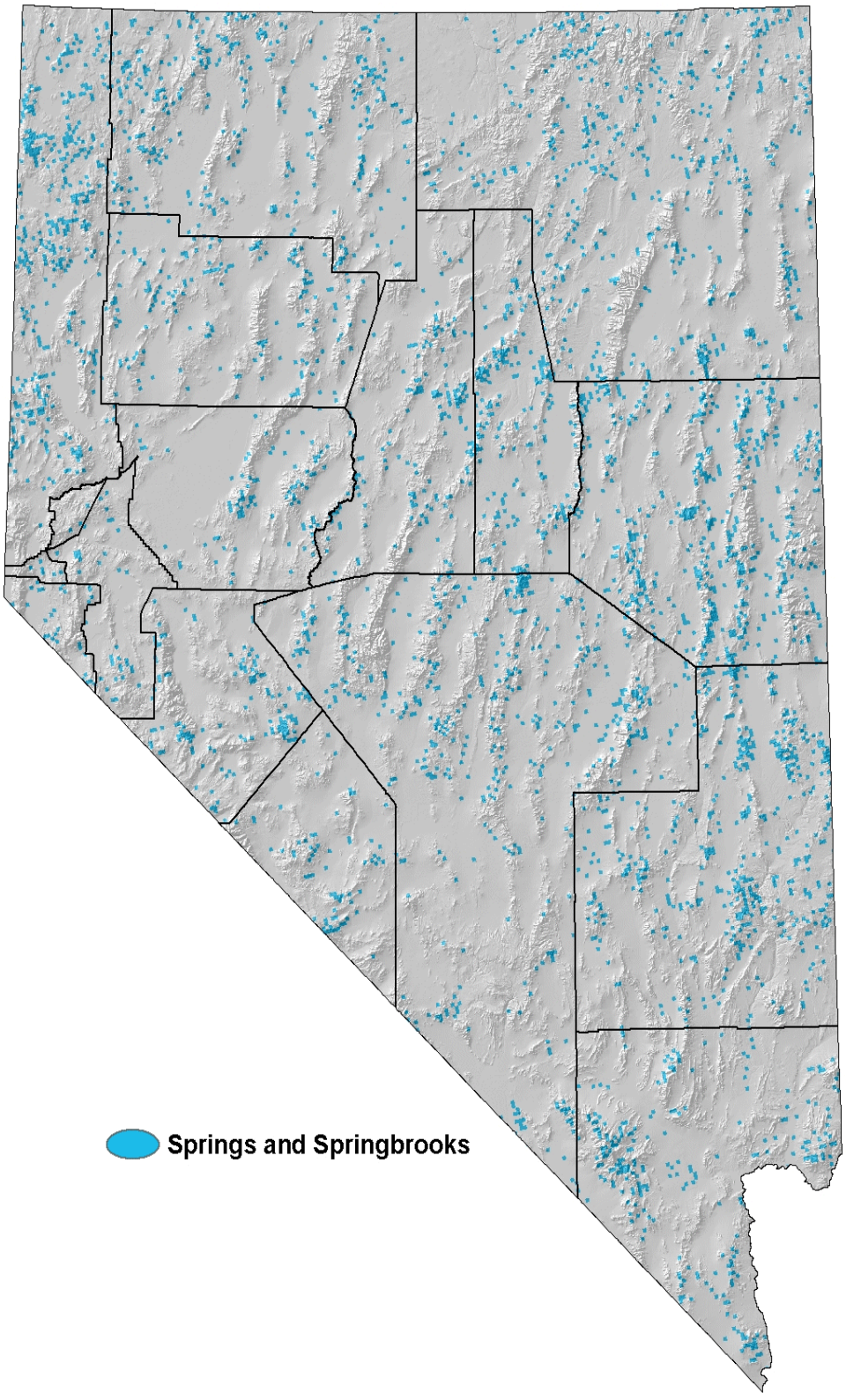

Figure 24. Distribution of Springs and Springbrooks in Nevada (data source: NatureServe 2004).

