Upper Columbia Basin Network
Land Cover and Use Protocol Development Summary
(August 2007)

Protocol: Land Cover and Use

Parks Where Protocol Will Be Implemented:
All UCBN Parks (BIHO, CIRO, CRMO, HAFO, JODA, LARO, MIIN, NEPE, and WHMI)

Justification/Issues being addressed:
Resiliency of biodiversity in a protected area is intimately tied to the ecological integrity of surrounding lands. Attributes of surrounding landscapes contribute to both abiotic and biotic dynamics of remnant areas (Saunders et al. 1991; Meffe and Carroll 1997) and are major determinants of short-term and long-term protection effectiveness (Schonewald-Cox 1988). Land cover composition, configuration, and connectivity help shape the complex of species occurring in an area, movements of individual organisms, and energy and material flows (Dunning et al. 1992; Taylor et al. 1993). Substantial changes in these land cover attributes occur in response to natural and anthropogenic processes. Natural disturbance regimes largely are driven by climatic factors (e.g., Swetnam and Betancourt 1998) and expected changes in climatic conditions may elevate the frequency and/or severity of natural disturbances such as wildfire and insect and disease outbreaks. Discerning between natural and anthropogenic forces of change is also critical to effective mitigation action. Management actions seldom can influence natural processes, but can be effective in mitigating human-induced changes. Anthropogenic disturbance along park boundaries is of special concern as increases in cross-border contrasts can lead to undesirable changes. For instance, habitat fragmentation has been associated with a variety of negative consequences to both wildlife and vegetative communities and also provides the opportunity for invasion of exotic or undesirable species (Wilcove et al. 1986; Yahner and Scott 1988).

Over 10 years ago, the National Park System Advisory Board recommended that "resource management should be addressed in broader context" and specifically recognized the impact of activities outside park boundaries (NPS 1993). In fact, concerns over external influences date as far back as 1933 (Wright et al. 1933), and management of adjacent lands has been identified as one of, if not the most, serious challenge facing park managers over the last 25 years (Shands 1979; NPCA 1979; NPS 1980; Buechner et al. 1992). The majority of parks are dependent on adjacent lands simply because their boundaries fail to encompass habitats and processes (e.g., migratory species, fire regimes) necessary to maintain complete species communities (Myers 1972; Western 1982; Curry-Lindahl 1972; Garratt 1984). Therefore, threats from outside park boundaries can, and are, significantly modifying biodiversity within parks (NPCA 1979; Garratt 1984; Sinclair 1998).

Monitoring long-term changes in land cover composition, configuration, and connectivity will help establish a broader context for each park, and can help natural resource managers determine patterns in land use change which may threaten future ecological integrity within parks. Selecting an adequate scale at which to evaluate the effects of land cover change and fragmentation is difficult without first identifying what is being managed (e.g., what species or

processes; Beatley et al. 2000) and the scales of disturbance to which those species/processes respond. By developing and implementing a protocol to efficiently and cost effectively monitor land cover change within and around UCBN parks at multiple spatial scales, the current knowledge of park ecosystem dynamics will be further advanced, allowing for better management practices and decision making in the future.

(*The following section is reproduced with permission from Townsend et al. 2006)*. The UCBN will use aerial photography and satellite imagery (collectively, remote sensing) to monitor the spatial extent of changes in land cover (i.e., conversion). The benefit of remote sensing for monitoring is it provides complete spatial coverage compared to point or plot samples. Remote sensing therefore complements survey data by providing information on the context of data sampled at points while also facilitating extrapolation of point measurements across landscapes. The results from remote sensing change detection analyses can also be used to identify areas of alteration to target management efforts. Although maps and mapping are inherently interesting for the purpose of developing comprehensive inventories, monitoring requires the derivation of meaningful information from those maps to interpret the nature and context of changes occurring between dates. Two approaches to landscape interpretation will be pursued: pattern analysis, which uses metrics of landscape pattern derived from categorical maps, and descriptive change detection via map-to-map or image-to-image comparisons. Not all methods are necessary to address all questions. The specific method will depend on the questions of interest, which are summarized below.

Specific Monitoring Questions and Objectives to be Addressed by the Protocol:
Monitoring questions addressed by this protocol include (*Reproduced with permission from Townsend et al. 2006*):

- What are the long-term trends in land cover distribution within and adjacent to the park, (i.e., how has land cover changed)?
- What are the patterns of relevant land cover types within and adjacent to the park (e.g., what are average patch sizes, densities, edge/core areas, inter-patch distances, etc.)?
- What are the appropriate temporal and spatial (grain size and map extent) resolutions for mapping and analyzing land cover in and adjacent to the parks?
- What is the relative proportion of streams and/or upstream catchment area with riparian buffers and how wide are those buffers?
- Are changes in water quality parameters or macroinvertebrate assemblage structure associated with changes in watershed land use/land cover?

Monitoring objectives addressed by this protocol include:

1) Determine long-term trends in land cover distribution within and adjacent to UCBN park boundaries.
Justification: (Reproduced with permission from Townsend et al. 2006) *Land cover distribution is a critical description of a park landscape, and may form the most obvious representation of the composition of resources within a park. Changes in land cover both within a park and adjacent to that park can dramatically influence a host of biological, physical and chemical resources within that park. Therefore, maps of land cover distribution and changes in those distributions are often a central component to*

assessing changes in other resources such as water quality, aquatic fauna, terrestrial vertebrates, and terrestrial vegetation communities.

