THE IMPORTANCE OF CONNECTED AND CONSERVED LANDSCAPES IN A TIME OF CHANGING CLIMATE

Allison Jones*

Questions that we will answer during this Symposium include: What does the field of conservation biology tell us about unconnected, fragmented wildlife habitat? What is the solution to this problem? What are these grand designs, these "wildland networks?" What is the science behind them, and how does one go about implementing them on the ground? And how does all of this tie back in to the "elephant in the room"—a changing climate?

So, what exactly is habitat fragmentation? Perhaps the simplest way to convey it is through photos (Figure 1) showing obvious swaths of forestland (which presumably still support the wildlife adapted to live in forests) adjacent to large swaths of clear-cut stubble that cannot support those species.

Figure 1. Obvious example of a fragmented landscape. Reprinted with the permission of Sterling (c) Center for Biodiversity and Conservation-American Museum of Natural History.

But, what about less obvious situations, such as native grassland converted over time to a mix of grazing pastures, mostly exotic grasses and farmland (Figure 2). This situation would probably not pose a barrier to movement for jack rabbits, foxes or some species of sparrows, but certainly could to pronghorn that cannot

* © 2011 Allison Jones, is the staff conservation biologist for the Wild Utah Project (the Wildlands Network affiliate for Utah).

pass under fences, or to any species of mammal or bird that depends on seeds from specific native grasses, or to any native species shown to decline in the presence of cattle grazing. One of the guiding principles of habitat fragmentation is that the human modification or land use that may pose a problem or barrier for one species may not be an issue at all for another species.

Figure 2. Less obvious example of habitat fragmentation. Public Domain image provided courtesy of Bureau of Land Management.

Take roads, for example. Most of our western states are completely permeated by roads (Figure 3). In the case of a large highway, studies have shown that very small animals, such as white footed mice, will very rarely attempt to cross them, effectively isolating populations of the species on either side.[1] Other sensitive species, such as lynx, wolves, and grizzly bears, have been shown to be more impacted by density of roads, where the number of roads in a given area, and in some cases, average use of roads by people per day, correlates to population decline of these species.[2] In these cases road density or use can be considered a

[1] A.L. JONES, K. DALY, E. MOLVAR & J.C. CATLIN, THE HEART OF THE WEST CONSERVATION PLAN 65 (2004), *available at* http://wildutahproject.org/resources.

[2] L.D. Mech, S.H. Fritts, G.L. Radde & W.J. Paul, *Wolf Distribution and Road Density in Minnesota*, 16 WILDLIFE SOC'Y BULL. 85, 85 (1988); M.J. Lovallo & E.M. Anderson, *Bobcat Movements and Home Ranges Relative to Roads in Wisconsin*, 24 WILDLIFE SOC'Y BULL. 71, 71 (1996); R.E. Mace, J.S. Waller, T.L. Manley, L.J. Lyon &

"surrogate" for many different kinds of human persecution, disturbance, and degradation of habitat quality in which, put simply, areas with very low road densities will be better for lynx, wolves and grizzly bears than the areas covered with roads. On the other hand, some animals do not seem to mind roads very much; one example is coyotes which readily travel on sparsely traveled dirt roads or packed snowplowed roads. Again, some barriers pose a greater problem for one species than for another.

In addition to roads, other causes of habitat fragmentation include agriculture (including over-grazing), logging, mining, hydroelectric dams, powerlines and pipelines, and urban, suburban and even rural development. And we must remember that some of these land uses, like agriculture or logging, will create large swaths of unsuitable habitat with patches of functional habitat left intact, and some, like dams and highways, can sever habitat, leaving isolated populations of wildlife on either side.

H. Zuuring, *Relationships Among Grizzly Bears, Roads and Habitat in the Swan Mountains, Montana*, 33 J. APPLIED ECOLOGY 1395, 1403 (1996).

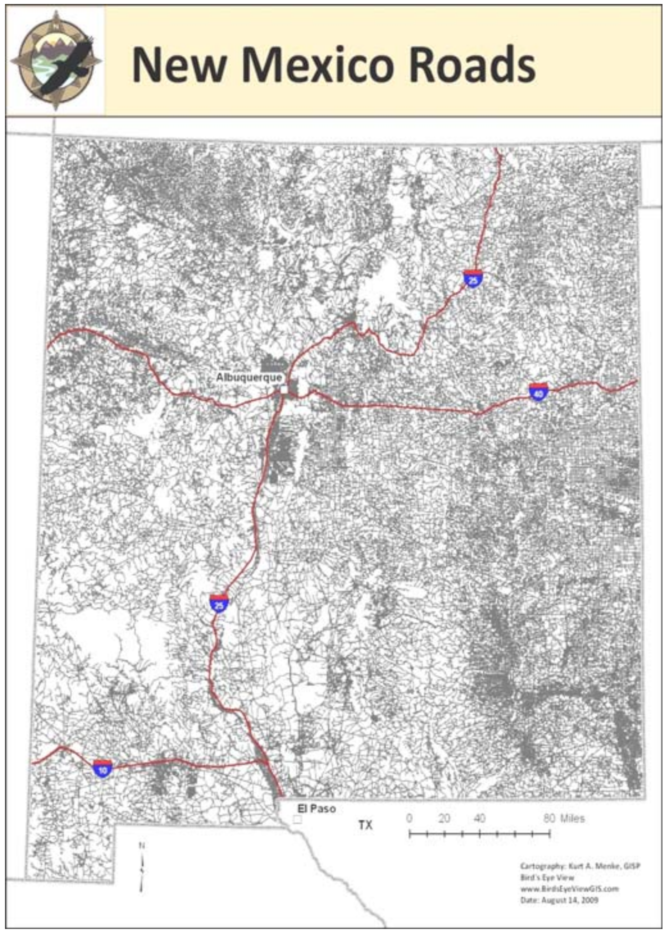

Figure 3. An example of how many roads exist in most western states. Reprinted with the permission of Kurt Menke, BirdsEye View GIS.

