From our findings it is apparent that among Mountain Chickadees an important principle of intraflock integration is the peck-right system. Unlike the situation in Steller's Jays (Brown, Condor 65:460, 1964) and perhaps in other birds (Marler and Hamilton, Mechanisms of animal behavior. Wiley, New York. 1966. p. 173), site-related dominance does not seem to be a factor operating at the intraflock level, but is important between flocks.

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PRESERVATION OF MAUI'S ENDANGERED FOREST BIRDS

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Of 56 perching birds (suborder Passeres) found exclusively in the Hawaiian Islands, 10 are known from Maui (Amadon 1950). However, since the Oo (*Moho* sp.) disappeared on Maui before a specimen was collected, only nine have been specifically described. Information on population status of Maui's native forest birds is summarized in table 1 (Banko 1967, 1968).

While definitive data on population size and range of Maui's native forest birds do not exist, none of Maui's historically rare birds (Oo, Akepa, Crested Honeycreeper, Nukupuu, Parrotbill, Ou) have been observed outside Haleakala's windward slopes. Populations of the latter four species are judged by US Department of Interior (1968) and International Union for Conservation of Nature (1968) to be in danger of extinction.

The Crested Honeycreeper has been seen a number of times in recent years at high elevations on windward slopes of Haleakala (Richards and Baldwin 1953; Kridler 1966; Banko 1968; Vogl, pers. comm.). This interesting bird apparently disappeared on Molokai, its only other range, sometime after 1907 when it was last reported. Maui Nukupuu was rediscovered and Parrotbill was reported for the second time this century from Kipahulu Valley, windward Haleakala (Banko 1968). The Ou has not been recorded from Maui since 1901 and may not now occur there. In addition to these four endangered birds, the Maui Akepa has been reported only once this century, in 1950 (Richards and Baldwin, op. cit.). The Maui Akepa should therefore be considered endangered if, in fact, a population still exists.

It is thus apparent that except for the Alakai Swamp area of Kauai, whose wilderness characteristics are protected by state law, no other Hawaiian forest of

TABLE 1. Checklist of Maui's native perching birds.

Species or race	Conservation status	Provisional status	Reported on Haleakala
Historically resident on Maui and other islands			
Hawaiian Amakihi	unlisted	abundant	1967
Loxops virens wilsoni	USDI[a]		
(Rothschild)	IUCN[b]		
Ou	endangered	possibly	1901
Psittirostra psittacea	USDI	extinct	
(Gmelin)	IUCN		
Apapane	unlisted	abundant	1967
Himatione sanguinea sanguinea	USDI		
(Gmelin)	IUCN		
Crested Honeycreeper	endangered	endangered	1969
Palmeria dolei	USDI		
(Wilson)	IUCN		
Iiwi	unlisted	common	1967
Vestiaria coccinea	USDI		
(Forster)	IUCN		
Exclusively resident on Maui			
Maui Creeper	unlisted, USDI	undetermined	1969
Loxops maculata newtoni	endangered, IUCN		
(Rothschild)			
Maui Akepa	unlisted	endangered	1950
Loxops coccinea ochracea	USDI		
Rothschild	IUCN		
Maui Nukupuu	endangered	endangered	1967
Hemignathus lucidus affinus	USDI		
Rothschild	IUCN		
Maui Parrotbill	endangered	endangered	1967
Pseudonestor xanthophrys	USDI		
Rothschild	IUCN		

[a] US Department of the Interior.
[b] International Union for Conservation of Nature.

comparable size supports as many endangered species of birds as the northeast slopes of Haleakala.

Hawaiian birds have had an especially fateful history of decline and extinction due to environmental changes wrought by civilized man. Preservation of the ecological integrity of Haleakala's windward forests is thus of paramount importance to the survival of at least three, and possibly as many as six, Hawaiian birds.

LITERATURE CITED

AMADON, D. 1950. The Hawaiian honeycreepers (Aves, Drepaniidae). Bull. Amer. Mus. Nat. Hist. 95:151–262.

BANKO, W. E. 1967. Hawaii's endangered birds—a status appraisal. Proc. 47th Ann. Conf. West. Assoc. St. Game Fish Comm. p. 247–261.

