs.	5 9.26	0 0.00	10 18.52	7 12.96	54
Total %	8 4.00	4 2.00	33 16.50	19 9.50	200 100.00

(*P*=0.054)

17. **Do you think it would be useful to go to a senator for help if you wanted better protection for the jungle on Guam? (q.44)**

Frequency Row %	Yes	No	Total	
18-25yrs.	18 85.71	3 14.29	21	
26-35yrs.	37 84.09	7 15.91	44	
36-45yrs.	31 79.49	8 20.51	39	
46-55yrs.	28 71.79	11 28.21	39	
>55yrs.	32 59.26	22 40.74	54	
Total %	146 74.11	51 25.89	197 100.00	(*P*=0.031)

18. **Do you know who the Division of Aquatic and Wildlife Resources (DAWR) is? (q.45)**

Frequency Row %	Yes	No	Total	
18-25yrs.	18 75.00	6 25.00	24	
26-35yrs.	42 93.33	3 6.67	45	
36-45yrs.	37 92.50	3 7.50	40	
46-55yrs.	33 82.50	7 17.50	40	
>55yrs.	40 72.73	15 27.27	55	
Total %	170 83.33	34 16.67	204 100.00	(*P*=0.023)

19. **Have you ever gone to DAWR to get a hunting or fishing permit? (q.45a)**

Frequency Row %	Yes	No	Total	
18-25yrs.	4 16.67	20 83.33	24	
26-35yrs.	7 15.56	38 84.44	45	
36-45yrs.	6 15.00	34 85.00	40	
46-55yrs.	6 15.00	34 85.00	40	
>55yrs.	0 0.00	54 100.00	54	
Total %	23 11.33	180 88.67	203 100.00	(*P*=0.051)

20. **Have you ever seen DAWR advertisements on TV? (q.45b)**

Frequency Row %	Yes	No	Total	
18-25yrs.	19 82.61	4 17.39	23	
26-35yrs.	30 66.67	15 33.33	45	
36-45yrs.	29 72.50	11 27.50	40	
46-55yrs.	30 78.95	8 21.05	38	
>55yrs.	26 48.15	28 51.85	54	
Total %	134 67.00	66 33.00	200 100.00	(*P*=0.007)

21. **Do you know anyone who has been arrested by DAWR for hunting illegally? (q.45d)**

Frequency Row %	Yes	No	Total	
18-25yrs.	3 12.50	21 87.50	24	
26-35yrs.	17 38.64	27 61.36	44	
36-45yrs.	14 35.00	26 65.00	40	
46-55yrs.	15 38.46	24 61.54	39	
>55yrs.	6 10.91	49 89.09	55	
Total %	55 27.23	147 72.77	202 100.00	(*P*=0.002)

APPENDIX 5

Statistics for selected variables analyzed by respondent gender

1. **How much do you know about Guam's wildlife? (q.1)**

Frequency Row %	Know a lot	Know little, nothing	Total	
Male	42 51.22	40 48.78	82	
Female	23 21.50	84 78.50	107	
Total %	65 34.39	124 65.61	189 100.00	(P<0.000)

2. **Do you like to eat fanihi? (q.3)**

Frequency Row %	Yes	No	Total	
Male	52 61.18	33 38.82	85	
Female	57 47.50	63 52.50	120	
Total %	109 53.17	96 46.83	205 100.00	(P=0.053)

3. **Do you think it's important to protect Guam's wildlife, even if that means less hunting? (q.7)**

Frequency Row %	Yes	No, no op.	Total	
Male	82 98.80	1 1.20	83	
Female	111 91.74	10 8.26	121	
Total %	193 94.61	11 5.39	204 100.00	(P=0.028)

4. **Do you think fanihi are nice to look at? (q.13)**

Frequency Row %	Yes	No	Total	
Male	76 92.68	6 7.32	82	
Female	78 68.42	36 31.58	114	
Total %	154 78.57	42 21.43	196 100.00	(P<0.000)

5. **Do you think fanihi are good for anything other than eating? (q.18)**

Frequency Row %	Yes	No	Don't know, no op.	Total	
Male	51 60.00	28 32.94	6 7.06	85	
Female	56 46.28	43 35.54	22 18.18	121	
Total %	107 51.94	71 34.47	28 13.59	206 100.00	(P=0.040)

6. **Where do you think the fanihi come from that come to Guam? (q.22)**

Frequency Row %	CNMI	Palau	FSM	Other	Don't know, no op.	Total
Male	9 10.98	47 57.32	17 20.73	3 3.66	6 7.32	82
Female	22 18.18	62 51.24	12 9.92	0 0.00	25 20.66	121
Total %	31 15.27	109 53.69	29 14.29	3 1.48	31 15.27	203 100.00

