

THE HAWAIIAN GOOSE, ITS DISTRIBUTION AND REDUCTION IN NUMBERS

By PAUL H. BALDWIN

The Hawaiian goose (*Nesochen sandvicensis*), known locally by the Hawaiian name, Nene, has existed through more than a century of white man's civilization. It is now much reduced in numbers and range. Even prior to the advent of the white man, it had the smallest range of any goose, as Miller (1937:1) points out. General statements regarding its distribution have been available for many years, but none is sufficiently detailed to satisfy the needs of the ecological investigator, who on the island of Hawaii must deal with a great diversity of climatic and vegetational conditions in adjacent areas. It is the purpose of this paper to present information on the distribution of the Nene gathered through visiting known localities of occurrence and interviewing ranchers and other outdoor observers. The laymen's records cited are considered reasonably reliable, for distinctive markings and habits render the Nene easy to identify in the field. Enough data on distribution were obtained to permit discussion on the course of the reduction in numbers and in range.

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DISTRIBUTION ON ISLAND OF HAWAII 18TH AND 19TH CENTURIES

In 1789 Captain John Meares of the *Iphigenia* noted that twelve geese were sent on board at Kawaihae (Locey, 1937:5), and in 1792, Edward Bell (1929), clerk of the *Chatham*, recorded the purchase of two small geese at Kealakekua Bay (fig. 7) and mentioned that six dozen had been carried to sea by a previous party. Since we know that Nene were raised by Hawaiians in early times, we may assume these domestic geese to have been that species. The presence of domestic flocks may indicate that wild Nene occurred at these places. Later records show that South Kohala indeed was a natural home of the Nene, and one record indicates that the central Kona lowlands were visited by Nene.

The next record of the Nene was made in 1823 when Wm. Ellis (1917:180), the missionary, "saw two flocks of wild geese, which came down from the mountains and settled among the ohelo bushes, near the pools of water" at the edge of Kilauea Crater.

He learned from natives that "there were vast flocks in the interior." Again, it is reasonable to conclude that these geese were Nene, both from the natives' comments and from subsequent records of Nene at Kilauea Crater.

In 1824, Andrew Bloxam (1925:62), naturalist of the *Blonde*, mentioned wild geese. Although it is not indicated that he actually saw these birds, he wrote that approaching the volcano from Puna at a distance between six and nine miles from Kilauea, the party passed several pools of water "which are often the resort of wild geese which frequent this part of the country and live on purple berries." Evidently he also was given information on the goose by natives. No doubt these remarks refer to the Nene, for the food habits and frequent visits by the birds accord with known Nene habits.

In the period 1838-1842, the United States Exploring Expedition visited the Hawaiian Islands. They found geese "on the volcanic mountains of the Island of Hawaii" (Peale, 1848). In their account no specific localities or regions are mentioned, except that shallow ponds occurring "between the mountains" are said to be breeding places of the geese. They remark that they have not been able to find the goose named by ornithologists, and they do not use the term Nene. The type specimen of *Nesochen sandvicensis* now in the United States National Museum was collected on this trip.

Subsequent references contain an implication of declining numbers of Nene, and we may assume that the recession of this species in numbers and perhaps also in range was noticed shortly after the middle of the 19th century. In 1864 W. T. Brigham (1909:12) ascended Mt. Hualalai in North Kona, probably up the eastern slopes. His guide shot a pair of Nene between two cones, probably about 6,000 to 7,000 feet elevation. He remarks that the number of Nene "has been much underrated," which nevertheless implies that their number in less remote areas was no longer large, though they were still abundant far in the interior.

Charles Wall, a sheep rancher between Hualalai and Mauna Loa in North Kona from 1859 to 1875, is said to have reported that native geese were abundant in that region (Pope, 1932:110).

Slender evidence is available to show that the Nene range probably extended into North Kohala in 1875 to 1880. I have been told by Ronald von Holt that a Hawaiian, J. K. Kaiamakini, used to herd Nene flocks at Kahua about 1880. The possibility exists that these geese were obtained in a wild state at Kahua.

