THE YAVAPAI COUNTY WILDLIFE CONNECTIVITY ASSESSMENT: REPORT ON STAKEHOLDER INPUT

November, 2013

Photo by G. Andrejko, AGFD

Arizona Game and Fish Department

In partnership with the Arizona Wildlife Linkages Workgroup

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Photo by Zen Mocarski, AGFD

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Photo by George Andrejko, AGFD

RECOMMENDED CITATION

Arizona Game and Fish Department. 2013. The Yavapai County Wildlife Connectivity Assessment: Report on Stakeholder Input. Phoenix, AZ.

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PARTNERS:
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Arizona Department of Transportation, Arizona Game and Fish Department, AZTEC Engineering, Bureau of Land Management, Defenders of Wildlife, Northern Arizona University, Sky Island Alliance, US Department of Transportation Federal Highway Administration, US Fish and Wildlife Service, USDA Forest Service

DEFINITIONS

*Note: Terms in this list are highlighted in **bold** where they first appear in the text.*

Arizona Missing Linkage – A subset of wildlife linkage areas identified in the statewide Arizona's Wildlife Linkages Assessment and county-level assessments, refined into detailed modeled corridors based on methods analyzing suitability characteristics of the landscape developed by Beier et al. (2007).

Diffuse movement area – A type of wildlife linkage in which animals move *within* a habitat block across a relatively broad area, rather than *between* habitat blocks through a well-defined linkage.

Habitat block – A relatively large and unfragmented area of land capable of sustaining healthy populations of wildlife into the foreseeable future.

Habitat connectivity – The extent to which an area of the landscape facilitates ecological processes such as unrestricted movement of wildlife. Habitat connectivity is reduced by habitat fragmentation.

Habitat fragmentation – The process through which previously intact areas of wildlife habitat are divided into smaller disconnected areas by roads, urbanization, or other barriers.

Important crossing area – A crossing identified by stakeholders as being important for wildlife movement across barriers, including canals, major roads, and highways.

Landscape movement area – A type of wildlife linkage in which animals move *between* distinct habitat blocks; the area may be relatively broad or through a well-defined linkage.

Riparian movement area – A type of wildlife linkage that includes vegetation, habitats, or ecosystems that are associated with bodies of water (streams or lakes) or are dependent on the existence of perennial or ephemeral surface or subsurface water drainage. Riparian linkages facilitate movement of both terrestrial and aquatic wildlife species. These can also include xeroriparian habitats (washes) that potentially only have surface water for a brief period (i.e. few hours a year) but may contain concentrated vegetation.

Umbrella species – In this report, refers to a group of species that represent the movement needs of all wildlife species within a linkage design or through a crossing structure. May also be known as a focal species.

Wildland block – Used interchangeably with habitat block.

Wildlife corridor – This term is often used interchangeably with "wildlife linkage" as we do in this report. Some biologists define the term "corridor" more narrowly to represent features such as canyons, ridgelines, riparian areas, and other landscape features that constrain or "funnel" wildlife movements into more restricted paths.

Wildlife linkage – An area of land used by wildlife to move between or within habitat blocks in order to complete activities necessary for survival and reproduction. Also referred to as a "wildlife movement area" or "wildlife corridor."

EXECUTIVE SUMMARY

This report and the accompanying geographic information system (GIS) datasets summarize the results of two stakeholder workshops held in Prescott, Arizona in 2009 and Mayer, Arizona in 2010. At these workshops, stakeholders representing a broad range of organizations and interests identified and mapped the locations of important wildlife linkages across Yavapai County. Participants included biologists, land managers, planners, and other professionals from federal, state, tribal, private, and non-governmental organizations. The workshops were supported by a partnership between the Arizona Game and Fish Department and the Arizona Wildlife Linkages Workgroup with the intention of producing the Yavapai County Wildlife Connectivity Assessment. This multi-agency, multi-disciplinary effort encouraged biologists and non-biologists alike to incorporate information about wildlife linkages and strategies for their conservation into transportation corridor and project planning as well as other community projects including land-use decisions. The workshops provided a forum for stakeholders to learn more about wildlife connectivity, outline the general locations of wildlife linkages on large maps, and provide descriptive information about each linkage on datasheets. Participants also identified the locations of barriers such as highways and railroads that may interfere with wildlife movements. The hand-drawn linkages and barriers were then digitized with GIS software, and later refined after an additional opportunity for stakeholder review. The linkages were then further refined to eliminate redundancy for this report.

This report provides background information on the importance and benefits of conserving wildlife linkages for both people and wildlife in Yavapai County, and describes the methods used in our stakeholder workshops and in developing our GIS products. It includes a series of maps generated from the digitized stakeholder data that depict the general locations of wildlife linkages and potential barriers to wildlife movement within Yavapai County. The maps are followed by tables with descriptive information about the habitat areas each linkage connects, the wildlife species each linkage serves, and any identified threats or potential conservation opportunities associated with each linkage and barrier. The information in this report reflects the views and expertise of workshop participants and likely does not represent an exhaustive mapping of all important linkages across Yavapai County. It should instead be considered an initial assessment of wildlife movement patterns to be supplemented by further analysis and refinement that includes additional expert input, GIS-based linkage modeling, and research studies of wildlife movement patterns. **The maps and GIS data in this report illustrate approximate locations of wildlife movements on the landscape and should be regarded as the starting point for further consultation with the Arizona Game and Fish Department and other wildlife and land management agencies, preferably in the early stages of project planning.** This report and associated GIS data provide a framework for professionals across a range of disciplines to begin to identify opportunities for maintaining and enhancing wildlife connectivity within project areas in Yavapai County. We hope that this report stimulates detailed planning and collaborative on-the-ground actions for conserving wildlife linkages through land acquisition and open space conservation, habitat restoration, creation of highway crossing structures for wildlife, and other approaches.

BACKGROUND

The beautiful natural areas, along with the abundant Arizona sunshine draw large numbers of new residents each year. The state has grown rapidly in recent years, with its human population rising 400% in the last four decades alone, (Arizona Department of Administration 2006, U.S. Census Bureau 2011). While communities across the state are expected to expand, much of the population growth will likely be concentrated throughout the "Sun Corridor" of the state, connecting Tucson, Phoenix, and areas of central Yavapai County. The population of Yavapai County has experienced a 26% change in population from 2000 to 2010, compared to a statewide rate of 24% (Yavapai County, 2012). Of Arizona's 15 counties, this rate of growth is only second to Pinal County, which is located between the population centers of Tucson and Phoenix (*Figure 1*), (Yavapai County, 2012).

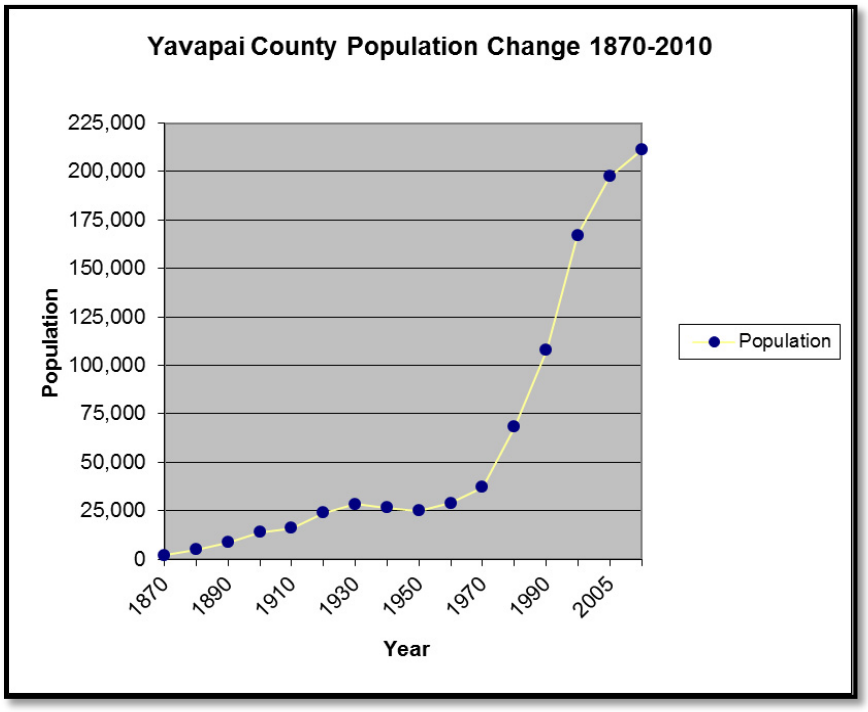


Figure 1: Decennial Census Population of Arizona Counties, Cities, Places: 1860-2010.

Yavapai County's topography makes a dramatic transition from the lower Sonoran Desert in the south to the heights of the Coconino Plateau to the north, and the Mogollon Rim to the east. The highest point above sea level in Yavapai County is Mount Union at an elevation of 7,979 ft (2,432 m) and the lowest is the Agua Fria River drainage, now under Lake Pleasant. This elevational gradient, combined with the region's diverse topography, creates conditions for a range of ecosystems and vegetation types including arid grasslands, pinyon-juniper woodlands, ponderosa pine forests, spring-fed and ephemeral wetlands, and mixed conifer stands. These vegetation communities support a diversity of wildlife, including commonly-occurring species such as black bear, mountain lion, elk, mule deer, pronghorn and javelina, as well as species that are not as common such as the black footed ferret, listed under the Endangered Species Act, and once thought to be extinct.

Yavapai County is named after the Yavapai people, who where the principal inhabitants at the time the territory was appropriated by the United States. Historical land uses were largely ranching, agriculture and mining (Yavapai County, 2012). Yavapai County is home to four National Monuments (Agua Fria, Montezuma Castle, Montezuma Well, and Tuzigoot), and four National Forests (Coconino, Kaibab, Tonto, and Prescott). In addition, the Verde River and Oak Creek Canyon traverse the landscape, providing recreational opportunities for both visitors and local residents.

During the past forty years, much of the ranching and agricultural uses have developed into urban growth and expansions of municipalities (Yavapai County, 2012). In the Prescott/Prescott Valley area from the late 1960s through the late 1970s, many sections of the Fain family ranch holdings in the "Lonesome Valley" area developed into the Prescott Country Club Subdivision and almost all of the present-day Town of Prescott Valley. Similar planned development of former ranch and farm properties occurred in the late 1960s-1970s in the Verde Valley (the Verde Villages and the Village of Oak Creek area), and in the Highway 69 Corridor areas (Spring Valley and Cordes Lakes). In the 1980s-1990s, planned area developments, such as Yavapai Hills, Haisley/Hidden Valley Ranches, the Ranch at Prescott and Sandretto Hills, were developed and annexed into the City of Prescott. More recent transitions from ranchland to master planned communities, from 1990 through to 2010, include those in Chino Valley/Paulden (Del Rio Springs and Bright Star/Meadow Ridge Ranch) and in the Williamson Valley Road area (Inscription Canyon, Whispering Canyon, American Ranch and Talking Rock Ranch). Other large ranches are currently being developed in several parts of the County. Transitions from agriculture and mining uses also resulted in many non-regulated land developments throughout Yavapai County (Yavapai County, 2012).

WHY WE NEED WILDLIFE LINKAGE PLANNING IN YAVAPAI COUNTY

POPULATION GROWTH

A great deal of the population growth in Yavapai County is expected to occur along State Route 89, expanding the footprints of Prescott, Prescott Valley, Chino Valley, and Paulden. The locus of development targets flat, easily-developed grassland habitat important to the largest remnant population of pronghorn antelope in the state.

