



The Ohio State University

Department of Zoology

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September 5, 1978

Mr. James M. Engel  
Senior Staff Biologist  
Endangered Species  
U.S. Fish and Wildlife Service  
Federal Building, Fort Snelling  
Twin Cities, Minnesota 55111

Dear Jim:

Enclosed is a preliminary project report on our Kirtland's warbler feather analyses study. We would like to extend the contract at no cost to June, 1979. We wrote to about 40 museums and collections around the country and some were slow to respond. In some instances the response was negative, curators refused to provide us with any amount of feathers for analysis. We did receive good cooperation from a number of museums, some sent what specimens they had in the mail and others requested that we come and take the specimens under their supervision. Mr. Means has been to Chicago but we are delaying his trip to Philadelphia and New York until the Philadelphia Museum can make their specimens available. They are in the process of moving, so we will not be able to make that trip until December. We would like the final report to contain data on all the specimens available to us, so we will submit that in June. The technique looks good now that Mr. Means is able to reproduce the results from our goose feather analyses. He is busy coating stubs and mounting the warbler feathers and we will get into the analyses shortly. We are getting the SEM time free, so we have to sort of wait our turn and cannot be too pushy.

The short report attached will provide you with some information about our work thus far. We have results on some warbler feathers and they look quite interesting. We appreciate the thoughtfulness of the Recovery Team and Dr. Walkinshaw. The specimens from Ontario and Wisconsin will be especially valuable in making our comparisons. We look forward to the completion of the project by June, 1979. Thanks for your continued support.

Sincerely,

Tony J. Peterle  
Chairman  
Department of Zoology

TJP:aw

cc: Dr. T. A. Bookhout, Ohio Cooperative Wildlife Research Unit

enc: Preliminary project report

## X-ray Microanalysis of Kirtland's Warbler Feathers

The purpose of this study is to investigate the use of a scanning electron microscope (SEM) together with an X-ray microanalyzer to determine the mineral content of Kirtland's warbler feathers. The mineral concentrations are thought to reflect the environment in which the feathers were grown. Subsequent differences in mineral concentrations would then serve to determine subpopulations and possibly natal or wintering areas of a species.

When an accelerated electron beam from the SEM strikes an atom in the feather, an electron is removed from the innermost (K) shell of the atom. When this occurs, a hole is created that is immediately filled by an electron from an outer (L or M) shell. When this electron moves, it releases a discrete amount of energy in the form of X-ray radiation. Each element produces a characteristic X-ray radiation that can be detected and quantified, giving relative concentrations of the elements in the feathers.

Preliminary data was collected on the scanning electron microscope with an acceleration voltage of 20 KV and an X-ray take-off angle of 30 degrees. Increased activation of the elements and the subsequent increase in the sensitivity of detection of elements was accomplished by increasing the acceleration voltage to 30 KV and changing the take-off angle to 35 degrees. Reproducible results were also obtained by this change as shown by the results of three scans of a Canada goose feather (Table 1). The feathers

are scanned for 400 sec to reduce residual error and to obtain statistically accurate results. The total time necessary for the analysis of one feather, including computer analysis, is about 20 min.

The aluminum stubs the feathers are mounted on for analysis are coated with a carbon compound called DAG. Carbon is not detected by the X-ray microanalyzer and it is used to block possible contamination from the stub. DAG is also used to make the feathers adhere to the stubs. We found it necessary to double coat the stubs with DAG to eliminate all of the aluminum contamination from the stub.

Six feathers have been received from live-trapped birds in Michigan, Ontario, and Wisconsin. Forty feather samples have been collected from museum specimens at Cornell University, Florida State University, The Field Museum of Natural History, the University of Kansas, and The Ohio State University. We anticipate collecting at least 12 more feather samples from the American Museum of Natural History and the Academy of Natural Sciences.

We are in the process of completing the first scan of the secondary feathers we collected. Once this is complete, analysis of body feathers will begin. All of the feathers will be scanned three times to assure consistent data collection. The mineral concentrations in the secondaries should give us an indication of where the birds spent the summer. Analysis of the body feathers should indicate where the birds spent the summer or winter, depending on when and where the birds were collected.

Table 1. Ratios of selected elements in the primary of a juvenile Canada goose as determined by X-ray microanalysis.

Elemental ratios	<u>Trial Number</u>		
	1	2	3
S/Al	30.54	27.31	30.74
S/Ca	5.67	5.55	5.97
Ca/Al	5.38	4.92	5.15
Al/Cu	1.59	3.07	1.87
Al/Mg	2.84	1.64	1.31