(P=0.003)

7. **Is it legal to hunt fanihi on Guam? (q.24)**

Frequency Row %	Yes	No	Don't know, no op.	Total	
Male	13 15.29	67 78.82	5 5.88	85	
Female	19 15.70	72 59.50	30 24.79	121	
Total %	32 15.53	139 67.48	35 16.99	206 100.00	(*P*=0.001)

8. **Is it true that fanihi actually help trees grow in the jungle by spreading seeds? (q.25)**

Frequency Row %	Yes	No	Don't know, no op.	Total	
Male	63 74.12	7 8.24	15 17.65	85	
Female	66 54.55	11 9.09	44 36.36	121	
Total %	129 62.62	18 8.74	59 28.64	206 100.00	(*P*=0.010)

9. **Do you know who the Division of Aquatic and Wildlife Resources (DAWR) is? (q.45)**

Frequency Row %	Yes	No	Total	
Male	77 90.59	8 9.41	85	
Female	95 78.51	26 21.49	121	
Total %	172 83.50	34 16.50	206 100.00	(*P*=0.022)

10. **Have you ever gone to DAWR to get a hunting or fishing permit? (q.45a)**

Frequency / Row %	Yes	No	Total	
Male	19	65	84	
	22.62	77.38		
Female	4	117	121	
	3.31	96.69		
Total	23	182	205	
%	11.22	88.78	100.00	(P<0.000)

11. **Do you know anyone who has been arrested by DAWR for hunting illegally? (q.45d)**

Frequency / Row %	Yes	No	Total	
Male	32	53	85	
	37.65	62.35		
Female	23	96	119	
	19.33	80.67		
Total	55	149	204	
%	26.96	73.04	100.00	(P=0.004)

12. **Do you ever hike? (q.46)**

Frequency / Row %	Yes	No	Total	
Male	47	36	83	
	56.63	43.37		
Female	34	87	121	
	28.10	71.90		
Total	81	123	204	
%	39.71	60.29	100.00	(P<0.000)

13. **Do you ever hunt? (q.46)**

Frequency Row %	Yes	No	Total	
Male	32 37.65	53 62.35	85	
Female	6 5.00	114 95.00	120	
Total %	38 18.54	167 81.46	205 100.00	(*P*<0.000)

14. **Do you ever camp? (q.46)**

Frequency Row %	Yes	No	Total	
Male	58 68.24	27 31.76	85	
Female	61 50.83	59 49.17	120	
Total %	119 58.05	86 41.95	205 100.00	(*P*=0.013)

15. **Do you ever reef-fish? (q.46)**

Frequency Row %	Yes	No	Total	
Male	67 78.82	18 21.18	85	
Female	54 44.63	67 55.37	121	
Total %	121 58.74	85 41.26	206 100.00	(*P*<0.000)

16. **Do you ever ocean-fish? (q.46)**

Frequency / Row %	Yes	No	Total	
Male	29	55	84	
	34.52	65.48		
Female	13	108	121	
	10.74	89.26		
Total	42	163	205	
%	20.49	79.51	100.00	(P<0.000)

17. **Do you ever do watersports? (q.46)**

Frequency / Row %	Yes	No	Total	
Male	26	59	85	
	30.59	69.41		
Female	13	108	121	
	10.74	89.26		
Total	39	167	206	
%	18.93	81.07	100.00	(P<0.000)

18. **Have you always lived on Guam? (q.52)**

Frequency / Row %	Yes	No	Total	
Male	53	31	84	
	63.10	36.90		
Female	94	27	121	
	77.69	22.31		
Total	147	58	205	
%	71.71	28.29	100.00	(P=0.023)

APPENDIX 6

Statistics for selected variables analyzed by respondent's education

1. **Do you like to eat fruit bat? (q.3)**

Frequency Row %	Yes	No	Total	
Element. School	54 73.97	19 26.03	73	
High School	43 46.74	49 53.26	92	
2 years College	6 27.27	16 72.73	22	
≥ 4 yrs. College	5 29.41	12 70.59	17	
Total %	108 52.94	96 47.06	204 100.00	(P<0.000)

2. **Do you think it's important for Guam to have a lot of tourism? (q.5)**

Frequency Row %	Yes	No	Total	
Element. School	20 31.25	44 68.75	64	
High School	47 55.29	38 44.71	85	
2 years College	11 52.38	10 47.62	21	
≥ 4 yrs. College	10 66.67	5 33.33	15	
Total %	88 47.57	97 52.43	185 100.00	(P=0.010)

