

Technical Report No. 73

**THE USE OF SHEEP WOOL
IN NEST CONSTRUCTION BY HAWAIIAN BIRDS**

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ABSTRACT

The utilization of sheep wool as a nesting material was examined from 1969 through 1975 on the island of Hawaii. **Of** the 10 bird species studied, **six** incorporated wool into their nests. Both introduced and endemic birds use wool, with a significantly greater usage by endemic birds.

Use of wool in nest construction appears correlated with the intricacy **of** the nest that a species builds, with a significant difference between degree of usage in complex and simple nests. Roughly built nests, like those of the Cardinal (Cardinalis cardinalis), contained no wool whereas the complex nest of the Elepaio (Chasiempis sandwichensis) had a great deal of wool. Wool is apparently used by the birds because it is a readily available material in certain areas, and because of its binding quality. The wool is gathered from tufts that snag on branches as the sheep pass or from dried skins on the ground. The amount **of** wool utilized in each nest varies both interspecifically and intraspecifically, but in all nests only the body of the nest contained wool, the lining always being **of** other materials.

A separate study was conducted to determine if wool is used only when available nearby or **is** a sought-after material. Only the Elepaio was found to consistently travel distances to procure wool, whereas the other species studied used **it** only when available within their territories,

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INTRODUCTION

Sheep were first introduced to the Hawaiian Islands by Captain James Colnett in April of 1791, when he left a ewe and ram on Kauai (Wyllie 1850). Captain Vancouver (1798) was responsible for introducing sheep to the island of Hawaii. On 14 February 1793 he landed a ram, two ewes, and a ewe lamb at Kawaihae, Hawaii, and then proceeded to Kealahou Bay where he landed another ram and two ewes. There is little record of the dispersion of sheep over Hawaii; however, Judd (1936) stated that the Reverend Goodrich saw eight or 10 dead sheep near the summit of Mauna Kea in 1822. This suggests that feral sheep had become established on Mauna Kea within 29 years of their introduction to the island. Bishop (1852) estimated that 3,000 wild sheep were roaming the island by 1851. Today sheep are distributed over the island of Hawaii in the higher more arid regions, with the herd on Mauna Kea estimated at 1,800 (Fig. 1).

While working in the forests of Hawaii I have noticed that, in areas of feral sheep habitation, many bird nests contain sheep wool, whereas in regions where sheep are absent this material is lacking in the nests. On the continental United States many authors (e.g. Bent 1968, Bailey 1928) cite the use of sheep wool by birds for nesting material, but I can find no reference to this in Hawaiian literature.

METHODS

To compare the extent to which wool was used by different species, I collected nests from 1969 through 1975 on the island of Hawaii and recorded the amount of wool in each. The density of sheep in each locality was also noted. The greatest number of nests was collected on the southwestern slope of Mauna Kea, where many of the feral sheep on Hawaii reside.

To ascertain if sheep wool is a sought-after nesting material, a study was initiated in 1970 at Puu Laau, on the southwestern slope of Mauna Kea. Nests were examined from two adjacent areas: one with sheep present and the other with them absent. In 1950 the Hawaii State Division of Fish and Game constructed a 300-acre holding pen for Mouflon sheep at approximately 7,500 feet elevation. In 1967 all sheep were removed from the pen, and it has since acted as an enclosure. There is no wool available to birds that nest within the enclosure; if wool is used in constructing nests, the birds must fly outside the fenced area

