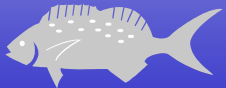


Prepared by:
The Arizona Wildlife Linkages
Workgroup



ARIZONA'S WILDLIFE LINKAGES ASSESSMENT



ARIZONA'S WILDLIFE LINKAGES ASSESSMENT



Arizona's Wildlife Linkages Assessment

Prepared by:

The Arizona Wildlife Linkages Workgroup

Siobhan E. Nordhaugen, *Arizona Department of Transportation, Natural Resources Management Group*

Evelyn Erlandsen, *Arizona Game and Fish Department, Habitat Branch*

Paul Beier, *Northern Arizona University, School of Forestry*

Bruce D. Eilerts, *Arizona Department of Transportation, Natural Resources Management Group*

Ray Schweinsburg, *Arizona Game and Fish Department, Research Branch*

Terry Brennan, *USDA Forest Service, Tonto National Forest*

Ted Cordery, *Bureau of Land Management*

Norris Dodd, *Arizona Game and Fish Department, Research Branch*

Melissa Maiefski, *Arizona Department of Transportation, Environmental Planning Group*

Janice Przybyl, *The Sky Island Alliance*

Steve Thomas, *Federal Highway Administration*

Kim Vacariu, *The Wildlands Project*

Stuart Wells, *US Fish and Wildlife Service*



First Printing Date: December, 2006
Copyright © 2006 The Arizona Wildlife Linkages Workgroup

Reproduction of this publication for educational or other non-commercial purposes is authorized without prior written consent from the copyright holder provided the source is fully acknowledged.

Reproduction of this publication for resale or other commercial purposes is prohibited without prior written consent of the copyright holder.

Additional copies may be obtained by submitting a request to:
The Arizona Wildlife Linkages Workgroup
E-mail:
arizonalinkages@azdot.gov





The Arizona Wildlife Linkages Workgroup Mission Statement

“To identify and promote wildlife habitat connectivity using a collaborative, science based effort to provide safe passage for people and wildlife”



Primary Contacts:

Bruce D. Eilerts

Siobhan E. Nordhaugen

Arizona Department of Transportation
Office of Environmental Services
Statewide Natural Resources Management Group

Ray Schweinsburg

Arizona Game and Fish Department
Research Branch

E-mail:

arizonalinkages@azdot.gov



Photo by Kelly Roberts





Siobhan Nordhaugen
Copyright (c) 2006 by the Arizona Wildlife Linkages Workgroup

EXECUTIVE SUMMARY



The phenomenal growth of Arizona's human population, economy, and infrastructure present challenges to maintaining natural ecosystems and wildlife populations that constitute an important part of Arizona's wealth. In particular, roads, urbanization, canals, railways, energy corridors and activities of illegal migrants and border security operations not only destroy habitat, but create barriers that isolate wildlife populations and disrupt ecological functions such as gene flow, predator-prey interactions, and migration. Addressing each of these potential barriers one-at-a-time is expensive and inefficient. In each landscape, we must address all these factors concurrently to successfully maintain or restore linkages between habitats and conserve the wildlife and natural ecosystems that Arizona's residents and visitors rely on and benefit from.

Conspicuous evidence of habitat fragmentation is wildlife road kill - a far too common sight along many Arizona roadways. These often fatal encounters have far-reaching effects. Wildlife-vehicle collisions can result in human deaths and injuries, millions of dollars in property damage, loss of game and non-game animals, and sometimes expose the State to liability. Working together, federal, state, county and private stakeholders can minimize these social costs while enhancing opportunities for movement of wildlife between Arizona's habitat areas.

The Arizona Wildlife Linkages Workgroup (AWLW) has taken the first step in that process. The AWLW is a collaborative effort between public and private sector organizations formed to address habitat fragmentation through a comprehensive, systematic approach. Through this partnership and commitment, a statewide assessment was conducted to identify large blocks of protected habitat, the potential wildlife movement corridors between as well as through them, and the factors threatening to disrupt these linkage zones. After four successful workshops and many hours spent coordinating, meeting, mapping and writing, we present our initial findings, methodology and recommendations – a product that is intended to evolve and ultimately be used as a planning instrument.

The *Arizona's Missing Linkages Workshop* held in April 2004 and the follow-up workshops that ensued are the basis for this report and mapping tool. Attendance at the workshops was well represented

with biologists, engineers, planners and land managers from state and federal agencies, universities, consulting firms and private sector conservation organizations. Individuals were divided into groups to address specific geographic regions. They used map transparencies and tailored questionnaires to assist in the identification of habitats, wildlife species, wildlife behavior and needs, *potential linkage zones* (see *Table 4-1*) as well as present and future threats or opportunities for conservation. One of the many products resulting from this process was a computerized geographic information system (GIS) projection graphically displaying the compiled information. There are over 150 potential linkage zones included in the Arizona's Wildlife Linkages Map.