3. **Do you think it's important to protect Guam's wildlife, even if that means less hunting? (q.7)**

Frequency Row %	Yes	No, don't know	Total	
Element. School	63 87.50	9 12.50	72	
High School	90 97.83	2 2.17	92	
2 years College	22 100.00	0 0.00	22	
≥ 4 yrs. College	17 100.00	0 0.00	17	
Total %	192 94.58	11 5.42	203 100.00	*(P=0.011)*

4. **Do you think that animals that you eat are more important than animals that you don't eat? (q.10)**

Frequency Row %	Yes	No	Total	
Element. School	51 72.86	19 27.14	70	
High School	46 53.49	40 46.51	86	
2 years College	10 45.45	12 54.55	22	
≥ 4 yrs. College	7 43.75	9 56.25	16	
Total %	114 58.76	80 41.24	194 100.00	(P=0.020)

5. **Do you think fanihi can be used as a symbol of Chamorro culture? (q.15)**

Frequency Row %	Yes	No	Total	
Element. School	66 92.96	5 7.04	71	
High School	73 82.02	16 17.98	89	
2 years College	11 52.38	10 47.62	21	
≥ 4 yrs. College	13 76.47	4 23.53	17	
Total %	163 82.32	35 17.68	198 100.00	(P<0.000)

6. **Do you consider eating fanihi an important part of being Chamorro? (q.17)**

Frequency Row %	Yes	No	Total	
Element. School	57 82.61	12 17.39	69	
High School	36 40.91	52 59.09	88	
2 years College	3 13.64	19 86.36	22	
≥ 4 yrs. College	4 23.53	13 76.47	17	
Total %	100 51.02	96 48.98	196 100.00	(P<0.000)

7. **Since Chamorros eat fanihi now from other islands, do you think they should make it their business to help protect those fanihi from dying out also? (q.20)**

Frequency Row %	Yes	No	Total	
Element. School	39 63.93	22 36.07	61	
High School	69 79.31	18 20.69	87	
2 years College	16 76.19	5 23.81	21	
≥ 4 yrs. College	17 100.00	0 0.00	17	
Total %	141 75.81	45 24.19	186 100.00	(*P*=0.013)

8. **Is it true that fanihi like fruit best after it ripens? (q.23)**

Frequency Row %	Yes	No, don't know	Total	
Element. School	65 89.04	8 10.96	73	
High School	59 63.44	34 36.56	93	
2 years College	12 54.55	10 45.45	22	
≥ 4 yrs. College	11 64.71	6 35.29	17	
Total %	147 71.71	58 28.29	205 100.00	(*P*=0.001)

9. **Is it true that each mother fanihi has 3 or 4 babies every year? (q.27)**

Frequency Row %	Yes	No	Don't know, no op.	Total	
Element. School	4 5.56	28 38.89	40 55.56	72	
High School	4 4.30	9 9.68	80 86.02	93	
2 years College	1 4.55	5 22.73	16 72.73	22	
≥ 4 yrs. College	0 0.00	3 17.65	14 82.35	17	
Total %	9 4.41	45 22.06	150 73.53	204 100.00	(P=0.001)

10. **About how many times each year do you eat fanihi? (Asked only if respondent claims to eat fanihi.) (q.31)**

Frequency Row %	Don't eat any-more	Once	Twice	Three to five times	>Five times	Total
Element. School	48 88.89	2 3.70	2 3.70	1 1.85	1 1.85	54
High School	29 67.44	7 16.28	3 6.98	3 6.98	1 2.33	43
2 years College	4 57.14	0 0.00	3 42.86	0 0.00	0 0.00	7
≥ 4 yrs. College	3 60.00	0 0.00	2 40.00	0 0.00	0 0.00	5
Total %	84 77.06	9 8.26	10 9.17	4 3.67	2 1.83	109 100.00

(P=0.011)

11. Do all kinds of fruit bats taste the same? (q.35)

Frequency Row %	Yes	No	Don't know, no op.	Total
Element. School	11 18.64	46 77.97	2 3.39	59
High School	12 21.05	32 56.14	13 22.81	57
2 years College	2 15.38	7 53.85	4 30.77	13
≥ 4 yrs. College	2 20.00	5 50.00	3 30.00	10
Total %	27 19.42	90 64.75	22 15.83	139 100.00

(P=0.034)

