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Climatic Niche Dynamics During the Recovery of Lost Anurans in Costa Rica

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Zusammenfassung

Ziel: Froschlurche (Anuren) haben weltweit beschleunigte Populationsrückgänge erlebt, die in einigen Fällen bis an den Rand des Aussterbens führten. Dennoch sind in den letzten Jahren einige dieser Arten wieder aufgetaucht, wobei weiterhin unklar ist, ob bestimmte Umweltbedingungen ihre Erholung begünstigen. Ziel dieser Arbeit ist es, die Persistenz nach dem Rückgang bei acht betroffenen Anurenarten neu zu bewerten, indem Veränderungen in der vorhergesagten klimatischen Eignung und den realisierten klimatischen Nischen zwischen Zeiträumen vor und nach den Populationsrückgängen quantifiziert sowie potenzielle klimatische Refugien identifiziert werden, die das Fortbestehen dieser Arten unterstützen.

Untersuchungsgebiet: Costa Rica sowie angrenzende Gebiete im südlichen Nicaragua und westlichen Panama.

Methoden: Ich kalibrierte Ensemble-Species-Distribution-Modelle (SDMs) getrennt für beide Perioden, indem ich eine umfassende Zusammenstellung historischer und aktueller Vorkommensdaten, Klimadaten sowie vier Modellierungsalgorithmen kombinierte. Ich quantifizierte Veränderungen der vorhergesagten geeigneten Fläche, um Änderungen der Verbreitungsgröße zu bewerten. Darüber hinaus untersuchte ich die Dynamik der klimatischen Nische mithilfe ordinationsbasierter Ansätze, einschließlich des Centroid of Occupied Environmental Space (COUE)-Frameworks und des Niche Margin Index (NMI), wodurch die Bewertung von Nischenstabilität, -expansion und -unbesetzung im Zeitverlauf ermöglicht wurde.

Ergebnisse: Sieben der acht Arten zeigten starke Kontraktionen der durch ihre realisierten Nischen abgedeckten Fläche vor und nach ihren Rückgängen (−45,6 % bis −97,9 %), was eher auf einen weit verbreiteten Verlust der realisierten klimatischen Nische als auf eine flächendeckende Erholung der Verbreitungsgebiete hinweist. Nur eine Art (der Rotaugenlaubfrosch *Agalychnis annae*) zeigte eine deutliche Zunahme der vorhergesagten geeigneten Fläche. Die Nischendynamik war heterogen: Während einige Taxa eine hohe Überlappung zwischen den Zeiträumen aufwiesen (hohe Stabilität bei gleichzeitig erheblichem „Unfilling“), zeigten sechs Arten Nischenerweiterungen, da sich Vorkommen nach dem Rückgang in Richtung der Nischenränder oder außerhalb des historischen Nischenraums verschoben, wie der NMI zeigt. Über alle Taxa hinweg konzentrierte sich die Persistenz auf stark eingeschränkte Refugialgebiete, einschließlich klimatisch marginaler oder potenziell krankheitsmindernder Umwelten.

Schlussfolgerung: Die Ergebnisse zeigen, dass das Wiederauftreten rückläufiger Amphibienarten in Costa Rica überwiegend eine lokal begrenzte Persistenz in verbleibenden klimatischen Refugien widerspiegelt und nicht eine flächendeckende Wiederbesiedlung ihrer ursprünglichen Verbreitungsgebiete. Die Muster der Persistenz nach dem Rückgang stehen im Einklang mit dem Zusammenspiel von Krankheitsdruck, klimatischen Einschränkungen und artspezifischer ökologischer Plastizität, was zu heterogenen Ergebnissen führt, die von stabiler Nischenüberlappung bis hin zu marginaler Persistenz und Verschiebungen der klimatischen Nische reichen. Diese Ergebnisse unterstreichen die Bedeutung der Identifizierung und des Schutzes verbleibender Refugialgebiete und mahnen zur Vorsicht, Wiederentdeckungen allein als Beleg für eine erfolgreiche Erholung von Arten zu interpretieren.

Abstract

Aim: Anurans have experienced accelerated population declines globally, in some cases reaching the edge of extinction. Nevertheless, in recent years, some of these species have reappeared but it is still unclear whether there are particular environmental conditions favoring their recovery. Here, I reassessed the post-decline persistence of eight decline-affected anuran species by quantifying changes in predicted climatic suitability and realized climatic niches between pre- and post-decline period**s**, and to identify potential climatic refugia supporting the continued persistence of these species.

Location: Costa Rica and adjacent portions of southern Nicaragua and western Panama.

Methods: I calibrated ensemble Species Distribution Models (SDMs) separately for each study period combining an exhaustive compilation of historical and recent occurrence records, climatic data, and four modeling algorithms. I quantified changes in the predicted suitable area to assess changes in range size. I further examined climatic niche dynamics using ordination-based approaches, including the Centroid of Occupied Environmental Space (COUE) framework and the Niche Margin Index (NMI), allowing evaluation of niche stability, expansion, and unfilling across time.

Results: Seven of the eight study species exhibited strong contractions in the area covered by their realized niches before and after their declines (−45.6 % to −97.9 %), suggesting widespread loss of realized climatic niche rather than range-wide recoveries. Only one species (the golden-eye treefrog, *Agalychnis annae*) showed an evident increase in predicted climatic space. Niche dynamics were heterogeneous: while some taxa showed high overlap between

periods (high stability with substantial unfilling), six species displayed niche expansions due to post-decline occurrences shifting toward niche margins or being outside the historical niche envelope, as indicated by NMI. Across taxa, persistence was concentrated in highly restricted refugial areas, including climatically marginal or potentially disease-mitigating environments.

Main conclusions: These results demonstrate that the resurgence of declining amphibian species in Costa Rica predominantly reflects localized persistence restricted to remnant climatic refugia rather than geographic range-wide recovery. Post-decline persistence patterns are consistent with the interaction of disease pressure, climatic constraints, and species-specific ecological plasticity, resulting in heterogeneous outcomes that range from stable niche overlap to marginal persistence and climatic niche shifts. These findings underscore the importance of identifying and protecting remaining refugial regions and caution against interpreting rediscovery alone as evidence of successful species recovery.

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Finally, I would like to thank my father, **Hamid Aref Zahed**, for setting up a terrarium when I was a child that allowed me to observe the incredible metamorphosis of common toads (*Bufo bufo*). We collected only a small number of tadpoles from a nearby pond that was heavily overcrowded, cared for them in a species-appropriate manner, and released them back into the same area where they had been collected. Being able to observe on a daily basis how these animals literally developed arms and legs, and caring for them, sparked my lasting fascination with amphibians and nature and contributed to my motivation to study their ecology and conservation. As my father does not speak English, I would like to include the Farsi version:
در پایان تشکر می‌کنم از پدرم حمید عارف زاهد که در دوران کودکی برای من یک تراریوم فراهم کرد و این امکان را به من داد تا تبدیل شگفت انگیز وزغ های معمولی را از نزدیک مشاهده کنم. ما تعدادی از این بچه وزغ ها را از برکه جمع اوری کردیم و به مناسب محیط زیستشان ازشان مراقبت کردیم و سپس آنها را در همان مکان که جمع اوری کرده بودیم در طبیعت ازاد کردیم. با مشاهده روزانه تکامل دست و پا این جانوران که چگونه به طور طبیعی رشد می‌کنند، علاقه من را به دوزیستان و طبیعت برانگیخت و انگیزه من را برای مطالعه محیط زیست و حفاظت از آنها برانگیخت.

