WEST Inc.

Environmental
& Statistical
Consultants

COMPANY PROFILE

WEST is committed to providing the highest level of professional consulting services resulting in original solutions to a wide range of natural resource problems.

Through the use of state-of-the-art statistical principles in the design, conduct and analysis of ecological field studies, WEST specializes in a common sense, defensible and professional approach to the solution of natural resource problems facing government and industry. WEST has a permanent core of ecologists and biometricians with broad experience in basic and applied ecological studies and the sophisticated analysis of natural resource data. This unique blend of disciplines and our years of experience in both areas allow us to provide original solutions to a wide range of natural resource issues. WEST also provides consulting services to government, industry and other organizations, and creates interdisciplinary teams from an extensive network of associates, providing expertise tailored for individual client needs.

OFFICE LOCATIONS

CORPORATE HEADQUARTERS

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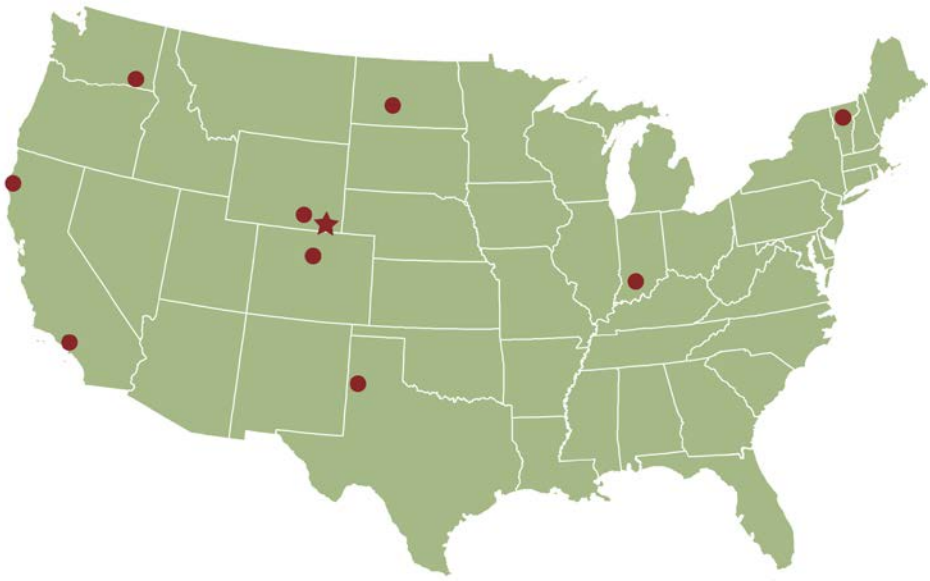
www.west-inc.com

BRANCH OFFICES

- Laramie, Wyoming
- Bloomington, Indiana
- Walla Walla, Washington
- Broomfield, Colorado
- Los Angeles, California
- Bismarck, North Dakota
- Waterbury, Vermont
- Arcata, California
- Littlefield, Texas



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AVIAN AND BAT PROTECTION PLANS

WEST has extensive experience working with avian and bat species protected under the Migratory Bird Treaty Act (MBTA), the Bald and Golden Eagle Protection Act (BGEPA), and Endangered Species Act (ESA) as well as state listed and sensitive species. WEST has written and participated in the development of Avian and Bat Protection Plans and Eagle Conservation Plans for wind projects and Biological Assessments for a variety of projects such as highway construction, wind power projects, gravel mines, and reservoirs. WEST personnel have a strong working knowledge with numerous listed species and are familiar with techniques necessary to study rare and uncommon wildlife and plants. The U.S. Fish and Wildlife Service has trained WEST personnel in Section 7 consultation, Habitat Conservation Planning, and survey protocols for a variety of listed species.

AVIAN AND BAT PROTECTION PLAN EXPERTISE

- Estimating Impacts and Take of Listed Species
- Assessing the Impacts of the Taking
- Conservation Planning and Minimization and Mitigation Measures
- Compliance Monitoring and Effectiveness Monitoring Plans
- Development of Adaptive Management Processes

WEST's approach to the development of ABPP's includes a collaborative process with Industry, the U.S. Fish and Wildlife Service, and state agencies ensuring the development of a defensible ABPP.

WEST has developed or is in the process of developing ABPP's throughout the U.S. including: Idaho, Wyoming, Utah, Arizona, New Mexico, California, Iowa, Indiana, and West Virginia.

AERIAL SURVEY & TELEMETRY STUDIES

WEST has combined statistical and ecological expertise to design and conduct aerial survey and telemetry studies for a wide range of species, including golden eagle, prairie chicken, sage grouse, Dall sheep, mule deer, elk, moose, pronghorn, walrus, bats, polar bear and marine mammals. Our ecologists are experienced with study design and data collection for a variety of studies, species, and geographic areas. Additionally, we are familiar with the latest survey techniques, field equipment and study methodologies. Our biometricians have many years of experience designing studies and analyzing data for aerial survey and telemetry issues and utilize state-of-the-art statistical methods and computers. This expertise includes the use of capture-recapture, distance sampling and aerial survey methods for all types of biological populations. WEST uses a statistical and ecological approach to provide clients with objective and scientifically credible results to address aerial survey and telemetry concerns.

AERIAL AND TELEMETRY EXPERTISE

- Resource Selection Analyses
- Population estimation
- Habitat Use Studies
- Spatial and temporal correlation analyses
- Impact Assessment
- Management and Conservation Plans
- Area Use and Movement Studies – Brownian Bridge Movement Model, Kernel Density Estimation

REPRESENTATIVE AERIAL SURVEY PROJECTS

- Dall Sheep Survey, Wrangell-Saint Elias National Park and Preserve, Alaska - designed and conducted helicopter surveys for estimation of abundance; U.S. National Park Service.
- Black tailed prairie dog monitoring methods - developed methods for range-wide monitoring of black tailed prairie dogs (Scientific Investigations Report, USGS)

- Mule Deer Sightability Study, Central Wyoming - used double-sampling procedure with ground and helicopter surveys to evaluate techniques used by agencies to estimate sex and age composition; Wyoming Game and Fish Department.
- Greater Sage-Grouse response to wind energy - Used aerial surveys to locate greater sage-grouse equipped with VHF radios as part of a study to evaluate response of sage-grouse to wind energy development in southeast Wyoming.

- Pronghorn Surveys with HD video – Used aerial surveys and HD video to monitor for changes in pronghorn abundance during development of a natural gas field in central Wyoming 2009-2011; Wyoming Game and Fish Department and Bureau of Land Management.
- Mule Deer Quadrat Counts - Used aerial quadrat count surveys to monitor for changes in mule deer abundance during development of a natural gas field in central Wyoming 2001-2011.

REPRESENTATIVE TELEMETRY/GPS SURVEY PROJECTS

- Use of Global Positioning System (GPS) radio-collars to identify timing and routes of mule deer migrations in western Wyoming. GPS collars provide large and precise data sets ideal for identifying migration routes, timing of movements, and habitat selection patterns. These GPS units collected locations every two hours for six months with a 99% success rate.
- Pronghorn Response to land development - designed and conducted a study to determine the spatial distribution and behavioral response by pronghorn to development in western Wyoming.
- Use of GPS transmitters to analyze flight height activity and for estimating and mapping space use for golden eagles using Brownian Bridge Movement Model and Kernel Density Estimator in Idaho and Arizona. GPS units collected locations every hour for multiple seasonal studies.
- Use of telemetry to analyze bat location data to determine area use for roost sites, maternity colonies and foraging areas at wind project study sites in the midwest.
- Equipped 42 elk with GPS-radio collars and the resulting fine-scale movement data collected pre- and post-construction to evaluate elk response to a multi-use pathway built along Teton Park Road in Grand Teton National Park for National Park Service.

BAT RESEARCH & MONITORING

WEST has been involved in bat research, monitoring and risk assessment since 1994. During that time, the WEST Bat Team has grown to five full-time MS and PhD Bat Biologists with over 45 years of combined bat research experience across North America.

WEST is permitted by USFWS to capture Indiana bat, gray bat, and big-eared bat across their ranges, and has conducted mist-net surveys for Indiana bat on approximately 465,700 acres in the Midwest and eastern U.S.

WEST has surveyed approximately 17,000 acres of forest habitat for Indiana bat

WEST bat biologists are leaders in quantitative and qualitative approaches for acoustic species identifications, including methods to estimate uncertainty in classifications, an industry first.

WEST bat biologists have provided external expertise in several cases involving acoustic identification of Indiana bats.

WEST has completed pre- and post-construction monitoring for bats at approximately 300 wind energy projects in 42 states.

The WEST Bat Team have the experience and skills to design and implement repeatable, defensible approaches to acoustic identification of endangered bat species and risk assessments.

REPRESENTATIVE SERVICES

- Mist-net surveys to document presence/absence of listed species, including Indiana bat, gray bat, and big-eared bats
- Habitat assessment and quantification for Indiana and eastern small-footed bat
- Pre-construction acoustic studies using Anabat™ and Full-Spectrum Detectors
- Analysis and species identification of Anabat™ acoustic data, including first-in-the-industry assessments of uncertainty in the identifications
- Cave and mine surveys to assess bat use
- Desktop assessments of potential bat habitat in proposed development areas
- Pedestrian surveys to estimate quantity and quality of potential bat habitat

- RADAR studies to assess temporal and spatial patterns of movements
- Habitat Conservation Planning and Avian and Bat Protection Planning
- Radio-telemetry studies (ground and aerial) to determine bat roosting and foraging areas
- Post-construction monitoring study design and implementation

KEY PUBLICATIONS

Barclay, R.M.R., E.F. Baerwald, and **J.C. Gruver**. 2007. Variation in bat and bird fatalities at wind energy facilities: assessing the effects of rotor size and tower height. Canadian Journal of Zoology 85: 381-387.

Britzke, E.R., J.E. Duchamp, **K.L. Murray**, R.K. Swihart, and L.W. Robbins. 2011. Acoustic identification of bats in the eastern United States: A comparison of parametric and nonparametric models. Journal of Wildlife Management 75(3): 660-667.

Gruver, J.C., M. Sonnenberg, K. Bay, and **W.P. Erickson**. 2009. Results of a Post-Construction Bat and Bird Fatality Study at Blue Sky Green Field Wind Energy Center, Fond du Lac County, Wisconsin, July 2008-May 2009.

Murray, K.L., E.R. Britzke, B.M. Hadley, and L.W. Robbins. 1999. Surveying bat communities: a comparison between mist nets and the Anabat II bat detector system. Acta Chiropterologica 1(1):105-112.

Timpone, J.C., J.G. Boyles, **K.L. Murray**, D.P. Aubrey, and L.W. Robbins. 2010. Overlap in roosting habits of the Indiana bat (Myotis sodalis) and northern bat (Myotis septentrionalis). American Midland Naturalist 163:115-123.