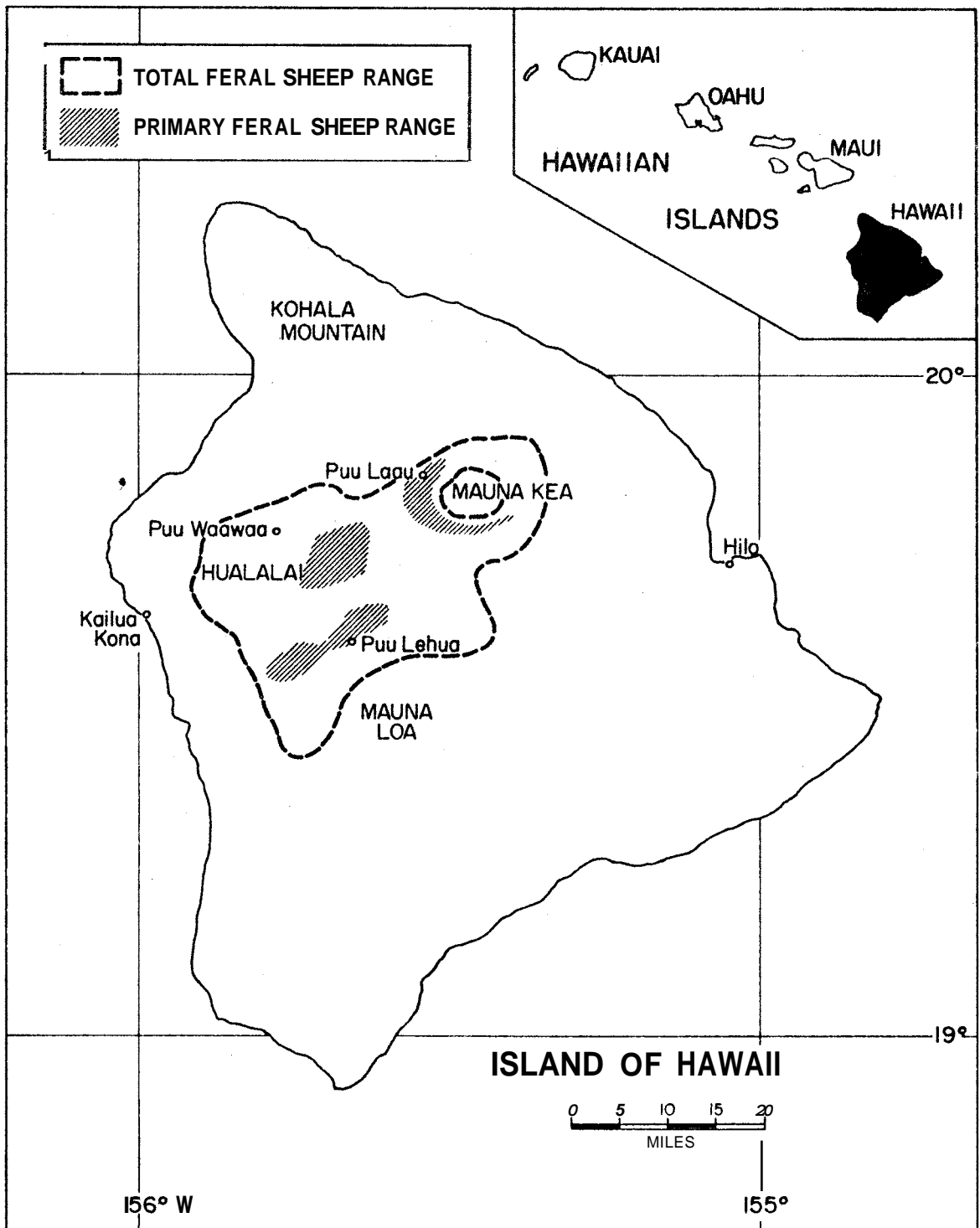


FIG. 1. A map of feral sheep distribution on the island of Hawaii.

to collect it.

RESULTS

Four of the 10 species of birds studied on Hawaii were not found to incorporate sheep wool in nest construction when it was available (Table 1). The Skylark (Alauda arvensis) is a ground-nesting bird, digging a shallow depression and lining it with grasses; therefore, this species has little use for wool as a nest material. The Melodious Laughing-thrush (Garrulax canorus), Ricebird (Lonchura punctulata), and Cardinal (Cardinalis cardinalis) all build nests of coarse grasses or twigs and were found not to utilize sheep wool.

The Red-billed Leiothrix (Leiothrix lutea), Japanese White-eye (Zosterops japonica), and House Finch (Carpodacus mexicanus) infrequently use wool in nest construction. The Japanese White-eye is not a common resident of the high altitude dry forests of Hawaii; therefore, I found very few nests. Guest (1974) noted the adaptability of this bird and the numerous types of nesting material it employed. The Red-billed Leiothrix builds a semipendant nest usually woven around two branches, with large leaves or bark strips used to form the bowl. None of the nests I found on Mauna Kea contained wool, but one nest in the Puu Lehua area of Mauna Loa did have wool incorporated between the large koa (Acacia koa) leaves forming the body. Of the 95 House Finch nests I have found, only three contained wool. The lack of sheep wool in House Finch nests on Mauna Kea has been discussed by van Riper (in press).