1. Introduction

The Anthropocene is witnessing a biodiversity crisis, in which extinction numbers exceed natural background levels by far (Ceballos et al., 2015; Pimm et al., 2014), raising concerns about a sixth mass extinction (Barnosky et al., 2011; IPBES, 2019). The International Union for Conservation of Nature (IUCN) Red List has evaluated more than 172,600 species, of which more than 48,600 are listed as threatened with extinction (IUCN, 2026). Biodiversity loss can trigger cascading consequences for humans and beyond humans (Ceballos et al., 2017). The main direct drivers include land- and sea-use change (habitat loss and degradation), direct exploitation, invasive alien species, pollution, and climate change, as well as interactions among these pressures, largely driven by human activities (IPBES, 2019). While many species exposed to such pressures have already gone extinct or continue to decline (Ceballos et al., 2015), others can persist or rebound, particularly where threats are mitigated and conservation action is effective (Bolam et al., 2021; Hoffmann et al., 2010). Understanding which ecological and life-history characteristics shape vulnerability, persistence, and recovery is therefore crucial for anticipating biodiversity trajectories and prioritizing conservation under global change (Fisher & Owens, 2004; Purvis et al., 2000).

Amphibians remain the most threatened among all vertebrates (Luedtke et al., 2023). According to the IUCN Red List, at least 41 % of all amphibians known globally are classified as threatened (IUCN, 2026). The extinction rate of anurans has dramatically increased since the 1970s (Alroy, 2015) but it was only in the 1990s that it started to be officially discussed (Gardner, 2001; Houlahan et al., 2000; Lips, 1998; Pounds & Crump, 1994). The widespread decline of anuran populations has been linked to multiple stressors, including pathogens, pesticides, habitat alterations, climate change, and invasive species (Carrasco et al., 2021; Cushman, 2006; Kats & Ferrer, 2003; Rohr & McCoy, 2010; Skerratt et al., 2007). The interactions between these stressors can have complex effects, with synergistic interactions being most common, followed by antagonistic effects (Rohr & Palmer, 2013). Among pathogens, the most important is the fungal pathogen *Batrachochytrium dendrobatidis* (hereafter, Bd) (Longcore et al., 1999), which causes chytridiomycosis, a deadly skin disease that affects most amphibian species (Berger et al., 1998). Bd has been pointed out as the cause of declines in over 500 species, including 90 presumed extinctions (Lambert et al., 2020; Scheele et al., 2019).

In Latin America, there is robust evidence that amphibian populations were negatively affected by Bd (Lips et al., 2008) but also by climatic anomalies, leading to widespread amphibian declines across the region (Young et al., 2001). In Costa Rica, the decline of amphibian populations started to be noticed during the 1980s (Bolaños Vives, 2009) and affected many species across the country (Lips, 1998; Pounds & Crump, 1994; Whitfield et al., 2016). Currently, the recent population trend for anurans shows that 66 species are stable, 56 are decreasing, 10 are increasing, and 23 are unknown. Three species are classified as extinct, and 21 are critically endangered (IUCN, 2026).

In recent years, several Costa Rican anurans that had severely declined and were previously considered extinct or possibly extinct have been rediscovered after long periods without confirmed records (e.g., García-Rodríguez et al., 2012; Leenders, 2016; Nadkarni & Wheelwright, 2000; Pounds et al., 2006; Puschendorf et al., 2005; Ryan et al., 2005). This pattern is not restricted to isolated cases but also applies to the focal species studied in this thesis, such as *Agalychnis annae*, *Agalychnis lemur*, *Atelopus varius*, *Craugastor ranoides*, *Duellmanohyla uranochroa*, *Isthmohyla rivularis*, *Isthmohyla tica*, and *Lithobates vibicarius*, which represent a subset of decline-affected species for which post-decline persistence or rediscovery has been comparatively well documented (Barrio Amoros et al., 2021; García-Rodríguez et al., 2012; Leenders, 2016; Nadkarni & Wheelwright, 2000; Pounds et al., 2006; Pounds & Crump, 1994; Puschendorf et al., 2005; Ryan et al., 2005).

Significantly, rediscovery does not equate to demographic recovery but is indicative of persistence in small, geographically confined relict populations that are extremely susceptible to stochastic disturbances, epidemics, and environmental degradation (Jiménez & Alvarado, 2017; Stuart et al., 2004). Therefore, identifying areas that offer the most favorable climatic and environmental conditions for persistence is critical to guide targeted conservation efforts for these critically endangered taxa.

Building on previous work that predicted suitable regions for relict populations of endangered frogs in Costa Rica using SDMs (García-Rodríguez et al., 2012), I developed the present thesis to reassess post-decline persistence in a subset of these affected taxa by quantifying changes in their predicted geographic suitability and realized climatic niches between the pre- and post-decline periods. In addition, this thesis includes *Agalychnis lemur*, a threatened species not considered in the original study.

Specifically, the aim of this thesis is to reassess post-decline persistence and recovery by quantifying changes in predicted geographic suitability and realized climatic niches between the pre- and post-decline periods, with the explicit objective of identifying potential climatic refugia that may support long-term persistence after population collapse.

To address this aim, I compiled occurrence records for all eight focal species from multiple sources, including museum specimen databases, global biodiversity repositories, citizen-science observations, and published literature records, and applied a standardized cleaning workflow to reduce spatial and taxonomic errors. I then modeled climatic suitability separately for pre- and post-decline periods using an ensemble SDM framework with multiple algorithms. Finally, I quantified changes in realized climatic niches between periods using complementary ordination-based niche metrics (COUE and NMI), which allow separating niche stability, expansion, and unfilling and determining whether post-decline occurrences persist within historical niche cores or extend towards margins (Broennimann et al., 2012, 2021; Guisan et al., 2014). This approach also allows testing the hypothesis that disease-driven declines contract species towards their historical niche cores rather than margins (Scheele et al., 2023, 2025).

Following this introduction, chapter two describes the study system, data sources and preprocessing, the environmental predictors, and the SDM and niche-comparison methods. Chapter three presents results on temporal and spatial occurrence patterns, changes in predicted suitable area, and climatic niche dynamics across species. Chapter four discusses these outcomes in species-specific sections and synthesizes cross-species patterns in relation to disease and habitat constraints. Finally, I conclude by summarizing key findings, including identifying climatic refugia and illustrating monitoring priorities as well as informing conservation strategies for amphibians that are challenged with decline in Costa Rica.

2. Methods

2.1 Study species

The study system of my thesis comprises eight anuran species that have experienced severe population declines across their known distributions in Costa Rica (Fig. 1). Most species are endemic to southern Central America and underwent sharp decimations and local extirpations during the amphibian decline crisis of the 1980s and 1990s (Lips, 1998; Pounds & Crump, 1994; Whitfield et al., 2016; Young et al., 2001). In the last decade, however, several relict and newly documented populations of these affected species have been rediscovered (Barrio

Amoros et al., 2021; Zumbado-Ulate et al., 2011, 2021), providing an opportunity to investigate whether recently reported populations represent shifts in geographic ranges and climatic niches relative to the pre-decline period.

