

Goat problems in the national parks
of the Netherlands Antilles

submitted by:

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submitted to:

The Netherlands Antilles National Parks Foundation
c/o Caribbean Marine Biological Institute
P.O. Box 2090
Curacao
Netherlands Antilles

Introduction

This report is based upon a series of field observations of goats on Curacao and Bonaire, Netherlands Antilles, and also upon discussions with the staffs of the Caribbean Marine Biological Institute (Carmabi), the Stichting Nationale Parkeu^{''} Nederlandse Antillen (Stinapa), the board of directors of Stinapa, and Ing. Murray Joubert of the Dept. of Agriculture, Animal Husbandry, and Fisheries. Ecological interpretations and management recommendations are based upon visual comparison of habitats within and between the two islands, and upon my experience in dealing with feral herbivores in other island systems. I was on Curacao from 29 July--22 August 1980, except 12-16 August when I was on Bonaire. Because of the very short time frame, quantitative studies were not initiated.

I offer my special thanks to Dr. Inguar^v Kristensen, director of Carmabi, for assistance in all phases of this effort.

Goats on Islands

I have previously reviewed the effects of goats on island ecosystems (Coblentz 1978). The history of goats on islands is unanimously unfavorable. They can truly be called "ecological dominants" (Bates 1956) in all island ecosystems where their numbers are excessive and unchecked. Goats have virtually destroyed the island of St. Helena (Wallace 1911), Guadalupe Island (Greenway 1958), Isla Pinta in the Galapagos (Hamann 1979), as well as parts of Santa Catalina Island, California (Coblentz 1978), and the Hawaiian Islands (Baker and Reeser 1972). After extensive observation on Curacao and Bonaire, I feel confident (and distressed) that these two islands can be added to the list of islands in which some areas or habitats have been destroyed.

The ecological problems caused by goats on islands are numerous, and somewhat predictable. In order, they are generally:

1. They reduce the diversity of plant species directly by selectively eliminating the most palatable forage species. On islands these are often the most susceptible to overutilization by herbivores. In fact, endemic species are usually the most sensitive because they have usually evolved over long periods of time isolated from herbivory. Some plant species are present only as mature trees because the fruits and seedlings are consumed. In such a situation a forest may exist for a period encompassing the average life expectancy of the trees, however, when the mature trees begin dying, the physical character of the habitat changes dramatically.

2. Goats indirectly have a profound influence on the native animal species. Some species are enhanced via the goats' habitat altering activities, and some are adversely affected. All those species that have evolved in the pristine climax habitats will be adversely affected. Only those species favoring disturbed, depauperate communities will be enhanced.

3. Goats favor the spread of less palatable forage species, especially those that are characteristic of earlier successional stages. In a sense, these species fill the void created by overutilization of more palatable (preferred) forage species.

4. Thus, although the total biomass of primary producers may not be drastically changed (actually, it usually is), the biomass of usable forage is greatly decreased. The result is greatly decreased carrying capacity of the habitat, and a profound reduction in the native primary consumer trophic level.

5. Thus, goats cause a reduction in native biomass of all trophic levels. The reduction of plant biomass, thus plant density, combined with the trampling and cutting action of goat hooves, leads to a very loose, bare, and easily erodable soil surface. Loose soil generally results in excessive sheet and gully erosion during heavy rains, and further reduces the carrying capacity of the land.

There are precedents for undertaking to control excessive grazing by feral (or nearly feral as on Curacao) herbivores. The dangers of excessive goats, sheep, pigs, etc. are currently being realized, and measures are being taken in many island groups. For example:

1. The World Wildlife Fund, the Smithsonian Institute, and the Ecuadorean National Park Service are committed to eliminating goats from the Galapagos archipelago. About 40,000 have been shot on Isla Pinta alone (Hamann 1979).

2. The U.S. National Park Service is committed to the eradication of feral goats from Hawaii Volcanoes National Park on the island of Hawaii. Fewer than 100 remain.