The growth of Arizona's human population and expanding infrastructure has consequences for Yavapai County's wildlife species and the habitats on which they depend. While human development and disturbance can adversely affect wildlife by causing direct loss or degradation of habitat, the disruption of wildlife movement patterns is a less obvious, but an equally important consequence. **Habitat connectivity** addresses this disruption by enabling animals to move across the landscape to varying extents in order to acquire the resources necessary for survival: food, water, protective cover, and mates. Mountain lion, black bear, mule deer and pronghorn roam over vast expanses that can encompass thousands of acres, while smaller animals such as Northern leopard frogs and tassel-eared squirrels engage in essential movements across a much smaller area. There is also variation in the temporal patterns of animal movement: some animal movements occur on a daily basis, while seasonal migrations may occur annually, and the dispersal of young from their natal sites to secure new breeding territories happens only once in an individual's lifetime. *Figure 2* illustrates the impact that man-made barriers can have on wildlife movement patterns, some to the degree that their presence may affect the long-term persistence of wildlife populations (Noss 1983, Wilcox and Murphy 1985, Noss 1987, Bennett 1999, Henle et al. 2004, Noss and Daly 2006).

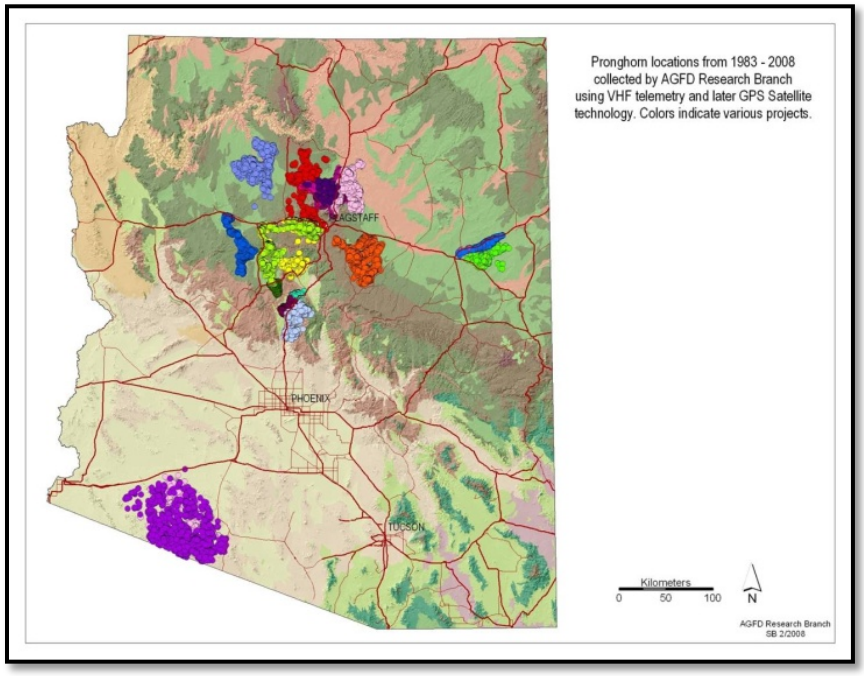


Figure 2: *Effect of roadways on movement of pronghorn. Radio and satellite telemetry studies by the Arizona Game and Fish Department reveal that major roadways can act as barriers to pronghorn movement. This barrier effect can effectively isolate populations, potentially reducing genetic diversity and reproductive success over time. Colors indicate groups of animals studied in separate projects.*

The following touches on other barriers that, in combination with urban development, have the potential to specifically interfere with wildlife movement and interrupt wildlife connectivity within Yavapai County.

TRANSPORTATION INFRASTRUCTURE

As a result of anticipated population growth in central Arizona, transportation planners recognize the need to support increased traffic demand through the expansion of existing roads and construction of new roads. Given the largely rural nature of Yavapai County, much of the population growth will involve expansion of cities and towns into relatively undeveloped areas, and expand the footprint of roadways such as State Route 89, 89A, Williamson Valley Road, Fain Road, State Route 169, and a new alignment proposed to connect I-17 to Fain Road. A new interstate (I-11), is proposed to connect Tucson and Las Vegas, though route alternatives have not yet been identified. However, it is likely to cut through at least a portion of Yavapai County, with a feeder loop connecting to Prescott.

In addition, a projected increase in rail traffic throughout the state in coming decades may include expansion of the existing Class 1 freight railroads, BNSF Railroad and the Union Pacific Railroad, (Arizona Department of Transportation 2010b).

UTILITY INFRASTRUCTURE

The growing population in Arizona will also bring increased energy demands. The development of wind and solar energy facilities, utility corridors, and other energy-related infrastructure may be considerable over the next several decades. In 2012, the Bureau of Land Management and Department of Energy completed a new policy framework for utility-scale (>20 megawatt) solar energy development on BLM lands, which will govern and guide the future of this rapidly growing form of energy development across millions of acres of land in the sun-rich state of Arizona. Concurrently, the Arizona BLM's Restoration Design Energy Project delineated low-conflict zones across multiple land ownerships where utility and sub-utility solar and wind Development will be incentivized. A recently published review paper by the United States Geological Survey (Lovich and Ennen 2011) concluded, "…it appears that insufficient evidence is available to determine whether solar energy development, as it is envisioned for the desert Southwest, is compatible with wildlife conservation". While this study reveals a void of scientific studies quantifying the effects of this relatively new form of energy development on wildlife, some of the known primary impacts of this form of development (i.e. habitat conversion, fragmentation, and disturbance) have been studied extensively elsewhere and have been shown to affect habitat quantity, quality, and connectivity. The expansion of renewable energy development in the West will also spur new development and retrofit of energy transmission infrastructure. For example, the Yavapai Wind and Solar project proposed for land owned and ranched by Yavapai Ranch L.P. and the Northern Yavapai LLC. This project encompasses a 130 megawatt wind power generating facility (approximately 81 turbines, 450' tall) and a 25-30 megawatt solar power generating facility totaling a project size of 4,969 acres with 35 miles of new road construction.

WHAT WILDLIFE CONNECTIVITY MEANS

The process through which previously intact areas of habitat are divided into smaller disconnected areas by roads, urbanization, and other barriers is known as **habitat fragmentation**, which decreases the degree of habitat connectivity of the landscape for wildlife. The disruption of animal movement by habitat fragmentation presents problems for Arizona's wildlife, ranging from direct mortality on roadways to the genetic isolation of separated populations. This disruption of animal movement patterns also negatively affects human welfare by increasing the risk of wildlife-vehicle collisions and the frequency of unwanted "close encounters" with wildlife. However, the effects of habitat fragmentation can often be mitigated by identifying and protecting areas that wildlife use for movement, known as **wildlife linkages** or **wildlife corridors** (Beier and Noss 1998, Bennett 1999, Haddad et al. 2003, Eggers et al. 2009, Gilbert-Norton et al. 2010). Ridgelines, canyons, riparian areas, cliffs, swaths of forest or grassland, and other landscape or vegetation features can serve as wildlife linkages. Wildlife linkages are most effective when they connect (or are located within) relatively large and unfragmented areas referred to as **habitat blocks** or **wildland blocks**. Habitat blocks are areas large enough to sustain healthy wildlife populations and support essential biological processes into the future (Noss 1983, Noss and Harris 1986, Noss 1987, Noss et al. 1996).

In order to distinguish between different types of wildlife movement, wildlife linkages are broken down into several categories within this report.

- **Landscape movement areas** refer to a type of wildlife linkage where animals move between habitat blocks.
- Animals may also move *within* a habitat block rather than through a well-defined corridor, a type of wildlife linkage we identify as a **diffuse movement area**.
- **Riparian movement areas** refer to a type of wildlife linkage where animals move primarily through riparian habitat, including desert washes classified as xeroriparian habitat.
- Often, wildlife use **important crossing areas**, such as drainage culverts, land bridges or wildlife overpasses, to move between habitat blocks or through riparian habitat where barriers exist. Stakeholders also indicated some of these barriers at the workshops.

Wildlife linkage planning should include conservation of wildlife linkages and the habitat blocks they connect, and, in most cases, require the implementation of multiple strategies such as land acquisition, community planning for developments, open space conservation, and habitat restoration. Installation of roadway mitigation features including wildlife crossing structures and fencing to funnel wildlife to crossing structures (*Figures 3a* and *3b*) are important considerations, best incorporated into the early planning and design stages of transportation and development projects.

a.

b.

***Figures 3a and 3b**: In early 2010, the Arizona Game and Fish Department initiated a Pronghorn Telemetry study in conjunction with the Chino Valley Bypass Project to identify potential locations for wildlife crossing structures to help mitigate the effects of right of way fencing. Pronghorn were captured and fitted with telemetry collars to determine movement corridors and potential areas for crossing structures.*

BENEFITS OF WILDLIFE LINKAGE PLANNING

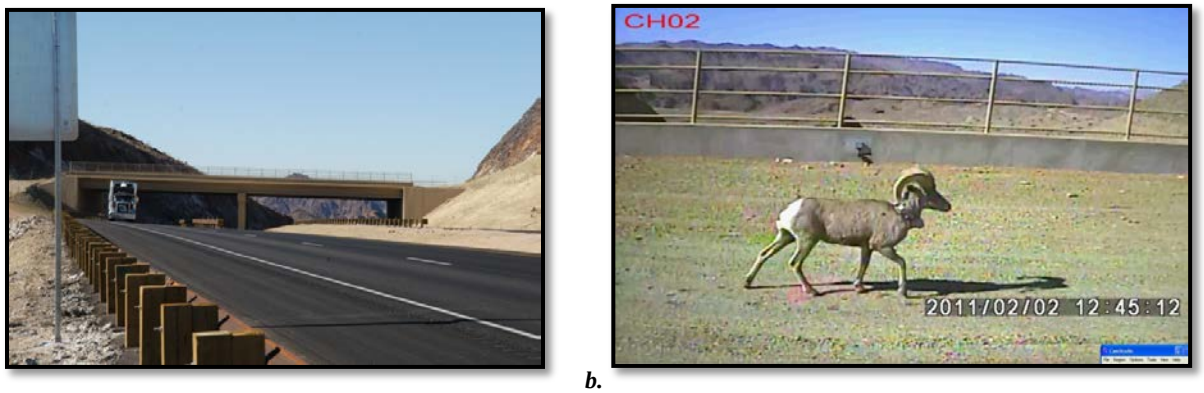
Identifying and conserving habitat connectivity by maintaining wildlife linkages can provide many important benefits for both humans and wildlife.

BENEFITS TO WILDLIFE

By facilitating wildlife movement patterns, linkages allow animals to access essential resources such as food and water needed during their daily activities. They also enable longer-range, seasonal migratory movements between summer and winter habitats and facilitate the movement of animals in search of breeding sites. Linkages that connect otherwise isolated populations help prevent small populations from extinction (Laurence 1991, Beier and Loe 1992), help maintain genetic diversity, and reduce the risk of inbreeding (Beier and Loe 1992, Bennett 1999). Habitat connectivity also helps ensure that critical ecological processes such as pollination and seed dispersal, which often depend on animal intermediaries, are maintained. In some cases the linkages themselves may sustain actively reproducing wildlife populations (Beier et al. 2007, Perault and Lomolino 2000). Linkages are also expected to play an important role in helping animal populations adapt to and endure the effects of climate change, by allowing animals to shift their range with latitude or elevation as vegetation communities change their distribution and suitable environmental conditions shift on the landscape (Hannah et al. 2002, Glick et al. 2009).

