

Conservation Needs Assessment Workshop for Threatened Guatemalan Amphibian Species



WORKSHOP REPORT



Photo © José Renato Morales

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Conservation Needs Assessment Workshop Report for Threatened Guatemalan Amphibian Species

2024

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2024

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Abbreviations

AArk	Amphibian Ark
ARNPG	Association of Private Natural Reserves of Guatemala (from its Spanish acronym)
ASA	Amphibian Survival Alliance
ASG	Amphibian Specialist Group
CNA	Conservation Needs Assessment
CONAP	National Council of Protected Areas of Guatemala (from its Spanish acronym)
CPSG	Conservation Planning Specialist Group
CR	Critically Endangered
DD	Data Deficient
EN	Endangered
IUCN	International Union for the Conservation of Nature
NT	Near Threatened
RNP	Private Natural Reserve (from its Spanish acronym)
SOTWA	State of the World's Amphibians
SSC	Species Survival Commission
USAC	Universidad de San Carlos de Guatemala
UVG	Universidad del Valle de Guatemala
VU	Vulnerable
WAZA	World Association of Zoos and Aquariums

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Executive Summary

There are 162 amphibian species described for Guatemala, but 60% are threatened with extinction. This positions the country in second place for threatened amphibians in the entire neotropics.

One of the tools in the species conservation toolbox is the *ex situ* management and breeding of threatened species. This supports the eventual reintroduction in suitable habitats, helping to restore populations in the wild.

Amphibian Ark, along with the Universidad del Valle de Guatemala, organized a workshop to assess the conservation needs of threatened Guatemalan amphibians. Ten Guatemalan field amphibian biologists participated. As a result of this workshop, 22 species were identified as in urgent need of the establishment of an *ex situ* conservation program within the country.

Bolitoglossa helmrichi
© Alejandra Zamora

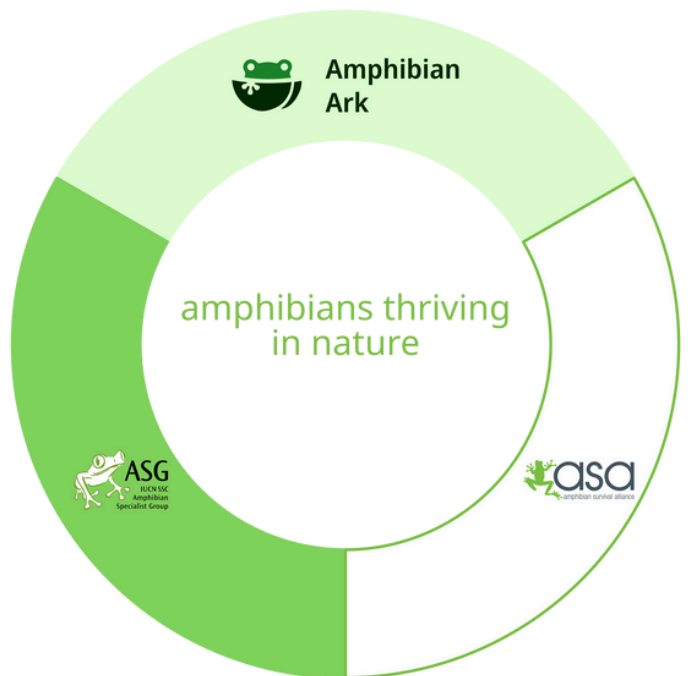
Amphibian Ark

Rescuing amphibians in crisis

Amphibian Ark (AArk) is a non-profit organization founded in 2007 by the IUCN Species Survival Commission's (SSC) specialist groups: the Amphibian Specialist Group (ASG) and the Conservation Planning Specialist Group (CPSG), in partnership with the World Association of Zoos and Aquariums (WAZA).

Our mission is to rescue amphibians in crisis, saving species that cannot currently be safeguarded in nature. At AArk we work to secure a future for those amphibian species likely to become extinct before their natural environment can be made safe for them again. For those species, we help set up *ex situ* assurance programs so that when it is safe to do so, they can be released back into the wild.

We collaborate closely with our sister organizations: the IUCN SSC Amphibian Specialist Group (ASG) and the Amphibian Survival Alliance (ASA). Together, the three organizations aim to amplify amphibian conservation efforts around the world, to achieve our shared vision: amphibians thriving in nature.



Cryptotriton veraepacis
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The Conservation Needs Assessment Process

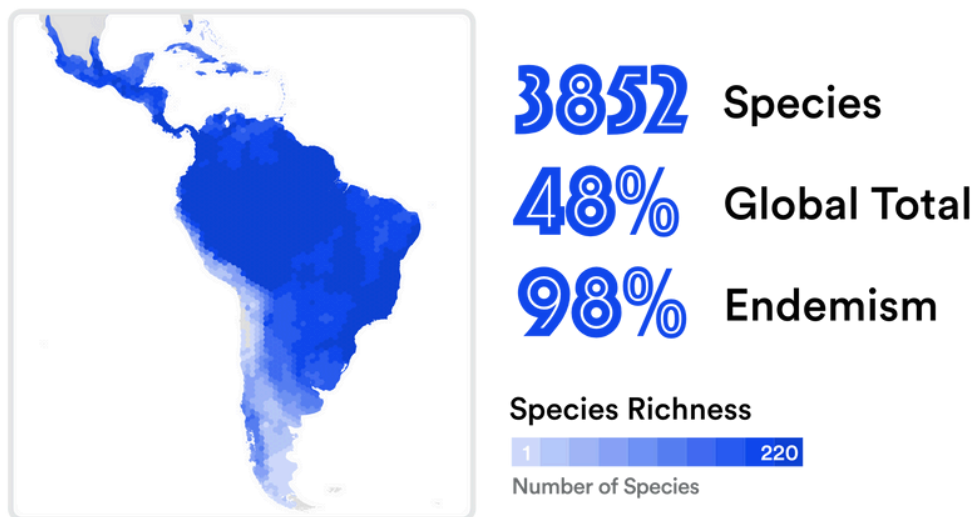
The Conservation Needs Assessment (CNA) process developed by AArk uses current knowledge of species in the wild to determine those with the most urgent conservation needs. It provides a basis for the development of holistic conservation action plans that combine *in situ* and *ex situ* actions, as appropriate. These assessments allow us to maximize the impact of limited conservation resources by identifying which measures could best serve those species that require assistance.



Plectrohyla hartwegi
© José Renato Morales

Amphibian Conservation Overview

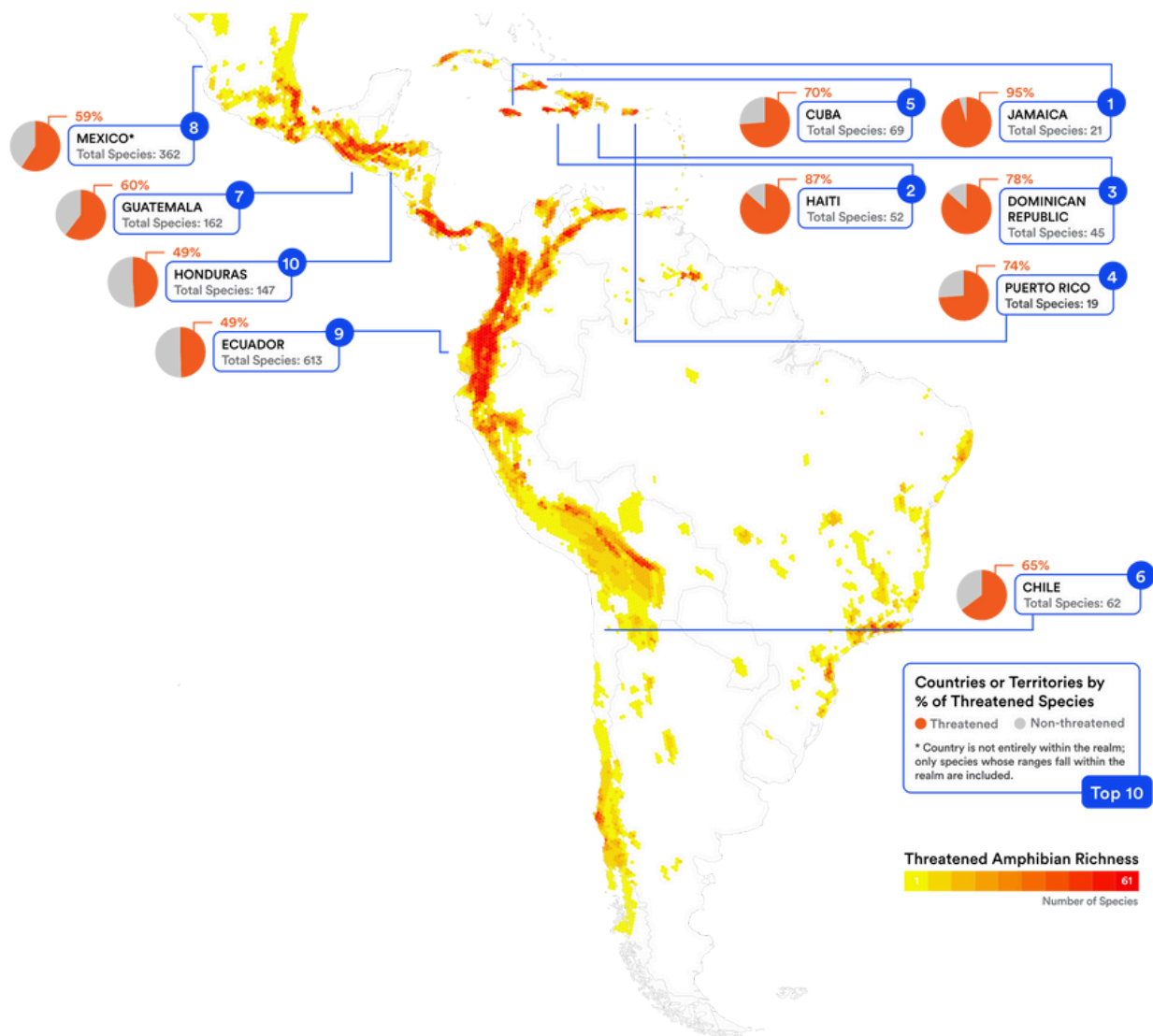
41% of amphibians—that is, two out of every five species—are threatened with extinction. This makes it the most endangered group of vertebrates worldwide. Out of the three groups that compose amphibians—frogs and toads, salamanders, and caecilians—salamanders are the most threatened (60%).



Amphibian species richness in the Neotropics. Extracted from: Re:wild, Synchronicity Earth, IUCN SSC Amphibian Specialist Group. 2023. [State of the World's Amphibians: The Second Global Amphibian Assessment](#). Texas, USA: Re:wild

According to the [International Union for Conservation of Nature](#), 162 amphibian species have been described in Guatemala. Unfortunately, 60% of these species are threatened with extinction, placing the country in second place for threatened amphibians in the entire neotropics. Further, two species are now considered extinct in the country: *Craugastor myllomyllon* and *Pseudoeurycea expectata*. A number of other species have not been seen since the 1980s.

According to the [State of the World's Amphibians \(SOTWA\)](#), habitat loss and degradation are the main threats to amphibians and affect more than 2,600 (93%) of threatened species. Another major threat to amphibians is climate change. Amphibians are ectotherms with moist, highly permeable skin and depend on the availability of water to survive. Hence, they are particularly sensitive to changes in humidity and temperature. Climate change can also exacerbate other threats, such as fires, diseases, or invasive species, thus compounding the impacts.



Countries of Latin America and the Caribbean by percentage of threatened amphibian species. Extracted from: Re:wild, Synchronicity Earth, IUCN SSC Amphibian Specialist Group. 2023. [State of the World's Amphibians: The Second Global Amphibian Assessment](#). Texas, USA: Re:wild

There are several urgent actions we can take to help amphibians:

- Develop large-scale multi-institutional collaborations for amphibian research and protection.
- Establish environmental management practices that allow a more harmonious coexistence between amphibians, their habitats, and people.
- Establish or expand conservation breeding programs, incorporating biobanks and assisted reproduction technologies, to safeguard against extinction and allow future reintroductions and translocations.



Plectrohyla ixil
© José Renato Morales

Conservation Needs Assessment Workshop

From July 1st to July 3rd 2024, a group of Guatemalan amphibian researchers met together with an AArk facilitator to carry out the Conservation Needs Assessments for 98 species considered threatened in Guatemala. The workshop was held at the School of Biology of the Universidad del Valle de Guatemala.

The results obtained in this workshop are summarized in this table:

Recommended Conservation Actions*	No. of species
Ark	0
Rescue	47
<i>In situ</i> conservation	96
<i>In situ</i> research	98
Husbandry research	8
Applied <i>ex situ</i> research	2
Mass production	0
Education	38
Supplementation	0
Biobank	47
None	0

*The explanation of each conservation action is described on the Appendix

Species Recommended for Rescue

As mentioned before, AArk focuses its efforts on rescuing amphibians that cannot currently be safeguarded in the wild. We do this through supporting *ex situ* conservation programs, training, and assessments. Ideally, an *ex situ* initiative should be temporary and seen as only one of the tools that can assist in the conservation of a species. Therefore, strong links between *ex situ* and *in situ* components are critical to the long-term success of species conservation.

The 11 species identified for Guatemala by the CNA tool for the development of *ex situ* conservation programs that: (1) have enough individuals in nature (*in situ*) that can be used as parents of the program, (2) that are clear biological units, and (3) have protected habitat where they can eventually be reintroduced are described in the following pages.



Bolitoglossa kaqchikelorum
© José Renato Morales

Craugastor inachus**Distribution**

From the middle of the Motagua Valley and associated areas in central and eastern Guatemala.

Protected area for reintroduction:

Reserva Privada Heloderma para la Conservación del Bosque Seco

Assessment

***Bolitoglossa daryorum*****Distribution**

Endemic to the Sierra de las Minas.

