

The current status of the Hawaiian Goose *Branta sandvicensis* and its recovery programme



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In the 18th century as many as 25,000 Hawaiian Geese *Branta sandvicensis*, commonly known as the Nene, inhabited the Hawaiian islands (Baldwin 1945). Mainly through excessive hunting of this very tame goose, the population declined to near extinction. The Nene was protected in Hawaii in 1907, when about 50 birds remained. By 1951, the wild population was estimated at only 30 geese (Smith 1952). Kear & Berger (1980) outlined the history of the international efforts to save the species through an intensive rearing and release programme. This programme succeeded in placing many birds back into the wild as well as building up captive stocks around the world. However, since Kear & Berger's account, Hawaiian workers have discovered that the population is in fact

dependent on releases of captive-bred stock to maintain numbers in the wild, thus the Hawaiian Goose is once more at risk; after two years of not releasing birds, numbers in the wild suffered a massive decline in some areas (Devick 1981a, Morin & Walker 1986).

This paper reviews the current situation of the Hawaiian Goose in the wild by documenting past and current counts, estimates and release efforts. We review some ideas about the limiting factors that are acting on the population and outline our plans for identifying and removing these factors. A comprehensive 5-year plan, called the Nene Recovery Initiative, was prepared by the Nene Recovery Action Group (a multi-agency collaboration) and is presented in a separate document (Black 1990).

Table 1. Details of current estimates of Hawaiian Geese in the wild (1989-1990).

Area	Highest Current Number	Date	Count Estim Type	Most Recent Number	Date	Count Estim Type	1989-90 Current Estimate
Kaua'i	-	-	-	32	8/90	b	32 b
Maui				200			
Haleakala Nat Park							
Inside the Crater	144	8/90	a	144	8/90	a	144 a
Outside the Crater	18	9/90	b	18	9/90	b	18 b
Hanawi Grassland	22	8/90	c	22	8/90	c	22 c
Hawaii				300			
Volcanoes NP							
Halfway House	33	2/88	d	12	11/90	b	12 b
Kilauea Crater	46	11/90	b	46	11/90	b	46 b
Ainahu	90	11/90	b	90	11/90	b	90 b
Mauna Loa	16	2/88	d	11	11/90	b	11 b
State Areas							
Keauhou I Sanctuary	-	-	-	10	3/90	b	50 c
Keauhou II Sanctuary	-	-	-	28	8/90	b	30 c
Kahuku Ranch & Sanctuary	-	-	-	15	8/90	b	30 c
Kipuka Ainahu Sanctuary	-	-	-	16	8/90	b	30 c
Keaau Ranch	32	8/90	b	32	8/90	b	40 c
Grand Total				476			555

a = Natividad Hodges (1991)

b = actual counts

c = maximum estimate based on previous releases and counts

d = Hoshide *et al.* (1990)

