MANAGEMENT OF FERAL AND EXOTIC GAME SPECIES ON GUAM

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Abstract: Six species of feral or exotic game animals have been introduced to Guam and now form the basis of the island's recreational hunting program. They are the feral pig (*Sus scrofa*), sambar deer (*Cervus unicolor*), feral water buffalo (*Bubalus bubalis*), feral goats (*Capra hircus*), black francolin (*Francolinus francolinus*), and the Philippine turtle-dove (*Streptopelia bitorquata*). Of these, the feral pig, because of its wide distribution and high density, appears to have the greatest negative impact on forest and agricultural resources. Destructive wallowing, feeding, and trampling of vegetation are common in most forested areas and can be quite severe at some locations. Deer and water buffalo occur at high densities only in localized areas. They appear to be less of a problem, but are known to adversely affect forest resources. Feral goats, black francolin, and Philippine turtle-doves do not appear to pose a significant threat to native fauna and forest resources at current population levels. Protection of forest habitat through control of feral and exotic game animals is recognized as necessary and is included as a task in the U.S. Fish and Wildlife Service recovery plans for Guam's endangered forest birds and bats. A relatively high human population density of 230/km², an extensive road network, and ease of physical access to hunting areas suggest that recreational hunting can be an effective low cost management tool for reducing ecological damage and controlling game populations in unhunted and under-hunted areas on Guam.

Guam's long history of introduced feral and exotic game animals dates to the 1600's when the Spanish successfully introduced game and domestic animals which eventually established feral populations. Various subsequent and mostly unsuccessful attempts have been made to introduce other exotic game animals, including such exotic species as redwinged tinamou (*Rhyncotus rufescens*) and armadillos (*Dasypus novemcinctus*).

The Guam Division of Aquatic and Wildlife Resources (GDAWR) was established in 1959 with the mandate to manage the natural resources of the Territory. The early work of the Division concentrated on management of game species which included three native birds, one fruit bat, two introduced mammals, and two introduced birds. Today, the Division manages the natural resources of the Territory on an ecosystem basis to provide recreational hunting and to protect and preserve native flora and fauna. Six introduced feral and exotic game animals are the only game species that have populations large enough to manage for recreational hunting on Guam today. This paper presents information on the management of feral and exotic game species and discusses recreational opportunities and ecological problems associated with these species.

STUDY AREA

The United States Territory of Guam is located at 13° 13' N, 145° 00' E in the west-central Pacific and is the largest and southernmost island in the Marianas chain. The island is about 45 km long and 6 to 13 km wide and encompasses an area of 540 km². The major vegetation types on the island are secondary and pristine limestone forest in northern Guam and savanna, ravine forest, and some limestone forest in southern Guam. An extensive network of paved and unpaved roads cover the island and services the work and recreational needs of the estimated 124,733 inhabitants.

RESULTS AND DISCUSSION

Feral Pigs

Early Spanish colonizers introduced domestic pigs to the Marianas between 1672 and 1685 (Intoh 1986). The first stock probably came from domestic herds in the Philippines and was likely introduced for husbandry purposes to support the growing military garrison, colonizers, and missionaries present on the island. Either through intent or mishap, domestic pigs established a large feral population by 1772 and were abundantly distributed throughout the island at the start of the American administrative period in the early 1900's.

Today, feral pigs remain distributed island wide and are legally hunted year-round. Bag limits of two pigs per day and 40 per season (GDOA 1987) provide a great deal of recreational hunting. Approximately 90 percent of the 400-500 active hunters hunt pigs and, in 1986, spent an estimated 8,710 hunter-days and harvested an estimated 1,273 pigs (GDAWR 1986).

