GAP ANALYSIS

Conservation in the Wyoming Basins Ecoregion: Planning Today by Assessing Future Scenarios

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Landscape level planning, exemplified by ecoregion-based conservation, is rapidly emerging as a necessary strategy for achieving meaningful conservation results. Ecoregional planning is a systematic process for identifying areas (a "portfolio" of priority sites) that, together, represent the majority of species, natural communities and ecological systems found within a particular ecoregion (Groves et al. 2000). Typically ecoregional plans utilized an optimization approach, in which the design of the portfolio is meant to meet the minimum viability needs of each biological target but to do so in a way that minimizes the amount of area selected. Even though areas outside of a portfolio have not been selected, they may still have value at meeting biodiversity goals. The flexibility in portfolio design provides the opportunity to examine tradeoffs between various development scenarios and conservation outcomes. The ultimate goal of an ecoregional assessment is a peer-reviewed conservation strategy with specific action plans that are widely embraced and implemented by a diversity of stakeholders. Detailed discussion of the steps involved in ecoregional assessments can be found in Dinnerstein et al. (2000) and Groves et al. (2000). Despite the success in ecoregional assessment in guiding conservation action (Sakar et al. 2006), not examining future land change scenarios is one of their key shortcomings (Pressey and Bothrill 2008).

The Wyoming Basins Ecoregion (WBE) comprises 13.3 million hectares of basin, plain, desert and "island" mountains in Wyoming, Montana, Idaho, Colorado and Utah (Bailey 1995). The area is a stronghold for the Greater Sage Grouse (*Centrocercus urophasianus*), an emblematic native gamebird now being considered for listing under the Endangered Species Act (Doherty et al. 2009). The ecoregion provides critical habitat for migratory big game, songbirds and raptors within the reaches of the Greater Yellowstone ecosystem. Some of the world's largest herds of mule deer (*Odocoileus hemionus*) and pronghorn (*Antilocarpa americana*) winter here, relying on snow-free forage to get them through harsh winter weather.

We are in the process of updating an earlier WBE assessment completed by The Nature Conservancy (TNC) in 2001 (Freilick et al. 2001). Initial steps in the ecoregional assessment process include selecting a suite of species, natural communities and ecological systems that represent the range of biological diversity present in an ecoregion, setting conservation goals to ensure their long-term persistence and assessing current land management status for these indicators. The spatial configuration is a primary driver in the selection of areas considered to be of high biodiversity significance and in need of conservation. Regional GAP land-cover data and species distribution models (SDMs) from the Northwest GAP (NWGAP) and Southwest Regional GAP (SWReGAP) are the core datasets that describe the spatial distribution of these indicators. The obvious benefits of the regional GAP data include their temporal relevance to informing near-term conservation action and their seamless coverage across much of the WBE. However, works remains to merge NWGAP and SWReGAP land-cover data and to determine how best to merge species distribution models across the two regions. Inconsistencies in methodological approaches used to produce available SDMs make attempts to reconcile models across states or regions difficult and highlights the need to systematically quantify errors associated with such efforts.

Incorporating Alternative Scenarios

Ecoregional plans have traditionally included an analysis of vulnerability of the selected conservation areas and the targets within them to current threats in order to prioritize areas for action. Few, however, have examined how alternative scenarios of future development (i.e., energy development) or different valuation of land use patterns might influence the outcome of this prioritization process, or perhaps even the make up of the network of conservation areas themselves. Rapidly changing pressures on biodiversity can present real challenges for the continued relevance of an assessment for conservation players in a landscape. With the second iteration of the Wyoming Basins ecoregional assessment, we will examine how the following variables might influence the selection or prioritization of conservation areas: 1) future energy development scenarios 2) climate change impact scenarios and 3) the overlap of selected ecosystem services with potential conservation areas. The goal of the process is to select and prioritize a robust network of conservation areas that is responsive to conflicts or synergies with future land use patterns.