These different ways that habitat can be fragmented can be conceptually represented with simple graphics (Figure 4). In the first example, *perforation*, one can easily imagine how a mining operation may "punch a hole" in an intact sagebrush system. The next example, *dissection*, could be a representation of an interstate highway through pristine habitat. The classic forest clear cutting operation could result in the third example, basically leaving "islands" of habitat in its wake. It turns out most of the science that has been done that looks at the problems wildlife face when their habitat base is reduced and left in patches focuses on what is called the "island effect."

What is considered to be the landmark study on this topic, in fact, was conducted on actual oceanic islands in the Pacific by Robert MacArthur in the

1960s. MacArthur found that the number of bird species that inhabited an island were greater on larger islands and fewer on smaller islands.[3]

This led to the popularization and acceptance of the well-known "species richness vs. area curve" and the emergence of a new avenue of ecology—called island biogeography. In the 1980s and 1990s, once the field of conservation biology had emerged, conservation scientists began testing MacArthur's principle of island biography in terrestrial systems, looking at everything from impacts on red-backed voles surviving on islands of clear-cut forests in the Pacific Northwest, to studies of the number of species of songbirds remaining in islands of coastal sagebrush chaparral in California surrounded by suburbia. What was compelling was that the scientists could start studying these terrestrial island systems just after the fire or logging operation that left the islands of habitat in its wake, and could thus document the decline in the number of species within that island over time. This process is known as "species relaxation." The decrease in species in a remaining patch is the result of increased competition between all those species in the decreased area.

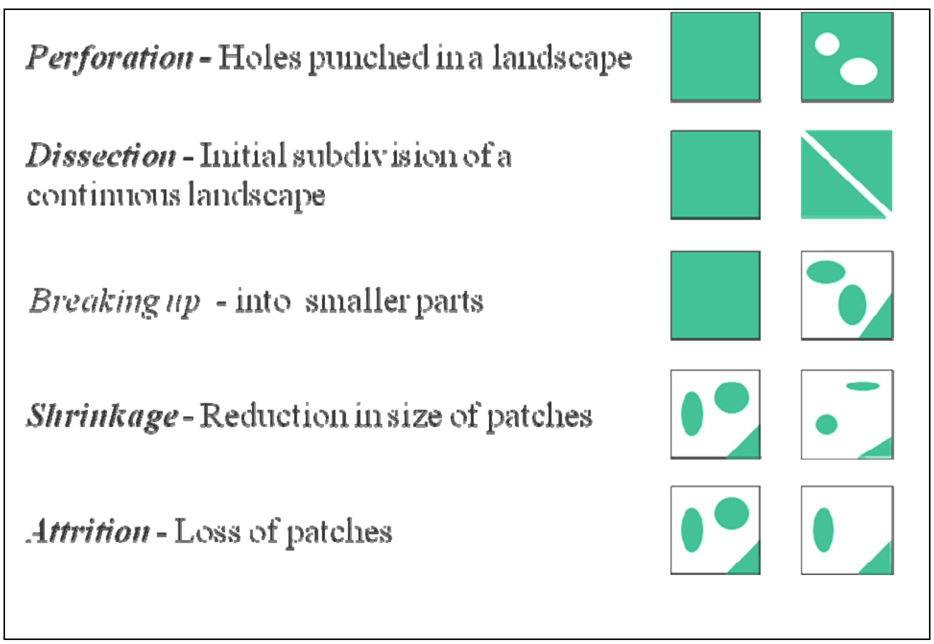

Figure 4. Technical terms for fragmentation process. Reprinted with permission of Murphy (c) Center for Biodiversity and Conservation-American Museum of Natural History.

[3] R.H. MACARTHUR & E.O. WILSON, THE THEORY OF ISLAND BIOGEOGRAPHY (Princeton Univ. Press 1967).

One of the landmark studies on island biogeography in terrestrial systems was conducted by Bill Newmark in the 1980s, which documented extirpations of larger species of mammals from North American national parks over time.[4] Newmark found that the larger parks such as Yellowstone and Banff have retained more of their original mammal species and small parks such as Bryce Canyon have retained fewer species, and have suffered extinctions of species such as grizzlies, wolverine and lynx.[5] This study was profound for a couple of reasons. First, it brought to center stage the disturbing notion that the (in most cases) publicly owned rangelands and forests that surround these national parks apparently are not protective enough to effectively conserve the full component of species that should be there. Secondly, Newmark's findings force us to ask: if these parks are in fact functioning like islands within more hostile habitat, are our national parks in the West large enough to host their full component of native large mammals and carnivores into perpetuity?

In fact Newmark's study illustrated what other wildlife biologists and conservation scientists across the world were discovering at the time, which is that carnivores and other wide-ranging species are typically the species most threatened by habitat fragmentation. And this problem is manifested in a number of ways, ranging from lack of sufficient habitat or prey, increased human persecution, elimination of seasonal habitats or barriers between them, and disruption of migration routes in fragmented and isolated habitats.

But carnivores are not the only animals that suffer these effects of fragmented habitats—they are usually just the "first to go" from highly fragmented systems, and so tend to be the most noticeable victims. Throughout the last many decades, scores of conservation scientists and population biologists have documented the impacts that result from populations of a species being "stranded" in a small island of suitable habitat. Small populations have been shown to suffer deleterious population-level effects resulting from isolation—such as inbreeding, low genetic diversity, and extirpation.[6] Habitat fragmentation also affects specialized needs of wildlife, such as limiting dispersal, reducing reproduction, and other life-cycle needs. To put it simply, increases in inter-patch distance and thus reduced migration rates reduces the likelihood of local populations in many patches sustaining one another (see Figure 5).[7]

---

[4] W.D. Newmark, Species Area Relationship and Its Determinants for Terrestrial Mammals in Western North American National Parks, 28 BIOLOGICAL J. OF THE LINNEAN SOC'Y 83, 89 (1986).