The potential linkage zones represent areas that are important to Arizona's wildlife and natural ecosystems. If integrated into regional planning frameworks, these areas have the potential to be maintained or preserved during this time of prosperity, growth and development. As such, for each potential linkage zone, the AWLW built on information collected from the workshops to further define existing conditions, recording biotic communities, listing species that depend on particular linkages, identifying land ownership within those linkages, and detailing known and anticipated threats.

For further refinement, potential linkage zones were prioritized based on biological importance threats - existing and anticipated - and opportunities for preservation and/or restoration purposes. Biological importance scores depended on the size and habitat quality of the *habitat blocks* (see *Table 4-1*) and on the ability of the potential linkage zones to support special status species, aquatic ecosystems, or seasonal migrations. Threat scores reflect the barrier effect of canals, roads, urbanization and railroads. Opportunity scores indicate ongoing and proposed conservation efforts in the areas, and whether impending major road projects provide an opportunity to increase the permeability of roads. As road construction programs are updated and development in the State progresses, this evaluation and resulting prioritization will need revision.

Our intention in this report is to provide a starting point for detailed consultation and coordination among the organizations and agencies that have a major role to play in maintaining habitat connectivity. To offer flexibility in the use of this report, all the maps within this

document have been created at the same scale so that the transparency of the Arizona's Wildlife Linkages Map included in the front of this document may be used as an overlay. Furthermore, the report was drafted in a manner to allow each individual chapter to be used as a stand-alone tool. For that reason, terminology common throughout the entire document is defined in each section. All technical terms are also collectively defined in the glossary.

Important to taking the next step in preserving or restoring habitat connectivity is the physical design and construction of linkages. To help facilitate these applications, this report outlines the methodology used to create specific linkage designs within potential linkage zones. In the coming years, the AWLW intends to develop linkage designs for each potential linkage zone through a combination of GIS analysis and fieldwork. This analysis coupled with a feasibility study on linkage protection will further define the present potential linkage zones into smaller, more site-specific delineations and is intended to aid in conservation and planning efforts. Linkages ranking highest in our prioritization will be addressed first. Future assessments will identify additional potential linkage zones.

This report represents the results of the first statewide wildlife linkages assessment. We hope to elevate the current level of awareness of wildlife connectivity areas and issues in Arizona. The tools in this report will allow land managers to incorporate the identified wildlife linkage zones into their management planning processes to address habitat fragmentation due to highways and other human development. We expect to facilitate the integration of the potential linkage zones presented in this report and those identified in the future into early project planning efforts. We acknowledge that this is only the first step in a continuing process of defining critical habitat connectivity areas.

Now more than ever, decision makers have a responsibility to protect and maintain wildlife linkages to sustain Arizona's diverse wildlife species and wild landscapes. We firmly believe that government agencies and citizens working together with a comprehensive, landscape-scale approach can achieve these conservation goals while accommodating the growth of Arizona's population, an expanding economy, and associated infrastructure.

- The Arizona Wildlife Linkages Workgroup





DISCLAIMER

Nothing in this report obligates the Arizona Department of Transportation, Arizona Game and Fish Department, Bureau of Land Management, Federal Highway Administration, Northern Arizona University, Sky Island Alliance, USDA Forest Service, US Fish and Wildlife Service or the Wildlands Project to commit or transfer any funds. Specific work projects or activities that involve the transfer of funds, services, or property among the various agencies and organizations referred to in this report will require separate agreements and be contingent upon the availability of appropriated funds. Appropriate statutory authority must independently authorize such activities. This report does not provide such authority. Negotiation, execution, and administration of each such agreement must comply with all applicable statutes and regulations.

In addition, this report is not intended to, and does not create, any right, benefit, or trust responsibility, substantive or procedural, enforceable at law or equity, by a party against the United States, the State of Arizona, their agencies, their officers, or any person.

This assessment should not be construed as a compliance document. Information provided in this assessment should be used as a guide only and should not be relied upon as the sole source of information relating to its content. While the information contained herein is believed to be accurate, it is supplied for informative purposes only and should not be considered certified or as a guarantee of satisfactory results by reliance thereon. Nothing contained herein is to be construed as a warranty or guarantee, express or implied, regarding any matter with respect to this product. Because the AWLW is continually improving and upgrading its product design, the information contained herein is subject to change.



