

SPECIMENS EXAMINED

- C. cherriei*.—
COSTA RICA:
Mt. Irazú, 1 ♂ (type)¹, 1 [? ♀]¹.
COLOMBIA:
San Gil, Santander, 1 [? ♀].
C. cryptus.—
PERÚ:
Inca Mine, 1 ♂ (type).
VENEZUELA:
Mt. Auyan-tepui, 1 [? ♂];
Mt. Ptari-tepui, 1 ♀².
COSTA RICA:
San Pedro, 1 ♀.
BRITISH GUIANA:
Kaietur Falls, 1 [? ♂].
C. f. fumigatus.—
BRAZIL:
São Francisco de Paula, Rio Grande do Sul, 1 ♂.
C. f. rothschildi.—
ARGENTINA:
Tapia, Tucumán, 1 ♂ (type), 1 "♂" [? = ♀];
Tucumán, 1 ♂, 1 ♀;
Perico, Jujuy, 1 ♂;
Rosario de Lerma, Salta, 2 ♂.
C. f. rothschildi (cont.).—
BOLIVIA:
Tarija, 1 ♂¹.
C. n. niger.—
SANTO DOMINGO: 7 ♂, 2 ♀.
ST. ANDREWS IS.: 1 ♂.
JAMAICA: 1 ♀.
DOMINICA: 2 ♂, 3 ♀, 2 [?].
GUADELOUPE: 2 ♂.
ST. VINCENT: 2 ♂.
CUBA: 5 ♂, 2 ♀.
C. n. borealis.—
U. S. A.
Colorado, 2 ♀;
California, 1 ♂, 1 ♀;
Washington, 1 ♀.
CANADA:
British Columbia, 12 ♂, 5 ♀.
C. n. costaricensis.—
COSTA RICA:
San Pedro, 1 ♂, 1 ♀;
El Pozo, 1 ♂.
C. senex.—
BRAZIL:
Chapada, Matto Grosso, 1 ♀.

American Museum of Natural History
New York, N. Y.

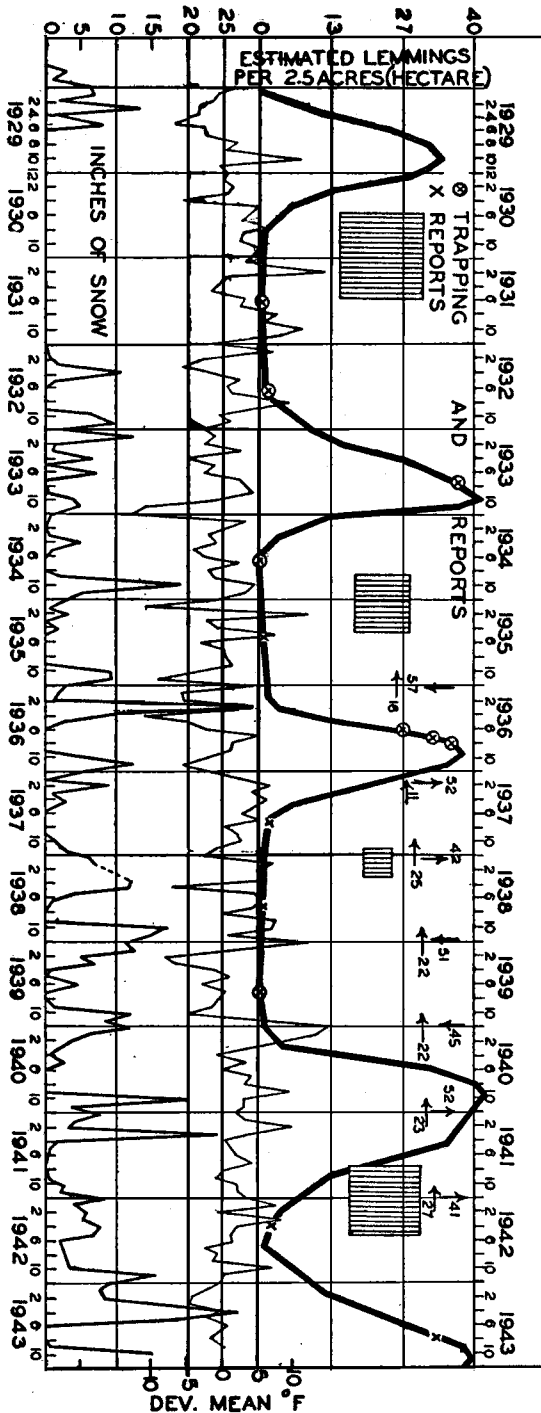
THE RELATION OF SNOWY OWL MIGRATION TO THE ABUNDANCE OF THE COLLARED LEMMING

BY V. E. SHELFORD

IN 1943 the writer published a description of the variations of the abundance of collared lemming in the Churchill area. It was found that increases in abundance were correlated with heavy snowfall in mild winters and that declines were associated with absence of snow and presences of predatory birds in the area. A colleague had expressed the view that the Snowy Owl, which is one of the important enemies of the lemmings, came south when the lemmings were abundant. This suggestion, coupled with the appearance of published reports of the large southward migration of Snowy Owls in the winter

¹ Specimens in the U. S. National Museum.

² Specimen in collection of William H. Phelps, Caracas.