Feral pig populations have apparently increased dramatically on two game management areas in northern secondary limestone forests since 1980. Combined annual harvest from hunting areas at Northwest Field on Andersen Air Force Base (AAFB) and Naval Communications Station (NCS) (areas of 9.8 km² and 5.3 km², respectively) increased from an average of 67.5 (range of 45-90) pigs during 1980-1983 to 314.7 (range of 291-329) pigs during 1984-1987. The amount of effort expended per pig harvested decreased from 14.1 (range of 9.2-20.5) days/pig to 7.4 (range of 6.9-7.9) days/pig during these two periods and is a further indication of a dramatic increase in pig populations. Harvest density for these areas reached 22 pigs/km² in 1984. Barrett (1978) reported that human kill averaged about 20 percent of the pig population on his study area in California. If a similar percentage is harvested on Guam, feral pig populations may have reached 110 pigs/km² in northern secondary

limestone forests in 1984. Population levels in southern and central Guam are unknown but feral pigs are common in many areas.

As has been documented in other locations (Stone 1985), high densities of pigs can cause considerable ecological damage. General observations indicate that wallowing, rooting, and trampling are common in most forested areas and can be quite severe locally. A large complex of wallows and feeding sites in the Tarague basin on AAFB measured in excess of 2.3 ha. As is typical of damage that pigs can cause, this site was stripped of its ground cover, the soil was exposed to erosion, and no tree or shrub seedlings were regenerating. Evidence of pig damage has been observed in forests on the Naval Magazine, NCS, Naval Facility, and AAFB military bases. Less severe damage has also been observed on Government of Guam forested and range lands at Anao, Bolanos and Cross Island Road.

Pigs also damage agricultural crops. An average of five permits per year are issued to control depredation on agricultural crops such as watermelon and taro. No doubt more farms sustain damage that goes unreported. Damage to agricultural crops has been reported in the Inarajan, Malojloj, Dandan, Talofofo, Bubulao, Cross Island Road, Barrigada, Dededo, and Yigo areas. Most recent complaints come from farmers in the Dandan and Yigo area. Pigs cause damage in residential areas by rooting in lawns and gardens. Damage has been reported at NCS housing, AAFB housing and the golf course on AAFB.

Sambar Deer

Sambar deer were introduced to Guam from the Philippines during the 1770's and have become established in the wild (Wheeler 1979). Deer are distributed throughout the island and are legally hunted during the months of October through December with a bag limit of one antlered deer per season (GDOA 1987). The harvest of does can be authorized during special either-sex hunts. The sambar deer is a popular game animal among local sportsmen, and about 80 percent of active hunters report they hunt deer. In 1986, 300 hunters spent 5,027 hunter-days pursuing deer (GDAWR 1986). This effort produced a harvest of 41 deer with effort per harvest of 122 days/deer and a success rate of 14 percent (GDAWR 1986).

Deer numbers are low throughout most of the island. Recent spotlight counts at Naval Magazine in central Guam detected an average of 2.9 (range of 0-8.5) deer/10 km of route driven (GDAWR 1986). This figure is typical of deer populations in most areas. Deer have been declining on the Naval Magazine since the late 1970's. Illegal hunting is thought to be the major cause of mortality and the primary factor limiting population growth. In contrast, the deer herd at Pati Point, AAFB is found in a restricted area which is protected from most poaching and only occasionally hunted. Numbers have been increasing here since the early 1980's. Spotlight counts in 1986 detected an average of 139.9 (range of 47.5-212.5) deer/10 km of route driven (GDAWR 1986).

At current population densities, deer appear to pose a serious threat to forest resources only in the Pati Point area. Heavy browsing pressure is evident on favored shrub and grass species such as *Triphasia trifolia* and *Pennisetum polystachyon* and a browse line has formed on vegetation in some areas. Negative impacts on other native species have not been documented. It is unknown at what population density deer browsing becomes a factor in degrading the habitat and affecting forest regeneration. However, if deer populations are high enough to cause a browse line on one key species, then other species are also likely affected. Deer and pig browsing on the seedlings of *Serianthes nelsonii* is thought to be a factor in the decline of this endangered species (USFWS 1987).

Deer damage to agricultural crops does not appear to be a problem. The GDOA has issued only four permits to control deer damage on agricultural crops in the past eleven years.

Feral Water Buffalo

The Asiatic water buffalo was introduced to Guam by Spanish missionaries sometime in the 1600's (Key 1968). Known locally as the carabao, this animal was likely introduced from domestic stock in the Philippines to be used as a beast of burden. A large, free-ranging herd exists on the Naval Magazine in central Guam and these feral individuals are classified as protected game animals. The population has never been legally hunted primarily because of base security restrictions, but the GDAWR, the US Navy, sportsmen and other potential users have shown a great deal of interest in managing this species.