TABLE OF CONTENTS



EXECUTIVE SUMMARY	<i>i</i>	Threat and Opportunity Value Weighting	20
DISCLAIMER	<i>ii</i>	Top Priority Linkages	20
TABLE OF CONTENTS	<i>iii</i>	SECTION VI ARIZONA’S WILDLIFE LINKAGES	21
LIST OF FIGURES	<i>vii</i>	Potential Linkage Zone Information	21
LIST OF TABLES	<i>viii</i>	SECTION VII POTENTIAL LINKAGE ZONES	41
LIST OF ACRONYMS	<i>ix</i>	Linkage 1 Beaver Dam Slope – Virgin Slope	41
GLOSSARY	<i>x</i>	Linkage 2 Beaver Dam – Virgin Mountains	41
ACKNOWLEDGEMENTS	<i>xi</i>	Linkage 3 Cedar Rim/Fredonia Pronghorn Crossing	42
SECTION I INTRODUCTION	1	Linkage 4 Kaibab – Paunsaugunt Plateau	43
The Challenge	1	Linkage 5 Kaibab Plateau – North Rim	43
Legal Environment	3	Linkage 6 Paria Plateau – Kaibab Plateau	44
Providing Solutions	4	Linkage 7 Skeleton Mesa – Black Mesa	44
SECTION II ARIZONA’S WILDLIFE LINKAGES WORKGROUP	5	Linkage 8 Chinle Valley – Chuska Mountains	45
Forming Partnerships	5	Linkage 9 Chuska Mountains – New Mexico	45
AWLW Mission Statement	5	Linkage 10 Mount Tipton – Mount Perkins	46
Primary Goals	5	Linkage 11 Grand Canyon – Prescott National Forest	47
Founding Individuals	6	Linkage 12 Coconino Plateau – Kaibab National Forest	47
SECTION III ARIZONA’S MISSING LINKAGES WORKSHOP	7	Linkage 13 South Rim Grand Canyon	48
Breakout Sessions	7	Linkage 14 Valle – Bellemont	49
Follow-up Workshops (November 2004)	9	Linkage 15 Garland – Arizona Divide	49
Arizona’s Missing Linkages Workshop Agenda (April 13 – 14, 2004)	10	Linkage 16 Flagstaff	50
SECTION IV ARIZONA’S WILDLIFE LINKAGES MAPPING	15	Linkage 17 Deadman Mesa – Gray Mountain	51
Layers	15	Linkage 18 Black Mountains – Cerbat Mountains	51
Mapping Generalities	16	Linkage 19 Mount Perkins – Warm Springs	52
Habitat Block Mapping Decision Rules	16	Linkage 20 Hualapai Mountains – Cerbat Mountains	53
Potential Linkage Zone Mapping Decision Rules	16	Linkage 21 I-40 and US 93 – Kingman	53
SECTION V ARIZONA’S WILDLIFE LINKAGES PRIORITIZATION	17	Linkage 22 Big Black Mesa – Hell Canyon	54
Biological Value	17	Linkage 23 Oak Creek Canyon – Munds Park	55
Biological Value Weighting	19	Linkage 24 Cottonwood – Sedona	56
Threat and Opportunity Value	19	Linkage 25 State Route 179	56
		Linkage 26 Northern I-17 Corridor	57
		Linkage 27 Mogollon Rim – Navajo Nation	58
		Linkage 28 North – South Petrified Forest	59
		Linkage 29 Warm Springs – Hualapai Mountains	60
		Linkage 30 Warm Springs – Aubrey Peak	60
		Linkage 31 The Needles – Mohave Mountains	61
		Linkage 32 Bill Williams – Aubrey Hills	62
		Linkage 33 Hualapai Mountains – Bagdad	62