I found three species that use wool extensively in nest construction. The Palila (Psittirostra bailleui), an endangered species found only on Mauna Kea, had wool in 22.2 percent of its nests. The Amakihi (Loxops virens), one of the two most abundant endemic birds, incorporated wool into 33.3 percent of its nests. The Elepaio (Chasiempis sandwichensis) showed the greatest usage, employing wool in 60.9 percent of its nests.

The use of wool in nest building varied within species, depending on whether nests were located inside or outside the sheep enclosure at Puu Laau (Table 2). Wool was not present in any Melodious Laughing-thrush, Red-billed Leiothrix, Skylark, Ricebird, or Cardinal nest. Light usage was found in the House Finch and heavy usage again occurred in the Palila, Amakihi, and Elepaio. There was a significant difference in the utilization of wool by endemic birds inside and outside the enclosure ($\chi^2_c = 7.92$, d.f. = 1, $p = < 0.01$), but introduced birds

TABLE 1. The amount of sheep wool used in nest construction where sheep were present and absent on the island of Hawaii.

SPECIES	NESTS BUILT WHERE SHEEP WERE PRESENT			NESTS BUILT WHERE SHEEP WERE ABSENT		
	without wool	with wool	percent with wool	without wool	with wool	percent with wool
<u>Alauda arvensis</u>	13	0	0	12	0	0
<u>Garrulax canorus</u>	6	0	0	7	0	0
<u>Leiothrix lutea</u>	8	1	11.1	11	0	0
<u>Zosterops japonica</u>	4	1	20.0	35	0	0
<u>Carpodacus mexicanus</u>	46	3	6.0	46	0	0
<u>Lonchura punctulata</u>	16	0	0	17	0	0
<u>Cardinalis cardinalis</u>	2	0	0	10	0	0
<u>Chasiempis sandwichensis</u>	11	31	73.6	14	8	36.4
<u>Loxops virens</u>	48	60	55.5	96	12	11.1
<u>Psittirostra bailleui</u>	10	8	44.4	18	0	0

TABLE 2. Comparison of **wool** incorporation into nests from inside and outside an enclosure at Puu Laau, Hawaii.

Species	Number inside	Number with wool	Percent with wool	Number outside	Number with wool	Percent with wool
<u>Alauda arvensis</u>	2	0	--	8	0	--
<u>Garrulax canorus</u>	4	0	--	5	0	--
<u>Leiothrix lutea</u>	10	0	--	6	0	--
<u>Carpodacus mexicanus</u>	18	0	--	20	2	10
<u>Lonchura punctulata</u>	4	0	--	15	0	--
<u>Cardinalis cardinalis</u>	1	0	--	4	0	--
<u>Chasiempis sandwichensis</u>	11	9	82	8	6	75
<u>Loxops virens</u>	33	4	12	26	10	38
<u>Psittirostra bailleui</u>	18	0	--	18	8	44

showed no difference inside and out ($\chi^2_c = 0.18$, d.f. = 1, $p = > 0.50$).

Sheep wool appears to be a sought-after nesting material in two species, as both the Amakihi and Elepaio will travel outside their territories to procure wool for construction. Of the 33 Amakihi nests found in the 300-acre pen, four (12%) contained wool from the outside. Wool is a preferred nesting material for the Elepaio as 82 percent of the nests I found within the fenced area contained wool. One nest near the center of the enclosure had a large amount of wool, meaning that the bird had to fly at least one-quarter mile to obtain this material.

DISCUSSION

The use of wool in nest construction by birds in Hawaii appears to be determined by how intricate a nest they build (Table 3). There were significant differences in the use of wool among those birds that build intricate nests and the four species that build simple nests of only woven grasses or twigs ($\chi^2_c = 26.91$, d.f. = 1, $p < .001$). The four species that do not utilize wool all build rather simple nests, whereas those birds that exhibit some use of sheep wool all build a slightly more complex structure. The simple semipendant nest of the Red-billed Leiothrix is an example in which large leaves or peeled bark are used to hold the nest together so that there is apparently little need for the binding quality of wool.