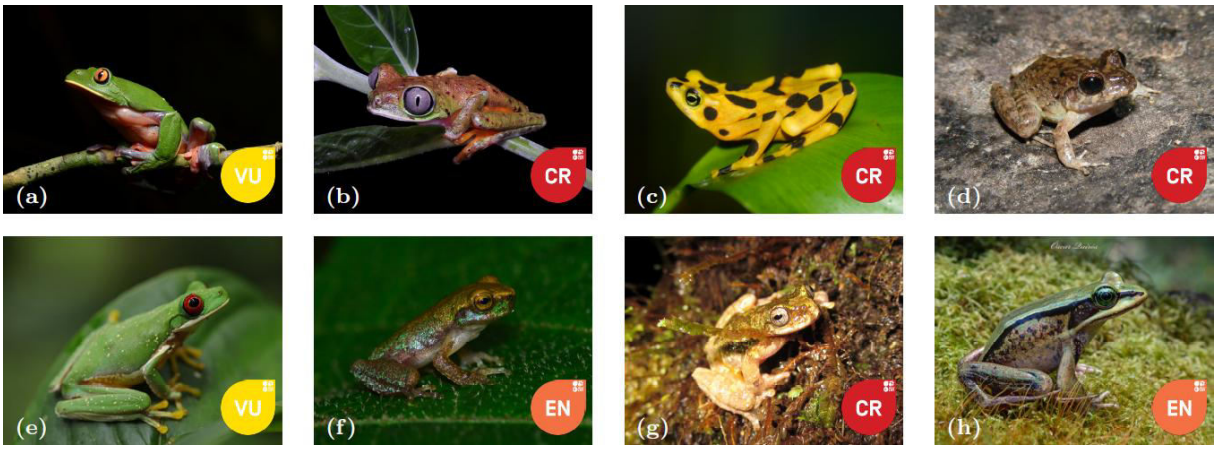


Figure 1: Study species: (a) *Agalychnis annae* (photo: Yucheol Shin); (b) *Agalychnis lemur* (photo: Andrés Espinoza Fonseca); (c) *Atelopus varius* (photo: Brian Gratwicke); (d) *Craugastor ranoides* (photo: Victor Acosta Chaves); (e) *Duellmanohyla uranochroa* (photo: Travell Erdan); (f) *Isthmohyla rivularis* (photo: Anthony Ramírez Murillo); (g) *Isthmohyla tica* (photo: Richard Monte Verdense); (h) *Lithobates vibicarius* (photo: osgeo photowild). All pictures are available on iNaturalist or NaturalistaCO.

Agalychnis annae (blue-sided treefrog; Fig. 1a) is a pond-breeding tree frog (Hylidae) that uses vegetation around small water bodies for reproduction (Hoffmann, 2006). This species is endemic to Costa Rica and Panama (IUCN SSC Amphibian Specialist Group, 2020a). It was historically found in the Central Valley of Costa Rica and surrounding premontane ranges, possibly extending into Cerro Colorado in western Panama (Arguedas-Porras, 2018; Hertz et al., 2011; Savage, 2002). This species declined sharply in pristine habitats during the 1980s and 1990s (H. Hoffmann, 2006; Kubicki, 2004), probably due to Bd, although remnant populations seem to exhibit tolerance to the pathogen (De León et al., 2019). After being classified as an endangered species in the IUCN assessments of 2002, 2008, and 2017, its current IUCN conservation status is Vulnerable (IUCN SSC Amphibian Specialist Group, 2020a).

Agalychnis lemur (lemur leaf frog; Fig. 1b) is a lightly built tree frog characterized by developed webs on either the fingers or the toes (Arguedas-Porras, 2018; Hertz et al., 2011; Savage, 2002). This species historically ranged from Costa Rica through Panama into northwestern Colombia, inhabiting humid lowland and montane forests between 440 and 1,600 m elevation (IUCN SSC Amphibian Specialist Group, 2020b; Kubicki, 2004). Due to severe population declines since the 1990s, largely attributed to chytridiomycosis,

compounded by habitat loss and climate change, the species is listed as Critically Endangered (IUCN SSC Amphibian Specialist Group, 2020b).

Atelopus varius (variable harlequin toad; Fig. 1c) is a small, slim-bodied toad with vivid aposematic colors, typically yellow-orange to lime-green overlain by irregular black mottling and a pattern that varies widely among individuals (Savage, 2002). It was historically widespread in Costa Rica and Panama, but now is classified as Critically Endangered and restricted to a handful of remnant populations (Barrio Amoros et al., 2021; Ryan et al., 2005). Regional surveys report that of 169 historically documented populations, only seven are known to persist in Costa Rica. Severe declines were registered from the late 1980s into the 1990s and are strongly associated with Bd acting with other environmental stressors (Lips et al., 2006; Pounds et al., 2006). Recent syntheses for the *Atelopus* genus indicate ongoing threat pressure and no clear, broad recovery signal, so current data are insufficient to conclude that declines have stabilized (Barrio Amoros et al., 2021; IUCN SSC Amphibian Specialist Group, 2020c).

Craugastor ranoides (streamside robber frog; Fig. 1d) is a medium-sized leaf-litter frog with a slender body, relatively long limbs, and an elongated, pointed snout; its dorsal coloration ranges from light brown to dark olive with darker mottling, which provides effective camouflage along stream banks and forest floors (Kubicki, 2004; Savage, 2002). Historically, the species occurred from Nicaragua through Costa Rica into western Panama, primarily inhabiting lowland and premontane forests in close association with small streams. It is currently listed as Critically Endangered, having disappeared from most of its former range, including protected areas (Zumbado-Ulate et al., 2011, 2014, 2022). Severe declines are mostly due to Bd, with habitat loss and degradation as additional threats (IUCN SSC Amphibian Specialist Group, 2020d).

Duellmanohyla uranochroa (Costa Rica brook treefrog; Fig. 1e) is a small, red-eyed treefrog found in moist lowland and montane forests and rivers in Costa Rica and Panama, between 300 m and 1,750 m elevation. The species has notably declined in regions such as Monteverde and is considered Vulnerable (IUCN SSC Amphibian Specialist Group, 2020e; Leenders, 2016) according to the IUCN conservation ranking. Chytridiomycosis is regarded as a significant potential threat, though Bd has never been detected in this species (De León et al., 2019).

Isthmohyla rivularis (Cinchona plantation treefrog; Fig. 1f) is a tan-colored, slender-bodied treefrog with relatively long limbs, typically seen perched in low vegetation along small

mountain streams, where males call throughout the year (Duellman, 1970). The species is endemic to Costa Rica and likely western Panama (IUCN SSC Amphibian Specialist Group, 2020f), and used to occur mainly in the Tilarán and Central mountain ranges, with additional records from the margins of the Talamanca range (Sasa et al., 2010; Savage, 2002). Major threats for this species include habitat loss and chytridiomycosis, and it is listed as Endangered due to its small and declining population (IUCN SSC Amphibian Specialist Group, 2020f).

Isthmohyla tica (Starrett's treefrog; Fig. 1g) is a nocturnal, stream-breeding hylid endemic to Costa Rica, which has been documented historically in the montane forests of the Cordillera Central and Talamanca ranges at elevations of 1,100–1,700 m. It reproduces along small, clear streams where males call from vegetation overhanging the water (Kubicki, 2004; Savage, 2002). Populations have suffered significant declines, with chytridiomycosis suspected as the primary driver, compounded by habitat loss from agriculture and deforestation, leading to the IUCN ranking of Critically Endangered (IUCN SSC Amphibian Specialist Group, 2020g).

Lithobates vibicarius (green-eyed frog; Fig. 1h) is a relatively large ranid with a robust body, smooth skin, and a distinctive green iris (Savage, 2002). It historically occupied highland rainforests (1,500–2,700 m) of Costa Rica and western Panama, where it bred early in the rainy season along montane streams, depositing gelatinous egg clutches (Kubicki, 2004; Savage, 2002). The species nearly disappeared from its former range and only a few populations have been documented over the last two decades (Acosta-Chaves et al., 2019). Major threats include chytridiomycosis, habitat loss, and the impacts of agricultural chemicals, leading to an Endangered conservation status (IUCN SSC Amphibian Specialist Group, 2020h).

To characterize the climatic niche and geographic range dynamics of the species studied, I conducted an exhaustive compilation of geographic and climatic data and combined it with SDM techniques and ordination approaches.

2.2 Study area

The study area encompasses a portion of Central America, specifically spanning from 7° to 11.5° North latitude and from 87° to 79.75° West longitude. This extent includes Costa Rica and parts of neighboring countries such as Nicaragua and Panama. To ensure analyses were limited to climatic conditions from terrestrial habitats, I applied a land mask using a shapefile of national boundaries obtained from Natural Earth (https://www.naturalearthdata.com/; Natural Earth, 2024). This allowed the exclusion of marine areas and offshore data points, ensuring that climatic and species occurrence data were geographically consistent and ecologically relevant.

