10

ADDING THINGS UP

Cumulative effects and why we need to monitor and assess them

A Commitment to Monitoring and Experimentation

Monitoring, learning, and adaptive management are fundamental elements of the trust's approach to stewardship of the VCNP. As each new management program or activity develops, the trust will put in place a monitoring program to assess the effects, positive or negative, that the program produces. The trust intends to reevaluate all of its programs regularly, and whenever it does so, it will draw on the learning that results from its monitoring and experimental efforts as a basis for decisions about the continuation or revision of the program being considered. Moreover, both the monitoring data and the learning it generates will be shared freely with the public. This is the essence of adaptive management.

Tracking the impacts of individual management programs and activities, however, is not enough. The trust will also seek and evaluate information about general changes in the ecosystems of the preserve. By their nature, ecosystems are interconnected and interacting communities of plants and animals. Human activities in one geographic area, or modifications of a single component of an ecosystem, can have cascading and cumulative effects on other areas and components of the ecosystem. These "components" can include plant or animal species or physical elements such as water and air. At a larger scale, they can also include the social and economic life of human communities, a subject that is addressed below. "Cumulative effects" are the changes in ecosystem components that occur over time throughout a given territory and that are attributable to management actions. Cumulative effects can even include future impacts—at least those that are "reasonably foreseeable." (For a more precise definition of cumulative effects, see the glossary on page 135.)

Although it is not possible to measure all impacts on all areas or components of ecosystems, it is possible to monitor particular locations and components that are broadly reflective of the dynamics of the overall system. An example is water quality and quantity. Monitoring these variables over a large landscape is analogous to taking periodic readings of a human being's blood pressure and blood chemistry. In either case, sustained monitoring of a few variables effectively profiles the health of the larger system. If the effects of multiple management programs are "accumulating" in the landscape, evidence of this is likely to appear in variables, such as water quality, that are broadly indicative of ecological condition.

A daunting challenge in cumulative effects measurement and assessment is to identify with certainty the causes of observed changes in the ecosystem. Distinguishing changes that arise as a result of natural variability (e.g., caused by weather and climate variations) from changes that are caused by humans can be extremely difficult. Ultimately, the goal of monitoring and cumulative effects analysis is not to obtain perfect information or absolute certainty, for these are elusive and largely unrealistic ideals. More often, the best we can hope for is to gather the best available information from multiple lines of evidence and, based on a synthesis of these sources, to make reasonable interpretations that guide the adjustment of management actions.

The trust's StARS process requires individual management projects and programs to be monitored. In addition, the trust will establish comprehensive monitoring and assessment procedures to meet the goal of assessing cumulative effects of management activities. Assessment of cumulative effects is a requirement of NEPA, and the integrated monitoring and assessment procedures for the VCNP will meet this requirement. The trust proposes to initiate development of these procedures by convening a workshop in 2004 to which it will invite scientists and land managers with expertise in cumulative effects analyses. The goal of this workshop will be to identify key variables the trust will monitor to assess cumulative effects. Other goals will be to identify the most economical means for obtaining high-quality information about key variables and to outline methods for deriving the greatest-possible learning from them.

