THE EFFECTS OF FERAL PIGS ON A MONTANE RAIN FOREST IN HAWAII VOLCANOES NATIONAL PARK

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INTRODUCTION

Feral pigs (Sus scrofa L.) are probably one of the most disruptive exotic agents in the rain forest, mountain parkland, and grassland communities of Hawaii Volcanoes National Park. Their damage to native vegetation has been described in many studies (Tomich 1969; Spatz & Mueller-Dombois 1972; Jacobi & Warshauer 1975; Warshauer 1976; Giffin 1978; Baker 1979). Although there is public hunting year-round with no bag limit and periodic hunting by Park employees, pigs are still very numerous and their destruction to Park lands extensive.

In July 1975 an experimental study site was selected along the east rift zone of Kīlauea Volcano 450 m southwest of Napau crater at 850 m (2789 ft) elevation. The vegetation type in this montane rain forest consists of 15 to 20 m closed 'ōhi'a (Metrosideros collina (J. R. & G. Forst.) Gray) canopy with hāpu'u (Cibotium glaucum (Sm.) H. & A.) understory. A pig fence exclosure, 25 m x 16 m, was constructed on the floor of a shallow prehistoric pit crater to assess pig damage and vegetation recovery. Extensive pig activity was noted with much of the herbaceous layer severely damaged or absent. Only the steep crater walls which were inaccessible to pigs, supported plants that may have once represented the ecosystem typical of the crater floor.

METHOD

A former Park employee initiated this study by establishing photo points and sampling vegetation cover along five transects using the point frequency method (Mueller-Dombois & Ellenberg 1974). Each transect was 20 m long of which 10 m were inside the exclosure and 10 m outside. He sampled this exclosure six times: July 1975, February 1976, June 1976, January 1977, June 1977, and February 1978.

When I continued this study in January 1979, much of the vegetation had outgrown the point frequency method due to its limitations in sampling vegetation greater than 1 m tall. I modified the method into belt transects with 3 m x 5 m subplots using the Braun Blanquet method to estimate species cover and

abundance. Only species from 0 to 2 m tall were sampled since this is the size class most affected by pigs. I also recorded the total number of individual plants for selected species and noted the occurrence and percent ground cover uprooted by pigs. Using this modified method I sampled the exclosure twice: January 1979 and January 1980.

RESULTS AND DISCUSSION

In the absence of pigs remarkable recovery of native vegetation occurred inside the exclosure. Figure 1 shows a photograph taken in July 1975 soon after the exclosure was constructed. Figure 2, taken from the same photo point in January 1980, shows a dramatic increase in floristic composition and cover. Seedlings of 11 native species became established terrestrially inside the exclosure. Outside, these same species either occurred as epiphytes, were absent, or occurred only on the steep crater walls inaccessible to pigs. Table 1 compares this presence and absence relationship.

Four exotic species, thimbleberry (Rubus rosaefolius (Sm.)); broomsedge (Andropogon virginicus L.); Hamakua pamakani (Eupatorium riparium Regel); and oriental hawksbeard (Youngia japonica (L.) DC.), are found outside the exclosure but are uncommon, i.e., less than 0.2% cover for each species. On the inside, oriental hawksbeard appeared in 1979 but was absent in 1980. Thimbleberry and broomsedge became established inside the exclosure in January 1978 but both appeared to be insignificant in 1980 with less than 0.3% cover each.

A steady increase in cover was evident in all native species inside the exclosure with 'ama'u fern (Sadleria pallida Hk. & Arn.) showing the greatest response from 4.9% in July 1975 to 47.8% in January 1980. Outside the exclosure 'ama'u declined from 3.0% in July 1975 to 1.5% in January 1980. Hāpu'u fern also showed a significant increase from 1.0% in July 1975 to 6.0% in January 1980. Clermontia parviflora Gaud. ex Gray was absent in July 1975, appeared in February 1976, and increased to 3.4% cover in January 1980. On the outside, it occurs only as an epiphyte.

Outside the exclosure pig damage increased from 40% rooting in July 1975 to 70% in January 1980. This high pig activity prevented the establishment of new seedlings and severely exposed roots of trees. This damage may have contributed to three trees that fell after the strong winds in December 1979. Two manono (Gouldia terminalis (H. & A.) Hbd.), 6 m tall, and one 'ōhi'a, 15 m tall, fell whereas no trees inside the exclosure were affected.

