

MAN - WILDLIFE RELATIONSHIPS ON GUAM

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ABSTRACT.

Man has been instrumental in greatly modifying the biotic component of terrestrial ecosystems on Guam. The effects of such modifications on the terrestrial vertebrate fauna are discussed. Human activities and land-use patterns have resulted in the following types of modifications: the introduction of new species, the extirpation of four native species, the endangering of 12 species, and the loss of considerable amount of habitat. The effects of past land and water management decisions on wildlife are examined and the potential effects of such future decisions are explored. Several types of activities have impacted on wildlife. The modification of wildlife habitat has resulted from agricultural and urban developments and additional stress has been placed on the terrestrial ecosystems by pesticides, military activities, and consumption. To offset future losses, the Government of Guam has developed a land-use plan for the years 1977-2000, designating certain areas as "unique terrestrial ecosystems" and recommending strict control of permissible uses. In addition, four conservation areas have been established to preserve wildlife habitat. On the federal level, the Air Force has established a 372 hectare (ha) preserve of limestone forest on the northeast coast of Guam. The Department of the Interior is currently reviewing critical habitat recommendations for 12 proposed endangered species. Much of this habitat is on military or government lands and when final designations are made, future developments in critical habitats will be reviewed for their potential effects on wildlife.

INTRODUCTION

In keeping with the theme of this year's convention, I am addressing the topic of land management decisions on Guam and how such decisions have and will affect the resident wildlife. Guam, obscurely known for its role during World War II, is sure to become an area of increasing concern, particularly in regards to its resident wildlife. Guam probably has one of the most unique faunas of any part of the United States. In this sense, it includes a number of species of Asiatic mainland origin that have subsequently become established over the eons by natural dispersal or as a consequence of man's activities.

Proposals are now before the Office of Endangered Species that if acted on positively would probably give Guam the dubious notoriety of having the greatest number of endangered species per area of land of any place in the nation. Obviously, such a situation is not normal, and the root causes lie in the history of the land, water and people management decisions. The purpose of this paper is to investigate this history to see how it has affected various wildlife species, and to present what directions are currently being taken to address these problems.

STUDY AREA

Guam is the southern-most and largest island of the Mariana archipelago. The island is 48 kilometers (km) in length, with a width varying from 6.4 km to 17.6 km. Geologically Guam may be divided into two provinces: a terraced plateau of coralline limestone in the northern part of the island, and laterite hills with some limestone capping and flat coastal areas in the south.

The climate is tropical and the weather is warm and humid regardless of the time of year. There are, however, two seasons: a wet season (July to November) during which 63 to 66 percent of the annual rain falls, and a dry season (January to May) during which 20 to 24 percent of the annual rain falls (about 80 inches). The relative humidity is commonly

in the range of 80 to 90 percent and daytime temperatures are usually between 80°F and 88°F (Moore and McMakin 1977, Tenorio et al. 1979).

Floristically, Guam has the following vegetation types (Fosberg 1960, Stone 1970, Moore and McMakin 1979):

1. limestone forest, a diverse community of deciduous broadleaved evergreens on a porous limestone substrate.
2. ravine forests with many of the same species found in limestone forest, but located in the more mesic areas in the southern volcanic hills.
3. swamps and marshes consisting primarily of poorly developed mangrove swamps and tall reed marshes dominated by *Phragmites karka*.
4. savannah on the volcanic hills, dominated by the grass *Miscanthus floridulus*, with scattered ironwood trees (*Casuarina equisetifolia*).
5. coastal strand characterized by a number of plants that are found most often growing near the sea, such as the coconut palm (*Cocos nucifera*).

HISTORICAL PERSPECTIVE

Prior to the discovery of Guam by Megellan in 1521, the island's first inhabitants, the Chamorros, lived in multiple chiefdoms and their population is estimated to have been between 80,000 and 100,000. They subsisted primarily by fishing and agriculture and made little use of the native terrestrial fauna (Carano and Sanchez 1964). Like many Pacific islands that are distant from mainland sources of colonizers, Guam was relatively depauperate of terrestrial fauna. Native resident wildlife included about half a dozen species of reptiles (primarily geckos and skinks), three species of mammals (all bats), and 22 species of birds.