Protected area for reintroduction:

Reserva de la Biosfera Sierra de las Minas and Refugio Universitario Mario Dary Rivera para la conservación del Quetzal

Assessment

***Bolitoglossa engelhardti*****Distribution**

From the southeastern tip of Chiapas, Mexico, along the Pacific slope to Volcano Atitlán, southwest of Guatemala.

Protected area for reintroduction:

Parque Regional Municipal San Rafael Pie de La Cuesta

Assessment

***Bolitoglossa flavimembris*****Distribution**

Slopes of Tacaná Volcano in Chiapas, Mexico, and mountains along the SW plateau of Guatemala.

Protected area for reintroduction:

Parque Regional Municipal San Rafael Pie de La Cuesta and Zonas de Veda Definitiva Volcanoes Tajumulco and Lacandón.

Assessment



Bolitoglossa kaqchikelorum**Distribution**

Eastern end of the Guatemalan plateau, including the highlands bordering the western side of Guatemala City and near Antigua.

Protected area for reintroduction:

Reserva Forestal Protectora de Manantiales Cordillera Alux and Zona de Veda Definitiva del Volcán de Agua.

Assessment***Bradytriton silus*****Distribution**

Vicinity of the type locality (Finca Chiblac), on the eastern slopes of the Sierra de los Cuchumatanes and Finca Ixcansan near Yalambojoch.

Protected area for reintroduction:

Reserva Natural Privada Yal Unin Yul Witz.

Assessment***Bolitoglossa franklini*****Distribution**

Pacific border of Chiapas (MX), SE of the Pacific slope of Guatemala to Atitlán Volcano. Tajumulco Volcano NP & Refugio del Quetzal San Marcos, Guatemala.

Protected area for reintroduction:

RNP Estación Científica Refugio del Quetzal - Volcán Atitlán and RNP Finca El Vergel

Assessment***Bolitoglossa morio*****Distribution**

It is known from much of the plateau region of Guatemala, from several of the Pacific volcanoes, and from the Las Nubes mountain block.

Protected area for reintroduction:

Reserva Natural Privada El Espinero.

Assessment

Bolitoglossa salvinii**Distribution**

Upper coastal plain on the Pacific slope of southern Guatemala.

Protected area for reintroduction:

Reserva Natural Privada Finca Patrocinio, El Palmar, Quetzaltenango and Reserva Natural Privada Oná, El Quetzal, San Marcos.

Assessment***Pseudoeurycea rex*****Distribution**

Sierra de los Cuchumatanes and the southwestern highlands.

Protected area for reintroduction:

Bosque Regional Municipal Todos Santos, Cuchumantanes.

Assessment***Bolitoglossa mulleri*****Distribution**

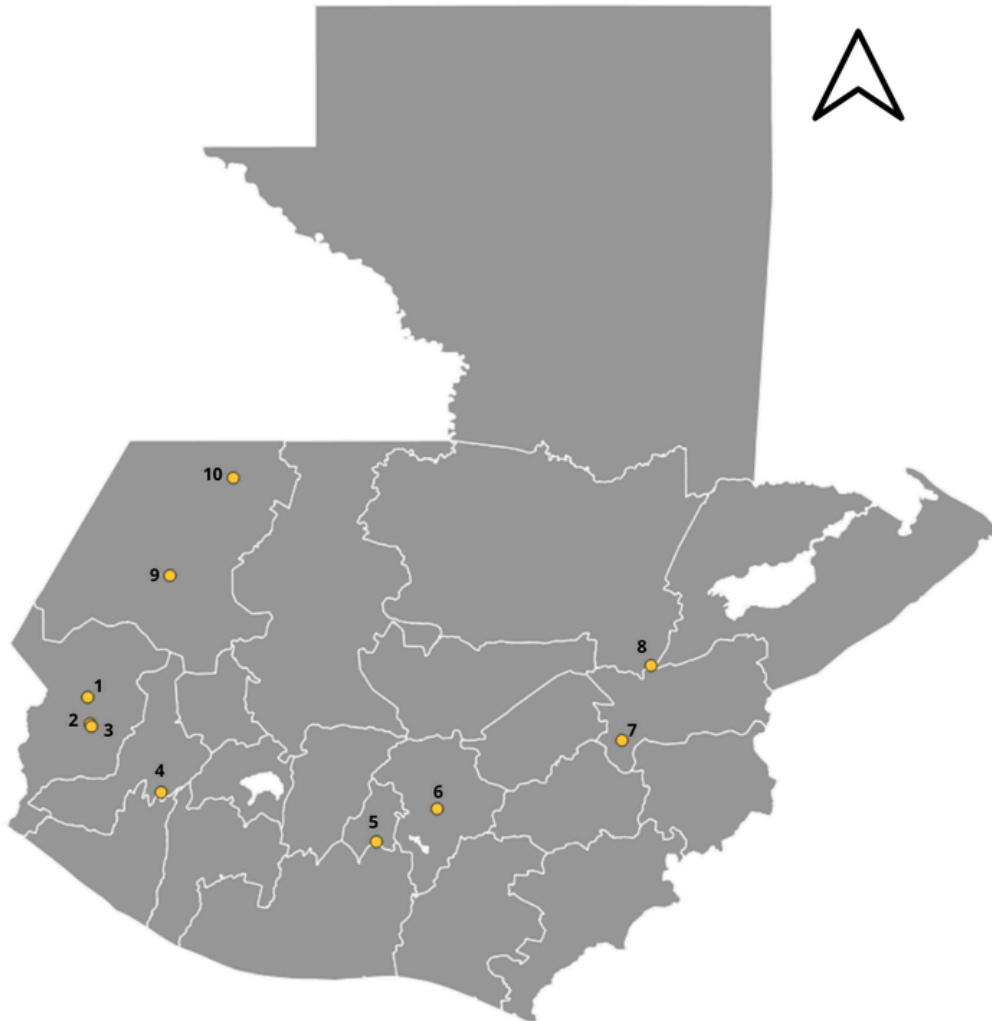
Sierra de los Cuchumatanes, in the highlands of Alta Verapaz and Quiché Departments.

Protected area for reintroduction:

Reserva Natural Privada Yal Unin Yul Witz and Parque Nacional Laguna Lachuá.

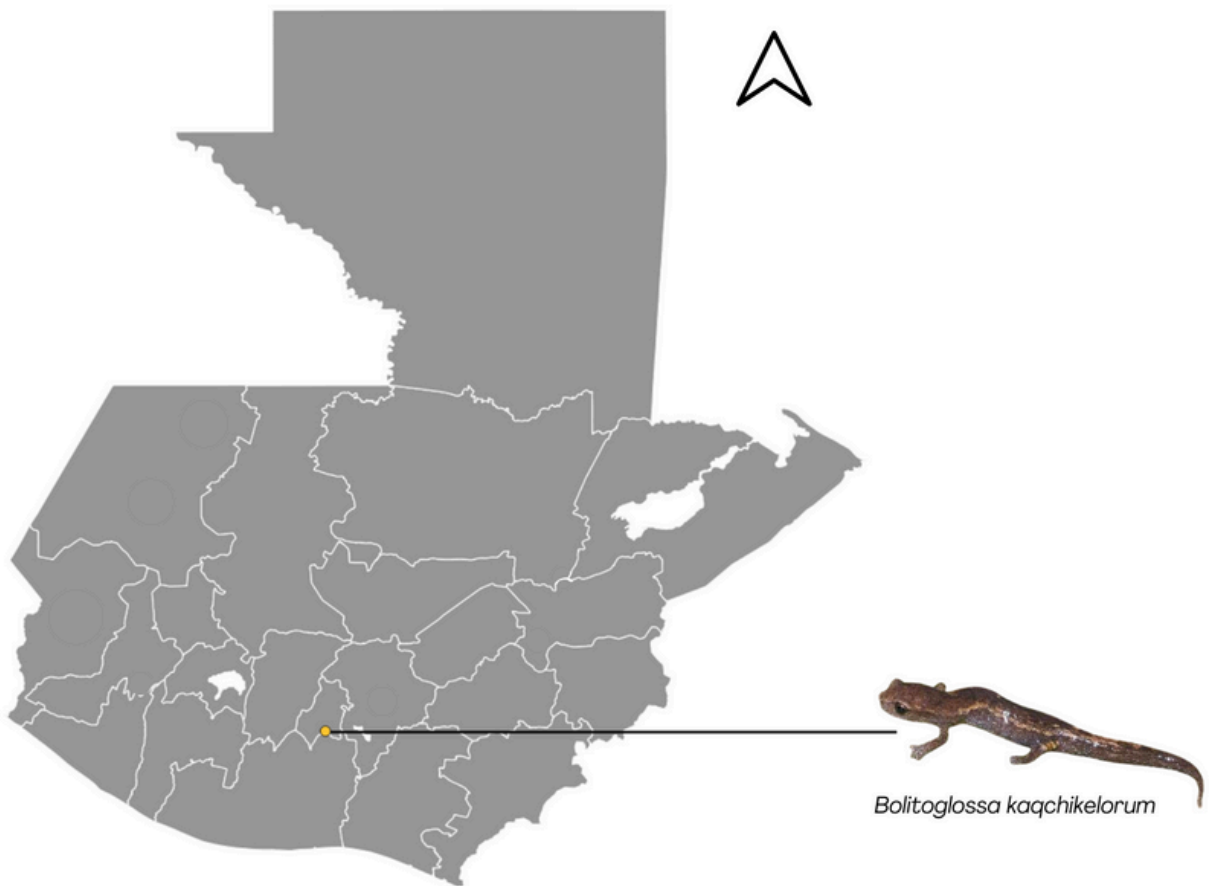
Assessment

Ex situ Rescue Species: Distribution



1. Parque Regional Municipal San Rafael Pie de La Cuesta
2. Zonas de Veda Definitiva de los Volcanes Tajumulco
3. Reserva Natural Privada Oná, El Quetzal, San Marcos
4. Reserva Natural Privada Finca El Vergel
5. Zona de Veda Definitiva del Volcán de Agua
6. Reserva Natural Privada El Espinero
7. Reserva Privada Heloderma para la Conservación del Bosque Seco
8. Reserva de la Biosfera Sierra de las Minas
9. Bosque Regional Municipal Todos Santos Cuchumatanes
10. Reserva Natural Privada Yal Unin Yul Witz

