Genetics/Genomics Research in the Central Region

Genetics-based research within the Biological Resources Discipline (BRD) Science Centers in the Central Region incorporates many aspects of the field of genetics. Research activities range from documenting patterns of genetic variation in order to investigate relationships among species, populations and individuals to investigating the structure, function and expression of genes and their response to environmental stressors. Research in the broad area of genetics requires multidisciplinary expertise and specialized equipment and instrumentation. Brief summaries of the capabilities of the five BRD Centers are given below.

Fort Collins Science Center

Research: Genetics research at the Fort Collins Science Center (FORT) addresses various aspects of species management. These include the investigation of population structure and viability, the documentation of genetic variability and distribution, the investigation of mating systems using maternity and paternity analysis, and estimating population size and survival rates using DNA as an individual marker. Expertise exists to work with both ancient DNA and small quantity DNA samples collected non-invasively. Center studies have involved numerous threatened, endangered, and at-risk species such as Gunnison sage-grouse, greater sage-grouse, Indiana bat, trumpeter swan, mountain plover, lesser prairie chicken, spring snails, rock cinquefoil, midget-faded rattlesnake, and wood frog.

Facilities: The FORT maintains a partnership with the University of Denver where the Rocky Mountain Center for Conservation Genetics and Systematics is housed. The laboratory is fully equipped with state-of-the-art instrumentation for genetic analyses: Polymerase Chain Reaction (PCR), fragment analysis, sequencing, gel electrophoresis, digital photo documentation, and full capability for sample storage and processing.

Scientist isolating DNA samples -(USGS Sage Grouse Project: Fort Collins Science Center).

Grizzly bear (Montana - USGS Greater Glacier Grizzly Bear DNA Project: Northern Rocky Mountain Science Center).

Northern Rocky Mountain Science Center

Research: Conservation genetics research in the Northern Rocky Mountain Science Center (NRMSC) addresses issues related to the conservation and management of wildlife species. Genetic techniques are being used to assess the population structure of grizzly bears in the Northern Continental Divide ecosystem and the genetic variability of the population. Genetic techniques are being used in studies involving grizzly bears in the Greater Yellowstone area to determine the role of Yellowstone Lake cutthroat trout in the diet of bears. Conservation questions regarding the structure of bighorn sheep populations within Glacier National Park are being addressed by demographic studies and genetics research. Additional work includes the genetic differentiation of interior bison herds throughout the Greater Yellowstone area and an analysis of black bear foraging habits within Teton National Park.

Facilities: The NRMSC does not have a genetics laboratory. Genetic analyses are conducted with a variety of University collaborators and private laboratories.

Purple loosestrife (Invasive Species Project: National Wetlands Research Center).

National Wetlands Research Center

Research: Genetics research at the National Wetlands Research Center (NWRC) involves both plants and animals, but has a primary emphasis on the ecological genetics of plants, with significant applications to wetlands restoration and the impacts of invasive species. Studies include factors affecting ecological success and long-term viability of populations occupying restored marsh habitats, seagrass habitat restoration, brown marsh restoration, and providing critical information on the sustainability of restoration strategies. Genetic studies on invasive species focus on hybridization and how it influences spread and invasiveness, targeting purple loosestrife, reeds and cattails. Genetic tools are used to estimate nutria populations, study red mangroves as indicators of pollution, determine genome size of several sturgeon species, and to examine ploidy of invasive Asian carp species. Conservation genetics has been applied to endangered plants in the Rio Grande corridor and shrimp in the Gulf of Mexico. The Center is merging genetics with GIS capability to develop landscape scale genetics information.

Facilities: The NWRC utilizes state-of-the-art molecular technology in a fully modern PCR-based genetics laboratory with high sample-throughput DNA sequencing and flow cytometry. NWRC geneticists are skilled in the use of many of the latest PCR-based techniques and are engaged in the development of novel PCR primers, with the appropriate facilities and equipment for conducting molecular cloning activities.

Columbia Environmental Research Center

Research: The Columbia Environmental Research Center (CERC) conducts genetics research in two areas, plant population genetics and functional genomics of fish. Plant genetic research at CERC focuses primarily on genetics of small, isolated populations, including those considered threatened or at risk. Isozymes, microsatellites, and intersimple sequence repeats (ISSRs) are used to diagram inter- and intrapopulation genetic relationships, estimate gene flow and genetic distance, and identify hybrid individuals/populations. These techniques are being applied to birch populations in Nebraska; on the herbaceous plant, death camas, in Ozark National Scenic Waterways; and aspen hybrids along the Niobrara River. Scientists are applying techniques of functional genomics to resource management issues. The main goals of this research are to: develop molecular probes of reproductive function, develop biomarkers of contaminant exposure and effects, and investigate linkages among molecular, physiological and population-level effects of environmental stressors. Currently, these tools are being used to examine the effects of thiamine deficiency, mercury and atrazine.

Paper birch (Nebraska-Paper Birch Decline Project: Columbia Environmental Research Center).

Facilities: The CERC has laboratory capabilities for conducting molecular biology and real-time quantitative-PCR measurement of gene expression. Plant conservation genetics is conducted through a partnership with the University of Missouri-Columbia.

Northern Prairie Wildlife Research Center

Research: The Northern Prairie Wildlife Research Center (NPWRC) is currently conducting genetics research on the mid-continent population of Sandhill cranes and on invasive plant species. The NPWRC will be initiating efforts to examine the impacts of genetically modified (GM) organisms on wildlife populations. For example, the portion of soybeans planted in the U.S. comprised of GM varieties increased from 5% in 1996 to >80% in 2002. Herbicide-resistant GM varieties of canola and corn are also in widespread use throughout the United States. These developments have brought about a fundamental change in cropping practices and a marked increase in efficacy of weed control resulting in suppression or elimination of foods sought by many species of seed-eating birds. The Center will utilize its extensive GIS capability to conduct research on a landscape scale where effects of GM crops on wildlife populations can be evaluated within the context of existing agricultural land use practices. Other studies are planned to examine effect of glyphosate on aquatic ecosystems in agricultural landscapes in the Prairie Pothole Region.

Facilities: The NPWRC has state-of-the-art GIS capabilities for studying the effects of GM crops on wildlife populations. Genetic analyses, when needed, are contracted to appropriate laboratories or performed by collaborators.

To obtain more information on USGS genetics research, please contact:

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