The resulting study area fully represents the known and potential range of the focal amphibian species. These preprocessing steps collectively helped improve the reliability of the data and ensured that SDMs were built upon ecologically meaningful and statistically sound datasets (Roberts et al., 2017; Zurell et al., 2020).

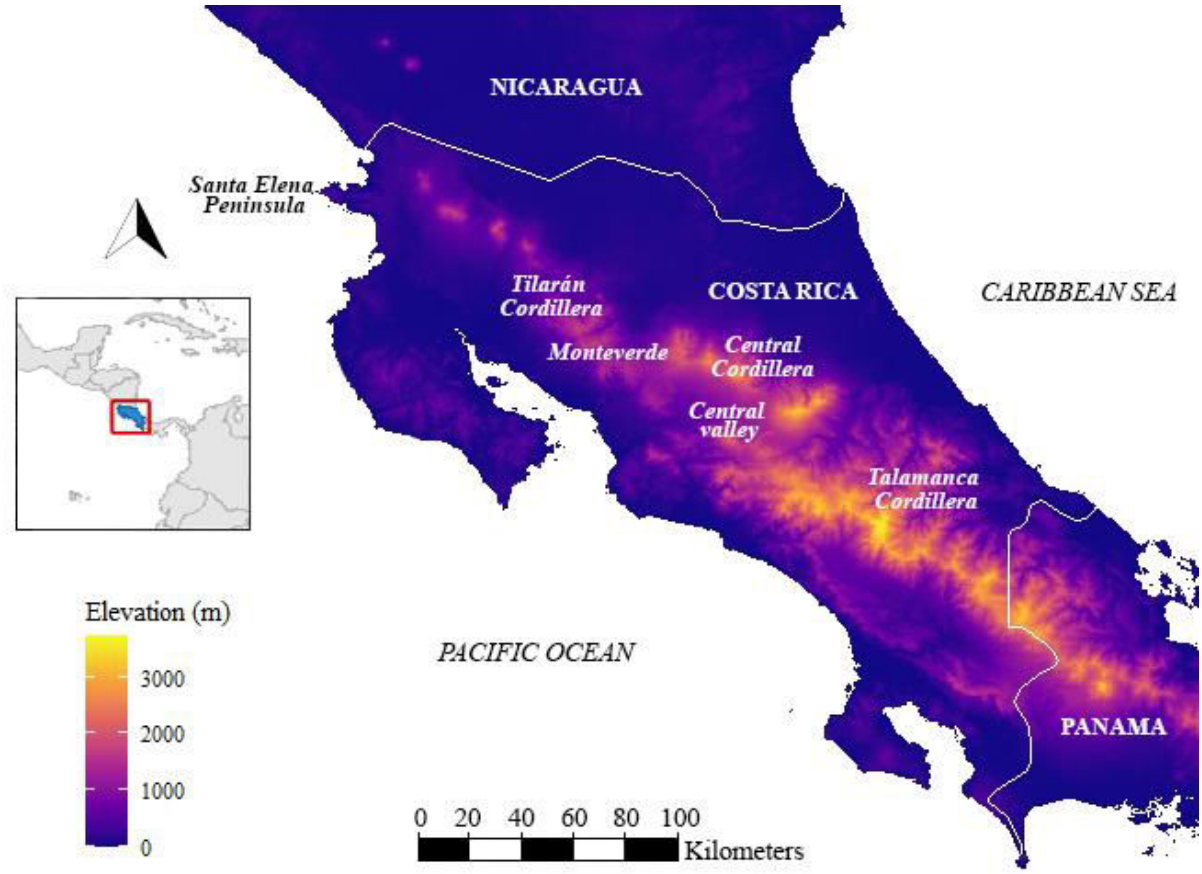


Figure 2: Study area in Costa Rica and adjacent parts of Nicaragua and Panama showing its topography.

2.3 Occurrence data

I gathered geographic point data on the species' historical distributions as well as on the most recent rediscovery reports from four main sources: 1. the Herpetology Collection of the Zoology Museum of Universidad de Costa Rica (https://mzcr.ucr.ac.cr; MZUCR), 2. the Global Biodiversity Information Facility (https://www.gbif.org; GBIF 2025), 3. the citizen science platform iNaturalist (https://www.inaturalist.org/), and 4. the published literature on recent rediscoveries. The MZUCR is the national repository of herpetological vouchers in Costa Rica and hosts over 24,000 cataloged specimens; therefore, it allows access to well-curated and precise data on species identifications and distributions (Sasa et al., 2025). Complementarily, GBIF is an international open-access platform that aggregates biodiversity

data from multiple sources, including museums, research institutions, and citizen science initiatives worldwide. It also provides access to complementary historical occurrences corresponding to specimens collected in the country but deposited in herpetological collections abroad. iNaturalist is a citizen science platform and social network for sharing biodiversity observations (*iNaturalist – A Community for Naturalists*, 2008). It represents a relevant source of recent observations, often accompanied by photographic evidence. Access to photographic evidence for each species allows cross-validation of species identifications. The published literature provides verified rediscovery records and associated locality information that may not yet be represented in online occurrence databases; for each rediscovery report, I extracted the locality (XY coordinates when available or georeferenced from the description), the date of rediscovery, and any supporting evidence such as voucher specimens or diagnostic photographs. As a reference system, I used WGS84 for the coordinates, vectors, and raster layers. Integrating these sources is particularly important for covering the full range of available information on species distributions and thereby obtaining a realistic reconstruction of the species' realized climatic niches (Elith & Graham, 2009).

Once all occurrence records were compiled, I performed a multi-step cleaning workflow to minimize spatial and taxonomic errors before subsequent analyses. To ensure data quality and reduce the risk of including erroneous records, I filtered species occurrence data prior to any exploratory analyses (including temporal plots), following established protocols (Zurell et al., 2020). I removed duplicate entries and records with missing, blank, or invalid coordinates. I then applied an automated coordinate plausibility screening using the R package CoordinateCleaner (Zizka et al., 2019), retaining only records flagged as "clean". Specifically, I excluded occurrences located at country centroids or capitals, institutional coordinates, zero coordinates, records with identical latitude and longitude, occurrences matching GBIF data-quality flags, and points falling in the sea (tests: capitals, centroids, equal, gbif, institutions, zeros, seas).

For the MZUCR dataset I filtered the data to the focal study species and removed records without coordinates (missing or empty latitude/longitude). I converted latitude, longitude, year, and catalog fields to numeric format and removed duplicates, defined as records sharing the same species, year, and geographic coordinates (longitude and latitude).

For GBIF records, I applied an equivalent cleaning strategy (removal of records without coordinates, duplicate removal using the same species–year–coordinate rule, and the same coordinate plausibility screening). In addition, I performed a spatial validation step using

species range polygons obtained from the IUCN Red List. I used range polygons as a plausibility filter to exclude spatial outliers and likely misgeoreferenced records. Occurrence points were retained only if they intersected (or touched) the corresponding IUCN range polygon; to reduce false exclusions due to minor georeferencing imprecision or polygon generalization, I used a small buffer of 5 km around the range polygons prior to intersection testing.

Finally, the cleaned MZUCR and GBIF datasets were combined into a common set of variables and merged. After merging, duplicates were removed again with the same species–year–coordinate criterion to produce the final occurrence dataset used for analyses. Furthermore, I partitioned all occurrence records into pre-decline and post-decline subsets on a species-specific basis, using the documented year of disappearance of each species as the cut-off. These cut-offs were derived from museum catalog notes, expert criteria, and published accounts for each taxon. I summarized the temporal structure using species-level histograms in Figure 2, where the vertical dashed line marks the cut-off year. Pre-decline records were used to characterize historical distributions and realized climatic niches, while post-decline records were reserved to assess contemporary persistence and validate projections.

Several species have shown recovery or have been rediscovered after their declines. For the analyses conducted in my thesis, I worked only with those that have a minimum of five records before and after the decline, as this threshold is the minimum number of occurrences needed to conduct the climatic comparisons between pre- and post-decline climatic niches (Broennimann et al., 2012). After this step, 12 species were excluded.