[5] *Id.* at 90.

[6] R.F. Noss, *A Regional Landscape Approach to Maintain Diversity*, 33 BIOSCIENCE 700, 703 (1983); L.D. HARRIS, THE FRAGMENTED FOREST: ISLAND BIOGEOGRAPHY THEORY AND THE PRESERVATION OF BIOTIC DIVERSITY 82 (Univ. of Chicago Press 1984); A. Dobson, K. Ralls, M. Foster, M.E. Soulé, D. Simberloff, D. Doak, J. Estes, S. Mills, D. Mattson, R. Dirzo, H. Arita, S. Ryan, E. Norse, R. Noss & D. Johns, *Regional and Continental Restoration*, *in* CONTINENTAL CONSERVATION: SCIENTIFIC FOUNDATIONS OF REGIONAL RESERVE NETWORKS 65 (M.E. Soulé & J. Terborgh eds., Island Press 1999).

[7] JONES, DALY, MOLVAR, & CATLIN, *supra* note 1, at 65.

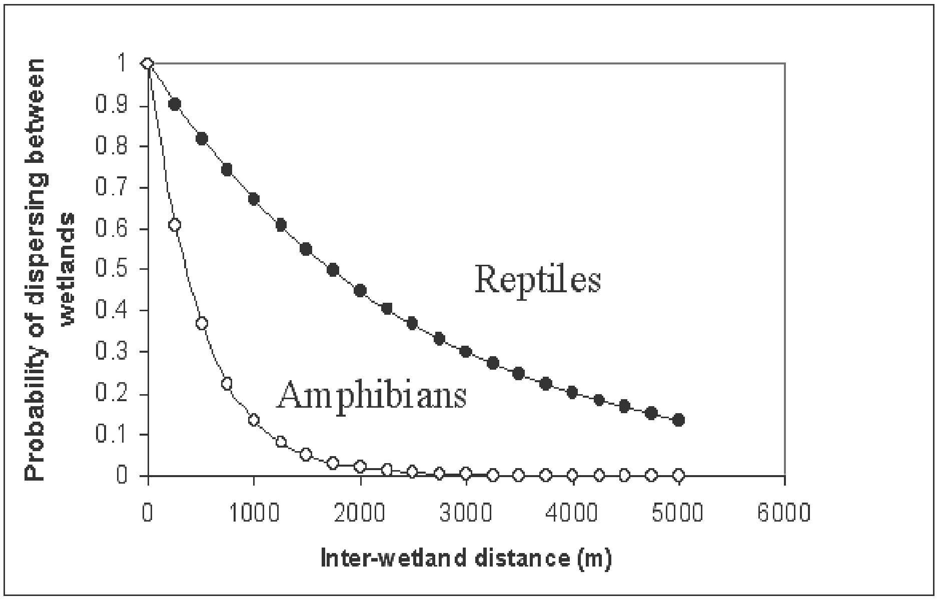

Figure 5. Gibbs (1998) illustrated that the farther away a suitable patch of habitat is, the less likely herpetofauna will travel to it. Reprinted with the permission of Gibbs, J.P., M.F. Laverty, L. Murphy, and G. Cullman. 2004. "Ecosystem Loss and Fragmentation." Presentation, Network of Conservation Educators and Practitioners, American Museum of Natural History. Available at: http://ncep.amnh.org.

What are the solutions to these myriad of problems associated with habitat fragmentation? At its simplest level, if you've identified that the chief problem facing western wildlife is unconnected, fragmented landscapes, then conservation planners need to be figuring out strategies for reconnecting habitat. If we can reconnect a fragmented landscape with functional "landscape linkages," we can prevent local extinction through demographic rescue, allow for recolonization after local extinction, and allow for gene flow, seasonal migration, and other ecological processes to better function across the landscape, ranging from pollination to seed dispersal to predator-prey interactions.

In the early 1990s, two of the "founding fathers" of the field of conservation biology, Reed Noss and Michael Soulé, founded the Wildlands Project. With a mission to reconnect severed wildlands and critical wildlife habitats across North America, the Wildlands Project aimed to design and implement on the ground "wildlands networks" which follow the core/corridor/buffer zone framework (Figure 6). As a movement founded by silverback scientists, it is ever informed by the science of population biology, evolutionary ecology and meta-population dynamics, all of which justify establishing these networks of protected areas on the ground. In the world of conservation science, wildlands networks are also referred to as protected area networks, conservation reserves, or conservation area designs. But they are all designed and informed by the same scientific principles, which basically tell us that implemented wildlands networks on the ground are what we need to avoid further loss of wildlife populations over the long term.