A visitor to Kilauea in 1884, MacFarlane (1887:212) says, "on the hills above the renowned volcano of Kilauea, there are still fair numbers of Hawaiian geese, *Bernicla sandvicensis*." The wording reveals again a general decrease in Nene on the island, probably evident throughout its entire range by now.

The situation during the 1890's is described in the accounts of Henshaw and of Perkins, the last statements to come from ornithologists who had first-hand knowledge of the Nene from field experience. Henshaw (1902:103, 105) says, "upon the island of Hawaii the haunts of the nene, for the greater part of the year, are the uplands from about 5,000 feet upwards. At or about the above elevation the range of this goose is quite extensive, and it is found from the district of Kona to the northeast flanks of Mauna Kea." He continues, "the greater number, probably all, leave the upper grounds beginning early in fall, and resort to lower altitudes, from about 1,300 feet downwards. There are barren lava flats near the sea in Puna, Kona, Kau, and Kohala, rarely visited by man, and it is to these deserted solitudes that the nene resorts at the beginning of the love season."

I have corroborated Henshaw's statement that Nene occurred on the northeast flank of Mauna Kea with one record: C. E. Blacow was once told by a rancher of Nene seen

lowlands to Kau around 1894, says Nene were plentiful above the inshore cliffs around 1,500 to 2,000 feet but not on the flats which line the shore. He saw them as far to the east as Panau. On the lava below Kahuku in Kau, Nene were seen in the 1890's (Henshaw, 1902:106). H. C. Palmer and G. C. Munro collected Nene on the lava flow of 1801 near sea level in North Kōna in December, 1891. In 1896, nine geese were shot along the Kaupulehu coast in North Kona by Captain Freeman (Locey, 1937:6). An Hawaiian informed von Holt that Nene formerly came to Makalawena on the shoreline in North Kona. Von Holt was likewise told by Hawaiians that they regularly made use of Nene for food at Kalahuipuaa in South Kohala and that Nene came to Puako several miles further north.

Perkins (1903:457-458) writes, "The nene is widely distributed on the island of Hawaii and in some localities is a fairly common bird. . . . In the summer months it affects the open upland region,—as parts of the plateau between the three great mountains of Hawaii, at an elevation of four or five thousand feet above the sea. Near the crater of Kilauea about two miles from the Volcano House hotel flocks of some size may be occasionally seen in the later summer." He continues, "In the winter months large numbers of these upland geese resort to the lowlands and remain there for such time as the vegetation is fresh and green."

A number of interview records can be added to our account of the 1890's. Flocks of 30-40 Nene were seen by Allen Wall during this decade at Aina Hou, a *kipuka* with grass and berry-laden shrubs on the north flank of Mauna Loa in North Hilo District at 6,000 feet. Not only did he see geese here but along the Humuula road and "all over the country between Mauna Loa and Mauna Kea." David Paris asserted that Nene were always to be found throughout the upper part of the Kona districts in the latter part of the 19th century. His uncle, J. D. Johnson, and an old Hawaiian, Charles Kaa, used to obtain living young Nene between Hualalai and Mauna Loa. Kaa also told Paris that flocks used to fly from above over the forests of lower elevations in Kona, including central Kona. Wall states that Nene were found everywhere between Mauna Loa and Hualalai and along the west slope of Mauna Loa to the south end of the mountain. Palmer and Munro collected Nene on Hualalai at the Huehue Ranch in North Kona around 2,000 feet but failed to find them between Mauna Loa and Hualalai in 1891. In 1899, J. Pritchard saw Nene scattered along the Ainapo Trail, Kau, below timberline (E. Horner).

20TH CENTURY

By 1900 the great decline in Nene numbers had occurred and the first investigations on Hawaiian birds had been made. Published records of Nene occurrence from then on lapsed.

