

**Species in the *Ex Situ* Research Role**

**43 species**

Species currently undergoing, or proposed for specific applied research that directly contributes to the conservation of the species, or a related species, in the wild (this would include clearly defined 'model' or 'surrogate' species).

Species	Extinction Risk	Founders available	Biological Distinctiveness	Threat mitigation	Husbandry Analogue	<i>Ex situ</i> research	Captive breeding
<i>Ambystoma bishopi</i>	Vulnerable (VU)	Yes	No aspect of biology known to be exceptional	Threats cannot/will not be reversed in time	Yes	Yes	Maintained but no successful breeding
<p>May qualify as endangered; Dodd - ongoing studies by Fla F&amp;GC; Dodd - protection is Eglin AFB &amp; Apalachicola WA; Barber - Jacksonville Zoo has plans to reintroduce in future; Dodd/Barrett - threats are climate change (droughts) and no one else is filling breeding ponds (Barrett - mitigation - habitat loss/ increased connectivity/landscape level occupancy/fill ponds). Barrett - so few populations left, expect difficult to resolve issue. Dodd - analog for <i>cingulatum</i> (which is even more critical); Dodd - education (attractiveness, habitat, regional endemic); natural history lacking</p>							
<i>Ambystoma cingulatum</i>	Vulnerable (VU)	Unknown	No aspect of biology known to be exceptional	Threats cannot/will not be reversed in time	No	Yes	Maintained but no successful breeding
<p>Dodd - possibly extinct in SC/GA, but FL populations known extant in last two years; Barrett - not seen in GA in more than a decade; Bishop is an analog for this species.; All - regional species awareness and threat awareness would be beneficial similar to small range species, Range state approval (Barrett - no in GA, Dodd - FL is ?, and Riverbanks were wild caught, so potentially possible). Natural history lacking</p>							
<i>Cryptobranchus alleganiensis</i>	Vulnerable (VU)	Yes	Aspect of biology shared with <6 other species	Threats are reversible in time frame	No	Yes	Yes bred to F1
<p><i>bishopi</i> needs to be pulled out as a full species and has been federally listed as Endangered (Weir said check with Jeff Briggler in Missouri) and the eastern populations are not doing well either; Phillips - St Louis Zoo has noted the captive issue low sperm motility (water quality issues per Mark Wanner); unique based on phylogenetic uniqueness and is large (3rd largest salamander species); cultural history high profile in Appalachia &amp; Ozarks - All; historically collected/eradicated - now elevated to Appendix 1 to reduce this; <i>C. allagenensis</i> is a good analog for <i>bishopi</i>; educate fishermen that they do not compete for fish/shouldn't be killed during gigging practices per Phillips; phylogenetics still inconclusive per Phillips. Low sperm motility; disease issues; plasticizers/pollutants in stream waters; Subspecies <i>bishopi</i> may require varied/different management recommendations based on more restrictive range.</p>							
<i>Eurycea rathbuni</i>	Vulnerable (VU)	Yes	Aspect of biology shared with <6 other species	Threats are reversible in time frame	Yes	Yes	Yes bred to F2

