Kentucky's Species of Greatest Conservation Need and their statuses.

name	Scientific name	Federal	Heritage	GRank	SRank
Amphibia (3 species).					
Eastern Spadefoot	*Scaphiopus holbrookii*	N	N	G5	S4
Northern Dusky Salamander	*Desmognathus fuscus*	N	N	G5	S5
Spotted Dusky Salamander	*Desmognathus conanti*	N	N	G5	S3

Literature cited Download all 3 new 2013 Amphibian Statewide Maps (2 MB)

CLASS Amphibia

Eastern Spadefoot ***Scaphiopus holbrookii***

Federal Status	Heritage Status	GRank	SRank	GRank (Simplified)	SRank (Simplified)
N	N	G5	S4	G5	S4

G-Trend Unknown

G-Trend Comment Data from across the range indicates that the overall population trend is thought to be stable to decreasing but populations are very difficult to monitor due to the irregular and unpredictable breeding habits of this species.

The Eastern Spadefoot is a wide-ranging species known from about 24 states in the eastern, midwestern, and southeastern U.S. and is listed by state heritage programs in about half of these (Conant and Collins 1991; U.S. Geological Survey/National Amphibian Atlas accessed 3/15/2010; NatureServe accessed 3/11/2010). Still, relatively little hard information is available on the distribution and abundance of this highly fossorial animal. Adults call only during brief, irregular breeding episodes during periods of heavy rain but otherwise spend much of their time underground (Lannoo 2005). State Conservation Statuses

(NatureServe, accessed 3/11/2010) are as follows: S1 in Connecticut, Ohio, Pennsylvania, Rhode Island, and West Virginia; S2 in Arkansas, Indiana, Massachusetts, and Missouri; S2/S3 in New York, S3 in Illinois; S4 in Delaware, Kentucky, Louisiana, Maryland, and Virginia; and S5 or unranked in Alabama, Florida, Georgia, Mississippi, New Jersey, North Carolina, South Carolina, and Tennessee.

Eastern Spadefoots are believed to have been extirpated from portions of their original range due to habitat destruction (McCoy 1982; Klemens 1993).

S-Trend Unknown

S-Trend The Eastern Spadefoot has been added to the Kentucky State Wildlife Action Plan

Comment for three reasons: (1) its overall distribution and abundance are poorly known in comparison with other native anurans; (2) most of the documented breeding sites are temporary pools that in recent years have usually gone dry before the tadpoles have transformed into froglets; and (3) complete larval die-offs from disease have been observed at 2 different breeding ponds that have been monitored regularly by the state herpetologist.

Eastern Spadefoots have been documented from at least 37 Kentucky counties ranging from Greenup, Lawrence, and Floyd in eastern Kentucky westward to Carlisle County at the base of the loess bluffs bordering the Mississippi River. Some of these records date back into the 1930's, and many are based on single

specimens. No records are available from the Bluegrass Region or Western Coal Field but this species does occur at least sparingly in all other sections of Kentucky. Within the past 10 years breeding sites have been found in Rowan, Powell, Rockcastle, Laurel, McCreary, Meade, Hart, and Edmonson counties. Massive tadpole die-offs have been noted at breeding ponds in Rockcastle and Edmonson counties during this time, indicating that diseases such as Ranavirus may be impacting this species in Kentucky. Several breeding sites that were monitored in Edmonson County from 2004-2009 have gone dry before the tadpoles could complete their development – this is not unusual for a species that often uses temporary pools for reproduction but in combination with disease it may contribute to the extirpation of local populations over time (JRM unpublished data).

Habitat / Life History

Eastern Spadefoots occur in both open and forested habitats in uplands or bottomlands that have friable sandy to loamy soils. Breeding takes place largely in temporary pools – even in low sections of flooded fields – and occasionally in permanent ponds (Hansen 1958, Pearson 1955, Lannoo 2005). At least 2 of the breeding ponds that are being monitored at Mammoth Cave National Park are old constructed farm ponds that were likely present when land for the park was purchased in the 1930's (JRM personal observation). Eggs are attached to submerged or floating vegetation; hatching and larval development periods vary

with temperature but tend to be relatively rapid in comparison with other anurans.