Kona and Kohala.—In and above South Kona, Paris encountered pairs of Nene as late as 1936 two miles east of Keanapaakai, Kahuku, and two miles east of Komakawai waterholes at 7,250 and 7,000 feet, respectively. In May, 1937, O. Crosby observed a pair just above the Polewai Water Holes. In 1940, von Holt saw several flocks of five to eight from the Alika Lava Flow north to Hooper Camp from 6,750 to 8,000 feet, and early in 1944, W. Thompson found three on the lava above Komakawai Water Holes.

Nene still were observed occasionally between Mauna Loa and Hualalai at the turn of the century, but since then F. R. Greenwell has found them comparatively scarce. He noted the lower limit of their wanderings on the south side of Hualalai to be around 5,000 feet. From 1929 to 1931, H. W. Baybrook saw nesting at Pohakuloa in Keauhou 2, but not subsequently. L. W. Bryan observed a few in the driest part of the plateau

between Hualalai and Mauna Loa in 1932. The southeast flank of Hualalai just above the plateau has harbored small flocks through the years up to 1940, according to Greenwell, though nesting was not observed by him. Three were seen by Baybrook on the plateau at Puu Keanui and one near Ahuaumi Heiau in 1941.

On the west and southwest sides of Hualalai, Nene, if present at all, were scarce, as no records are at hand for any area south of Kaupulehu.

On the north slope of Hualalai about 1910, Paris came across Nene at the Kaupulehu Lava Flow along the Waimea road. Nene are recorded in later years from here. Wall caught goslings on the north slope about 1913 and has reared their offspring to this day. T. Vredenberg remembers Nene in fair numbers in 1942 along the edges of the Kaupulehu Lava Flow from 2,550 to 4,400 feet. The birds came to the grassy pahoe-hoe lava two miles east of the Huehue ranch house, and in November, 1942, 14 came to a watering trough one mile from the house. Recently Paris has seen one or two along the road by the Kaupulehu flow.

Apparently, Puuwaawaa Ranch includes the most populated nesting area today. The continuous presence of Nene since 1900 is recalled by L. Hind. In March, 1942, Hind saw 26 near the hill, Puu Waawaa, and once in 1941 he saw a flock of 33 there. During 1943 the largest flock he found was of 13. Nene nest especially in Waiho and Halekula, in paddocks between Puu Waawaa and Hualalai, from about 2,300 to 4,000 feet, according to Hind. One of his employees, T. Lindsey, reported nesting above Halekula in November, 1941, and in February, 1942, watched an adult with young at Poo-hohoo. He had noted also several at Halekula in March, 1942, and 16 at Waiho at 3,000 feet in April, 1942. On April 11, 1942, the writer saw five adults at 3,700 feet near Poohohoo.

The Puuwaawaa shoreline is visited by Nene, as Hind observed 19 at Luahinawai in 1937.

Nene were also seen in the adjacent lands of Puuanahulu both above and below the belt road in the homesteads area during the years around 1906 by Greenwell and by Eben Low, who told Paris that they bred here. From 1915 to 1930, E. Horner saw occasional pairs in the vicinity of the 1859 Lava Flow above and below the road. The last was seen about 1930. He once saw a pair flying toward the shore in the early morning and perhaps the same pair flying toward Mauna Loa that evening.

Several miles above the shore in Puuanahulu and Waikoloa are several grassy *kipuka* where Nene were known perhaps as late as the 1920's, according to F. I. Brown. Brown and von Holt occasionally have come across them near shore ponds just north of Keawaiki Bay during the past few years.

In the South Kohala district Nene were noticed near the seashore at Puako until 1915 (von Holt). The most northern specific records in South Kohala are in Lalamilo at 2,000 feet, where Lindsey saw "some nene" at Waiulaula Gulch in the early 1900's. Brown learned of seven here in 1941. Lindsey saw some south of here at Keamuku in Waikoloa at about 3,250 feet in 1925.