2.4 Environmental predictors

For the reconstruction of climatic niches and the SDMs, I sourced climatic variables from the WorldClim 2.1 dataset (https://www.worldclim.org/data/worldclim21.html). The dataset contains 19 abiotic variables that summarize annual means, seasonality, and limiting extremes of temperature and precipitation derived from monthly minimum/maximum temperature and precipitation for 1970–2000 at 30-arc-second (1 km) resolution (Fick & Hijmans, 2017). First, I cropped all climatic layers (and, where relevant, masked them) to the geographic extent of the study area to ensure that a posteriori assessment of collinearity reflects the correlations of the environmental conditions available within the study region. To reduce multicollinearity among environmental predictors and avoid information redundancy (Dormann et al., 2013), I conducted a variance inflation factor (VIF) analysis (O'Brien, 2007). From this, I retained only

variables with VIF values below the threshold of 10 (Zizka et al., 2019). Based on this, the following uncorrelated climatic variables were retained for modeling:

Table 1: Subset of WorldClim 2.1 bioclimatic variables used as environmental predictors.

Variable	Description
BIO1	Annual Mean Temperature
BIO2	Mean Diurnal Range (mean of monthly [Tmax - Tmin])
BIO4	Temperature Seasonality (SD × 100)
BIO10	Mean Temperature of Warmest Quarter
BIO11	Mean Temperature of Coldest Quarter
BIO16	Precipitation of Wettest Quarter
BIO17	Precipitation of Driest Quarter
BIO18	Precipitation of Warmest Quarter

2.5 Species distribution models

For each species, I calibrated three SDM sets based on data partitioning and each set comprised four candidate algorithms:

(i) a full-data model ("All") fitted with all available occurrence records,
(ii) a pre-decline model fitted with occurrences at or before the species-specific cut-off year, and
(iii) a post-decline model fitted with occurrences after that cut-off.

To model current and historical habitat suitability, I used an ensemble SDM approach implemented in the BIOMOD2 R package (Thuiller et al., 2023). For each species, I combined presence records with 10,000 randomly generated pseudo-absences to strengthen the contrast between occupied and unoccupied environmental conditions and to support stable model training (Barbet-Massin et al., 2012; Van der Wal et al., 2009). I selected four algorithms – Generalized Linear Models (GLM), Generalized Additive Models (GAM), Random Forest (RF), and Gradient Boosting Machines (GBM) – to cover a broad range of statistical and machine learning techniques (Table 2). GLMs served as an interpretable baseline using a specified link function, whereas GAMs extended GLMs by fitting smooth functions to capture non-linear responses. RF is a decision-tree ensemble that averages predictions across many trees built on random subsets of the data, improving accuracy and reducing overfitting. In contrast, GBM builds trees sequentially to iteratively correct previous errors and capture subtle

patterns. The combination of the described algorithms allowed me to integrate both interpretability and flexibility into the ensemble framework while minimizing the reliance on any single modeling assumption (Elith & Graham, 2009; Marmion et al., 2009).

Table 2: Overview of modeling approaches used in this study.

Name	Description
GLM	GLM served as my baseline model. It models linear relationships between predictors and the response variable given a specified link function and makes it straightforward to interpret effects of variables. I used GLMs to understand basic species-environment associations and to compare more complex models to a well-understood benchmark (Dobson & Barnett, 2018).
GAM	To model nonlinear species-environment relationships without losing interpretability, I used GAMs. These models extend GLMs by replacing linear terms with smooth functions, freeing me to capture ecological thresholds or unimodal responses that frequently occur in species distributions (Wood, 2017).
RF	I included RF to leverage the power of decision-tree ensembles. RF builds multiple decision trees on random subsets of data and predictors and averages their outputs, which improves predictive accuracy and reduces overfitting. This method handles complex interactions and non-linearities well, making it particularly valuable when species respond to multiple interacting climate variables (Cutler et al., 2007).
GBM	GBM, in turn, allowed me to capture even finer patterns in the data. GBM builds trees sequentially, with each new tree correcting the errors of the previous one. This iterative learning process often results in high predictive performance and has proven effective in species distribution modeling, especially when patterns in the data are subtle or noisy (Elith et al., 2008).

By combining these four algorithms, I built an ensemble that balances generalizability, interpretability, and accuracy (Araujo & New, 2007; Thuiller et al., 2009). This strategy improves model robustness and reduces the risk of biased predictions caused by any single modeling approach. Model performance was assessed using multiple complementary metrics (Table 3), including the Boyce Index, which evaluates whether presences are predicted more frequently in high-suitability than low-suitability areas and was used to weight ensemble models (excluding models with Boyce values < 0.6) (Boyce et al., 2002); the True Skill Statistic (TSS), which balances sensitivity and specificity and is robust to prevalence (Allouche et al., 2006); the Area Under the ROC Curve (AUC), a threshold-independent measure of discrimination between presences and absences (Fielding & Bell, 1997); and Cohen's Kappa, which quantifies agreement between predicted and observed occurrences while accounting for

chance (Manel et al., 2001). TSS, AUC, and Cohen's Kappa were calculated to provide complementary perspectives on model discrimination and classification performance but were not used for model filtering or ensemble weighting, which relied exclusively on the Boyce Index (Supplementary Table in the Annex).

Table 3: Evaluation metrics used to assess model performance.

Name	Description
Boyce	The Boyce Index evaluates how much more frequently the model predicts presences in high-suitability areas compared to low-suitability ones. It works especially well with presence-only or pseudoabsence data and captures how well predictions align with the environmental preferences of a species (Boyce et al., 2002). I relied on the Boyce Index to weight models in the ensemble and excluded models with a score below 0.6.
AUC	AUC assesses the model's ability to distinguish between presences and absences without requiring a classification threshold. This metric offers a threshold-independent evaluation of discrimination power and supports comparison across models. While AUC doesn't measure calibration, it remains valuable for identifying how well models separate suitable from unsuitable areas (Fielding & Bell, 1997).
Kappa	Cohen's Kappa helps quantify agreement between predicted and observed presence–absence values while adjusting for chance agreement. Kappa is especially helpful when interpreting binary model outputs and complements TSS by adding another angle on classification consistency (Manel et al., 2001).
TSS	TSS directly balances sensitivity and specificity, making it ideal for presence–absence or presence–pseudoabsence data. Unlike simple accuracy, TSS remains unaffected by prevalence and provides a meaningful measure of model reliability under class imbalance (Allouche et al., 2006).

To avoid inflating model accuracy due to spatial autocorrelation, I applied a block cross-validation strategy (Roberts et al., 2017), which divides the study area into four spatially independent blocks. This approach reduced data leakage between training and testing sets and better simulated real-world scenarios where models must predict into unsampled regions (Hijmans, 2012; Roberts et al., 2017; Wenger & Olden, 2012). By combining the four evaluation metrics mentioned above with a spatially structured validation, I aimed to conduct a model evaluation that is statistically rigorous, ecologically meaningful, and relevant for conservation-focused predictions. This modeling framework provided a rigorous foundation for assessing range shifts and identifying potential climatic refugia for the species studied.

Model performance was evaluated using four complementary metrics: True Skill Statistic (TSS), Area Under the ROC Curve (AUC), Cohen's Kappa, and the Boyce Index. Each metric contributes a unique perspective on prediction quality.

2.6 Climatic niche comparisons

To evaluate climatic niche changes after the decline of the studied amphibian species in Costa Rica, I applied two complementary approaches that compare pre- and post-decline realized niches in a common climatic space. First, I used the COUE framework (Broennimann et al., 2012; Guisan et al., 2014), which projects occurrences into PCA-transformed climatic space and quantifies niche dynamics between time periods. From this approach, I derived three niche dynamics metrics: (i) niche stability, which is the proportion of the post-decline niche overlapping the pre-decline niche (i.e., retained climatic conditions); (ii) niche expansion, the proportion of the post-decline niche occurring in climatic conditions not occupied before the decline (newly occupied climatic conditions); and (iii) niche unfilling, the proportion of the pre-decline niche not occupied post-decline despite remaining available (previously occupied climates no longer used). In addition, COUE captures shifts in the centroid of occupied climatic space between periods, providing a direct measure of broad-scale niche displacement along the main climatic axes.

