Dragonflies and damselflies: Invertebrate indicators of ecological health

By Carol DiSalvo, Richard Orr, and David Foote

INVERTEBRATES, magnificent spineless creatures that few people ever ponder in a positive way, constitute the bulk of biological diversity on Earth and in our national parks. They dominate every global ecosystem in terms of species richness, biomass, and ecological function and are the foundation of every food chain, inhabiting niches from caves to the Arctic. Invertebrates play essential and remarkably diverse roles as decomposers, food sources, herbivores, dispersal agents, and pollinators. And they are important indicators of ecosystem health.

Despite their importance and abundance, invertebrates have been largely overlooked. Research focusing on this huge taxonomic group has been poorly funded compared with the study of more charismatic species such as mammals, birds, and fish. Fortunately, the critical importance of invertebrates is finally being acknowledged thanks to brilliant ecologists and enthusiasts such as E. O. Wilson and a handful of exceptional and pioneering natural resource managers of the Department of the Interior. These stewards are demonstrating how surveys of invertebrates can help park managers evaluate and detect change in ecosystem health and biodiversity.

Dragonflies and damselflies, of the order Odonata, are well-known invertebrates and are of great ecological importance. The odonates comprise a significant animal component of aquatic environments. As insect predators low in the food chain, odonates reflect changes in the health of aquatic ecosystems much faster than can be recognized through monitoring most other animal or plant groups. Using these indicator species in baseline surveys provides a measure of the current health of the various aquatic systems in a park and is an excellent monitoring tool for predicting future changes in those environments. Furthermore, information on the presence and function of damselflies and dragonflies in national parks is important if an ecosystem approach to management is to be successful. Yet, to date, only a handful of parks have begun this type of monitoring.

The larval *Megalagrion koelense* damselfly (above) perches on the leaf of a native Hawaiian lily where it completes its life cycle by preying on other insects.

The Hawaiian damselfly *Megalagrion koelense* (adult male depicted, left) breeds in leaf pockets of native lilies.

Hawaiian damselflies *Megalagrion calliphya* perch on emergent aquatic vegetation (below). The red male holds on to the green female while she inserts eggs into the plant stem.

Eastern North America is one of the global hot spots of dragonfly biodiversity and an ideal region for realizing the potential of monitoring odonates. One of the first surveys of this type is occurring at Harpers Ferry and C&O Canal National Historical Parks, and Rock Creek Park. Increasing concern about the consequences for nontarget species of proposed insecticide used to combat West Nile Virus has led resource managers to initiate a three-year study of odonates. The survey has begun to describe the distribution and abundance of species, including those that are rare, threatened, or endangered. This baseline information may help delineate risks and avoid unnecessary insecticide treatments. Odonates are the most common and conspicuous animals around the aquatic wetlands of the three parks, and more than 90 species were identified in the first field season of the survey. This includes a number of state-listed species and the first location of viable populations of mocha emerald and clamp-tipped emerald dragonflies (*Somatochlora linearis* and *S. tenebrosa*, respectively) in the District of Columbia. Although the study is not complete, scientists expect that additional state- and district-listed rare or threatened species will be found.

In the West, Carlsbad Caverns National Park announced in July the discovery of a rare damselfly, *Argia leonorae*, not previously known in New Mexico. A University of Texas biology class led by John Abbott made the discovery. Abbott and his students found a single adult male, which is blue in color. Known as Leonora's dancer, it is named for Leonora Gloyd, who studied North American damselflies for 50 years. This species was federally listed as rare in 1996 and is thought to be extirpated from its only population in Texas, 100 miles south of the park, because of habitat changes.

The Hawaiian Islands host 36 species of odonates, including an entire genus of 25 damselflies (*Megalagrion* species) that are unique to the islands. The two endemic Hawaiian dragonflies, the Blackburn dragonfly (*Nesogonia blackburni*) and the giant Hawaiian dragonfly (*Anax strenuus*), are common to remote montane forest streams. In contrast, a number of the *Megalagrion* damselflies have become rare, especially in lowland habitat. Six of these *Megalagrion* species are under consideration for listing under the Endangered Species Act.

