soil for isotopic determination. J. Chromatogr. 331: 371-381.

———, ———, & ———. 1991a. Nitrogen and carbon isotope compositions relate linearly in cormorant tissues and its diet. Isotopenpraxis 27: 166-168.

———, ———, & ———. 1991b. Linear correlation between latitude and soil ^{15}N enrichment at seabird rookeries. Naturwissenschaften 78: 34-36.

———, & E. WADA. 1985a. Combustion of organic samples by infrared furnace for carbon isotope analysis. Anal. Biochem. 146: 90-95.

———, & ———. 1985b. High-performance liquid chromatographic determination of uric acid in soil. J. Chromatogr. 331: 359-369.

———, & ———. 1988. Nitrogen and carbon isotope ratios in seabird rookeries and their ecological implications. Ecology 69: 340-349.

MOORS, P. J. 1986. Decline in numbers of Rockhopper Penguins at Campbell Island. Polar Rec. 23: 69-73.

———, T. W. SPEIR, & G. L. LYON. 1988. Soil analyses and $^{13}C/^{12}C$ ratios identify sites of deserted Rockhopper Penguin colonies. Auk 105: 796-799.

PETERS, K. E., R. E. SWEENEY, & I. R. KAPLAN. 1978. Correlation of carbon and nitrogen stable isotope ratios in sedimentary organic matter. Limnol. Oceanogr. 23: 598-604.

SCHOENINGER, M. J., & M. J. DENIRO. 1984. Nitrogen and carbon isotopic composition of bone collagen from marine and terrestrial animals. Geochim. Cosmochim. Acta 48: 625-639.

———, ———, & H. TAUBER. 1983. $^{15}N/^{14}N$ ratios of bone collagen reflect marine and terrestrial components of prehistoric human diet. Science 220: 1381-1383.

WADA, E., T. KADONAGA, & S. MATSUO. 1975. ^{15}N abundance in nitrogen of naturally occurring substances and global assessment of denitrification from isotopic viewpoint. Geochem. J. 9: 139-148.

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On the Validity of *Bubo virginianus occidentalis* Stone

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Stone (1896) described the geographic variation in, and provided the first revision of, the Great Horned Owls (*Bubo virginianus*) of North America. Prior to his study, the name *subarcticus* had been used for the pale birds of the interior of the United States. Stone (in consultation with Ridgway) found the type of *subarcticus* to represent the boreal nesting population, and they considered the name to be a synonym of *Strix arcticus* Swainson, then in use for the pale subarctic nesting population. Stone (1896) then provided a key to the forms he recognized, and he introduced the name *Bubo virginianus occidentalis* for the pale birds of the Great Plains. He used for the type a pale, unsexed specimen from Mitchell County, Iowa, taken in winter of 1880 and then available in the Academy of Natural Science of Philadelphia. He did not attempt to define the range of *occidentalis*.

Almost immediately he apparently reached the conclusion that his type "proves to be intermediate between *B. virginianus* and *arcticus* and does not belong to the race which I had intended to rename; *the latter not extending that far east* [italics mine]" (Stone 1897). Using a specimen from the Watson Ranch, 18 miles southwest of San Antonio, Texas, he renamed the smaller and pale western birds *pallescens*.

In 1904 H. C. Oberholser published his classic revision of the species. The revision was uniformly accepted—with minor exceptions—and has been followed since. Oberholser gave *occidentalis* subspecific status, apparently ignoring Stone's recognition that the type was a migrant of the boreal population, although Oberholser (1904) cited Stone's 1897 paper as the source of *pallescens*. Oberholser assigned *occidentalis* a range from western Minnesota to southeastern Oregon, and south in the prairies to Kansas. In his introduction Oberholser wrote that ". . . with the exception of *occidentalis* and *wapacuthu*, all seem to be strictly nonmigratory . . . ," (Oberholser 1904) but he did not indicate which specimens of *occidentalis* he considered to be migrants.