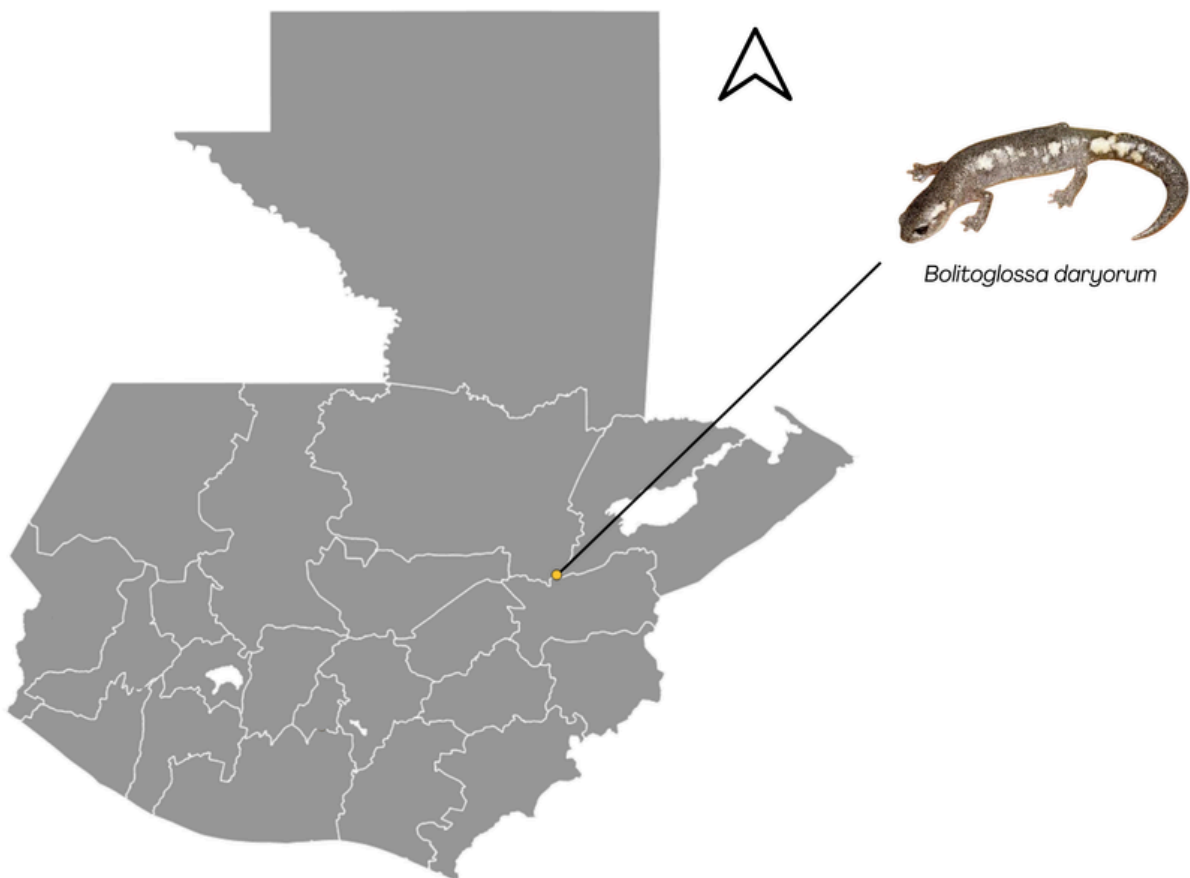
Ex situ Rescue Species: Central Region



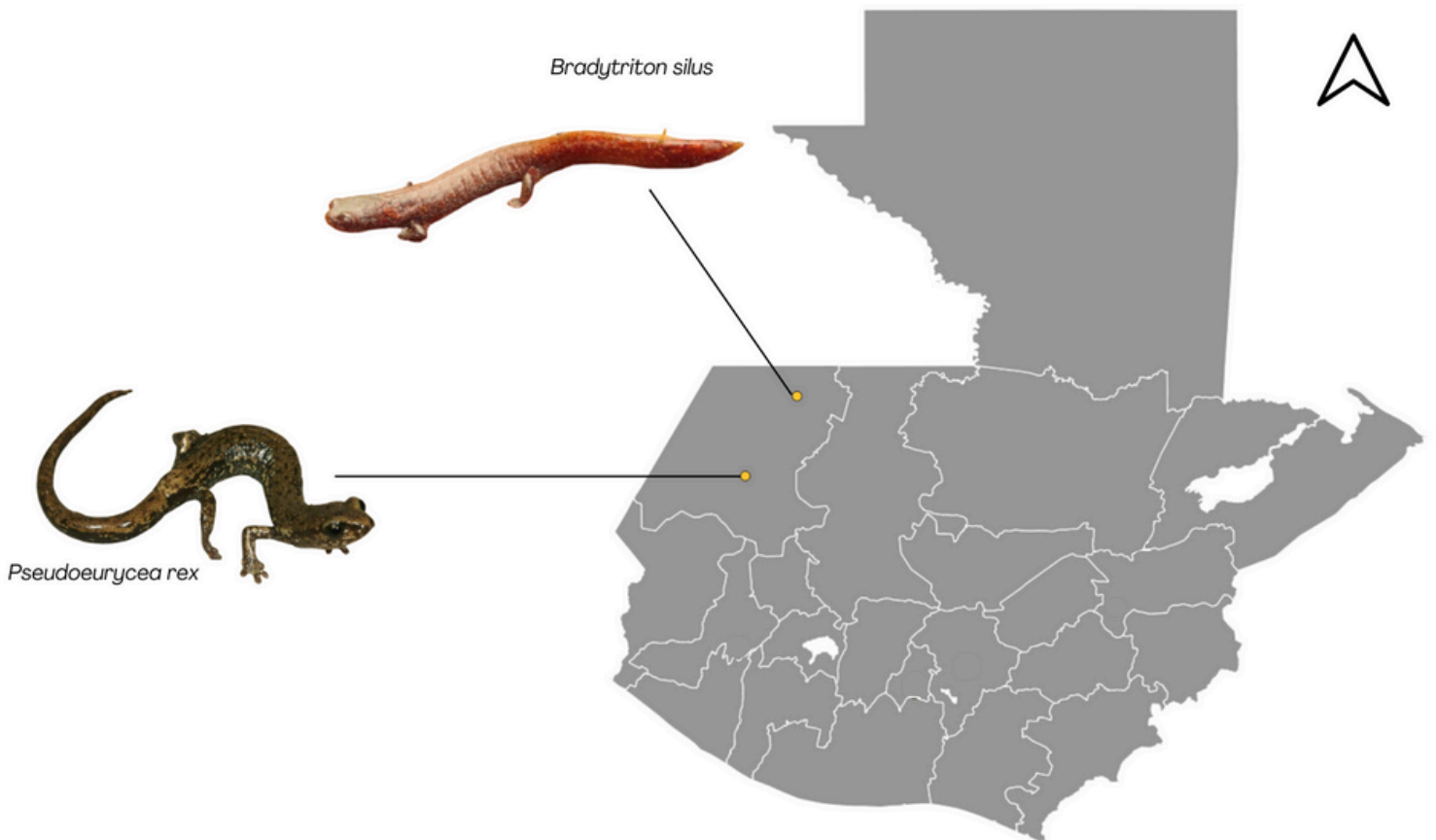
Ex situ Rescue Species: Metropolitan Region



Ex situ Rescue Species: Northern Region



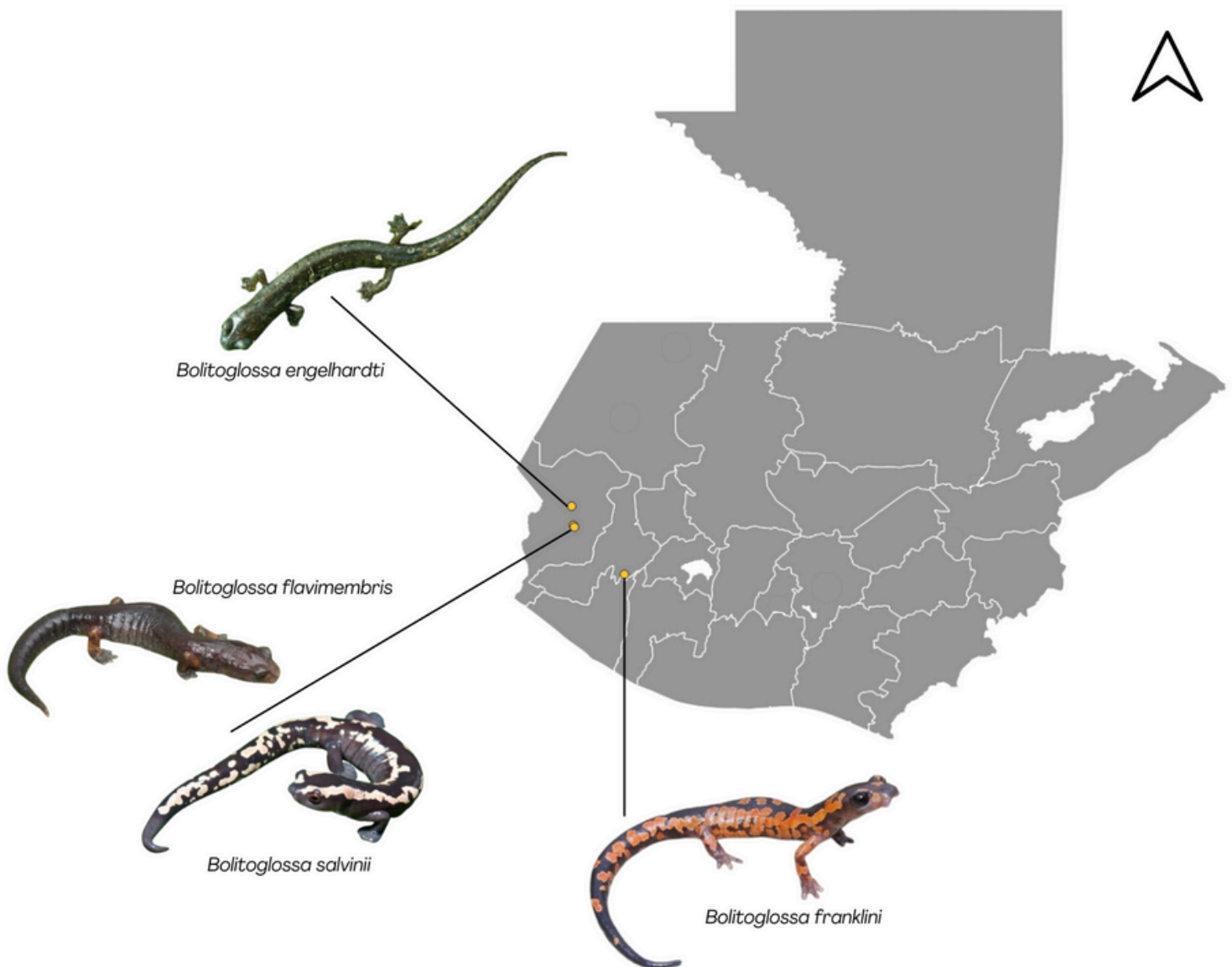
Ex situ Rescue Species: Northwestern Region



Ex situ Rescue Species: Northeastern Region



Ex situ Rescue Species: Southwestern Region



Species Recommended for Rescue that Need Habitat Restoration

It was also possible to identify species that require *ex situ* conservation that (1) have enough individuals in nature that can be used as founders for the program, (2) that are clear biological units, but (3) that at the moment do not have a safe habitat for their reintroduction. These 12 species are described in the following pages.

Of the 47 species identified as needing rescue (page 7), the remaining 24 are not included in this report because they currently lack sufficient individuals in the wild to serve as founders or do not meet other necessary criteria. These species remain a priority for further assessment and conservation planning as more information becomes available.



Bolitoglossa centenorum
© Todd Pierson

Bolitoglossa centenorum**Distribution**

Type locality near San Mateo Ixtatán in Cerro Bobic, Huehuetenango

Protected area:

None

Assessment***Bolitoglossa suchitanensis*****Distribution**

Upper slopes of Suchitán Volcano, above Aldea Suchitán and in the vicinity of La Piedrona, Municipality of Santa Catarina Mita, Department of Jutiapa.

Protected area:

Zona de Veda Definitiva Volcán Suchitán

Assessment***Dendrotriton chujorum*****Distribution**

Northern region of the Sierra de los Cuchumatanes

Protected area:

None

Assessment***Dryophytes bocourti*****Distribution**

Highlands of Baja Verapaz and southern Alta Verapaz.

Protected area for reintroduction:

None

Assessment

Oedipina chortiorum**Distribution**

Headquarters of Finca San José, about 6 km southeast of Concepción Las Minas, Chiquimula

Protected area:

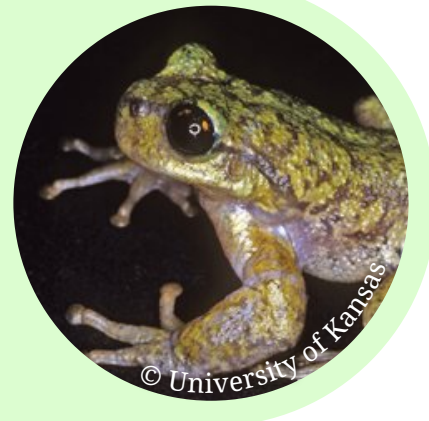
None

Assessment***Plectrohyla glandulosa*****Distribution**

Sierra de los Cuchumatanes

Protected area:

None

Assessment***Bolitoglossa la*****Distribution**

Northern edge of the Guatemalan Plateau and at the western end of the Sierra de Chuacús

Protected area:

None

Assessment***Bolitoglossa omniusanctorum*****Distribution**

Western portion of the Sierra de los Cuchumatanes, the Cuilco Mountains and the eastern end of the Sierra de Chuacús.

Protected area for reintroduction:

None

Assessment

Oedipina ignea**Distribution**

Pacific volcanic chain in the municipalities of Villa Canales (Guatemala Department), San Pedro Yepocapa (Chimaltenango), San Rafael Las Flores (Municipality of Santa Rosa), and in the Department of Jutiapa

Protected area:

None

Assessment***Plectrohyla acanthodes*****Distribution**

Sierra de los Cuchumatanes

Protected area:

None

Assessment***Quilticohyla sanctaecrucis*****Distribution**

Sierra de Santa Cruz and in San Mateo Ixtatán around the Yolnabaj Lake, Huehuetenango

Protected area:

Área de protección especial Sierra de Santa Cruz

Assessment***Bolitoglossa stuarti*****Distribution**

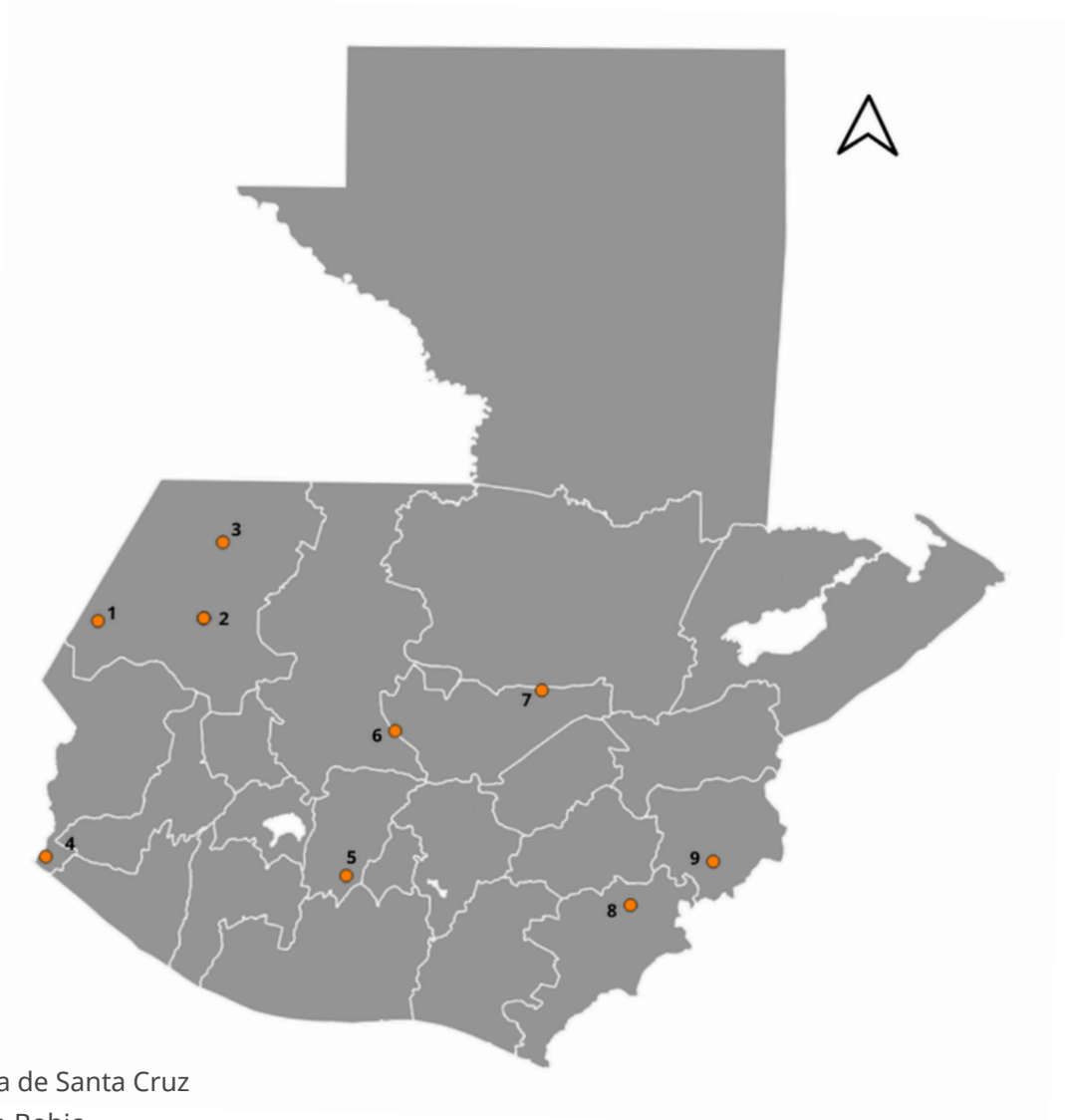
Interior valley of southern Chiapas, México, and extends to the western tip of Guatemala