On the gentle slopes of Mauna Kea in South Kohala, Vredenberg in recent years saw "flocks of Nene" in Waikii Gulch at 4,150 feet. A pair built a nest containing three eggs on rough ground three miles northeast of Keamuku at 3,750 feet in 1940, according to Paris.

The northernmost record was obtained by von Holt when he disturbed a pair of Nene at Kapole (Waikapole) Gulch in Makiloa, North Kohala, at 800 feet in 1938. This is the only sight record from that district.

Interior of the Island.—Nene are frequently seen in the interior from Puuwaawaa to Aina Hou and from the latter place to Kau. Vredenberg reports that there was a small flock on the Keamuku Lava Flow immediately south of the cinder cone, Puu ka Pele, at 6,000 feet in 1942. An undated record from Donaghho (1937:8) cites 19 seen by Payne "between Mauna Kea and Hualalai." Vredenberg says Nene have occurred in Mamani groves above Kipuka Kalawamauna during recent years. Farther to the east S. Nakamura and an Hawaiian boy independently reported Nene at the cinder cone, Omaokoili, during April, 1943. One circled in flight over the Parker Ranch cabin a few miles east of Puu ka Pele when W. Rickard was there in 1939.

The eastern half of the plateau between Mauna Kea and Mauna Loa lies in North Hilo District. Here Aina Hou has continued to attract geese; however, Paris saw only a few there in the 1930's compared to numbers seen in the early 1900's. J. J. Ignacio saw 18 there in August, 1937 (Lamb, 1937:2), 8 in a single group in 1940, and 3 or 4 in 1941. Just above Aina Hou is another grassy *kipuka* called "Kipuka o Nene." Here von Holt saw a number during a visit in the 1930's and states that W. Kaneho frequently found Nene there on regular trips from 1940 to 1941. The elevation is 6,300 to 7,000 feet.

Toward Kilauea from Aina Hou, Hawaiian geese were seen on the south side of the lava flow of 1852 along the Puu Oo-Volcano Trail in the 1930's by Bryan. Recent Nene droppings were found on the flow of 1855 at 5,900 feet by the writer in November, 1942. Farther south, Wall saw flocks above Waiakea in the early 1900's.

North of Aina Hou the writer found droppings at several places along the edge of a lava flow and near small ponds three miles south of the Puu Oo Ranch house at 5,400 to 5,750 feet in November, 1942. H. Shipman occasionally has seen Nene on the Puu Oo Ranch during the past fifteen or twenty years.

Kau and Puna.—All of Puna and parts of Kau seem to have been abandoned by the Nene. Nowhere in these districts are there now to be found concentrations of the geese.

George Lycurgus knew of flocks coming to Kilauea Crater in the vicinity of the Sulphur Banks during the years 1904 to 1907. This is the last record at hand of wild geese in this constantly peopled area. An Hawaiian resident of the Kilauea region, the late Charles Kauhi, however, related that they occasionally would visit the barren Kau Desert to the southwest of the crater, though not the so-called "Kipuka o Nene" due south of the crater. A collection of perhaps month-old droppings was made by the writer in August, 1941, at the "Koa Oasis," two miles south of Kilauea Crater. The park warden reported four or five Nene at Kipuka Pepeiau in July, 1940.

Records of Nene occurrence above Kilauea Crater on Mauna Loa are numerous for the past few years because of the interest taken by employees of the Hawaii National Park and their frequent traversing of this area. The records are summarized in table 1. Though Nene have been recorded here frequently it is not an unusually favorable spot for them.

About five miles to the northeast of the park is Keawewai, a water hole where Nene stop rather frequently. Paris saw flocks there in the early 1900's. In July, 1940, ranchers likewise encountered a small flock and told me of seeing them there more recently.