Since sheep are such a recent addition to Hawaii, it is interesting to find the three species utilizing wool to the greatest extent are all native. Endemic species use sheep wool with much greater frequency than do exotic species, and there are significant differences in utilization: in the presence ($\chi^2_c = 73.38$, d.f. = 1, $p < .001$) and absence ($\chi^2_c = 15.23$, d.f. = 1, $p < .001$) of sheep. The Amakihi and Palila both use approximately the same percentage of wool, and both build statant nests, with the outside composed of smaller woven grasses and a separate cup of fine rootlets or lichen (see Berger 1972). Of all the species examined, the Elepaio builds the most complex nest and also exhibits the greatest preference for wool. Conant (1975) found that the Elepaio uses large amounts of spider web to hold the nest together. When wool is available the Elepaio apparently uses this more and spider web less.

There appear to be two main reasons that birds select wool as a nesting material. First, in many areas wool is a readily available commodity. In areas

TABLE 3. The date of introduction of bird species to Hawaii and the type of nest they build.

Species	Date introduced*	Type of nest construction
<u>Alauda arvensis</u>	1865-1870	Simple
<u>Garrulax canorus</u>	1900-1918	Simple - coarse grasses
<u>Leiothrix lutea</u>	1918-1929	Complex
Zosterops japonica	1929	Complex - intricate
<u>Carpodacus mexicanus</u>	1870	Complex
<u>Lonchura punctulata</u>	1865	Simple - coarse grasses
<u>Cardinalis cardinalis</u>	1929-1931	Simple - coarse grasses
<u>Chasiempis sandwichensis</u>	Endemic	Complex - intricate
<u>Loxops virens</u>	Endemic	Complex
<u>Psittirostra bailleui</u>	Endemic	Complex

that have been heavily grazed, such as tree line on Mauna Kea, I find that a greater percentage of nests contain wool than in areas where ground cover **is** available. Secondly, the lightness and binding quality of wool makes **it** an easily manipulated nesting material.

The wool that **is** used in nest construction **is** gathered from two different sources. **As** the sheep move through the vegetation their wool catches on dried branches, **is** pulled off in tufts, and birds collect what remains hanging. A second source **is** dried skins, either left by hunters or from dead animals. **An example** of this usage occurred during April 1974 when **I** observed a male Elepaio frequenting a sheep head **I** had placed in a wire fence. The bird would first search for insects, then pick wool from the head and carry **it** off to the nest site.