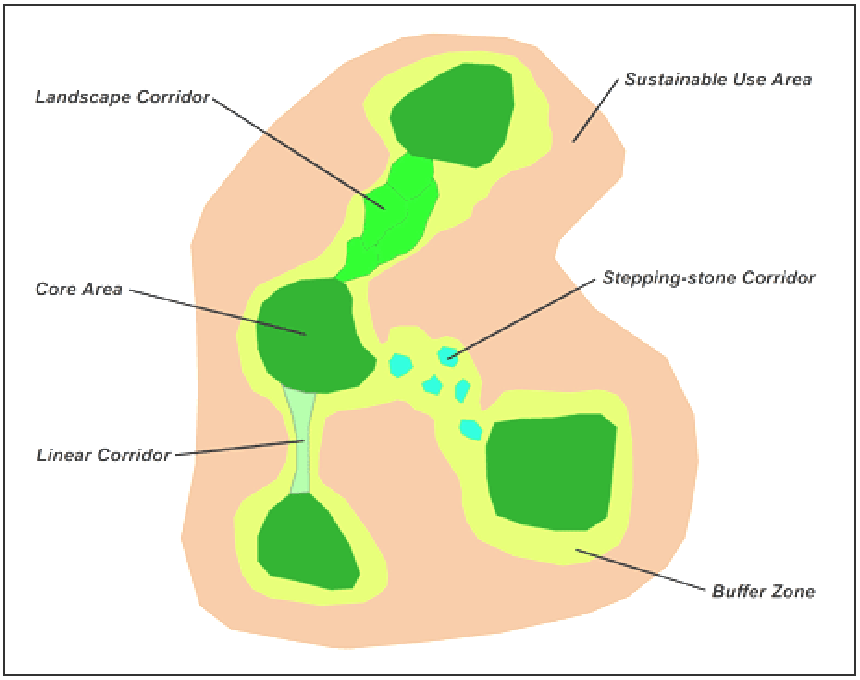

Figure 6. The classic core/corridor/buffer zone model of land protection to achieve maintenance of biological diversity and ecological processes across the land. Reprinted with the permission of The Rewilding Institute.

A wildlands network can be designed for virtually any scale, ranging from a county or community network of parks, to an entire state (Figure 7). The wildlands network design originally designed for Florida by Reed Noss in the 1980s was one of the first ones put out there.[8] The fact that Noss's design for Florida was rather conceptual in nature underscores the fact that wildland networks do not have to be fancy. If the core areas are relatively intact blocks of mostly roadless areas known to be important to a variety of wildlife, that's usually good enough. And by the same token, if the proposed linkage corridors are in wildland tracts that incorporate known movement corridors for wildlife, that is going to go a long way towards meeting conservation planning goals.

That said, wildland network design has gotten more sophisticated since 1987. Today, conservation planners employ Geographic Information Systems (GIS) to run complex models that run simulated annealing algorithms on terabytes of data encompassed within overlaid digital layers to come up with a perfect design that

---

[8] R.F. Noss, *Protecting Natural Areas in Fragmented Landcapes*, 7 NAT. AREAS J. 2, 8 (1987).

has just the right mix of species and ecosystem types "captured" in the final set of core areas. And not only that, on-the-ground studies are continually helping us ground truth these models, thus helping us to better design wildland networks. For example, empirical research helps us answer the questions: Is it better to have just one or two very large core areas or several small cores? Is a round core area better, or a long, skinny core? Is it better to have core areas close together or far apart? These questions comprise a popular chapter in most textbooks on conservation biology. Ecological studies done within configurations of land that look like the examples posed in these questions, or actual implemented sets of core area and linkages, can look at how well species and populations are doing in the set of cores and intact habitat patches, and whether animals are actually using the proposed linkages. All of this empirical data can feed back into the process of how to better design these wildland networks.

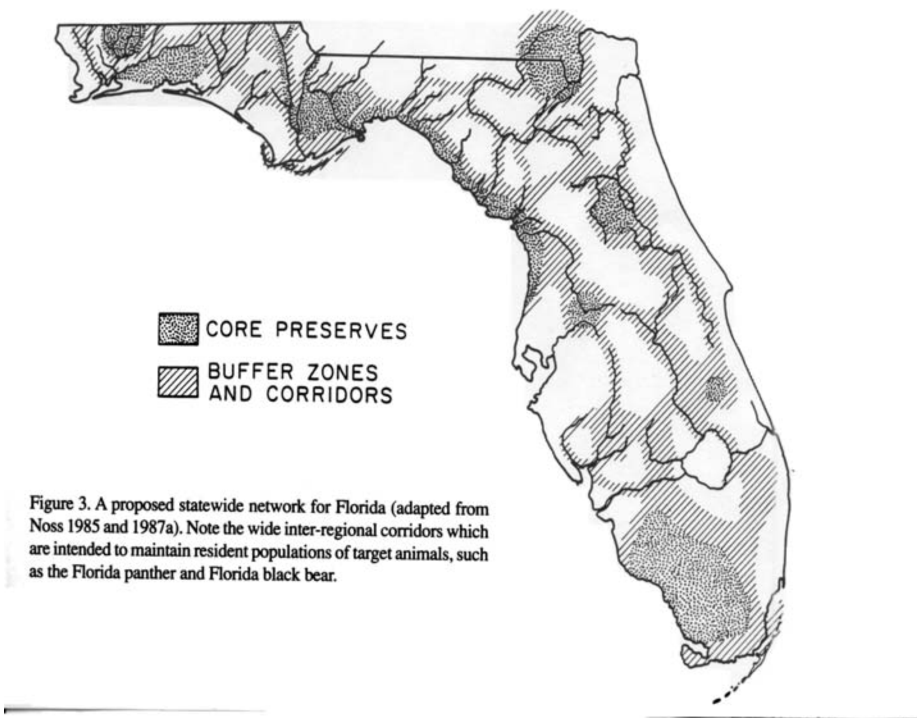

Figure 7. A statewide wildlands network for Florida proposed by Reed Noss (1987). Reprinted with the permission of Reed Noss.

A rigorous and scientifically informed wildland network will incorporate the "3 track approach," and make sure that the final set of core areas will (1) include adequate *representation of all the major vegetation types* in the region, (2) include most of the very rare species or ecotype occurrences (known as "*special elements*"), such as endangered plants, and (3) protect a suitable amount of area for key "*focal species*," whose habitat needs can serve as a surrogate or "umbrella species" for many other species.[9]

Focal species serve critical ecosystem roles and are indicative of healthy, functioning systems. These species, especially those that migrate, or are predators, are relatively wide ranging, or require intact and relatively wide movement corridors, are great species to use with movement models to help place the corridors in a wildlands network.[10] Exactly which species or suite of species to use is a question for each individual wildland network and is usually a matter of debate. Generally, the wider the corridor the better, and care should be taken to delineate corridors within the most natural and undisturbed habitat possible, or along a river or stream.