DESCRIPTION OF TEXT-FIGURE 1

The heavy curve shows the relative abundance of lemmings as estimated in numbers per hectare (2.5 acres) in the Churchill area in 1929 to 1943. The diameters of the shaded squares represent the relative abundance of southward migrating Snowy Owls in New England as estimated by Dr. A. O. Gross. The arrows refer to the Snowy Owl populations as indicated by the Canadian Arctic Wild Life Enquiry (see Chitty and associates in list of references cited). Arrows pointing upward indicate increases in owl population; the percentage of returns of individual cooperators reporting increase is represented by the adjacent figures (adjacent figures indicate percentage in all cases). Arrows pointing downward indicate decreases in population. Horizontal arrows indicate no change. The center curve indicates deviations above and below normal monthly temperature in degrees F. The lowest curve indicates snowfall in inches.

of 1941-42, led to correspondence with Dr. A. O. Gross, who has kept excellent records of the appearance of Snowy Owls in New England. He was kind enough to supply data. Previously, Dr. G. M. Sutton had called attention to his published winter observations on lemmings and Snowy Owls which was overlooked. Additional lemming data for 1941, 1942 and 1943 from I. H. Smith made possible the extension of the graph of lemming abundance at Churchill. The reports of the Canadian Arctic Wild Life Enquiry are also available and this paper is an attempt to correlate the several phenomena indicated by the several reports. The writer is indebted to the gentlemen named above and also to Mr. J. Patterson of the Meteorological Division of Canada for weather data.

Sutton (Sutton and Hamilton, 1932) found lemmings abundant from the last of August, 1929 to the middle of July, 1930. He reported heavy mortality in mid-June. They were drowned out of their burrows by the spring thaw. Some were dead on the tundra, and some dead ones were floating down streams. They were preyed upon by many birds and mammals. The reports for Churchill showed that there were many in 1929, May to September, and considerably fewer in 1930 during the same period. This indicates that the decline was probably general preceding the winter of 1930-1931 (Text-fig. 1).

The Canadian Arctic Wild Life Enquiry began in 1935 and has been carried on through 1942. It made possible comparison of the different areas. There was, in some cases, a difference of one year in the time of maximum abundance between Churchill and some of the northern localities. At Chesterfield Inlet there was a large increase in rodents (all small rodents are considered together) in 1939 while lemmings were at a minimum at Churchill. In 1940 lemmings rose to a maximum at Churchill and showed continued increase at Chesterfield. This is indicative of the minor variations from point to point in the tundra. Wild Life Enquiry reports cover the trapper year, beginning in June, August, or September, depending on the time the trapper moved away from his trapping grounds to market his skins and secure supplies, and the length of his stay.

It was found in connection with the lemming study at Churchill, that while the maximum abundance of mice appeared to precede that of the lemmings, the minima of both mice and lemmings came at the same time in that area. This tendency probably prolongs the large population effects on predators and accentuates the minima. It is probably to be expected as a result of space competition during the lemming maximum.

Recent reports on the dates of the appearance of the Snowy Owls in

New York and New England have indicated that they came south following years in which there was a sharp decline in lemming population. In the discussion of lemming declines (Shelford, 1943) predation was considered the chief cause. One of the principal predators credited with reducing the number of lemmings from the large populations shown in Text-figure 1 was the Snowy Owl. The figures below were supplied by Dr. A. O. Gross.

Relative abundance of Snowy Owls in New England during winter of southward migration, 1926 to 1942.

1926-1927	10
1930-1931	6
1934-1935	4
1937-1938	2
1941-1942	5

The estimates have been given expression in Text-figure 1 by using Dr. Gross's figure as the diameter of a shaded square placed with its center on January 1.

In 1940, 1941, and 1942 there was general agreement throughout the North American tundra both as to rodent abundance and weather conditions, especially heavy snowfall and moderate temperatures. For this reason the right-hand portion of Text-figure 1 will be discussed first. A comparison of the Snowy Owl squares with the lemming curve shows that there was a large owl migration following the sharp decline in lemmings and other rodents outside the Churchill area in 1941-1942. In connection with each year the percentage of reports showing an increase or decrease of Snowy Owls (whichever was larger) is shown. In this period (1940-1942) the reports of increases and no change made up 68% to 75% of the Wild Life Enquiry reports from coöperating individuals.

Turning attention to the earlier years (1929 to 1939) when there are no records except at Churchill (1929-1935), there was some variation in different parts of the tundra as to the years in which rodents were abundant (1935-1939). However, the same general relations hold good. There was southward migration of owls following each decline in lemming population. There is also indication of a decline in owl population in the second and third years following the periods of low rodent population as indicated at Churchill. There was an October peak of lemming population followed by a decline during the following winter and spring; *e. g.*, in 1933 the decline in rodents took place in the winter of 1933-1934. The owl migration came in the winter of 1934-1935. The Wild Life Enquiry showed a decline in owl

population the following year. This series of events was essentially duplicated in 1936-1939. For the period covered by the report, a decline in owl population is suggested for one or more years following a southward migration. The difference in the size of the southward migrating Snowy Owl population is probably related to the somewhat spotty distribution of large populations of rodents which enable them to find their prey by migration from place to place within the tundra in years for which rodent declines are not quite general.

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OBSERVATIONS ON YOUNG TARSOMETATARSI OF THE
 FOSSIL TURKEY *PARAPAVO CALIFORNICUS* (MILLER)

BY HILDEGARDE HOWARD

Plate 25

THE abundance of turkeys [*Parapavo californicus* (Miller)] in the Pleistocene deposits of Rancho La Brea, California, has been frequently commented upon in previous publications, and the presence of large numbers of young turkey bones has led to the conclusion that the species must have bred in the region of the tar traps.

In the Rancho La Brea collections at the Los Angeles County Museum, the series of turkey tarsometatarsi, alone, numbers well over