Knowledge of wildlife linkage locations helps inform project planners about what appropriate mitigation needs to occur for roads that affect many wildlife species. Roadway mitigation features such as crossing structures and parcel acquisitions, can be expensive and should be designed and implemented to accommodate **"umbrella species"**, which suggest that conservation strategies designed for one species my benefit co-occurring species (Beier et al. 2007, Lowery and Blackman 2007). However, certain species may require specific landscape features (i.e. ridgelines, stream corridors, etc.), vegetation composition and structure, crossing structure designs (i.e. specific length or "openness"), and certain thresholds of human disturbance/activity in order to be functional (*Figures 4a* and *4b*). Planning for effective wildlife crossings must also consider what is going to happen on those lands in the immediate proximity

of the crossing, which may also influence priorities for rural and urban open space planning and acquisition. Allowing development to occur near crossing structures and placing structures in locations that do not provide suitable habitat for the target species generally affect their use by wildlife (Beier and Loe 1992).



a. ***b.***

Figures 4a and 4b*: (a) Wildlife overpasses, like the one designed for bighorn sheep on US Route 93 mitigate for the barrier effects of roads on wildlife connectivity. (b) Desert bighorn sheep have been documented using the wildlife crossing structure. Such crossing structures sustain important wildlife linkages while greatly reducing the threat of vehicular collisions. Crossing structures are most effective when they are designed to meet the needs of species known to be using the linkage. (Photograph: Arizona Game and Fish Department).*

BENEFITS TO PEOPLE

Maintaining an interconnected network of wildland blocks will provide benefits to the local human communities as well, perhaps most obviously by improving public safety. It has been estimated that approximately 20% of the land area in the United States is ecologically affected by the country's road network (Forman et al. 2003). The implications of this widespread impact include threats to connectivity and hazards to motorists (Forman and Alexander 1998). One study estimated that each year more than 200 motorists are killed and approximately 29,000 are injured as a result of deer-vehicle collisions in the United States (Conover 1995). Such collisions can cost $2 billion annually (Danielson and Hubbard 1998). Identifying important wildlife movement areas that traverse transportation corridors prior to the construction of new roads or road improvements allows for the informed siting of wildlife-friendly over- and underpasses that can greatly reduce the likelihood of collisions (Clevenger et al. 2001, Forman et al. 2003, Dodd et al 2007; *Figures 4a* and *4b*). Along Arizona State Route 260, for example, a combination of wildlife underpasses and ungulate-proof fencing reduced elk-vehicle collisions by 80% (Dodd et al. 2007). A study by Lowery and Blackman (2007) detected direct road kill or evidence of the presence of 55 unique species along Twin Peaks Road in Pima County.

As the optimal objective of providing wildlife linkages is to maintain the connectivity between wildland blocks, there are circumstances where it is important to accommodate a linkage that, either partially or in its entirety, crosses through urban and suburban environments where open spaces invite (intended or not) passive recreation activities. In such situations, the linkage may also serve as a buffer between developed areas and wildland blocks and can help protect the wildland network from potentially damaging external influences. Incorporating and designing rural and urban greenways and/or open spaces that support wildlife movement into municipal planning efforts also helps retain the natural vistas and aesthetic attributes that Arizona residents

and visitors value. Since evidence suggests that some species are sensitive to the presence of humans (Clevenger and Waltho 2000, Taylor and Knight 2003), multi-use buffer zones should be made wide enough to maintain separation between human recreation activities and the needs of the wildlife species using the corridor.

Maintaining linkages that facilitate the ecological health of wildland blocks can also be a significant investment in contributing to the diversity and vitality of an area's economy and the American economy. The Outdoor Industry Association developed a report in 2012 on "The Outdoor Recreation Economy". The report recognized outdoor recreation as being critical to the economy through direct spending, manufacturing, finance, retail, tourism and travel. Also emphasized in the report, "Not only is access to quality places to play outside critical to our businesses, it is fundamental to recruiting employers and at the heart of healthy and productive communities. Open spaces and recreation areas are magnets that draw after-work activity and tourists alike". The economic value associated with fish and wildlife-related recreation is significant for Yavapai County and contributes greatly to Arizona's economy. A national survey of fishing, hunting, and wildlife-associated recreation has been conducted about every five years since 1955 to evaluate national trends. The survey provides information on the number of participants in fishing, hunting, and wildlife watching (observing, photographing, and feeding wildlife), and the amount of time and money spent on these activities. In the most recent survey, it was reported that in 2011, state resident and nonresidents spent $2.4 billion on fishing, hunting, and watchable wildlife related recreation in Arizona (U.S. Department of the Interior 2012). In 2013, a county-level analysis of the national survey data revealed that in Yavapai County watchable wildlife activities generated a total economic effect of $49 million, supporting 430 jobs, providing residents with almost $16 million in salary and wages, and generating $3 million in state tax revenue (*Table 1*, Southwick Associates 2013). Fishing and hunting recreation in 2001 generated a total economic effect of $50 million for the County, supporting 800 jobs, providing residents with $10 million in salary and wages and generating $2 million in state tax revenue (Silberman 2003). These economic benefits illustrate that conserving our wildlife populations, through efforts such as maintaining or restoring habitat connectivity is also good for business in the County.

Yavapai County	Economic Effect	Number of Jobs Supported	Amount in Salary and Wages	Amount in State Tax Revenue
Watchable Wildlife	$49,000,000	430	$16,000,000	$3,000,000
Fishing and Hunting	$50,000,000	800	$10,000,000	$2,000,000

Table 1: Economic Impact of Wildlife-related recreation activities in Yavapai County.

Overview of Regional Planning Efforts That Acknowledge the Importance of Conserving Wildlife Linkages

There is a growing appreciation among local governments, land management agencies, transportation departments, conservation organizations, energy and utility companies, and citizens across Yavapai County of the importance of conserving wildlife linkages and mitigating the impacts of barriers to wildlife movement.

The Department is currently working with Prescott National Forest, Central Yavapai Metropolitan Planning Organization, and Yavapai County to incorporate recognition of linkages into their planning documents. The Federal Highway Administration and the Arizona Department of Transportation recognize wildlife-vehicle collisions as a serious problem along major northern Arizona roadways, and have supported collaborative research with Arizona Game and Fish Department biologists to identify wildlife movement patterns and design effective mitigation strategies (Gagnon and Nelson 2010, Gagnon et al. 2010). The National Forests have identified the maintenance of habitat connectivity as an important goal in the revision of their forest plans (USDA 2010a, b), and have begun to integrate wildlife linkage data into their wilderness designation process (Coconino National Forest, pers. comm.).

Planning efforts in other areas of Arizona have also begun to incorporate information on wildlife linkages. For example, Pima County's Conservation Lands System (Pima County 2001), an outgrowth of the widely-acclaimed Sonoran Desert Conservation Plan and adopted as policy in the County's Comprehensive Plan, includes protection and restoration of wildlife linkages as a key objective in the evaluation of Plan amendments and all land uses requiring rezoning. The Town of Oro Valley incorporated the conservation of an important wildlife linkage in the Arroyo Grande planning area as an amendment to its General Plan (Town of Oro Valley 2008). The Resource Management section of the Flagstaff Area Open Spaces and Greenways Plan (1998), the Natural Environment element of the Coconino County Comprehensive Plan (2002), and the Environmental Planning and Conservation element of the revised Flagstaff Area Regional Land Use and Transportation Plan (in preparation) all include preservation of wildlife movement areas among their conservation goals. This focus on maintaining habitat connectivity for wildlife will only grow as Arizona becomes more developed and populous in coming decades and the threat of habitat fragmentation increases (*Figure 5)*.

Figure 5. Development within the Central Highlands Planning Area. Photo courtesy Arizona Department of Water Resources.

THE YAVAPAI COUNTY WILDLIFE CONNECTIVITY ASSESSMENT

To assemble current knowledge of wildlife linkages and barriers to wildlife movement across Yavapai County and to help build collaborative partnerships with local jurisdictions for eventual implementation efforts, AGFD joined with partner organizations (please see Acknowledgments for a list) to initiate the Yavapai County Wildlife Connectivity Assessment. This project grew out of prior initiatives including the statewide Arizona Wildlife Linkages Workgroup (AWLW) known as Arizona's Wildlife Linkages Assessment, or AWLA. The AWLA used an expert-based approach to create a statewide map of potential linkage areas and barriers at a coarse scale (Arizona Wildlife Linkages Workgroup 2006; *Figure 6*). This Yavapai County Wildlife Connectivity Assessment represents a continuation of these previous efforts and is intended to identify wildlife linkages at a finer scale that may have been overlooked in the earlier assessment, as well as those that will be useful for regional and local transportation or land-use planning efforts.

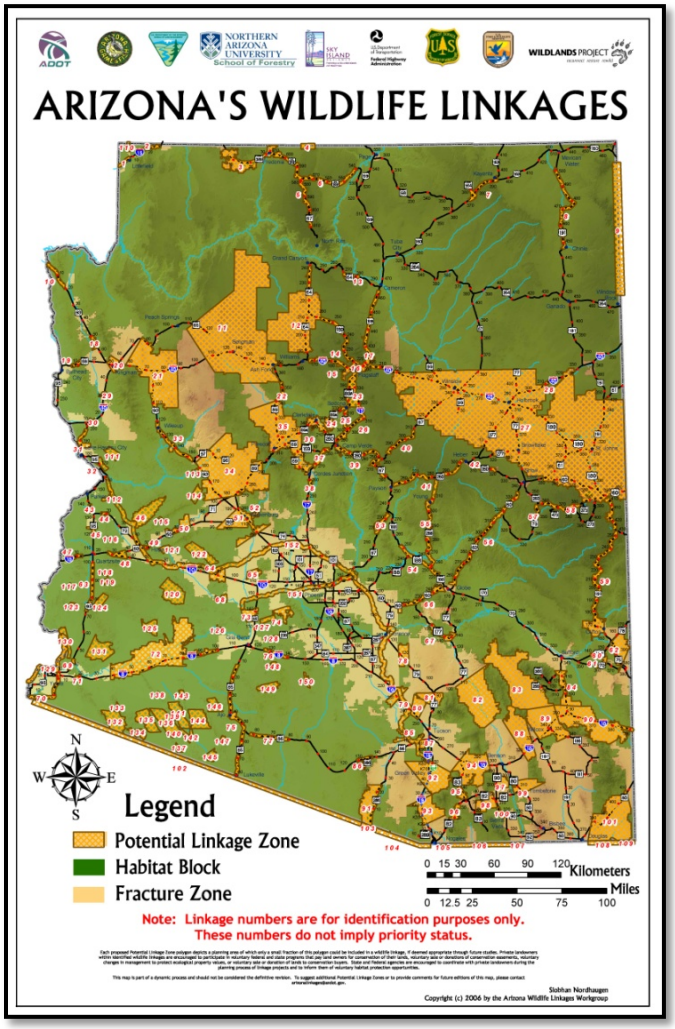


***Figure 6**: Statewide map of wildlife linkages and barriers created for Arizona's Wildlife Linkages Assessment (2006).*

METHODS

INITIAL STAKEHOLDER WORKSHOP

In the fall of 2009, AGFD partnered with the Arizona Wildlife Linkages Workgroup (AWLW) to host a workshop for stakeholders and experts in the fields of wildlife management and land-use planning. Attendees included private citizens and representatives from consulting groups, federal agencies, state agencies, non-profit organizations, and tribal and local governments. Following a brief series of presentations on wildlife connectivity principles and the goals of the Yavapai County Wildlife Connectivity Assessment, stakeholders were instructed to visit one or more of five stations where a portion of the county was displayed on a paper map. These maps had backgrounds of recent aerial imagery and topographic features and represented the locations of major roads and other important features. Participants mapped important wildlife linkages and areas of known wildlife movement, including diffuse movement areas within habitat blocks and locations where wildlife cross (or may have previously crossed) barrier features between habitat blocks. Participants were encouraged to use additional clear film overlays depicting vegetation type, conservation status, and land ownership as needed for reference. For each wildlife linkage drawn, participants were instructed to fill out a datasheet describing wildlife movement patterns and existing or future land uses that may affect the wildlife in the area (Appendix A).