Species	Extinction Risk	Founders available	Biological Distinctiveness	Threat mitigation	Husbandry Analogue	Ex situ research	Captive breeding
	Chippendale/Gluesenkamp/Chamberlin - southern Edwards' Plateau, lives under the range of nana; potential habitat reintroduction at Wonder Cave (part of natural range); exceptionally extreme troglolbite in Amphibia (more than olm in our opinion!); cultural - on beer/wine, research ; analog for waterlooensis and robusta; Education for Edwards Aquifer biodiversity (flagship) Research required into environmental contamination; developmental biology; eye development.						
<i>Dicamptodon ensatus</i>	Near Threatened (NT)	Yes	No aspect of biology known to be exceptional	Threats are being managed	No	No	Maintained but no successful breeding
	Incidental threat mitigation as a result of fish population management (salmon); use locally as ambassador for salamanders.						
<i>Necturus alabamensis</i>	Endangered (EN)	Yes	No aspect of biology known to be exceptional	Threats are reversible in time frame	No	No	Maintained but no successful breeding
	Keyster keeping them (using beyeri as an analog) with intention of program.						
<i>Rhyacotriton kezeri</i>	Near Threatened (NT)	Yes	No aspect of biology known to be exceptional	Threats are being managed	No	No	Not held in captivity to date
	Hassock - streamside buffer laws in WA.						
<i>Phaeognathus hubrichti</i>	Endangered (EN)	Yes	No aspect of biology known to be exceptional	Threats are reversible in time frame	No	Yes	Maintained but no successful breeding
	Local regional species - increase awareness of its fossorial presence. Natural history data lacking.						
<i>Necturus lewisi</i>	Near Threatened (NT)	Yes	No aspect of biology known to be exceptional	Threats are reversible in time frame	No	No	Not held in captivity to date
	Lannoo - accumulates PCB toxins; rapidly urbanizing areas (siltation, etc.) per Dodd.						
<i>Lithobates areolatus</i>	Vulnerable (VU)	Yes	Aspect of biology shared with <6 other species	Threats are reversible in time frame	No	No	Not held in captivity to date
	Lannoo - one of the most secretive frogs in NA, undergoing a recent & precipitous decline; Obligate requires another species makes it biologically exceptional - All; cryptic species for grassland and conservation efforts for education; Lannoo - state endangered in IN and IA, and special concern in KS, few populations throughout rest of range.						
<i>Necturus maculosus</i>	Least Concern (LC)	Yes	Aspect of biology shared with <6 other species	Species does not require conservation action	Yes	No	Yes bred to F1
	Analog for genus Necturus, especially alabamensis ; host to a freshwater mussel (Glocidia sp.); introduced into Conn. River (Weir); commercially valuable for scientific industry; education value for awareness of genus.						

Species	Extinction Risk	Founders available	Biological Distinctiveness	Threat mitigation	Husbandry Analogue	Ex situ research	Captive breeding
<i>Rhyacotriton olympicus</i>	Vulnerable (VU)	Yes	No aspect of biology known to be exceptional	Species is effectively protected	No	No	Maintained but no successful breeding
	Hassock - park surrounded by managed timberland so effectively managed; lowest thermal tolerance of any species.						
<i>Rana muscosa</i>	Endangered (EN)	Yes	No aspect of biology known to be exceptional	Threats are reversible in time frame	Yes	Yes	Yes bred to F1
	Becklin - species was split in 2007 into sierrae (southern) & muscosa (northern range); largest declines in muscosa is federally endangered in CA, but the rest of the range is; sierrae is state listed and candidate for federal listing (Grow); main threat is Bd and invasive species; already in captivity with husbandry in progress, so can be used as an analog for other high elevation ranid species (cascase and sierrae); education for species awareness support for conservation of species. Biocontrol for chytrid fungus.						
<i>Rana sierrae</i>	Endangered (EN)	Yes	No aspect of biology known to be exceptional	Threats are reversible in time frame	No	Yes	Maintained but no successful breeding
	Becklin - translocations to a novel site within range; Vredenburg has had them in the lab for a while; education for species awareness support for conservation of species.						
<i>Spea hammondi</i>	Near Threatened (NT)	Yes	Aspect of biology shared with <6 other species	Threats are reversible in time frame	No	No	Maintained but no successful breeding
	Becklin - being held by many private individuals.						
<i>Urspeleperes brucei</i>	Endangered (EN)	Yes	No aspect of biology known to be exceptional	Threats are reversible in time frame	No	Yes	Maintained but no successful breeding
	Newly recognized species; extremely rare - highly endangered; known an 8.5km <sup>2</sup> area in Stephens Co., GA and Oconee Co, SC; stream dwellers. (Post workshop: I have a small group of Urspeleperes brucei at home, also recently collected (still bait in GA). They are doing well, though most are larvae. Todd Pierson and Carlos Camp are analyzing eDNA samples as we speak and hopefully with detect a broader distribution. Tim Herman, pers. comm. Oct 2013). Natural history and reproduction.						
<i>Amphiuma pholeter</i>	Near Threatened (NT)	Yes	No aspect of biology known to be exceptional	Threats are reversible in time frame	No	Yes	Maintained but no successful breeding
	Phillips - basic life history lacking; phylogenetics have been completed. (1) animal in captivity at Philly Zoo per ISIS. Natural history lacking.						
<i>Pseudacris illinoensis</i>	Near Threatened (NT)	Yes	Aspect of biology shared with <6 other species	Threats are reversible in time frame	No	No	Not held in captivity to date
	Exceptional because it uses forelimbs for burrowing (only 4 species including streckeri and two in Africa).						

