

Usefulness of Genetic Marker Studies to Resource Managers

The use of genetic studies to differentiate populations of a species is fairly new. The first extensive raptor genetic studies using bald eagles were conducted by Dr. Don Morizot, University of Texas Science Center. They successfully documented a pattern of small genetic difference among two widespread populations, Alaska and Arizona. Dr. Morizot decided to attempt similar research using the peregrine falcon (*Falco peregrinus tundrius*).

Padre Island was selected as a study site. Peregrines reach Padre Island by two flyways, one group from Greenland and the other from Arctic Alaska and Canada. The nesting area from which migrating falcons converge is expansive. Peregrines from the following areas have been captured at Padre Island:

Alaska – Western drainage of the Kuskokwin River, Western lower and upper Yukon River, Tanana River, Colville River.

Canada – Northern Northwest Territory. Ungava Bay, Alberta.

Greenland – Near Sondrestrom, Western coastal Greenland.

Capturing efforts are concentrated during spring and fall migrations. After receiving an approved Collecting Permit, in addition to the permit required by the U.S. Fish and Wildlife Service to work with a threatened species, researchers set up camp and begin trapping birds. One blood sample is withdrawn from the brachial vein of each bird. Two cubic centimeters are collected, centrifuged with buffers extracting blood proteins and frozen for later analysis.

Approximately 60 blood protein products are surveyed using electrophoresis. Vertical starch gel electrophoresis using an electrical charge in a gel medium orients the blood proteins in thin, vertical lines. Chromosomes can be differentiated. Loci, (positions on a chromosome of a particular gene or allele,) are identified. Alleles, (a group of genes that occurs alternately at a given locus), are compared.

Since raptors contain from 10,000-100,000 genes, identification of the few genes or alleles that are different between populations is necessary. Geographic differ-



Peregrine falcon band number is recorded.

entiation is identified from three genetic alleles or markers by introducing three different enzymes to the blood plasma during electrophoresis: lactate dehydrogenase-1 (LDH1), mannosephosphate isomerase (MPI) and nucleoside phosphorylase (NP). The genetic markers are identified with the enzymes.

Data to date indicate that the MPI allele has been observed only in peregrines from Colville River, Alaska, and in Padre Island migrants at very low frequencies. Therefore the usefulness of MPI as a genetic marker has been minimal.

The NP locus has four alleles identified with it. It differentiates European, North and South American and Australian populations.

Natal origin of Padre Island peregrine migrants from two different methods:

Genetic marker

	Band Recovery ¹	LDH1 Allele ²	NP Allele ²
Alaska	58%	70%	—
Greenland	10%	—	21%

¹Yates et.al.

²Morizot, 1985.



Researcher Tom Maechtle attaching band on a restrained, hooded peregrine falcon at Mudflats, Padre Island.

The LDH1 allele has been observed only in Alaskan birds. There are appreciable levels of this allele in the Padre Island population which presumably reflects a substantial proportion of Alaskan birds in the migrant flock utilizing this staging area. Band recovery data confirm the genetic data.

Discrepancies in the percentages of birds at Padre Island can be explained: 1. unsampled Greenland populations may have substantially higher NP frequencies, 2. the NP allele occurs at appreciable frequencies in unsampled North American populations, or 3. the Padre Island samples may have been taken in years with unusually large proportions of Greenland migrants.

From worldwide samples, common alleles at most, if not all, loci in peregrine falcons occur worldwide. This implies either a recent evolutionary origin of peregrine populations or extensive gene flow presently or in the recent past.

By trapping and taking blood samples from migratory species, changes in their environment can be detected. Animals high on the food chain such as raptors bioaccumulate toxins to levels that are easily measured. A small amount of blood can detect low levels of pesticides, heavy metals or other toxins. If it is not possible to collect and analyze a large number of grab samples of water, soil or vegetation, collection of a single blood sample from several resident raptors may identify an environmental problem area.

The use of techniques from other disciplines can be of valuable assistance to parks. Blood electrophoresis and genetic markers already are used to differentiate populations of peregrine falcons and could be of considerable use for avoiding inbreeding in captive breeding programs, in identifying natal origins of other migratory populations, in determining paternity and maternity and possibly in identifying and delineating endemic populations.

Bibliography

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The elation felt by the Crater Lake NP staff following successful hatching of three peregrine falcon chicks was dashed on May 3, when the adult female and her three chicks disappeared during the night.

A thorough investigation by NPS Natural Resource Specialist Jim Milestone and the U/Cal Predatory Bird Research Group representative Brent Hetzler turned up no information. Since no evidence of human disturbance was found, it is presumed the birds were lost to a natural predator.



Wings of the peregrine falcon are gently wrapped to prevent harming the bird.