Linkage 34 Tres Alamos Wilderness – Prescott National Forest	63	Linkage 80 Saguaro – Tortolita	96
Linkage 35 East – West Prescott National Forest	64	Linkage 81 Santa Catalina – Tortolita	97
Linkage 36 Yeager Canyon – Camp Verde	65	Linkage 82 Santa Catalina – Galliuero	97
Linkage 37 North – South Black Hills	66	Linkage 83 Galliuero – Pinaleno	98
Linkage 38 Bradshaw Mountains – Agua Fria National Monument	67	Linkage 84 Pinaleno – San Simon Valley	99
Linkage 39 SR 260 West from I-17 to SR 87	67	Linkage 85 Avra Valley	100
Linkage 40 East – West Mogollon Plateau	68	Linkage 86 Kitt Peak	100
Linkage 41 SR 260 Payson – Heber	69	Linkage 87 Tucson Mountains – San Xavier (San Robles Pass)	101
Linkage 42 Aripine – Cibecue	69	Linkage 88 Galliuero – Winchester – Dragoon	102
Linkage 43 Parker Valley – Cactus Plain	70	Linkage 89 Wilcox Playa – Winchester – Pinaleno – Dos Cabezas	102
Linkage 44 Cactus Plain – Plomosa Mountains	71	Linkage 90 Pinaleno – Dos Cabezas – San Simon Valley	103
Linkage 45 La Posa Plain	71	Linkage 91 Baboquivari – San Luis Mountains	104
Linkage 46 Buckskin Mountains – Harcuvar Mountains	72	Linkage 92 San Xavier – Sierrita – Santa Rita	104
Linkage 47 Dome Rock Mountains	73	Linkage 93 Tumacacori – Santa Rita	105
Linkage 48 Ranegras Plain	73	Linkage 94 Rincons – Whetstone – Santa Rita	106
Linkage 49 Granite Wash – Little Harquahala Mountains	74	Linkage 95 Santa Rita – Empire Complex	106
Linkage 50 Harcuvar Mountains – Harquahala Mountains	75	Linkage 96 Patagonia – Santa Rita	107
Linkage 51 Wickenburg	75	Linkage 97 Whetstone – San Pedro River	108
Linkage 52 Hassayampa River – Red Picacho	76	Linkage 98 Las Cienegas – Huachuca	108
Linkage 53 North – South Mazatzal Mountains	77	Linkage 99 Dragoon – San Pedro River	109
Linkage 54 Sierra Ancha – Superstition Mountains	78	Linkage 100 Fort Huachuca – San Pedro River	110
Linkage 55 East – West Sierra Ancha SR 288	78	Linkage 101 Chiricahuas– Peloncillos	110
Linkage 56 Sevenmile – Sevenmile East US 60	79	Linkage 102 Western International Border	111
Linkage 57 Faught Ridge – Baldy SR 73	80	Linkage 103 Altar Valley – Mexico	112
Linkage 58 State Route 260 East	81	Linkage 104 Tumacacori – Mexico	112
Linkage 59 Correjo Crossing – Clifton US 191	81	Linkage 105 Santa Cruz – Mexico	113
Linkage 60 Black Hills – Tollgate Canyon	83	Linkage 106 Patagonia/Huachuca – Mexico	114
Linkage 61 Black Hills – Peloncillo Mountains	83	Linkage 107 San Pedro River – Mexico	114
Linkage 62 State Route 75	83	Linkage 108 San Bernadino – Mexico	115
Linkage 63 Trigo Mountains – Kofa Mountains	84	Linkage 109 Peloncillo – Mexico	116
Linkage 64 Bighorn Belmont – Saddle Mountain	85	Linkage 110 Beaver Dam Slope East – West	116
Linkage 65 White Tanks – Hassayampa River	85	Linkage 111 Mohave Mountains – Castaneda Hills	117
Linkage 66 Superior – Miami US 60	86	Linkage 112 Gibraltar Mountain – Cactus Plain	118
Linkage 67 Gila River – El Capitan	87	Linkage 113 Poachie Range – Black Mountains	118
Linkage 68 Saddle Mountain – Gila Bend Mountains	87	Linkage 114 Harcuvar Mountains – Black Mountains	119
Linkage 69 Laguna Mountains – Muggins Mountains	88	Linkage 115 Cunningham Pass	120
Linkage 70 Arizona Service Highway (ASH)	89	Linkage 116 North – South Plumosa Mountains	120
Linkage 71 North – South Gila Mountains	89	Linkage 117 South Trigo Peaks – Trigo Mountains	121
Linkage 72 Sentinel Plain	90	Linkage 118 Indian Well – Livingston Hills	122
Linkage 73 Gila Bend Mountains – North Maricopa Mountains	91	Linkage 119 Livingston Hills – Kofa Mountains	122
Linkage 74 North Maricopa Mountains – Sierra Estrella Mountains	92	Linkage 120 Eagletail Mountains – Clanton Hills – Little Horn Mountains	123
Linkage 75 State Route 85	92	Linkage 121 Harquahala Mountains – Little Harquahala Mountains	124
Linkage 76 South Maricopa Mountains – Sand Tanks	93	Linkage 122 Harquahala Mountains – Belmont Mountains – Big Horn Mountains	124
Linkage 77 Quijotoa Valley	94	Linkage 123 Mohave Peak – Chocolate Mountains	125
Linkage 78 State Route 79	95	Linkage 124 Kofa Mountains – Castle Dome	126
Linkage 79 Ironwood – Tortolita	95	Linkage 125 Tank Mountains – Palomas Mountains	126
		Linkage 126 Bunyan Peak – Painted Rock Mountains	127