Protected area for reintroduction:

None

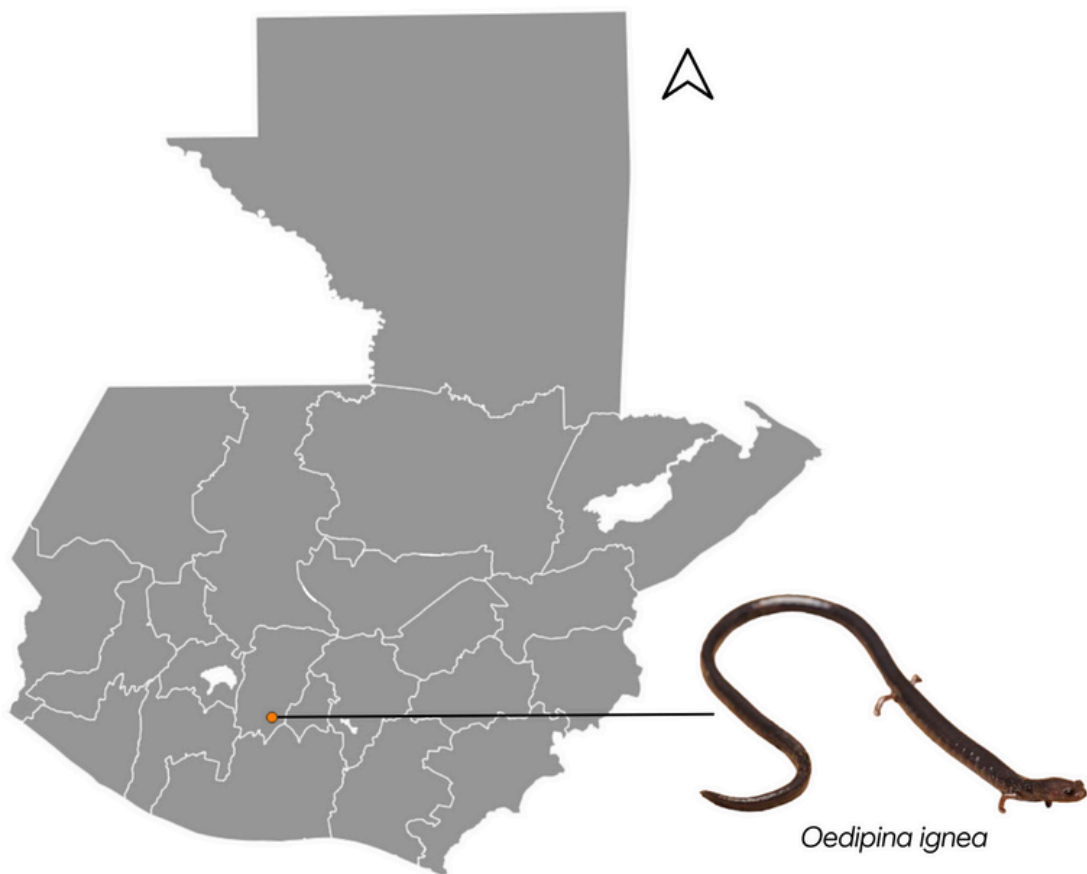
Assessment

Ex situ Rescue Species in Need of Habitat Restoration: Distribution



1. Sierra de Santa Cruz
2. Cerro Bobic
3. Sierra de los Cuchumatanes
4. Valle interno del Sur de Chiapas, México a Guatemala
5. Yepocapa, Chimaltenango
6. Sierra Chuacús
7. Montañas de Baja Verapaz/Alta Verapaz
8. Zona de Veda Definitiva Volcán Suchitán
9. Finca San José, Chiquimula

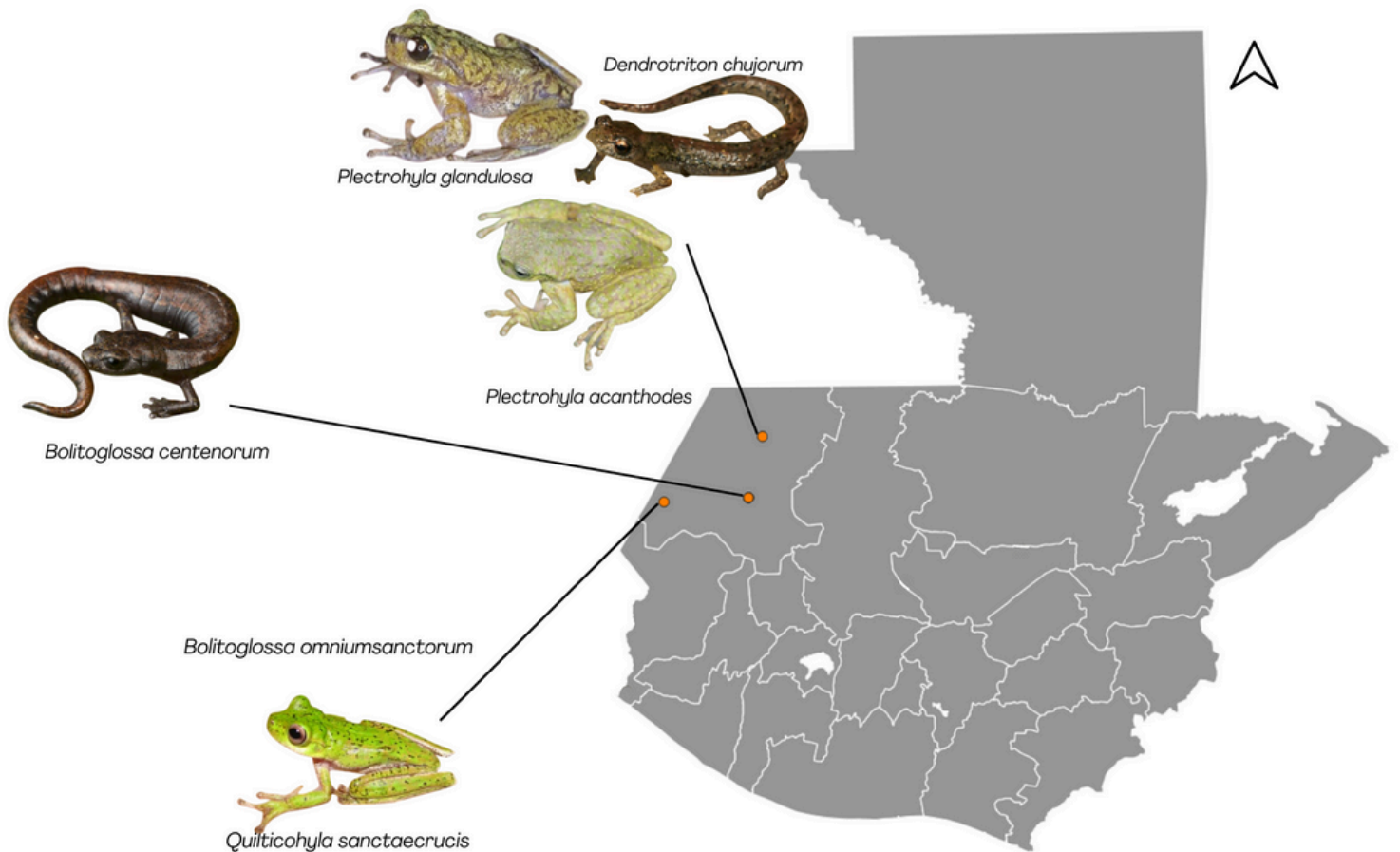
Ex situ Rescue Species in Need of Habitat Restoration: Central Region



Ex situ Rescue Species in Need of Habitat Restoration: Northern Region



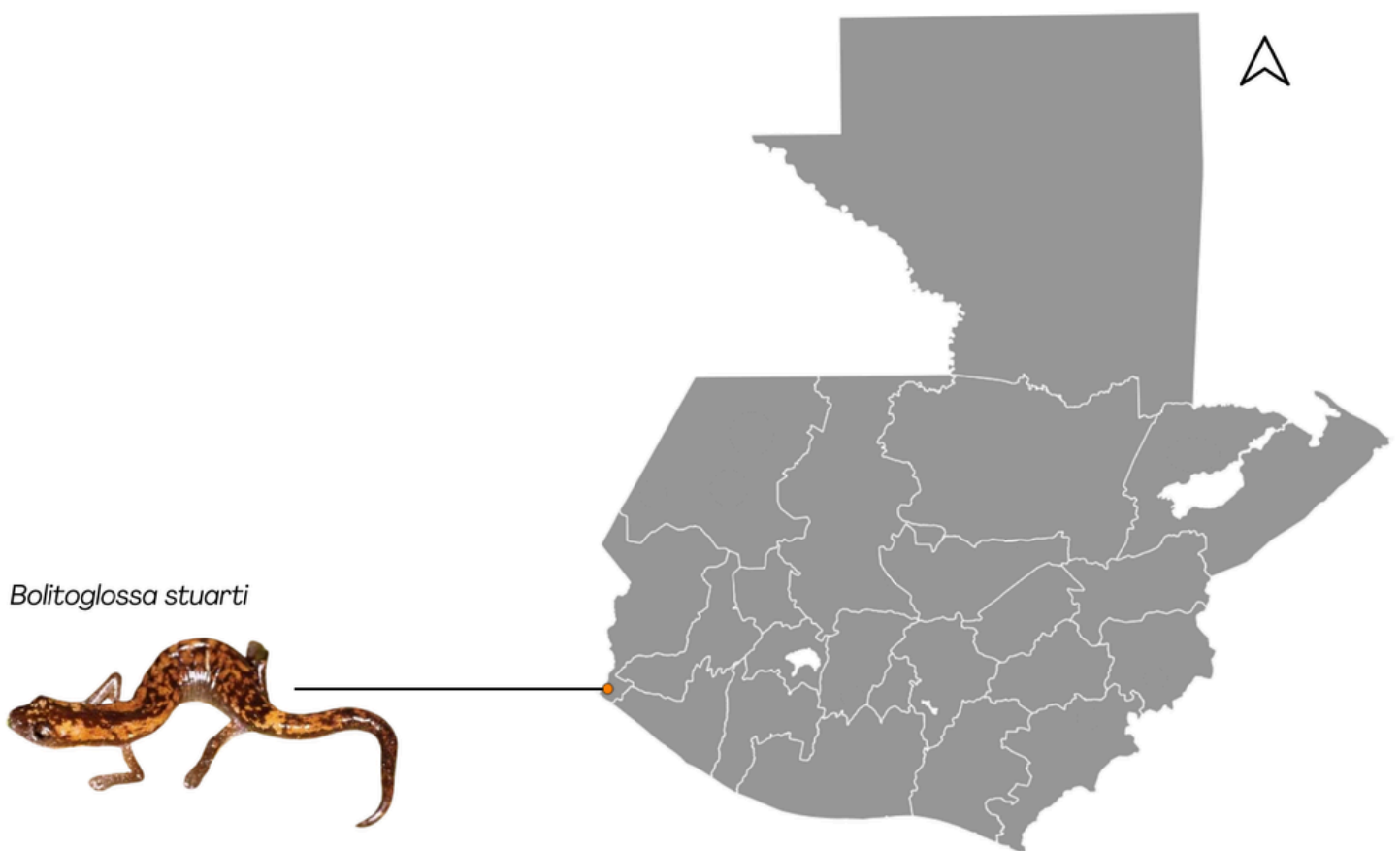
Ex situ Rescue Species in Need of Habitat Restoration: Northwestern Region



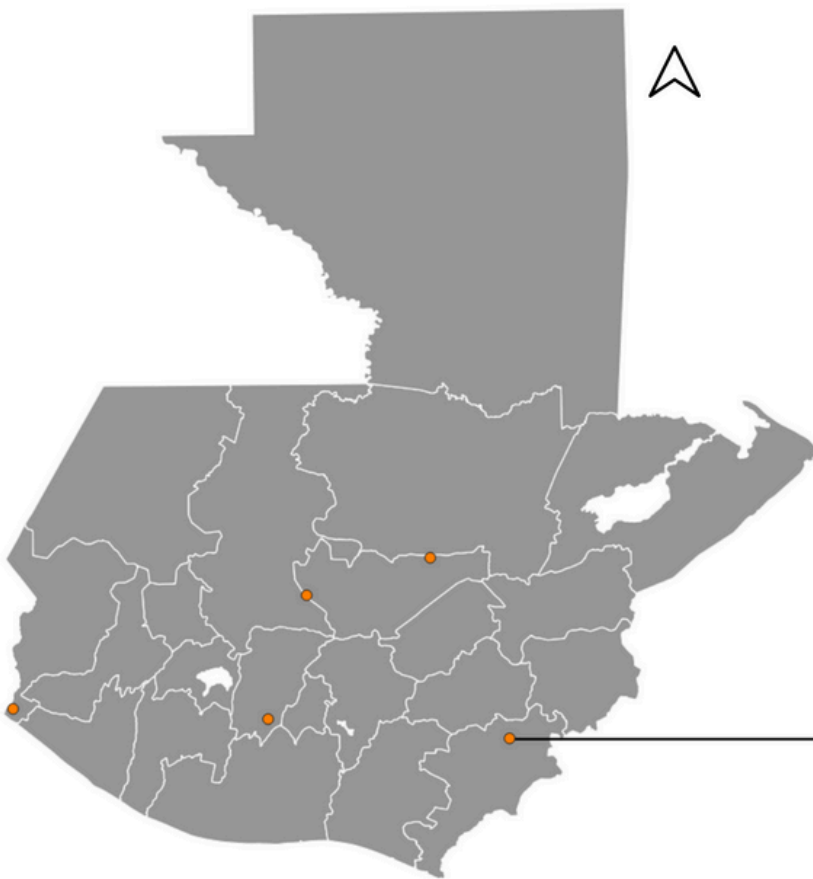
Ex situ Rescue Species in Need of Habitat Restoration: Northeastern Region



Ex situ Rescue Species in Need of Habitat Restoration: Southwestern Region



Ex situ Rescue Species in Need of Habitat Restoration: Southeastern Region



Bolitoglossa suchitanensis

Lost Species

We also identified 13 species that, although not declared extinct, have not been seen in over two decades. This could be either because their populations have decreased drastically; the habitat has been practically devastated; or there have not been targeted expeditions to search for them. We believe it is important to make a collective effort to find the species on this list and work together for their conservation.