In Kentucky, metamorphs have appeared as early as 30 days after the eggs were laid (JRM personal observation). The Eastern Spadefoot can breed at just about any time from March-October in Kentucky but most breeding takes place from May-July (JRM personal observation). Breeding activity is primarily initiated by heavy rains, and populations at some locations breed very infrequently. One Powell County breeding site was used only twice in seven years. A breeding pond in Edmonson County, on the other hand, was used 4 times in a single year but went dry each time before the tadpoles were able to transform (JRM personal observation).

Key Habitat Laurel County (breeding site in a natural vernal pool along KY 192 NE of Baldrock); Edmonson County (Mammoth Cave National Park (several breeding sites continue to be regularly used and likely produce numerous young during some years).

Guilds Emergent and shrub-dominated wetlands, grassland/agricultural, standing water, upland forest.

Statewide Map Eastern_Spadefoot.pdf

Conservation Issues

Aquatic habitat degradation

2E Stream channelization/ditching. Aquatic habitat degradation – especially the

elimination of riparian or floodplain breeding pools due to channelization, conversion to cropland, and development.

2F Riparian zone removal (Agriculture/development). Aquatic habitat degradation – especially the elimination of riparian or floodplain breeding pools due to channelization, conversion to cropland, and development.

Biological/ consumptive uses

5K Lack of suitable habitat for spawning, nesting, or breeding. Breeding ponds that can retain water for 6-8 weeks following heavy rains are not common, and, once lost, are not easily replaced. Complete die-offs of tadpoles from as-yet unidentified diseases have been observed in 2 KY breeding ponds.

5L Parasitism and disease. Breeding ponds that can retain water for 6-8 weeks following heavy rains are not common, and, once lost, are not easily replaced. Complete die-offs of tadpoles from as-yet unidentified diseases have been observed in 2 KY breeding ponds.

Miscellaneous Mortality Factors

6G Stochastic events (droughts, unusual weather, pine beetle damage, flooding etc.). Once breeding has been initiated by heavy rains, additional rainfall is needed to allow temporary ponds to retain water for a long enough time for tadpole development to be completed. Often such rains never come until too late.

Point and non-point source pollution

4E Agricultural runoff – including fertilizers/animal waste, herbicides, pesticides. Temporary ponds in cropland may contain fertilizer and/or pesticides. Seasonal ponds located along paved roads may have high concentrations of deicing salts, oil, etc.

4I Runoff from transportation routes (deicing salt, gas, others). Temporary

ponds in cropland may contain fertilizer and/or pesticides. Seasonal ponds located along paved roads may have high concentrations of deicing salts, oil, etc.

Siltation and increased turbidity

1F Recreational activities (atv, horseback riding). Although this species sometimes breeds in road ruts created or maintained by ATV use, several natural breeding ponds in eastern Kentucky have seen severe adverse impacts by ATV use as well.

Terrestrial habitat degradation

3A Row-crop agriculture (conversion to, annual reuse of fields, etc). Ponds in row crop fields may contain fertilizer and/or pesticides;

3F Urban/residential development. Development and surface mining often eliminates and/or contaminates seasonal ponds.

3K Surface mining. Development and surface mining often eliminates and/or contaminates seasonal ponds.

3P Pollution/toxicity (e.g., heavy metals, pesticides, herbicides, acid rain). Ponds in row crop fields may contain fertilizer and/or pesticides

3R Habitat and/or Population Fragmentation. Development and surface mining often eliminates and/or contaminates seasonal ponds

3T Suppression of disturbance regimes. Long-term fire suppression may cause natural and man-made ponds to slowly disappear as basins fill with undecayed leaves and debris.