Key Habitat: Springs and Sringbrooks

Ecoregions

Great Basin ..... 3,123 springs
Columbia Plateau ..... 814 springs
Mojave Desert ..... 467 springs
Sierra Nevada ..... 2 springs
Total ..... 4,406 springs

Ecological Systems

A012 - Ephemeral springs/springbrooks
A013 - Cold perennial springs/springbrooks
A014 - Thermal (warm) and hot perennial springs/springbrooks

Key Habitat Description

Nevada has the most known thermal/hot springs of any state in the US. Over 4,000 Nevada springs of various temperatures and flow have been mapped. A spring occurs where deep or shallow groundwater flows from bedrock or natural fill onto the land surface and forms surface flow or a body of water. Springbrooks are the areas of flowing water linked to the spring source. Springs are generally divided into three main categories: cold springs (springs near or below mean annual air temperature), warm or thermal springs (springs 5 to 10°C (41 to 50°F) above mean annual air temperature), and hot springs (springs more than 10°C (50°F) above mean annual air temperature). Over 100 of the known thermal/hot springs in Nevada have surface temperatures 38°C (100°F) or higher. The source and subterranean pathway of water may be local or regional. Thousands of springs occur in a variety of landform settings throughout the state.

In addition to thermal conditions, the characteristics of individual spring and spring brook systems can vary tremendously in terms of flow, water chemistry and habitats provided for terrestrial and aquatic wildlife species. Many spring systems important to wildlife represent little more than seeps. Even relatively small spring and spring outflows can support important populations of endemic gastropods and other aquatic invertebrates. Several locations in Nevada also contain individuals or groupings of large, regionally important springs which are in most cases thermal or hot water systems associated with regional aquifer flow systems. Big Warm Spring in Railroad Valley, Nye County, for example, has a recorded discharge varying from 22 to 24 cubic meters per second (777 to 848 cubic feet per second) at 30° to 33° C (86 to 91°F), from a source pool 24 m (79 ft) in diameter (USFWS 1997). Similar regional spring discharge areas such as Soldier Meadow, Upper White River Valley, Pahranagat Valley, Ash Meadows and the Warm Springs area of Clark County support important diverse assemblages of spring-dependent endemic species. These larger (and some smaller) spring systems generally support extensive springbrook outflow habitats, downstream wetland and marsh habitats, and may also contribute significant flow to associated tributary and first order stream and river systems, such as the upper White River and Muddy River.

Value to Wildlife

Gains in scientific knowledge about the contribution of spring habitats to biodiversity and the longevity of "ancient" water supply sources and gains in knowledge regarding the importance of groundwater to the springs and the distribution or morphology of underground flow systems have drawn attention to spring conservation and management.

Early studies described many unique fishes endemic to spring and springbrook habitats, and studies since the mid-1980s have described a number of endemic spring-dwelling macroinvertebrates (primarily gastropods and aquatic insects). Other surveys also document endemic mammals, amphibians, crustacea, and plants from spring-fed wetlands.

An important aspect of thermal aquatic systems is that fish are able to move within the system to meet their temperature needs; during winter months they can move closer to the spring source to meet thermal maintenance requirements, while using cooler outflow systems during warm weather periods. Springs provide crucial habitat to a significant percentage of Nevada's federally-listed and state protected aquatic species.

In addition to springs' critical role in the survival and conservation of endemic aquatic species, they also play a very important role for other wildlife species. Nevada, which has the lowest annual rainfall in the US, , has limited surface water resources, particularly during drought. Springs provide a vital water source between infrequent surface waters, providing water availability and food resources for a wide range of Nevada's wildlife, from bighorn sheep, elk, and deer; to birds and bats. The broad distribution of functional spring and spring outflow systems of all types across Nevada's landscape is an important element in maintaining Nevada's wildlife diversity.

Key Elements of Springs and Springbrooks of Importance to Wildlife

Ephemeral Springs
Great Basin Columbia Spotted Frog

Cold Springs and Springbrooks

Big Smoky Valley speckled dace
Big Spring spinedace
Clover Valley speckled dace
Big Smoky Valley tui chub
Independence Valley speckled dace
Diamond Valley speckled dace
Fish Lake Valley tui chub
Railroad Valley tui chub
Monitor Valley speckled dace
Oasis Valley speckled dace
Pahranagat roundtail chub
Pahranagat speckled dace
White River desert sucker
White River speckled dace
White river spinedace
Amargosa toad
Columbia Spotted Frog
Relict leopard frog
Southwestern toad
Northern leopard frog
Great Plains toad
Juga, smooth

Thermal (warm)/Hot Springs and Springbrooks

Relict leopard frog
Ash Meadows Amargosa pupfish
Ash Meadows speckled dace
Meadow Valley speckled dace
Newark Valley tui chub
Relict dace
Warm springs pupfish
Devils Hole pupfish
Fish Creek Springs tui chub
Moapa dace
Moapa White River springfish
Moorman White River springfish
desert dace
Railroad Valley springfish
Hiko White River springfish
White River springfish
Preston White River springfish
Pahrump poolfish