Ptychohyla dendrophasma

Distribution

Quebrada Sancapech, Finca San Francisco, Huehuetenango

Last seen: 1998

Assessment



Pseudoeurycea goebeli

Distribution

Volcán Tajumulco, San Marcos; Volcán Chicabal, Quetzaltenango; Volcán de Agua, Sacatepéquez

Last seen: 2005

Assessment



Pseudoeurycea brunnata

Distribution

Volcán Chicabal, Quetzaltenango

Last seen: 1980s

Assessment



Nototriton brodiei**Distribution**

Sierra Caral, Izabal

Last seen: 2007Assessment***Incilius tacanensis*****Distribution**Volcán Tacaná, San Marcos y Volcán Zunil,
Quetzaltenango**Last seen:** 1984Assessment***Dryophytes bocourti*****Distribution**

Zonas altas de Baja Verapaz y el sur de Alta Verapaz

Last seen: 1990sAssessment***Cryptotriton nasalis*****Distribution**

Cerro Pozo de Agua, en la Sierra de Caral, Izabal

Last seen: 1990sAssessment***Craugastor trachydermus*****Distribution**

Sierra Caral, Izabal

Last seen: 1989Assessment

Craugastor adamastus**Distribution**

Sierra de las Minas, San Pedro Sacatepequez

Last seen: 1981Assessment***Bolitoglossa tzultacaj*****Distribution**

Southern slope of the Sierra de las Minas, between the Departments of Zacapa, Izabal, and Alta Verapaz

Last seen: 1992Assessment***Bolitoglossa psephena*****Distribution**

Finca Santa Elena, Cordillera Tecún Umán

Last seen: 1992Assessment***Bolitoglossa ninadormida*****Distribution**

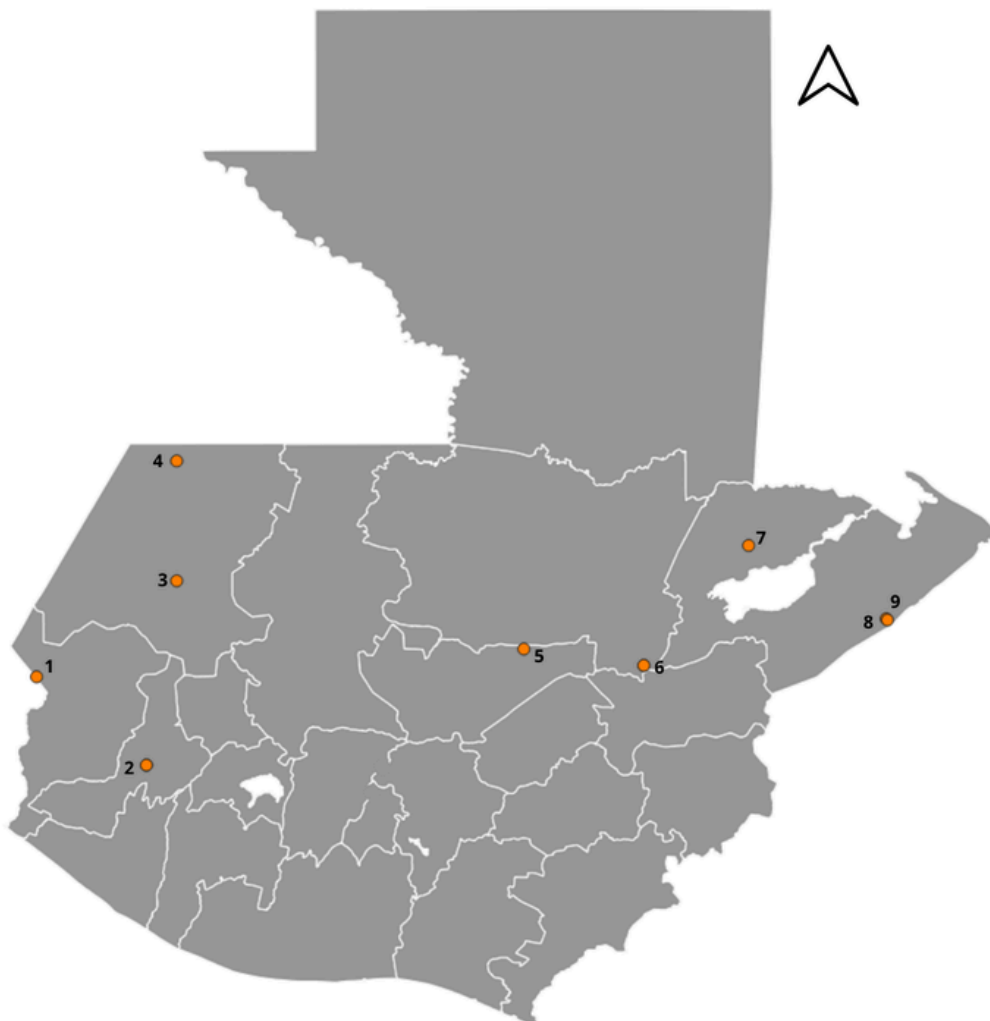
Sierra de los Cuchumatanes, near Todos Santos and San Juan Ixcoy, Huehuetenango

Last seen: 1997Assessment***Bolitoglossa nussbaumi*****Distribution**

Todos Santos, Sierra de los Cuchumatanes, Huehuetenango

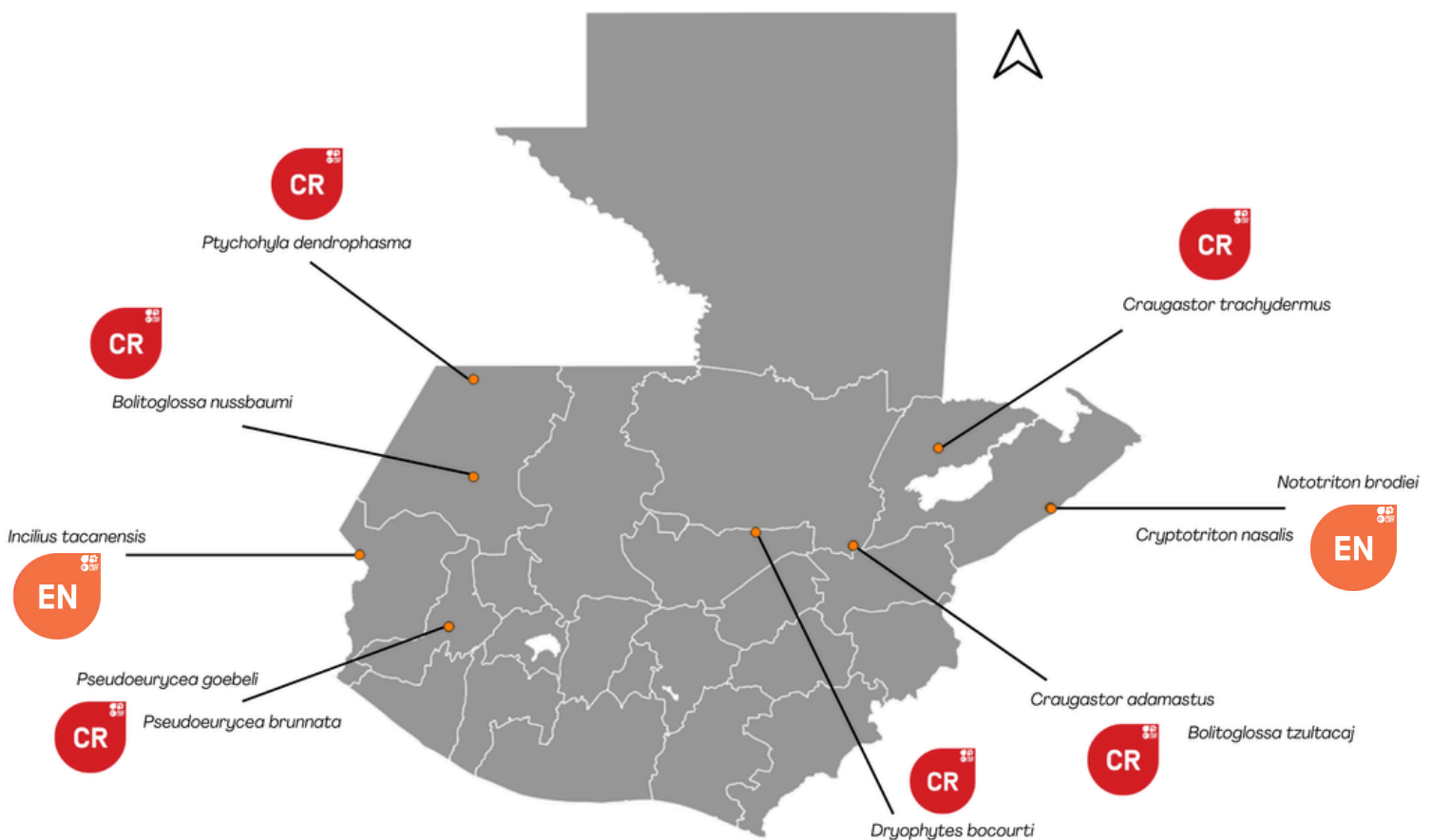
Last seen: 1998Assessment

Lost Species: Distribution



1. Volcán Tacaná, San Marcos
2. Volcán Chicabal, Quetzaltenango
3. Todos Santos, Sierra de los Cuchumatanes, Huehuetenango
4. Quebrada Sancapech, Finca San Francisco, Huehuetenango
5. Zonas altas de Baja Verapaz y el sur de Alta Verapaz
6. Vertiente sur de la Sierra de las Minas
7. Sierra de Santa Cruz, Izabal
8. Sierra Caral, Izabal
9. Cerro Pozo de Agua, Sierra Caral, Izabal

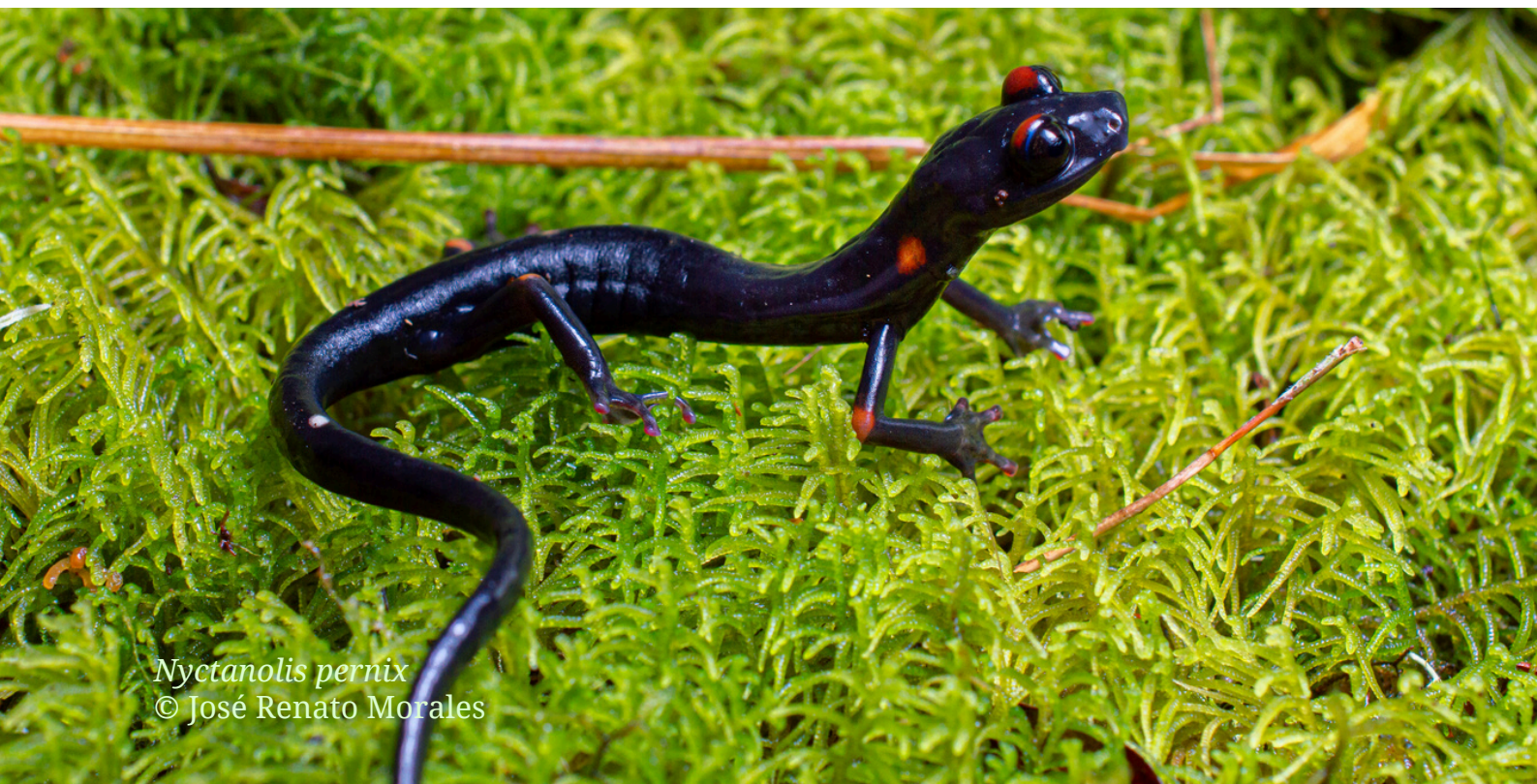
Lost Species: Distribution and IUCN Red List Category



Threatened Species in Private Natural Reserves

The Association of Private Natural Reserves of Guatemala (ARNPG from its Spanish acronym) is a non-governmental organization that works for the conservation of Guatemala's natural resources. To date, there are 186 RNPs registered with the ARNPG and 136 associates. These include both Reserves and other conservation models registered at the National Council of Protected Areas (CONAP from its Spanish acronym), totaling more than 80,000 hectares of voluntary conservation.