3U Loss, lack and degradation of special and unique microhabitats. Long-term fire suppression may cause natural and man-made ponds to slowly disappear as basins fill with undecayed leaves and debris. development and surface mining often eliminates and/or contaminates seasonal ponds

Unknown factors/variables

7A Unknown threats. Although we have observed tadpole die-offs at 2 breeding ponds in Kentucky, the exact causative agents remain unknown.

CLASS Amphibia

Northern Dusky Salamander ***Desmognathus fuscus***

Federal Status	Heritage Status	GRank	SRank	GRank (Simplified)	SRank (Simplified)
N	N	G5T5	S5	G5	S5

G-Trend Stable

G-Trend Comment Apparently stable at a rangewide scale, but local declines in Northern Dusky Salamander populations have been documented in some portions of the range. Petranka (1998) refers to this salamander as one of the most common species in North America.

The Northern Dusky Salamander occurs in about 19 states in the eastern, Midwestern, and southeastern United States (U.S. Geological Survey/National Amphibian Atlas, accessed 3/15/2010). State heritage programs list this species as S4, S5, or unranked throughout its range as follows: Connecticut (S4), Delaware (S5), District of Columbia (S5), Indiana (S4), Kentucky (S5), Maine (S5), Maryland (S5), Massachusetts (S4S5), New Hampshire (S5), New Jersey (SNR), New York (S5), North Carolina (S5), Ohio (SNR), Pennsylvania (S5), Rhode Island (S4), South Carolina (SNR), Tennessee (S5), Vermont (S5), Virginia (S5), and West Virginia (S5) (NatureServe, accessed 3/11/2010).

Despite this rosy assessment, there appear to be problems in some areas. Urbanization has wiped out populations in portions of the Midwest and New England (Lannoo 2005); stream scouring [from rapid runoff], siltation, and loss

of ground cover are likely among the major reasons for low densities of this species in urban areas (Petranka 1998). Surface mining has been implicated in the elimination of Northern Dusky Salamanders from many small streams in portions of the Appalachian region (Petranka 1998). “Dusky salamanders are sensitive to stream pollution and siltation. Desmognathus fuscus larvae are absent from many streams draining coal strip mines in Kentucky and Tennessee… stream siltation and high metal concentrations appear to be the two primary factors in reducing or eliminating Desmognathus from these streams…” (Gore 1983). Perhaps the most disturbing recent report concerning this species has come from Acadia National Park in Maine: “We investigated and reviewed the current and historic distribution of Northern Dusky Salamanders in Acadia National Park (ANP)…during 1938-2003. Historical data indicated that Northern Dusky Salamanders were once widespread and common in ANP. We conducted intensive surveys for stream salamanders during 2000-2003 and observed only two adult Northern Dusky Salamanders on one stream. No eggs or larvae were observed…This investigation is the first to document the decline of a stream-dwelling amphibian species in a national park with widespread mercury contamination of its surface waters.” (Bank et al 2006). Another study coauthored by some members of this group (Bank, Crocker, Connery, and Amirbahman 2007) reported high levels of mercury in the tadpoles of green frogs and bullfrogs from several ponds within Acadia National Park. The source of the mercury is believed to be atmospheric deposition from solid waste

incinerators and other facilities upwind from the park.

S-Trend Decreasing

S-Trend Comment Decreasing in at least some sections of Kentucky. The Northern Dusky Salamander is being added to the Kentucky Wildlife Action Plan on the basis of documented population declines in the Mammoth Cave National Park region (MacGregor 2007) and large sections of the state impacted by surface mining (i.e. see Gore 1983), and suspected declines in Rowan and Elliott counties in northeastern Kentucky (MacGregor, unpublished data).

Barbour (1971) considered the Northern Dusky Salamander to be an abundant species in the state, writing that "…Nearly every little woodland stream in Kentucky supports a population." Data gleaned from numerous museum collections and biologists' field notes shows that this species has been documented from about 80 Kentucky counties and ranges across the state from the Cumberland River in Livingston, Lyon, and Trigg counties eastward to the Virginia and West Virginia borders. The only large gaps in the Kentucky range are in portions of the Bluegrass Region and Western Coal Field. West of the Cumberland River this species is replaced by the closely-related Spotted Dusky Salamander (Desmognathus conanti).