3. The New Zealand DSIRO is committed to eradication of feral goats from some of their offshore islands. They were completely eradicated from Macauley Island (Williams and Rudge 1969).

4. The U.S. Dept. of the Navy is committed to eliminating feral goats from San Clemente Island, California. Over 20,000 have been removed to date.

It is apparent from the preceding that the basics of the goat problem on Curacao and Bonaire are not unique. Nor would be the decision to make a concerted effort to control, or at least exclude goats from the national parks.

Food Habits

Similar to reports of goat food habits elsewhere (Baker and Reeser, Coblenz 1977) goats on Curacao seem to eat most of the species available. Although my own observations were quite limited, and obviously during a single season, I did witness some unseasonal rains and a rapid response by herbaceous plants to the rains. Thus, I saw goats feeding during dry season and wet season conditions.

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Goats were observed eating primarily perennial legumes, especially Acacia tortuosa, and various annual and perennial herbaceous species.

Kristensen (personal communication) reported to me that the seedlings and young of the lignum vitae (Guaiacum officinale) are favored ^{in the dry season when no other food is available,} thus although the tree is fairly common, only mature trees are present. The young do not survive. My observations indicate that a similar situation may occur with brazil (Haematoxylin brasiletto).

On Curacao, cardboard and other discarded paper seems to comprise a measurable portion of the diet, however, the goats do not eat nearly enough to make inroads into the vast amount available.

In general, the goats eat most of the available plant species. A few notable exceptions are croton (Croton flavens), prickly pear cactus (Opuntia spp.), and the rubber vine (Cryptostegia grandiflora). I did see goats feeding on croton a few days after a heavy rain, when the croton was actively growing and flowering, but it was obvious prior to the rain that the plant was avoided when dry. ^{As a} The result of the avoidance of these species by the goats, large areas are completely dominated by any of the 3 species, either singly or in combination, often along with Acacia tortuosa which survives in spite of heavy use by goats largely due to its very large, stout, sharp paired thorns.

Although goats turned more to herbaceous vegetation after the rains, by no means did they stop eating the leaves of the woody perennials. The woody species are also attuned to rainfall, and they began growing and flowering as quickly as the herbaceous species. The actively growing parts of the perennials are of high quality, therefore the goats continue to use them.

Effects of Goats in Cristoffel Park

I drove through most of the park, and got out and hiked to observe goats and/or vegetation in most areas. Goats have altered virtually the entire park.

The most visually noticeable effect of the goats is the large areas that are predominantly prickly pear. The goats apparently eat everything else in these areas and continually transport the cactus pads which adhere to them for a short while before dropping off. Individual cactus pads root readily when they rest on the ground, and soon grow into a separate plant. In this way the cactus spreads very rapidly in the seeming absence of flowering and subsequent fruit production. A very dense stand of cactus results, in which there is little other forage.

The biomass of herbaceous vegetation in the park is very small, a phenomenon directly attributable to the goats. There is obviously little seed source in the soil of these areas, in addition to relentless grazing pressure. There is also considerable evidence of the presence of goats, most notably numerous trails and mechanically (goat hooves) disturbed soil.

No baseline data exists on the former abundance and distribution of native terrestrial animals on Curacao, therefore it is impossible to quantify the effects of goats on these species. However, the white-tailed deer (Odocoileus virginianus curassavica) and cottontail rabbits (Sylvilagus sp.) undoubtedly eat many of the same foods as the goats, and thus must undoubtedly be adversely impacted. In fact, any herbivorous

species feeding within roughly 5 feet of the ground surface would be adversely affected by the presence of goats. The extent of the influence of goats upon insectivorous terrestrial species is unknown, but probably measurable.

Management Recommendations

There are two approaches that can be taken toward management of goats in Cristoffel Park. The first is to document quantitatively the ecological impacts of goats to develop persuasive arguments for elimination of goats from the park; the second approach is to simply begin eliminating goats.