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<i>Rhyacotriton cascadae</i>	Near Threatened (NT)	Yes	No aspect of biology known to be exceptional	Species is effectively protected	No	No	Not held in captivity to date
<i>Lithobates capito</i>	Vulnerable (VU)	Yes	No aspect of biology known to be exceptional	Threats are reversible in time frame	Yes	No	Maintained but no successful breeding
	Analog for <i>L. sevosa</i> ; captive reared, but no knowledge of being bred within group; life-cycle education for species awareness; Lannoo - in process for being petitioned.						
<i>Lithobates chiricahuensis</i>	Vulnerable (VU)	Yes	No aspect of biology known to be exceptional	Threats are reversible in time frame	No	Yes	Yes bred to F1
	Barber - suggests that this species be re-evaluated fully; education - local awareness for conservation efforts (in place). Disease research - peptide and husbandry research.						
<i>Eurycea sosorum</i>	Vulnerable (VU)	Yes	No aspect of biology known to be exceptional	Threats are reversible in time frame	Yes	Yes	Yes bred to F2
	Chippendale/Gluesenkamp/Chamberlain - southern Edwards' Plateau; impervious cover limits within county; cultural - locally recognized species; analog for others within southern complex; needs more outreach to help awareness (water quality, species issues). Natural history; water quality.						
<i>Eurycea tonkawae</i>	Vulnerable (VU)	Yes	Aspect of biology shared with <6 other species	Threats are reversible in time frame	No	Yes	Yes bred to F1
	Chippendale/Gluesenkamp/Chamberlain - northern Edwards' Plateau; Scientifically important - skeletal resorption (hormone leptin impacting osteoporosis), which may make it exceptional as it's only one known to shrink/grow on own.						
<i>Desmognathus wrighti</i>	Near Threatened (NT)	Yes	No aspect of biology known to be exceptional	Threats are reversible in time frame	Yes	No	Yes bred to F1
	Dodd - climate change potential impacts; Dodd - and could have been broken up into two species (northern - aka <i>D. organi</i> and southern as <i>D. wrighti</i> ); analog for <i>organi</i> . (Post workshop: I do know that <i>D. wrighti</i> was bred by a hobbyist, and I recently collected a small group to work with at home. I've bred <i>D. aeneus</i> at home for several generations and from what I've heard the care is similar. They are syntopic at one site in Macon Co., NC. Tim Herman, pers. comm. Oct 2013).						
<i>Spea bombifrons</i>	Least Concern (LC)	Yes	Aspect of biology shared with <6 other species	Species does not require conservation action	Yes	No	Maintained but no successful breeding
	Lannoo - difficult to detect; Lannoo - has cannibalistic morphs triggered by high density (in <i>Spea</i> only, not <i>Scaphiopus</i> ) makes exceptional; analog for other <i>Spea</i> - life history (cannibalism).						
<i>Ambystoma tigrinum</i>	Least Concern (LC)	Yes	No aspect of biology known to be exceptional	Species does not require conservation action	Yes	No	Yes bred to F2