Linkage 127 Margies Peak – Sheep Mountain	128
Linkage 128 North Maricopa – South Maricopa Mountains	128
Linkage 129 Southern Colorado River	129
Linkage 130 Chocolate Mountains – Trigo Mountains – Laguna Mountains	130
Linkage 131 Castle Dome Mountains – Red Bluff Mountains – Muggins Mountains	131
Linkage 132 Tinajas Altas Mountains – Cabeza Prieta Mountains	131
Linkage 133 Copper Mountains – Cabeza Prieta Mountains	132
Linkage 134 Cabeza Prieta Mountains – Tule Mountains	133
Linkage 135 Sierra Pinta – Cabeza Prieta Mountains	133
Linkage 136 Mohawk Mountains/Bryan Mountains – North Sierra Pinta	134
Linkage 137 South Sierra Pinta – Papago Well	135
Linkage 138 Northern Mohawk Mountains	135
Linkage 139 Mohawk Mountains – Bryan Mountains	136
Linkage 140 Bryan Mountains – Antelope Hills	137
Linkage 141 Granite Mountains – Mohawk Mountains/Bryan Mountains	137
Linkage 142 Granite Mountains – Antelope Hills	138
Linkage 143 Aguila Mountains – Granite Mountains	139
Linkage 144 Growler Mountains – Granite Mountains	139
Linkage 145 Bates Mountains/Cipriano Hills – Agua Dulce Mountains/Quitobaquito Hills	140
Linkage 146 Childs Mountains – Growler Mountains	141
Linkage 147 Growler Mountains – Bates Mountains	141
Linkage 148 Round Butte – Javelina Mountain	142
Linkage 149 Sand Tank Mountains – Saucedo Mountains	143
Linkage 150 Little Table Top – Vekol Mountains	143
Linkage 151 Gila/Salt River Corridor Granite Reef Dam – Gillespie Dam	144
Linkage 152 Central Arizona Project Canal	145
SECTION VIII RIPARIAN HABITAT/LINKAGE ZONES	147
Arizona Riparian Areas	147
Arizona Hydrological Classifications	150
Unique Waters	152
Wild and Scenic Rivers	152
Impaired Waters	162
Potential Impacts	162
Overview of Spatial and Temporal Impacts of Road or Other Construction Projects	162
Phase Descriptions	164
Ecological Components Consideration	164
General Recommendations	165
Section IX FUTURE DIRECTIONS	167
Additional Potential Linkage Zone Identification	167
Linkage Designs	167
Interactive Linkage Map Tool	168
Integrated Planning and Interagency Coordination	169
Outreach	169
Section X CONNECTIVITY RELATED PROJECTS	171
Wildlife Research	171

Road Kill Database	174
SECTION XI CONTRIBUTOR’S CONNECTIVITY EFFORTS	175
Arizona Department of Transportation	175
Arizona Game and Fish Department	175
Bureau of Land Management	176
Comprehensive Wildlife Conservation Strategy	176
The Federal Highway Administration	176
The Nature Conservancy	177
Northern Arizona University	177
The Sky Island Alliance	177
USDA Forest Service	177
The Wildlands Project	178
SECTION XII SOURCES FOR CONNECTIVITY RESOLUTION	179
Acres for America	179
Arizona Game and Fish Commission Heritage Fund	179
Arizona Growing Smarter Grant Program	180
Arizona Wildlife Conservation Fund	181
Arizona Partners in Amphibian and Reptile Conservation	181
Arizona Water Protection Fund	181
Bring Back the Natives	181
Candidate Conservation Agreements with Assurances	182
Conservation Innovation Grants	182
Conservation Reserve Program	182
Conservation Banking	182
Conservation Security Program	183
Cooperative Endangered Species Conservation Fund	183
Doris Duke Charitable Foundation	184
Environmental Quality Incentives Program	184
Farm and Ranch Land Protection Program	184
FishAmerica Foundation	184
Fish and Wildlife Habitat Improvement Grants	185
Five-Star Restoration Matching Grants Program	185
Grassland Reserve Program	185
Healthy Forests Reserve Program	186
Land and Water Conservation Fund	186
Landowner Incentive Program	186
Leonardo DiCaprio Foundation	186
Local, Regional and State Parks Heritage Fund	187
More Fish Partnership Fund	187
Multistate Conservation Grants Program	187
National Fish Passage Program	188
National Fish and Wildlife Foundation General Matching Grants Program	188
National Fish and Wildlife Foundation in Partnership with the NRCS	188
National Scenic Byways Grants Program	189
Native Plant Conservation Initiative	189
Neotropical Migratory Bird Conservation Act Grants Program	189