During the workshop, we also identified threatened amphibian species that have been recorded in several of the RNPs and that are therefore proof that the RNPs are fulfilling their conservation mission. We believe that the voluntary citizen participation in the conservation of species and their habitats is key, as well as the promotion of the creation of more protected areas by the civil society. It would also be important to make coordinated efforts between the Association, researchers, universities, and local, state, and national governments to fully understand the amphibian species that are being favored by the conservation and preservation of the habitat within private reserves.



Nyctanolis pernix
© José Renato Morales

Bolitoglossa franklini**Private Natural Reserve (RNP):**

RNP Estación Científica Refugio del Quetzal - Volcán Atitlán; RNP Finca El Vergel

Assessment

***Bolitoglossa helmrichi*****Private Natural Reserve (RNP):**

RNP Pamac; RNP Finca Pamac; RNP SacWach Já; RNP Chicacnab; RNP Chelemha and RNP K'anti Shul

Assessment

***Bolitoglossa jacksoni*****Private Natural Reserve (RNP):**

RNP Yal Unin Yul Witz

Assessment

***Bolitoglossa morio*****Private Natural Reserve (RNP):**

RNP La Tacita; RNP El Espinero

Assessment

***Bolitoglossa mulleri*****Private Natural Reserve (RNP):**

RNP Yal Unin Yul Witz

Assessment



Bolitoglossa salvinii
Private Natural Reserve (RNP):
 RNP Finca Patrocinio, RNP Oná

Assessment



Bolitoglossa tenebrosa
Private Natural Reserve (RNP):
 RNP Cerro Verde

Assessment



Bolitoglossa xibalba
Private Natural Reserve (RNP):
 RNP Yal Unin Yul Witz

Assessment



Bolitoglossa zacapensis
Private Natural Reserve (RNP):
 RNP Planada de Margot

Assessment



Bradytriton silus
Private Natural Reserve (RNP):
 RNP Yal Unin Yul Witz

Assessment



Craugastor bocourti
Private Natural Reserve (RNP):
 RNP Pamac

[Assessment](#)



Craugastor daryi
Private Natural Reserve (RNP):
 RNP Sierra de Xucaneb, RNP Cerro Verde

[Assessment](#)



Craugastor greggi
Private Natural Reserve (RNP):
 RNP Finca La Esperanza

[Assessment](#)



Craugastor rivulus
Private Natural Reserve (RNP):
 RNP Sierra de Xucaneb

[Assessment](#)



Cryptotriton xucaneborum
Private Natural Reserve (RNP):
 RNP Chelemha

[Assessment](#)



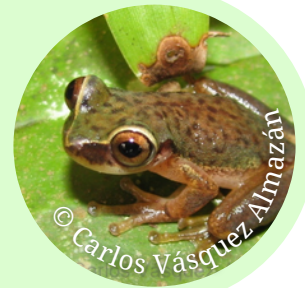
Dryophytes walkeri
Private Natural Reserve (RNP):
 RNP Pamac

Assessment



Exerodonta perkinsi
Private Natural Reserve (RNP):
 RNP La Soledad

Assessment



Incilius aurarius
Private Natural Reserve (RNP):
 RNP Yal Unin Yul Witz

Assessment



Nyctanolis pernix
Private Natural Reserve (RNP):
 RNP Kantishul Yalihux

Assessment



Oedipina ignea
Private Natural Reserve (RNP):
 RNP Guardabarranca

Assessment



Oedipina tzutujilorum**Private Natural Reserve (RNP):**

RNP Atitlán; RNP Refugio Quetzal; RNP Los Andes; RNP Los Tarrales

Assessment

***Plectrohyla hartwegi*****Private Natural Reserve (RNP):**

RNP Estación Científica Refugio del Quetzal - Volcán Atitlán; RNP Yal Unin Yul Witz

Assessment

***Plectrohyla ixil*****Private Natural Reserve (RNP):**

RNP La Soledad; RNP Yal Unin Yul Witz

Assessment

***Plectrohyla quecchi*****Private Natural Reserve (RNP):**

RNP Posada Montaña del Quetzal; RNP Sierra de Xucaneb

Assessment

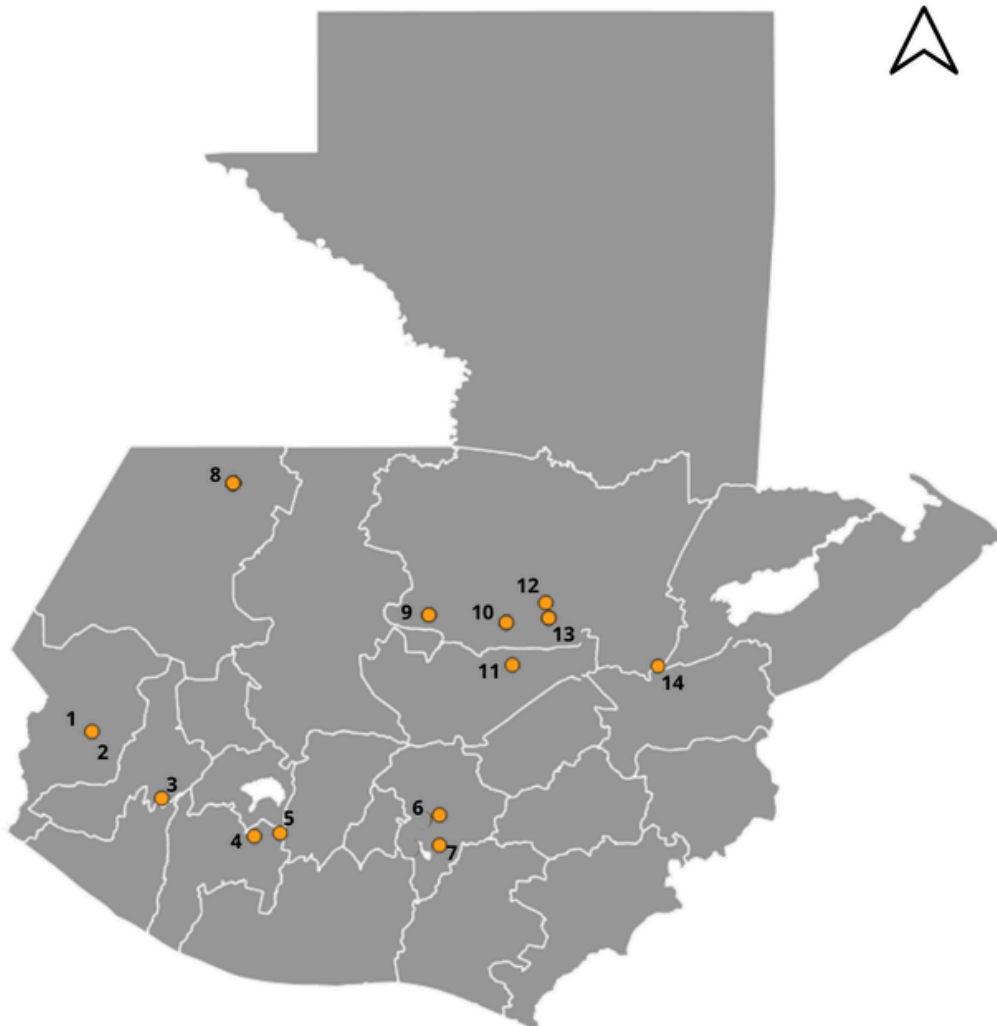
***Ptychohyla hypomykter*****Private Natural Reserve (RNP):**