The best-documented decline in the Northern Dusky Salamander in Kentucky has taken place at Mammoth Cave National Park (MCNP), a 70,000-acre block of

land that has seen very little disturbance since the time that much of the area was purchased for protection in the 1930's. Museum specimens and field note records in MCNP files for this salamander from springs and spring-fed creeks within the park date back as far as 1929; many additional collections and observations were made through the 1930's and these salamanders continued to be found in abundance at least until 1961. In the early 1980's, Marilyn Hale, a graduate student at the University of Louisville, conducted an amphibian survey at

MCNP and was able to document Northern Duskies in very low numbers and at only two locations within the park (Hale 1984). More recently, MacGregor (2007) searched nearly every previously known Northern Dusky Salamander location within the park and was able to locate only a single specimen in a rocky spring in the head of Big Hollow – an area where the species had been seen abundantly in 1961. All of these springs and headwater streams that were surveyed still contain Southern Two-lined Salamanders (Eurycea cirrigera), Longtail Salamanders (E. longicauda), and Red Salamanders (Pseudotriton ruber)

but the Northern Dusky Salamanders have virtually disappeared. Other serious declines appear to have taken place in the areas near Morehead in northeastern Kentucky but the historic locality data is so vague that good documentation of population changes is difficult. Coal is largely absent from this region and there has been little or no mining activity.

Habitat / Life History

Barbour (1971) wrote that: "…they are far more abundant under the stones and logs along small woodland streams…springs and spring runs are commonly inhabited. Information from NatureServe (accessed 3/11/2010) described the habitat as follows: "Rock-strewn woodland streams, seepages, and springs…usually near running or trickling water…hides under leaves, rocks, or other objects in or near water, or in burrows. Eggs are laid near water under moss or rocks, in logs, and in stream-bank cavities. Larval stage usually aquatic."

Northern Dusky Salamanders remain fairly common in many areas in eastern Kentucky where there are rocky woodland streams that have not been severely impacted by coal mining and other mineral extraction activities.

Key Habitat

Carter County (along Cave Branch at Carter Caves State Resort Park).

Guilds

Caves, rock shelters, and clifflines, Forested wetland, Running water, Upland forest.

Statewide Map

Northern_Dusky_Salamander.pdf

Conservation Issues

Aquatic habitat degradation

2B Gravel/sand removal or quarrying (e.g., mineral excavation). Degradation of headwater stream habitat by gravel mining, stream channelization, agriculture and development, alteration or loss of springs and seeps, and valley fills. Adults and aquatic larvae are affected.

2E Stream channelization/ditching. Degradation of headwater stream habitat by gravel mining, stream channelization, agriculture and development, alteration or loss of springs and seeps, and valley fills. Adults and aquatic larvae are affected.

2F Riparian zone removal (Agriculture/development). Degradation of headwater stream habitat by gravel mining, stream channelization, agriculture and development, alteration or loss of springs and seeps, and valley fills. Adults and aquatic larvae are affected.

2I Periodic cessation or removal of spring flows or seeps. Degradation of headwater stream habitat by gravel mining, stream channelization, agriculture and development, alteration or loss of springs and seeps, and valley fills. Adults and aquatic larvae are affected.

2M Valley fills. Degradation of headwater stream habitat by gravel mining, stream channelization, agriculture and development, alteration or loss of springs and seeps, and valley fills. Adults and aquatic larvae are affected.

Biological/ consumptive uses

5H Isolated populations (low gene flow). Biological and consumptive factors likely to be affecting this species in Kentucky include low gene flow between isolated populations (particularly in the Bluegrass Region)

5L Parasitism and disease. Biological and consumptive factors likely to be affecting this species in Kentucky include emerging diseases such as chytrid fungus.

5O Bait collection. Bait collection may affect local populations but does not seem to be a major factor in the current decline.