North American Wetlands Conservation Act Grants Program189

North American Bat Conservation Fund189

Partners for Fish and Wildlife Program189

Private Stewardship Grant190

Pulling Together Initiative190

Resource Conservation and Development Program190

Riparian Trust Fund190

Rockefeller Brothers Fund191

Safe Harbor Agreements191

State Comprehensive Wildlife Conservation Support Program191

State Lake Improvement Fund Grant Program192

Surdna Foundation192

Transportation Enhancement Grants192

Tribal Landowner Incentive Program192

Tribal Wildlife Grants192

United States Golf Association Wildlife Links192

Wetlands Reserve Program193

Wilburforce Foundation193

Wildlife Habitat Incentives Program193

Wildlife Action Opportunities Fund193

Wildlife Habitat Policy Research Program193

Excerpts from the Highway Transportation Bill SAFETEA-LU194

APPENDIX A LINKAGE DATA SHEET197

APPENDIX B WORKSHOP PARTICIPANTS199

REFERENCES203



LIST OF FIGURES



Figure 3-1. Arizona’s Ecoregions	8
Figure 3-2. Workshop Resource Maps	7
Figure 3-3. Flowchart of Project Development	9
Figure 3-4. Priority Conservation Areas Identified by The Nature Conservancy through Ecoregional Assessments	12
Figure 4-1. Diagram of Refinement Progression	16
Figure 5-1. Prioritization Graph	17
Figure 5-2. Upper Right Quadrant of Prioritization	20
Figure 6-1. Arizona’s Wildlife Linkages	22
Figure 6-2. Arizona’s Wildlife Linkages Across Habitat Blocks	23
Figure 6-3. Fracture Zones	24
Figure 6-4. Arizona’s Biotic Communities	25
Figure 6-5. Landownership	26
Figure 6-6. Tribal Nations	27
Figure 6-7. USDA Forest Service	28
Figure 6-8. Department of Defense	29
Figure 6-9. Arizona Highway System	30
Figure 6-10. ADOT Engineering Districts	31
Figure 6-11. ADOT Maintenance Boundaries	32
Figure 6-12. ADOT Natural Resources Management Section	33
Figure 6-13. Arizona Game and Fish Department Regions	34
Figure 6-14. Bureau of Land Management Districts	35
Figure 6-15. Bureau of Land Management Field Offices.....	36
Figure 6-16. Congressional Districts	37
Figure 6-17. Council of Governments	38
Figure 6-18. Federal Highway Administration Engineering Districts	39
Figure 6-19. Legislative Districts	40
Figure 8-1. Classification of Rivers and Streams	147
Figure 8-2. Riparian Habitat/Linkage Zones	148
Figure 8-3. Perennial Rivers, Stream and Selected Washes	149
Figure 8-4. Major Pathways of Exchanges of Materials, Energy and Organisms in the Longitudinal, Lateral and Vertical Dimensions of a Riverine System (From Ward and Wiens 2001 and Wiens 2002)	147
Figure 8-5. Hierarchical Classification of Stream Habitats (Wiens 2002)	150
Figure 8-6. Arizona Department of Water Resources Surface Water Basins	151
Figure 8-7. Unique Waters	153
Figure 8-8. Wild and Scenic Rivers	154
Figure 8-10. Impaired Waters	163
Figure 8-11. Temporal and Spatial Extent of Ecological Impacts on Riparian Areas Due to Three Phases of Road Development (Angermeier et al. 2004)	163



LIST OF TABLES



Table 4-1. Important Terms 15

Table 5-1. HB1 Size of Habitat Blocks 17

Table 5-2. HB2 Habitat Quality of the Smaller Block 18

Table 5-3. HB3 Presence of Linkage Dependent Species 18

Table 5-4. L1 Facilitates Seasonal Migration 18

Table 5-5. L2 Riparian Area 18

Table 5-6. L3 Conservation Ownership 18

Table 5-7. L4 Special Status Species WITHIN the Linkage Zone 19

Table 5-8. L5 Other Linkages Depend on This One 19

Table 5-9. Weighting for Biological Values 19

Table 5-10. T1 – T5 Development Threats 19

Table 5-11. O1 Linkage to Other State or Mexico 19

Table 5-12. O2A ADOT 5-Year Plan 19

Table 5-13. O2B ADOT Long Range (20-Year) Plan 19

Table 5-14. O3 Active Conservation Efforts 20

Table 5-15. Weighting for Threats and Opportunities 20

Table 8-1. Arizona’s Designated Unique Waters 152

Table 8-2. Arizona Waters Potential Candidates for Wild and Scenic Designations 155



