had supposed it to be, but a bird with many Pintail characters. Thinking about it afterwards, I am convinced that this is still very near to 'the original duck'—that is to say that it is descended, and perhaps not very much altered by selective pressure, from a basic *Anas* which was common ancestor to Mallard and Pintail. This seemed to me to be a moment of truth, and perhaps one of the most valuable conclusions to be drawn from the whole of the tour. To me, what is most fascinating about the study of evolution is to be able, by looking at a branch, to judge just how high up the trunk it branched off in those far-away times. So the Brown Duck is a primitive and not a degenerate. The Chestnut Teal has varied more, no doubt under heavier selective pressure in Australia.

So we filmed the pair of Brown Duck in the evening light and found that they had kept an excellent dinner for us at the hotel.

NE-NE IN HAWAII

Preliminary Report on the Ne-ne in Hawaii

by William H. Elder

Dr Elder, who is Professor of Zoology at the University of Missouri, has just completed a year's survey of the Ne-ne in Hawaii. His past contributions to this Report (7th Annual Report, *pp. 123–132*) *followed a season during which he accompanied the rocket-netting team to Scotland and Northern England, and worked for a period at Slimbridge.*

JUST eight years ago the world's population of the Ne-ne had reached an all-time low. But thirteen birds remained in all the aviaries of the world—all in the Hawaiian Islands. Except two lone birds, all were in the flock of Herbert C. Shipman, long their protector. Little was known of their status in the wild. That they were scarce, all agreed. In the five years since Paul Baldwin's (1945) study, Ne-ne had been seen less than half a dozen times. The Schwartzes (1949) had failed to find any birds in the wild during their two years of intensive field work in the islands. Smith (1952) estimated their numbers in the wild as less than 30.

Since then two significant events occurred in the Ne-ne world. One morning in July 1955, 24 birds passed an observation-point manned by Big Island biologist, Dave Woodside (1956). Did this indicate a real increase or a seasonal concentration of all the remaining birds? No one knew. Secondly, captive birds were supplied through the generosity of Herbert Shipman to start the Board of Forestry and Agriculture's Ne-ne farm at Pohakuloa and to the Wildfowl Trust. Now their aggregate numbers exceed those of birds remaining in the wild (Table I).

TABLE I

Ne-ne known to be alive 1 September 1957

In Hawaii	
In the wild	at least 35
Honolulu Zoo	2
Mr Shipman's ranch at Ainahou ..	9
Pohakuloa project	34
Outside Hawaii	
Wildfowl Trust, England	40
Leckford, England	3
Clères, France	2
Rotterdam, Holland	2
Litchfield, Conn., U.S.A.	2
	Total 129

Thus, it was hoped that a restocking programme could soon be started to repopulate some of the former range of the Ne-ne on the island of Hawaii.

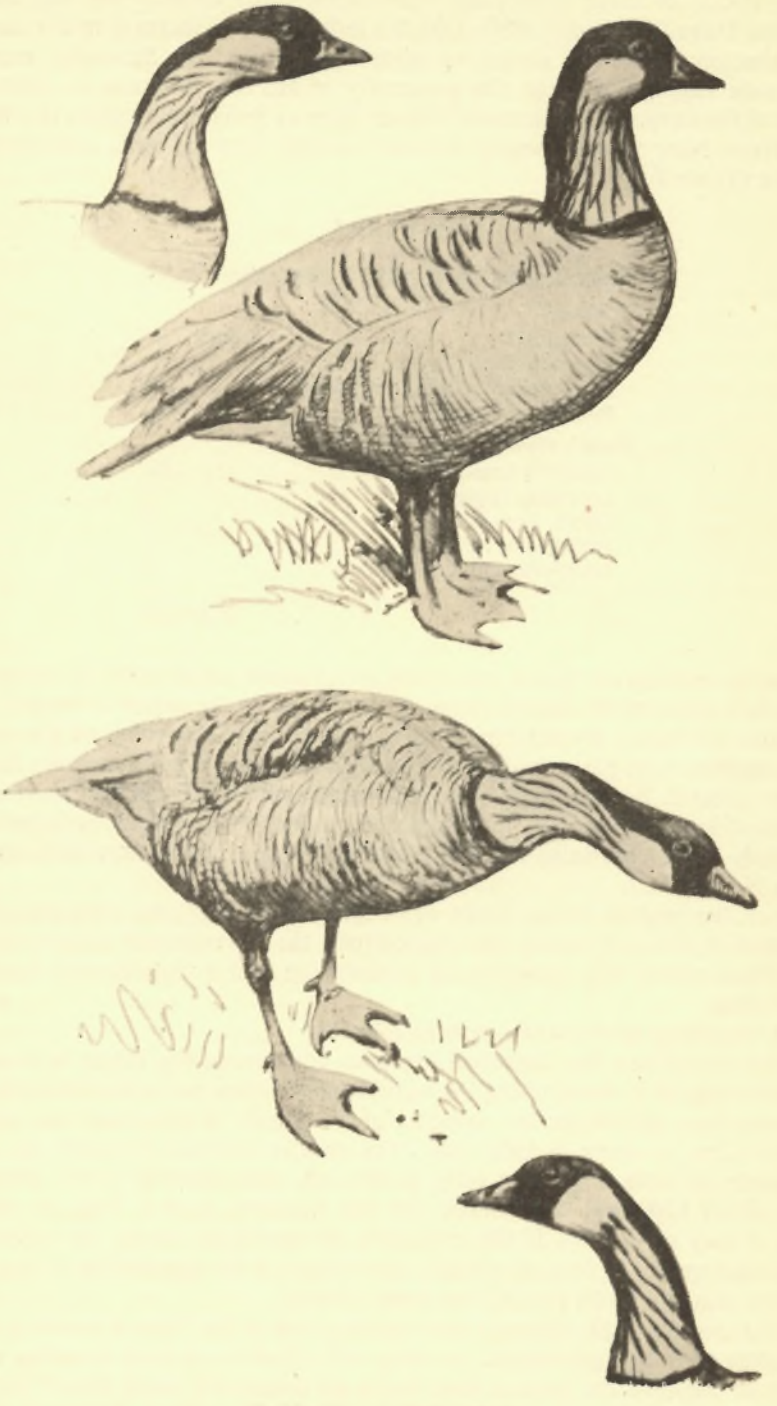
Success of such a project hinges upon a better understanding of the causes of the decline of the Ne-ne and knowledge by which the current mortality factors can be reduced. For any species to survive, the rate of production must equal the rate of losses, or *natality* must equal *mortality*. If the balance is tipped ever so slightly, so that mortality exceeds, a species declines. This is what has happened to the Ne-ne.

