birds is apparently the product of the culmen depth and length, as noted by Harris and Jones (1969), whereas in Newfoundland birds it is weight. Should measurements be used to discriminate between populations (subspecies) yet another variable may be important; i.e. the tarsus is the best measurement to use in separating British and Newfoundland birds.

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Individual Differences in the Head and Neck Plumage of Ruddy Turnstones (*Arenaria interpres*) During the Breeding Season

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Sexual dimorphism in the breeding plumage of Ruddy Turnstones (*Arenaria interpres*) has been described by Witherby et al. (1940) and Nettleship (1967). During the course of a survey in 1974 of the breeding populations of wading birds in Ørsted Dal, northeast Greenland (Ferns and Mudge 1976) it was observed that, in addition to sexual variation, individual Ruddy Turnstones possessed distinctly different patterns of black and white markings on the head and neck. The object of this note is to describe these individual differences and to discuss their possible significance.

Eight adults were captured either at the nest or while attending young in Ørsted Dal and several color transparencies were taken of each of these, as well as of another four adults captured on Traill Ø about 85 km farther north. Drawings were subsequently prepared from these transparencies by R. M. Bishop (Fig. 1). These birds were sexed on the basis of their plumage. Only one breeding pair is actually illustrated (band numbers 7046185 and 7046186). In the remaining cases, only one member of each pair was caught though both were observed in the field.

Distinct individual differences are evident in Fig. 1. For example, the black band that runs across the forehead between the eyes is wide in 7046185, narrow in 8160019, and incomplete in 7046186. The white bib in the region of the chin is large in 7046167, small in 7046164, and absent in 8160379. The black band across the upper mantle is wide in 8160339, broken in 7046186, and absent in 8160348. The neck has an almost complete white collar in 7046167, a partial one in 8160379, and none at all in 7046163.

These differences enabled a degree of discrimination to be made in the field when birds were seen from the back or the front, as well as from the side. Abrasion, fading, and the early onset of prebasic molt

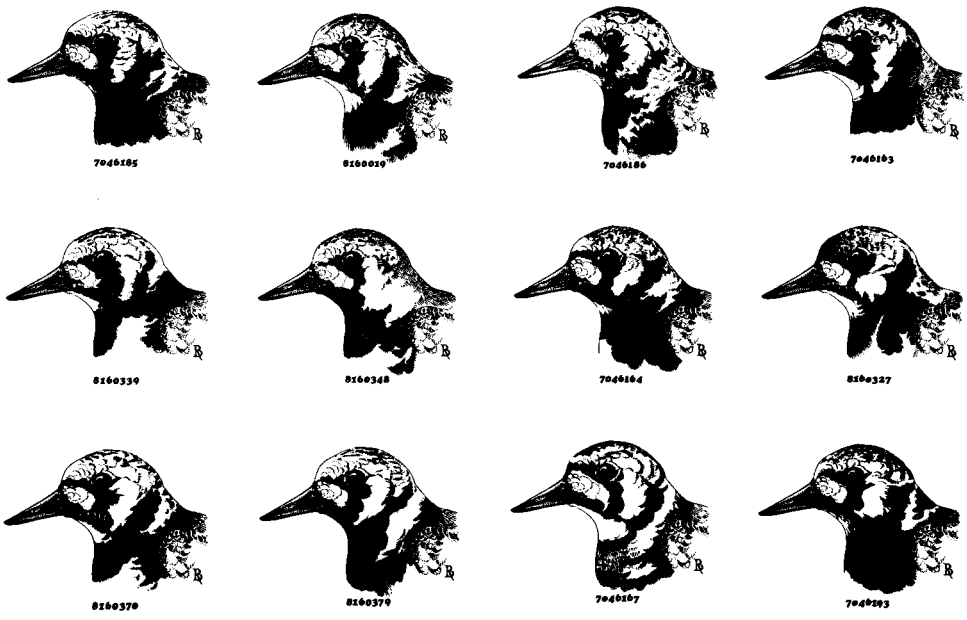

Fig. 1. Heads of individual Ruddy Turnstones. Each head is labelled with the bird's band number. The six birds to the left are males, the six on the right females.

produced some changes in the plumage of individuals toward the end of the breeding season, but these were relatively minor. In addition to the head and neck features described above, there was also considerable variation in the intensity of the red-brown coloration of the mantle, scapulars, and wing coverts. Finally, to human ears at least, some individuals uttered the "kiti-kiti-tit-tet" alarm call in a discernibly distinct fashion. Bergman (1946) considered that territory holders were capable of distinguishing intruders from their own mates by this means.