Energy Development

Although a good portion of the sagebrush steppe found in the Wyoming Basins remains intact, the WBE is also home to some of the western United States' richest oil and gas deposits, including some that intersect areas selected in the current ecoregional assessment (Kiesecker et al. 2009a). The number of producing wells in the ecoregion has nearly tripled since the 1980s and is expected to increase over the next 30 years (Copeland et al. 2007, Kiesecker et al. 2009b). Conservation of the biological diversity in this ecoregion is in question, in part because the U.S. government has authorized exploration and development in 4 million of the 8 million hectares of the federal mineral estate within the ecoregion (Doherty et al. 2009, Copeland et al. In Review). TNC has been developing an approach, Development by Design, to address the conservation impacts of surface disturbances relating to energy development (Kiesecker et al 2009 a&b). This approach combines the information generated by ecoregional assessments with the mitigation hierarchy that seeks to sequentially avoid, minimize and mitigate harm to biodiversity targets in a development area (Kiesecker et al. 2009a). Residual impacts to biodiversity that cannot be mitigated onsite can potentially be offset with conservation action elsewhere to balance the overall impact of an energy development project.

The benefits of incorporating alternative scenarios of energy development allow us to address questions regarding what targets might potentially be impacted by different development scenarios. Based on these potential impacts we can act to influence the siting of future energy development infrastructures to avoid those occurrences of conservation indicators with limited or no alternatives for conservation action. Additionally, because we have identified the spatial distribution of ecoregion targets and set conservation goals for long-term viability of those targets, we have established standard methods to provide measureable conservation outcomes of potential offset activities. That is, in addition to knowing what targets will potentially be impacted, we can address questions about potential offset sites and measure whether those offsets are ecologically equivalent to losses in impacted areas on a regional scale.

Climate Change

While recent climate change modeling efforts have provided a perplexing and inconsistent picture of what future climate scenarios might look like, there is a consensus that future species distributions will be very different from today (Shafer et al. 2001; Rehfeldt et al. 2006). These include changes in species composition, stress due to site maladaptation, loss of habitat and extirpation. The potential for impacted conservation targets to respond to likely climate change may very well be constrained by other land use changes as well. As in the case of analyzing alternative scenarios of energy development, future climate instability highlights the need for forward planning, recognizing areas of conflict between those areas of high biodiversity significance and high degree of climate instability.

It is widely anticipated that climate change will result in range shifts for diverse species and ecological communities, and we are endeavoring to project such changes in the WBE. We are especially interested in the following two phenomena: (1) range expansions and (2) local extinctions (extirpations). Due to complex mechanistic relationships in process (snow/rain ratio) and timing (i.e., frost-free period) of climate, it is difficult to account for variation and effect through time. As a result, predictive models for changes in species distribution have been more accurate at anticipating local extinctions than range expansions, often indentifying areas of instability. We will use a spline-based climate model (Rehfeldt 2006) to focus on future climate change over a 100-year time frame, identifying areas at high risk of climactic instability. Thus, informing the selection of a conservation portfolio, assessing how robust that portfolio is over time in meeting conservation goals.

Ecosystem Services

Processes provided by a healthy functioning natural system that are important for continued human well-being and valued economically as such are collectively called ecosystem services. Including ecosystem services in the portfolio design makes sense – we get a more realistic view of how competing economic and conservation values of different lands may drive future land use patterns (Polasky 2008). We intend to explore the spatial distribution of selected ecosystem services to examine the joint impacts or tradeoffs between services and between services and conservation objectives. Building on recent work which suggests that there are few tradeoffs between services and conservation objectives (Nelson et al. 2009), we will explore how maximizing services over biodiversity conservation changes the areas selected for inclusion in the portfolio. In addition, knowing the spatial distribution of services may help inform conservation strategies for a selected portfolio of conservation areas and significantly boost our ability to implement actions to reach our goals by aligning biodiversity conservation with services valued by a broader group of stakeholders.

Summary

The central question of the updated WBE assessment remains the same – how best to effectively and efficiently conserve the representative biodiversity of the ecoregion for the long term. However, assessments to date have failed to fully consider the implications of likely future change. Where future development activities (i.e., oil and gas development) or future climate change scenarios can be estimated, these projections can be mapped either in association with an existing portfolio or utilized as part of the development of a new conservation plan. The portfolio could be designed to avoid conflict with areas of high risk for development or change. Areas where future change could prevent the achievement of conservation goals should be identified and examined in greater detail. If adopted, the latter would provide an opportunity to avoid conflict between areas at risk of development or alterations resulting from climatic change and areas that are critical for biodiversity and provide the structure to guide decisions of how to proactively resolve conflicts between these potential changes and conservation outcomes.