A consequence of this voluntary, stakeholder-based approach is that not all geographic areas were equally represented by knowledgeable stakeholders and the information we were able to collect about wildlife linkages was more comprehensive in some areas than in others. There may be important wildlife linkages in areas of Yavapai County where none appear on our maps, so this absence should be interpreted with caution pending further study. Also, the type and amount of evidence on which each linkage was based varied from isolated personal observations to long-term empirical data from telemetry studies. This variation in the amount and source of stakeholder input available for each linkage may be reflected in the level of detail we were able to provide in the "Wildlife Linkage Descriptions" tables below, which is derived directly from the information provided on the datasheet. Thus a relative lack of detail for a given linkage, in terms of species using the linkage, current or potential threats, or additional "Notes" (see below), should not lead to the conclusion that a linkage is not important. Additional information collected in the future should expand these descriptions, as well as point out locations of additional linkages across the County.

GIS DIGITIZING AND EDITING METHODS

Stakeholder linkages from workshops were digitized in GIS and their associated datasheets entered into a database. Some rules or explanations in the section that follow may contain codes indicated by a letter and number combination. These codes can be used to reference particular information in the "Wildlife Linkages Descriptions" section of this report and are used to label linkages on the maps in this report. Project staff used the following guidelines when digitizing stakeholder drawings in GIS:

- Trace contour lines to digitize canyons or hills when a drawing or description indicates a topographic feature is being used.

- When a linkage polygon is drawn across a road but information from the datasheet indicates that stakeholder meant to identify a barrier only and not specify a linkage, define the stretch of road as a barrier.
- Where linkages overlap or fall inside larger linkages, keep only those shapes which provide unique information or show movement in contrasting directions. Otherwise merge the shapes and combine the information from each datasheet (e.g. species using linkage) into attributes for the single merged shape.
- Do not include linkages for which the data provided are insufficient. Follow up with stakeholders whenever possible to obtain needed information about the linkage.
- Examine each digitized linkage and ensure its correct representation based on stakeholder drawings, data, and additional input.
- Categorize each linkage as a diffuse movement area (movement within a habitat block), landscape movement area (movement between habitat blocks), or riparian movement area (movement through riparian habitat) based on the landscape and the data provided by stakeholders.
- Use digitized locations of washes to replace hand drawn riparian movement areas and buffer 0.5 miles on either side for consistent representation on maps. Beier et al. (2006a), used a minimum linkage width of 1 km and 1.5 km in many of their **Arizona Missing Linkage** designs. However, for the purpose of this report a minimum width of 1 mile was used to represent riparian movement areas in order to highlight the area and allow for refinement.

ARIZONA MISSING LINKAGES

Following the 2006 AWLW publication of Arizona's Wildlife Linkages Assessment, a sample of the mapped linkages were prioritized and modeled using GIS tools by the Corridor Design Team at Northern Arizona University. This GIS modeling was funded through the Arizona Game and Fish Department Heritage Fund and was based on methods analyzing habitat suitability characteristics of the landscape (Beier et al. 2007). A series of reports titled Arizona Missing Linkages containing maps of final linkage designs around Arizona were published to help guide transportation and development planning decisions and are available at corridordesign.org. The linkage designs represented in the Arizona Missing Linkages reports are distinguished from the stakeholder-derived data on the maps in this report.

FOLLOW-UP WORKSHOP AND GIS REFINEMENT

A second stakeholder workshop was convened in the summer of 2010 to allow participants to review the digitized linkage polygons for accuracy, omissions, and redundancy. Participants were also encouraged to provide additional information about the linkages including the species served, habitat blocks connected, and threats to connectivity that may have been overlooked the first time around. Input from the second stakeholder workshop was also incorporated following the decision rules described above and linkage and barrier polygons were re-digitized when necessary. This report contains the final version of the information provided through the stakeholder workshop process.

HOW TO USE THIS REPORT AND ASSOCIATED GIS DATA

A SCREENING TOOL FOR WILDLIFE LINKAGE PLANNING

This report and the associated GIS datasets are intended to help transportation planners and engineers, land-use planners, developers, land managers, and biologists incorporate consideration of important wildlife linkages and barriers into their projects. The wildlife linkages contained in the shapefile and shown on the maps are not intended to identify finite boundaries. Instead they illustrate the *general* locations of wildlife movements on the landscape and should be regarded as the starting point for consultation with biologists and land managers including AGFD, the U.S. Fish and Wildlife Service (especially when federally-listed species may be affected), the USDA Forest Service, and other entities as appropriate—ideally in the early stages of project planning. These materials thus comprise a *screening tool* to help identify areas where linkage planning goals or concerns for wildlife connectivity may exist.

It is also important to emphasize that the information in this report reflects the views and expertise of workshop participants, and that these participants had diverse expertise and varying degrees of individual familiarity with wildlife linkages and barriers in different areas of Yavapai County. Given that there may have been some areas of the County for which fewer expert participants were present at the stakeholder workshops or for which less is known in general about wildlife movement patterns, this report should not be regarded as an exhaustive representation of all important wildlife linkages. While we have attempted to provide a comprehensive analysis, the information we present will benefit from further refinement through additional stakeholder input, GIS-based linkage modeling, and additional research on wildlife movement patterns.

Clarification should be given as to the species identified within linkages throughout this effort. While the stakeholders were asked to identify species known to the linkage area, these are not exhaustive lists, and may not include species of special concern as identified through AGFD's Heritage Data Management System or Online Environmental ReviewTool (or by other local and federal natural resource agencies). If a linkage falls within a project proponent's area of interest, we recommend utilizing the Online Environmental Review Tool and/or contacting AGFD for further identification of species to consider within a project or planning area. More information on this and other available datasets is provided in the "Other Resources" section below.

To best integrate knowledge of wildlife linkages into planning efforts, we recommend a collaborative approach involving project proponents, local planners, transportation, wildlife and land management agency specialists, citizen groups, and others with an interest in conserving habitat connectivity for wildlife in a manner compatible with regional goals. It is crucial that users of this report understand that conservation of the habitat blocks that these movement areas are connecting is also essential for the long-term health of wildlife populations in Yavapai County. While we have not delineated the limits of these habitat blocks on our maps they are named in the descriptions of each linkage (see "Wildlife Linkage Descriptions" below).

GEOSPATIAL (GIS) DATASET

The geospatial dataset associated with this report should be used with GIS software to allow users to incorporate information of wildlife linkages into land use planning, construction, or

project level spatial decision-making processes. As explained above, the borders of the linkages in the GIS dataset are not intended to show the exact boundaries of linkages, nor are the habitat blocks included in the shapefile. To obtain a copy of the GIS dataset for use in your local planning efforts please contact the Habitat Program at the Arizona Game and Fish Department's Kingman office (928-692-7700) or the Department's GIS Program (gis@azgfd.gov).

OTHER RESOURCES

Additional tools are available from the Arizona Game and Fish Department to help planners identify wildlife resources in a project planning area. These tools include the Species and Habitat Conservation Guide (SHCG), a model depicting areas of wildlife conservation potential and the Geospatial Planning Tool HabiMap of Arizona, http://www.habimap.org, an online geospatial data viewing platform that serves as a data exploration tool for AGFD's wildlife datasets. Site-specific reports on wildlife species of concern are available through the Online Environmental Review Tool (Tool). In addition to these resources, guidelines documents and other information is available on the Arizona Game and Fish Department's "Planning for Wildlife" web page at http://www.azgfd.gov/WildlifePlanning.

For a description of GIS wildlife corridor modeling approaches and to download ArcGIS modeling tools developed by scientists at Northern Arizona University please see the CorridorDesign website at http://corridordesign.org. Here you will also find a number of completed wildlife linkage designs produced by the CorridorDesign team through funding provided by the Arizona Game and Fish Department's Heritage Fund.

NEXT STEPS

Future project activities may include using the information in this and other county-level reports to support the development of finer-scale, GIS-based wildlife corridor models using established methodology (Beier et al. 2007). These models will further refine a subset of the stakeholder-identified linkage areas represented in this report based on habitat requirements of focal wildlife species that rely on each linkage and will help identify land parcels of highest conservation priority within the stakeholder linkages—both of which are necessary for a successful implementation phase. Once finalized, these reports will be made available at the "Planning for Wildlife" web page at http://www.azgfd.gov/WildlifePlanning. While detailed linkage designs have already been created in Yavapai County, we anticipate that the creation of additional fine-scale corridor models and collaborative conservation efforts will be needed in the future as Arizona's developed landscape changes and our knowledge of wildlife habitat use and movement patterns grows.

MAPS

The following maps display linkage polygons and barriers to wildlife movement identified by stakeholders in the 2009 and 2010 workshops. In addition to the countywide map, we provide additional maps, zoomed to varying extents, to aid the user in visualizing both larger landscape-scale and smaller, more localized identified barriers to wildlife movement. Further inspection or analysis of the data should be conducted using GIS software. **The linkage polygons are intentionally symbolized with a gradient fill: the exact extent of each polygon and the shape of its edges are not intended to be sharply defined, but should in all cases be regarded as "fuzzy" (please see "How to use this report and associated GIS data" for further explanation).**

Numeric labels for each linkage polygon or barrier correspond to numbered narrative descriptions that follow the maps, the source of which are datasheets filled out by workshop participants for each linkage. Linkage descriptions include a name associated with the geographic location, the habitat types or features connected by the linkage, a list of species known or expected to use the linkage, threats to functional habitat connectivity in the linkage, and additional notes. Barrier descriptions include a name and additional notes focusing on current and future threats to connectivity and/or opportunities for conservation actions to improve connectivity in the area.