2) Determine patterns of relevant land cover types within and adjacent to UCBN park boundaries.
Justification: (Reproduced with permission from Townsend et al. 2006) *Objective measures of landscape pattern are required to assess changes in the amount and distribution of landscape resources in and around the parks (and/or their surrounding landscapes). The configuration and connectivity of land cover help shape the complex of species occurring in an area, movements of individual organisms, and energy and material flows.*

Basic Approach:
Several national and regional NPS efforts are underway to develop land cover change protocols. The UCBN will adopt, and adapt as necessary, pre-existing protocols. We are currently assessing the utility of the approach presented by Townsend et al. (2006) for the National Capital Region Network, which is similar to the UCBN in its makeup of many disparate and small parks. This same development team is also working with the Appalachian Highlands Network. There is also a protocol development effort underway in the North Coast Cascades Network that may be of use to the UCBN.

Principal Investigators and NPS Lead:
Principle Investigator(s): To be determined. NPS Lead: To be determined.

Development Schedule, Budget, and Expected Interim Products:
We will initiate protocol development in 2008. A draft protocol ready for peer-review will be complete in 2009.

Literature Cited:
Beatley, T. 2000. Preserving biodiversity: challenges for planners. Journal of the American Planning Association **66**:5-21.

Buechner, M., C. Schonewald-Cox, R. Sauvajot, and B. A. Wilcox. 1992. Cross-boundary issues for national parks: What works “on the ground.” Environmental Management **16**:799-809.

Curry-Lindahl, K. 1972. Ecological research and management. Pages 197-213 *in* R. Osten, editor. World national parks: progress and opportunities. World Conservation Union, Brussels.

Dunning, J. B., B. J. Danielson, and H. R. Pulliam. 1992. Ecological processes that affect populations in complex landscapes. Oikos **65**:169-175.

Garratt, K. 1984. The relationship between adjacent lands and protected areas: Issues of concern for the protected area manager. Pages 65-71 *in* J. A. McNeely, and K. R. Miller, editors. National parks, conservation and development: the role of protected areas in sustaining society. Proceedings of the World Congress on National Parks, Bali, Indonesia, October 11-22, 1982. Smithsonian Institute Press, Washington, D.C.

Meffe, G. K., and C. R. Carroll. 1997. Conservation reserves in heterogeneous landscapes. Pages 305-346 *In* G. K. Meffe, and C. R. Carroll, editors. Principles of conservation biology. 2nd Edition. Sinauer Associates, Sunderland, MA.

Myers, N. 1972. National parks in savannah Africa. Science **178**:1255-1263.

National Park Service (NPS). 1980. State of the Parks -1980: A report to the congress. National Park Service, US Department of Interior, Washington, D.C.

National Park Service (NPS). 1993. Science and the National Parks II: Adapting to Change. Government Printing Office, Washington, DC

National Parks and Conservation Association (NPCA). 1979. NPCA adjacent lands survey: No park is an island. National Parks and Conservation Magazine **53**:4-9.

Saunders, D. A., R. J. Hobbs, and C. R. Margules. 1991. Biological consequences of ecosystem fragmentation: a review. Conservation Biology **5**:18-32.

Schonewald-Cox, C. M. 1988. Boundaries in the protection of nature reserves: Translating multidisciplinary knowledge into practical conservation. BioScience **38**:480-486.

Shands, W. E. 1979. Federal resource lands and their neighbors. Conservation Foundation, Washington, D.C.

Sinclair, A. R. E. 1998. Natural regulation of ecosystems in protected areas as ecological baselines. Wildlife Society Bulletin **26**:399-409.

Swetnam, T. W., and J. L. Betancourt. 1998. Mesoscale disturbance and ecological response to decadal climatic variability in the American Southwest Journal of Climate **11**:3128-3147.

Taylor, P. D., L. Fahrig, K. Henein, and G. Merriam. 1993. Connectivity is a vital element of landscape structure. Oikos **73**:43-48.

Townsend, P.A., R.H. Gardner, T.R. Lookingbill, and C.C. Kingdon. 2006. Remote sensing and landscape pattern protocols for long-term monitoring of parks in the National Capital Region. Draft Protocols Report. January 2006. University of Maryland Center for Environmental Science, Appalachian Laboratory, Frostburg, MD. 12pp. plus appendices.

Western, D. 1982. Amboseli National Park: Enlisting landowners to conserve migratory wildlife. Ambio **11**:302-308.

Wilcove, D. S., C. H. McLellan, and A. P. Dobson. 1986. Habitat fragmentation in the temperate zone. Pages 237-256 *in* M. Soulé, editor. Conservation biology: The science of scarcity and diversity. Sinauer Associates, Sunderland, MA.

Wright, G. M., J. S. Dixon, and B. H. Thompson. 1933. Fauna of the national parks: A preliminary survey of faunal relations in national parks. Fauna series No. 1. US Government Printing Office, Washington, D.C. Online. http://www.cr.nps.gov/history/online_books/fauna1/fauna.htm.

Yahner, R. H., and D. P. Scott. 1988. Effects of forest fragmentation on depredation of artificial avian nests. Journal of Wildlife Management **52**:158-161.