Species	Extinction Risk	Founders available	Biological Distinctiveness	Threat mitigation	Husbandry Analogue	Ex situ research	Captive breeding
	Lannoo - split into malvortium (westerns), but both species ar Dodd - reintroduced into NJ/ MD barrowpit project is questionable; Crump - deliberate reintroductions across range. Dodd - cannibalistic paedomorphs alternative life history strategy (fewer than 10-20 species worldwide); Dodd - bait species (Poole - disease spread potential); Barber - use as analog for mexicanum; All - education potential: invasive species, large charismatic.						
<i>Dicamptodon tenebrosus</i>	Least Concern (LC)	Yes	No aspect of biology known to be exceptional	Species does not require conservation action	Yes	No	Maintained but no successful breeding
	Analog for ensatus; education - locally as ambassador for larger salamander.						
<i>Amphiuma means</i>	Least Concern (LC)	Yes	No aspect of biology known to be exceptional	Species does not require conservation action	Yes	Yes	
	Phillips - basic life history lacking; phylogenetic work is completed; used as analog for pholeter. Natural history lacking.						
<i>Amphiuma tridactylum</i>	Least Concern (LC)	Yes	No aspect of biology known to be exceptional	Species does not require conservation action	Yes	Yes	Maintained but no successful breeding
	Phillips - basic life history lacking; phylogenetic work is completed; used as analog for pholeter. Natural history lacking.						
<i>Rhyacotriton variegatus</i>	Least Concern (LC)	Yes	No aspect of biology known to be exceptional	Species does not require conservation action	Yes	No	Not held in captivity to date
	Hassock - analog for all other Rhyactriton.						
<i>Anaxyrus boreas</i>	Near Threatened (NT)	Yes	No aspect of biology known to be exceptional	Threats are reversible in time frame	Yes	No	Yes bred to F2
	Dodd - some populations found by Richard Tracy (UN - Reno) to expand range; in decline in south and east due to Bd; Analog for exsul; Glusenc - widely recognized as flagship for range (manageable); mandates are state specific.						
<i>Eurycea spelaea</i>	Near Threatened (NT)	Yes	Aspect of biology identified that is unique to species	Threats are reversible in time frame	No	No	Maintained but no successful breeding
	Exceptional because noted recently to consume bat guano - so only coprophagic amphibian! Larval are surface and go back into caves as adults (and grow skin over eyes to protect them during life above ground); threats are water quality and non-native fish predators; this species may be split up per Chippendale.						
<i>Eurycea robusta</i>	Data Deficient (DD)	Yes	Aspect of biology shared with <6 other species	Threats are reversible in time frame	No	No	Not held in captivity to date
	Chippendale/Gluesenkamp/Chamberlin - southern Edwards' Plateau; known from very few specimens which hasn't been seen in a while; exceptional because of extreme troglobitism.						