With the characters of *occidentalis* being only size (the type is probably a female) and darkness relative to *pallescens*, I was confused as I attempted to identify pale birds from the east (New York, New Jersey, and Connecticut) and even specimens from South Dakota, and more recently as I attempted to resolve the status of *occidentalis* vs. *pallescens* in the prairie nesting populations of eastern New Mexico. An east-west range transecting the middle of North America and spanning the northern prairies and the Rocky Mountains from western Minnesota to northeastern California (AOU 1957) is improbable biogeographically. There is a series of good dark and ochraceous specimens typical of *virginianus* from Nebraska in the Denver

Museum of Natural History, and several specimens intermediate with or closer to *virginianus* from eastern Colorado. Thus I reexamined the type of *occidentalis*.

Stone (1897) was absolutely right. Unfortunately, he used a pale "western" (from Philadelphia) specimen as the type of *occidentalis*, not knowing the northern form was moderately to highly invasive. Oberholser's concepts of *occidentalis* were (I believe) based on migrants of the subarctic nesting form—or intergrades between it and the various adjacent more southerly populations as evidenced by his recognizing, at least in Colorado, a "dark phase" (p. 191). Thus, as Stone stated correctly, his *Bubo virginianus occidentalis* becomes a synonym of *Bubo virginianus subarcticus* Ridgway (see Browning and Banks 1991).

With *occidentalis* recognized as a synonym of *subarcticus*, the characters of *pallescens* vs. *subarcticus* must now be determined to delimit their ranges in the midcontinent area from Texas northward through the continuous grasslands east of the Rockies to the western and northern prairie provinces of Canada.

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LITERATURE CITED

AMERICAN ORNITHOLOGISTS' UNION. 1957. Check-list of North American birds, fifth edition. Washington, D.C., Am. Ornithol. Union.

BROWNING, M. RALPH, & R. C. BANKS. 1991. The identity of Pennant's "Wapacuthu Owl" and the subspecific name for the populations of *Bubo virginianus* from the western Hudson Bay. J. Raptor Res. 24. In press.

OBERHOLSER, H. C. 1904. A revision of the American Great Horned Owls. Proc. W. S. Natl. Mus. 27: 177–192.

STONE, W. 1896. A revision of the North American Horned Owls with description of a new subspecies. Auk 13: 153–156.

———. 1897. Proper name for the western Horned Owl of North America. Am. Nat. 31: 236.

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Egg-laying Times of American Robins

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The time of day when birds lay their eggs has generally not been well studied. Almost all reports of egg-laying times are anecdotal, with few based on more than a handful of observations (Skutch 1952, 1976; Schifferli 1979). We present observations of egg-laying times of American Robins (*Turdus migratorius*) and test the hypothesis that birds lay their eggs at times when they are normally inactive, because carrying a developing egg constrains female activity (Schifferli 1979).

Schifferli (1979) compiled the most comprehensive summary to date of egg-laying times of passerine birds and found that most species lay their eggs at dawn. However, a few species lay their eggs well after sunrise (Schifferli 1979). For example, Feare et al. (1982) found that European Starlings (*Sturnus vulgaris*) lay eggs on average about midmorning. Our first objective in this study was to document laying times of American Robins.

Little theoretical attention has been paid to the question of when birds should lay their eggs. The prevalence of egg laying around dawn may imply that the developing egg in the oviduct before laying constrains female activity (Schifferli 1979). Because females are inactive at night regardless of whether or not they have an egg in their oviduct, then laying in the morning does not interfere with normal diurnal activity. In support of this hypothesis, Schifferli (1979) showed that the capture and handling of female House Sparrows (*Passer domesticus*) in late afternoon on the day preceding egg laying did not damage oviducal eggs, whereas similar treatment in late evening caused damage. He concluded that oviducal eggs become more vulnerable to damage as they approach completion and that normal diurnal activity before egg laying would damage eggs. The weakness of this experiment is that it is not obvious that normal activity should traumatize an oviducal egg to the same extent that capturing and handling the female would. Our second objective in this study was to test the hypothesis that the activity of female American Robins is constrained when they are carrying an egg in their oviduct.

We report observations collected while studying robin reproductive biology at the Queen's University Biological Station in eastern Ontario in 1987 and 1988 (Weatherhead and McRae 1990). We found many nests before egg laying and determined the time period in which 37 eggs were laid in 19 nests. During the laying period we checked easily accessible nests repeatedly throughout the day. If a female was on the nest she was left undisturbed, and if the nest was unattended