REPRESENTATIVE CLIENTS

Acciona ● AECOM ● Apex Wind ● Bat Conservation International ● Bonneville Power Administration ● BP Wind Energy, North America ● CH2MHill ● Dominion Power Electric Power Research Institute ● Energy Northwest ● enXco ● ERM ● Eurus Energy America Corporation ● F.E. Warren Air Force Base ● FPL Energy, Inc ● Horizon Wind Energy ● Iberdrola Renewables ● Invenergy ● Kittitas & Klickitat Counties, Washington National Wind Coordinating Committee ● National Renewable Energy Laboratory PacifiCorp ● Renewable Energy Systems ● Renewable Northwest Project ● Shell Wind Energy ● Third Planet Windpower ● URS Corporation ● Xcel Energy

The WEST Bat Team is ready to help you assess the risks and needs for your project. Please contact us with inquiries and to begin developing solutions:

Eastern Region: Kevin Murray
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Western Region: Jeff Gruver
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jgruver@west-inc.com

BIG GAME RESEARCH & MONITORING

WEST has combined statistical and ecological expertise to design and conduct a wide range of big game species, including Dall sheep, bighorn sheep, mountain goat, mule deer, white-tailed deer, pronghorn, elk, moose, and also several large carnivores including grizzly bear, polar bear, and mountain lion. Our ecologists are experienced with study design and data collection for a variety of studies, species, and geographic areas. Additionally, we are familiar with the latest capture techniques, field equipment and study methodologies. Our biometricians have many years of experience designing studies and analyzing data for a variety of big game issues and utilize state-of-the-art statistical methods and computers. Big game management is often a top priority for agencies, industry and to the public. WEST uses a statistical and ecological approach to provide clients with objective and scientifically credible results to address big game concerns.

BIG GAME EXPERTISE

- Resource Selection Analyses
- Estimates of Population Characteristics (abundance, density, survival, mortality, and reproduction)
- Population and Habitat Modeling
- Identification of Movement and Migratory Patterns
- Impact Assessment
- Management and Conservation Plans
- GPS and VHF Telemetry Studies

REPRESENTATIVE BIG GAME PROJECTS

- Dall Sheep Survey, Wrangell-Saint Elias National Park and Preserve, Alaska - designed and conducted helicopter surveys for estimation of abundance; U.S. National Park Service.
- Dall Sheep and Mountain Goat Survey, Kenai National Wildlife Refuge, Alaska - designed survey protocol and analyzed survey data; U.S. Fish and Wildlife Service and Alaska Department of Fish and Game.
- Developed Northern Great Plains Mule Deer Habitat Suitability Index (HSI) model using Habitat Evaluation Procedures; U.S. Forest Service, Nebraska National Forest.

- Mule Deer Sightability Study, Central Wyoming - used double-sampling procedure with ground and helicopter surveys to evaluate techniques used by agencies to estimate sex and age composition; Wyoming Game and Fish Department.
- Compendium on Management and Research on Mountain Lions in Wyoming; Wyoming Game and Fish Department.
- Use of Global Positioning System (GPS) radio-collars to identify timing and routes of mule deer migrations in western Wyoming. GPS collars provide large and precise data sets ideal for identifying migration routes, timing of movements, and habitat selection patterns. These GPS units collected locations every two hours for six months with a 99% success rate.
- Kenai Brown Bear Resource Selection; developed resource selection models for brown bears on the Kenai Peninsula, Alaska; Chugach National Forest.
- Mule Deer Impact Assessments; designed protocols and implemented long term study to assess impacts from energy development on western Wyoming mule deer herds; Questar, Bureau of Land Management and Wyoming Game and Fish Department.
- Moose Abundance and Resource Selection; developed and participated in implementation of study protocols for moose population size and resource selection at several National Wildlife Refuges in Alaska.
- Pronghorn Response to Wind Power; designed and conducted a study to determine the spatial distribution and behavioral response by pronghorn to a wind plant in southern Wyoming.
- Use of satellite imagery and GPS technology to evaluate potential effects of oil and gas development on mule deer in the Green River Basin of Wyoming.

BIOSTATISTICS & MARINE MAMMAL & ALASKA EXPERIENCE

WEST has over 22 peer-reviewed publications on marine mammal work, mostly in Northern climates in the Beaufort and Chuckchi Sea. These studies include population and demographic modeling of polar bears, habitat and global warming impact assessment for polar bears, assessment of anthropogenic sound impacts on bowhead whales, population and habitat estimation for walrus, impact assessment of Navy rocket launches on seals and sea lions, habitat estimation of gray whales in Russian controlled waters, and others. The field methods employed during these studies involved live capture, radio telemetry, and remote video capture (both land based and from unmanned aerial vehicles). The statistical techniques employed during these studies included capture-recapture analysis, resource selection analysis, simulation of study design to assess precision, line transect analyses, acoustic analyses, and assistance with study design.

REPRESENTATIVE PROJECTS

- **South Beaufort Polar Bear Demography**
  Estimation of population size, survival and trends in both using 30+ years of capture-recapture information. Offshore of Prudhoe Bay, Alaska. Study area from Barrow, Alaska to Tukoyuktuk, Canada
- **Polar Bear Sea Ice Habitat Selection and Projections**
  Projections of polar bear (Ursus maritimus) sea ice habitat distribution in the polar basin during the 21st century were developed to understand the consequences of anticipated sea ice reductions on polar bear populations. We used location data from satellite-collared polar bears and environmental data (e.g., bathymetry, distance to coastlines, and sea ice) collected from 1985 to 1995 to build resource selection functions (RSFs). RSFs described habitats that polar bears preferred in summer, autumn, winter, and spring. When applied to independent data from 1996 to 2006, the RSFs consistently identified habitats most frequently used by polar bears. We applied the RSFs to monthly maps of 21st-century sea ice concentration projected by 10 general circulation models (GCMs) used in the Intergovernmental Panel of Climate Change Fourth Assessment Report, under the A1B greenhouse gas forcing scenario (see Durner et al. 2009, Ecological Monographs 79:25 – 58). In 2007, Two WEST, Inc. employees received Awards for Excellence by the Dirk Kempthorne, U.S. Secretary of Interior for their work on this project.
- **Black Oystercatcher Monitoring, Prince William Sound Alaska**
  Over 50% of the world's Black Oystercatcher (Haematopus bachmani) population is thought to breed in Alaska (Andres and Falxa 1995). Of that number, 800-1200 individuals inhabit Prince William Sound (PWS). WEST, Inc. was contracted by the Chugach National Forest to help develop a study design and analysis for monitoring black oystercatchers in Prince William Sound, AK.

- **Exxon Valdez Oil Spill, Prince William Sound Alaska**
  Statistical design and analysis for the Trustees in the natural resource damage assessment following the Exxon Valdez oil spill in Prince William Sound, Alaska
- **Kenai Peninsula Grizzly Bears**
  Design procedures to estimate grizzly bear abundance using hair traps and DNA
- **Northstar Bowhead Whales, Prudhoe Bay, Alaska**
  Monitoring of Bowhead Whale migration near an offshore oil production island.
- **Dall Sheep Survey, Wrangell-Saint Elias National Park and Preserve, Alaska**
  Designed and conducted aerial surveys for estimation of abundance
- **St. Lawrence Island Walrus, Nome, Alaska**
  Habitat selection of walrus using satellite data
- **Shell Bowhead Whales, Kaktovick, Alaska**
  Monitoring of bowhead whale migration along the Arctic coast

SELECTED PEER-REVIEWED PUBLICATIONS

Irons, D.B., S.J. Kendall, **W.P. Erickson**, L.L. McDonald, and B.K. Lance. 2000. Nine years after the *Exxon Valdez* oil spill: effects on marine bird populations in Prince William Sound, Alaska. The Condor. 102: 723-737.

Streever, B., R. P. Angliss, R. Suydam, M. Ahmaogak, C. Bailey, S. B. Blackwell, J. C. George, C. R. Greene,Jr., R. S. Jakubczak, J. Lefevre**, T. L. McDonald**, T. Napageak, and W. J. Richardson, (2008)" Progress Through Collaboration: A Case Study Examining Effects of Industrial Sounds on Bowhead Whales", Bioacoustics v17, p. 345-347.

Yazvenko, S. B., **T. L. McDonald**, S. A. Blokhin, S. R. Johnson, S. K. Meier, H. R. Melton, M. W. Newcomer,R. Nielson, V. L. Vladimirov, and P. W. Wainwright (2007) "Distribution and abundance of western gray whales during seismic survey near Sakhalin Island, Russia" Environmental Monitoring and Assessment v134, p. 45-73.

Amstrup, S. C., G. M. Durner, I. Stirling, and **T. L. McDonald** (2005) "Allocating harvests among polar bear stocks in the Beaufort Sea", Arctic v58, p. 247-259.

Lee, S. H., D. M. Schell, **T. L. McDonald**, and W. J. Richardson (2005) "Regional and seasonal feeding by bowhead whales Balaena mysticetus as indicated by stable isotope ratios", Marine Ecology Progress Series, v285, p. 271-287.

FISHERY STATISTICAL SUPPORT

WEST has extensive experience in the statistical design, analysis, and reporting of a broad spectrum of fishery and fishery related projects. Our main goal is to provide our clients with the best analyses available using methods and techniques that are up to date and well represented in the peer-reviewed literature. WEST's criteria for estimation and inference include unbiasedness, accuracy, consistency and minimum variance estimation, the hallmarks of modern statistical science. Particular areas of expertise include population and survival estimation by mark-recapture methods, analysis of fish contaminant data, estimation of salmonid escapement, investigation and estimation of optimal sustainable harvest levels, abundance monitoring, environmental impact analysis, angler survey design, statistical sampling methods, fishery bycatch, simulation modeling, run forecast modeling and computer intensive estimation.

WEST biometricians provide clients with solutions to complex quantitative problems often of a non-standard nature. Unique problems WEST has resolved include research on optimal flow regimes to minimize hydrological impacts on fisheries and the application of simulation models to understanding the effects of net selectivity on size composition of chinook salmon stocks. WEST is a leader in sampling theory and has successfully designed state-of-the- art sampling protocols for a variety of marine and freshwater fishery projects. Among these include before and after contaminant collections using generalized randomized tessellation sampling and seagrass sample design in estuary refuges in Alaska.