12. Are there some fanihi that you don't like to eat? (Asked only if respondent claims to eat fanihi.) (q.36)

Frequency Row %	Like all bats	Don't like non-Guam bats	Don't like female bats	Don't like (other)	Don't know, no op.	Total
Element. School	20 34.48	24 41.38	0 0.00	12 20.69	2 3.45	58
High School	18 46.15	12 30.77	1 2.56	0 0.00	8 20.51	39
2 years College	4 40.00	2 20.00	1 10.00	1 10.00	2 20.00	10
≥ 4 yrs. College	1 14.29	4 57.14	0 0.00	1 14.29	1 14.29	7
Total %	43 37.72	42 36.84	2 1.75	14 12.28	13 11.40	114 100.00

(P=0.018)

13. **Do you think it would be useful to go to a senator for help if you wanted better protection for the jungle on Guam? (q.44)**

Frequency Row %	Yes	No	Total	
Element. School	42 60.00	28 40.00	70	
High School	75 83.33	15 16.67	90	
2 years College	15 71.43	6 28.57	21	
≥ 4 yrs. College	15 88.24	2 11.76	17	
Total %	147 74.24	51 25.76	198 100.00	(*P*=0.004)

14. **Have you ever seen DAWR advertisements on TV? (q.45b)**

Frequency Row %	Yes	No	Total	
Element. School	38 53.52	33 46.48	71	
High School	70 76.09	22 23.91	92	
2 years College	14 63.64	8 36.36	22	
≥ 4 yrs. College	12 75.00	4 25.00	16	
Total %	134 66.67	67 33.33	201 100.00	(*P*=0.020)

15. **Do you ever hike? (q.46)**

Frequency Row %	Yes	No	Total	
Element. School	18 25.00	54 75.00	72	
High School	45 48.91	47 51.09	92	
2 years College	11 50.00	11 50.00	22	
≥ 4 yrs. College	6 35.29	11 64.71	17	
Total %	80 39.41	123 60.59	203 100.00	(P=0.012)

16. **Do you ever do watersports? (q.46)**

Frequency Row %	Yes	No	Total	
Element. School	3 4.11	70 95.89	73	
High School	23 24.73	70 75.27	93	
2 years College	10 45.45	12 54.55	22	
≥ 4 yrs. College	3 17.65	14 82.35	17	
Total %	39 19.02	166 80.98	205 100.00	(P<0.000)

17. **How do you find out the news on Guam: newspaper? (q.48c)**

Frequency Row %	Yes	No	Total	
Element. School	61 83.56	12 16.44	73	
High School	89 95.70	4 4.30	93	
2 years College	21 95.45	1 4.55	22	
≥ 4 yrs. College	17 100.00	0 0.00	17	
Total %	188 91.71	17 8.29	205 100.00	(*P*=0.016)

18. **Have you always lived on Guam? (q.52)**

Frequency Row %	Yes	No	Total	
Element. School	59 80.82	14 19.18	73	
High School	68 73.12	25 26.88	93	
2 years College	10 45.45	12 54.55	22	
≥ 4 yrs. College	10 58.82	7 41.18	17	
Total %	147 71.71	58 28.29	205 100.00	(*P*=0.008)

APPENDIX 7

Statistics for selected variables analyzed by respondent income level

1. **Do you like to eat fanihi? (q.3)**

Frequency Row %	Yes	No	Total	
Low income	63 61.76	39 38.24	102	
Middle income	37 45.12	45 54.88	82	
High income	9 42.86	12 57.14	21	
Total %	109 53.17	96 46.83	205 100.00	(*P*=0.048)

2. **Is it important for Guam to have a lot of tourism? (q.5)**

Frequency Row %	Yes	No	Total	
Low income	34 36.96	58 63.04	92	
Middle income	42 55.26	34 44.74	76	
High income	12 66.67	6 33.33	18	
Total %	88 47.31	98 52.69	186 100.00	(*P*=0.014)

3. **Do you consider eating fanihi an important part of being Chamorro? (q.17)**

Frequency Row %	Yes	No	Total	
Low income	62 63.27	36 36.73	98	
Middle income	31 39.24	48 60.76	79	
High income	8 40.00	12 60.00	20	
Total %	101 51.27	96 48.73	197 100.00	(*P*=0.004)

4. **Since Chamorros eat fanihi now from other islands, do you think they should make it their business to help protect those fanihi from dying out also? (q.20)**

Frequency Row %	Yes	No	Total	
Low income	60 65.93	31 34.07	91	
Middle income	67 85.90	11 14.10	78	
High income	15 83.33	3 16.67	18	
Total %	142 75.94	45 24.06	187 100.00	(*P*=0.008)

5. **About how many times each year to you eat fanihi? (Asked only if respondent claims to eat fanihi.) (q.31)**