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<i>Eurycea wallacei</i>	Vulnerable (VU)	Yes	Aspect of biology shared with <6 other species	Threats are reversible in time frame	No	Yes	Maintained but no successful breeding
<p>Weir - noted genus has been updated to Haideotriton, but it may not be recognized; Dodd - one of the blind group makes it exceptional; Education - local awareness campaign. Life history research (Dante Fenolio at Atlanta Botanical Gardens).</p>							
<i>Gyrinophilus porphyriticus</i>	Least Concern (LC)	Yes	No aspect of biology known to be exceptional	Species does not require conservation action	Yes	Yes	Yes bred to F1
<p>Kast - bred at Toledo but listed in ISIS under their subspecies; has been added for review by FWS as Endangered species status (Barber) - which will require full recovery plan; education - local awareness campaign will only help species recover (All); analog for palleucus and subterraneous. (Post workshop: Toledo has never bred Gyrinophilus. We have maintained them for many years, but I still do not know how to sex them without possibly anesthetizing and examining the cloacal lining. So we may not even have sexual pairs. I am not aware of any successful captive reproduction with the genus. Tim Herman, pers. comm. Oct 2013). Natural history lacking in genera.</p>							
<i>Anaxyrus americanus</i>	Least Concern (LC)	Yes	No aspect of biology known to be exceptional	Species does not require conservation action	Yes	No	Yes bred to F2
<p>Analog for many other toad species (i.e., Wyoming); historical use as scientific research species.</p>							
<i>Anaxyrus hemiophrys</i>	Least Concern (LC)	Yes	No aspect of biology known to be exceptional	Species does not require conservation action	Yes	No	Maintained but no successful breeding
<p>Chippendale: distribution is fairly patchy in Canada and most probably fall outside of protected areas. Possibly habitat for reintroduction, butt not sure. A good person to ask would be David Green at McGill University/Redpath Museum in Montreal; analog for baxteri (for husbandry techniques).</p>							
<i>Batrachoseps attenuatus</i>	Least Concern (LC)	Yes	No aspect of biology known to be exceptional	Species does not require conservation action	Yes	No	Maintained but no successful breeding
<p>Adam - ask David Wake/Hansen/Sam Sweet (threats/pop status?); (2) held at Vancouver Aquarium; Barber - use as analog for Batrachoseps since already in captivity.</p>							
<i>Eurycea chisholmensis</i>	Vulnerable (VU)	Yes	No aspect of biology known to be exceptional	Threats are reversible in time frame	No	Yes	Maintained but no successful breeding

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	Chippendale/Gluesenkamp/Chamberlain - known from (6) populations per Gluesenkamp; This Genera can also be considered so tied to its localized habitat such that they would only displace another of the same genus if introduced in other nearby areas (so reintroduction may not be warranted unless they were originally known from those springs); Dallas Zoo has them but has not had breeding success yet; Education might help with awareness (Gluesenkamp has attempted for past 3 years, but needs more help). Chippendale - this is part of the northern group from Edwards plateau. Husbandry and natural history research with assurance colony.						
<i>Eurycea nana</i>	Vulnerable (VU)	Yes	No aspect of biology known to be exceptional	Threats are reversible in time frame	Yes	Yes	Yes bred to F2
	Chippendale/Gluesenkamp/Chamberlain - southern Edwards' Plateau; analog for the southern clade complex; education for flagship spring species within range (endangered plants, inverts, fish, salamanders all on university property); bred heavily at San Marcos Fed. Fish Hatchery. Natural history data; thermal tolerances; hormonal.						
<i>Eurycea neotenes</i>	Vulnerable (VU)	Yes	No aspect of biology known to be exceptional	Threats are reversible in time frame	Yes	Yes	Yes bred to F2
	Chippendale/Gluesenkamp/Chamberlain - Dallas Zoo bred this species and at San Marcos Fed Fish Hatchery so would make good analog for the southern clade complex; southern Edwards' Plateau.						
<i>Taricha granulosa</i>	Least Concern (LC)	Yes	No aspect of biology known to be exceptional	Species does not require conservation action	Yes	No	Maintained but no successful breeding
	Philips - have tetrodotoxin (TTD); analog for Taricha; diurnal, toxins, behaviors make good education species.						
<i>Plethodon jordani</i>	Near Threatened (NT)	Yes	No aspect of biology known to be exceptional	Species is effectively protected	Yes	Yes	Yes bred to F1
	Dodd - threats are climate change and forest change (i.e. woody adelgid, etc.); introduced into Maine unsuccessfully as part of an ecological in 1960s; iconic/flagship species for Great Smoky Mountains park (iconic - on T-shirts, mugs, key chains, etc.) and Appalachian salamanders; analog for rest of the jordani complex (isolated mountaintop) species. (Post workshop: A hobbyist in Detroit posted photos of his P. jordani that reproduced in captivity for him. Unfortunately they are quite illegal, regardless of where he obtained them. In any case, it is possible. Tim Herman, pers. comm. Oct 2013). Climate change impacts (i.e. soil acidification from acid rain) for mountaintop species.						