On the Kau slopes of Mauna Loa, Nene also occur. Jagger (1919:138) saw two in grassy Kipuka o Nene in Kahuku. In 1926, young were seen at Puu Kinikini by E. G. Wingate. On the slopes of Mauna Loa above the Kau Forest Reserve, Nene were sighted by E. Y. Hosaka in 1937 (Donaghho, 1937:8). M. Martinson saw two at Punaluu Kahawai at 7,250 feet in November, 1942. The occurrence of Nene in the Kahuku low-

lands in Kau is now rare, as Martinson, who is in that country frequently, has not seen any since 1931 or 1932, at which time he secured some goslings below Kipuka Kapulehu.

DISTRIBUTION ON ISLAND OF MAUI

Complete proof of the former existence of Nene on Maui is lacking, for no specimen is known to have been saved. Enough records are available, however, to indicate satisfactorily that a wild goose, presumably identical with the Nene, occurred on Maui. No specific breeding records are available.

The earliest mention of Nene on Maui is by Brigham (1909:12), who attributes them to the "highlands" in the 1860's. A hill at the base of Haleakala has always been called Puu Nene, "nene hill." By the 1890's the Nene was scarce on Maui, as Perkins (1903:457) writes, "The nene . . . is said to have formerly frequented Haleakala, Maui, although neither in my many visits to the summit, nor when camping in the bottom of the great crater, did I myself get sight of one." Henshaw (1902:103) writes that it "is said to have nested in past times in the crater of Haleakala. At the present time, however," he continues, "there is no reason to believe that the Nene is found upon Maui, inquiry in 1891 failing to disclose that it had been seen there for several years." Lorna von Tempsky says her father saw Nene at "Waikanene" at 7,700 feet on the north slope of Haleakala sometime around the turn of the century.

Since 1900 the Nene seems to have turned up as a rarity. David Fleming tells of seeing about six by small ponds on Laie Flats in Haleakala Crater in 1906. His brother, John, shot one on the slopes of Haleakala "above Paia" about the same time. Robert von Tempsky saw two at one of the ponds, Wai Anapanapa or Waiale, high on the northeast slope of Haleakala in 1912 or 1914.

NENE ON OTHER ISLANDS

It was the belief of some of the early residents that Hawaiian geese occasionally occurred on Kauai and Niihau. Von Holt tells that his mother, who lived on Kauai, spoke of seeing them there. Henshaw (1902:103) believes its occasionally recorded occurrence on Kauai and Niihau "was probably in the nature of an accident, if indeed it was not mistaken for one of the species of American geese which are known to visit the islands not rarely."

REDUCTION IN NUMBERS

Earliest available records indicate that a large population of Nene existed at least until 1823. Later ones show a decline, for in 1864, Brigham, although speaking optimistically, implied that the population on Hawaii was becoming smaller, as did MacFarlane in 1887. After 1890 we learn they are gone from Maui and scarce on Hawaii. From 1900 on the Nene has been rare.

Not having a numerical estimate of the original Nene population, for convenience we shall make our own. Twenty-five thousand may be a reasonable approximation: certainly the number was well up in the thousands. The number existing today is difficult to judge because of the bird's habitual movement and the remoteness of its feeding and breeding areas. Fifty was the figure proposed by Hawaii National Park staff members in 1939. This was a good estimate, but the size of flocks at Puuwaawaa in 1941 indicates the total may have been slightly larger at that time. Since 1941 the Puuwaawaa flocks have been smaller, however, and do not support an estimate of over 50.

The decline may have had a slow beginning in the late 1700's and gradually increased in speed until the high rate of decline was reached around 1850. From 1900

on the rate of decline fell and a lowest known population total was reached during the 1920's. From 1930 to the early 1940's the number was nearly constant. Bryan believes the Nene decreased until about 12 years ago and has remained static since, while Lindsey in 1942 thought the population at Puuwaawaa reached its lowest point in 1929 and had actually increased a little since then. The difficulty of detecting population trends is illustrated by Brigham's (1909:12) remark in 1864: "Although they are found only on the highlands of Hawaii and Maui, their number admits of the annual slaughter of several hundred without sensible diminution." This, at the time when the population curve was well into its sharp plunge.