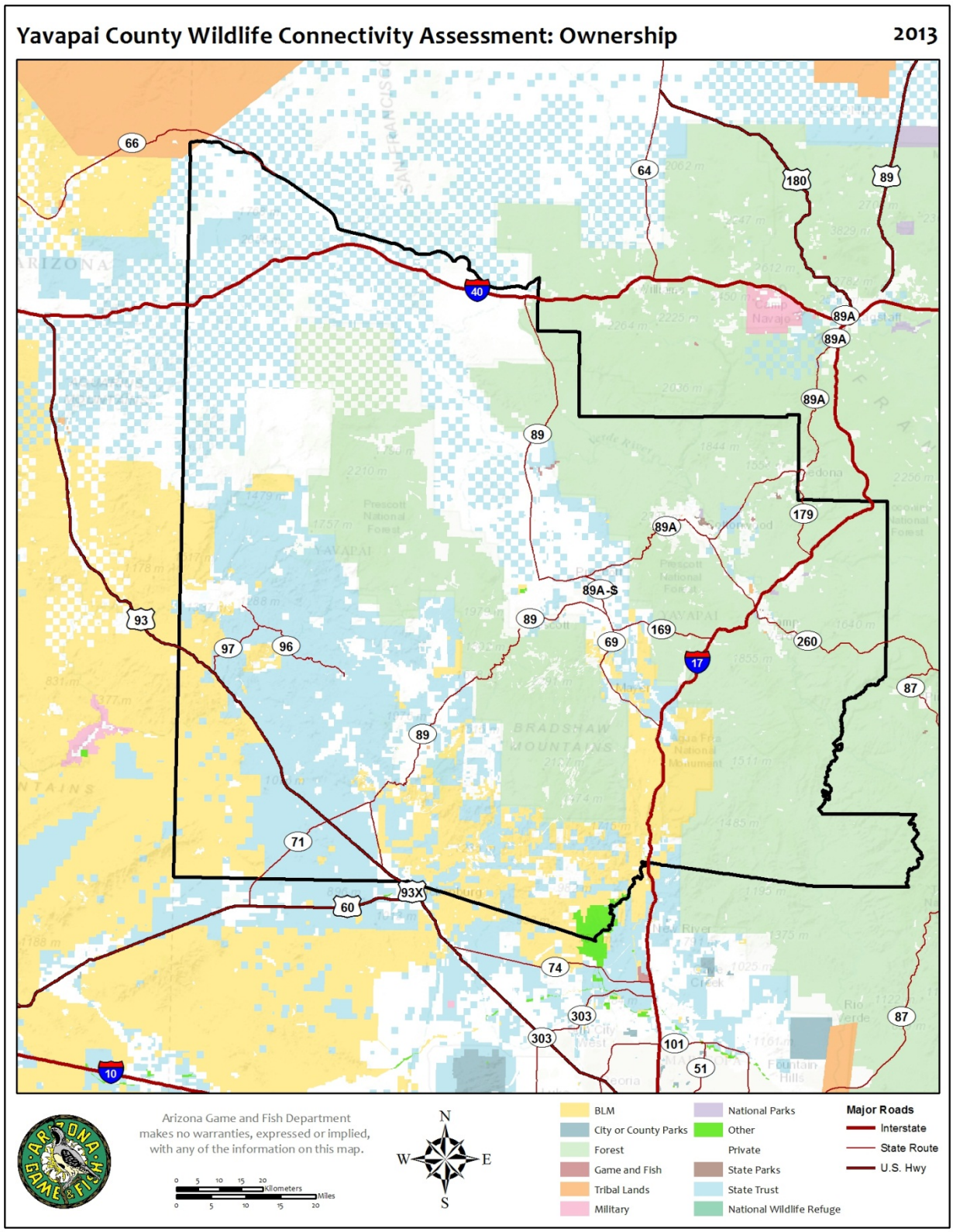


Figure 7. Ownership status in Yavapai County

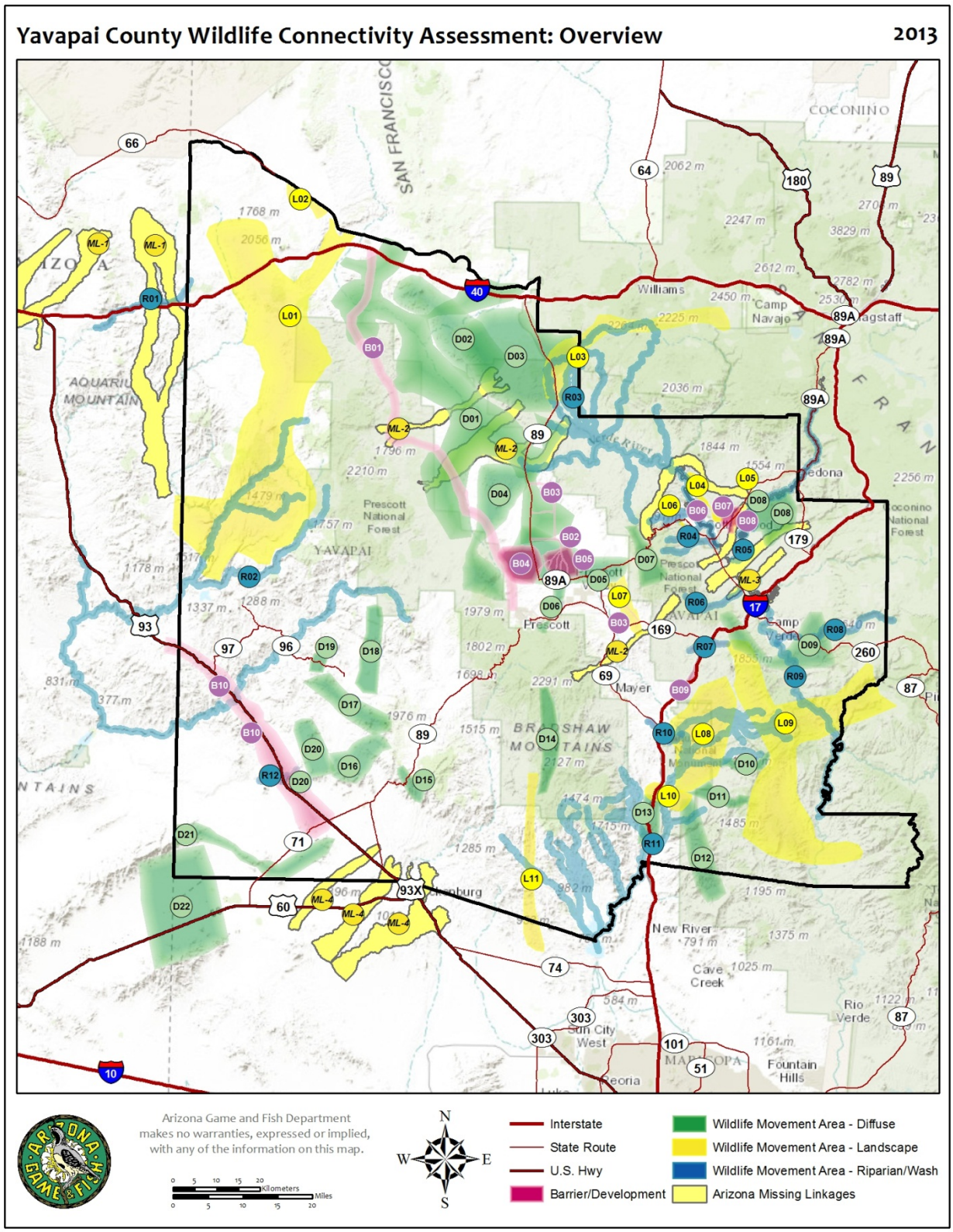


Figure 8. County overview map showing all stakeholder-identified linkages.

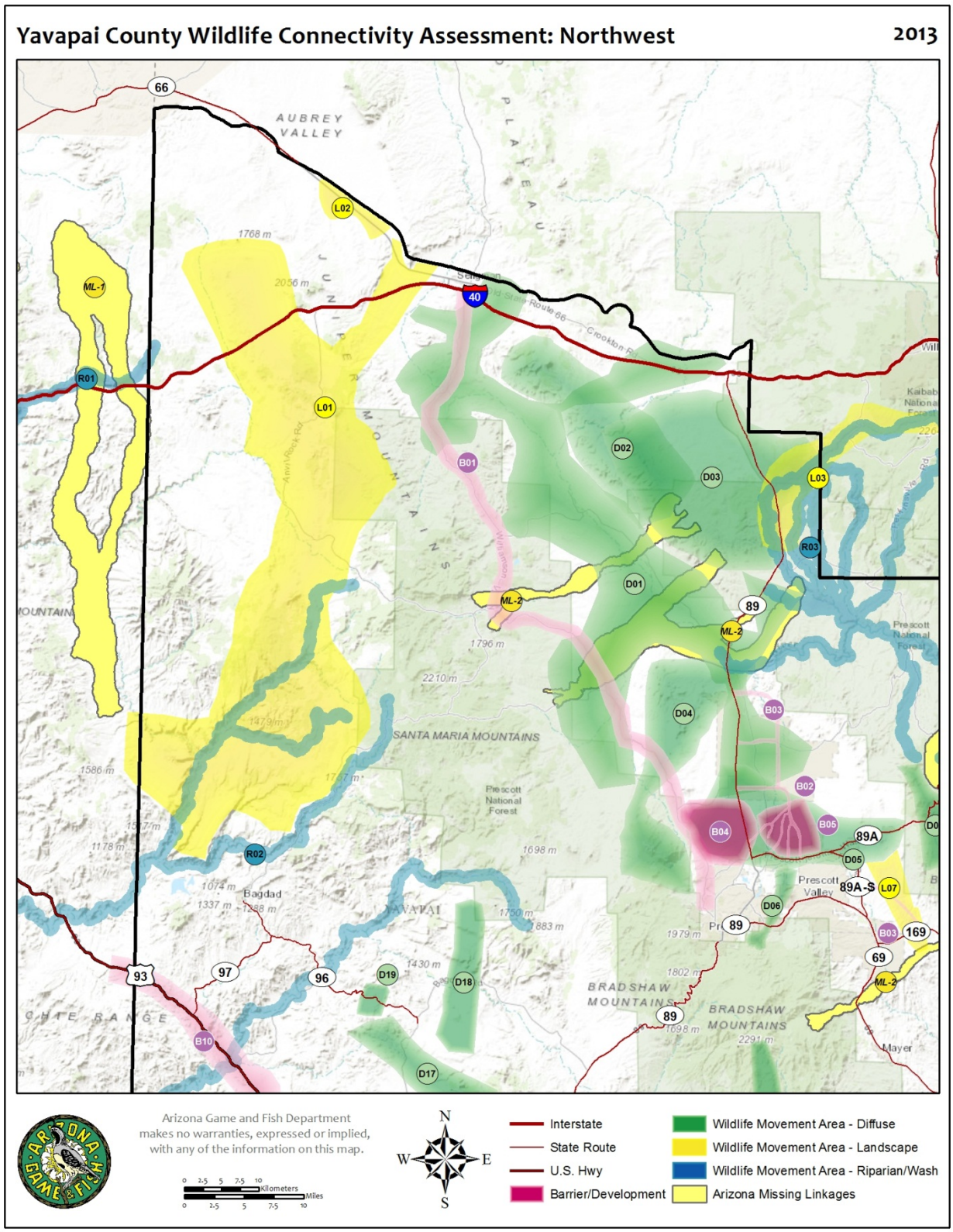


Figure 9. Stakeholder-identified linkages in Northwest Yavapai County.