A good example of a regional scale wildlands network is the Heart of the West Wildlands Network (Figure 8).[11] This design incorporates the massive Middle Rockies region from Yellowstone National Park along the Wasatch Front and Book Cliffs of Utah to north of Colorado River and up the Continental Divide to the Big Horn mountains in Wyoming. The placement of core areas is based heavily on inventoried roadless areas but also used the Three-Track Approach to capture a balanced representation of different vegetation types, rare hot spots of biodiversity (endemic plants for example), and needs of focal species such as wolves, cutthroat trout and sage grouse. This design was a joint effort in which The Nature Conservancy developed the wildlands network for the mountainous area, and the Heart of the West Coalition (a coalition of many regional conservation groups) designed the wildland network for the lowland and desert areas.[12] The two separate designs were then stitched together, because the same methods were used to build them.

---

[9] R.F. Noss, *The Wildlands Project: Land Conservation Strategy*, *in* ENVIRONMENTAL POLICY AND BIODIVERSITY 239 (R. Edward Grumbine ed., Island Press 1994).

[10] JONES, DALY, MOLVAR, & CATLIN, *supra* note 1, at 89.

[11] *Id.*

[12] *Id.* at 1; REED NOSS, CARLOS CARROLL, KEN VANCE-BORLAND, & GEORGE WUERTHNER, ECOREGIONAL PLAN FOR THE UTAH-WYOMING MOUNTAIN ECOREGION: REPORT TO THE NATURE CONSERVANCY (2001), *available at* http://conserveonline.org/ workspaces/cbdgateway/era/reports/index_html.

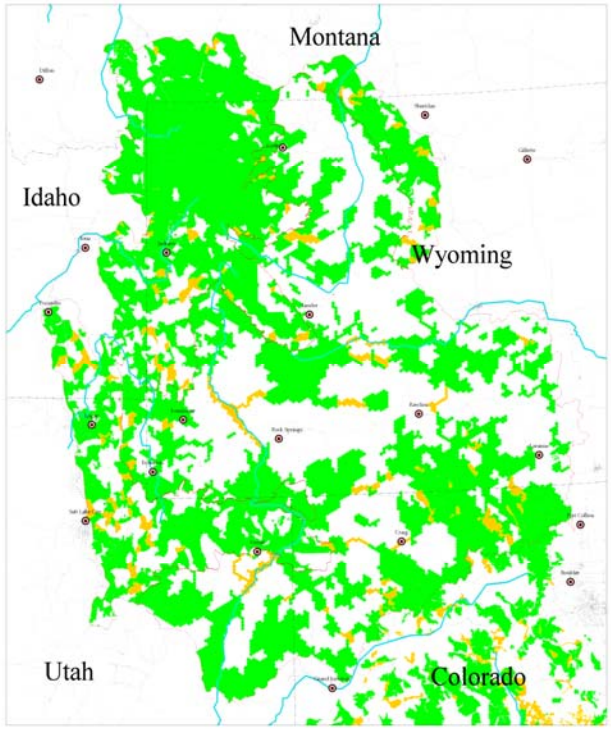

Figure 8. The Heart of the West Wildlands Network Design. Green areas are proposed core areas, yellow areas are corridors. This was a joint effort by The Nature Conservancy and the Heart of the West Coalition. Reprinted with permission of Wild Utah Project.

So how does one go about implementing a wildlands network on the ground? Many tools must be employed simultaneously to achieve eventual success. It may come as no surprise that one of the very best tools we have for implementing a proposed core area on the ground is wilderness designation. Wilderness by definition is roadless, and conservation science tells us that areas free from roads offer perhaps the best bang for the buck for biodiversity. This is true for a variety of reasons, ranging from predators' need to escape from human persecution, to rare plants needing refuge from exotic plant species that tend to march in along roads. As such, the protection of roadless areas as wilderness is probably the ideal way to achieve long term protection of core areas.

The holy grail of wilderness is just one tool in a very large toolbox for implementing pieces of wildland networks on the ground. Other tools include:

- State and Congressional **Legislation** (e.g. Congressional wilderness proposals, state-federal land trades etc.).
- **Administrative** protective designation on federal lands (e.g. designations of national monuments and parks, US Forest Service Resource Natural

Areas, Bureau of Land Management Areas of Critical and Environmental Concern, other protective designations in federal land use plans).

- Pushing for **ecologically based land management** for both cores and linkages, and compatible use areas (e.g. good decisions in USFS Travel Plans, BLM Grazing Permit renewals).
- **State and county level** opportunities like state parks, county parks, and other state initiatives (e.g. wildlife corridor designations, highway crossings).
- **Private land tools**: land trusts, conservation easements, cooperative agreements on private lands.

Working for better land management actions is not only an important goal in proposed cores and corridors, but also in the matrix area between cores and corridors. This can be as simple as reducing the number of off-road vehicle routes on a certain national forest, permitting only directional drilling in an oil and gas field, or reducing the stocking rate on certain BLM grazing allotments. If we can achieve better or more protective land use management in these matrix areas (whether they are called buffer zones or compatible use areas), and achieve permeable habitat for wildlife, there will be increased probability of wildlife movement between core areas without having to rely on a few functional wildlife corridors.