Second, I calculated the Niche Margin Index (NMI) (Broennimann et al., 2021) for all post-decline sites to assess whether they occur within the species' historical climatic niche. To define the accessible climatic background for each species, I extracted climate values within a 2.5 km buffer around pre-decline occurrences and conducted a PCA on the regional climatic background conditions to derive the environmental space. In mountainous regions, this buffer-based approach may slightly overestimate the extent of the pre-decline climatic niche by including nearby elevational gradients; however, this represents a conservative framework for evaluating whether post-decline occurrences remain within the historical niche space.

For each species, I then constructed a climatic envelope around pre-decline occurrences using kernel density estimation in this PCA-derived environmental space and computed NMI values as normalized distances of post-decline occurrences to the pre-decline niche boundary. NMI ranges from −1 to +1 and quantifies whether post-decline records fall closer to the core or toward the margins of the pre-decline climatic niche: values close to +1 indicate persistence within the climatic core, values near 0 indicate marginal conditions close to the niche boundary, and negative values indicate that post-decline occurrences fall outside the historical

niche. Values ≥ 0 therefore indicate that occurrences fall within the pre-decline niche envelope, whereas negative values indicate occurrences under marginal or outside-niche conditions not represented in the pre-decline occurrences.

By combining COUE and NMI, I aimed to capture both broad-scale changes in realized climatic niches (centroid displacement and overlap dynamics) and finer-scale assessments of niche contraction or erosion (margin distance). Together, these metrics allowed me to disentangle whether post-decline occurrences are associated with stable, shifting, or eroding climatic niches across species.

3. Results

3.1 Geographical range dynamics

The magnitude and timing of post-decline records differed markedly among species. Some species show clear clusters of recent localities, while others are characterized by isolated post-decline records separated by long temporal gaps. Species also varied in how strongly post-decline occurrences were skewed toward the most recent years.

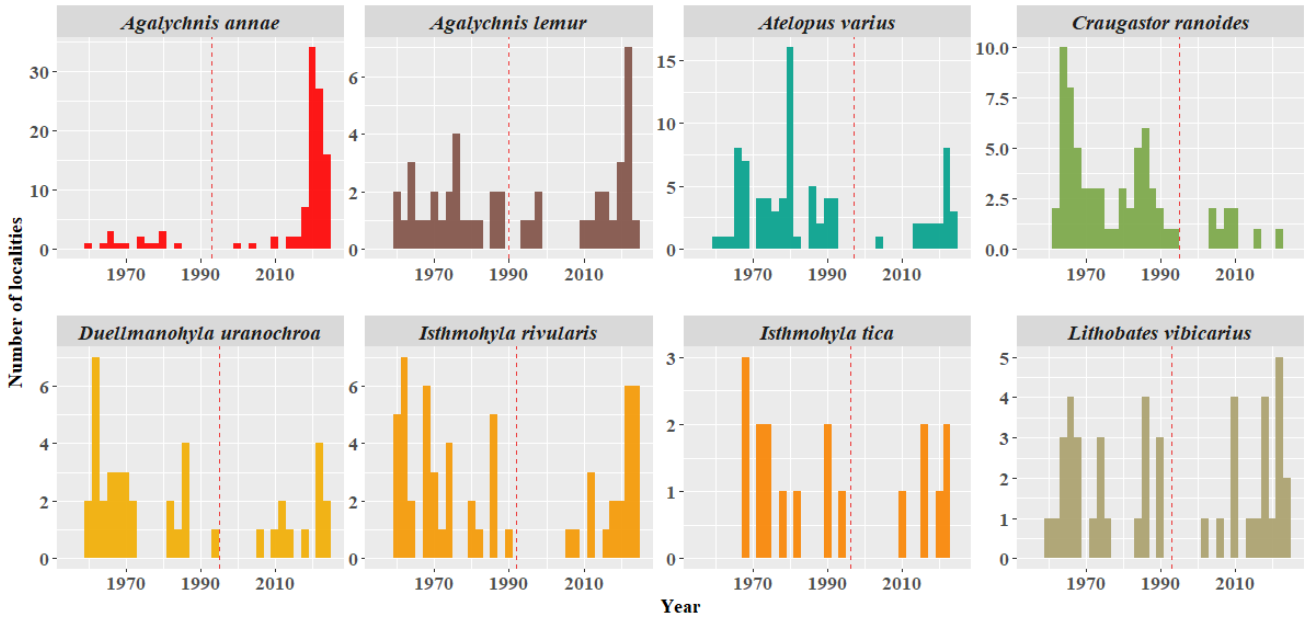


Figure 3: Temporal distribution of unique occurrence localities for all rediscovered species, separated by the species-specific decline cut-off year (red dashed line). Across taxa, most records are concentrated in the decades before the documented declines (mainly the 1960s–1990s), whereas post-decline occurrences are generally fewer and more sporadic, reflecting both the contraction of realized distributions and the rarity of confirmed detections after population collapse.

Overall, these temporal patterns provide the basis for the subsequent analyses of geographic range dynamics, where pre-decline records are used to represent historical distributions and post-decline records to characterize contemporary persistence and the spatial footprint of rediscoveries. To provide spatial context for the analyses, I mapped historical (pre-decline) and contemporary (post-decline) records for each focal species across Costa Rica (Fig. 4). This overview shows where recent observations coincide with historical localities along the main cordilleras, setting the stage for the SDM analyses that follow.