The preliminary results of this study show that pigs greatly reduce the herbaceous layer and the chance for seedlings to get established. However, when pigs are removed, the vegetation responds almost immediately, increasing both quantitatively and

qualitatively. It should be cautioned that this study may be a "show case" exclosure, i.e., the more opportunistic and aggressive exotic species such as firetree (Myrica faya Ait.); banana poka (Passiflora mollissima (HBK.) Bailey); strawberry guava (Psidium cattleianum Sabine); and Rubus ellipticus Sm., are not yet in the immediate vicinity of the exclosure.

RECOMMENDATIONS

The likelihood for Hawaii Volcanoes National Park to re-establish near pristine communities lessens as feral pigs continue their destruction. It is highly recommended that the Park immediately implement a sustained and systematic program to eliminate pigs. The present public and Park employee hunting program which began in 1972 has since eliminated over 1500 pigs from the Park; however, the results have been insignificant. One major factor working against an effective program is the absence of physical barriers to keep pigs out of managed areas. Unless there are drift and boundary fences coupled with more efficient pig control methods such as the use of chemicals, the present pig management program will have no significant effect in the restoration of native ecosystems.

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TABLE 1. Presence and absence of seedlings (2 m tall) inside and outside the Nāpau pit crater exclosure (where + = terrestrial and date appeared; 0 = epiphyte; and - = absent).

Scientific Name	Common/Hawaiian Name	Inside Exclosure	Outside Exclosure	Crater Wall (inaccessible to pigs)
Clermontia parviflora		+ 1976	0	+
Gouldia terminalis	Manono	+ 1976	-	+
Pelea clusiaefolia	Alani	+ 1976	-	+
Pipturus albidus	Mamaki	+ 1976	-	+
Psychotria sp.	Kopiko	+ 1976	-	+
Coprosma sp.	Pilo	+ 1977	-	+
Astelia menziesiana	Pa'iniu	+ 1978	0	+
Freycinetia arborea	'Ie'ie	+ 1979	0	+
Cyrtandra paludosa		+ 1980	-	+
Ilex anomala	Kāwa'u	+ 1980	-	+
Wikstroemia sp.	'Ākia	+ 1980	-	+
Cyanea pilosa		-	-	+
Labordia sp.	Kāmakahala	-	-	+

FIGURE 1. Nāpau Pit Crater Exclosure: Photograph taken in July 1975 by Terry Parman. Note the absence of the herbaceous layer.

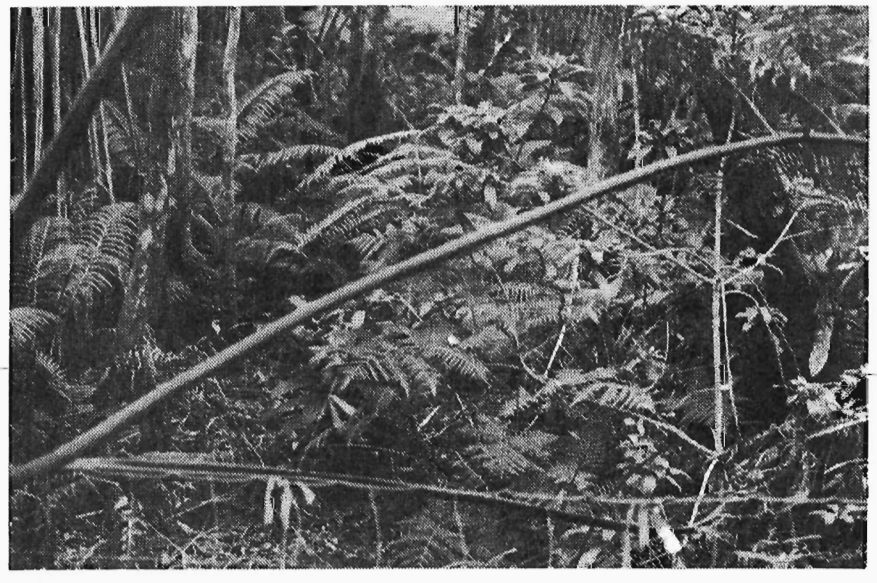

FIGURE 2. Nāpau Pit Crater Exclosure: Photograph taken in January 1980 from same photo point as Figure 1. Cover is dominated by 'ama'u fern.