LIST OF ACRONYMS



AASHTO	American Association of State Highway and Transportation Officials	DDT	Dichlorodiphenyltrichloroethane	NEPA	National Environmental Policy Act
ADEQ	Arizona Department of Environmental Quality	DOD	Department of Defense	NFWF	National Fish and Wildlife Foundation
ADOT	Arizona Department of Transportation	DPS	Department of Public Safety	NMBCA	Neotropical Migratory Bird Conservation Act
ADWR	Arizona Department of Water Resources	EDTM	Efficient Transportation Decision Making	NMFS	National Marine Fisheries Service
AG	Attorney General	EIS	Environmental Impact Statement	NPS	National Park Service
AGFD	Arizona Game and Fish Department	EPA	U.S. Environmental Protection Agency	NRCS	Natural Resources Conservation Service
AHR	Americans for Our Heritage and Recreation	EQIP	Environmental Quality Incentives Program	PAG	Pima Association of Governments
AHS	Arizona Highway System	ESA	Endangered Species Act	PARC	Partners in Amphibian and Reptile Conservation
ALRIS	Arizona Land Resource Information System	FHWA	Federal Highway Administration	PCA	Patch Configuration Analysis
AORCC	Arizona Outdoor Recreation Coordinating Commission	FMPO	Flagstaff Metropolitan Planning Organization	PTI	Pulling Together Initiative
A.R.S.	Arizona Revised Statutes	FRPP	Farm and Ranch Land Protection Program	RMP	Resource Management Plan
ASH	Arizona Service Highway	FSA	USDA Farm Service Agency	SEAGO	South Eastern Arizona Governments Organization
ASLD	Arizona State Land Department	FWCA	Fish and Wildlife Coordination Act	SEPM	Spatially Explicit Population Model
ASP	Arizona State Parks	GIS	Geographic Information System	SCWCs	State Comprehensive Wildlife Conservation Strategy
ATIS	Arizona Transportation Information System	GPS	Global Positioning System	SLIF	State Lake Improvement Fund
AWLW	Arizona Wildlife Linkages Workgroup	GRP	Grassland Reserve Program	SR	State Route
AZ	Arizona	HCP	Habitat Conservation Plan	SWG	State Wildlife Grant
BBN	Bring Back the Natives	HFRP	Healthy Forests Reserve Program	TDML	Total Maximum Daily Load
BIA	Bureau of Indian Affairs	I	Interstate	TNC	The Nature Conservancy
BLM	Bureau of Land Management	km	Kilometer	TU	Trout Unlimited
BOR	Bureau of Reclamation	LCCA	Least Cost Corridor Analysis	U.S.	United States
CAB	Conservation Acquisition Board	LIP	Landowner Incentive Program	USAF	U.S. Air Force
CACOG	Central Arizona Council of Governments	LRSP	Local, Regional and State Parks	USC	United States Code
CAP	Central Arizona Project	LWCF	Land and Water Conservation Fund	USDA	U.S. Department of Agriculture
CCAA	Candidate Conservation Agreements with Assurances	MAG	Maricopa Association of Governments	USDOl	U.S. Department of Interior
CCC	Commodity Cooperation Corporation	MBTA	Migratory Bird Treaty Act	USFWS	U.S. Fish and Wildlife Service
CERI	Craighead Environmental Research Institute	MFP	Management Framework Plan	USGS	U.S. Geological Service
CFR	Code of Federal Regulations	MOU	Memo of Understanding	WACOG	Western Arizona Council of Governments
CIG	Conservation Innovation Grants	MP	Milepost	WCS	Wildlife Conservation Society
Corps	U.S. Army Corps of Engineers	MSCGP	Multistate Conservation Grant Program	WHIP	Wildlife Habitat Incentives Program
CRP	Conservation Reserve Program	NACOG	Northern Arizona Council of Governments	WHPRP	Wildlife Habitat Policy Research Program
CSP	Conservation Security Program	NAU	Northern Arizona University	WMA	Weed Management Area
CWA	Clean Water Act	NAWCA	North American Wetlands Conservation Act	YMPO	Yuma Metropolitan Planning Organization
CWCS	Comprehensive Wildlife Conservation Strategy				
CYMPO	Central Yavapai Metropolitan Planning Organization				