If studies of the goats are to be undertaken, then the first information that is absolutely necessary is the total number of goats using the park. Goat densities have been estimated to not exceed 1 goat/ha in the Savonnet portion of the park, but there are no reliable estimates for the remainder of the park. Estimates of the total number of goats using the park range up to as many as 10,000 (M. Joubert, personal communication). Obviously, a reasonably accurate estimation of the total number of goats in the park would be helpful.

rough 3000

It will be necessary to determine just what portion of the goats are feral, and how many of those there are. Truly feral animals should be closely observed or radio-collared so that their habits are learned; i.e. daily activity patterns, bed grounds, etc.

The next step is to quantitatively determine the impacts of the goats, and this has begun through a series of exclosures. The exclosures

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that I observed in the park will, in time, show a dramatic difference between goat-impacted and goat-free vegetation, especially if one or two wet years occur. However, the exclosures are quite small, and will not be representative of entire habitat types (plant communities) because of the size limitation. For complete representation of a habitat, an exclosure of perhaps 50 meters on a side is necessary to allow for recovery of the entire spectrum of species characteristic to the area, even relatively scarce species. In essence, the larger the exclosure, the more likely that it will contain most, and perhaps all, of the varied microhabitats associated with a particular habitat type.

In the exclosures total percent cover, seedling regeneration by species, and herbaceous production should be measured annually, and compared to adjacent unprotected plots.

An exclosure exists around one of the native palms to determine if it is the goats that are preventing seedling regeneration. Similar exclosures should be constructed around other sensitive species, for example *lignum vitae*. *Walter*

Lastly, the diets of these goats should be quantified to determine their preferences (based upon availability and utilization in the study area). In this way sensitive plants might be determined. Food habits analysis would best be done by the fecal method; all that would be required would be a good reference collection of plant fragment slides.

If a food habits reference collection is established, it would then be advantageous to determine the food habits of the feral burros, white-tailed deer, rabbits, and herbivorous lizards. In this way any dietary overlap between goats and any other species could be quantitatively ascertained.

If Stinapa determines that elimination of the goats is a more urgent need than ecological studies of the goats (I would support this alternative), then some rather direct actions will be necessary.

Initially, the perimeter fence must be dealt with. A fence is not a fence unless it is entire; the fence surrounding Cristoffel Park is missing several kilometers. In addition, there are gaps which allow goats easy access to and from the park. If the fence is not completed, and the gaps covered over, then it is simply an expensive monument to futility. In that case it would be better to remove it than to have to absorb a high annual maintenance cost.

The solution to the problem of goats in the national park is in reality simple. They must be eliminated. The justification for elimination is also quite simple. On the other hand, it is the implementation of any program to eliminate goats that is fraught with cultural and political difficulties.

On the premise that the national park belongs to all the people, the people whose goats use the national park are extracting a very large personal benefit, to the detriment of the park, and therefore to the detriment of all the people of the Netherlands Antilles. It is an insidious form of welfare that extracts both material and ecological value.

Everyone has a "price" at which they will sell out. Probably the only means by which goats can rapidly be eliminated from the park is to purchase both the goats, and the imaginary grazing rights that the goat owners feel they have. If the goats and grazing rights are purchased,

the fence must then be closed, and no new goats allowed in the park. All goats remaining in the park after a set date could then be shot, trapped, or eliminated by any appropriate means. Such a program would be expensive in absolute terms, but it would be cheap in comparison with 2 million dollars spent for a fence that has little protective function.

Regarding a plan to purchase goats and grazing rights, it would be helpful to begin a rumor that goats were going to be excluded from the park in a year or two. This would probably hasten the goat owners' willingness to sell.