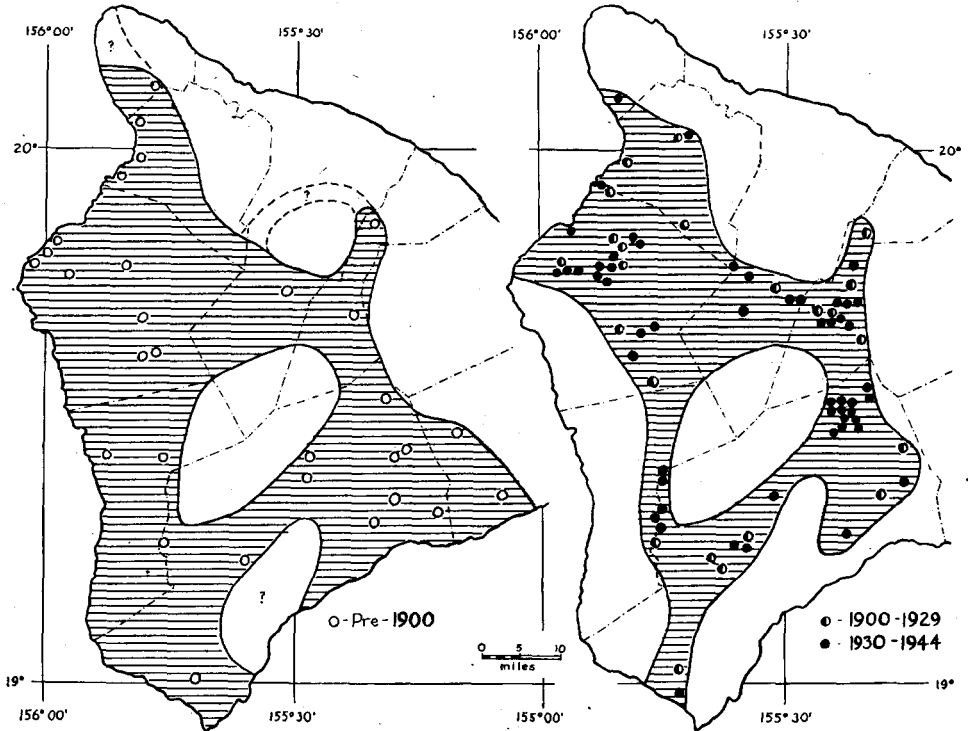


Fig. 8. Distribution of the Nene on Hawaii. Left-hand map shows range prior to 1900; right-hand map shows range after 1900. Circles indicate specific localities where Nene have been recorded. Nene may have entered areas marked with a question sign.

The causes of the decline were no doubt multiple. Direct influences were brought to bear upon the Nene by white man directly and indirectly through altered environment. The following list gives a few of the events occurring after civilization of the Western world penetrated the Hawaiian Islands:

Activities of man: exploration, hunting with firearms, probable increase in capture of live birds and eggs, flushing and frightening of birds from nests and foraging grounds, sandalwood gathering in uplands, ranching developments and activities, and building of beach resort homes and of military roads in uplands.

Indirect agents of the white man's activities: introduced animals such as the rat, goat, sheep, cattle, horse, pig (new stock), ass, feral dog and cat, mongoose, game birds (pheasant, quail, guinea hen, jungle fowl, turkey, peafowl), the mynah, and the ant. Introduced plants such as pasture weeds and grasses, mesquite, thimble-berry, and pampas grass.