RNP Yal Unin Yul Witz; RNP La Soledad

Assessment

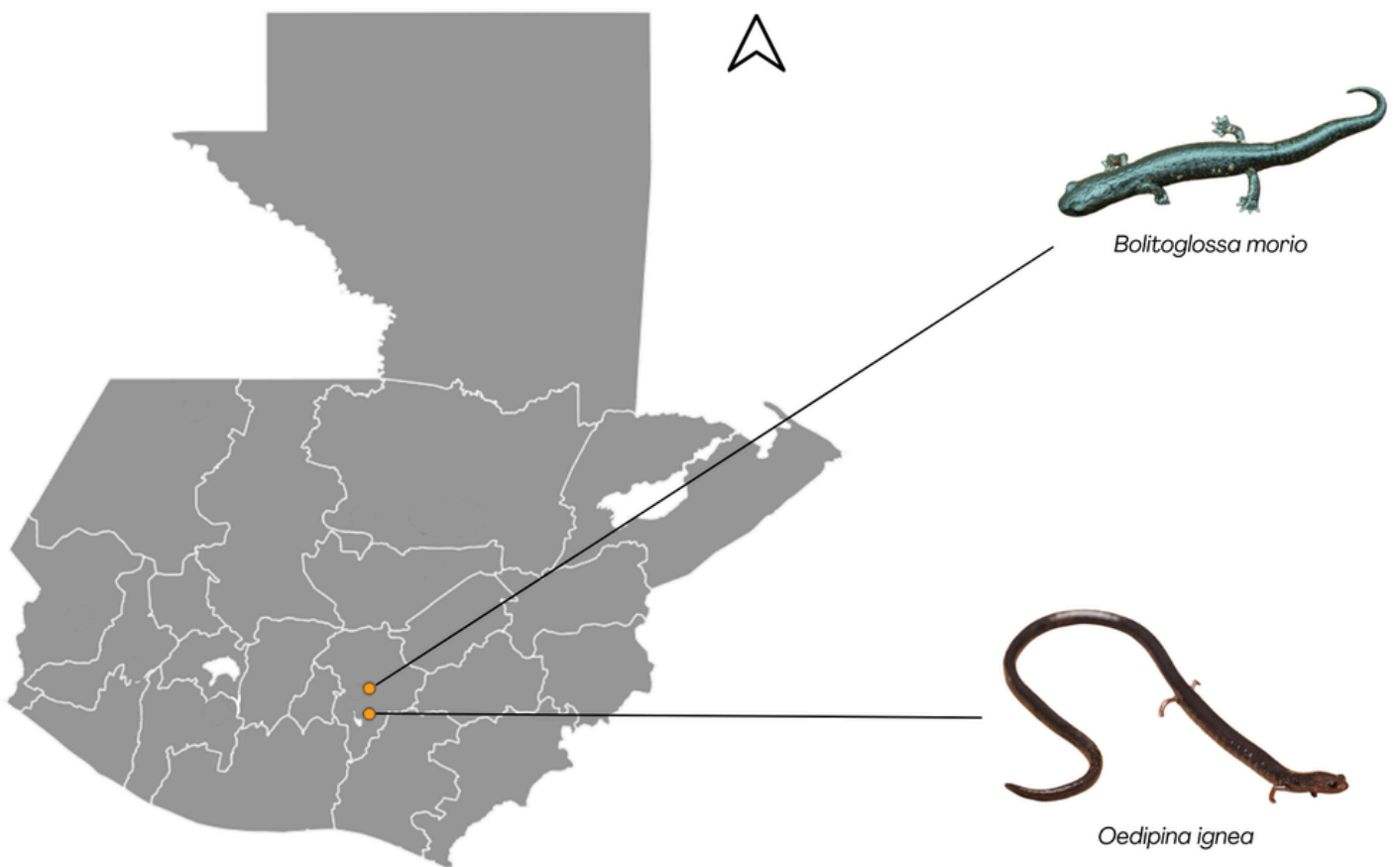


Threatened Species in Private Nature Reserves: Distribution

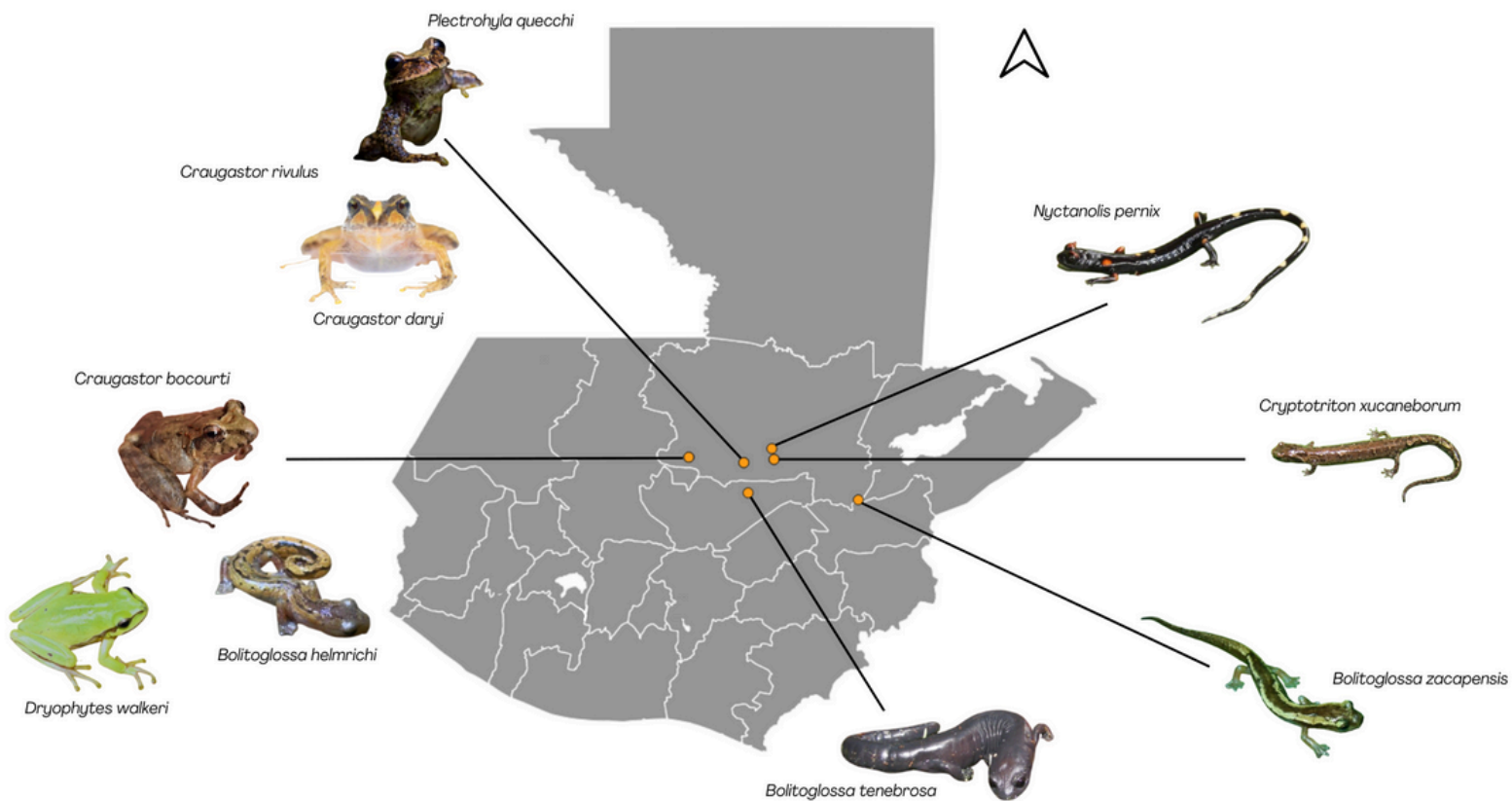


1. RNP Finca La Esperanza
2. RNP Finca El Vergel
3. RNP Finca Patrocinio
4. RNP Los Tarrales
5. RNP La Soledad
6. RNP El Espinero
7. RNP Guardabarranca
8. RNP Yal Unin Yul Witz
9. RNP Pamac
10. RNP Sierra de Xucaneb
11. RNP Cerro Verde
12. RNP Kantishul Yalihux
13. Chelemha
14. Planada de Margot

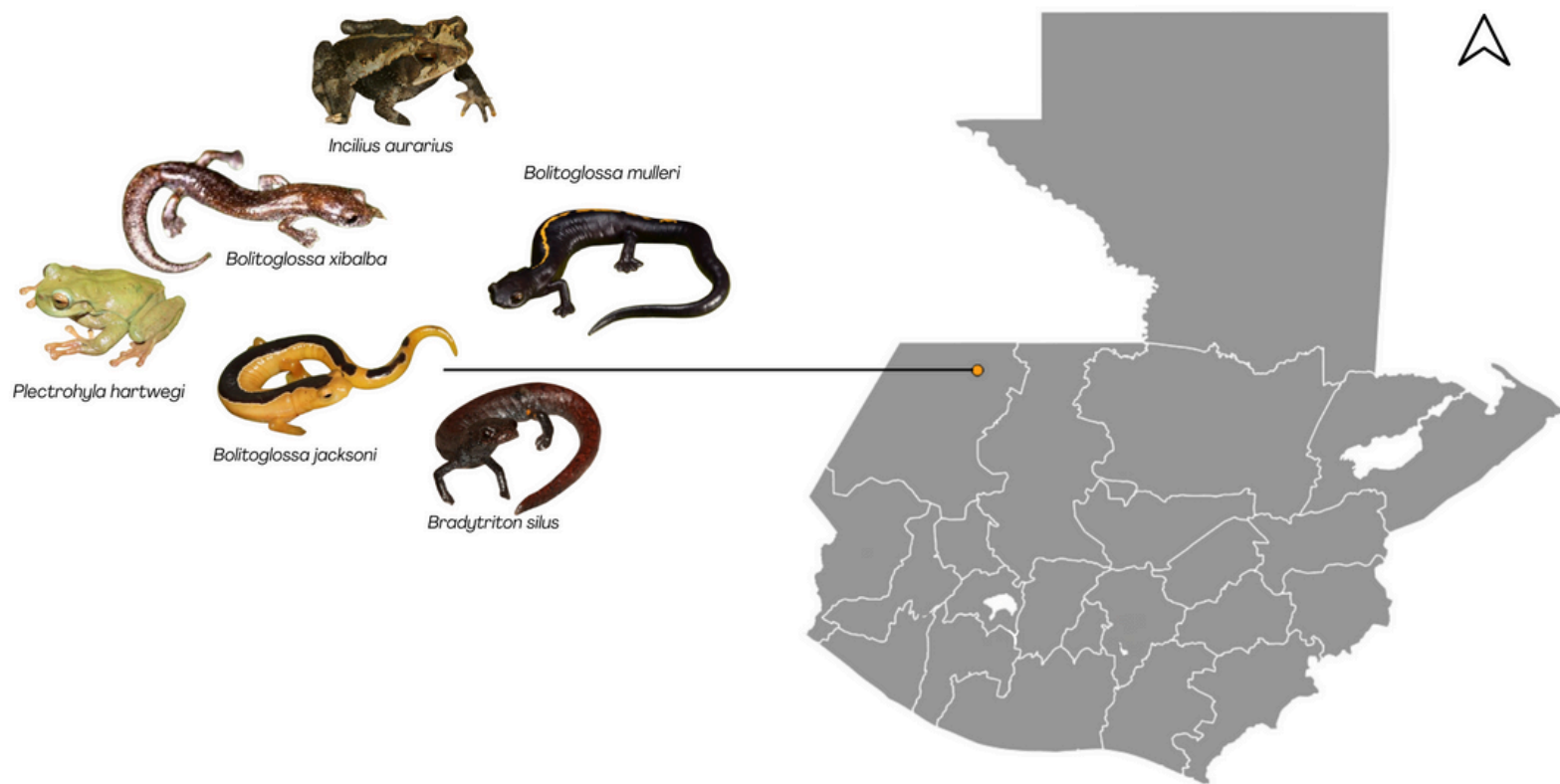
Threatened Species in Private Nature Reserves: Metropolitan Region



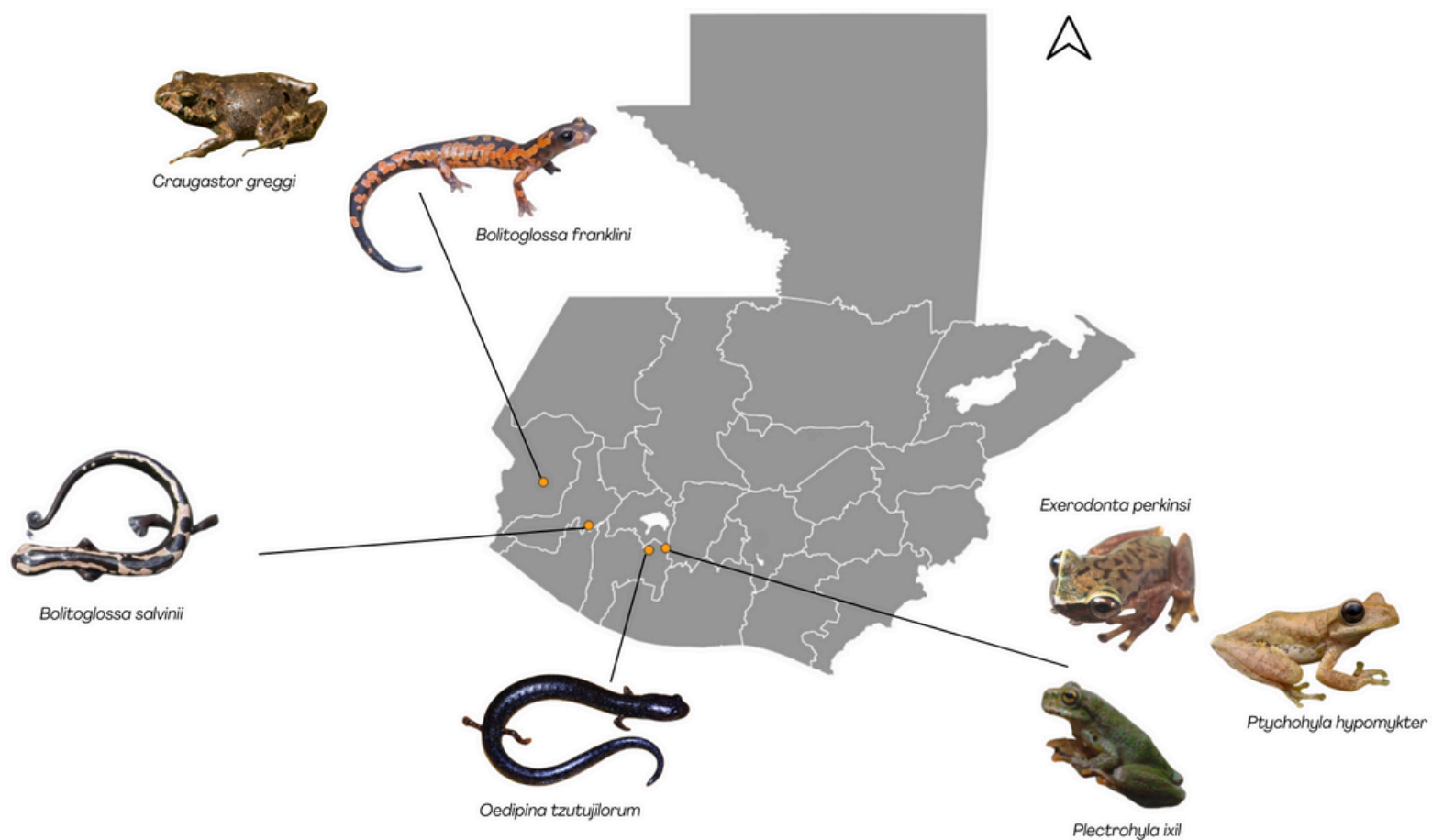
Threatened Species in Private Nature Reserves: Northern Region



Threatened Species in Private Nature Reserves: Northwestern Region



Threatened Species in Private Nature Reserves: Southwestern Region



Potential Analog Species

We also identified several analogous species during the workshop. These are species with a lower degree of threat but with biological characteristics similar to those of the target species that require *ex situ* conservation. These analogous species are used to test and refine maintenance and reproduction protocols before applying them to the more threatened species, increasing the likelihood of success for the *ex situ* program.

The identified species include species for which we could obtain specimens as founders to start an *ex situ* conservation program. Further, we group these species into two groups:

- **Group 1:** Species with available habitat for reintroduction. These species can serve as founders for *ex situ* conservation programs, as their habitat is already protected and suitable for reintroduction.
- **Group 2:** Species without available habitat for reintroduction. Although specimens could be obtained as founders, their habitat is not currently protected. For these species, habitat recovery efforts would need to precede their introduction.

Within the first group, we identified two species that have been assigned an analogous species with which we could start working as soon as possible: *Bolitoglossa engelhardti* (EN) and *Bolitoglossa franklini* (VU).

Analog Species



Bolitoglossa helmrichi

VU



Bolitoglossa lincolni

NT



Bolitoglossa morio

VU



Pseudoeurycea rex

VU

Group 1

Group 2



Plectrohyla guatemalensis

NT

Target Species



Bolitoglossa engelhardti

EN



B. franklini

VU



B. omniumsanctorum

EN



P. brunnata

CR



P. goebeli

CR



P. glandulosa

CR



P. acanthodes

EN

Species for Conservation Education Programs

Finally, we identified 38 species for which conservation education programs are being carried out or are required to be carried out. This list is made up of species that are mostly colorful or that due to other characteristics are excellent candidates for the development of these programs. It is important to emphasize that in Guatemala, one of the most diverse countries in salamander species, there is a popular belief that salamanders are poisonous and that is why people often kill them.

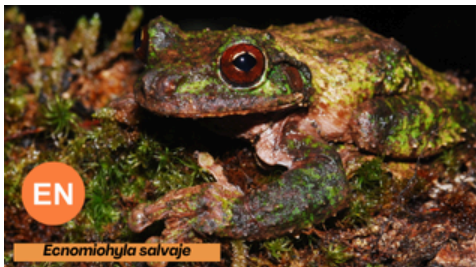


Bolitoglossa pacaya
© José Renato Morales

Species for Conservation Education Programs



Species for Conservation Education Programs



Species for Conservation Education Programs



Conclusions

Guatemala is one of the countries with the highest proportion of threatened species due mainly to habitat loss due to human activities. It is also one of the countries with the largest number of species for *ex situ* rescue, making the participation of all stakeholders imperative to achieve their conservation.