Literature Cited

Bailey, R.G. 1994. *Ecoregions of the World.* Washington, D.C., Department of Agriculture, Forest Service. Report No.1391

Copeland, H., J. Ward and J.M. Kiesecker. 2007. Threat, cost and biological value: Prioritizing conservation within Wyoming ecoregions. *Journal of Conservation Planning* 3: 1-16

Copeland, H., K.E. Doherty, D.E. Naugle, A. Pocewicz and J.M. Kiesecker. Making energy development and biodiversity compatible. *Conservation Biology*. In Review

Dinerstein E, G. Powell, D. Olson, E. Wikramanayake, R. Abell, C. Loucks, E. Underwood, T. Allnutt, W. Wettengel, T. Ricketts, H. Strand, S. O'Connor and N. Burgess. 2000. *A workbook for conducting biological assessments and developing biodiversity visions for ecoregion-based conservation*. Conservation Science Program, November, 2000 WWF

Doherty, K., D. Naugle, H. Copeland, A. Pocewicz and J.M. Kiesecker. 2009. Energy development and conservation tradeoffs: Systematic planning for sage-grouse in their eastern range. *Studies in Avian Biology* In Press.

Freilich, J., B. Budd, T. Kohley and B. Hayden. 2001. *The Wyoming basins ecoregional plan*. The Nature Conservancy Wyoming Field Office, Lander, Wyoming.

Groves, C.R. 2003. *Drafting a Conservation Blueprint: A Practitioner's Guide to Planning for Biodiversity*. Washington DC: Island Press.

Kiesecker, J.M., H. Copeland, A. Pocewicz, N. Nibbelink, B. McKenney, J. Dahlke, M. Holloran and D. Stroud. 2009. A Framework for Implementing Biodiversity Offsets: Selecting Sites and Determining Scale. *BioScience* 59:77-84.

Kiesecker, J.M., H. Copeland, A. Pocewicz and B. McKenney 2009. Development by Design: Blending Landscape Level Planning with the Mitigation Hierarchy. *Frontiers in Ecology and the Environment.* In Press.

Nelson, E., G. Mendoza, J. Regetz, S. Polasky, H. Tallis, D.R. Cameron, K.M. Chan, G.C. Daily, J. Goldstein, P.M. Karieva, E. Lonsdorf, R. Naldoo, T.H. Ricketts and M.R. Shaw. 2009. Modeling multiple ecosystem services, biodiversity conservation, commodity production and tradeoffs at landscape scales. *Frontiers in Ecology and the Environment* 7(1):4-11.

Polasky, S. E. Nelson, J. Camm, B. Csuti, P. Fackler, E. Lonsdorf, C. Montgomery, D. White, J. Arthur, b. Garber-Yonts, R. Haight, J. Kagan, A. Starfield and C. Tobalske. 2008. Where to put things? Spatial land management to sustain biodiversity and economic returns. *Biological Conservation* 141:1505-1524.

Pressey, R.L. and M.C. Bottrill. 2008. Opportunism, threats and the evolution of systematic conservation planning. *Conservation Biology* 22: 1340-1345.

Rehfeldt, G.E, N.L. Crookston, M.V. Warwell and J.S. Evans. 2006. Empirical Analyses of Plant-Climate Relationships for the Western United States. *International Journal of Plant Sciences*. 167(6):1123–1150.

Sarkar, S., R.L. Pressety, D.P. Faith, C.R. Margules, T. Fuller, D.M. Stoms, A. Moffett, K.A. Wilson, K.J. Williams, P.H. Williams and S. Andelman. 2006. Biodiversity Planning Tools: Present Status and Challenges for the Future. *Annual Review of Environment and Resources* 31:123-159.

Shafer, S. L., P. J. Bartlein, R. and S. Thompson. 2001. Potential changes in the distributions of Western North America tree and shrub taxa under future climate scenarios. *Ecosystems* 4: 200-215.