Gastropods

Tryonia, desert
Springsnail, Lake Valley
Tryonia, grated
Springsnail, Landyes
Tryonia, minute
Springsnail, large gland Carico
Tryonia, Monitor
Springsnail, Lockes
Tryonia, Point of Rocks
Springsnail, longitudinal gland
Tryonia, sportinggoods
Springsnail, median-gland
Springsnail, Antelope Valley
Springsnail, Moapa Valley
Springsnail, bifid duct
Springsnail, neritiform Steptoe Ranch
Springsnail, Big Warm Spring
Springsnail, northern Soldier Meadow
Springsnail, Butterfield
Springsnail, northern Steptoe
Springsnail, Camp Valley
Springsnail, northwest Bonneville
Springsnail, carinate Duckwater
Springsnail, Oasis Valley springsnail
Springsnail, Carlin
Springsnail, ovate Cain Spring
Springsnail, Corn Creek
Springsnail, Pleasant Valley
Springsnail, Crittenden
Springsnail, Sada's
Springsnail, Crystal Spring
Springsnail, small gland Carico
Springsnail, distal-gland
Springsnail, southeast Nevada
Springsnail, Dixie Valley
Springsnail, southern Duckwater
Springsnail, Duckwater
Springsnail, southern Soldier Meadow
Springsnail, Duckwater warm springs
Springsnail, southern Steptoe
Springsnail, Elko
Springsnail, Spring Mountains
Springsnail, elongate Cain Spring
Springsnail, squat Mud Meadows
Springsnail, elongate Mud Meadows
Springsnail, sterile basin
Springsnail, elongate-gland
Springsnail, sub-globose Steptoe Ranch
Springsnail, Emigrant
Springsnail, Surprise Valley
Springsnail, Fairbanks
Springsnail, Toquerville
Springsnail, Fish Lake
Springsnail, transverse gland
Springsnail, Flag
Springsnail, Twentyone Mile
Springsnail, flat-topped Steptoe
Springsnail, upper Thousand Spring
Springsnail, Fly Ranch
Springsnail, Vinyard's
Springsnail, Hardy
Springsnail, western Lahontan

Existing Environment

Habitat Conditions

Like other water-associated habitats, dewatering, diversion works, channelization, and invasion of nonnative plants and animals have altered springs (U.S. Bureau of Land Management 2001). The introduction of nonnative aquatic organisms into spring and springbrook habitats, particularly the establishment of thermally tolerant invasive species into warm and thermal spring systems, has significantly impacted resident endemic species through competition and predation and represents the single greatest threat to a number of species of high conservation need. The establishment of emergent invasive plant species such as cattails and phragmites in spring pools and outflows has severely modified and altered some spring habitat and flow characteristic. In some basins, groundwater pumping has been found to depress spring flow and a small number of larger regional springs have demonstrated temporary or permanent dewatering as a result of groundwater development. Field studies have documented degraded habitat conditions, declines in sensitive plants and animal populations, and species extinctions. Similar to other wetlands, springs are intensively used. Livestock, wild horses, and diversions were the predominant disturbances found in one study of 511 northern Nevada springs (Sada 1991), and disturbance from trampling can be particularly detrimental to water quality and spring pool and spring brook habitat characteristics.

A substantial number of springs on private and public lands have been historically altered by piping of outflows or the construction of spring head boxes. These practices eliminate or significantly modify spring pool and spring outflow habitats for wildlife and can eliminate important source water locations for use by resident wildlife species. More recent efforts to provide wildlife access to these modified spring systems are important, but have focused on terrestrial species needs with limited attention to restoring natural spring system functions to support

spring-dependent endemic aquatic communities. Concerns exist that current protection and management attention is not sufficient to sustain spring ecological site integrity and long-term water production. Springs, particularly larger regional spring complexes, are also popular centers of human recreational activities. Although recreation can be managed to minimize effects on spring ecosystems in most cases, uncontrolled or poorly planned recreational use can have significant negative effects on spring habitats and biota.