VARIABLES TO BE MONITORED

Monitoring of key ecosystem components has already begun on the

ASSESSING CUMULATIVE EFFECTS

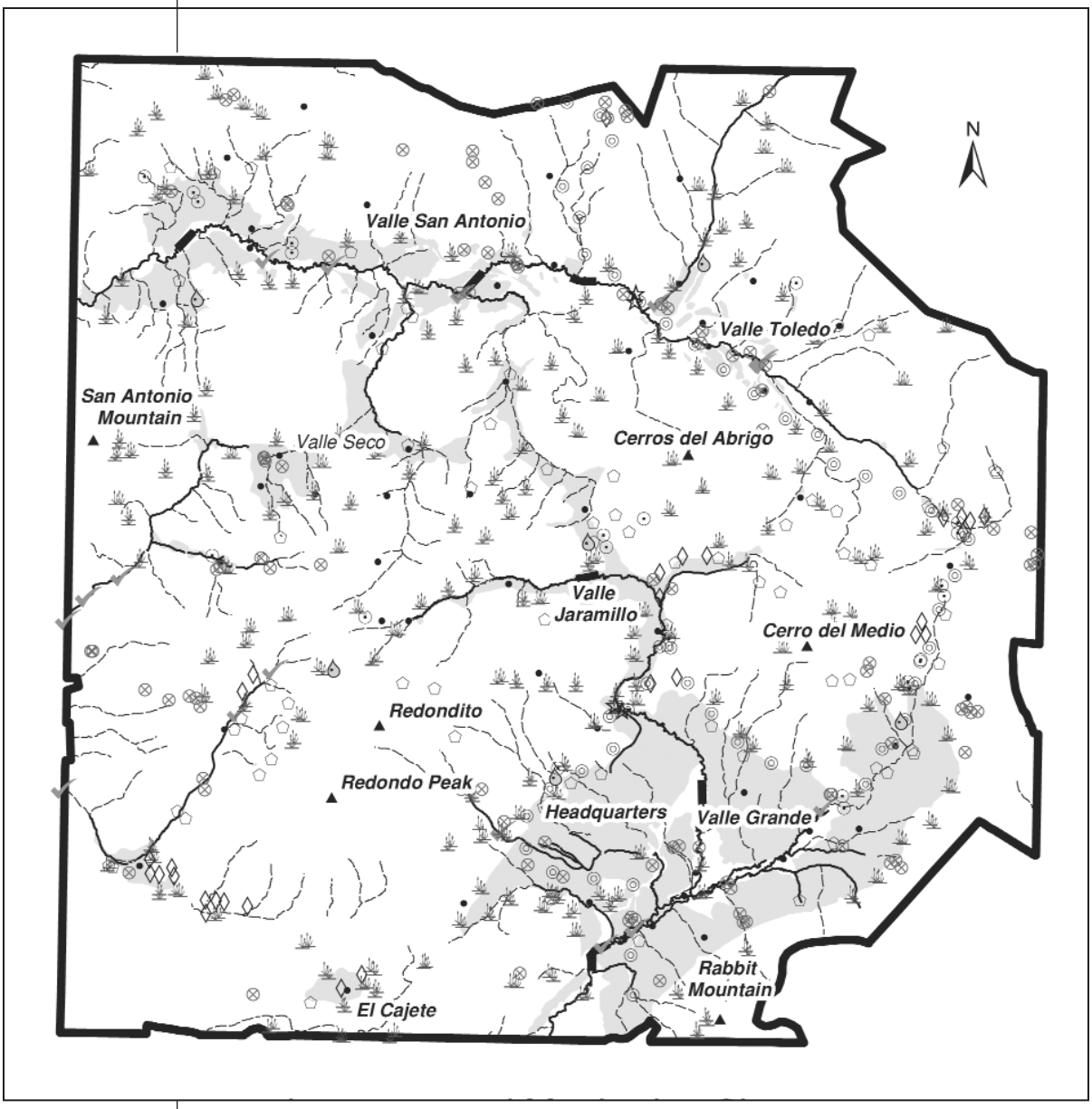
The VCT's procedures for assessing cumulative effects will be guided by eight principles identified in the 1997 handbook of the Council on Environmental Quality (CEQ): *Considering Cumulative Effects under the National Environmental Policy Act* (available at http://ceq.eh.doe.gov/nepa/ccenepa/ccenepa.htm):

- Include past, present, and future actions;
- Include all federal, nonfederal, and private actions;
- Focus on each affected resource, ecosystem, and human community;
- Focus on truly meaningful effects;
- Use natural boundaries [i.e., appropriate temporal and spatial boundaries];
- Address additive, countervailing, and synergistic effects;
- Look beyond the life of the action;
- Address the sustainability of resources, ecosystems, and human communities.

preserve. An extensive network of transects to monitor upland and riparian range conditions was established in 2001 and 2002. In 2003 construction of livestock and elk exclosures began. These structures will support a long-term experiment to assess the respective impacts of elk and domestic cattle on the principal creeks and riparian areas of the preserve. In 2001 and 2002 the New Mexico Environment Department assisted the trust by establishing numerous testing sites along the preserve's streams and rivers and by collecting extensive baseline information on water quality. In consultation with the department, the preserve will develop a program for continued water quality monitoring in future years.

Monitoring is by no means restricted to biological variables. The trust is also monitoring the reaction of participants to the programs of the trust to learn what level of satisfaction the visitor experience produced and to solicit recommendations for improvement. These kinds of assessments will continue to be a regular feature of the trust's recreation, hunting, and fishing programs.

Examples of possible ecosystem components and social variables to be measured include (but are by no means limited to) the following:



Inventory and Monitoring Sites

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- Preserve Boundary
- Stream, Intermittent
- Stream, Perennial
- Water Quality Monitoring
- Rain Gauge Locations
- Whirling Disease Survey
- Amphibian and Reptile Survey
- Breeding Bird Survey
- Butterfly Survey
- Elk Browse Survey (shrubs)
- Range Monitoring
- Vegetation Sample Plots
- Canada Thistle
- Exclosure
- Prairie Dog Survey

- Precipitation, temperature, and other meteorological variables;
- Water quality and quantity;
- Sedimentation and erosion rates;
- Upland and riparian plant growth and diversity;
- Forest growth, diversity, and fragmentation;
- Selected indicator or key animal populations (e.g., elk, fish, aquatic invertebrates, raptors, prairie dogs, butterflies);
- Air quality, sound, and light pollution;
- Visitor satisfaction and perceptions;
- Elk hunting (e.g., economic returns, hunter satisfaction);
- Trends in traffic flow;
- Local economic impacts of visitor programs.