Most of these factors have been adverse, but a few of the plants have provided preferred foods. Whatever the proportionate individual importance, the aggregate effect

caused the drastic reduction of the Nene population. Certain events leading to introduction of adverse factors can be dated easily, as, for instance, the introduction of the mongoose in 1883 (Bryan, 1915:296). This mammal is an important predator and egg destroyer, and an increase in its influence on the Nene can be anticipated henceforth. Activities of man are often intricate and devious in their effects. Ranching activities, for instance, include the establishment or introduction of cattle in paddocks, fences, buildings, water troughs, water sheds, trails and roads, camps, cats and dogs, heavy use of upland water holes by livestock, impoundment and piping of water from them, open water tanks (Nene drown in them), daily horseback trips by ranch hands into the paddocks, sowing of range grasses, clearing of brush by hand and burning, gradual reduction of vegetation from forest toward pasture type, and many others. The result of these cannot be so easily dated, but a gradual increase in deleterious effects is assumed from 1794, when cattle were introduced.

The extreme scarcity of the Nene in the late 1920's and early 1930's caused some to conclude erroneously that this bird had disappeared altogether from natural sites of occurrence. This was based partly on the fact that flocks at Puuwaawaa would come to the ranch house for food in a semi-domesticated manner. L. Hind has asserted that they were not held captive at the ranch but came of their own volition. In spite of the fact that Puuwaawaa flocks depended on man in part, during these same years Nene were still established as breeding birds elsewhere. The presence of young birds in the Kahuku uplands in 1927 and in the Kahuku lowlands in the early 1930's proves this. The continuity of the wild Nene population has remained unbroken.

The future of the Nene is uncertain. With no protection other than that of laws which prohibit shooting or molesting of the Nene, there is little prospect it will survive the present development of the island. That it has survived the last 15 years is perhaps evidence of ability to withstand the many adverse influences in spite of low numbers. This lends hope to the thought that means may be found to preserve the species.

REDUCTION OF RANGE

The early range of the Nene on Hawaii, as deduced from foregoing records, was more extensive than that now occupied. The range of 1800 is contrasted with that of 1900 to 1940 in figure 2. The former includes a total of 2,475 square miles, the latter 1,150. Thus shrinkage of range during 140 years amounted to over half the original range on Hawaii, or 1,325 square miles.

The range of the Nene on Maui apparently included lowlands as well as upper slopes of Haleakala and the crater itself. The lowlands must have been abandoned at an extremely early date and the uplands by the end of the 19th century. It is judged that the range on Maui was less than one-fifth that on Hawaii, or a maximum of 450 square miles. The two areas combined total 2,925 square miles, which represents the approximate size of the original range.

The reduction of range on Hawaii may well have occurred in the following manner:

1. Before 1850: withdrawal from marginal areas and localities already in heavy use by Hawaiians.
2. 1850 to 1900: abandoning of wide lowland areas.
3. 1900 to 1944: slow shrinkage in uplands and lowlands.

In the first period, withdrawal from populated areas was given impetus by introduction of firearms. Whether or not Nene ever occupied the upper northern slopes of Mauna Kea and the extreme northern part of North Kohala is not actually known,

Table 1
Summary of Nene records in Hawaii National Park above Kilauea Crater from 1936 through February, 1944.