REPRESENTATIVE PROJECTS AND EXPERIENCE

- **Salmonid Survey Design for Coastal Streams of California**
  WEST assisted with the development of monitoring techniques and standards to allow California Department of Fish and Game and NMFS to assess both current status and future trajectory of salmonid populations in all coastal recovery units, the "California Plan".
- **Central Valley California Angler Survey Design and Analysis**
  WEST is reviewing the sampling design and analysis methods of the Central Valley California angler survey conducted annually by the California Fish and Game Department. WEST's contribution is expected to improve the variance estimator of catch statistics resulting in more effective management of the Central Valley's Chinook salmon fishery.
- **Central Valley California Chinook Escapement Estimation**
  WEST developed state of the art mark-recapture techniques to estimate Central Valley natural origin Chinook salmon spawner abundance in the Sacramento River and its tributaries. WEST's work in Chinook escapement estimation is expected to reduce existing uncertainty in population status, improve management and assist in recovery of endangered Chinook stocks.

- **Central Valley California Steelhead Video Monitoring: Design, Implementation and Escapement Estimation**
  WEST designed methods for deployment, evaluation and validation of steelhead escapement estimates derived from three fish counter devices and development of improved statistical methods for unbiased steelhead escapement estimates from device counts. This project is expected to prove an objective and more precise measure of natural origin steelhead escapement in the Central Valley and improved monitoring of steelhead population status.
- **Sacramento River Steelhead Population Estimation from Mark-Recapture: Design, Implementation and Escapement Estimation**
  WEST reviewed PSMFC's plans to implement fyke trap mark-recapture natural steelhead population estimation in the main-stem Sacramento River. A statistically valid mark-recapture method was designed to estimate the total abundance and the variance of estimated abundance of natural steelhead during the spawning migration period. A simulation study was undertaken to provide trapping effort levels necessary to result in the client's desired degree of precision in the estimate of total abundance. WEST's work will contribute much needed main-stem Sacramento River steelhead abundance information on a timely in-season basis.
- **Factors Affecting San Francisco Estuary Delta Smelt Population Abundance**
  WEST assisted Nossaman analysts in statistical modeling used to estimate physical, biological and anthropogenic stressors affecting changes in abundance of San Francisco estuary delta smelt populations. The results of the modeling has assisted in elucidating the complex dynamics of delta smelt population change leading the way for adaptive management alternatives designed to ameliorate future population declines.
- **Predictive Modeling of Changes in Abundance of the San Francisco Estuary Delta Smelt**
  WEST assisted Metropolitan Water's senior ecologist in developing statistical models to predict population changes in San Francisco estuary delta smelt.
- **Modeling Mercury Concentrations in San Francisco Estuary Small Fish Species**
  WEST developed hierarchical linear mixed models to identify factors influencing the concentration of mercury in Mississippi silversides and topsmelt. WEST's work for SFEI is expected to contribute to information useful for the state of California to better manage the water quality of the San Francisco estuary.
- **Statistical Modeling of Factors Influencing Siletz River Turbidity: Effects of Timber Harvest and Local Geology**
  WEST investigated the relationships between intensity of timber harvest on turbidity of the Siletz River which supports a major chinook salmon fishery. The models WEST has developed have been instrumental in the management of the timing and spatial extent of timber harvesting to maintain high water quality in the Siletz River.
- **Hood River Chinook and Steelhead Salmon Run Forecast Models**
  WEST applied multiple linear regression modeling to make one-year-ahead predictions of the total run abundance of spring and fall chinook adults and summer and winter steelhead adults in the Hood River in Oregon. Steelhead and chinook smolt abundance were also modeled to provide one-year-ahead forecasts.

- **Lyman McDonald (WEST, Inc.) - Member of the Northwest Power Planning Council's Scientific Advisory Board**
  Lyman McDonald was a member of the ISAB. Service involved providing independent scientific advice and recommendations regarding scientific issues that relate to Pacific Northwest state and federal agencies'' fish and wildlife programs.

- **Evaluate Feasibility of a Comprehensive Database for Understanding of Juvenile Salmon Abundance in Central Valley of California**

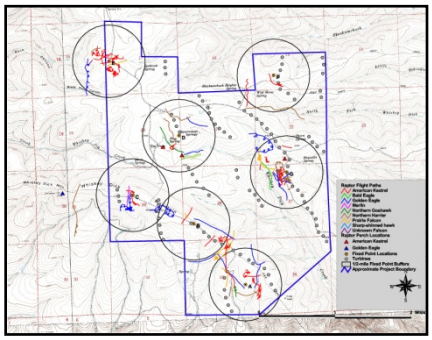
  WEST is assisting PSMFC and US Fish and Wildlife in evaluating the feasibility of developing a comprehensive database to document and understand changes in the abundance of juvenile salmon in the Central Valley of California. WEST, Inc., will develop recommendations for common data collection and analysis across all USFWS screw traps in the Central Valley.

- **Aquatic Sampling Plan for North Cascade National Park Network**
  WEST has assisted National Park Service biologists in design and implementation of a long-term monitoring plan for aquatic resources in wadeable streams of North Cascade National Park, Olympic National Park, and Mount Rainier National Park. This work lead to further assistance designing monitoring plans for large rivers, lakes and ponds, and vegetation in small prairies.

GEOGRAPHIC INFORMATION SYSTEMS

WEST specializes in the design and conduct of ecological field studies. An integral part of study design, data collection, and analysis often includes large sets of spatial data that require Geographic Information Systems (GIS) software. WEST has years of GIS experience creating, converting, viewing, analyzing, and mapping a variety of image, raster, vector, and point files. Additionally, WEST has poster-size plotting capability to produce high-quality maps of assorted size.

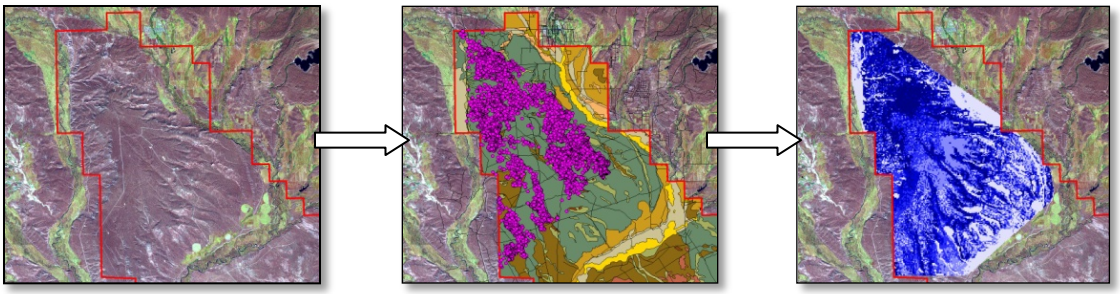
GEOGRAPHIC INFORMATION SYSTEMS EXPERTISE

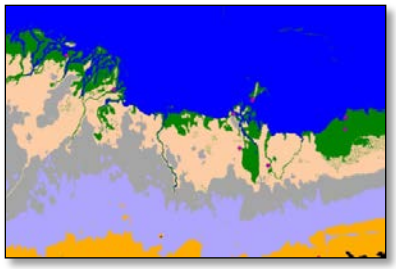


- Mapping
- Data Extraction, Analysis, and Query
- Modeling (e.g. Habitat Selection, Impact Assessment, Viewshed, Analysis, etc.)
- Creating Digital Data
- Database Construction and Query
- Global Positioning System (GPS) Data Collection, Analysis, and/or Mapping

GEOGRAPHIC INFORMATION SYSTEMS CLIENT EXAMPLES

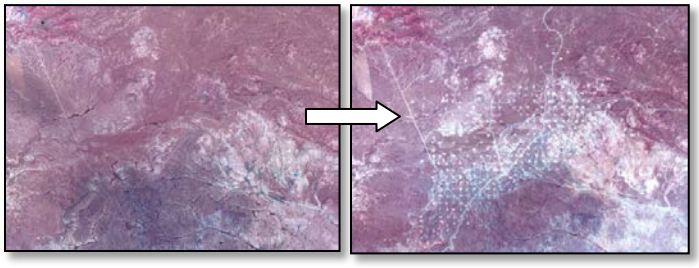
- Image data is often used as a base layer to extract or plot data. In this example, satellite imagery is combined with a variety of other variables (e.g. slope, aspect, vegetation type, road density) to develop habitat selection models for mule deer.





- Digital elevation model (DEM) data is often used for modeling purposes and to develop slope and aspect coverages. In this example DEM data and associated slope and aspect values are used to evaluate polar bear den site selection on the North Coast of Alaska.

- In this example satellite imagery is used to calculate and quantify surface disturbance for a gas field.



HABITAT CONSERVATION PLANS

WEST has extensive experience working with threatened and endangered (T&E) species and compliance projects under the Endangered Species Act (ESA). WEST has written and participated in development of Habitat Conservation Plans for wind projects and forest projects and Biological Assessments for a variety of projects such as highway construction, wind power projects, gravel mines, and reservoirs. WEST personnel have a strong working knowledge with numerous listed species and are familiar with techniques necessary to study rare and uncommon wildlife and plants. The U.S. Fish and Wildlife Service has trained WEST personnel in Section 7 consultation, Habitat Conservation Planning, and survey protocols for a variety of listed species.

HABITAT CONSERVATION PLAN EXPERTISE

- Estimating Impacts and Take of Listed Species
- Assessing the Impacts of the Taking
- Conservation Planning and Minimization and Mitigation Measures
- Compliance Monitoring and Effectiveness Monitoring Plans
- Development of Alternatives to the Taking
- Changed and Unforeseen Circumstances

WEST has developed a collaborative process for building defensible Habitat Conservation Plans with the U.S. Fish and Wildlife Service through a stepwise process fulfilling the mandatory elements of an HCP:

(1) Determining an accurate assessment of the incidental take.
In general, there are several acceptable means by which take can be estimated; for example, a habitat equivalency approach, or a surrogate species approach, all of which have merit and may be variably applicable for different projects and may be combined to corroborate the level of estimated take.

(2) Determining the impacts of the take.
Assessing the impacts of the taking is a mandatory element of an HCP and requires an accurate assessment of the potential incidental take (step 1) and a thorough understanding of the baseline conditions for the resource potentially impacted. Determining the impacts of the take is a significance evaluation.

(3) Determining an effective conservation plan.
This is a mandatory element and the heart of an HCP. Once the impacts of the take are determined, measures to minimize the impact of the taking and mitigate for unavoidable take can be developed.

(4) Develop a process for monitoring the impacts of the take.
In addition, a mandatory element of an HCP, WEST has extensive experience developing quantitatively based monitoring plans to insure compliance with the Incidental Take Permit.

These four elements are integral to developing an effective HCP and serve as milestones in successfully negotiating a conservation plan that fulfills requirements under the ESA for acquiring an Incidental Take Permit. Once these milestones have been successfully negotiated with the USFWS, an HCP that meets the issuance criteria is compiled.