Frequency Row %	Don't eat any-more	Once	Twice	Three to five times	>Five times	Total
Low income	58 90.62	2 3.12	1 1.56	3 4.69	0 0.00	64
Middle income	22 59.46	5 13.51	9 24.32	0 0.00	1 2.70	37
High income	5 55.56	2 22.22	0 0.00	1 11.11	1 11.11	9
Total %	85 77.27	9 8.18	10 9.09	4 3.64	2 1.82	110 100.00

(*P*<0.000)

6. **What can you and other Chamorros do to help protect the fanihi from disppearing on Guam and other islands in the Pacific? (q.41)**

Frequency Row %	Stop hunting, eating	Control seasons	Control develop., protect habitat	Enforce and punish more	Ranch bats	Total
Low income	29 28.71	6 5.94	15 14.85	14 13.86	2 1.98	101
Middle income	28 34.57	9 11.11	6 7.41	15 18.52	5 6.17	81
High income	4 20.00	0 0.00	1 5.00	3 15.00	1 5.00	20
Total %	61 30.20	15 7.43	22 10.89	32 15.84	8 3.96	202 100.00

6. **(Q.41) continued:**

Frequency Row %	Wildlife Center	Environ-mental ed.	Other	Don't know, no op.	Total
Low income	7 6.93	1 0.99	15 14.85	12 11.88	101
Middle income	1 1.23	3 3.70	9 11.11	5 6.17	81
High income	0 0.00	0 0.00	9 45.00	2 10.00	20
Total %	8 3.96	4 1.98	33 16.34	19 9.41	202 100.00

(*P*=0.018)

7. **Do you think it would be useful to go to a senator for help if you wanted better protection for the jungle on Guam? (q.44)**

Frequency Row %	Yes	No	Total	
Low income	63 63.64	36 36.36	99	
Middle income	69 86.25	11 13.75	80	
High income	16 80.00	4 20.00	20	
Total %	148 74.37	51 25.63	199 100.00	(*P*=0.002)

8. **Have you ever gone to DAWR to get a hunting or fishing permit? (q.45a)**

Frequency Row %	Yes	No	Total	
Low income	5 4.90	97 95.10	102	
Middle income	13 15.85	69 84.15	82	
High income	5 23.81	16 76.19	21	
Total %	23 11.22	182 88.78	205 100.00	(*P*=0.010)

9. **Do you know anyone who has been arrested by DAWR for hunting illegally? (q.45d)**

Frequency Row %	Yes	No	Total	
Low income	17 16.83	84 83.17	101	
Middle income	30 36.59	52 63.41	82	
High income	8 38.10	13 61.90	21	
Total %	55 26.96	149 73.04	204 100.00	(*P*=0.005)

11. **Do you ever collect plants in the jungle? (q.46)**

Frequency Row %	Yes	No	Total	
Low income	55 53.40	48 46.60	103	
Middle income	33 40.24	49 59.76	82	
High income	5 23.81	16 76.19	21	
Total %	93 45.15	113 54.85	206 100.00	(*P*=0.024)

APPENDIX 8

Statistics for selected variables analyzed by consumption of fruit bat

Interviewer:

Frequency Row %	Lili Sheeline	Maria S. Yatar	Total	
Eat	54 50.94	52 49.06	106	
Don't eat	69 73.40	25 26.60	94	
Total %	123 61.50	77 38.50	200 100.00	(P=0.001)

1. Gender of respondent:

Frequency Row %	Male	Female	Total	
Eat	52 47.71	57 52.29	109	
Don't eat	33 34.38	63 65.62	96	
Total %	85 41.46	120 58.54	205 100.00	(P=0.053)

3. Why do you think there are less fanihi now on Guam? (q.4)

Frequency Row %	Hunting	Snake pred.	Develop-ment	Typhoons, WWII	Total
Eat	37 34.26	24 22.22	11 10.19	7 6.48	108
Don't eat	55 57.29	8 8.33	7 7.29	3 3.12	96
Total %	92 45.10	32 15.69	18 8.82	10 4.90	204 100.00

3. (q.4) continued:

Frequency Row %	Parasites, disease	Other	Don't know, no op.	Total	
Eat	8 7.41	12 11.11	9 8.33	108	
Don't eat	6 6.25	5 5.21	12 12.50	96	
Total %	14 6.86	17 8.33	21 10.29	204 100.00	(*P*=0.009)

4. Do you think that animals that you eat are more important than animals that you don't eat? (q.10)

Frequency Row %	Yes	No	Total	
Eat	75 72.12	29 27.88	104	
Don't eat	40 44.44	50 55.56	90	
Total %	115 59.28	79 40.72	194 100.00	(*P*<0.000)