Locality	Date	Record	Source	
Kipuka Kulalio	Aug. 25, 1938	Saw 5 in eastward flight, 6,250 ft.	P. H. Baldwin	
	Aug. 28, 1938	One standing on lava flew into Koa forest, 5,750 ft.	P. H. Baldwin	
	July 7, 1939	Saw 5 flying at 400 or 500 ft. in flat "V," 6,700 ft.	P. E. Schulz	
	June 16, 1940	Saw flock of 3, 6,500 ft., and flock of 5, 6,000 ft. in flight.	P. H. Baldwin	
	July 31, 1940	Small flock in underbrush, 6,700 ft.	P. H. Baldwin	
	Dec. 18, 1943	One flushed from ohelo shrubs, 6,800 ft.	P. H. Baldwin	
	Jan. 13, 1944	2 flushed, 6,500 ft., circled to higher elevation.	P. H. Baldwin	
	"3-trees Kipuka," ¼ mi. west Kipuka Kulalio, 6,250 ft.	July 21, 1937	Saw flock of 8	H. Craddock (1937), W. Donaghho (1937)
		April, 1940	Saw flock of 3 on 3 days.	P. H. Baldwin
		May, 1940	Saw flock of 2 on 2 days, 1 on 1 day.	P. H. Baldwin
Oct. 22, 1940		Saw 2.	P. H. Baldwin	
Nov. 27, 1940		2 roosted during the night	P. H. Baldwin	
June, 1941		Abundance of signs indicates heavy use by Nene in May after little use in previous months	P. H. Baldwin	
Oct., 1941		Few signs indicate light use during October (first since May)	P. H. Baldwin	
Nov. 28, 1941		1 seen	P. H. Baldwin	
1881 Lava Flow, 6,500 ft.	June, 1941	Signs indicate use of vicinity during May	P. H. Baldwin	
Mauna Loa Trail	1936	Says Nene reported from time to time	K. J. Williams	
	Sept., 1938	Saw 5, 7,500 ft.	B. F. Moomaw, Jr.	
	Aug. 14, 1939	Saw 4, 7,500 ft.	E. S. Mollenhoff	
	April, 1940	Saw 2, 7,500 ft.	H. J. Quick	
	July 14, 1940	Saw 3, 7,500 ft.	J. H. Christ	
	Oct. 15, 1940	Saw 1, 7,000 ft.	J. H. Christ	
	Aug. 21, 1942	Saw 1, 7,800 ft.	P. H. Baldwin	
	Mar. 3, 1943	Saw 1, 7,500 ft.	A. L. Mitchell	
	Oct. 8, 1943	Saw 1, 7,500 ft.	A. B. Medeiros	
	Feb. 21, 1944	Saw 1, 8,000 ft.	A. B. Medeiros	

but it is possible they did. Inquiries have been made concerning the upper, northern portion of Mauna Kea without success as to discovery of either the early presence of Nene or reasons for its withdrawal if it ever was there. The Hawaiian crow is an example of a bird that seems not to occupy all available range; the Nene may likewise have failed to do so.

The second period coincided with the years of greatest reduction. Continued interference by man with Nene nesting in the lowlands was probably an important factor. The withdrawal may have resulted from extermination of Nene in the affected areas, the discontinuation of breeding by birds frequenting them, or by shifting of the breeding activities into other areas.

In the third period range shrinkage has continued through the 1930's. This might be interpreted as evidence of continuing population decline through the 1930's.

A characteristic of the changes in range and population just described is that the population continued to be spread out, but thinly, over a relatively large area. Thus, the population has undergone a much greater proportionate reduction than has the total areal range.

SUMMARY

The present range of the Hawaiian Goose, or Nene, encircles Mauna Loa on Hawaii between roughly 5,000 and 7,500 feet elevation and extends to or near the seashore in parts of Kau, North Kona, and South Kohala. Nene range was formerly more extensive on Hawaii than it now is, having decreased from 2,475 to 1,150 square miles. The Nene range of 1800 included larger tracts of lowland areas than that of 1900 to 1940. The present center of the Nene population is Puuwaawaa north of Mt. Hualalai.

Conclusive proof that the Nene existed on Maui is not available, although the species appears to have occurred there during the 19th century. Occurrence of the Nene on Kauai and other islands is doubtful. Nene range on Maui might have included about 450 square miles, bringing the total area occupied by the Hawaiian Goose up to a possible 2,925 square miles.

The wild Nene population may have totalled 25,000 or more in the latter part of the 18th century. It is now reduced to about 50 birds. The reduction began between 1778 and 1850, progressed rapidly between 1850 and 1900, and tapered off slowly from 1900 to 1930. Since 1930 the Nene population appears to have remained constant, although the available evidence may be deceptive. The continuity of the wild Nene population has not yet been broken. The Nene has survived during the past 15 years at a low population level.

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