REPRESENTATIVE HCPS

- American Wind Energy Association, Whooping Crane and Lesser Prairie Chicken Programmatic HCP. WEST was selected as a lead contractor for developing the Wind Energy Whooping Crane Action Group Bi-Regional HCP for Whooping Cranes, Lesser Prairie Chicken, Interior Least Tern, and Piping Plover.
- Radar Ridge Wind Project, Pacific County, Washington. WEST is primary contractor for development of the HCP and Environmental Assessment for the Radar Ridge Wind Project for Marbled Murrelet and Spotted Owl.
- Beech Ridge Wind Energy Center, Greenbrier and Nicholas Counties, West Virginia. WEST is developing the HCP for the Beech Ridge Wind Project addressing Indiana Bat and Virginian Big-Eared bat.
- Fowler Ridge Wind Resource Area, Benton County, Indiana. WEST is developing the HCP for Indiana bat for the Fowler Ridge Wind Project
- Nodaway Wind Project, Nodaway County, Missouri. WEST is developing the HCP for Indiana bat for construction and operation of the Nodaway Wind Project.
- Criterion Wind Project, Garret County, Maryland. WEST is developing the HCP for Indiana bat for operation and maintenance of the Criterion Wind Project.
- Kittitas Valley Wind Project, Kittitas County, Washington. WEST developed the low-effect HCP for bald eagles for the Kittitas Valley Wind Project.
- Desert Claim Wind Project, Kittitas County, Washington. WEST developed the low-effect HCP for bald eagles for the Desert Claim Wind Project.

NATIONAL ENVIRONMENTAL POLICY ACT

WEST has extensive consulting experience in state and federal environmental regulation compliance including work under the National Environmental Policy Act (NEPA). WEST has acted as both sole consultant and as a team member with other firms conducting NEPA projects, including preparation of Categorical Exclusions, Environmental Assessments (EA), and Environmental Impact Statements (EIS). WEST has also prepared support documents for NEPA projects, such as baseline studies, records of decision, and mitigation and monitoring plans. In addition, WEST specializes in conflict resolution and negotiation of natural resource issues with the public and private sectors.

NEPA COMPLIANCE EXPERIENCE

- Public scoping and issues identification
- Purpose and need development
- Alternatives evaluation and analysis
- Affected environment description
- Environmental effects analysis
- Mitigation plans
- Public comment review and synthesis
- Final environmental documents
- Preparation and critical reviews of NEPA documents

REPRESENTATIVE NEPA PROJECTS

- Greybull Valley Dam and Reservoir Environmental Impact Statement; prepared for the Bureau of Land Management and U.S. Army Corps of Engineers.
- Platte River Programmatic EIS, Executive Director of effort to develop proposed action; in cooperation with states of Colorado, Nebraska, Wyoming and the U.S. Department of the Interior.
- Pine Ridge Indian Reservation Four Winds Casino Environmental Assessment; prepared for the National Gaming Commission.
- Confederated Tribes of the Colville Reservation Mill Bay Casino Environmental Assessment; prepared for the U.S. Bureau of Indian Affairs.
- Klamath Tribes, Oregon, Gaming Facility Environmental Assessment; prepared for the U.S. Bureau of Indian Affairs.
- Environmental Assessment for Reclamation of over 30 sites; prepared for the Wyoming Department of Environmental Quality, Abandoned Mine Land Program.
- Wasatch Gathering System Sour Gas Pipeline Environmental Assessment, wildlife section; prepared for Union Pacific Resources.

- Greater Wamsutter Oil and Gas Environmental Assessment, third party review and mitigation plan; conducted for Union Pacific Resources.
- Mullican Draw Gas Field Environmental Impact Statement review; conducted for Union Pacific Resources.
- Wyoming Highway 131, Sinks Canyon Road Environmental Assessment; prepared for the Federal Highway Administration and Wyoming Department of Transportation.
- Wyoming Highway 34, Bosler Junction-Wheatland Environmental Assessment; prepared for the Federal Highway Administration and Wyoming Department of Transportation.
- Wyoming Highway 130, Snowy Range Road Environmental Assessment; prepared for the Federal Highway Administration and Wyoming Department of Transportation.
- Environmental Assessments for Wyoming Cities participating in the Wyoming States Revolving Funds Program, prepared for the Wyoming Department of Environmental Quality.
- Categorical Exclusions for various road construction projects throughout Wyoming, prepared for the Wyoming Department of Transportation.
- Environmental Impact Statement for the Halligan-Seaman Water Management Project to analyze the environmental consequences of the project in full compliance with requirements of the Council on Environmental Quality and the NEPA and regulatory requirements of the Army Corps of Engineers, prepared for the Cities of Fort Collins and Greeley, Colorado.
- Environmental Impact Statement in compliance with the National Environmental Policy Act to analyze the environmental consequences of the Westside Irrigation District's proposed acquisition of 16,500 acres of federal lands in Washakie and Big Horn Counties prepared for the Wyoming Water Development Commission and Bureau of Land Management, Wyoming.
- Environmental Assessments for the Conservation Reserve Program in thirteen Western states including Wyoming; conduct impact analysis for vegetation, wildlife and protected species.

Oil & Gas Natural Resource and Environmental Support

WEST scientists have many years of experience in supporting oil and gas exploration and development projects throughout various states. Our approach and support on mineral development projects remains consistent regardless of whether the client has a single well or full field development. WEST personnel have many years experience designing studies, collecting data, and preparing documents for a variety of natural resource issues in relation to energy development. Our expertise provides clients with credible, objective, and responsible solutions to natural resource questions and problems.

Wildlife and Vegetation Surveys

WEST has several experienced biologists and botanists on staff to conduct biological surveys or habitat assessments to support agency permitting of oil and gas projects. WEST staff are knowledgeable of standardized protocols or can develop project specific methods to obtain precise data on the wildlife use of an area proposed for development. Biologists use their vast knowledge to identify potential adverse affects that may occur to individuals or populations and suggest mitigation to minimize these affects.

Baseline surveys to determine occurrence (presence/absence) of federally listed species or their critical habitats within areas proposed for development.

- Black-footed Ferret
- Greater Sage-Grouse
- Preble's Meadow Jumping Mouse
- Ute Ladies'-tresses
- Blowout Penstemon
- Colorado Butterfly Plant

WEST biologists routinely perform the following surveys or assessments for the following sensitive species:

- Raptor Nest Searches
- Bald Eagle Winter Roost Surveys
- Mountain Plover Breeding and Nesting Surveys
- Pygmy Rabbit Surveys
- Big Game Winter Range Surveys

During maintenance and operation of oil and gas facilities, WEST routinely conducts surveys to evaluate wildlife response to oil and gas development. Survey requirements are typically established by in agencies as a permit condition and WESTs knowledge of specific seasonal or timing requirements ensures that data is collected according to established protocols with minimal disturbance to individuals or populations.

WEST has performed these services to various oil and gas companies within the following locations:

- Niobrara Shale Play in central and southeastern Wyoming
- Powder River Basin Coal Bed Methane Play in northeastern Wyoming and southern Montana
- Pinedale Anticline and Jonah Gas Fields in western Wyoming

Additional Services

- Biological Assessments and Biological Evaluations on Federal lands
- Biological Surveys and Environmental Assessments for Geophysical 3D Seismic Projects
- Sage-Grouse Core Area DDCT analysis.

National Pollutant Discharge Elimination System

Permitting

WEST scientists have extensive experience in permitting point source discharges under Section 402 the Clean Water Act. Our staff has drafted and submitted over 100 Wyoming National Pollutant Discharge Elimination System (WYPDES) permit applications, modifications and renewals to the Wyoming Department of Environmental Quality (WDEQ) for conventional oil well and coal bed natural gas projects throughout Wyoming.

Monitoring and Compliance Reporting

In addition to permitting discharges, WEST staff can also conduct routine permit compliance sampling, monitoring and reporting as established by the individual or general permits. WEST can provide efficient and cost effective monitoring programs to ensure oil and gas operators remain in compliance with permit conditions.

Our field staff is proficient in collecting outfall samples, adhering to chain of custody requirements, reviewing analytical results for compliance with permit conditions, and submitting results to federal and state agencies. WEST can develop plan-of-actions to promptly address compliance issues or formal enforcement actions.

Storm Water Permitting, Monitoring and Compliance Reporting

WEST scientists provide support for oil and gas facilities compliance with storm water discharge permitting and monitoring. Scientists have drafted or aided clients in drafting and submitting Notice of Intents for single wells or field wide storm water permits. WEST has drafted Storm Water Pollution Prevention Plans, performed routine inspections during various phases of construction and reclamation, and submitted Notice of Terminations for facilities meeting re-vegetation requirements.

We offer experience in Storm Water Pollution Prevention Plan inspection services to our oil and gas clients. The inspections are structured to help keep clients in compliance with current regulations and permit requirements. Any non-compliance issues are promptly identified and reported to the clients to minimize impacts to the environment.

Compliance Audits

WEST scientists have performed NPDES compliance audits for energy clients to evaluate conformance with the NPDES program and permits issued to the operators. Audits are structured to evaluate both internal and subcontractor operations to ensure compliance with individual or general permit conditions, identify areas of regulatory and environmental liability, and offer solutions to mitigate or eliminate these liabilities.

RECLAMATION PLANS

WEST scientists have prepared reclamation plans for oil and gas projects in accordance with federal land management agency policy. Baseline soil and vegetative data is collected to develop site specific reclamation plans to conform to agency requirements. Post-construction vegetation density and diversity studies are conducted to evaluate reclamation success. Noxious weeds and invasive plants management plans are developed with operators to minimize the opportunity for weeds to move into disturbed areas. Plan are developed to describe methods to control and prevent further spread.

BIOMONITORING

- Big game winter range monitoring during exploration activities. Conducted weekly surveys to document pronghorn and mule deer abundance in relation to surface disturbing and drilling activities.
- Daily and hourly monitoring of active raptor nests during construction activities. Recorded bird behavior and response to oil and gas activities
- Monitored installation of pipeline in regards to BLM sensitive plant species
- Conducted bi-weekly surveys to document the occurrence of sage-grouse within areas proposed for surface disturbance.
- Mountain plover monitoring during installation of overhead and underground power lines to document response to construction activities on breeding and nesting plover.
- Daily clearance surveys for bald eagle winter roost habitat.
- Participated in collaborative monitoring program to document nest occupancy and productivity within operating gas fields.

POST-CONSTRUCTION FATALITY MONITORING STUDIES: TIER 4 AND 5

WEST has been a leader in the field of wind power impact assessment, monitoring and research, natural resources research and permitting of wind energy developments since 1994. WEST has been the lead company in the design, conduct, analysis and reporting of post-construction studies of the impacts of wind projects of birds and bats for a wide variety of projects and developments across the U.S.

WEST has a demonstrated record of accomplishment for developing new field and analytical techniques for fatality studies and collision risk modeling. They have published studies on developing cost effective fatality monitoring designs to meet standard objectives regarding fatality monitoring. They have led collaborative stakeholder studies looking at changes in turbine operations to reduce impacts to both birds and bats. WEST and its team members have researched and developed the best statistical methods for estimating fatality rates, as well as have developed a comprehensive database of fatality data from wind energy facilities as well as from other studies that is useful for comparing new project data.