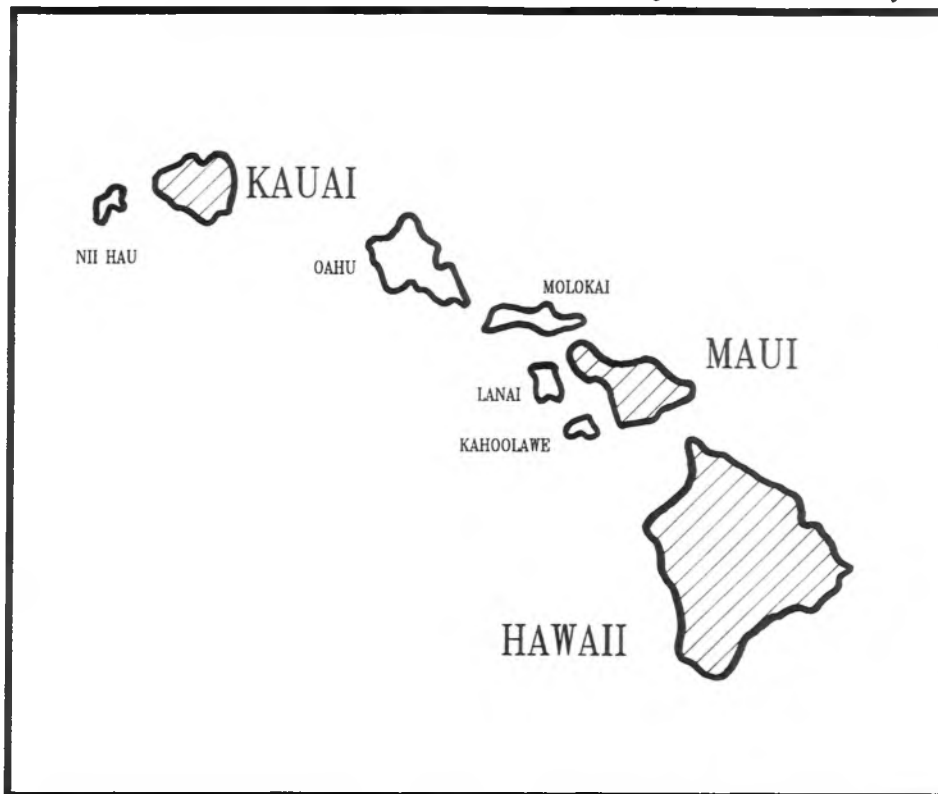


Figure 1. The main Hawaiian islands. The shaded islands are where Hawaiian Geese are currently found.

Current numbers

In 1989-1990 we estimated that between 476 and 555 Hawaiian Geese were surviving in the wild (Table 1). This estimate included two new feral flocks which raised the total by 73 birds; without the feral birds, the population numbered 403-482.

Captive-bred releases and current numbers

Since 1960, 2127 Hawaiian Geese have been reared in captivity and released into eight regions on three islands (Fig. 1). The vast majority were reared at the Hawaiian Forestry and Wildlife Pohakuloa Center - now at the Olinda Endangered Species Facility (82%). Others were reared at The Wildfowl & Wetlands Trust, Slimbridge (9%) and Volcanoes National Park (8%) with 1% elsewhere. Figure 2 illustrates the relationship between the number released and the number that were estimated in the wild. Historical estimates for each island are listed in

Table 2. The general pattern was an increase in numbers between 1960 and 1977 during which 1742 geese were released (mean = 97 birds per year), then a sharp decline after 1981-82 when releases were temporarily curtailed. Our current estimate of about 450 birds in total closely matches the estimates in 1980 (Devick 1981a,b). Between 1982 and 1990 an average of 30 birds per year were released.

One crude but revealing method of assessing which of the released subpopulations are maintaining themselves is to compare the number released with the number remaining in the area (Table 3) - a measure which includes survival of released birds and new recruitment; little movement occurs between areas (Santos & Hoshide unpubl. data).

In four of the eight regions, current numbers are substantially lower than the number released, less than 15%. Numbers in Haleakala National Park have been sustained at a higher level (36% of releases) and there is some indication that this flock is gradually increasing (or at least remaining stable) without further releases; in 1980, 100-150 geese were estimated

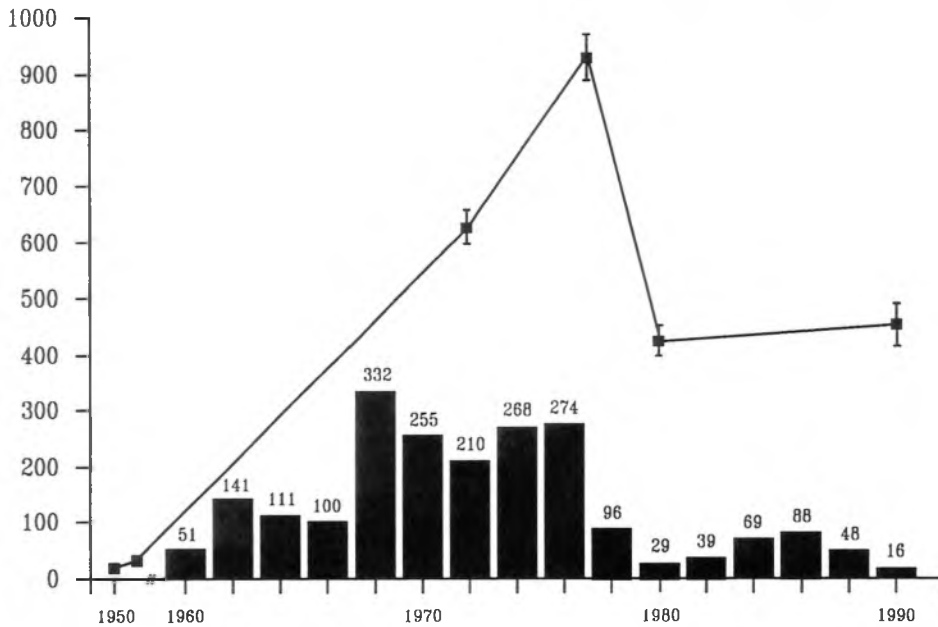


Figure 2. The trend in number of Hawaiian Geese in the wild (upper line) and the number that were released (lower histogram). The range in estimates (minimum and maximum) are marked in the upper line. Numbers in the histogram are two year sums.

and in 1990, 180 were counted. In Volcanoes National Park, the number released and current number are roughly similar, whereas the two feral flocks are increasing since their initiation in the early 1980s.