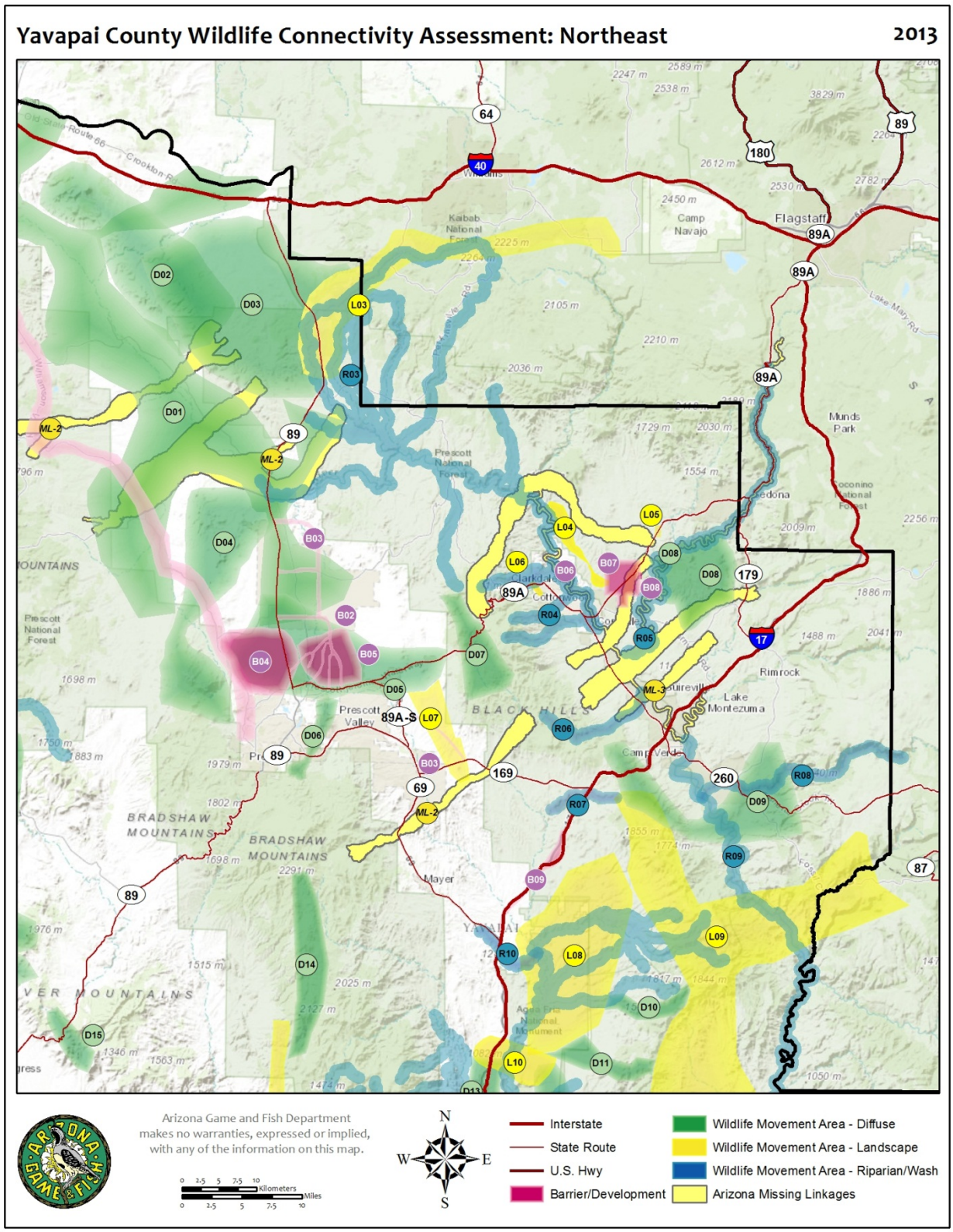


Figure 10. Stakeholder-identified linkages in Northeast Yavapai County.

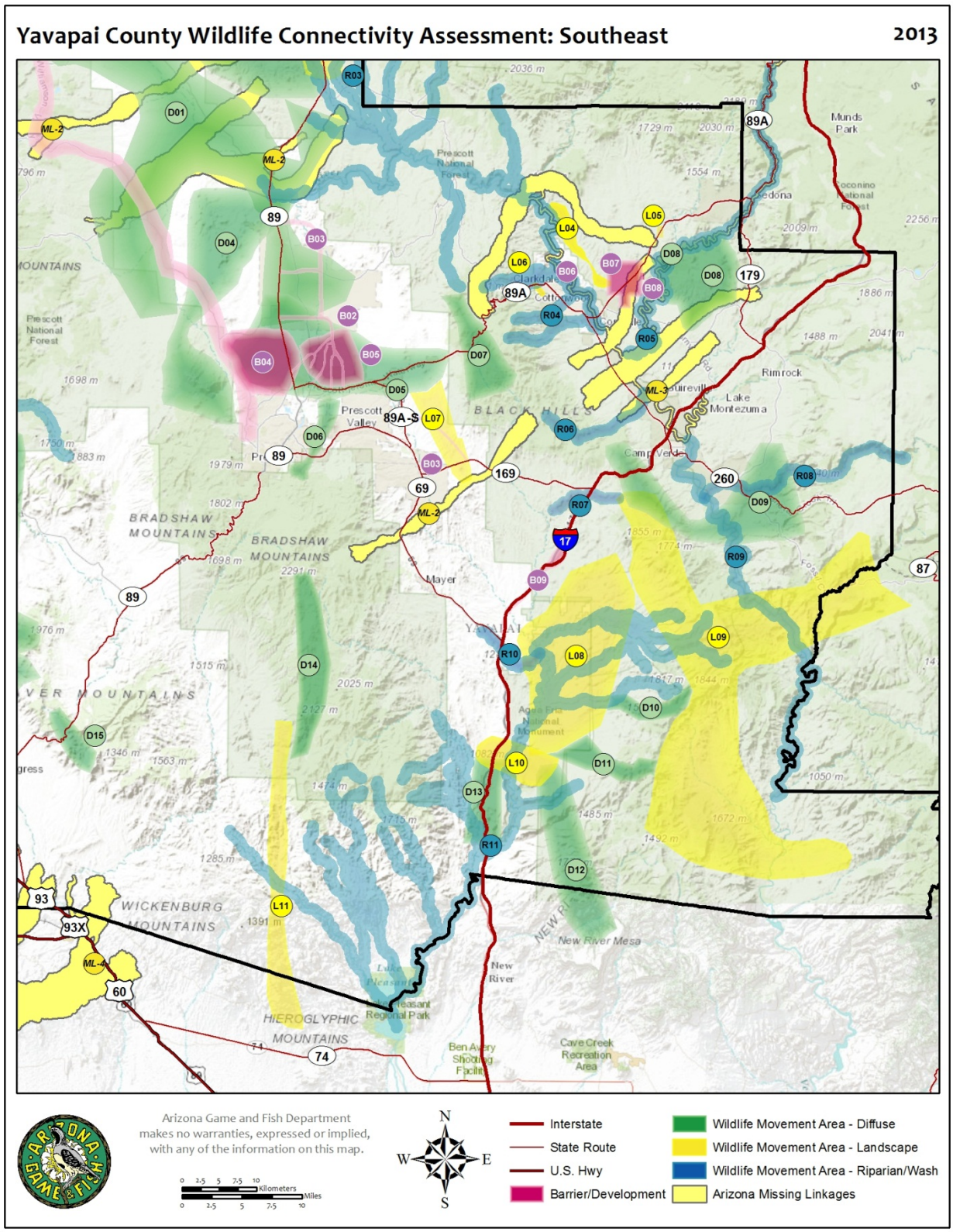


Figure 11. Stakeholder-identified linkages in Southeast Yavapai County.

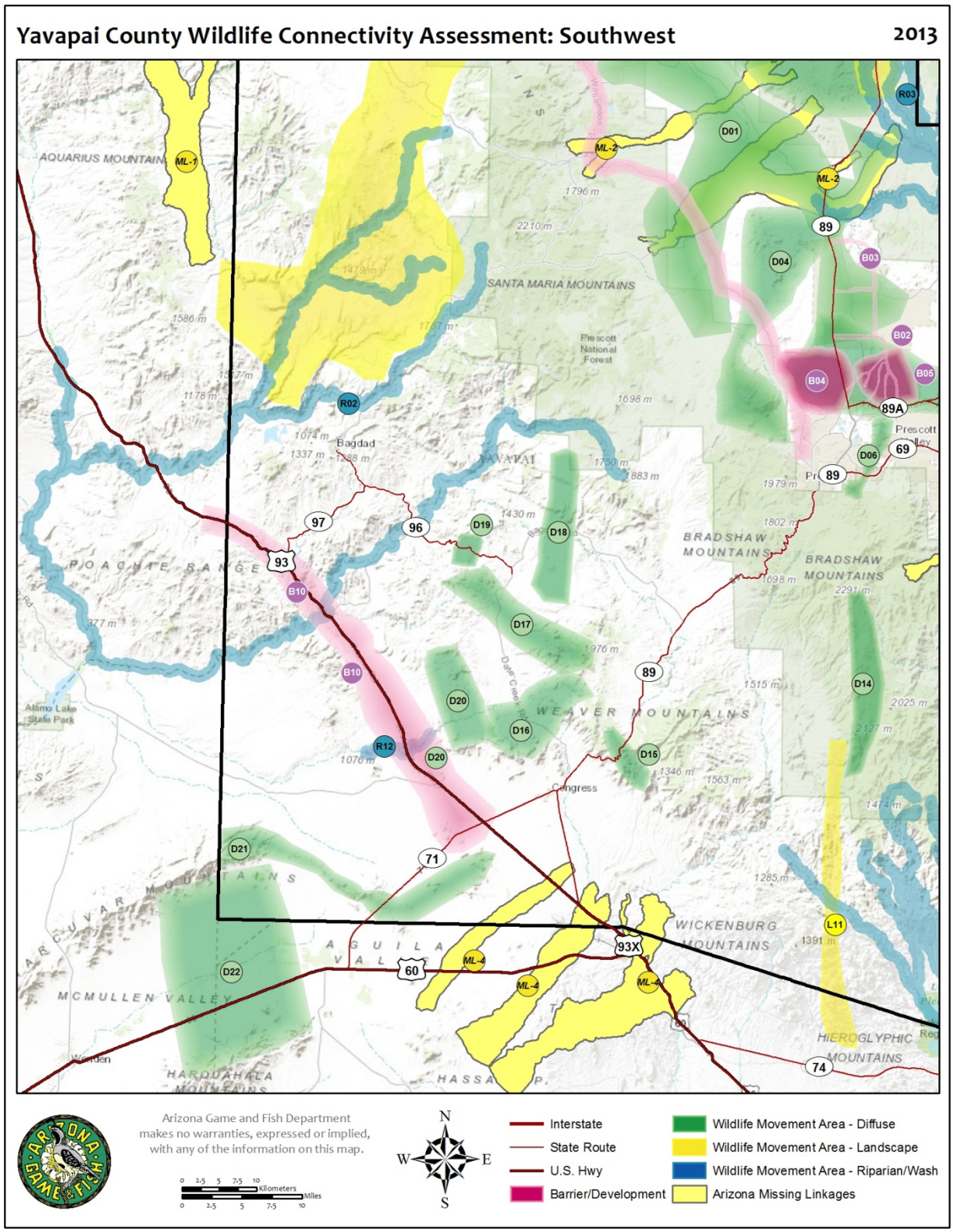


Figure 12. Stakeholder-identified linkages in Southwest Yavapai County.