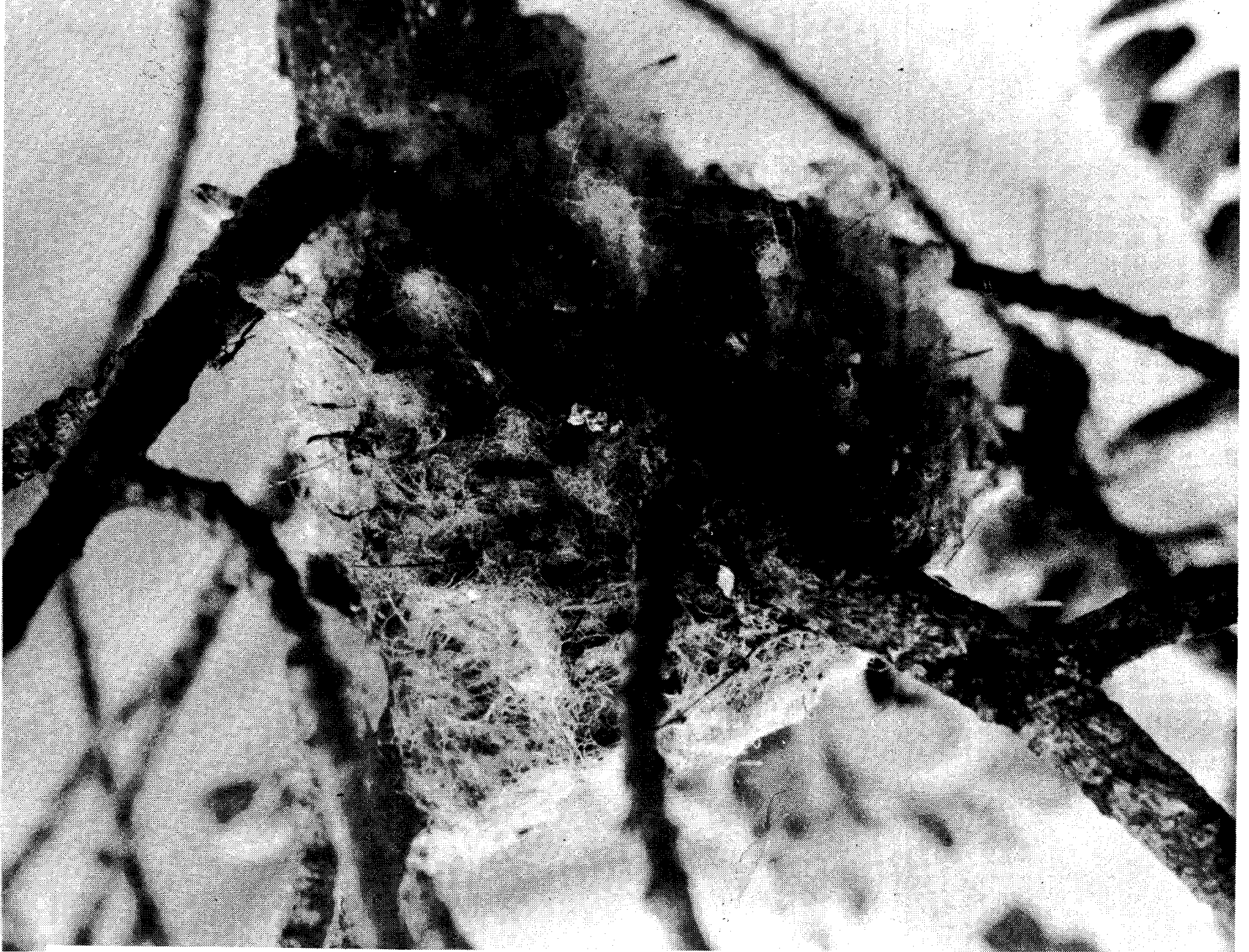
The amount of wool a species uses in nest construction varies from only a small piece, as in the House Finch (van Riper 1975), to almost the whole nest constructed of wool, as in the Elepaio (Fig. 2). Wool **is** used only in the body of the nest; **I** have never found wool in the lining. The tufts are placed into the exterior and, except by the Elepaio, are not spread or woven around other materials.

If wool **is** immediately available, some birds will use **it**, but only the Elepaio and Amakihi will fly any distance for **it**. Pettingill (1971) found that the Tree Swallow (Tridoprocne bicolor) may sometimes fly several miles to a chicken farm to obtain the much-preferred white feathers. Almost all of the Elepaio nests within the experimental enclosure contained wool, meaning that these birds had to fly some distance to find this material.

Although 12 percent of the Amakihi nests inside the enclosure contained wool, this species will not usually fly great distances to obtain this material. **In** 1970 on Hualalai, where sheep were present, every nest (12) **I** found contained wool. Only one-half mile away, in a pasture that excluded sheep, not a single nest had wool. On Mauna Kea in 1974, a color-banded pair **of** Amakihi had no wool **in** their first nest, but their second nest had a considerable amount (they had **renested** 300 feet away above an old sheep **skin**).

It is interesting to note that within the last 150 years the native bird species of Hawaii have adapted to the use of sheep wool as a nesting material. On the other hand, the newly introduced exotic species have not yet adjusted to incorporating this material into nest construction (see Table 3). Although

FIG. 2. An Elepato (*Chasiempis sandwichensis*) nest containing sheep wool from Puu Laau, Hawaii.



utilized in areas of Hawaii, it is apparent that to most bird species wool is not a sought-after nesting material.

SUMMARY

From 1969 through 1975 use of sheep wool in nest construction was examined on Hawaii. Both introduced and endemic birds use wool, with greater usage by endemic birds. Use of wool is determined by how intricate a nest that species builds, with a difference in usage between complex and simple nests. Roughly built nests contained no wool whereas complex ones had a lot.

Of the 10 bird species studied, six were found to use wool. Wool is apparently utilized by birds because it is readily available and because of its binding quality. Only the body of the nest contains wool. The amount of wool used by a species varied with each nest.

A study comparing an area void of sheep and an adjacent one containing sheep was conducted to determine if wool is a sought-after material. Only the Elepaio was found to consistently travel distances to procure wool, whereas the other species studied used it only when available within their territories.

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