Several readily identifiable differences exist between some areas which may have influenced the disparity in numbers of released birds and current numbers. The four areas with less than 15% of the total released are upper elevation sites (1770 m to 2740 m) and consist of dry upper volcanic-montane habitat. Supplemen-

tary feed (cracked maize and chicken crumble) is provided at about five sites. These areas are extensive and predator control efforts are localised. All areas contain introduced predators: mongooses *Herpestes auropunctatus*, feral cats *Felis catus* and dogs *Canine* sp. Most goslings were incubator hatched and reared in groups without parents. Upon release in the first year birds were made temporarily flightless and placed in release pens from which they eventually flew (described in Kear & Berger 1980). The most recent releases have been of younger

Table 2. Past and current estimates of Hawaiian Geese on the islands of Hawaii, Maui and Kaua'i.

Hawaii Date	(Big Island) Estimate	Maui Date	Estimate	Kaua'i Date	Estimate
1778	25,000 ab	-	+++?	-	+++?
1920	50 ab	-	0	-	0
1945	50 b	-	0	-	0
1951	30 d	-	0	-	0
1972	450 e	1975	150-200 e	-	0
1977	650 e	1977	225-325 e	-	0
1980	300 e	1980	100-150 e	1982	12 f
-	-	-	-	1985	18
-	-	1989	118-171	1987	27
1990	260-339	1990	184	1990	32

a Baldwin (1945)

b Stone *et al.* (1983)

c Elder & Woodside (1958)

d Smith (1952)

e Devick (1981a,b)

f escapes which now make up a feral flock

Table 3. The number of captive-bred Hawaiian Geese that have been released in eight locations on three Hawaiian islands.

Location	First Release	Latest Release	Total Released	Current Number	Percent of Released Remaining
Hawaii					
Keauhou Sanctuary	1960	1990	366	50	14%
Keauhou II Sanctuary	1961	1976	348	30	9%
Kahuku Sanctuary	1967	1988	404	30	7%
Kipuka Ainahou Sanctuary	1973	1975	319	30	9%
Keaau Estate Feral Flock	1984	1988	7	40	571%
Volcanoes National Park	1975	1989	177	159	90%
Maui					
Haleakala National Park	1962	1981	494	184	37%
Kaua'i					
Feral Flock †	1983	-	12	32	267%
Grand Totals			2127	555	26%

† At the time of printing, this flock increased even further to 55 birds due to an exceptional breeding season (now 458% of original numbers).

birds before their flight feathers had developed.

Haleakala National Park, at about 2500 m elevation, can be described as a wet upper volcanic montane habitat. Most rearing and releases were conducted much like those described above, although 21 goslings were parent-reared on site and flew from rearing pens. Here one of the main causes of gosling mortality is heavy rainfall when goslings are still downy (Banko 1988, Natividad Hodges & Medeiros unpubl. data). Mongooses and feral cats frequent the crater but an intensive trapline is run throughout the goose nesting season. Birds that live outside the crater have been killed by cars. The majority of the diet is probably lush grass from horse-pastures which grow year around.

Within Volcanoes National Park, where disparity in numbers is less, the geese utilise a variety of vegetation types between about 300 m and 1300 m (Banko 1988, Hoshide *et al.* 1990). Here the birds probably utilise grass pastures more than in the upper elevation sites on Hawaii, but also nest within scrub land. Most of these birds were hatched and reared by captive parents and allowed to fly from release pens as and when they want. All types of predator also occur, although traplines are routinely set. Hoshide *et al.* (1990) reported that about 26% of the current flock ($n = 159$) were unbanded birds that were potentially hatched in the wild; ring loss from captive-bred releases does occur. Banko (1988) showed that females whose nests were near to grass pastures (< 1 km) succeeded in hatching eggs better than those whose nests were far from pastures (up to 5 km).