Water buffalo numbers have been on the decline since 1982. Spotlight counts in forest areas on Naval Magazine averaged 26.1 (range of 15.7-34.1) buffalo/10 km of route driven in 1982 (GDAWR 1982). Counts in 1986 detected an average of 16.8 (range of 8.0-34.8) buffalo/10 km of route driven (GDAWR 1986). As with deer on Naval Magazine, illegal hunting appears to be the major cause of the decline.

High densities and the gregarious habits of water buffalo have resulted in some localized habitat damage on the Naval Magazine. Mud wallows, broad trails, vegetation trampling, droppings, and tracks are visible in many areas. The most evident damage appears to be from wallowing and vegetation trampling. One particularly large wallow covered 0.1 ha and measured 1.0 m deep. Some areas are so heavily trampled that ground cover has

been denuded and soil erosion scars and slumping are evident. Browse lines are not evident on native forest vegetation at current population levels, but other types of damage may be occurring.

Feral Goats

Domestic goats were introduced to Guam by the Spanish during their early colonization of the island. A feral population became established during the early 1700's but was decimated from overhunting by 1801 (Haswell 1917). At present, a small feral population exists in northern cliffline areas, but the species is not considered an important game resource. Regulations allow year-round hunting of goats with no bag limit. The intent of this liberal bag limit is to prevent any future increase in the feral population. Seventeen goats were reported harvested during 1986, all from private property in the Uruno basin. GDAWR staff occasionally observe goats in the Ritidian basin on Naval Facility and more rarely in the Anao basin on the northeast side of the island. Damage to forests is undocumented and, if occurring, may be restricted to private property.

Black Francolin

The black francolin was introduced to Guam from northern India in 1961 as part of the Foreign Game Bird Introduction Program of the U.S. Fish and Wildlife Service. From an initial stock of 171 birds released in southern grasslands, the francolin has now become well established in savanna and shrub-grass habitats in southern and central Guam (GDAWR 1986). Black francolin are currently the only game bird legally hunted and are harvested during the months of January and July. The daily bag limit is set at five birds with no season limit (GDOA 1987). Francolin are hunted by 10-15 percent of legal hunters providing about 400 hunter-days of recreation per year. An estimated 100-300 birds are harvested annually (GDAWR 1986). Francolin are most numerous in the Pulantat, Cross Island Road, Ija, Merizo, and Dandan areas. Bird surveys conducted during 1985 and 1986 detected average station counts of 3-10 birds/station in these areas (GDAWR 1986).

Introduced game birds have been identified as a reservoir of avian disease in the Hawaiian islands (Van Riper and Van Riper 1985). Black francolin screened for disease on Guam showed no evidence of carrying infectious diseases or blood parasites (Savidge 1986). However, introduced birds may be having a more subtle indirect impact on native avifauna. As an alternate prey resource for the introduced brown tree snakes (*Boiga irregularis*), they may contribute to the maintenance of high populations of this predator which allows it to decimate more vulnerable native species.

Philippine Turtle-Dove

The Philippine turtle-dove was introduced to Guam from the Philippines in the late 1700's and became one of the more abundant components of the avifauna. During the 1960's and 1970's, this species was an important game bird and provided recreational hunting for 10-15 percent of the island's sportsman and an annual harvest of about 500-1,000 birds. Turtle-dove populations began to decline in southern and central areas during the mid-1960's and 1970's and in northern areas during the early 1980's (Conry 1987). Heavy predation by the brown tree snake appears to be the cause of the decline (Conry 1988). A two-year moratorium on hunting turtle-doves was implemented in 1985 and the season closed in 1987 (GDOA 1987).

Turtle-dove numbers remain low throughout the main island but are higher on Cocos Island, a 45 ha snake-free islet off southern Guam. Bird surveys conducted in the spring of 1986 detected average station counts ranging from 0-3.0 birds/station at 22 survey locations on the main island and 5.9 birds/station on Cocos Island (Conry 1987). Turtle-doves screened for disease on Guam showed no evidence of carrying infectious diseases or blood parasites that would pose serious problems for native birds (Savidge 1986, Conry 1987).