5. Do you think fanihi are nice to look at? (q.13)

Frequency Row %	Yes	No	Total	
Eat	93 88.57	12 11.43	105	
Don't eat	61 67.03	30 32.97	91	
Total %	154 78.57	42 21.43	196 100.00	(*P*<0.000)

6. **Do you thnk people who illegally hunt Guam's fanihi should have to pay fines or go to jail? (q.16)**

Frequency Row %	Yes	No	Total	
Eat	80 74.07	28 25.93	108	
Don't eat	80 86.02	13 13.98	93	
Total %	160 79.60	41 20.40	201 100.00	(P=0.036)

7. **Do you consider eating fanihi an important part of being Chamorro? (q.17)**

Frequency Row %	Yes	No	Total	
Eat	75 71.43	30 28.57	105	
Don't eat	26 28.57	65 71.43	91	
Total %	101 51.53	95 48.47	196 100.00	(P<0.000)

8. **Do you think fanihi are good for anything other than eating? (q.18)**

Frequency Row %	Yes	No	Don't know, no op.	Total	
Eat	62 56.88	40 36.70	7 6.42	109	
Don't eat	45 46.88	31 32.29	20 20.83	96	
Total %	107 52.20	71 34.63	27 13.17	205 100.00	(P=0.009)

9. **Since Chamorros eat fanihi now from other islands, do you think they should make it their business to help protect those fanihi from dying out also? (q.20)**

Frequency Row %	Yes	No	Total	
Eat	65 67.71	31 32.29	96	
Don't eat	77 85.56	13 14.44	90	
Total %	142 76.34	44 23.66	186 100.00	(*P*=0.004)

10. **Is it true that fanihi like fruit best after it ripens? (q.23)**

Frequency Row %	Yes	No, don't know	Total	
Eat	90 82.57	19 17.43	109	
Don't eat	58 60.42	38 39.58	96	
Total %	148 72.20	57 27.80	205 100.00	(*P*<0.000)

11. **Is it legal to hunt fanihi on Guam? (q.24)**

Frequency Row %	Yes	No	Don't know, no op.	Total	
Eat	15 13.76	84 77.06	10 9.17	109	
Don't eat	17 17.71	55 57.29	24 25.00	96	
Total %	32 15.61	139 67.80	34 16.59	205 100.00	(*P*=0.004)

12. **Is it true that hunting fanihi on other islands to bring them to Guam is causing them to disappear from other islands? (q.26)**

Frequency Row %	Yes	No	Don't know, no op.	Total	
Eat	65 59.63	23 21.10	21 19.27	109	
Don't eat	57 60.00	9 9.47	29 30.53	95	
Total %	122 59.80	32 15.69	50 24.51	204 100.00	(*P*=0.030)

13. **Is it true that each mother fanihi has 3 or 4 babies every year? q.27)**

Frequency Row %	Yes	No	Don't know, no op.	Total	
Eat	6 5.56	32 29.63	70 64.81	108	
Don't eat	3 3.12	14 14.58	79 82.29	96	
Total %	9 4.41	46 22.55	149 73.04	204 100.00	(*P*=0.019)

14. **Do brown tree snakes eat fanihi? (q.28)**

Frequency Row %	Yes	No	Don't know no op.	Total	
Eat	53 48.62	14 12.84	42 38.53	109	
Don't eat	30 31.25	13 13.54	53 55.21	96	
Total %	83 40.49	27 13.17	95 46.34	205 100.00	(*P*=0.032)

15. **Does anyone else in your house eat fanihi? (q.34)**

Frequency Row %	Yes	No	Total	
Eat	70 64.22	39 35.78	109	
Don't eat	39 43.33	51 56.67	90	
Total	109	90	199	
%	54.77	45.23	100.00	(P=0.003)

16. **If someone gave a talk on fanihi and their protection at the community center, do you think you would go? (q.42)**

Frequency Row %	Yes	No	Total	
Eat	84 79.25	22 20.75	106	
Don't eat	56 62.22	34 37.78	90	
Total	140	56	196	
%	71.43	28.57	100.00	(P=0.009)

17. **Do you think it would be useful to go to a senator for help if you wanted better protection for the jungle on Guam? (q.44)**

Frequency Row %	Yes	No	Total	
Eat	69 66.35	35 33.65	104	
Don't eat	78 82.98	16 17.02	94	
Total	147	51	198	
%	74.24	25.76	100.00	(P=0.008)