The two regions where numbers have in-

creased beyond numbers released have the common features of being lowland sites (< 10 m elevation) where the geese spend the majority of their time on grass pastures. The pastures at both sites are regularly irrigated, so fresh grass shoots are available throughout the year. Keaau Ranch has few mongooses (through intensive management) and Kaua'i has no mongooses. Supplemental food is available to the geese at both sites.

The Nene Recovery Initiative

The starting point for our current management and research efforts, therefore, takes into account the following possibilities: released Hawaiian Geese appear to need prolonged access to growing plants (most often pastures), predators should be controlled and rearing and release techniques may need further improvements (also see Stone *et al.* 1983, Morin & Walker 1986, Banko 1988).

Santos (in Banko & Elder 1989 draft) has shown that 38% of 473 known releases in the dry upper elevation areas died within the first year of release and 52% died before the second year. With geese generally, mortality in the first two years of life after fledging, other than from hunting, is usually between 5%-9%; although in species that migrate long distances, as many as 35% and 38% have been known to die in their first year (Owen & Black 1989, 1991). These upper elevation sites were where the last remaining Hawaiian Geese were found in the 1950s (Elder & Woodside 1958). The remaining birds in these areas, however, are finding mates and to a limited

extent producing offspring (Devick 1981a) with traits that are capable of surviving in this terrain. As movement between these sub-populations is negligible, we may need to conduct limited translocations to incorporate these traits into other areas (Morin & Walker 1986).

The ultimate goal of the recovery programme is to enable the Nene to be self-sustaining in the wild. In order to achieve this goal, several investigations and practices have been or are about to be initiated and maintained. The new initiative includes an initial 13 investigations under three headings: Management Research, Aviculture & Release Research and a Long-term Monitoring Programme (Black 1990).

In addition, a comprehensive Community Education Programme is currently being formulated. The aims of the project are:

1. To continue the investigation into the causes of the Nene's low productivity and survival in the wild.
2. To investigate the success and cost of various creative management practices in current habitats which increase the birds' productivity and survival rate (e.g. enhance food quality, control predators, etc.) and to identify additional habitats that are more conducive to the Nene's requirements.
3. To assess avicultural and release techniques by collecting data from intensive monitoring

of released individuals and through further research in captivity.

4. To better manage the behavioral, health and genetic quality of both captive and wild flocks.
5. To produce an agreed Management and Monitoring Programme for the Nene within the first 5-year phase and to stipulate the means by which the Programme could continue to be evaluated and enhanced until the Nene becomes self-sustaining without further releases.
6. To make the findings available for communication to a range of audiences and to heighten awareness of the Nene as the Hawaiian State bird (see The Community Education Action Plan) in order to ensure the success of the Management and Monitoring Plan.

Several of the studies have been initiated at the time of writing. Others will begin as further funding is anticipated in 1991. The main research projects involve 1) monitoring enhancement regimes: a study of plant phenology and goose usage, 2) experimental food choice trials, 3) assessing predator control techniques, 4) a genetic analysis: the effects of inbreeding, 5) a survey of potential parasites and other diseases, 6) studbook management analyses, 7) mark-recapture (resighting) analyses - e.g. population dynamics, and 8) effective rearing and release techniques.

Other members of the Nene Recovery Action Group include personnel from Forestry and Wildlife (Honolulu), USFWS (Volcanoes and Honolulu), National Park Service (Haleakala and Volcanoes), The National Zoological Park (Smithsonian), and the members of the Threatened Species Group at The Wildfowl & Wetlands Trust (Slimbridge). Additional advice was sought from the University of Hawaii at Manoa, the International Waterfowl and Wetlands Research Bureau (Slimbridge), Aquatics (Hawaii DLNR) and the IUCN Captive Breeding Specialist Group. In particular we acknowledge the participation of the following people who took part in the creation of the new management/research plan: Ron Bachman, Paul Banko, Paul Conry, Bill Devick, Rob Fleischer, Rennata Gassman-Duvall, Andy Green, Jim Jacobi, Larry Katahira, Janet Kear, William Kramer, Ann Marshall, Joe Mello, Marie Morin, Mike Ounsted, Myrfyn Owen, Liz Rave, Wayne Taka and Meyer Ueoka. Special thanks go to Ron Walker, Thane Pratt, Carol Terry, Dan Taylor, Chuck Stone, Ron Nagata and Mike Buck for their continual encouragement and constructive comments.

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This Hawaiian Goose was fitted with a plastic leg-band 'AJ' by members of The Nene Recovery Action Group in August 1990 at the Haleakala National Park

Photo by J. Black/WWT