Land Uses

Groundwater development	Road development
Development and diversion of flow	Motorized and non-motorized recreation
Livestock grazing	Urban/suburban and industrial development

Problems Facing the Species and Habitats

Spring and springbrook habitats and associated species are primarily threatened by water diversion, excessive livestock grazing, groundwater depletion, recreation, mining (de-watering activities), and establishment of nonnative species. Detrimental introduced plant species include tamarisk, purple loosestrife, Canada thistle, knapweed, and perennial pepperweed. Detrimental introduced animals include mosquito fish, goldfish, mollies, bullfrogs, crayfish, a snail, and several introduced sport fish (rainbow trout, largemouth bass). Improper grazing by cattle can also cause significant damage by eliminating riparian vegetation and/or trampling (leading to topsoil loss during rainfall and snowmelt events, and to "sealing" of the spring in areas with high clay content). The same impacts can also occur with wild horse and burro use. Species such as elk can also impact springs; in areas where large populations exist, their impacts can be similar to those of livestock.

The development of springs and seeps, a common historic practice for livestock watering, domestic water supply and other reasons, is a significant concern because of the critical importance of spring resources as a source of surface water for terrestrial wildlife and also because many springs and seeps of all sizes support unique endemic aquatic biota. The development and modification of spring sources and source pools directly alters or removes important aquatic habitats, modifications can limit access to remaining surface water by wildlife, and the diversion of water away from outflow channels modifies and can reduce or destroy associated riparian and wetland habitat, as well as limiting or eliminating flowing water habitats for springbrook associated endemic species. Hydrologic changes have severely impacted aquatic species in Las Vegas Valley. Although not directly related to the development and alteration of spring systems, groundwater development has been a historic stressor on Nevada wildlife and habitats and continues to represent a significant ongoing threat. As demonstrated in areas such as Ash Meadows and Pahrump Valley in southern Nevada, excessive groundwater withdrawal can alter groundwater flow and recharge patterns, resulting in loss of connectivity between groundwater and surface water habitats and concurrent impacts to vegetative communities and surface flow of groundwater from springs and seeps. These impacts are often not well understood, and can vary considerably depending on local geology, the characteristics of groundwater development actions, and the nature of the groundwater resources being accessed.

Springs are also susceptible to pollution because they are often supplied by shallow aquifers that can easily become polluted if spilled chemicals percolate from the surface through rock fractures or joints. Some potential sources are refuse disposal, hazardous material, injection fields, oil and gas development, ungulate fecal material, and bleach/soap added to the springs as a result of recreational use. Recreational use impacts also include soil compaction, removal of vegetation and resulting erosion from camping along the edges of springs, and manipulation of spring flow from installing "tubs" and water diversions.

Priority Research Needs

- Impacts of groundwater withdrawals on a regional scale
- Groundwater interbasin connections and recharge intervals
- Determine status of Great Plains toad at springs in Lincoln County

- Invertebrate adaptability to alterations in water level, water chemistry and other tolerance parameters
- Effective methods for control and removal of invasive and nonnative animal species, particularly in larger regional spring systems where flow and physical characteristics make conventional physical and chemical control methods impractical
- Effective methods for restoration and reconstruction of fully-functioning spring habitats

Conservation Strategy

Goal: Springs and springbrook habitats functioning naturally within the natural fluctuation inherent to the spring type (recognizing that regional springs are inherently much more stable than those supported by local aquifers).

Objective: A measurable increase in the number of springs and springbrooks functioning naturally and supporting the natural ecological community expected for each spring by 2015.

Action: Assess the current functional status of Nevada's springs.

Action: Establish a working group to contribute expertise, pool data, develop and implement a management plan for Nevada springs. (springs already addressed under other management plans will be noted in the plan)

Action: Map springs and digitally document their historical condition, desired condition, and restoration potential.

Action: Prioritize management and restoration activities by spring.

Action: Restore degraded springs and associated riparian areas. Identify factors affecting site potential and adjust land uses to allow for natural spring and springbrook recovery.

Action: Maintain the ecological structure and function of spring habitats by stabilizing discharge and spring brook morphology.

Action: Manage springs and their riparian areas as a unit using guidelines appropriate to these systems, such as those used to manage wetland areas and riparian zones.

Action: Manage for a minimal standard of proper functioning condition (PFC) for springs and associated riparian areas on public lands, utilizing existing guidance and standards for spring and springbrook ecosystems.

Action: Incorporate standardized biological assessment as an adaptive management feedback mechanism to assess spring management effectiveness.

Action: Work with landowners to maximize appropriate spring habitats, including providing information about optimum habitat, invasive species, and available grant and other funding opportunities.

Action: Establish conservation easements, Safe Harbors Agreements, and Candidate Conservation Agreements from willing landowners, MOAs, or acquire key habitats or water rights from willing sellers.

Objective: No net loss of spring/springbrook-dependent Species of Conservation Priority concern.