Point and non-point source pollution

4A Acid mine drainage other coal mining impacts . Impacts to headwater

stream ecosystems from coal mining, oil and gas drilling, and highway runoff (deicing salts, etc.).

4D Oil and gas drilling operations associated runoff. Impacts to headwater stream ecosystems from coal mining, oil and gas drilling, and highway runoff (deicing salts, etc.).

4I Runoff from transportation routes (deicing salt, gas, others). Impacts to headwater stream ecosystems from coal mining, oil and gas drilling, and highway runoff (deicing salts, etc.).

Siltation and increased turbidity

1A Coal mining. Siltation and increased turbidity from coal mining, agriculture, road construction, urbanization, timber harvest, and certain recreational activities such as horseback riding and ATV use. Such activities can smother larvae in headwater streams.

1B Agriculture. Siltation and increased turbidity from coal mining, agriculture, road construction, urbanization, timber harvest, and certain recreational activities such as horseback riding and ATV use. Such activities can smother larvae in headwater streams.

1C Road construction. Siltation and increased turbidity from coal mining, agriculture, road construction, urbanization, timber harvest, and certain recreational activities such as horseback riding and ATV use. Such activities can smother larvae in headwater streams.

1D Urbanization/Development General Construction. Siltation and increased turbidity from coal mining, agriculture, road construction, urbanization, timber harvest, and certain recreational activities such as horseback riding and ATV use. Such activities can smother larvae in headwater streams.

1E Silviculture. Siltation and increased turbidity from coal mining, agriculture,

road construction, urbanization, timber harvest, and certain recreational activities such as horseback riding and ATV use. Such activities can smother larvae in headwater streams.

1F Recreational activities (atv, horseback riding). Siltation and increased turbidity from coal mining, agriculture, road construction, urbanization, timber harvest, and certain recreational activities such as horseback riding and ATV use. Such activities can smother larvae in headwater streams.

Terrestrial habitat degradation

3J Bridge/Highway construction/maintenance. Terrestrial habitat degradation in areas bordering headwater streams, springs, and seeps by road construction, – populations become fragmented and unique essential microhabitats such as springs and seeps are lost or degraded.

3K Surface mining. Terrestrial habitat degradation in areas bordering headwater streams, springs, and seeps by surface mining – populations become fragmented and unique essential microhabitats such as springs and seeps are lost or degraded.

3M Timber harvest. Terrestrial habitat degradation in areas bordering headwater streams, springs, and seeps by timber harvest, become fragmented and unique essential microhabitats such as springs and seeps are lost or degraded.

3P Pollution/toxicity (e.g., heavy metals, pesticides, herbicides, acid rain). Terrestrial habitat degradation in areas bordering headwater streams, springs, and seeps by various kinds of water pollution – populations become fragmented and unique essential microhabitats such as springs and seeps are lost or degraded.

3R Habitat and/or Population Fragmentation. Terrestrial habitat degradation in areas bordering headwater streams, springs, and seeps by cause populations

become fragmented and unique essential microhabitats such as springs and seeps are lost or degraded.

3U Loss, lack and degradation of special and unique microhabitats. Terrestrial habitat degradation in areas bordering headwater streams, springs, and seeps by cause populations become fragmented and unique essential microhabitats such as springs and seeps are lost or degraded.

Unknown factors/variables

7A Unknown threats. They nearly disappeared from springs and spring-fed creeks in the vicinity of Mammoth Cave National Park where they once could be found in abundance. Similar declines are suspected in NE Kentucky. The exact causes of these declines remain unknown.

CLASS Amphibia

Spotted Dusky Salamander ***Desmognathus conanti***

Federal Status	Heritage Status	GRank	SRank	GRank (Simplified)	SRank (Simplified)
N	N	G5T5	S3	G5	S3

G-Trend Stable

G-Trend Comment Apparently stable on a rangewide scale, but local declines in Spotted Dusky Salamander populations have been documented in some portions of the range. At the present time, the extensive contact zone between the Northern and Spotted Dusky Salamanders has not been thoroughly documented and the ranges of these two very similar species have not been completely worked out in many areas, including southern Illinois (Bonett 2002).