The Hawaiian damselflies represent a remarkable instance of ecological diversification during their evolution on the islands. Some *Megalagrion* damselflies are found at traditional breeding sites such as stream edges and freshwater pools, but others occur in very unusual settings. For instance, many breed on freshwater seeps that flow across moss-covered rocks well above a stream, in some cases along the edge

of waterfalls. Even more amazing are two semiterrestrial species that have abandoned streams altogether and breed in water that collects in the bases of leaves of climbing vines and lilies. The larvae use these small pockets of water to capture and feed on other insects and small snails. The most extreme case is the completely terrestrial *Megalagrion oahuense*, a Hawaiian damselfly that has abandoned not only the streams but also the leaf pockets. Its hairy larvae live in damp leaf litter under banks of uluhe ferns in the wet upper-elevation rainforests on the island of Oahu. This species has completely lost the ability to breed in water.

The diversity of breeding habitats among *Megalagrion* damselflies has recently been used by researchers with the U.S. Geological Survey at Hawaii Volcanoes National Park. USGS ecologists are measuring how communities of damselflies change in response to moisture stress and temperature change. They are observing systematic shifts in damselfly community composition associated with changing hydrologic conditions. In this way, Hawaiian damselflies are serving as a focal group to better understand the consequences of long-term climate change.

Major threats to Hawaiian damselflies include habitat degradation and alien species introductions. Lower- and mid-elevation aquatic habitats are often invaded by alien fish that prey on the damselfly larvae. On Oahu, the endemic orange-black damselfly (*M. xanthomeles*) is a proposed threatened species and the focus of ongoing conservation efforts. It is being restored to low-elevation breeding sites that are free of alien fishes, and is also being studied at Kaloko Honokohau National Historical Park on the island of Hawaii, where the species breeds in rare coastal pools that are threatened by upslope industrial development. This is another example of how *Megalagrion* can serve as sentinels of ecosystem health in a wide range of unique habitats in national parks of Hawaii.

The odonates are important ecological, scientific, and educational park resources. Information from inventory and monitoring applied to management practices will reduce risks to odonates and other invertebrates and their habitats. In addition, this information is valuable for addressing threatened and endangered species issues and the conservation, planning, and management of freshwater aquatic ecosystems. ■

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award-winner

Doug Smith heads wolf restoration project

For his leadership in the restoration of the gray wolf in the northern Rocky Mountains, Dr. Doug Smith received the Director's Award for Natural Resource Management. As Wolf Project leader, Doug has played a major role in the success of this venture. (See *Natural Resource Year in Review—2001*, page 51.) This project serves as a model for how to restore, manage, monitor, and live with a large predator, and has far-reaching implications for the restoration of wildlife worldwide.

When the wolves were first brought from Canada in 1995 and 1996, Doug managed their care in the acclimation pens and has continued to do so since their release, developing procedures to restrict human use around active wolf dens, managing nuisance wolves outside the park, and investigating wolf fatalities. Monitoring wolves is difficult but crucial to this project. Doug devised innovative long-term wolf monitoring and research procedures. His winter study strategy has allowed investigators to closely observe wolves making kills and interacting among themselves and with other species. These data have led to the development of statistical methods for estimating how often wolves kill large prey.

Armed with this kind of information, Doug and fellow project advocates can rebut charges from angry opponents of the project that the wolves are decimating the elk herds, and that their population is exploding. His many outreach activities are important for winning support and raising funds. He is an educator about wolves, making presentations to lay audiences, teaching wildlife education courses, mentoring graduate students, and contributing articles to journals and books. He has integrated more than 150 volunteer scientists into the park's management and research programs, and through the Yellowstone Visiting Scholars Program has welcomed wildlife biologists from around the country and abroad.

Dr. Doug Smith receives the Director's Award for Natural Resource Management from Dr. Lee Talbot, a coauthor of the Endangered Species Act, and Yellowstone Center for Resources Director John D. Varley.

Growing up in rural Ohio, Doug says, "My interest in nature and remote places was nurtured by my father and then focused on wolves when my brother bought me the classic book *The Wolf* by L. David Mech," prompting him, at age 16, to write Mech asking for a job. Now, a few decades later, young people are contacting Doug with aspirations of working with wildlife in remote places. ■