With the arrival of the Spanish colonists the native Chamorro population was decimated to about 1,000 individuals as a result of disease and warfare. Guam was under Spanish rule for nearly 300 years and has had one of the longest histories of European and other foreign contacts of any island in the Pacific Ocean. During Spanish colonial rule, Guam served as an intermediate port for galleons traveling between Mexico and the Philippines (from 1665 to 1815). As a consequence of this contact, new species made their way to the island with the assistance of man.

UNGULATES

Sambar deer (*Cervus unicolor*) were brought to Guam around 1772 by the Spanish Governor Don Marino Tobias (Safford 1905) and have since become a successful colonizer, occupying limestone forests and ravine forests. Though populations are small, this deer is highly prized as food by the native people and does offer limited hunting (Wheeler 1979a).

By far the most successful introduced ungulate is the pig (*Sus scrofa*), which was also introduced during Spanish colonial rule. Feral pigs became established in many areas throughout the island as domestic stock was commonly allowed to run loose. Pigs are now hunted by most (68.7 percent) legal hunters, who are generally successful (54.5 percent hunter success in 1978) (Wheeler 1979b). Although Guam wild pigs weigh less on the average than pigs reported from other areas (mean weight of 1978 boars was 42.8 kg), the season is three months long (October to December), with a season limit of 10 pigs.

Domestic Asiatic water buffalo (*Babalis babalis*) were introduced to Guam in the 1600's from the Philippines to be used as beasts of burden (Gibson 1977). Prior to World War II about 2,000 head existed on several private ranches in the southern hills of Guam. During the Japanese occupation (1941-1944) many of these herds were decimated for food, and some were turned loose to wander freely over the more remote, interior regions of savannah interspersed with swamp forest. Since that time these feral animals have established a viable breeding population on a large land reserve of the U.S. Navy (Leeke 1977).

We have conducted monthly night spotlight counts on the Naval Magazine to assess the population status of deer according to a procedure described in Wheeler (1979a). During some of these counts, records were kept of the number of water buffalo sighted, and in some cases the sex and age group (calf or adult) were recorded. The mean and maximum number of buffalo sighted per time period were determined (Figure 1), and these parameters suggest an increasing population during the 1970's. The ratio of calves to adults show a similar trend (Table 1), however, this ratio is still lower than that reported for feral water buffalo in Australia (Tulloch 1978). In addition, group sizes on Guam (Table 2) are much smaller than those reported in Australia, where groups of 40 to 261 were studied (Tulloch 1978).