Are there good examples of implementation of wildlands networks out there? One of the places to look to is the Wildlands Project (but now with a new name, Wildlands Network), which sponsors coalitions of conservation groups and scientists in various parts of North America to develop, promote and implement wildlands network designs for different ecoregions. The Heart of the West Wildlands Network Design mentioned above overlaps to its south with the Southern Rockies Wildland Network—developed by Southern Rockies Ecosystem Project. The Southern Rockies Wildland Network in turn overlaps with the New Mexico Highlands Wildlands Network at the Colorado-New Mexico border (Figure 9), which in turns overlaps with the Sky Islands Wildlands Network, which links up a string of proposed core areas and corridors from the New Mexico highlands clear to the Mexican border and the Sierra Madre.

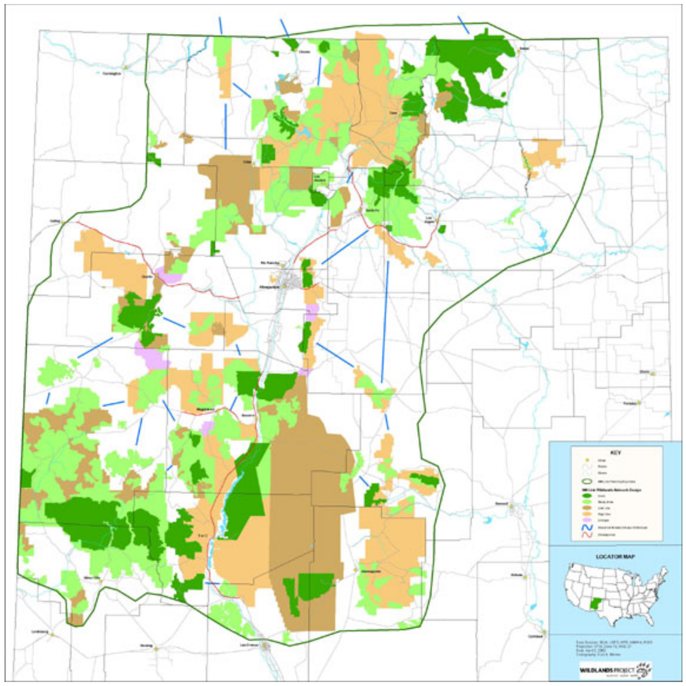

Figure 9. Wildlands Network sponsored a coalition of New Mexico conservationists and scientists to design this proposed set of core areas and corridors in the New Mexico Highlands Wildlands Network. Reprinted with the permission of Wildlands Network.

Wildlands Network has essentially linked these individual wildland network designs into a grand vision called the Spine of the Continent (Figure 10), with the ultimate goal of linking up core protected areas and corridors from the Yukon to the Yucatan, so that in theory a grizzly bear or wolf could travel safely, through relatively permeable and unimpeded habitat, from the Canadian Rockies to the Sky Islands Mountains via the Yellowstone to Yukon Wildlands Network, the Heart of the West, the Southern Rockies Network, the New Mexico Highlands Network, and the Sky Islands.

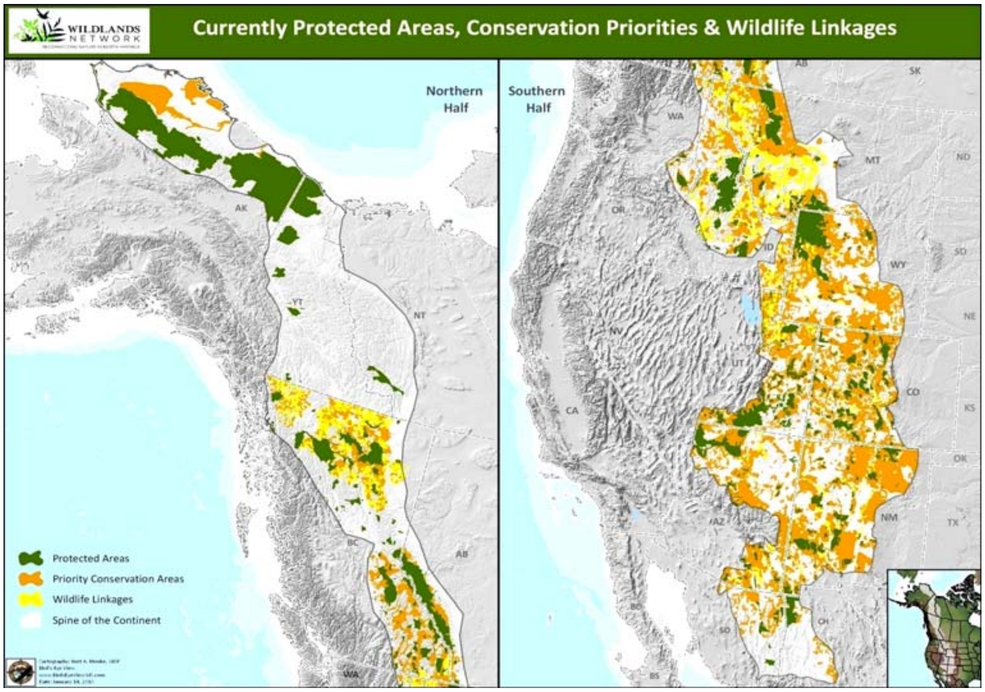

Figure 10. Wildlands Network's Spine of the Continent vision for land protection. Green areas are currently protected, orange areas are proposed core areas, and yellow areas are corridors. Reprinted with the permission of Wildlands Network.