MANAGEMENT PROBLEMS AND OPPORTUNITIES

Of the six feral or exotic game species on Guam, the feral pig appears to have the greatest negative impact on forest resources and should be aggresively controlled to minimize vegetation damage. Deer and water buffalo appear to be less of a problem but have localized impacts on forest resources and should also be controlled. At current population levels, feral goats, black francolin and Philippine turtle-doves do not appear to pose a threat to native fauna and forest resources.

The GDOA has implemented changes in the hunting regulations to increase harvest of problem species in hunted areas. Pig hunting regulations have been liberalized from a three month season with 1/day and 10/season bag limits in 1982 to year round hunting with bag limits of 2/day and 40/season in 1987. In cooperation with AAFB, GDOA held special either-sex deer hunts at Pati Point during the last two years in an effort to reduce deer numbers and vegetation damage.

A major problem in effectively managing game species on Guam is restricted access to military, private, and remote public lands. Guam's small size and extensive road network provide easy physical access to most areas. Military and private land owners, however, may prohibit access to their land, either to hunt or to transit en route to public hunting areas. These are serious problems

and limit opportunities to manage game populations and control ecological damage. Guam law requires that hunters obtain written permission prior to hunting on private property. Public lands that are open to hunting are often land locked by military or private holdings without marked boundaries making ownership difficult to determine. Because of these difficulties, most hunters prefer to hunt on military bases where hunting areas are clearly marked. There has been little interest on the part of private land owners to allow recreational hunting for the public.

The Air Force and Navy control large blocks of forested land on the island making them an important partner in managing natural resources. AAFB, NCS, and Naval Facility have hunting programs, but place restrictions on who can hunt, where, and with what weapons. Access on NCS and Naval Facility is restricted to active duty personnel, dependents, employees, and persons they sponsor. This greatly reduces the pool of available hunters. Other bases, such as the Naval Magazine, totally restrict recreational hunting. Consequently, much of the forested land on military bases is either totally closed to recreational hunting or hunting methods and seasons are severely restricted. These lightly-hunted areas become refuges where game numbers go unchecked. Herds can build up and can cause serious damage to vegetation on these and adjoining lands. These problems are being addressed in wildlife management plans being prepared by both the Air Force and Navy.

A major management concern of the GDAWR is to maintain an adequate quantity and quality of native forest to provide habitat for endangered fauna and flora. Control of feral and exotic game animals is recognized as an important measure to protect native forest resources. The USFWS recovery plans for Guam's endangered birds and fruit bats, jointly prepared by the GDAWR and the USFWS, include tasks "to determine the effects of feral goats, pigs, and sambar deer on the essential forest habitat and develop control methods, if needed" (USFWS in press a, b). To date, no studies are available to clearly document the extent to which feral pigs, deer, and water buffalo damage forest resources. Information is also needed to determine what animal density levels affect forest regeneration. Exclosure studies have been proposed in the base wildlife management plan for AAFB. That plan also calls for an expanded hunting program and additional public hunting opportunities. Similar programs may also be included in the wildlife management plans now being prepared for naval bases.

Guam's relatively high human population density, extensive road network, and ease of physical access to hunting areas suggest that recreational hunting can be an effective management tool for reducing ecological damage and controlling game populations. Declining populations of deer and water buffalo on Naval Magazine suggest that human take can significantly reduce population levels. Interviews with hunters in the field and inquiries to the GDAWR office indicate a demand exists for additional hunting areas and opportunities on the island. The 15 km² Northwest Field and NCS hunting area received 3,600 hunter-sorties in 1987. This occurred even though access was restricted, much of the area was only open on weekends, and an additional license fee was required. Hunting efforts island wide can exceed 8,700 hunter-days (GDAWR 1986). Recreational hunting can lower game population sizes and thereby reduce vegetation damage in areas that are currently closed to hunting or under-hunted such as on military bases and is a management tool that should be more fully utilized to control game populations.

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