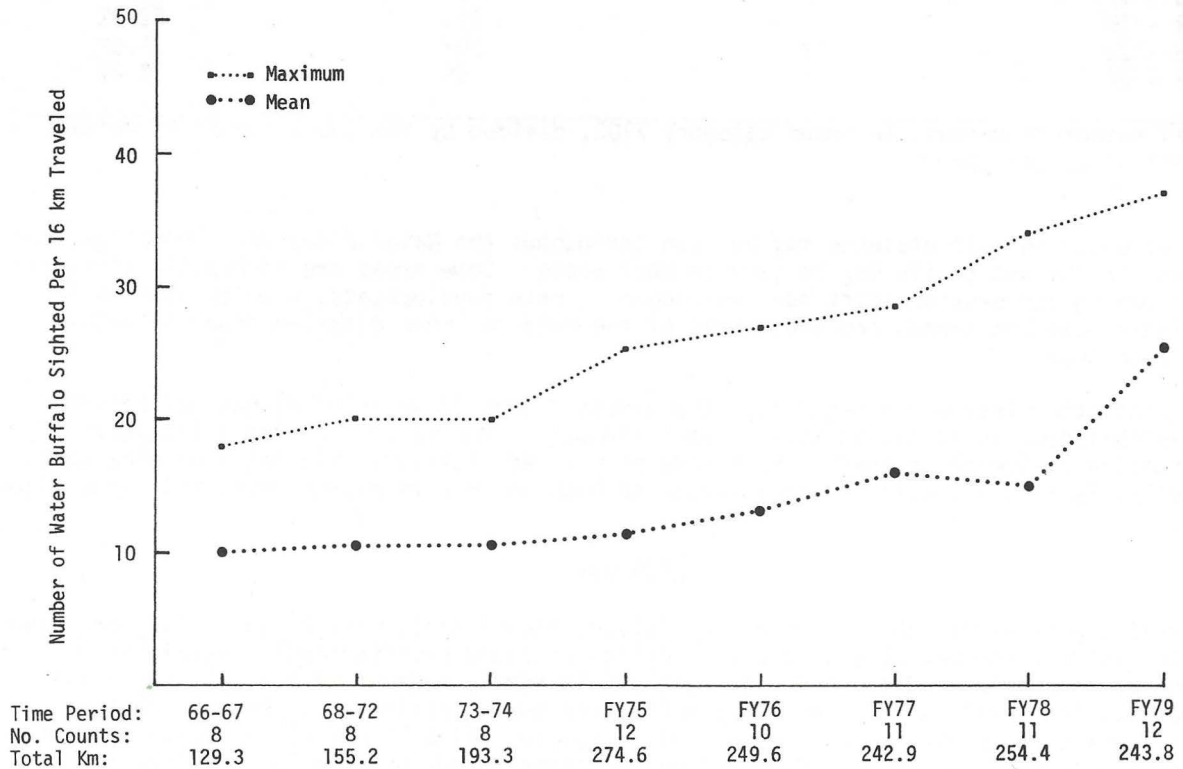


FIGURE 1. Mean and maximum numbers of water buffalo sighted on the U.S. Naval Magazine, Guam during night spotlight counts conducted between 1966 and 1979.

TABLE 1. Ratio of calves to adults of wild water buffalo on the Naval Magazine.

Time Period	Adults (No. Classed)	Calves (No. Classed)	Ratio of Calves to Adults
1966 - 1969	53	6	0.11 : 1
1971 - 1974	14	2	0.14 : 1
1975 - 1978	343	58	0.17 : 1

The count data and age data of water buffalo on Guam are suggestive of an increasing population. Hunting of this animal is prohibited, and reports of mortalities are few. Three reported mortalities were the result of illegal hunting, while one other mortality was possibly a drowning of a very old bull. Feral dogs are occasionally sighted on the Naval Magazine, however, it is the policy of the security personnel to dispatch these animals when possible. Other potential predators of water buffalo are absent from the island.

TABLE 2. Social grouping of wild water buffalo on the Naval Magazine.

Group Size (No. of Animals)	No. Groups	Total No. Animals In Group Size	Percent of Animals In Group Size*
1 - 5	44	144	18.9%
5 - 10	12	87	13.0%
11 - 15	12	153	22.9%
16 - 20	12	207	31.0%
21 - 26	3	95	14.2%

* Total number of animals in group category X100, divided by the total number of animals in all group categories.

Signs of water buffalo presence may be seen throughout the Naval Magazine. Droppings, mud wallows, tracks and trails may be seen in most areas. Some areas are so heavily traversed that slumping and erosion scars have developed. These developments, coupled with an increasing population trend, are indicative of the need for more detailed study of water buffalo on Guam.

Unlike the other introduced ungulates, the domestic goat (*Capra hircus*) has not become well established, as it has on many islands throughout the world. During 1 1/2 years of extensive fieldwork on Guam, I have made only three sightings of a total of nine goats. Hopefully, feral goats will not proliferate on Guam and become a problem as they have elsewhere.

PREDATORS

The feral dog is almost ubiquitous on the island, occasionally attacks and kills deer fawns (Wheeler 1979a), and may play a role in preying on ground nesting birds. Feral cats, though not as common as dogs, are often sighted in remote regions of the island, as well as near housing developments. Military activities during World War II brought to Guam the Philippine rat snake (*Boiga irregularis*), a species which is now quite common and often reaches a length of two meters (Gomoll 1968). Another predator, the monitor lizard (*Varanus indicus*), has been on the island at least since the turn of the century (Safford 1905) and reaches a length of about 125 cm. It is very adept at climbing trees and occasionally robs nests of eggs and young birds, and on one occasion is known to have taken an adult tropicbird (Dryden 1965).

While food habit studies have not been done on predators with the exception of the monitor lizard, introduced predators have doubtless played some role in the decline of some native bird species. Further study of this problem is warranted in light of the decline in abundance of several bird species to the point of being threatened or endangered.