On its face Figure 10 would indicate that the scientists and conservationists who generated these proposals really have their work cut out for them in terms of implementation. But the power behind citizen-generated wildland network designs like these should not be underestimated. These proposals offer a long-term blueprint for land protection and better management that is scientifically defensible, since the best science and most current, on the ground resource data are used to build the networks. These designs offer a collective vision for all the conservation groups in the region to get behind, because the conservationists who envision these wildland networks know that the best way to design them is to try to bring all conservationists and stakeholders in the region into the process early on through stakeholder workshops and expert peer review. Then the conservation groups can divvy up the work involved in achieving implementation of the design. For example one group can be pushing a statewide wilderness proposal in congress that incorporates a lot of the core areas, one group can be working with the state department of transportation on certain wildlife over or underpasses on a particularly key linkage corridor; another can focus on private lands that would make great cores and work to get those places under conservation easements. Other organizations may focus on the matrix between the core areas and corridors, working for habitat permeability through trying to affect better management of livestock grazing and ORVs on public lands.

Does this approach to implementation work? One good example of successful implementation can be seen with the Southern Rockies Wildlands Network, where regional conservation groups have focused on a very key wildlife linkage that connects the Eagles Nest Wilderness core with the Holy Cross Wilderness core area in the heart of the Colorado Rockies. All sorts of wildlife, including the still new and growing lynx population in Colorado, use this corridor, but I-70 poses a major barrier and road kill is significant along this stretch of the highway. The Southern Rockies Ecoregion Project helped write and lobby for a bill in Congress that was ultimately successful, and which has led to the appropriation of half a million dollars to the Colorado Department of Transportation for preliminary analysis and design for a state of the art wildlife overpass to help animals using this linkage to cross I-70 (Figure 11). With construction slated to commence in a year or so, this will be the first vegetated wildlife overpass in Colorado.

Another good implementation example can be found to the south of the Southern Rockies in the New Mexico Highlands Wildlands Network (Figure 9), where regional conservationists encountered a similar problem (a key wildlife corridor in the network bisected by a major highway). In this case, I-40 east of Albuquerque was bisecting a key wildlife linkage, used by large numbers of mule deer moving between two wilderness core areas. In this case the corridor was considered so important and so endangered that a brand new coalition was formed to deal with the problem. Called the Tijeras Canyon Safe Passage Coalition, this group convinced the New Mexico Department of Transportation to put up the funds to fence five full miles of both sides of the highway and funnel wildlife into three existing wildlife underpasses that were not being used.[13] Then NMDOT cleared all the brush out of the underpasses to ensure the deer would use them without fear of being ambushed by a cougar. Before the project was undertaken in 2007, there was an average of 20–30 cases a year of wildlife collisions with vehicles along that one stretch of highway.[14] After the project went in there has been a total of three collisions.[15]And follow-up monitoring indicates that the deer are indeed using the underpasses.

[13] *See* Press Release, New Mexico Land Conservancy, Hawkwatch Property in Tijeras Canyon Newest Open Space Acquisition by City of Albuquerque (Apr. 13, 2007), *available at* http://www.nmlandconservancy.org/Projects/Images/Hawkwatch4-13-07.pdf.

[14] Moises Velasquez-Manoff, *In New Mexico Canyon, a Novel Way to Prevent Roadkill*, CHRISTIAN SCIENCE MONITOR, Dec. 9, 2008, *available at* http://www.csmonitor.com/Environment/Wildlife/2008/1209/in-new-mexico-canyon-a-novel-way-to-prevent-roadkill.

[15] *Id.*

Figure 11. Proposed overpass over Interstate 70 near Vail, CO which will help implement a functional corridor for wildlife between two proposed core areas within the Southern Rockies Wildlands Network. Reprinted with the permission of Center for Native Ecosystems.

While the conservation groups who developed and support these wildland networks are making some progress on their implementation, the big question is whether state and federal land management agencies are buying into these designs. The answer in part depends on the state, but more often than not, the answer seems to be yes. For example in Arizona, the Arizona Department of Transportation teamed up with Arizona Game & Fish to create their own wildlands network, called the Arizona's Wildlife Linkages Project (Figure 12).[16] The process began with engagement of all the key stakeholders—including Wildlands Network.

[16] ARIZONA WILDLIFE LINKAGES WORKGROUP, ARIZONA WILDLIFE LINKAGES ASSESSMENT (2006), *available at* http://www.azdot.gov/inside_adot/OES/AZ_WildLife_Linkages/PDF/assessment/arizona_wildlife_linkages_assessment.pdf.

Wildlands Network was pleased with the outcome, because the same places that Arizona Linkages called "wildland blocks" were by and large the same places that Wildlands Network's sponsored network—called the Sky Islands Wildlands Network—called core areas. And, while the Arizona Linkages effort is very focused on using road underpasses to implement corridors because the project was spearheaded by AZDOT, the places where they are putting the underpasses are not only the places where deer are getting killed on the roads (though this is part of it). The Linkage Project used a cutting edge "Least Cost Path" computer model to figure out where the most important corridors exist for connecting the wildland blocks, and this information, along with road kill data, is what was used to determine the placement of the underpasses. There are now at least a dozen of these underpasses in various stages of design and development in Arizona.