YAVAPAI COUNTY WILDLIFE LINKAGE DESCRIPTIONS

YAVAPAI COUNTY DIFFUSE MOVEMENT AREAS: D1-D22

(WILDLIFE MOVEMENT WITHIN A WILDLAND BLOCK)

D01. Seligman – Lonesome Valley

Species Identified:	Pronghorn
Current Threats/Barriers:	• Agriculture • Invasive species (cheatgrass, red brome) • Off-highway vehicle use • Railroad • Residential development (high and low density) • Roads: Big Chino Road, Williamson Valley Road
Future Threats/Opportunities:	Water pipeline proposal, wind and solar energy development on private ranches, BQAZ identified commuter/passenger rail development, residential development proposed on several large private ranches, proposed widening of Big Chino Road and Williamson Valley Road
Notes:	High quality pronghorn habitat

D02. Picacho Butte – South Butte – Big Black Mesa

Species Identified:	Deer (mule deer), Elk, Mountain lion
Current Threats/Barriers:	• None current
Future Threats/Opportunities:	Residential development (low density) would block travel routes
Notes:	None

D03. Ashfork – Hell Canyon

Species Identified:	Deer (mule deer), Elk, Mountain lion
Current Threats/Barriers:	• Agriculture • Invasive species • Off-highway vehicle use • Pipeline • Railroad • Roads: SR 89
Future Threats/Opportunities:	SR89 maintenance (vegetation removal and fence repair from Ash Fork to Hell Canyon)
Notes:	None

D04. Granite Mountain – Table Mountain – Sullivan Butte – Upper Verde

Species Identified:	Deer (mule deer), Mountain lion
Current Threats/Barriers:	• Off-highway vehicle use • Residential development (high and low density) • Roads: Williamson Valley Road, SR 89
Future Threats/Opportunities:	Del Rio subdivision, Williamson Valley Road widening
Notes:	Forest, State Trust, private lands

D05. Prescott Valley – Chino Valley

Species Identified:	Badger, Porcupine, Pronghorn
Current Threats/Barriers:	• Agriculture • Commercial/industrial development • Invasive species • Off-highway vehicle use • Pipeline • Powerline • Residential development (high and low density) • Canal • Roads: US Highway 89, US Highway 89A, Fain Road
Future Threats/Opportunities:	None identified at workshop
Notes:	Pronghorn populations isolated by Fain Road/89A

D06. Badger Mountain – Glassford Hill

Species Identified:	Coyote, Deer, Javelina, Mountain lion, Skunk
Current Threats/Barriers:	• Commercial/industrial development • Communications installations (top of Glassford Hill) • Mining (strip mining hillside) • Powerline • Recreational activity (trails with horse usage) • Residential development (high density, ranchettes) • Roads: SR 69
Future Threats/Opportunities:	General commercial development, proposed State Trust Land Reform area
Notes:	None

D07. Mingus Mountain – Woodchute Mountain

Species Identified:	Black bear, Deer, Squirrel, Turkey
Current Threats/Barriers:	• Off-highway vehicle use • Powerline • Roads: US Highway 89A, Prescott National Forest Road 3
Future Threats/Opportunities:	None identified at workshop
Notes:	Forest lands

D08. House Mountain

Species Identified:	Deer, Elk, Herpetofauna (Western diamondback rattlesnake), Javelina
Current Threats/Barriers:	• Canal • Roads: SR 79
Future Threats/Opportunities:	None identified at workshop
Notes:	House Mountain wildlife block

D09. West Clear Creek Wilderness – Black Hills

Species Identified:	Elk
Current Threats/Barriers:	• Residential development (high density—Camp Verde) • Roads: Interstate 17
Future Threats/Opportunities:	None identified at workshop
Notes:	Elk movement between game management units 21, 6A, 19A across I-17 and the Verde River

D10. Pine Mountain Wilderness – Perry Mesa

Species Identified:	Black bear, Deer, Mountain lion
Current Threats/Barriers:	• None identified
Future Threats/Opportunities:	Private inholdings that could be subdivided and built out
Notes:	BLM and Forest lands

D11. Perry Mesa – Hutch Mesa

Species Identified:	Deer (mule deer), Mountain lion,
Current Threats/Barriers:	• None identified
Future Threats/Opportunities:	None identified at workshop
Notes:	Three major watersheds, connects BLM wildlife block with Forest wildlife block

D12. Perry Mesa – New River Mesa

Species Identified:	Pronghorn
Current Threats/Barriers:	• Off-highway vehicle use
Future Threats/Opportunities:	None identified at workshop
Notes:	Pronghorn migration and general movement

D13. Black Mesa – Black Canyon

Species Identified:	Bats (California leaf-nosed bat), Black bear, Deer (mule deer), Desert tortoise, Herpetofauna (Black-tailed rattlesnake), Mountain lion
Current Threats/Barriers:	• Commercial/industrial development • Invasive species • Off-highway vehicle use • Pipeline • Residential development (low density) • Roads: Interstate 17
Future Threats/Opportunities:	I-17 and associated development
Notes:	Southern portion on steep slope at habitat transition

D14. North Bradshaw Mountains – South Bradshaw Mountains

Species Identified:	Large mammals
Current Threats/Barriers:	• Roads: Senator Road
Future Threats/Opportunities:	None identified at workshop
Notes:	Forest lands

D15. Weaver Mountains – Rich Hill

Species Identified:	Black bear, Deer (mule deer), Elk, Javelina
Current Threats/Barriers:	• Residential development (low density) • Roads: US 89
Future Threats/Opportunities:	None identified at workshop
Notes:	Private land

D16. Weaver Mountains – Date Creek Mountains

Species Identified:	Deer (mule deer), Desert tortoise, Javelina, Mountain lion
Current Threats/Barriers:	• Railroad • Residential development (low and potentially high density) • Roads: Date Creek Road
Future Threats/Opportunities:	Potential for wind energy development, high density residential development
Notes:	None

D17. Weaver Mountains – McCloud Mountains – Grayback Mountains

Species Identified:	Deer (mule deer), Desert tortoise, Javelina, Mountain lion
Current Threats/Barriers:	• Mining (boulder operations) • Off-highway vehicle use • Railroad • Residential development (low density) • Roads: Date Creek Road
Future Threats/Opportunities:	Date Creek Road may possible be paved in the future, potential for high density residential development
Notes:	None

D18. Tank Creek – Hillside Mesa

Species Identified:	Deer (mule deer), Javelina, Pronghorn
Current Threats/Barriers:	• Roads: County Highway 15
Future Threats/Opportunities:	None identified at workshop
Notes:	Pronghorn are currently isolated to the south

D19. McCloud Mountains – Quail Spring Wash

Species Identified:	Deer (mule deer), Javelina, Mountain lion
Current Threats/Barriers:	• Roads: SR 96
Future Threats/Opportunities:	None identified at workshop
Notes:	Roadkill observed attempting to cross SR 96 west of Hillside

D20. Date Creek Mountain – Unnamed Mountains

Species Identified:	Deer (mule deer), Desert tortoise, Javelina, Mountain lion
Current Threats/Barriers:	• Mining (boulder operations) • Off-highway vehicle use • Residential development (low density)
Future Threats/Opportunities:	Potential for high density residential development, possibility of wind energy development and powerlines
Notes:	None

D21. Harcuvar Mountains – Forepaugh Peak – Sols Wash

Species Identified:	Bighorn sheep, Deer (mule deer), Javelina
Current Threats/Barriers:	• Agriculture • Invasive species
Future Threats/Opportunities:	None identified at workshop
Notes:	Almost all land is BLM

D22. Harcuvar Mountains – Harquahala Mountains

Species Identified:	Bighorn sheep, Deer (mule deer), Javelina
Current Threats/Barriers:	• Railroad • Residential development (low density) • Roads: US Highway 60
Future Threats/Opportunities:	Solar energy development (McMullen Valley Solar)
Notes:	None

YAVAPAI COUNTY LANDSCAPE MOVEMENT AREAS: L1-L11
(WILDLIFE MOVEMENT BETWEEN WILDLAND BLOCKS)

L01. Aubrey Valley – Seventyfour Plains – Goodwin Mesa

Species Identified:	Deer (mule deer), Pronghorn
Current Threats/Barriers:	• Agriculture • Commercial/industrial development • Invasive species • Mining • Off-highway vehicle use • Pipeline • Powerline • Railroad • Residential development (High and low density) • Roads: Interstate 40
Future Threats/Opportunities:	Solar energy development along north end
Notes:	None

L02. Aubrey Valley – Juniper Mountains

Species Identified:	Black-tail prairie dog, Black-footed ferret
Current Threats/Barriers:	• Railroad • Roads: Route 66 through Aubrey Valley
Future Threats/Opportunities:	None identified at workshop
Notes:	Black-footed ferret reintroduction area

L03. Garland Prairie – Wagon Tire Flat – Page Flat

Species Identified:	Deer (mule deer, white-tailed deer), Elk, Pronghorn
Current Threats/Barriers:	• Grazing • Invasive species (pinyon-juniper invasion of grasslands) • Pipeline • Powerline • Railroad • Roads: Associated with Drake Cement Plant
Future Threats/Opportunities:	None identified at workshop
Notes:	Pronghorn winter movements

L04. Sycamore Canyon Wilderness – Sheepshead Canyon

Species Identified:	Pronghorn
Current Threats/Barriers:	• Grazing • Off-highway vehicle use • Roads: Bill Gray Road, Sycamore Canyon Road
Future Threats/Opportunities:	None identified at workshop
Notes:	None

L05. White Flat – Red Canyon Road

Species Identified:	Pronghorn
Current Threats/Barriers:	• Roads: US Highway 89A
Future Threats/Opportunities:	Proposed waste treatment plant
Notes:	City of Sedona owns the site – existing wetlands may be expanded

L06. Deception Gulch – Bitter Creek

Species Identified:	Pronghorn
Current Threats/Barriers:	• Residential development (low density) • Roads: US Highway 89A
Future Threats/Opportunities:	None identified at workshop
Notes:	Fence and guardrail along 89A, some private and Forest lands

L07. Round Hill – Grapevine Gulch

Species Identified:	Deer (mule deer)
Current Threats/Barriers:	• Residential development (low density) • Roads: State Route 169
Future Threats/Opportunities:	Proposed highways
Notes:	Forest and private lands

L08. Perry Mesa – Yellow Jacket Mesa

Species Identified:	Pronghorn
Current Threats/Barriers:	• Agriculture • Off-highway vehicle use • Residential development (low density) • Roads: Dugas Road, Bloody Basin Road
Future Threats/Opportunities:	Private inholdings may be developed
Notes:	Primarily Forest and BLM/Agua Fria National Monument lands with some willing sellers of private inholdings; documented seasonal movement of pronghorn

L09. Fossil Creek – Arnold Mesa – Verde River

Species Identified:	Bighorn sheep, Black bear, Deer, Elk, Mountain lion, Turkey
Current Threats/Barriers:	• Off-highway vehicle use • Powerline • Roads
Future Threats/Opportunities:	None identified at workshop
Notes:	Forest and BLM/Agua Fria National Monument lands

L10. Perry Mesa – New River Mesa – Black Mesa

Species Identified:	Pronghorn
Current Threats/Barriers:	• Roads: Interstate 17
Future Threats/Opportunities:	I-17 widening
Notes:	Important migration corridor for pronghorn

L11. Hieroglyphic Mountains – Hells Canyon Wilderness – Prescott National Forest

Species Identified:	Bats (California leaf-nosed and Townsend's big-eared), Black bear, Bobcat, Deer (Mule deer, White-tailed deer), Desert tortoise, Gila monster, Herpetofauna, Javelina, Mountain lion
Current Threats/Barriers:	• Agriculture • Off-highway vehicles use • Residential development (low density) • Roads: Castle Hot Springs Road
Future Threats/Opportunities:	None identified at workshop
Notes:	None

YAVAPAI COUNTY RIPARIAN MOVEMENT AREAS: R1-R12
(WILDLIFE MOVEMENT THROUGH RIPARIAN HABITAT)