A suggestion has been made that perhaps light grazing by goats is beneficial to the park. I would reject that hypothesis on two grounds:

1. The island flora has apparently evolved without heavy herbivore impact, although the deer and rabbits may well have been very abundant in pristine times. In any event, there is no indication that they had nearly as severe an effect as the goats, a deduction made simple by reasoning that the vegetation has changed so dramatically as a result of the goats. It is the function of a national park to preserve an entire ecosystem in a state as nearly pristine as possible. On both biological and aesthetic grounds then, the goats do not belong. If goats were removed, deer and rabbits would increase if they were protected from hunting, and the role of the herbivore would persist in the park.

2. Goats, like other herbivores, have distinct dietary preferences. The most preferred foods are heavily impacted first, and then the class of next most preferred, and so on. Light

grazing, rather than being beneficial, would still impact the most favored forage plants, many of which may be extinct or nearly so, or may exist only as dormant seeds. With light grazing, the species composition of the flora would continue to be less than what might potentially be present.

M. Joubert of the Department of Agriculture, Animal Husbandry, and Fisheries has proposed that the goat problem in the park could be alleviated by creating improved pastures outside the park boundaries to draw off goat use from the park. The reasoning is that once the goats find the areas of good forage, they will cease using the park, or at least greatly curtail their use of the parks. While I agree that the goats would probably use the park less, they nevertheless would continue to use it, and there would still be a significant adverse effect on all portions of the park where goats continued to forage. Furthermore, providing goat owners with improved pasture areas would most likely encourage people to maintain larger numbers of goats to take advantage of the increased forage.

I agree that improved pastures would greatly aid the raising of goats on Curacao, but it should be accomplished independently of plans to eliminate grazing in the park. In other words, getting goats out of the park is the primary concern. If totally eliminating goats from the park is to be accomplished simultaneously with establishment of improved pastures, that is good. If the park remains available to goats after the establishment of improved pasture areas, little will have been gained. A very low density of goats can prevent recovery of favored forage species. What is required is a complete cessation of grazing.

Creation of improved pastures does have the additional problem of possibly introducing exotic plant species which can become ecologically dominant, perhaps to the point of excluding some native species. Improved pastures will definitely increase livestock production, but ecologically they may be an ecological time bomb. All exotic forage species should be extensively evaluated for this potential.

Once goats are eliminated from the park, other steps should be taken to hasten the recovery of impacted areas. Areas with particularly high densities of prickly pear cactus should be cleared of it (as much as practical). The only feasible method of clearing prickly pear is to rake it into piles and burn it. Since prickly pear is a dominant plant only when other vegetation is suppressed by the goats, removal of the cactus will speed regeneration by other, more favorable plant species. This could eliminate many years of waiting for natural succession to proceed.

Similarly, there is a problem with naturalized exotic plants. Calabash (Crescentia cujete) is evident in many areas of the park, and although it doesn't seem to aggressively dominate the flora, it should be cut down wherever encountered to prevent the possibility of it spreading to such an extent that control is impossible. The rubber vine or palu di lechi is a highly aggressive exotic that virtually smothers competing vegetation. It is successfully spreading throughout the island and poses a very distinct and immediate danger to the native flora. It should be cut at the base (which then receives an application of herbicide) wherever and whenever encountered in the park.

✓ *Balanites
aegyptiaca*

Regarding the feral burros in Cristoffel Park, I disagree that they have little ecological effect. Burros have been shown to have profound effects on vegetation in the American deserts, and they most likely are detrimental to the park. They should be removed.

Establishing the national park as a showcase example of the potential of the island's natural habitats (without goats) is a most necessary first step. Once the park has recovered and island people can readily see how much more beautiful the natural habitats are, they will have a tendency to realize that the goats are indeed destructive to the island. If a strong conservation education program is fostered in the schools, people of Curacao will develop a greater appreciation and protectiveness for their island.