Ruddy Turnstones show a number of contrasts in behavior when compared with other shorebirds breeding in the same geographical areas. In Ørsted Dal, they breed alongside Ringed Plovers (*Charadrius hiaticula*), Red-backed Sandpipers (*Calidris alpina*), Knots (*Calidris canutus*), and Sanderlings (*Crocethia alba*). All these species have relatively uniform breeding plumage, though slight sexual differences do exist. Furthermore, they all establish and defend breeding territories by means of conspicuous aerial songs and songflights. Ruddy Turnstones have no clearly differentiated song and no directly comparable songflight. Instead, they defend territories by means of ground displays and aerial pursuits, combined with raucous alarm calls (Bergman 1946, Nettleship 1973). There is thus a considerable element of direct confrontation in territorial defense. Both members of a pair exhibit this behavior but the male plays the major role (Nettleship 1973). In this context, the variations in head and neck plumage may allow ready visual identification of neighboring individuals and thereby fulfil the same kinds of functions that auditory recognition of neighbors is believed to serve in songbirds (e.g. Falls 1969).

The preferred breeding habitat of Ruddy Turnstones in northeast Greenland is tundra heath, whilst on Ellesmere Island marshes are also occupied (Nettleship 1973). Such habitats are richly vegetated and provide favorable feeding conditions, but are only patchily distributed. As a result, Ruddy Turnstone territories are often very small and tend to occur in clusters (Parmelee et al. 1967, Nettleship 1973). Under such circumstances, direct confrontation and display may be a more efficient method of establishing and defending territories than song. Aerial songflights are perhaps better suited to the defense of a large area by a small bird. Although Ruddy Turnstone territories are small, they are used at least in part for feeding and vary in size in relation to the food supplies that they contain (Nettleship 1973).

Although Ruddy Turnstones possess sufficiently variable breeding plumage to allow human observers to distinguish between individuals, experiments are needed to prove that the birds themselves are capable of such discrimination. Bergman (1946) was able to detect differences in the landing, attacking, and copulatory responses of Ruddy Turnstones to a variety of two-dimensional models. Measurements of the relative strength of response of territory holders to lateral-view models mimicking neighboring and non-

neighboring individuals could provide a means of testing the capacity for individual recognition. It should also be possible to induce changes in the strength of response to neighboring individuals by altering their plumage with dyes.

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Overnight Weight Loss in Dark-eyed Juncos (*Junco hyemalis*)

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Because most birds confine feeding to daylight hours, energy to fuel overnight expenditures must be stored in advance (King 1972). Obviously, if a bird is unable to store energy during the day or if its rate of fat utilization is so great that stores are depleted before it is able to feed again, death may follow. The risks of overnight fasting may be greatest during winter, when nights are long, food sometimes scarce or difficult to find, and rates of energy utilization high (Chaplin 1974, Ketterson and Nolan 1976). In this connection, Calder (1974, 1975) has suggested that individuals of greater body size have greater fasting endurance because stored energy increases with size at a greater rate than does utilized energy. Fasting endurance, the ratio of stored energy to utilized energy, should therefore be greater in bigger birds. In many species, males tend to be larger than females. Ketterson and King (1977) have shown sexual differences in fasting ability among captive White-crowned Sparrows (*Zonotrichia leucophrys gambelii*) when males were heavier than females, as they typically are in the field (King and Farner 1966).

From a population of freshly-captured Dark-eyed Juncos (*Junco hyemalis*) we gathered data on body size and rate of overnight weight loss under controlled conditions. Here we relate variability in weight loss to size and sex. Among juncos, males have longer wings than females and have greater wet weight and lean body mass (Helms et al. 1967). Wet weight reflects mass but also includes contents of the gut, water content of tissues, and level of fat stores, all of which may vary with time of day and temperature (Kontogiannis 1967, Kendeigh et al. 1969, King 1974). Wing length is correlated with wet and dry fat-free weight in juncos, but in at least one population the relationship was linear only in females (Helms et al. 1967), and obviously factors other than mass may influence wing length (e.g. feather wear). Despite these deficiencies, we used wet weight (nearest 0.1 g) and wing length (nearest mm) as measures of body size because more satisfactory alternative measures of intrasexual size variation in live birds were not available.

Following Calder's model, we expected that males should be larger than females and consequently should lose more weight overnight at a faster rate, but the proportion of total body weight lost should