Action: Develop a public outreach program utilizing interpretive programs, watchable wildlife opportunities, and other educational approaches regarding the importance of springs in partnership with BLM, USFWS, NPS and other cooperators.

Action: Actively pursue strategies for prevention of introduction of nuisance aquatic plant and animal species, including educational campaigns targeted at pet stores, water gardens, classrooms, researchers, biologists, etc.

Action: Support actions by land management partners and local governments to control invasive and noxious plants and weeds, especially tamarisk and emergent plant species which directly impact functioning of spring and springbrook aquatic habitats

Action: Continue implementation of existing recovery and conservation programs for spring and springbrook dependent Species of Conservation Priority including endemic amphibians, and species occurring within the upper White River, Pahranagat Valley, Muddy River, Railroad Valley, Independence Valley, and Clover Valley systems..

Action: Organize cooperative conservation implementation working groups to develop and implement conservation strategies for Desert Dace and Ash Meadows endemic fishes.

Action: Develop and implement a regional Conservation Agreement and Strategy for isolated spring systems and dependent Species of Conservation Priority including land management partners and adjacent state responsible entities.

Action: Encourage research on innovative methods and strategies for the control and removal of invasive and nuisance animal species from spring and springbrook systems, particularly crayfish and thermally dependent nonnative fishes.

Partnerships

Land owner/manager	Percent
Bureau of Land Management	63.1
Private	18.8
US Forest Service	12.2
US Fish and Wildlife Service	2.4
US Department of Defense	1.3
Other	2.2

Existing partnerships, plans, and programs

Species Teams, Recovery Plans, and Conservation Agreements

- White River Recovery Implementation Team
- Railroad Valley Recovery Implementation Team
- Big Spring Spinedace Recovery Implementation Team
- Muddy River
- Soldier Meadow Recovery Working Group
- Pahranagat Valley

Conservation Agreements and Strategies

- Amargosa Toad CAS
- Amargosa Toad Management Plan
- Relict Leopard Frog CAS
- Northeast Nevada Columbia Spotted Frog Conservation Agreement and Strategy
- Toiyabe Columbia Spotted Frog Conservation Agreement and Strategy
- Draft Tui Chub SMP
- Big Spring Spinedace Recovery Plan & Recovery Implementation Plans
- Recovery Plan for the Endangered Species of Clover & Independence Valleys
- Railroad Valley Springfish Recovery Plan
- Recovery Plan for the Aquatic and Riparian Species of Pahranagat Valley
- Pahranagat Valley Native Fishes Management Plan

- Recovery Plan for the Pahrump Killifish
- White River Native Fishes Management Plan
- Indian Spring CCAA and SHA
- Recovery Plan for the Endangered and Threatened Species of Ash Meadows, Nevada
- Recovery Plan for the Rare Aquatic Species of the Muddy River Ecosystem
- Recovery Plan for the Rare Species of Soldier Meadows
- Spring Mountains National Recreation Area

Federal Agencies

- Bureau of Land Management
- U.S. Forest Service
- U.S. Fish and Wildlife Service
- Natural Resources Conservation Service/Conservation Districts
- Bureau of Reclamation
- National Park Service
- U.S. Geological Survey (Biological Resources Division)

State Agencies

- Nevada Department of Wildlife
- Nevada Division of Forestry
- Nevada Department of Agriculture
- Nevada Natural Heritage Program

Conservation Organizations

- The Nature Conservancy
- Sierra Club

Partner-based Restoration and Management Efforts

- Muddy River Regional Environmental Impact and Alleviation Committee (MRREIAC)
- Muddy River Project (TNC)
- Oasis Valley Project (TNC)
- Recovery Plan for the Rare Species of Soldier Meadow

Habitat Conservation Plans

- Clark County Multiple Species Habitat Conservation Plan
- Spring Mountain Ranch HCP

Other Key Partners

- Counties
- Tribes
- University of Nevada (UNR, UNLV, Cooperative Extension)
- Southern Nevada Water Authority

Focal Areas (Refer to gastropod map for snail focal areas)

Oasis Valley
Northern Big Smoky Valley (south end)
Condor Canyon
Clover Valley
Independence Valley
Upper White River (Kirch to Preston)
Black Canyon
Overton Arm
Upper Muddy River
Meadow Valley Wash

Cottonwood Canyon
Diamond Valley
Fish Lake Valley
Railroad Valley
Duckwater\Bull Creek
Monitor Valley
Ferguson Springs
Ash Meadows
Pahranagat Valley
Soldier Meadow
Red Rock Canyon
Spring Valley