EXPERTISE & SERVICES

- **New Wind Turbine Guidelines**

  WEST has a unique familiarity with the new Wind Turbine Guidelines. Dale Strickland, CEO of WEST, was a scientific technical advisor on the FAC committee and lead author to the Comprehensive Guide to Studying Wind Energy / Wildlife Interactions

- **Conduct of Standard Cost Effective Post-Construction Monitoring Studies**

  WEST has conducted, or is in the process of conducting over 40 different monitoring studies. With this extensive experience, they have established the methods and infrastructure to conduct standard monitoring studies in an efficient, cost-effective manner. Also, because WEST employs both highly trained wildlife biologists and statisticians, these two facets are linked throughout the study process. Data collection methods are informed by statistical expertise, and costly outsourcing of data collection and analysis work is prevented. This unique trait possessed by WEST also expedites the quality assurance process, resulting in accurate and timely reporting. Once studies are completed, results can be compared to those in WEST's comprehensive database to gauge levels of mortality in relationship to other wind energy facilities with similar characteristics.

- **Development of Rigorous Study Protocols, Design and Analysis Methods**

  WEST is uniquely qualified to develop effective protocols and sampling designs. As a leader in research on the impacts of wind energy generation on wildlife, they have designed and implemented numerous monitoring plans for a variety of differently sized projects in different landscapes. To guide this process, during the past year, WEST has conducted simulation studies to determine the best sampling design to achieve maximum precision of fatality estimates. The results of these simulations are used to determine the best protocol for specific project areas. Simulations and

probability calculations for Indiana bat fatalities have also been completed. These results are used when designing monitoring plans to create the most effective protocols for detection of Indiana bats in areas where this species is thought to occur and to predict possible levels of Indiana bat take. WEST is a key contributor to discussions on fatality estimation methods, leading the way in identifying the best, unbiased fatality estimators for analysis of fatality monitoring data.

- **Development of Collision Risk Models**

WEST has developed mathematical simulation models for predicting collisions between birds and wind turbines. These models incorporate substantial details concerning turbine design, spatially explicit representations of wind project layout, and bird flight characteristics. A collision model was employed as a component of WEST's avian risk assessment for the proposed Long Island Offshore Wind Park (LIOWP). WEST has produced a more detailed version of this model for predicting marbled murrelet fatalities at the proposed Radar Ridge Wind Project in the Pacific Northwest. WEST has also performed collision risk modeling for existing wind projects in Oaxaca, Mexico.

- **Conduct of Research-oriented Monitoring Studies**

WEST has been involved in numerous research oriented monitoring studies. They collaborated with Bat Conservation International on the Mountaineer project, California Energy Commission on several projects such as Altamont and Tehachapi, and NREL at Foote Creek rim on the UV study. WEST is currently collaborating with DeTect,Inc to use state-of-the-art radar technology to study avoidance patterns as well as the relationship between passage rates and mortality. Curtailment strategies for reducing fatalities at wind farms have been a recent research interest of WEST. Several projects studying curtailment have been completed, including two recently developed facilities in the Midwest. WEST has also been involved with fatality monitoring and research of sensitive species interactions with wind turbines for Indiana bat, whooping cranes, golden eagles, marbled Murrelet and others.

- **Database Characteristics**

WEST's database includes fatality information for studies conducted in several US states as well as areas in Canada. WEST has compiled data from more than 70 publicly available post-construction reports from wind-energy facilities spanning the timeframe of 1996 through early 2010. The data compiled includes general study information, including; county, state, dominant habitat, survey frequency, dates, number of turbines at site and number of turbines searched, and other turbine attributes. When possible, we have also compiled actual fatality-specific information, including; species, date the fatality was found, location of the fatality, correction factors such as searcher efficiency and carcass removal estimates, and any conditional information that was provided. The data compiled includes fatality information from both standardized and non-standardized fatality studies. Specific data was collected on approximately 11,700 fatalities (~6,900 bats fatalities and ~4,800 bird fatalities), not all necessarily related to the wind-energy facility.

Invited Expertise

WEST personnel have been invited speakers at numerous wind-wildlife meetings nationwide regarding post-construction fatality monitoring. WEST personnel have served as technical experts for the Federal Advisory Committee, the New York State Energy Research and Development Authority, the Virginia Regulatory Advisory Panel, the American Wind Energy Association, National Academy of Sciences Resource Council, and the National Wind Coordination Collaborative. WEST personnel have solid working relationships with USFWS and state wildlife agency personnel along the Atlantic coast the Great Lakes. They have presented papers and been invited speakers at national meetings of the North American Symposium on Bat Research, American Wind Energy Association, The Wildlife Society, Partners in Flight, Bat Wind Energy Cooperative, the National Wind Coordinating Collaborative, Northern Arizona University Renewable Energy Department, National Renewable Energy Laboratory and American Ornithologist Union.

Representative Wind Power Clients

- Acciona
- AECOM
- Apex Wind
- Bat Conservation International
- BP Wind Energy, North America
- Bonneville Power Administration
- California Energy Commission
- CH2M Hill
- Duke Energy
- Distributed Generating Systems
- Dominion Power
- Electric Power Research Institute
- Energy Northwest
- enXco
- ERM
- Eurus Energy America Corporation
- FPL Energy, Inc.
- Iberdrola
- Invenergy
- Kittitas , Klickitat Counties, Washington
- National Wind Coordinating Committee
- National Renewable Energy Laboratory
- PacifiCorp
- Renewable Energy Systems
- Renewable Northwest Project
- SeaWest Windpower, Inc.
- Shell Wind Energy
- Third Planet Windpower
- URS
- Xcel Energy

Peer Reviewed Publications

Kerlinger, P. J. Gehring, W. Erickson, R. Curry, J. Guarnaccia and A. Jain. Night Migrant Fatalities and Obstruction Lighting at Wind Turbines in North America. *The Wilson Journal of Ornithology* 122(4):744–754, 2010

Johnson, G.D., M.D. Strickland, W.P. Erickson, and D.P. Young, Jr. 2007. Use of data to develop mitigation measures for wind power development impacts to birds. Pages 241-257 in *Birds and Wind Farms, Risk Assessment and Mitigation.* M. de Lucas,G.F.E. Janss, and M. Ferrer, (eds.). Quercus Press, Madrid, Spain.

Strickland, M.D., W.P. Erickson, D.P. Young, Jr., and G.D. Johnson. 2007. Selecting study designs to evaluate the effect of windpower on birds. Pages 117–136 in *Birds and Wind Farms, Risk Assessment and Mitigation.* M. de Lucas, G.F.E. Janss, and M. Ferrer, (eds.). Quercus Press, Madrid, Spain.

Arnett, E.B., W.K. Brown, W.P. Erickson, J.K. Fiedler, B.L. Hamilton, T.H. Henry, A.Jain, G.D. Johnson, R.R. Koford, C.P. Nicholson, T.J. O'connell, M.D. Piorkowski, and R.D. Tankersley Jr. 2008. Patterns of Bat Fatalities at Wind Energy Facilities in North America. Journal of Wildlife Management 72:61–78.

Kunz, T.H., E.B. Arnett, W.P. Erickson, A.R. Hoar, G.D. Johnson, R.P. Larkin, M.D. Strickland, R.W. Thresher, and M.D. Tuttle. 2007. Ecological impacts of wind energy development on bats: questions, research needs and hypotheses. *Frontiers in Ecology and the Environment* 5:315-324.

Johnson, G.D. 2005. A review of bat mortality at wind-energy developments in the United States. *Bat Research News* 46:45-49.

Johnson, G.D., M.K. Perlik, W.P. Erickson, and M.D. Strickland. 2004. Bat activity, composition and collision mortality at a large wind plant in Minnesota. Wildlife Society Bulletin 32:1278-1288.

Johnson, G.D., W.P. Erickson, M.D. Strickland, M.F. Shepherd, D.A. Shepherd, and S.A. Sarappo. 2003. Mortality of bats at a large-scale wind power development at Buffalo Ridge, Minnesota. *The American Midland Naturalist* 150:332-342.

Johnson, G.D., W.P. Erickson, M.D. Strickland, M.F. Shepherd, D.A. Shepherd, and S.A. Sarappo. 2002. Collision mortality of local and migrant birds at a large-scale wind power development on Buffalo Ridge, Minnesota. Wildlife Society Bulletin 30:879-887.

RADAR STUDIES

WEST has been a leader in the field of wind power impact assessment, monitoring, natural resources research, and study of wind energy development since 1994. WEST has participated in various aspects of wind projects throughout the U.S. and has played a leading role in understanding, assessing, and placing into perspective the impacts of wind projects on wildlife and habitat using scientifically credible and defensible monitoring and research methods. WEST has developed risk assessments for proposed wind energy facilities, which incorporate comparable datasets and meta-analyses on multiple spatial scales and for different taxonomic groups.

WEST has shown a proven ability to work with and adapt new technologies, including various state of the art technologies for understanding bird and bat migration, use, and collision risk. WEST has developed and implemented X-band marine radar for numerous applications, including studying bird movements and migration in offshore, coastal and interior environments, studying bat migration, bat movements near large bat hibernacular, marbled murrelet movements. WEST has consulted on development of curtailment approaches using radar for reducing bird fatalities, including methods for reducing nocturnal migrant risk and eagle risk.

WEST can design and implement standard radar bird migration studies with the overall purpose of characterizing bird species composition and activity over the project area and provide data that can be used to determine the relative magnitude of movement over the proposed development area when compared to other sites or areas within the site. The primary data collected from WEST radar laboratories include baseline information on flight direction, passage rates, and flight altitude of nocturnal migrants at a representative sampling location for the proposed development area. WEST can implement numerous technologies at study sites depending on objectives of the studies, including radar, acoustic bat monitoring devices, bird acoustic detectors, night vision equipment, thermal imaging equipment, and other emerging technologies. WEST's large staff of statisticians is uniquely qualified in analyzing data from these technologies.