The results of the workshop and the conservation actions generated for each species are the basis for developing a holistic conservation action plan for the threatened amphibian species of Guatemala.

Appendix

Conservation Actions Explained:

Ark	A species that is extinct in the wild (locally and globally) and will become completely extinct without <i>ex situ</i> management.
Rescue	A species in imminent danger of extinction (locally or globally) which require <i>ex situ</i> management as part of a comprehensive conservation program to ensure their survival.
<i>In situ</i> conservation	A species for which effective mitigation of threats in nature and/or the creation of additional protected habitats is required as part of an integrated action plan to ensure successful survival and conservation.
<i>In situ</i> research	A species that requires further <i>in situ</i> research as part of conservation actions. At least one critical piece of information is still to be known.
Husbandry research	Species recommended as reproductive analogs of more threatened species that have been recommended for <i>ex situ</i> recovery. These species should be used to study and develop handling protocols that can be applied to more threatened species.
Applied <i>ex situ</i> research	Species recommended for <i>ex situ</i> research projects other than husbandry research, which directly contribute to the conservation of this species, or a related species, in the wild.

Conservation Actions Explained (cont.):

Mass production

A species threatened in the wild due to its collection (*e.g.* as a food source), which can be bred in captivity at this time—usually in the country of origin of the species—to meet the demand for special purposes that would otherwise imply collecting species from the wild. This category generally excludes breeding for pets, except in cases where the careful and coordinated breeding and handling can demonstrate reduced pressure of threatened species in the wild.

Education

Species selected for management with the purpose of inspiring visitors of zoos and aquariums, national parks, recreation areas and forests, and in ecotourism activities to increase their knowledge and promote behavioral change in people. For example, when a species is used to promote financial or other support for field conservation projects (including “flag” species or “ambassador species” that are clearly defined).

Supplementation

A species for which *ex situ* management would benefit wild populations through a breeding-and-release program as part of conservation action recommendations.

Biobank

Species for which storage of sperm or cells to perpetuate their genetic variation is urgently recommended due to the serious threat of extinction of the species.

None

Species that do not require any conservation action at this time.

List of all species included in this report:

Species recommended for Rescue

<i>Craugastor inachus</i>	<i>Bradytriton silus</i>	<i>Bolitoglossa kaqchikelorum</i>
<i>Bolitoglossa daryorum</i>	<i>Bolitoglossa franklini</i>	<i>Pseudoeurycea rex</i>
<i>Bolitoglossa engelhardti</i>	<i>Bolitoglossa morio</i>	<i>Bolitoglossa flavimembris</i>
<i>Bolitoglossa salvinii</i>		

Species recommended for Rescue that Need Habitat Restoration

<i>Bolitoglossa centenorum</i>	<i>Bolitoglossa la</i>	<i>Bolitoglossa suchitanensis</i>
<i>Bolitoglossa omniun-sanctorum</i>	<i>Dendrotriton chujorum</i>	<i>Oedipina ignea</i>
<i>Dryophytes bocourti</i>	<i>Plectrohyla acanthodes</i>	<i>Oedipina chortiorum</i>
<i>Quilticohyala sanctaecrucis</i>	<i>Plectrohyla glandulosa</i>	<i>Bolitoglossa stuarti</i>

Lost Species

<i>Ptychohyala dendrophasma</i>	<i>Incilius tacanensis</i>	<i>Craugastor adamastus</i>
<i>Pseudoeurycea goebeli</i>	<i>Dryophytes bocourti</i>	<i>Bolitoglossa tzultacaj</i>
<i>Pseudoeurycea brunnata</i>	<i>Cryptotriton nasalis</i>	<i>Bolitoglossa psephena</i>
<i>Nototriton brodiei</i>	<i>Craugastor trachydermus</i>	<i>Bolitoglossa ninadormida</i>
<i>Bolitoglossa nussbaumi</i>		

Species in Private Natural Reserves

<i>Bolitoglossa franklini</i>	<i>Bolitoglossa helmrichi</i>	<i>Bolitoglossa jacksoni</i>
<i>Bolitoglossa morio</i>	<i>Bolitoglossa mulleri</i>	<i>Bolitoglossa salvinii</i>
<i>Bolitoglossa tenebrosa</i>	<i>Bolitoglossa xibalba</i>	<i>Bolitoglossa zacapensis</i>
<i>Bradytriton silus</i>	<i>Craugastor bocourti</i>	<i>Craugastor daryi</i>
<i>Craugastor greggi</i>	<i>Craugastor rivulus</i>	<i>Cryptotriton xucaneborum</i>
<i>Dryophytes walkeri</i>	<i>Exerodonta perkinsi</i>	<i>Incilius aurarius</i>
<i>Nyctanolis pernix</i>	<i>Oedipina ignea</i>	<i>Oedipina tzutujilorum</i>
<i>Plectrohyla hartwegi</i>	<i>Plectrohyla ixil</i>	<i>Plectrohyla quecchi</i>
<i>Plectrohyla hypomykter</i>		

List of all species included in this report (cont.):

Species recommended for husbandry research (analog-target species)

<i>B. helmrichi</i> — <i>B. engelhardti</i>	<i>B. lincolni</i> — <i>B. franklini</i>	<i>B. morio</i> — <i>B. omniusanctorum</i>
<i>P. rex</i> — <i>P. brunnata</i>	<i>P. rex</i> — <i>P. goebeli</i>	<i>P. guatemalensis</i> — <i>P. glandulosa</i>
<i>P. guatemalensis</i> — <i>P. acanthodes</i>		

Species for Conservation Education Programs

<i>Atlantihyla panchoi</i>	<i>Bolitoglossa centenorum</i>	<i>Bolitoglossa conanti</i>
<i>Bolitoglossa cuchumatana</i>	<i>Bolitoglossa daryorum</i>	<i>Bolitoglossa eremia</i>
<i>Bolitoglossa flavimembris</i>	<i>Bolitoglossa franklini</i>	<i>Bolitoglossa heiroreias</i>
<i>Bolitoglossa huehuetenanguensis</i>	<i>Bolitoglossa jacksoni</i>	<i>Bolitoglossa kaqchikelorum</i>
<i>Bolitoglossa la</i>	<i>Bolitoglossa meliana</i>	<i>Bolitoglossa morio</i>
<i>Bolitoglossa mulleri</i>	<i>Bolitoglossa pacaya</i>	<i>Bolitoglossa salvinii</i>
<i>Bolitoglossa suchitanensis</i>	<i>Bolitoglossa tenebrosa</i>	<i>Craugastor daryi</i>
<i>Craugastor xucanebi</i>	<i>Cryptotriton monzoni</i>	<i>Dendrotriton rabbi</i>
<i>Duellmanohyla soralia</i>	<i>Ecnomiohyla minera</i>	<i>Ecnomiohyla salvaje</i>
<i>Exerodonta perkinsi</i>	<i>Incilius aurarius</i>	<i>Nyctanolis pernix</i>
<i>Oedipina motaguae</i>	<i>Plectrohyla avia</i>	<i>Plectrohyla hartwegi</i>
<i>Plectrohyla ixil</i>	<i>Plectrohyla tecunumani</i>	<i>Pseudoeurycea rex</i>
<i>Ptychohyla hypomykter</i>	<i>Quilticohyla sanctaerucis</i>	

Photographers of the species' photographs used in the maps

Ex situ rescue

Central Region (page 13)

Bolitoglossa kaqchikelorum Eric Nelson Smith

Metropolitan Region (page 14)

Bolitoglossa morio Sean Rovito

Northern Region (page 15)

Bolitoglossa daryorum Eric Nelson Smith

Northwestern Region (page 16)

Bradytriton silus Manuel Acevedo

Pseudoeurycea rex Todd Pierson

Northeastern region (page 17)

Craugastor inachus Alejandra Zamora

Southwestern Region (page 18)

Pseudoeurycea engelhardti Sean Rovito

Bolitoglossa flavimembris Sean Rovito

Bolitoglossa salvini Javier Sunyer

Bolitoglossa franklini Alejandro Calzada

Ex situ rescue that need habitat restoration

Central Region (page 24)

Oedipina ignea Jake Scott

Northern Region (page 25)

Bolitoglossa la Todd Pierson

Northwestern Region (page 26)

Plectrohyla glandulosa University of Kansas

Dendrotriton chujorum Todd Pierson

Plectrohyla acanthodes Sean Rovito

Bolitoglossa centenorum Todd Pierson

Bolitoglossa omniunsanctorum Foto no disponible

Northeastern Region (page 27)

Oedipina chortiorum Foto no disponible

Southwestern Region (page 28)

Bolitoglossa stuarti Eric Nelson Smith

Southeastern Region (page 29)

Bolitoglossa suchitanensis Sean Rovito

Photographers of the species' photographs used in the maps (cont.)

Species in Private Natural Reserves of the ARNPG

Metropolitan Region (page 42)

<i>Bolitoglossa morio</i>	Sean Rovito
<i>Oedipina ignea</i>	Jake Scott

Northern Region (page 43)

<i>Craugastor rivulus</i>	Foto no disponible
<i>Craugastor daryi</i>	Rudy Botzoc iNaturalist
<i>Plectrohyla quecchi</i>	Renato Morales
<i>Craugastor bocourti</i>	Hellen Dahinten Bailey
<i>Dryophytes walkeri</i>	Sean Rovito
<i>Bolitoglossa helmrichi</i>	Adriana Girón
<i>Nyctanolis pernix</i>	Sean Rovito
<i>Cryptotriton xucaneboum</i>	Carlos Vásquez Almazán
<i>Bolitoglossa zacapensis</i>	Sean Rovito
<i>Bolitoglossa tenebrosa</i>	Carlos Vásquez Almazán

Northwestern Region (page 44)

<i>Plectrohyla hartwegi</i>	Carlos Vásquez Almazán
<i>Incilius aurarius</i>	Todd Pierson
<i>Bolitoglossa mulleri</i>	Todd Pierson
<i>Bolitoglossa xibalba</i>	Eric Nelson Smith
<i>Bolitoglossa jacksoni</i>	Carlos Vásquez Almazán
<i>Bradytriton silus</i>	Todd Pierson

Southwestern Region (page 45)

<i>Craugastor greggi</i>	Javier Sunyer
<i>Bolitoglossa franklini</i>	Alejandro Calzada
<i>Bolitoglossa salvinii</i>	Carlos Vásquez Almazán
<i>Oedipina tzutujilorum</i>	Josiah Townsend
<i>Exerodonta perkinsi</i>	Paola Nicté Cotí
<i>Plectrohyla ixil</i>	Manuel Acevedo
<i>Ptychohyla hypomykter</i>	Sean Rovito

Species recommended for conservation education programs

(page 49)

<i>Atlantihyla panchoi</i>	Sean Rovito
<i>Bolitoglossa centenorum</i>	Todd Pierson
<i>Bolitoglossa conanti</i>	Andrew Snyder
<i>Bolitoglossa cuchumatana</i>	Todd Pierson
<i>Bolitoglossa daryorum</i>	Eric Smith
<i>Bolitoglossa eremia</i>	Eric Smith

Photographers of the species' photographs used in the maps (cont.)

Species recommended for conservation education programs (cont.)

(page 49 cont.)

<i>Bolitoglossa flavimembris</i>	Sean Rovito
<i>Quilticohyla sanctaecrucis</i>	Carlos Vásquez Almazán
<i>Bolitoglossa franklini</i>	Alejandro Calzada
<i>Bolitoglossa heiroreias</i>	Vladlen Henríquez
<i>Bolitoglossa huehuetenanguensis</i>	Todd Pierson
<i>Bolitoglossa jacksoni</i>	Carlos Vásquez Almazán
<i>Bolitoglossa kaqchiquelorum</i>	Eric Smith
<i>Bolitoglossa la</i>	Todd Pierson
<i>Bolitoglossa meliana</i>	Sean Rovito
<i>Bolitoglossa morio</i>	Sean Rovito
<i>Bolitoglossa mulleri</i>	Todd Pierson
<i>Bolitoglossa pacaya</i>	Renato Morales

(page 50)

<i>Bolitoglossa salvinii</i>	Javier Sunyer
<i>Bolitoglossa suchitanensis</i>	Sean Rovito
<i>Bolitoglossa tenebrosa</i>	Adriana Girón
<i>Craugastor daryi</i>	Renato Morales
<i>Craugastor xucanebi</i>	Renato Morales
<i>Cryptotriton monzoni</i>	Sean Rovito
<i>Dendrotriton rabbi</i>	Carlos Vásquez Almazán
<i>Duellmanohyla soralia</i>	Sean Rovito
<i>Ennomiohyla minera</i>	Carlos Vásquez Almazán
<i>Ennomiohyla salvaje</i>	Andrew Snyder
<i>Incilius aurarius</i>	Todd Pierson
<i>Nyctanolis pernix</i>	Renato Morales
<i>Oedipina motaguae</i>	Manuel Acevedo
<i>Plectrohyla avia</i>	Manuel Acevedo
<i>Plectrohyla hartwegi</i>	Manuel Acevedo
<i>Plectrohyla ixil</i>	Carlos Vásquez Almazán
<i>Plectrohyla tecunumani</i>	Manuel Acevedo
<i>Pseudoeurycea rex</i>	Sean Rovito

(page 51)

<i>Ptychohyla hypomykter</i>	Todd Pierson
<i>Exerodonta perkinsi</i>	Carlos Vásquez Almazán

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Bolitoglossa xibalba
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