GLOSSARY



HABITAT BLOCK: an area of land that consists of important wildlife habitat and can reasonably be expected to remain wild for at least 50 years. Habitat blocks are primarily comprised of lands within National Forests, National Parks, National Wildlife Refuges, large military reservations, tribal lands and lands managed by Bureau of Land Management or Bureau of Reclamation. Although some of these lands contain bombing ranges, barracks, reservoirs, and other non-natural elements, they still have a long-term prospect of serving as wildlife habitat. We recognize that tribal sovereignty retains the right to develop those lands. Habitat blocks also include private lands that are managed for conservation, such as Nature Conservancy preserves and some large ranches whose owners are committed to long-term conservation. All other private lands and land owned by Arizona State Land Department (which has no conservation mandate under current law) have for the most part been excluded. (Note: To keep maps readable, some habitat block polygons include small private and state inholdings that may not be conserved).

FRACTURE ZONE: areas of reduced permeability between habitat blocks. These regions are largely State Land, private holdings and transportation corridors. Roads, canals, urban areas, railroads, or border security operations limit or prevent animal movement, or threaten to do so in the foreseeable future in these zones. Most fracture zones need significant restoration to function as reliable linkages. Portions of the fracture zone are designated as potential linkage zones (see definition below). Resource agencies and conservation groups should continue to protect and enhance washes, streams, and rivers as major corridors in all areas of the fracture zone, including improvements to culverts and bridges to promote wildlife permeability.

POTENTIAL LINKAGE ZONE: a portion or subset of the fracture zone or habitat block identified as an area critical to wildlife movement. Threats must be managed if connectivity is to be maintained or restored. We emphasize that these polygons depict planning areas within which a functional linkage(s) must be designed and conserved. In most cases, only a small fraction of the proposed potential linkage zone will be included in the linkage design (*Section X*), which will be developed in future detailed analyses.

RIPARIAN HABITAT/LINKAGE ZONE: streams that historically supported riparian communities and perennial water flow (in some cases pools linked by subsurface flow for much of the year). Each potentially provides essential habitat for aquatic species, and critical landscape connectivity for both aquatic and terrestrial animals (*Section VIII*).



ACKNOWLEDGEMENTS



Special thanks to:

Mark Endries, Florida Fish and Wildlife Commission;
Paul Garrett, Federal Highway Administration;
Bob Hollis, Federal Highway Administration;
Alex Levy, Federal Highway Administration;
Rob Marshall, The Nature Conservancy;
Victor Mendez, Arizona Department of Transportation;
Bill Ruediger;
Duane Shroufe, Arizona Game and Fish Department;
Dale Turner, The Nature Conservancy; and
Trish White, Defenders of Wildlife

We would like to acknowledge all of the photographers whose photos are displayed in this document. Every attempt was made to identify the credits associated with each photo but the nevertheless some sources were not found. The striking cover photo of the mule deer is the generous contribution of Shawn Olson (<http://www.shawnolson.net/>). The chuckwalla is one of the wonderful photos from Ron Horloff's beautiful collection (<http://www.pbace.com/ronhrl>). The magnificent Swainson's hawk is the work of E. J. Peiker.



Gratitude and appreciation to the Arizona Department of Transportation's Jessica Gonzales of for ceaselessly printing, sorting and stacking; Mike Mingo for supplying running commentary through this process; and to Nicole Carpenter for editing above and beyond the call of duty. Many thanks for the patience of ADOT's Maintenance Permits.

We would like to recognize the efforts of Jiray Du, Jaclyn Srynoski and Tyson Kelsey.

Thanks and appreciation to Kristian Nordhaugen for his support and coming to the rescue on several occasions.

And many thanks to Stuart Wells, wherever you are.

Thanks to all of our workshop sponsors: Arizona Department of Transportation, Arizona Game and Fish Department, Bureau of Land Management, Federal Highway Administration, Northern Arizona University, Sky Island Alliance, USDA Forest Service, US Fish and Wildlife Service, the Wildlands Project, Earth Friends Wildlife Foundation, National Park Service, the Appleton-Whittell Audubon Research Ranch and the Phoenix Zoo.

Thanks to The Nature Conservancy for contributing the use of their conservation plans for each ecoregion.

Thanks to Sue Boe, Joyce Francis, Chuck Paradzick and Sabra Schwartz of the Arizona Game and Fish Department for their substantial contributions to bring our efforts together.