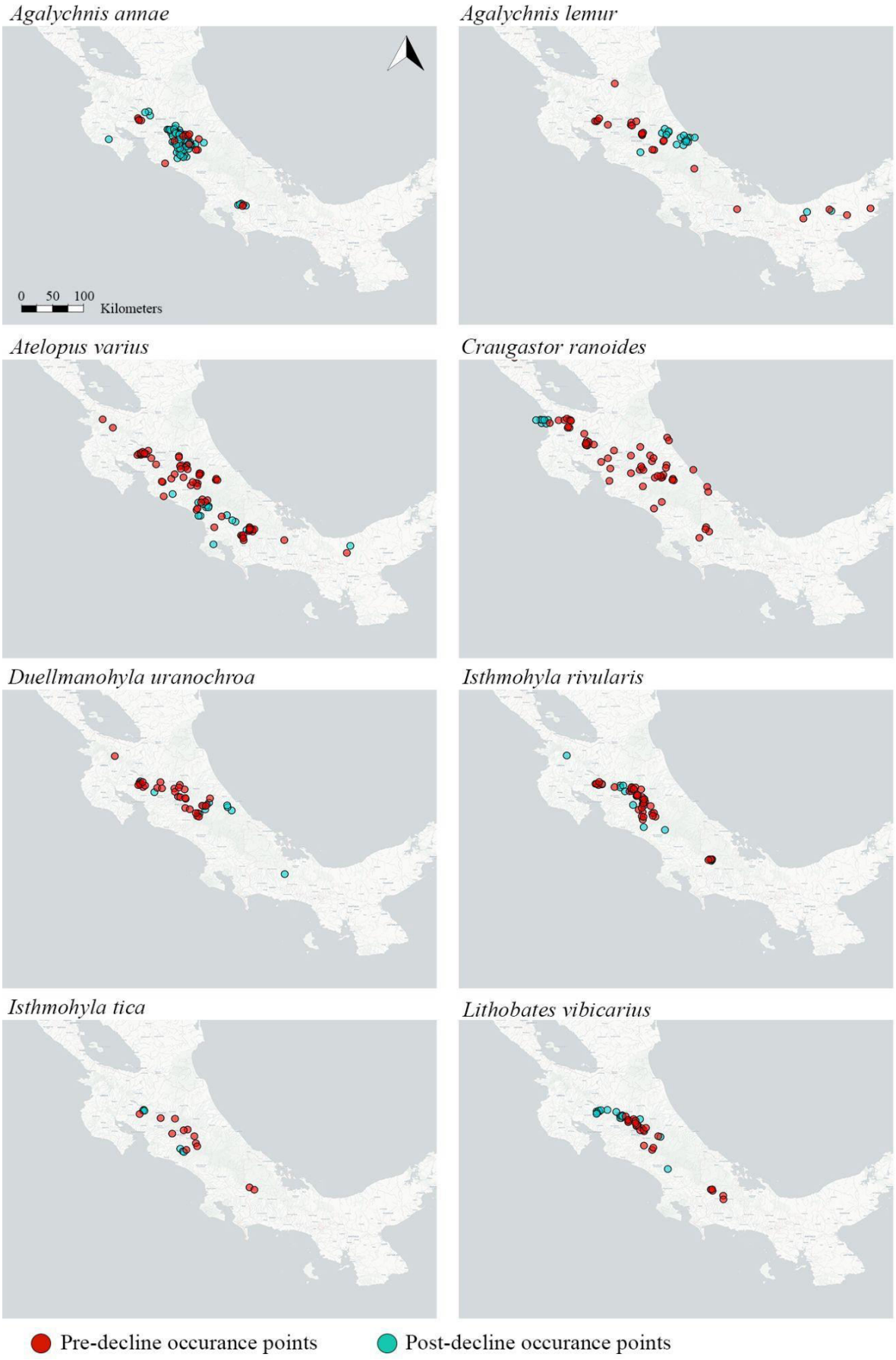


Figure 4: Spatial distribution of historical and contemporary occurrence records from 1961 to 2024.

Across most species, contemporary records are reduced and spatially restricted compared to historical distributions. *Agalychnis annae* remains concentrated in the Central Valley, with additional occurrences near Monteverde, on the Nicoya Peninsula, and close to the Panama border. *Agalychnis lemur* shows a shift toward the Caribbean slope. *Atelopus varius* exhibits a southward shift, with recent records concentrated in the Central and Southern Pacific, including the Osa Peninsula. In contrast, *C. ranoides*, formerly widespread, is now largely restricted to the northwestern Santa Elena Peninsula. *D. uranochroa*, previously recorded in the Central Valley and Monteverde, shows more recent occurrences on the Caribbean slope and a single record in western Panama. *I. rivularis*, formerly present in the Central Valley and Monteverde region, is no longer recorded from Monteverde and shows a highly fragmented distribution, including an isolated record in Guanacaste. *I. tica* remains associated with the Monteverde and Central Valley regions but appears strongly reduced, with only a single more recent record extending toward the Central Pacific. *Lithobates vibicarius* is no longer recorded from the Talamanca region and shows a westward shift from the Central Valley toward the Tilarán range and western portion of the Central range.

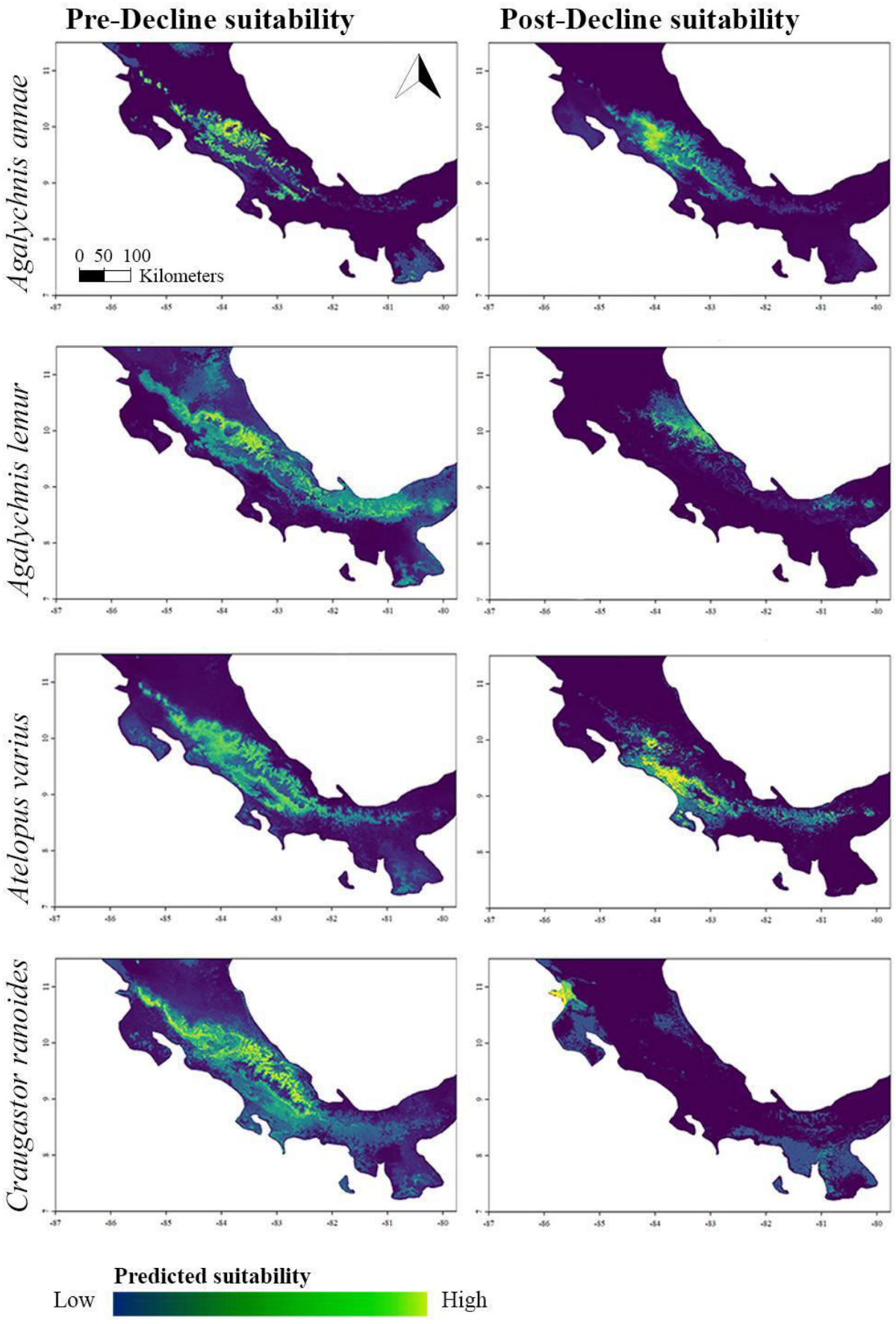
Table 4 reports the median (min–max) Boyce across candidate single models and the Boyce of the resulting ensemble; ensemble TSS is provided for additional context (Table 4). Across all species and periods, cross-validated median Boyce values of single models ranged from −0.40 to 0.74, while ensemble Boyce values ranged from 0.005 to 1.000, and the number of models retained for ensemble construction varied among species–period combinations (Table 4).

Table 4: Cross-validated SDM performance by species and period. For the Boyce Index, the table shows the median, minimum, and maximum. Metric values for the ensemble model are shown for the Boyce Index and the TSS.