WETLANDS

The wetlands of Guam are of two types: mangrove swamps and marshes. Mangrove swamps are limited in extent and do not approach the development seen in other parts of the world (Moore and McMakin 1977). Marshes are more extensive on Guam, and they usually contain almost impenetrable monotypic stands of *Phragmites karka*.

Guam's wetlands have been diminishing in recent times. Historically, some wetlands were converted to rice and taro production by the Chamorros prior to colonization. Military activities on Guam during World War II resulted in further losses, with large areas being asphalted for use as runways, and certain areas being bombed or shelled. The result was an altering of the coastal drainage pattern with subsequent loss of some wetland habitat. In addition, new plant invader species made their way to the islands which were home for 68 endemic species of Angiospermeae (Stone 1970). The altering of vegetational composition combined with disrupting activities undoubtedly had a detrimental affect on wildlife species associated with wetlands.

Historically, some of Guam's wetlands were the homes for the Marianas mallard (*Anas oustaleti*), the nightingale reed-wabler (*Acrocephalus l. luscini*a), and the Micronesian megapode (*Megapodius l. laperouse*). These species are now extirpated on Guam and endangered on other islands in the Mariana chain (Tenorio et al. 1979). The Marianas gallinule (*Gallinula chloropus guami*), a proposed endangered species, can still be found in limited numbers in Agana Swamp and around Fena Lake. Wetland preservation is now essential to maintain the habitat of this bird. In addition, there is a possibility of re-introducing extirpated species such as the Marianas mallard and the reed-warbler, providing sufficient habitat is maintained. The U.S. Fish and Wildlife is currently attempting captive propagation of mallards netted on Saipan at facilities in Hawaii. There are still sufficient numbers of reed-wablers on Saipan to make possible re-introduction of this species as well. With proper land use planning and research effort, the wetlands of Guam can be preserved and their wildlife restored.

CAVE DWELLERS AND PESTICIDES

An interesting geological feature of Guam is the presence of numerous natural caves in coralline limestone. These caves range in size from just large enough for a man to occupy to the large Talofofa Cave which is 10 m by 10 m by 15 m high. Some of these caves were historically occupied by thousands of Vanikoro swiftlets (*Collocalia vanikorensis bartschi*), which nest exclusively in caves, and by sheath-tailed bats (*Emballonura semicaudata*). Both species suffered heavily during World War II as many of the natural caves were used for defense purposes. Grenades were often thrown into caves to eliminate enemy troops (Drahos 1977). In spite of these setbacks, many swiftlets and insectivorous bats remained after the war, but the losses of these species due to war activities were compounded by subsequent routine insecticide sprayings. Subsequent to recapturing Pacific islands, U.S. military operations included the liberal spraying of insecticides. Sprays and dusts of DDT and other insecticides were applied by hand and by plane as frequently as once a week (Baker 1946). Military spraying requirements were .13-.26 kilograms of DDT per acre (Herald, in Baker 1946). Military insecticide sprayings on Guam continued through the 1960's and 1970's, however, these more recent sprayings were with malathion. Compounding this problem, there has been an increased use of pesticides for agriculture during the past two decades.

In 1973, two samples of guano from Tarague cave and three from a cave on the Naval Magazine were sent to the U.S. Fish and Wildlife Service's Chemical Research and Analytical Section in Denver, Colorado to determine residual pesticide levels. The Tarague cave (northern Guam) samples contained 0.06 ppm DDE and the Naval Magazine (southern Guam) samples contained 0.04 ppm DDE (Drahos, unpublished).

In 1975, eight swiftlets were collected on the Naval Magazine and their body tissues were analyzed for chlorinated hydrocarbons. Body lipids contained 0.17-0.39 ppm DDE (Drahos, unpublished). While these analyses suggest pesticide accumulation in swiftlets, further studies are needed to document a casual relationship between pesticide use and avian population declines. Such a relation is suspected because of other insectivorous bird species population decline. The nightingale reed-warbler is now extirpated from Guam, and the Guam flycatcher (*Myiagra freycineti*) and cardinal honey-eater (*Myzomela cardinalis*) have suffered serious population declines and are now restricted to a narrow belt of limestone forest on the north coast of the island. The insectivorous bat has not been sighted since 1973.