BANKO, W. E. 1968. Rediscovery of Maui Nukupuu, *Hemignathus lucidus affinis*, and sighting of Maui Parrotbill, *Pseudonestor xanthophrys*, Kipahulu Valley, Maui, Hawaii. Condor 70:265–266.

INTERNATIONAL UNION FOR CONSERVATION OF NATURE AND NATURAL RESOURCES. 1969. Red Data Book 2. Aves. Morges, Switzerland.

KRIDLER, E. 1966. A recent record of the Crested Honeycreeper on Maui, Hawaii. Elepaio 26(10): 88.

RICHARDS, L. P., AND P. H. BALDWIN. 1953. Recent records of some Hawaiian honeycreepers. Condor 55:221–222.

US DEPARTMENT OF THE INTERIOR. 1968. Rare and endangered fish and wildlife of the United States. Govt. Printing Office, Washington, D. C.

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PLUMAGE COLOR AND ENERGETICS

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In the past two years it has been suggested that black plumage coloration in birds is selected for because of the decreased energy requirements of these birds due to increased absorption of solar radiation (Hamilton and Heppner 1967a; Heppner 1970). Heppner (1970) states that "it may be that the energy advantages offered by blackness have resulted in a selection for black coloration, rather than grayish or brownish coloration, in those birds that live in climatic conditions where black might be metabolically useful."

In some of my own work (Lustick 1969) with the black male cowbird (*Molothrus ater obscurus*), the brown female cowbird, the gray wild-type Zebra Finch (*Poephila castanotis*), and the albino Zebra Finch, it was observed that there were only small differences in the reflectance curves from the dorsal surfaces of the black, brown and gray birds when compared with differences between black and white and black and yellow birds (see tables 1 and 2). Related to these small differences in reflectances was the fact that there was no significant difference in energy conservation between black, brown, or gray birds receiving artificial insolation at an air temperature of 10°C (table 3), a temperature well below the lower critical temperature for cowbirds (35°C, Lustick 1969) and for Zebra Finches (36°C, Cade et al. 1965).

The size difference between black cowbirds and gray Zebra Finches (36 g and 12 g, respectively) might allow the Zebra Finch to use insolation more effectively (the smaller bird would have a larger surface area to volume ratio) even though the finch is lighter in coloration. However, there are only slight differences in size between the male and female cowbirds (about 3 g) and energy conservation was similar in these birds when receiving insolation.

Thus, it is possible that black has not been selected over brown or gray because black is a more suitable color for metabolic use, any dark pigmentation being equally advantageous to thermoregulation. As pointed out by Hamilton and Heppner (1967b), there is probably more than one selective pressure acting on plumage coloration and thermoregulation could possibly be one of them.

Since there is such a big difference between dark birds and white birds in the ability to use solar radiation to thermoregulate (table 3), it would be interesting to look at some of the intermediate plumage colors (yellow, red, tan) that have reflectances between those of the black birds and white birds (table 1) and determine if the energy conservation at low air temperature is also intermediate when these birds receive solar radiation. The correlation between climate, color, and energy conservation of these intermediate colored birds might help to answer the question of how important thermoregulation is in the selection of plumage coloration.

The differences in reflectances between the black male cowbird and the other colored birds tested (table 2) points out how important it is to know exactly what wavelength the birds are using to conserve energy. For example if the birds are using energy within the range of wavelengths of 400–700 μ (where there is the greatest difference in absorbance between black and white birds) the differences in absorbance

TABLE 1. Per cent reflectance from the dorsal surface of various colored birds.

Bird and color	Wavelength (μ) 400	500	600	700	800	900	1000	1100	1200	1300	1400
Zebra Finch (white)	62	78	86	88	84	85	86.5	87	87.5	87.5	82
Zebra Finch (gray)	7	9.5	13	15	20	29	38	48	57.5	66	70
White-crowned Sparrow[a] (brown)	6	8	10.5	13	16	29	37	46	55	62	65
Cowbird (male black)	3	3	3	3	4	10	19	30	40	49	54
Cowbird (female brown)	5	7	9	10	17	24	34	43	51	55	58
Goldfinch[b] (yellow)	9	31	39	42	49	53	58	62	68	70	70

[a] *Zonotrichia leucophrys.*
[b] *Spinus tristis jewetti.*