REPRESENTATIVE PROJECTS

- Design and analysis of bird surveys, development of a bird/turbine collision model, compilation of available bat information and completion of an avian and bat risk assessment for the proposed Long Island Offshore Wind Park (LIOWP)
- Post-construction monitoring study investigating and evaluating biological indicators of high risk for collision of nocturnal migrants along the Texas Gulf Coast using Merlin radar system, visibility sensors and other possible risk indicators

- Pre-construction bird and bat studies for a proposed coastal wind turbine for the Sea Girt National Guard Training Center, Sea Girt, New Jersey
- Pre-construction bird and bat studies for the Mount Storm Project in West Virginia including a designed study to investigate nocturnal migration passage over varying topographic regions using marine radar.
- Nocturnal marine radar surveys, raptor migration surveys, breeding bird surveys, winter waterfowl and raptor surveys, acoustic and mist-netting bat surveys, and preparation of the Environmental Impact Assessment and Biological Assessment at the St. Lawrence Windpower Project, New York
- Nocturnal marine radar surveys, raptor migration surveys, breeding bird surveys, winter waterfowl and raptor surveys and acoustic bat surveys. and preparation of the Environmental Impact and Biological Assessments at the Cape Vincent Wind Project, New York

STATISTICS & BIOMETRICS

Biometricians with WEST are internationally known for their common sense application of statistics to solve natural resource problems. They specialize in practical, state-of-the-art design and analysis of field and laboratory studies. WEST's statisticians have written and published 9 books and over 250 manuscripts on the use of statistics in natural resource applications. To complement these books and articles, WEST offers short courses and workshops on a variety of statistical topics related to natural resource and wildlife applications.

AREAS OF EXPERTISE

- General and Advanced Statistical Analysis Techniques
- Design and Statistical Analysis of Ecosystem Studies
- Estimation of Biological Population Size, Including Capture/Recapture and Distance Methods
- Resource Selection Studies
- Design and Analysis of Radio-Telemetry Studies
- Design and Analysis of Environmental Monitoring Studies
- Design and Analysis of Wildlife and Plant Risk Assessment Studies
- Design and Analysis of Bird and Bat Studies
- Pre-, During-, and Post-Construction Wind Farm Studies
- Design and Analysis of Marine Mammal Studies
- Educational Workshops, Short-Courses and Professional Training

GENERAL AND ADVANCED STATISTICAL ANALYSIS TECHNIQUES

WEST statisticians can advise on and conduct a wide range of statistical techniques from basic descriptive and graphical analyses to complex modeling of correlated data. The following is a partial list of the statistical expertise that the team members of WEST possess:

- Descriptive and Graphical Analyses
- Sampling
- General and Generalized Linear Models
- 1-D, 2-D and 3-D Smoothing Techniques
- Mixed Models
- Survival Analysis
- Bootstrapping and other Computer Intensive Techniques
- Telemetry and Triangulation Methods
- Simulation Techniques
- Bayesian Statistical Techniques
- Non-Parametric Methods
- Distance Sampling Methods
- Capture/Recapture Methods
- Statistical Methods for Risk Assessment
- Resource Selection

WEST uses the most modern and advanced statistical and mathematical software including SAS, R, MATLAB and ARC GIS, as well as programming languages such as FORTRAN and C.

Estimation of Biological Population Size

WEST can provide state-of-the-art consulting on all aspects of studies designed to estimate size and geographic extent of a biological population. This expertise includes the use of capture-recapture, distance sampling and aerial survey methods for all types of biological populations. WEST has been actively involved in the development, review, and analysis of capture-recapture studies for the estimation of population parameters. Professor Bryan F.J. Manly and Dr. Trent McDonald are internationally known experts in the development of models for analysis of capture-recapture data and are editors of a book on the subject. Dr. Trent McDonald has published a freely available package of R routines used by researchers around the world to conduct capture-recapture analyses.

Resource Selection Studies

WEST is a leader in the development of modern modeling techniques for study of resource selection by animal population. Four senior-level WEST statisticians co-authored a book in which methods are standardized and developed. The statistical staff at WEST developed the first method to correct resource selection estimates for missing radio and GPS telemetry locations.

Radio Telemetry Studies

WEST has experience in the conduct and statistical analysis of radio-telemetry studies, including resource selection and animal movements, and the complexities of analyses incorporating spatial and temporal correlations.

Design and Analysis of Field Studies

WEST's major contribution in many studies is expert consultation on design and statistical analysis of field ecology studies. Emphasis is placed on development of study protocols and standard field procedures that result in statistical inferences, which are justified by the study design. WEST employees contribute to field studies by directly participating in collection of field data.

Design and Analysis of Bird and Bat Studies

WEST is the industry leader in design and analysis of bird and bat studies, particularly around wind farm developments. WEST employs state-of-the-art methods and instruments to estimate use, carcass removal, mortality, and impact of developments on local bird and bat populations.

Books and Publications

WEST statisticians have authored or co-authored over 250 professional journal articles and nine books on the statistical methods applied to wildlife and other natural resource problems.

WORKSHOPS AND SHORT COURSES

WEST offers workshops and professional training in a 1-day and 5-day format on the following topics:

- Resource Selection by Animals
- Capture-Recapture Methods
- Environmental and Ecological Sampling
- Computer Intensive Statistics
- Introductory Statistics

THREATENED & ENDANGERED SPECIES

WEST has extensive experience working with threatened and endangered (T&E) species and compliance with the Endangered Species Act (ESA). WEST has conducted numerous Biological Assessments for a variety of projects such as highway construction, wind power plants, gravel mines, and reservoirs. WEST personnel have working knowledge with numerous listed species and are familiar with techniques necessary to study rare and uncommon wildlife and plants. WEST personnel have been trained by the U.S. Fish and Wildlife Service in Section 7 consultation, Habitat Conservation Planning, and survey methods for a variety of species including: black-footed ferrets, Wyoming toads, Preble's meadow jumping mouse, Mexican spotted owls, Ute ladies' tresses orchid, and Colorado butterfly plant.

REPRESENTATIVE PROJECTS

- Biological Assessments to evaluate impacts to T&E species for numerous highway construction projects in Wyoming and Montana.
- Biological Assessments to evaluate impacts to the proposed mountain plover associated with the Foote Creek Rim Wind Plant in Wyoming.
- Biological Assessments to evaluate impacts to bald eagle from wind plants in central Washington.
- Biological Assessments to evaluate impacts to the endangered Indiana and Virginia big-eared bats associated with wind power development in the state of West Virginia.
- Greybull Valley Dam and Reservoir Project Biological Assessment; Bureau of Land Management and Army Corps of Engineers.
- Executive Director for the effort to develop a recovery implementation program for four threatened and endangered species that use the Platte River in Nebraska; the whooping crane, piping plover, least interior tern, and pallid sturgeon, States of Colorado, Nebraska, Wyoming, and the Department of the Interior.
- City of Buffalo, Wyoming hydropower plant site Biological Assessment; Federal Energy Regulatory Commission and States West Water Resources Corporation.
- Wind River Indian Reservation dam modification projects Biological Assessment; Natural Resource Consulting Engineers.
- Wyoming Department of Environmental Quality, Abandoned Mine Land Program Biological Assessments; these assessments were written for over forty abandoned mine sites.
- Montana Department of Transportation highway reconstruction projects Biological Assessments for bull trout and west slope cutthroat trout.
- Habitat Conservation Plan for whooping cranes and lesser prairie chicken. American Wind Energy Association.

Species Studies, Surveys and Clearances

- Black-footed ferret searches for numerous projects for the Wyoming Department of Transportation, Farmers Home Administration, Union Pacific Resources, Department of Energy, and private oil development interests.
- Black-footed ferret release, Shirley Basin, Wyoming analysis of data; Wyoming Game and Fish Department.
- Wyoming toad searches 1994-1995, Laramie Basin, Albany County; Wyoming Toad Task Force, Wyoming Department of Agriculture, and Wyoming Department of Transportation.
- Evaluation of subspecies differences of the California gnatcatcher using morphological data; Chevron Land and Development Company.
- Preble's meadow jumping mouse surveys, Wyoming Department of Transportation, City of Cheyenne, U.S. Air Force, City of Torrington, U.S. Fish and Wildlife Service.
- Surveys for Ute ladies' tresses orchid, Colorado butterfly plant, Blowout Penstemon, Desert Yellowhead; Wyoming Department of Transportation, Bureau of Land Management, BP Amoco.
- Surveys for listed bats - Indiana bat, gray bat, Virginia big-eared bat - New York, Pennsylvania, Virginia, Missouri, Arkansas, Indiana, Illinois.

Endangered Species Experience

- Indiana Bat (Myotis sodalis), endangered-Indiana, West Virginia
- Grey Bat (Myotis griscens), endangered-Indiana
- Grizzly Bear (Ursus arctos horribilis), threatened-Wyoming
- Black-footed Ferret (Mustela nigripes), endangered-Wyoming, South Dakota
- Preble's Meadow Jumping Mouse (Zapus hudsonuis preblei), threatened- Colorado
- Swift Fox (Vulpes velos), endangered-Nebraska
- Washington Ground Squirrel (Spermophilus washingtoni), threatened-Oregon
- Virginia Big Eared Bat (Corynorhinus townsendii virginianus), endangered-West Virginia
- Bald Eagle (Haliaeetus leucocephalus), threatened-Wyoming, Washington, Oregon

- Wood Stork (Mycteria americana), endangered-Georgia
- Mexican Spotted Owl (Strix occidentalis lucida), endangered-Arizona
- Mountain Plover (Charadrius montanus), proposed-Wyoming
- Whooping Crane (Grus americana), endangered-Nebraska
- California Gnatcatcher (Polioptila californica)-California
- Interior Lesser Tern (Sterna antillarum athalassos), endangered-Nebraska
- Piping Plover (Charadruis melodus), threatened-Nebraska
- Greater Sage Grouse (Centrocercus urophasianus), candidate - Washington; sensitive - Wyoming, Idaho, Oregon, California, Nevada
- Lesser Prairie Chicken (Tympanuchas pallidicinctus), candidate - Texas, Oklahoma, Kansas, Colorado
- Copperbelly Water Snake (Nerodia erythrogaster neglecta), threatened-Indiana
- Kirtland's Snake (Clonophis kirlandii), threatened-Indiana
- Green Sea Turtle (Chelonia mydas), endangered-Florida
- Desert tortoise (Gopherus agassizii), endangered - California
- Allen's Cay Rock Iguana (Cyclura cychlura inornata), endangered- Exuma Cays, Bahamas
- Riley's Rock Iguana (Cyclura rileyi), endangered- Exuma Cays, Bahamas
- Wyoming Toad (Bufo baxteri), endangered-Wyoming
- Bull Trout (Salvelinus confluentus), threatened-Montana
- Westslope Cutthroat Trout (Oncorhynchus clarki lewsi), proposed-Montana
- Pallid Sturgeon (Scaphirhynchus albus), endangered-Nebraska
- Ute Ladies' Tresses Orchid (Spiranthes diluvialis), threatened-Wyoming, Washington, Montana
- Colorado Butterfly Plant (Guara neomexicana coloradensis), threatened-Wyoming, Colorado
- Blowout Penstemon (Penstemon haydenii), endangered-Wyoming
- Desert Yellowhead (Yermo xanthocephalus), endangered-Wyoming
- Western Prairie Fringed Orchid (Platanthera praeclara), threatened-Nebraska

TRANSMISSION LINE EVALUATION & MONITORING

WEST personnel have worked on all aspects of environmental permitting for transmission lines (69kV-500kV) including siting studies, habitat assessments, wildlife surveys, endangered species investigations, preparation of NEPA documents, Biological Assessments and Section 7 consultation, and implementation of monitoring programs. WEST possesses a thorough understanding of natural resource regulations and agency requirements, and has worked on transmission line projects in the Midwest, Intermountain West, Great Basin, Southwest, and Pacific Northwest regions. Dr. Terrence Enk joined WEST in March 2010 and brought with him extensive experience managing biological resource investigations and analyses in support of permitting for large, complex transmission line projects throughout the United States.