Hence the present Ne-ne study was begun under the joint auspices of the Hawaiian Board of Forestry and Agriculture, the International Committee for Bird Preservation, the Guggenheim Foundation and a Yale-Bishop Museum Fellowship.

The objectives of the study were as follows:

1. To re-examine the historical evidence concerning the Ne-ne in a search for clues helpful in interpreting the significance of changes in land-use patterns that may have altered the life equation of the species. If Henshaw was entirely correct when he wrote in 1902 that: 'The greater number, probably all, leave the upper grounds beginning early in the fall, and resort to lower altitudes, from about 1200 feet downwards' for the breeding season, then we should know if they still do so. If the expansion of cane-fields nearly up to the fern forest has forced the Ne-ne to remain above this belt for the nesting season, it is possible that the bird's fertility has been affected.

2. To discover what changes have taken place in the former breeding areas not taken over by agriculture. Are they still suitable, or have invading exotic plants so changed the habitat that Ne-ne no longer will come there? Such an area was recently visited with Mr William Meinecke in Kau. Where he found young Ne-ne in open country at the turn of the century, there is now little but



Ne-Ne (*Branta sandvicensis*)

brushland grown up to the exotic plants Lantana, Christmas berry and Apple of Sodom.

3. To discern, if possible, the seasonal food limitations of the summer ranges —5000 to 7500 feet—during the breeding season and ensuing winter period. If birds are now forced to stay higher than formerly, are they subject to impoverished diets or are there plenty of foods for them to shift to after the end of the berry season?

4. To learn the significance of standing water for Ne-ne. This species, sometimes called 'lava goose', certainly frequents dry habitats by choice through much of the year. Is open water, even in small pools, essential for the breeding season? Some species of geese in captivity lay only sterile eggs when no pool is available in which they can mate.

5. To appraise the role of predators as a limiting factor upon the Ne-ne. When pueo and io were once abundant, so were Ne-ne; so the native Hawaiian predators, the owl and the hawk, cannot be implicated in any way in the decline of the goose. One even wonders if the introduced predators of such long standing as the rats and pigs could have been of great importance. But the spread of the mongoose is more closely timed with the period of rapid Ne-ne decline. And feral cats and dogs surely increased with the rise in human populations. Perhaps no one of these alone can ever be said to be the limiting factor; but all may have contributed.

6. The last objective of this current Ne-ne study was to learn some of the details of their behavior for comparison with detailed studies that have been made of the pairing, nesting, incubating and brooding activities of the Canada Goose—most likely the nearest of kin to Ne-ne. This may shed new light on the origin of the island species, so long isolated from its mainland progenitors. We may also learn whether hand-reared birds should be liberated in pairs or as families when the time comes to release captive-reared stock in the wild.