18. **Have you ever seen DAWR advertisements on TV? (q.45b)**

Frequency / Row %	Yes	No	Total	
Eat	63 59.43	43 40.57	106	
Don't eat	71 74.74	24 25.26	95	
Total %	134 66.67	67 33.33	201 100.00	(*P*=0.022)

19. **Do you ever hunt? (q.46)**

Frequency / Row %	Yes	No	Total	
Eat	29 26.61	80 73.39	109	
Don't eat	9 9.47	86 90.53	95	
Total %	38 18.63	166 81.37	204 100.00	(*P*=0.002)

20. **Do you ever collect plants in the jungle? (q.46)**

Frequency / Row %	Yes	No	Total	
Eat	58 53.21	51 46.79	109	
Don't eat	35 36.46	61 63.54	96	
Total %	93 45.37	112 54.63	205 100.00	(*P*=0.016)

21. Do you ever do watersports? (q.46)

Frequency Row %	Yes	No	Total	
Eat	14 12.84	95 87.16	109	
Don't eat	25 26.04	71 73.96	96	
Total %	39 19.02	166 80.98	205 100.00	(*P*=0.016)

22. Have you always lived on Guam? (q.52)

Frequency Row %	Yes	No	Total	
Eat	85 78.70	23 21.30	108	
Don't eat	61 63.54	35 36.46	96	
Total %	146 71.57	58 28.43	204 100.00	(*P*=0.017)

APPENDIX 9a

Duncan's Multiple Range Test for respondent knowledge scores analyzed by respondent age

Respondent age	n	Mean knowledge score	Duncan grouping
Over 55 years	51	59.93	A
46 to 55 years	36	58.67	A
36 to 45 years	39	58.27	A
26 to 35 years	43	46.98	B
18 to 25 years	23	40.29	C

APPENDIX 9b

Multiple Regression Analysis of respondent knowledge scores analyzed by selected variables

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
Intercept (Knowledge score)	1	42.10	3.91	10.76	0.0001
Age of respondent	1	5.07	0.80	6.36	0.0001
Gender of respondent	1	-10.08	1.94	-5.19	0.0001
Education of respondent	1	1.40	0.88	1.59	0.1127
Consumption of fruit bat	1	-2.70	2.13	-1.27	0.2070

Appendix 10

Village:_____ Date: _____

Street: _____ Time of day: _____

Name of Respondent: _____ Sex: M [ ] F [ ]

Mailing address: _____ Interviewer's Initials:

_____ _____

	a lot	just a little	nothing
1. How much do you know about Guam's wildlife?	1	2	3
2. How much do you know about fanihi?	1	2	3

	Y	N
3. Do you like to eat fanihi?		
4. Why do you think there are less fanihi now on Guam? _____		
5. Do you think it's important for Guam to have a lot of tourism?	Y	N
6. Do you think that commercial development on Guam is more important to Chamorros than protecting the jungle?	Y	N
7. Do you think it's important to protect Guam's wildlife (gaga halumtano), even if that means less hunting?	Y	N
8. Do you think Guam should save some parts of jungle where there would be no building allowed at all?	Y	N
9 Do you like to watch TV shows about nature?	Y	N
10. Do you think that animals that you eat are more important than animals that you don't eat?	Y	N
11. Do you think it's important to build new roads and hotels on the coast, even if that might hurt the reef?	Y	N
12. Do you think it would be good to tax commercial development on Guam and use that money to protect the jungle and wildlife?	Y	N
13. Do you think fanihi are nice to look at?	Y	N
14. Do you know people who would shoot a fanihi on Guam even if it's not allowed?	Y	N
15. Do you think fanihi can be used as a symbol of Chamorro culture?	Y	N
16. Do you think people who illegally hunt Guam's fanihi should have to pay fines or go to jail?	Y	N
17. Do you consider eating fanihi an important part of being Chamorro?	Y	N

18. Do you think the fanihi are good for anything other than eating? Y N

19. If eating fanihi meant that they were going to disappear from the jungle forever, would you (do you think people should) stop eating them? Y N

20. Since Chamorros eat fanihi now from other islands, do you think they should make it their business to help protect <u>those</u> fanihi from dying out also? Y N

[*KNOWLEDGE*]

21. Do you think there are a lot of these animals on Guam?

a. Rail/koko	Y	N	e. Turtle dove/senesa	Y	N
b. fanihi	Y	N	f. Deer/benado	Y	N
c. Brown tree snake/caiebla	Y	N	g. Kingfisher/sihek	Y	N
d. Fruit dove/totot	Y	N	h. Carabao	Y	N