Spotted Dusky Salamanders occur in about 9 states, ranging from extreme southern Illinois (?) and western Kentucky southward and eastward into eastern Arkansas, Louisiana, Mississippi, Alabama, Georgia, and northwestern Florida (U.S. Geological Survey/National Amphibian Atlas, accessed 3/15/2010). Five state heritage programs within its range list this species as S5 as follows: Alabama (S5), Georgia (S5), Louisiana (S5), Mississippi (S5), and Tennessee (S5), but it is listed as an S1 species in Arkansas, S2 in Illinois, and S3 in Kentucky and is unranked in Florida (NatureServe, accessed 3/11/2010).

Populations along Crowley's Ridge in eastern Arkansas seem to have disappeared

(Lannoo 2005). Other local populations have been extirpated or reduced as a result of urbanization (near Atlanta, GA – Orser and Shure 1972) and stream siltation and sedimentation due to the effects of construction and farming (Petranka 1998). A recent study completed at Eglin Air Force Base in northwestern Florida (Means and Travis 2007) showed that Spotted Dusky Salamanders had declined in numbers by 68% between an early survey during 1969-1975 and a second survey of the same ravines by the same researcher in 1997-1998. Salamander capture rates in 26 ravines sampled both times fell from 13.56/hour during the initial survey to 4.66/hour during the follow-up study. During the same study, Southern Dusky Salamander (Desmognathus auriculatus) numbers fell from 8.65/hour to 0 – showing total extirpation – while catch per unit effort remained nearly unchanged between the survey periods for both the Southern Two-lined Salamander and Red Salamander. The areas surveyed for salamanders were forested ravines and steepheads that had not been logged or otherwise visibly disturbed between survey periods.

S-Trend Unknown

S-Trend Comment The Spotted Dusky Salamander is being added to the Kentucky Wildlife Action Plan due to its ecological similarity to the Northern Dusky Salamander, its limited range in our state that includes at least two small, isolated, fragile populations, and the unexplained declines that have occurred in other parts of the range (Crowley's Ridge in Arkansas and Eglin Air Force Base in Florida).

The Type Locality for the Spotted Dusky Salamander is a small unnamed spring-

fed stream located about 2 miles south of Smithland in Livingston County (Rossman 1958.

Spotted Dusky Salamanders are known from 7 counties in western Kentucky. The largest populations occur between the Cumberland and Tennessee Rivers in Livingston County, at Land Between the Lakes (LBL) in Lyon and Trigg counties,

and in the Blood River drainage in southeastern Calloway County. Additional populations are scattered and isolated; a colony occurs in the Terrapin Creek drainage in Graves County near the Calloway County line; another occupies several small springs near the Tennessee River in northeastern McCracken County; and a small colony occupies seepage habitats near Laketon in Carlisle County. The McCracken County and Carlisle County populations appear to be very vulnerable to extirpation. A formerly healthy population of Spotted Dusky Salamanders inhabiting a spring-fed woodland stream on the west side of LBL was eliminated during the relocation and reconstruction of highway 68/80 during 2008-2009 (JRM, personal observation).

Habitat / Life History

Populations in Livingston, Lyon, and Trigg counties occupy small rocky spring-fed creeks in forested habitats. Populations along the Blood River and Terrapin Creek occur in cold springs, seeps, and lowland spring-fed streams along the floodplain in close association with another SWAP species, the Three-lined Salamander (Eurycea guttolineata). Extensive logging activity north of Grubbs Road in Calloway County in the mid-2000's resulted in extensive sediment deposits at some downstream locations. The imperiled McCracken County

colony occupies at least 2 small gravelly streams within the city limits of Paducah. The highly imperiled Carlisle County colony occurs in seepage habitat at the base of the loess bluffs bordering the Mississippi River floodplain near Laketon (MacGregor, unpublished data).