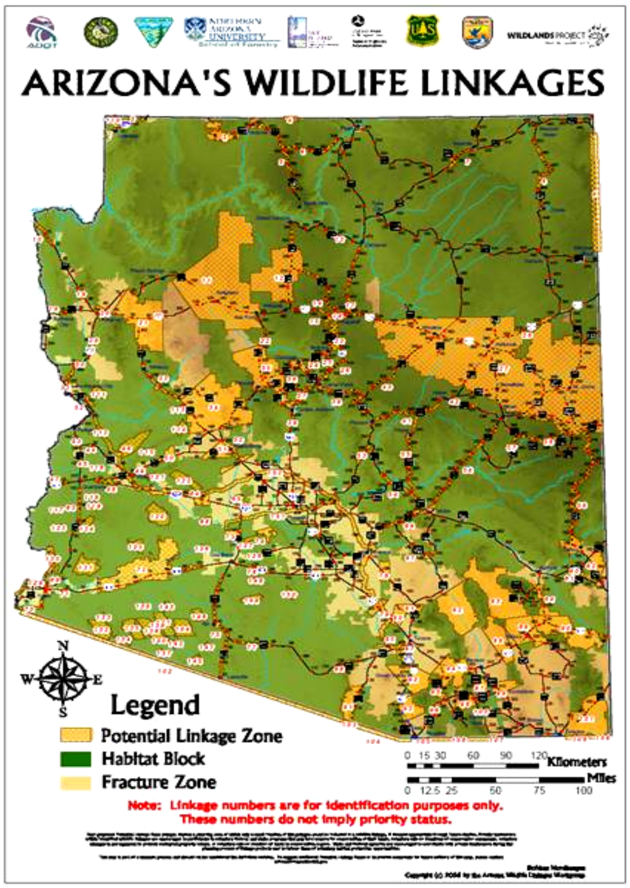

Figure 12. Arizona Wildlife Linkages Project, spearheaded by Arizona Department of Transportation and Arizona Game & Fish, in cooperation with Wildlands Network. Reprinted with the permission of The Arizona Wildlife Linkages Workgroup.

Yet another example of states getting on board with wildlands network implementation is Florida, where the conceptual wildlands network Reed Noss produced in the mid 1980s has morphed into a very sophisticated design (Figure 13). The state has fully bought into this design, and up until two years ago (when Florida came upon more difficult financial times with the downturn in the national economy), the state was averaging about $300 million a year for land protection efforts, focused largely on the core areas on this map. This is perhaps one of the best wildlands network implementation success stories to date.

Now it is time to address that elephant in the room—how will these wildland networks help our wildlife in the face of a changing climate? We are already seeing some of the impacts that climate change will bring for our wildlife populations. For example, dozens and dozens of species are already shifting their ranges northward and upwards in elevation in response to shifting vegetation patterns. The scientists doing this modeling tell us that there will be more of these range shifts to come in the near future. While, in many cases herbivores and pollinators will follow certain plants that experience range shifts and predators will follow prey, the data we already have indicate that these range shifts are happening more often on the basis of individual species, rather than whole communities shifting together. These species will tend to differ in their tolerances of different climatic conditions, dispersal abilities and other individual life-history factors. As such, it is critically important that existing protected areas are functionally connected by healthy, protected movement corridors that will allow plants and animals to shift, individually, upslope and northward across the landscape over time. If we do not do this, we will eventually witness significant extirpations of plant and animal species inside of protected areas.

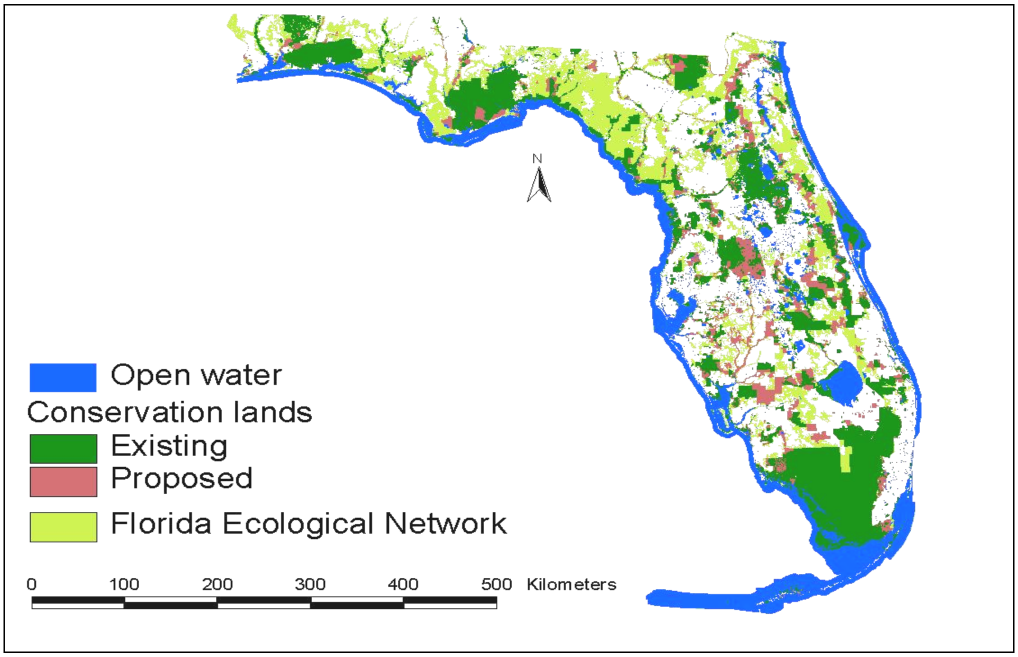

Figure 13. Many areas proposed for wildland core protection in Florida have become protected in the last two years, thanks to the state embracing this wildlands network design. Reprinted with the permission of Tom Hoctor, Ph.D., Director, Center for Landscape Conservation Planning, University of Florida.

Moreover, over the next many decades while species are attempting to move their ranges north and upwards in elevation, our population will still be expanding, and encroaching into more wildlife habitat, and the places where wildlife will be attempting to move through. Models predict that even in now relatively unsettled places along the Spine of the Continent, urbanization will spread. Climate scientists have told us that we need to move quickly to curtail our CO_2 emissions in the next decade in order to stave off a potential climate catastrophe. But now, conservation scientists are telling us that we may have to move just as quickly to protect critical wildlife core areas, and functionally connect them together with healthy landscape linkages to allow species to react to a shifting climate, in order to preserve biodiversity and ecological processes for the long term. If we do not do this, we stand not only to loose certain species within some protected areas, we stand to witness many species suffering complete extinction.