22. Where do you think the fanihi come from that come to Guam? (*Can respondent name 2 sources* ?)

a._____ b._____

23. Is it true that fanihi like to eat fruit best after it ripens? Y N DK

24. Is it legal to hunt fanihi on Guam? Y N DK

25. Is it true that fanihi actually help trees grow in the jungle by spreading seeds? Y N DK

26. Is it true that hunting fanihi on other islands to bring them to Guam is causing them to disappear from other islands? Y N DK

27. Is it true that each mother fanihi has 3 or 4 babies every year? Y N DK

28. Do brown tree snakes eat fanihi, or only birds? Y N DK

29. Do fanihi sleep in caves during the day? Y N DK

30. How many fanihi do you think Guam imports every year?
a) less than 5,000? b) 5,000 - 10,000? c) more than 10,000?

[*BEHAVIOR*]

31. (*If respondent doesn't eat fanihi, SKIP this question*)
About how many times each year do you usually eat fanihi? _____

32. When do you (or other people) usually eat fanihi? (*READ OUTLOUD*)

a. weddings/fandangos	Y	N	d. village fiestas	Y	N
b. funerals	Y	N	e. Christenings/baptismals	Y	N
c. political rallies	Y	N	f. whenever you can get them	Y	N

33. <u>Why</u> do you (or others) eat fanihi? _____

34. Does anyone else in your house eat fanihi? Y N

35. Do all kinds of fanihi taste the same? Y N

36. (*SKIP if doesn't eat fanihi*) Are there some fanihi that you <u>don't</u> really like to eat?
a) No (likes them all) b) Yes - don't really like:

_____

37. Have you ever sent frozen fanihi to people outside of Guam as gifts? Y N

38. Would you buy fanihi if you knew it was smuggled into Guam? Y N
f

39. Do you ever buy fanihi: a) at the grocery store? Y N
b) from the Harmon flea market? Y N
c) at roadside stands? Y N
d) from someone who comes house-to-house? Y N

40. What price would be <u>too expensive</u> to buy <u>one</u> fanihi?:
$10 $20 $30 $40 $50 Never too expensive/Other_____

41. What are two things that you and other Chamorros can do to help protect the fanihi from disappearing on Guam and other places in the Pacific? ("advice")

1. _____ 2. _____

42. If someone gave a talk on fanihi and their protection at the community center, do you think you would go? Y N

43. Would you give $10 each year to a local group if they were doing things to protect Guam's land and coasts? Y N

44. Do you think it would be useful to go to a Senator for help if you wanted better protection for the jungle on Guam? Y N

45. Do you know who the Division of Aquatic and Wildlife Resources ("Fish & Wildlife") is? (*Explain to them briefly if they don't*) Y N
a. Have you ever gone to DAWR/Fish & Wildlife to get a hunting or fishing permit? Y N
b. Have you ever seen DAWR/Fish & Wildlife advertisements on TV? Y N
c. Have you ever seen or read about DAWR/Fish & Wildlife in the news? Y N
d. Do you know anyone who has been arrested by DAWR/Fish & Wildlife for hunting illegally? Y N
e. Have you ever heard anyone from DAWR/Fish and Wildlife give a talk on anything (eg. hunting, fishing, etc.) Y N

46. Do you ever:

hike for fun	Y	(a lot)	(a little)	N
hunt	Y	(a lot)	(a little)	N
camp	Y	(a lot)	(a little)	N
inland and reef fish	Y	(a lot)	(a little)	N
ocean fish	Y	(a lot)	(a little)	N
collect plants in the jungle	Y	(a lot)	(a little)	N
do water sports	Y	(a lot)	(a little)	N

47. Have you been a member of an environmental group? Yes No

(*If "yes"*) which? _____

48. How do you find out what's happening on Guam (in terms of news and information)?

a. Television Yes N
(*If "yes"*) which channel?
_____

b. Radio Yes N
(*If "yes"*) which station?
_____

c. Newspaper Yes N
(*If "yes"*) which paper?
_____

d. Word-of-mouth Yes N

49. Would you mind telling me your age?/Your age is between:
a) 18-25 years b) 26-35 years c) 36-45 years d) 46-55 years e) 56 years or older

50. Your household income is:
a) less than $25,000
b) between $25,000 and $39,000
c) between $40,000 and $54,000
d) between $55,000 and $69,000
e)more than $70,000

51. How far did you go in school?
a) Elementary school
b) High school
c) 2 years of college
d) 4 years of college
e) Graduate degree

52. Have you always lived on Guam? Yes No

If not, how long were you away? _____

WWF

World Wildlife Fund