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.

Accepted for publication 15 June 1970.

PLUMAGE COLOR AND ENERGETICS

SHELDON LUSTICK
Academic Faculty of Zoology
The Ohio State University
Columbus, Ohio 43210

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.*

TABLE 2. Differences in per cent reflectance between the black male cowbirds and other birds tested at same wavelengths.

Bird and color	Wavelength (μ) 400	500	600	700	800	900	1000	1100	1200	1300	1400
♀ cowbird (brown)	2	4	6	7	13	14	15	13	11	6	4
White-crowned Sparrow (brown)	3	5	7.5	10	12	14	18	16	15	13	11
Zebra Finch (gray)	4	6.5	10	12	16	19	19	18	17.5	17	16
Zebra Finch (white)	59	75	83	85	80	75	67.5	50	47.5	32.5	28
Goldfinch (yellow)	6	28	36	39	45	43	39	32	28	21	16

of insolation between, say, black, brown, and gray are smaller than between the wavelengths of 800–1000 μ and one would not expect a black bird to have much, if any, advantage over a brown or gray bird. Whereas, if using the longer wavelengths 800–1000 μ, the differences in absorbance are greater (though not much) and one might expect very slight differences in their ability to use insolation in thermal regulation. Above 1100 μ, and especially above 1400 μ, differences in absorbance between various colored birds are small (Lustick 1969; Heppner 1970) and Hammel (1956) has stated that most animals, regardless of color, absorb long wave radiation as a black body. These data suggest that dark pigments (black, brown, gray) might be selected over light pigments (white, yellow) in a cold climate and not that black is selected over brown or gray pigments in a cold climate.

TABLE 3. Energy conservation of birds receiving artificial insolation over those not receiving artificial insolation at 10°C.

Bird and color	n tested	$\bar{x}$ % energy conserved
Cowbird ♂ (black)	5	25.0
Cowbird ♀ (brown)	3	24.9
Zebra Finch (gray)	4	25.1
Zebra Finch (white)	5	6.5

LITERATURE CITED

CADE, T. J., C. A. TOBIN, AND A. GOLD. 1965. Water economy and metabolism of two estrildine finches. Physiol. Zool. 38:9–33.

HAMILTON, W. J. III, AND F. H. HEPPNER. 1967a. Radiant solar energy and the function of black homeotherm pigmentation. Science 155:196–197.

HAMILTON, W. J. III, AND F. H. HEPPNER. 1967b. Black pigmentation: adaptation for concealment or heat conservation. Science 158:134.

HAMMEL, H. T. 1956. Infrared emissivities of some arctic fauna. J. Mammal. 37:375–378.

HEPPNER, F. 1970. Metabolic significance of absorption of radiant energy. Condor 72:50–59.

LUSTICK, S. 1969. Bird energetics: effects of artificial radiation. Science 163:387–390.

Accepted for publication 1 July 1970.

PELAGIC OBSERVATIONS OF THE JAPANESE WHITE-EYE IN THE CENTRAL PACIFIC

CHARLES A. ELY

Department of Biological Sciences
Fort Hays Kansas State College
Hays, Kansas 67601

During the period 1963–1965 biologists of the Pacific Ocean Biological Survey Program recorded Japanese White-eyes (*Zosterops japonica*) on several occasions at sea between Oahu and Johnston Atoll and on Johnston Atoll itself. All sightings undoubtedly are from the introduced and well established Hawaiian Islands population. The 11 pelagic sightings were made during three different periods, all in late fall and early winter. In addition, at least five different individuals were seen or collected on Johnston Atoll, four of them between mid-October and late January and a fifth in late March.

Nine of the pelagic sightings were in an area some 100 mi. in diameter and centered about 175 statute mi. SW of Kauai. Both of the remaining sightings were in early morning and followed s:ghtings of the previous day; they may represent birds which remained wtih the ship, undetected, overnight. One sighting was approximately 360 mi. SW of Kauai and about 340 mi. NE of Johnston Atoll. The second was about 310 mi. SSW of Kauai and about 410 mi. ENE of Johnston Atoll. Details of the pelagic sightings follow.

4–5 December 1963. Calling was heard at 13:55 and a flock of 42 birds appeared flying S about 200 ft above the water. At 15:45 calling was again heard and a single bird appeared flying S about 50 ft above the water. It circled the ship twice, once flying over the bow. At 07:30 next morning two birds alighted on the ship and were collected. Weather conditions were: scattered high clouds, 10 mile visibility, wind 5–10 knots from NNE to SSE.

3 November 1964. At 17:29 two birds appeared and one attempted to alight on the ship but then flew off. Weather conditions were: scattered clouds, 10 mile visibility, wind 4–10 knots from NNE to ENE.

9–10 November 1965. Calling was heard at 14:18 and two birds flew past the ship at 15:23. Calls were heard again at 07:39 next morning but no birds were seen. Members of the ship's crew reported that one might have been on board but this could not be confirmed. Weather conditions were: scattered clouds, 4–10 mile visibility, wind 4–10 knots from ENE to NE.

16 November 1965. Calling was heard at 13:55 and a flock of 15 appeared flying S or SE. One was collected. At 14:27 two birds approached about 50 ft above the water and a second was collected. Weather conditions were: partly cloudy and overcast, wind 18–25 knots from NNE.