HABITAT LOSSES

The land tenure system on Guam is such that about one-third of the land is held by the military, one-third is owned and administered by the Government of Guam, and one-third is in private ownership. Military land-use patterns have had some good and some detrimental effects. Extensive areas that were historically limestone forest have been cleared since U.S. re-occupation in 1944, to make way for numerous antenna fields, air strips, munitions facilities and other military facilities. The result has been the loss of extensive stands of native forest that historically covered the entire northern plateau (Fosberg 1960). On the positive side, the military restrict access to their lands, lending some protection to what little forest habitat and wildlife remains. This practice has inhibited to some degree poaching activities in prime deer and fruit bat habitat. At this time

wildlife is most abundant on such restricted military land, whereas lands readily accessible to the public are relatively impoverished of bird and mammal fauna. In contrast to the outlook of the precontact Chamorros, "Almost every species of bird found in the limestone forest is [now] considered edible by the Guamanian, so that the number of birds to be found there is minimal," (Moore and McMakin 1979).

The military have made recent efforts to preserve native habitats. The Pati Point Natural Area, a 372 ha preserve of limestone forest, was established in 1973. The largest protected forest area in Guam is that around Feno Lake and the Naval Magazine (Stone 1970). This area has been maintained by the Navy as a preserve since 1946 to maintain the watershed feeding Feno Lake, a major source of fresh water.

Government and private lands have also been the target of development activities. Guam experienced an economic boom in the 1970's with significant expansion in the tourism, housing and construction industries. These activities have contributed to additional wildlife habitat losses.

Frequent man-caused fires have also played a role in forest habitat losses. Fires are sometimes set in the southern hills of Guam to burn off swordgrass (*Miscanthus*), or so that tender green shoots are emitted and deer are attracted to the area. Fires often burn out of control killing marginal trees and forcing forests to retreat to streambed gullies (Stone 1970). What remains is bare ground, sometimes resulting in loss of topsoil and subsequent erosion.

Loss of native forest habitat has had an adverse impact on two native doves, the white-throated ground dove (*Gallicolumba xanthonura*) and the Marianas fruit dove (*Ptilinopus roseicapillus*), both of which depend on mature forest vegetation. Similarly, the Marianas crow (*Corvus kubaryi*), Guam rail (*Rallus owstoni*), bridled white-eye (*Zosterops conspicillata*), and Mariana fruit bat (*Pteropus mariannus*) have all suffered population declines, partially as a consequence of forest habitat losses.

MANAGEMENT ACTIONS

To offset future habitat losses, the Government of Guam has developed a land-use plan for the years 1977-2000, designating certain areas as "unique terrestrial ecosystems" and recommending strict control of permissible uses (Bureau of Planning 1977). Included under this ecosystem preservation plan are the following categories: terrestrial pristine ecological communities, wildlife refuges, proposed critical habitats, and limestone forest. The governor's office is encouraged to strongly adhere to these guidelines, particularly in light of the precarious nature of many of Guam's native terrestrial fauna.

Additionally, a widespread pesticide sampling and monitoring study should be initiated. It is hoped that pending determination of endangered status for several native birds, endangered species funding will become available to aid in initiating a study on pesticide-wildlife relationships.

What few undisturbed wetlands remain should be strictly protected from development and maintained as habitat for the Marianas gallinule and for possible re-introduction of the Marianas mallard and the nightingale reed-wabler.

The relationship between introduced predators and native fauna is poorly known and it is probably that introduced predators have played some role in avian population declines. A study should be initiated to determine to what extent rodents, snakes, cats and dogs predate on the nests, nestlings and adult birds of the avian species that are experiencing population declines.

Finally, the general public on Guam needs to be made aware of the values of environmental conservation. To this end, the Division of Aquatic and Wildlife Resources has recently launched a conservation education program. Since the end of World War II, Guam has undergone a transition from a subsistence existence to a standard of living comparable to other areas of the United States. Unfortunately, the subsistence philosophy of many of the people is still prevalent, particularly in regards to fish and wildlife. The conservation education program is being planned to address this problem.

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