R01. Lookout Wash – Willow Creek

Species Identified:	Deer (Mule deer), Herpetofauna (Gila monster, Lowland leopard frog), Javelina, Mountain lion
Current Threats/Barriers:	• Agriculture • Invasive species • Mining • Off-highway vehicle use • Pipeline • Roads: Interstate 40
Future Threats/Opportunities:	None identified at workshop
Notes:	None

R02. Alamo Lake – Big Sandy River – Burro Creek – Santa Maria River

Species Identified:	Riparian obligate species
Current Threats/Barriers:	• Grazing • Invasive species • Mining (Bagdad copper mine) • Off-highway vehicle use • Powerline • Roads: US 93, SR 97, Gravel road from Bagdad to Camp Wood on the PNF
Future Threats/Opportunities:	Potential widening of US 93 as part of I-11 development, potential location for solar steam plant, potential reopening of Anderson Mine
Notes:	None

R03. Upper Verde River

Species Identified:	Birds (migratory), Fish (Native fish including chub, spike dace, Sonoran sucker, loach minnow; Non-native fish including red shiner, green sunfish, carp, large mouth bass, catfish), Pronghorn, Riparian obligate species, many others
Current Threats/Barriers:	• Agriculture (sedimentation) • Commercial/industrial development (Drake cement plant) • Dispersed camping • Grazing • Invasive species (annual grasses, non-native fish, tamarisk) • Mining • Off-highway vehicle use • Pipeline • Powerline • Railroad • Residential development (high and low density) • Roads: Verde Ranch Road, Drake Road • Solar energy development • Wind energy development
Future Threats/Opportunities:	Projected 4 lane, 75 mph divided highway crossing river
Notes:	None

R04. Verde River Tributaries

Species Identified:	Black bear, Bobcat, Burrowing Owl, Coyote, Deer, Fox, Herpetofauna, Javelina, Mountain lion, Pronghorn, Ringtail cat
Current Threats/Barriers:	• Commercial/industrial development • Grazing • Invasive species • Mining (cement plant) • Off-highway vehicle use • Residential development (high and low density) • Roads: US Highway 89A
Future Threats/Opportunities:	Potential highway connecting Clarkdale and Ash Fork, Mingus Foothills development
Notes:	None

R05. Oak Creek

Species Identified:	Herpetofauna (Coachwhip snake, gopher snake, Mexican gartersnake, Narrow-headed gartersnake, Patch-nosed snake, whipsnake)
Current Threats/Barriers:	• Agriculture (runoff) • Grazing • Invasive species (non-native fish, crayfish)
Future Threats/Opportunities:	None identified at workshop
Notes:	None

R06. Cherry Creek Wash – Verde River

Species Identified:	Dove, Elk, Javelina, Mountain lion
Current Threats/Barriers:	• Commerical development (near Highway 260) • Grazing • Off-highway vehicle use
Future Threats/Opportunities:	None identified at workshop
Notes:	Mostly Forest lands, becoming private land near Highway 260 and the Verde River

R07. Interstate 17: Cienaga Creek

Species Identified:	Black bear, Deer (mule deer, white-tailed deer), Javelina
Current Threats/Barriers:	• Grazing • Roads: Interstate 17
Future Threats/Opportunities:	Future I-17 widening
Notes:	ADOT has wildlife crossing data in this area; Cienega Creek (USFS allotment is heavily grazed)

R08. West Clear Creek – Verde River

Species Identified:	Black Hawk, Elk, Fish (native), Riparian/aquatic obligate species
Current Threats/Barriers:	• Agriculture • Canals • Invasive species (Salt cedar, tamarisk, tree of heaven, non-native fish, crayfish, bullfrogs) • Mining (including sand and gravel in river channel/floodplain) • Off-highway vehicle use • Residential development (high and low density) • Roads: SR 79
Future Threats/Opportunities:	None identified at workshop
Notes:	Forest and private lands

R09. Verde River

Species Identified:	Birds (SW Willow Flycatcher, Yellow-billed cuckoo), Deer (white-tailed deer), Fish (Native fish, Pikeminnow, Razorback sucker, Roundtail chub), Riparian/aquatic obligate species
Current Threats/Barriers:	• Agriculture • Canals • Commercial/industrial development • Invasive species (tamarisk, tree of heaven, non-native fish, crayfish, bullfrogs) • Mining (including sand and gravel in river channel/floodplain) • Off-highway vehicle use • Residential development (high and low density) • Roads: State Route 260 and Interstate 17 • Solar energy development
Future Threats/Opportunities:	Groundwater/surface water depletion, adjacent development
Notes:	None

R10. Interstate 17: Big Bug Creek

Species Identified:	Riparian obligate species
Current Threats/Barriers:	• Roads: Interstate 17
Future Threats/Opportunities:	Reconfiguration of I-17 from mile marker 261-264
Notes:	None

R11. Agua Fria and Tributaries

Species Identified:	Bat (Red bat), Birds (Important Bird Area, Yellow-billed cuckoo), Black bear, Fish (Gila chub, Gila topminnow, Longfin dace), Herpetofauna (Mexican gartersnake, lowland leopard frog), Riparian obligate species
Current Threats/Barriers:	• Agriculture • Canals • Grazing • Invasive species (Bullfrogs, non-native fish, crayfish) • Mining • Off-highway vehicle use • Residential development (low density) • Roads: Dugas Road, Bloody Basin Road, Castle Hot Springs Road, Cow Creek Road, Forest Road from Cordes Junction to E2 Ranch/Box Bar Ranch,
Future Threats/Opportunities:	Grazing, Groundwater pumping, OHV use, Residential development (low density and increasing)
Notes:	None

R12. Upper Date Creek – Lower Date Creek

Species Identified:	Deer (mule deer), Javelina, Mountain lion
Current Threats/Barriers:	• Agriculture • Residential development (low density) • Roads: US Highway 93, Alamo Lake Road
Future Threats/Opportunities:	Widening of US Highway 93
Notes:	None

YAVAPAI COUNTY BARRIERS TO WILDLIFE MOVEMENT: B1-B10

B01. Williamson Valley Road: Seligman – Prescott. Prevent interruption of deer/elk movement when Williamson Valley Road is paved from Prescott to Seligman—presently unfenced and gravel.

B02. Great Western Drive. Potential annexation and subsequent development.

B03. Paulden – Great Western Drive; Highway 169 – Fain Road. From the CYMPO 2030 Regional System Map: New alignment for SR 169 Connector to Fain Road; New alignment for Chino Valley Extension, New alignment for Great Western Drive

B04. US Highway 89N: Pioneer Parkway. Potential annexation and subsequent development.

B05. US Highway 89/89A : Lonesome Valley. Subdivisions proposed.

B06. Clarkdale Sustainability Park. Sustainability development activities may include solar energy development, biodiesel converter, waste management systems, etc.

B07. Sheepshead Canyon State Trust Land. State trust land may be annexed and developed. Species affected include pronghorn, mountain lion, great horned owl, javelin, fox, coyote, badger, rabbit. Current threats include grazing, OHV use and camping, residential development (high and low density), commercial/industrial development, roads (Oak Creek Valley Road, Highway 89A, Bill Gray Road).

B08. Spring Creek Ranch. Development in this area threatens riparian habitat.

B09. Interstate 17: North of Cordes Junction. Pronghorn habitat is bisected by I-17 and a crossing structure could be constructed near the Agua Fria River or Ash Creek to benefit pronghorn and secondary species such as mule deer and javelin).

B10. US Highway 93 – State Route 71. Widening of US Highway 93 from 2 lanes to 4 lanes from Santa Maria to Wickenburg. Aware of Bighorn sheep, Desert tortoise, Mule deer, Ringtail cat, and Mountain lion in the area.

ARIZONA MODELED WILDLIFE LINKAGES: ML1-ML4 (DETAILED/MODELED WILDLIFE LINKAGE DESIGNS)

ML1. Hualapai - Peacock (Beier and Majka 2006)

See Missing Linkage report at *http://corridordesign.org/dl/linkages/reports/Hualapai-Peacock-Kingman_LinkageDesign.pdf* for complete list of modeled species, current and future threats and barriers, and additional recommendations on providing connectivity between these wildland blocks.

ML2. Granite Mountain – Black Hills (Beier et al. 2008)

See Missing Linkage report at *http://corridordesign.org/dl/linkages/reports/Granite_Mountain-Black_Hills_LinkageDesign.pdf* for complete list of modeled species, current and future threats and barriers, and additional recommendations on providing connectivity between these wildland blocks.

ML3. Black Hills – Munds Mountain (Beier et al. 2006a)

See Missing Linkage report at *http://corridordesign.org/dl/linkages/reports/BlackHills-Munds-VerdeRiver_LinkageDesign.pdf* for complete list of modeled species, current and future threats and barriers, and additional recommendations on providing connectivity between these wildland blocks.

ML4. Wickenburg – Hassayampa (Beier et al. 2006b)

See Missing Linkage report at *http://corridordesign.org/dl/linkages/reports/Wickenburg-Hassayampa_LinkageDesign.pdf* for complete list of modeled species, current and future threats and barriers, and additional recommendations on providing connectivity between these wildland blocks.

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APPENDIX A – SAMPLE DATASHEET USED IN STAKEHOLDER WORKSHOPS

YAVAPAI COUNTY LINKAGE DATASHEET

Your name(s): _____

Linkage number: _____

Linkage description (Please try to describe the areas being connected with as much detail as possible)**:**

_____

_____

What are the main threats to the linkage? Use a separate line for each major paved road crossing the linkage.

**** 1 is least severe and 5 is most severe****

Threat	Severity (1-5)**	Details (Describe the type of threat, area impacted, etc.)
Agriculture (grazing, farming)		
Exotic species invasion		
Canals (with names)		
Mining		
OHV Use		
Pipeline		
Powerline		
Wind energy development		
Solar energy development		
Uranium mining		
Railroad		
High Density Residential Dev.		
Low Density Residential Dev.		
Industrial/Commercial Dev.		
Paved road (with name)		
Paved road (with name)		
High Traffic Gravel Road (with name)		

Describe federal, state, or local support for conserving the linkage (willing land sellers, agencies interested in acquisition, formal conservation planning for the linkage, etc.)

If you have information you would prefer not appear in print but that you are willing to discuss, provide your name and contact information.

Continues on back →

Provide details on FUTURE or PROPOSED road or development projects.

Name of Project	**Road/Hwy Description** (e.g., realign 20 mile of existing road, 2 lanes each way) **Development description** (e.g., 20,000 new homes, plus commercial and industrial areas)	Entitled or Platted?	Funded?	Est. start date	Env. review completed?	Contact person, affiliation (e.g., "John Doe, ADOT PHX")
		Yes/No	Yes/No		Yes/No	
		Yes/No	Yes/No		Yes/No	
		Yes/No	Yes/No		Yes/No	

Provide any other helpful information (e.g., location, number, and size of key parcels in the linkage, ongoing restoration projects in the linkage, etc.).

Key contacts for this linkage: Please provide the names of one or more persons we can contact for additional information and future planning efforts.

Name	Affiliation	Phone	Email

Species using this linkage: Please provide information for species you believe are using the linkage. Consider species with large area requirements, specialized habitat needs, or special federal/state status

Species Name	Evidence of use (roadkill data, telemetry studies, personal observation, etc)	Type of movement (seasonal migration, diffuse/general movement, dispersal, etc)	Direction of movement	Notes/arrow description