REPRESENTATIVE PROJECTS AND EXPERIENCE

- **Sigurd to Red Butte Transmission Project, Utah, Rocky Mountain Power**
  Managed biological resource inventory and analyses in support of an EIS for a 345kV transmission line in Utah. Primary biological issues include Utah prairie dog, greater sage-grouse, big game winter range, and raptor nests. The BLM was lead agency.
- **Energy Gateway South, Wyoming/Colorado/Utah/Nevada, PacifiCorp**
  Managed biological resource inventory and analyses in support of an EIS for a 500kV transmission line from Rawlins, WY to Las Vegas, NV. Primary biological issues included greater sage-grouse, big game habitat, raptor nests, and more than 30 T & E species. The BLM was lead agency.
- **Mona to Oquirrh Transmission Project, Utah, Rocky Mountain Power**
  Managed biological resource inventory and analyses in support of an EIS for one 500kV transmission line, two 345kV transmission lines, and two substations west of Salt Lake City. Primary biological issues included raptor nesting areas, greater sage-grouse, crucial seasonal habitats for mule deer and elk, and waterfowl and shorebirds. Prepared a Biological Assessment and participated in the Section 7 consultation process. The BLM was lead agency.
- **Southwest Intertie Project, Idaho/Nevada, L.S. Power**
  Managed field surveys for greater sage-grouse and pygmy rabbits for a 500kV transmission line between Jerome, Idaho and Ely, Nevada. Developed a pygmy rabbit habitat model to identify potential habitat. The BLM was lead agency.
- **Transmission Line Routing and Siting Studies, Utah, PacifiCorp**
  Managed biological resource inventory and analyses to support routing and siting studies in northeast Utah. Primary biological issues were federally listed species, Utah sensitive species, and sensitive habitats.
- **Mountain States Transmission Intertie, Montana/Idaho, Northwestern Energy**
  Managed biological resource inventory and analyses to support and EIS and Montana Major Facilities Siting Act application for a 500kV transmission line in Montana and Idaho. Coordinated data collection efforts with five national forests, six BLM field offices, two state wildlife agencies, and Natural Heritage programs in Montana and Idaho. Primary biological issues included greater sage-grouse, raptor nesting areas, big game seasonal habitats, waterfowl, and listed and sensitive plant and wildlife species. The BLM was lead agency.

- **Sunrise Tap Transmission Line Project, Nevada, Nevada Power Company**
  Managed biological resource inventory and analyses to support an EA and Section 7 consultation for a 500kV transmission line and associated substations in Nevada. Coordinated surveys for sensitive plant and wildlife species including desert tortoise, yellow-billed cuckoo, Yuma clapper rail, and Las Vegas bearpoppy. The Bureau of Reclamation and BLM were lead agencies.
- **Rhodes to Phillipsburg Transmission Line Project, Kansas, Sunflower Electric**
  Managed biological resource inventory and analyses to support an EA for a 115kV transmission line and two substations in Kansas.
- **CJ Strike to Riddle Transmission Line, Idaho, Raft River Rural Electric Coop**
  Managed biological resource inventory and analyses to support an EA and Section 7 consultation for a 138kV transmission line in southern Idaho. Primary issues included pygmy rabbit, greater sage-grouse, Columbia spotted frog, bald eagle, and yellow-billed cuckoo. The BLM was lead agency.
- **Prairie State Interconnect Project, Illinois, AmerenIP**
  Managed biological resource inventory and analyses to support an application for a 345kV transmission line in Illinois. Primary issues included bald eagle nests, Indiana bat, and numerous state-listed reptile and amphibian species. Prepared a Conservation Plan for the Illinois Department of Natural Resources involving 17 species.
- **Antelope-Wasatch Corridor Study, Wyoming/Utah, PacifiCorp**
  Managed biological resource inventory and analyses to support a corridor study for 430 miles of 500kV transmission line. Project included data collection, habitat assessments and sensitivity analysis, alternative corridor identification, route comparison, and preparation of a siting study report. Coordinated with three national forests, eight BLM field offices, and two State wildlife agencies.
- **Cambridge-Council-McCall Transmission Line, Idaho, Idaho Power Company**
  Managed biological resource inventory and analyses to support an application for a 138kV transmission line in Idaho. Primary biological issues included bald eagle, gray wolf, Canada lynx, northern goshawk, northern Idaho ground squirrel, southern Idaho ground squirrel, and Columbia spotted frog. Prepared a Biological Assessment and participated in the Section 7 consultation process. The BLM and U.S. Forest Service were co-lead agencies for this project.
- **Yreka-Weed Transmission Line, California, PacifiCorp**
  Managed biological resource inventory and analyses to support a CEQA EA for a 115kV transmission line in California. Primary biological issues included badger, bald eagle, yellow-billed cuckoo, sandhill crane, Swainson's hawk, fairy shrimp, and anadromous fish.
- **Belfield-Rhame Transmission Line, and Williston-Tioga Transmission Line, North Dakota, Basin Electric Cooperative**
  Managed and implemented breeding bird nest clearances as part of compliance with MBTA and EA requirements. In addition, conducted tree and shrub inventory and developed replanting plans for state PSC compliance.

VEGETATION SAMPLING & PLANT SURVEYS

WEST has conducted numerous research studies to quantify vegetation using line transect, point transect, quadrat and plotless techniques. These studies have been conducted to obtain quantitative baseline data for use in future comparisons, to monitor success of reclamation, and to monitor success of created wetlands. WEST has also prepared numerous vegetation maps in a variety of habitats, along with both quantitative and qualitative descriptions of habitat types. WEST has conducted numerous searches for federally-listed plant species including blowout Penstemon, Ute's Ladies' Tresses, and Colorado butterfly plant, as well as searches for U.S. Forest Service, Bureau of Land Management, and state-listed rare plants. WEST has also conducted qualitative plant surveys for National Environmental Protection Act projects and prepared extensive plant lists to describe a variety of habitats. WEST employees have completed formal training in plant identification.

REPRESENTATIVE VEGETATION SAMPLING & PLANT SURVEY CLIENTS

- BP Amoco
- Wyoming Department of Transportation
- Montana Department of Transportation
- Cheyenne Board of Public Utilities
- Wyoming Water Development Commission
- Wyoming Department of Environmental Quality
- Merit Energy Company
- Union Pacific Resources
- Central Nebraska Public Power and Irrigation District
- Northwestern Wind Power
- Bonneville Power Administration
- Renewable Energy Systems

REPRESENTATIVE VEGETATION SAMPLING & PLANT SURVEY PROJECTS

- Documented baseline condition (species composition, percent cover, heights and age classes) of willows and alders using line transect surveys along 7.5 miles of woody riparian areas to be used for riparian mitigation south of Rawlins, Wyoming.
- Conducted an intensive, quantitative vegetation survey on two properties totaling 6,670 acres adjacent to the Platte River in central Nebraska. Eight habitat types were sampled using the modified step-point sampling method and the point-center quarter plot method.
- Prepared vegetation maps for six wind power turbine sites in Washington and Oregon. Habitat types were mapped on black and white aerial photography in the field; maps were then digitized using ArcView™.

- Monitored success of reclamation of 41-mile Wahsatch Sour Gas Gathering System pipeline on Utah/Wyoming border through quantifying vegetation species composition and percent cover using line transects and Daubenmire frames.
- Developed extensive species lists and collected quantitative vegetation data using point intercept technique at the site of a former refinery in Casper, Wyoming to provide data required to prepare a wildlife risk assessment.
- Developed plant species lists and conducted rare plant survey and prepared vegetation and sensitive plant species portions of Environmental Assessments for 30 abandoned mine reclamation projects under Wyoming's Abandoned Mine Land Program.

- Mapped vegetation types, developed plant species lists, conducted rare plant surveys and prepared the vegetation portion of an EIS for highway reconstruction project in Fremont and Teton Counties, Wyoming.
- Conducted surveys for the endangered blowout penstemon (*Penstemon haydenii*) and threatened Ute's Ladies' Tresses (*Spiranthes diluvialis*) and Colorado butterfly plant (*Gaura neomexicana*) for numerous sites in southeast Wyoming.

WETLANDS & WATER QUALITY

WEST has conducted numerous wetland delineations to determine jurisdictional status pursuant to Section 404 of the Clean Water Act. WEST is also experienced in developing wetland mitigation plans and monitoring the success of created wetlands. Several WEST employees have completed formal training in wetland delineation, plant identification, and wetland construction and restoration for the *Wetland Training Institute.* Delineations are conducted according to the U.S. Army Corps of Engineers 1987 manual. WEST has also conducted several water quality monitoring projects and is experienced in the use of EPA rapid bioassessment method.

REPRESENTATIVE WETLANDS & WATER QUALITY CLIENTS

- Wyoming Department of Transportation
- Montana Department of Transportation
- Utah Department of Transportation
- Bonneville Power Administration
- Wyoming Water Development Commission
- City of Buffalo, Wyoming
- City of Laramie, Wyoming
- Wheatland Irrigation District
- Kennedy Engineering, Inc.
- Merit Energy Company
- Wyoming Department of Environmental Quality
- BP Amoco
- Texaco

REPRESENTATIVE WETLANDS & WATER QUALITY PROJECTS

- Monitored success of 17 created and two restored wetlands near Buffalo, Wyoming using line transects and quadrats to quantify vegetative composition, density, and vigor by documenting wildlife use of created wetlands.
- Monitored water quality, substrate composition, and aquatic invertebrates using standard monitoring procedures and EPA's rapid bioassessment methods on North Fork of Shoshone River, Park County, Wyoming.

- Conducted aquatic bioassessment using EPA rapid bioassessment method on Little Goose Creek in Sheridan, Wyoming to assess effects of an oil spill on the stream.
- Delineated wetlands along North Platte River, selected wetland mitigation sites, and prepared conceptual wetland mitigation designs for two closed refinery remediation projects in Casper, Wyoming.
- Delineated wetlands for numerous highway construction projects encompassing an estimated 350 miles of road in Wyoming and Montana.
- Selected mitigation sites and assisted with design of mitigation plans to mitigate 17 acres of wetland and 60 acres of riparian area impacts associated with the High Savory Dam in Carbon County, Wyoming.
- Designed reclamation of 28 ponds on abandoned bentonite mines in Wyoming to improve waterfowl habitat value, and prepared U.S. Army Corps of Engineers Section 404 Permit applications for reclamation of the ponds.
- Delineated 900 acres of wetlands in Carbon County, Wyoming for inclusion in the Wyoming Wetland Bank. These wetlands were the first accepted for the bank in the state of Wyoming.