Nearly all Ne-ne sightings in the past decade have been on Mauna Loa, Mauna Kea and Hualalai. These mountain slopes between 5000 and 8000 feet are sparsely vegetated with gnarled open-grown koas, stunted ohia trees and such fruit-bearing shrubs as pukeawe, ohelo and the creeping kukainene with its beautiful glistening black berries. All these, along with the unique golden, native strawberry, provide food for the Ne-ne. But their preference, we found, is for greens, especially the succulent leaves, stems and buds of two native yellow flowers: pualele (*Sonchus oleraceus*) and gosmore (*Hypochaeris radicata*). To these the Ne-ne adds seeds stripped from the heads of grasses and sedges. His water comes from fog drip, the dew which forms on all vegetation and hangs from it nearly every afternoon in this particular band around the mountains.

It was here that my first few months in the islands were spent, looking, listening, hoping for signs of these rare and elusive birds. Five thousand miles by jeep, days on horse and mule, and seemingly endless miles on foot over vast, rough lava fields of jagged aa' (and a new pair of boots every month), finally paid off. With Territorial Biologist, Dave Woodside, we not only found the first nest of a Ne-ne seen for many years but were able to get what we believe are the first photos ever made of a wild Ne-ne nest with eggs and of babies not a day old.

News of the find was withheld for many weeks to protect the young from disturbance by sightseers or others who might be accompanied by dogs. The

nest came to naught, for the single gosling that hatched vanished the next day. I trapped a mongoose just twenty feet away.

Within the next few weeks we found five more Ne-ne pairs within a mile of the nest and each with a brood of downy young (Table II). Each day a hundred hazardous pitfalls must have been negotiated as they scrambled over the loose lava until their feet—larger proportionately than those of Canada Geese and only half webbed—grew tough and their legs strong. Only then, when five weeks of age, did their feathers begin to show above the long, fuzzy grey down that covered their fast-growing bodies. Not until another seven weeks had passed and the young had reached the age of three months were their wing feathers fully hardened so they could fly.

TABLE II

Ne-ne families observed in the wild on Mauna Loa, 1957

1	pair	with	..	..	..	0	young
1	„	„	..	..	..	1	„
2	„	„	..	..	..	2	„
1	„	„	..	..	..	3	„
1	„	„	..	..	..	4	„
	Total young reared in the wild					10	

Geese that raise their young in the far north see them grow twice as fast, and thus escape the hazards of ground-running predators in half the time. But the Ne-ne can't match them because days are so much shorter in the tropics than in Canada or Iceland. Then, too, the Ne-ne nests in November, December and January, when days are shorter than at any other time of the year. This means many fewer hours in which to find food—no wonder the Hawaiian Goose grows at half the rate of his northern cousins!

How this reversal in nesting season came about is one of the great mysteries still to be solved. Ignorance of this fact of winter-time nesting contributed heavily to the decline of the species, for the hunting season was set in mid-winter, just as it was in North America, thus legalising the shooting of helpless young and flightless parents. (Like other members of the family of ducks, geese and swans, Ne-ne lose all large wing feathers at one time and are grounded until new ones grow.) No wonder the largest and finest of Hawaiian land birds nearly vanished from the earth before restoration measures were started.

As the year's study comes to an end, some preliminary conclusions become clear:

1. No longer does the Ne-ne nest at low elevations. What land is unsuitable for sugar-cane is now in close-cropped pasture or grown up in a tangle of exotic shrubs and vines. But there is little evidence that these lower altitudes were ever abundantly used for nesting.

2. At altitudes now frequented by Ne-ne, 5000 to 8000 feet, there is no evidence of food shortage at any season. Grasses and other greens, making up most of their diet, are never scarce in this zone of nearly daily rain and fog-drip, and frosts are very infrequent.

3. This moisture on all vegetation precludes the possibility of any shortage in drinking water. Despite the fact that copulation among captives has frequently been observed on land, Ne-ne do seek ponds and water-tanks at the onset of the breeding season—perhaps they prefer to perform the precopulatory display in the water.

4. Mongooses and dogs are probably the most significant predators, but the innate tameness and curiosity of the Ne-ne make them extremely vulnerable to poaching and very dubious as a game or sporting species.

It is a universal human weakness that we fail to cherish a thing of beauty until it is taken from us. Many a lovely flower is nurtured with greatest care far from its normal habitat, yet ignored at home merely because it is common. Thus few men thought about the Ne-ne or its future while thousands still roamed the slopes in Kau, Kona and Kohala. But today every effort is being made to rescue this native Hawaiian species from the brink of eternity.

In the past year many important administrative steps have been taken by the Board of Forestry and Agriculture. As soon as our findings were made available, the summering grounds of the birds were closed to all hunters for six months of each year. A co-operative agreement has been made with C. Brewer and Co., lessees of the ranch known as Keauhou. The upper end of this ranch contains the nesting area, where we found the six pairs that bred last year in the wild. This nesting area is to be posted, patrolled and the predators poisoned. And at the last meeting of the Territorial Legislature, the Ne-ne was declared the official bird of the islands. Thus the people of Hawaii have voluntarily taken on a new obligation for its perpetuation.

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