The ultimate decision that needs to be made is whether the national park will be an area protected sufficiently to allow recovery of the native biota, or simply a geographical area of public land where people can see a restored plantation, hike to the top of Cristoffel, and drive around. It appears to be contradictory to teach people (especially children) the evils of the goats in the park, and yet not aggressively search for solutions to those very same problems.

Impressions from Washington National Park, Bonaire

In driving along the leeward side of Bonaire toward Gotomeer, the dense vegetation was immediately obvious in contrast to the depauperate flora of Curacao. It was only upon reaching the area bordering the park that overgrazing became evident. Areas in the interior of the island

were similar in character to Curacao in that overgrazing had caused a shift toward croton and prickly pear and had reduced the apparent species diversity as well as vegetation density. Similarly the area between Rincon and the park gate, and a large portion of the park, show evidence of considerable overgrazing, although not on the scale seen in Cristoffel Park. What is perhaps worse in Washington Park is that a diversity of grazers and browsers is present. Sheep and cattle were observed in the park, as well as goats.

Unlike Cristoffel Park, many of the goats in Washington Park were quite wary, and fled at the first approach of a vehicle. They gave many indications that they were not accustomed to the presence of humans, and avoided any contact. It is my guess that many of these goats were feral. This needs to be conclusively determined. If they are feral, they should be eliminated immediately and completely. Local people could perhaps be invited to catch or shoot them for a limited time, after which Stinapa personnel should eliminate them by shooting. It is important to kill every last goat. This will require considerable effort once the goats become scarce; this is the point at which the effort should be increased rather than diminished.

Numerous feral burros were observed on Bonaire, but not in the park. They were primarily observed on the south end of the island from the southern end of the salt pans around the windward side to Sorobon, and also along the road from Sorobon to Bachelor's beach. A total of 29 feral burros were counted on one evening drive of the area.

A few presumably feral burros were also observed near the lighthouse on the peninsula called Bolivia. This too is a very sparse

landscape with low annual productivity. The habitat here can ill afford grasing pressure by feral burros.

Since most feral or wild equids regularly use certain water sources, and since there is virtually no free fresh water in the areas occupied by burros on Bonaire, attempts at removing the burros should be concentrated where they water. Either trapping or shooting would be effective; care would have to be taken to ensure that trapped burros were disposed of so that there was no chance that they would be returned to the wild.

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U.S. Virgin Islands
St. John

GEITEN RAPPORT

Department of
Fisheries and Wildlife



Corvallis, Oregon 97331 (503) 754-4531

9 September 1980

Dr. Ingvar Kristensen, Director
Caribbean Marine Biological Institute
P.O. Box 2090
Piscadera Baai
Curacao
Netherlands Antilles

Dear Dr. Kristensen:

Enclosed is my report summarizing my observations and recommendations concerning the problems with goats and other feral herbivores in the national parks of Curacao and Bonaire. The report is completely straightforward; I realize that implementation of my recommendations would arouse considerable animosity among some people, but your situation is critical and time is of the essence.

Thank you for your hospitality and for the assistance of your staff.

Sincerely,

Bruce E. Coblenz

Bruce E. Coblenz
Associate Professor of
Wildlife Ecology

cc: Ing. Murray Joubert
Dr. Adolphe Debrot

8227 525 42 180

Goat problems in the national parks
November 10, 1980

of the Netherlands Antilles

Dr. Bruce E. Coblentz
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Dear Dr. Coblentz:

I thank you extremely much for your Report on our goat problems. I think that this report may prove to be most useful in solving these problems. Moreover, it is always more convincing if a foreigner comes with such a report than if a country man is giving his opinion.

You will understand that our goat problem cannot be solved in a couple of months, but now we have a wonderful guideline when starting our anti-goat campaign.

We all are very grateful.

With warm greetings to your wife,

Sincerely yours,

The Netherlands Antilles National Park Foundation
P.O. Box 10000, Willemstad, Curacao

Ingvar Kristensen

Secretary
Netherlands Antilles