WILDLIFE RESEARCH & MANAGEMENT

With our unique combination of ecologists and biometricians, WEST is outstanding in the field of wildlife and natural resource studies. WEST ecologists have many years of experience designing and conducting a wide variety of natural resource studies and are skilled in numerous field methods and techniques. WEST biometricians have many years experience designing studies and analyzing data for a variety of natural resource issues and utilize state-of-the-art statistical methods and computers. The combination of expertise provides our clients with credible, objective, and responsible solutions to natural resource questions and problems.

WILDLIFE EXPERTISE

- Estimation of Animal Abundance and Biodiversity
- Resource Selection Analyses
- Population and Community Level Studies and Gap Analysis
- Terrestrial, Avian and Aquatic Resources Impact Assessments
- Management, Conservation and Monitoring Plans

REPRESENTATIVE WILDLIFE PROJECTS

Non-game and General Wildlife Studies

- Black Oystercatcher Monitoring Protocol; Chugach National Forest, AK
- Water for Wildlife Foundation Strategic Plan and program development; Water for Wildlife Foundation
- Resident and migratory bat surveys-use of mist nets and bat echolocation detectors (Anabats) to survey bat populations in and near wind resource areas in southwest Minnesota.
- Neotropical Migratory Bird Survey and Nest Searching, Naval Surface Warfare Center, Crane, Indiana; U.S. Navy.
- Raptor nest monitoring and relocation, Abandoned Mined Land Program and Wyoming Department of Transportation projects; proposed and constructed Wind Plants, Wyoming, Oregon, and Washington.
- Mountain plover surveys and nest monitoring in agriculture setting, wind resource areas, BLM lands, Wyoming.
- Wintering Waterfowl Studies, South Platte River, Denver, Colorado- evaluated waterfowl abundance, species composition, habitat use, behavior and food habits.
- Evaluation of Timber Management on Nongame Birds, Ashland Wildlife Research Area; Missouri Department of Conservation.
- Prairie Dog Management Plan, Pine Ridge Indian Reservation; Bureau of Indian Affairs.

Big Game Studies

- Use of satellite telemetry studies to evaluate effects of oil and gas development on mule deer in the Green River Basin of Wyoming.
- Developed Northern Great Plains Mule Deer Habitat Suitability Index (HSI) model using Habitat Evaluation Procedures; U.S. Forest Service, Nebraska National Forest.
- Resource selection model for elk west of the Cascade crest in OR and WA.

- Mule Deer Surveys, Rattlesnake and Shirley Mountains, Wyoming-conducted ground surveys and evaluated helicopter survey data for estimating sex and age composition; Wyoming Game and Fish Department.
- Compendium on Management and Research on Mountain Lions in Wyoming; Wyoming Game and Fish Department.
- Dall Sheep and Mountain Goat Survey, Kenai National Wildlife Refuge, Alaska-designed survey protocol and analyzed survey data; U.S. Fish and Wildlife Service and Alaska Department of Game and Fish
- Mule Deer Impact Assessments-designed protocols and implemented long term study to assess impacts from energy development on western Wyoming mule deer herds; Bureau of Land Management and Wyoming Game and Fish Department.
- Effects of a multi-use pathway on elk habitat use in Grand Teton National Park.
- Polar Bear Survey Protocol for the Chukchi Sea; U.S. Fish and Wildlife Service.

WIND ENERGY SERVICES

WEST has been a leader in the field of wind power impact assessment, monitoring, natural resources research, and permitting of wind energy development since 1994. WEST has participated in various aspects of wind projects throughout the U. S. and has played a leading role in understanding, assessing, and placing into perspective the impacts of wind projects on wildlife and habitat using scientifically credible and defensible monitoring and research methods. WEST has developed risk assessments for proposed wind energy facilities, which incorporate comparable datasets and meta-analyses on multiple spatial scales and for different taxonomic groups. WEST has successfully worked for all stakeholders involved in wind issues, including state and federal agencies, industry, consultants, utilities, and conservation organizations.

EXPERTISE AND SERVICES

- Site Characterization Studies, Phase One Risk Assessments, Critical Environmental Issues Analyses
- Baseline Avian and Bat Research Studies and Assessments
- Threatened, Endangered and Sensitive Species Surveys
- Biological Assessments and Habitat Conservation Plans for Federally Listed Threatened and Endangered Species
- State Incidental Take Permit Application, e.g. New York State Article 11
- Bat and Avian Acoustic Surveys; Marine Radar Surveys
- Permitting, Siting Analyses, Environmental Impact Studies
- Construction Monitoring and Environmental Training
- Post-Construction Impacts Monitoring; Research Studies
- Mitigation, Reclamation, and Re-vegetation Planning
- On-Shore and Off-Shore Studies

RESEARCH STUDIES

- Investigation of factors potentially affecting collision risk at San Gorgonio and Tehachapi Pass WRA's, California

- Effects of UV reflective paint on avian mortality, Foote Creek Rim Wind Project, Wyoming
- Bat and wind turbine interactions at the Buffalo Ridge Wind Project, Minnesota
- Grassland bird displacement impacts at the Stateline Wind Project, Oregon/Washington
- Mountain Plover population studies, Foote Creek Rim Wind Project, Wyoming
- Programmatic Habitat Conservation Plan for Whooping Cranes and Lesser Prairie Chickens, American Wind Energy Association

Invited Expertise

WEST personnel have been invited speakers at numerous wind-wildlife meetings nationwide. WEST personnel have served as technical experts for the Federal Advisory Committee, the New York State Energy Research and Development Authority, the Virginia Regulatory Advisory Panel, the American Wind Energy Association and the National Wind Coordination Collaborative. WEST personnel have presented papers and been invited speakers at national meetings of the North American Symposium on Bat Research, American Wind Energy Association, The Wildlife Society, Partners in Flight, Bat Wind Energy Cooperative, the National Wind Coordinating Collaborative, Northern Arizona University Renewable Energy Department, and the American Ornithologists' Union.

General Services Experience for Wind Projects

WEST has provided the following services at wind projects throughout the U.S.: avian, bat, wildlife, threatened and endangered species, vegetation, and wetland surveys - risk and impact assessments - baseline study plans - mitigation and monitoring plans - monitoring and research studies - Habitat Conservation Plans (HCP) - fatal flaw analysis - statistical analysis - GIS mapping - Conditional Use Permit Applications (CUP) - Environmental Impact Statements (EIS) - Environmental Assessments (EA) - Biological Assessments (BA) - USFWS Consultation - wind turbine siting - agency and conservation group meetings.

Wildlife and Vegetation Study Experience

WEST has conducted a wide variety of wildlife studies at wind projects throughout the U.S.: raptor surveys - passerine surveys - mountain plover surveys - raptor nest surveys - owl surveys - big game surveys - prey availability surveys - habitat mapping - vegetation surveys - sensitive species surveys - sage grouse lek surveys - nocturnal migration radar studies - searcher efficiency trials - ground squirrel surveys - scavenger removal trials - bat habitat surveys - mortality studies - bat mist-netting - bat acoustic surveys - general wildlife observations - Phase I risk assessment studies- threatened and endangered species surveys- bald and golden eagle surveys - rare plant surveys – radio telemetry studies.

REPRESENTATIVE WIND POWER CLIENTS

Acciona
AECOM
Apex Wind
Bat Conservation International
BP Wind Energy, North America
Bonneville Power Administration
CH2M Hill
Distributed Generating Systems
Dominion Power
Electric Power Research Institute
Energy Northwest
enXco
ERM
Eurus Energy America Corporation
FPL Energy, Inc.
Horizon Wind Energy
Iberdrola
Invenergy
Kittitas , Klickitat Counties, Washington
National Wind Coordinating Committee
National Renewable Energy Laboratory
PacifiCorp
Renewable Energy Systems
Renewable Northwest Project
SeaWest Windpower, Inc.
Shell Wind Energy
Third Planet Windpower
URS
Xcel Energy

PEER REVIEWED PUBLICATIONS

Kerlinger, P. J. Gehring, W. Erickson, R. Curry, J. Guarnaccia and A. Jain. Night Migrant Fatalities and Obstruction Lighting at Wind Turbines in North America. *The Wilson Journal of Ornithology* 122(4):744–754, 2010

Johnson, G.D., M.D. Strickland, W.P. Erickson, and D.P. Young, Jr. 2007. Use of data to develop mitigation measures for wind power development impacts to birds. Pages 241-257 in *Birds and Wind Farms, Risk Assessment and Mitigation.* M. de Lucas,G.F.E. Janss, and M. Ferrer, (eds.). Quercus Press, Madrid, Spain.

Strickland, M.D., W.P. Erickson, D.P. Young, Jr., and G.D. Johnson. 2007. Selecting study designs to evaluate the effect of windpower on birds. Pages 117–136 in *Birds and Wind Farms, Risk Assessment and Mitigation.* M. de Lucas, G.F.E. Janss, and M. Ferrer, (eds.). Quercus Press, Madrid, Spain.

Arnett, E.B., W.K. Brown, W.P. Erickson, J. Fiedler, B.L. Hamilton, T.H. Henry, A. Jain, G.D. Johnson, J. Kerns, R.R. Koford, C.P. Nicholson, T. O'Connell, M. Piorkowski, and R. Tankersley, Jr**.** 2007. Patterns of fatality of bats at wind energy facilities in North America. *Journal of Wildlife Management*: In Press.

Kunz, T.H., E.B. Arnett, W.P. Erickson, A.R. Hoar, G.D. Johnson, R.P. Larkin, M.D. Strickland, R.W. Thresher, and M.D. Tuttle. 2007. Ecological impacts of wind energy development on bats: questions, research needs and hypotheses. *Frontiers in Ecology and the Environment* 5:315-324.

Johnson, G.D. 2005. A review of bat mortality at wind-energy developments in the United States. *Bat Research News* 46:45-49.

Johnson, G.D., M.K. Perlik, W.P. Erickson, and M.D. Strickland. 2004. Bat activity, composition and collision mortality at a large wind plant in Minnesota. Wildlife Society Bulletin 32:1278-1288.

Johnson, G.D., W.P. Erickson, M.D. Strickland, M.F. Shepherd, D.A. Shepherd, and S.A. Sarappo. 2003. Mortality of bats at a large-scale wind power development at Buffalo Ridge, Minnesota. *The American Midland Naturalist* 150:332-342.