Key Habitat Generally Good at LBL since Forest Service management will likely maintain forest cover along headwater streams. Fair in Blood River area and Terrapin Creek where sites are vulnerable to activities on private lands nearby. Poor in McCracken and Carlisle counties where colonies are small and isolated.

Guilds Forested wetland, Running water, Upland forest.

Statewide Map Spotted_Dusky_Salamander.pdf

Conservation Issues

Aquatic habitat degradation

2B Gravel/sand removal or quarrying (e.g., mineral excavation). Degradation of headwater stream habitat by gravel mining, stream channelization, agriculture and development, and alteration or loss of springs and seeps. Adults and aquatic larvae are affected.

2E Stream channelization/ditching. Degradation of headwater stream habitat by gravel mining, stream channelization, agriculture and development, and alteration or loss of springs and seeps. Adults and aquatic larvae are affected.

2F Riparian zone removal (Agriculture/development). Degradation of headwater stream habitat by gravel mining, stream channelization, agriculture and development, and alteration or loss of springs and seeps. Adults and aquatic larvae are affected.

2I Periodic cessation or removal of spring flows or seeps. Degradation of headwater stream habitat by gravel mining, stream channelization, agriculture and development, and alteration or loss of springs and seeps. Adults and aquatic larvae are affected.

Biological/ consumptive uses

5H Isolated populations (low gene flow). Biological and consumptive factors likely to be affecting this species in Kentucky include low gene flow between isolated populations (particularly in Carlisle, Graves, and McCracken counties)

5L Parasitism and disease. Biological and consumptive factors likely to be affecting this species in Kentucky include emerging diseases such as chytrid fungus.

5O Bait collection. Bait collection may be affecting some populations but does

not seem to be a major factor in the current decline.

Point and non-point source pollution

4I Runoff from transportation routes (deicing salt, gas, others). Impacts to headwater stream ecosystems from highway runoff (deicing salts, etc.).

Siltation and increased turbidity

1B Agriculture. Siltation and increased turbidity from agriculture, road construction, timber harvest, and certain recreational activities such as horseback riding and ATV use. Such activities can smother larvae in headwater streams.

1C Road construction. Siltation and increased turbidity from agriculture, road construction, timber harvest, and certain recreational activities such as horseback riding and ATV use. Such activities can smother larvae in headwater streams.

1E Silviculture. Siltation and increased turbidity from agriculture, road construction, timber harvest, and certain recreational activities such as horseback riding and ATV use. Such activities can smother larvae in headwater streams.

1F Recreational activities (atv, horseback riding). Siltation and increased turbidity from agriculture, road construction, timber harvest, and certain recreational activities such as horseback riding and ATV use. Such activities can smother larvae in headwater streams.

Terrestrial habitat degradation

3J Bridge/Highway construction/maintenance. Terrestrial habitat degradation in areas bordering headwater streams, springs, and seeps by road construction. Road construction has recently eliminated an excellent site at LBL.

3M Timber harvest. Terrestrial habitat degradation in areas bordering headwater

streams, springs, and seeps by timber harvest– populations become fragmented and unique essential microhabitats such as springs and seeps are lost or

3P Pollution/toxicity (e.g., heavy metals, pesticides, herbicides, acid rain). Terrestrial habitat degradation bordering headwater streams, springs, and seeps by road construction, timber harvest, and agricultural runoff – populations become fragmented and unique essential microhabitats such as springs and seeps are lost/degraded

3R Habitat and/or Population Fragmentation. Terrestrial habitat degradation bordering headwater streams, springs, and seeps by road construction, timber harvest, and agricultural runoff – populations become fragmented and unique essential microhabitats such as springs and seeps are lost/degraded

3U Loss, lack and degradation of special and unique microhabitats. Terrestrial habitat degradation bordering headwater streams, springs, and seeps by road construction, timber harvest, and agricultural runoff – populations become fragmented and unique essential microhabitats such as springs and seeps are lost/degraded

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