MEASURING AND ASSESSING CUMULATIVE EFFECTS

Numerous tools and strategies are available for measuring and assessing cumulative effects. The 1997 CEQ handbook (cited earlier) describes many of these approaches (see box on page 132). The trust has already committed itself heavily to the core strategy of recording baseline data for ecosystem components and tracking subsequent trends through continued monitoring. Experimental approaches (e.g., livestock/elk exclosures and treatment replicates) will be used when feasible. New technologies, such as remote sensing, may also prove to be key tools for identifying spatial and temporal conditions and changes. For example, in 2003 the trust contracted with remote sensing and GIS specialists to inventory plant communities and conditions across the VCNP. These spatial data sets will provide baselines for assessing future changes in plant communities. Real-time (or near real-time) imagery from satellites is increasingly available for assessing eco-system conditions (e.g., plant vigor and moisture content) at fine-scale spatial resolutions of tens of meters. These kinds of technologies might be used to track certain kinds of ecosystem changes (e.g., the effects of drought) encompassing the VCNP and surrounding landscapes.

In the design and adoption of its StARS process and NEPA procedures, the trust institutionalized to the greatest extent practical its commitment to adaptive management. This commitment is also evident in the administrative structure the trust has built. A key to this structure is the inclusion of a preserve scientist on the executive staff of the trust. The duties of the preserve scientist include the design and oversight of the inventory, monitoring, and research programs. Cumulative effects analysis will be a chief responsibility of this individual. Many aspects of the trust's science program, however, remain a work

EXAMPLES OF PRIMARY METHODS FOR ASSESSING CUMULATIVE EFFECTS (FROM THE CEQ HANDBOOK)

- Trends analysis to assess the status of resources, ecosystems, and human communities over time and identify cumulative effects problems, establish appropriate environmental baselines, or project future cumulative effects;
- Overlay mapping and GIS to incorporate locational information into cumulative effects analysis and help set the boundaries of the analysis, analyze landscape parameters, and identify areas where effects will be the greatest;
- Modeling to quantify the cause-and-effect relationships leading to cumulative effects;
- Questionnaires, interviews, and panels to gather information about the wide range of actions and effects needed for a cumulative effects analysis;
- Checklists to identify potential cumulative effects by reviewing important human activities and potentially affected resources;
- Matrices to determine the cumulative effects on resources, ecosystems, and human communities by combining individual effects from different actions;
- Networks and system diagrams to trace the multiple, subsidiary effects of various actions that accumulate upon resources, ecosystems, and human communities.

in progress. The final composition of the suite of monitoring programs the trust will support, the way these programs are integrated, and the utilization of the data they generate for the VCNP cumulative effects assessments are yet to be determined. The trust hopes that the cumulative effects workshop expected to convene early in 2004 will contribute toward answering some of these questions.

CUMULATIVE EFFECTS OF THE VCNP'S IMPACT ON THE JEMEZ REGION

The presence of the VCNP as a visitor destination will undoubtedly have a series of impacts on the surrounding cities, towns, and pueblos of northern New Mexico. For example, anticipated increases in tourism will provide for increased economic opportunities for small businesses directed at tourists, while

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real estate development on nearby private lands may accelerate. Vehicle traffic will increase, perhaps resulting in localized increases in highway noise and pollution. Overall increases in community development may require additional police and emergency medical resources. The trust, in collaboration with local, state, and federal agencies and private organizations, will continue to assess such accumulated impacts on the region so as to provide planning to avoid or mitigate negative impacts.

CUMULATIVE EFFECTS ANALYSIS AND THE STATE OF THE PRESERVE

Learning from past management is the keystone of the trust's science-informed adaptive management approach. Through our planning and decision-making process, we will utilize scientific assessments of ecological conditions to enable us to adjust our management actions to achieve desired resource conditions. To better understand how our management is affecting the preserve as a whole, the trust will prepare an assessment of the "state of the preserve," consisting of a concise account of the systematic review of monitored outcomes and other interpretive information. The trust will update this assessment of cumulative effects at least every five years. These analyses will also form the basis on which the trust will assess

cumulative effects in its environmental documents.

Although the state of the preserve assessment will set the stage for evaluating cumulative effects in the analyses associated with environmental documents, it is also required as a means to inform the board in developing its strategic guidance. Any time the board elects to alter the goals it has provided as strategic guidance, it must first reassess the state of the preserve. For example, if the trust elects to pursue goals that are not contemplated by the present framework, it will need to prepare an up-to-date state of the preserve assessment before altering its strategic guidance to accommodate the new goals. Because these assessments are required prior to the pursuit of a new direction, the program goals outlined by the board in its strategic guidance will undergo thorough consideration in light of the most current information on the condition of the preserve.