Species	Period	N kept: Boyce ≥ 0.6	Boyce median	Boyce min	Boyce max	Ensemble Boyce	Ensemble TSS
Agalychnis annae	All	11	0.727	0.260	0.929	0.983	0.939
Agalychnis annae	Pre	5	0.454	-0.653	1.000	0.895	0.949
Agalychnis annae	Post	12	0.732	0.401	0.921	0.965	0.919
Agalychnis lemur	All	12	0.735	-0.047	1.000	0.940	0.773
Agalychnis lemur	Pre	8	0.635	-1.000	1.000	0.774	0.752
Agalychnis lemur	Post	8	0.551	-0.727	1.000	0.805	0.945
Atelopus varius	All	7	0.535	0.104	0.921	0.950	0.765
Atelopus varius	Pre	10	0.682	-0.361	0.952	0.639	0.829

Species	Period	N kept: Boyce ≥ 0.6	Boyce median	Boyce min	Boyce max	Ensemble Boyce	Ensemble TSS
Atelopus varius	Post	6	0.518	-0.485	1.000	0.710	0.903
Craugastor ranoides	All	7	0.554	-0.590	1.000	0.725	0.567
Craugastor ranoides	Pre	8	0.602	-1.000	1.000	0.940	0.640
Craugastor ranoides	Post	4	0.188	-1.000	1.000	1.000	0.997
Duellmanohyla uranochroa	All	6	0.501	-0.032	1.000	0.765	0.874
Duellmanohyla uranochroa	Pre	8	0.626	-0.305	1.000	0.979	0.880
Duellmanohyla uranochroa	Post	2	-0.400	-1.000	1.000	0.072	0.955
Isthmohyla rivularis	All	8	0.613	0.284	1.000	0.652	0.883
Isthmohyla rivularis	Pre	7	0.442	0.199	1.000	0.783	0.918
Isthmohyla rivularis	Post	5	0.186	-0.449	1.000	0.503	0.949
Isthmohyla tica	All	6	0.460	-0.238	1.000	0.246	0.881
Isthmohyla tica	Pre	6	0.510	-0.678	1.000	0.552	0.911
Isthmohyla tica	Post	7	0.344	-1.000	1.000	0.005	0.992
Lithobates vibicarius	All	10	0.742	0.302	1.000	0.651	0.894
Lithobates vibicarius	Pre	7	0.576	-0.200	1.000	0.705	0.887
Lithobates vibicarius	Post	6	0.548	0.031	1.000	0.828	0.899

The resulting ensemble SDM projections of climatic suitability for each species before and after the decline are shown in Fig. 5. For each species (rows), the left and middle panels show continuous suitability predictions for the pre- and post-decline periods, and the right panel shows the intersection of binarized maps (Pre ∩ Post), highlighting areas predicted suitable in both periods. These maps provide the basis for the subsequent assessment of geographical range dynamics.


Pre-Decline suitability
Post-Decline suitability
Agalychnis annae
Agalychnis lemur
Atelopus varius
Craugastor ranoides
0 50 100
Kilometers
Predicted suitability
Low
High

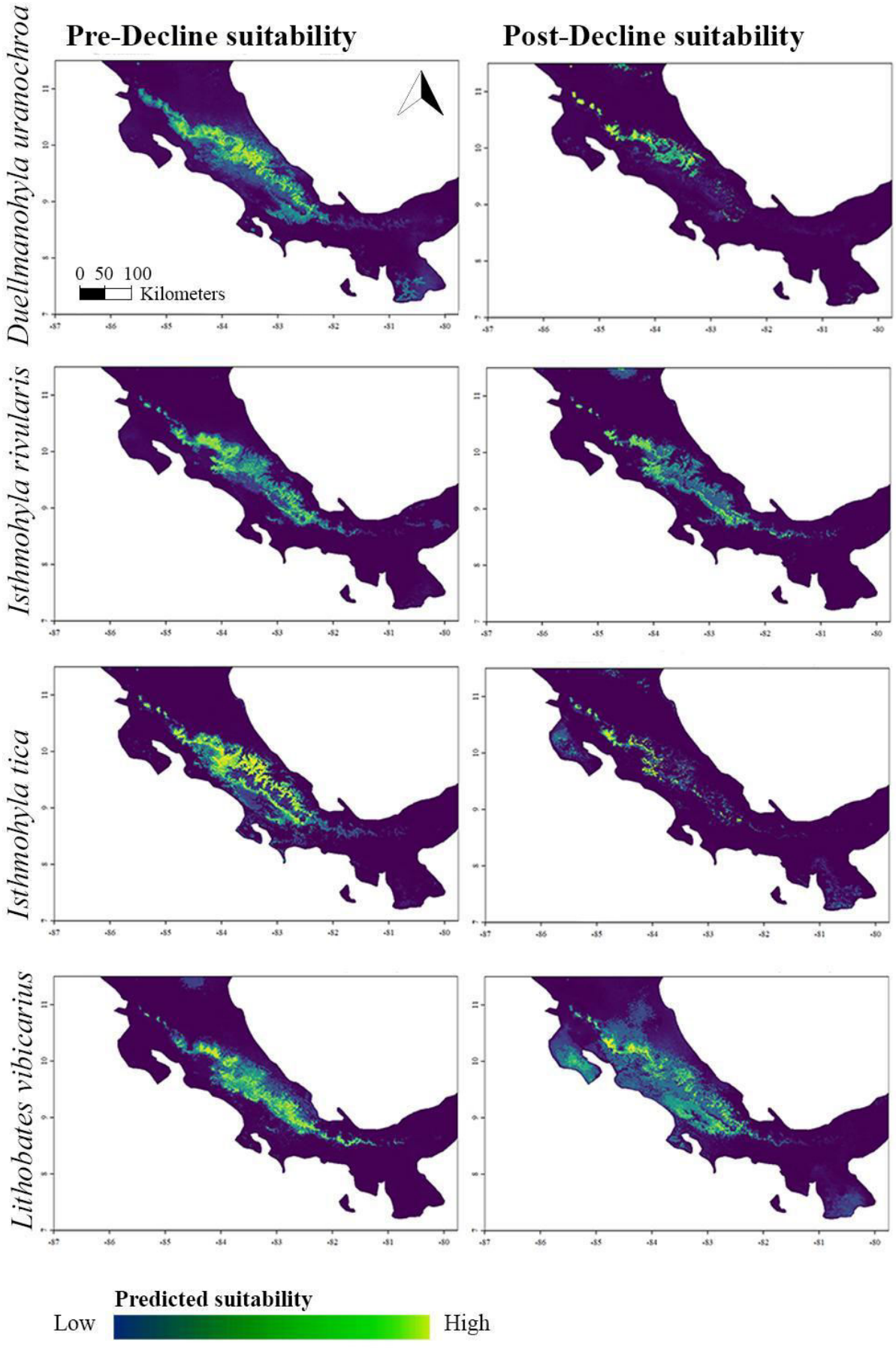

Pre-Decline suitability
Post-Decline suitability
Duellmanohyla uranochroa
Isthmohyla rivularis
Isthmohyla tica
Lithobates vibicarius
0 50 100
Kilometers
Predicted suitability
Low
High

Figure 5: SDM predictions of climatic suitability areas across time periods. For each species (rows), the left and middle panels display continuous ensemble suitability predictions for the pre-decline and post-decline periods, respectively. The right panel shows the intersection of binarized suitability maps (Pre ∩ Post), highlighting areas predicted suitable in both periods.

Across most species, post-decline suitability is markedly reduced compared to pre-decline conditions, reflecting substantial contractions of geographic ranges and climatic niches. In contrast, *A. annae* represents an exception, showing a relative increase in predicted suitable area.

Following the ensemble projections shown in Fig. 5, I quantified changes in the extent of predicted suitable area between the pre- and post-decline periods. Only models with Boyce index values ≥ 0.6 were retained for ensemble construction. Continuous ensemble suitability outputs were converted to binary maps using the threshold that maximized the True Skill Statistic (TSS), a commonly used and relatively conservative approach that balances sensitivity and specificity (Allouche et al., 2006). For each species and period, I calculated the total area classified as suitable and computed the percentage change as

$$\frac{(Apost - Apre)}{Apre * 100}$$

where *Apre* and *Apost* denote the total predicted suitable area in the respective period (Fig. 6 & 7).

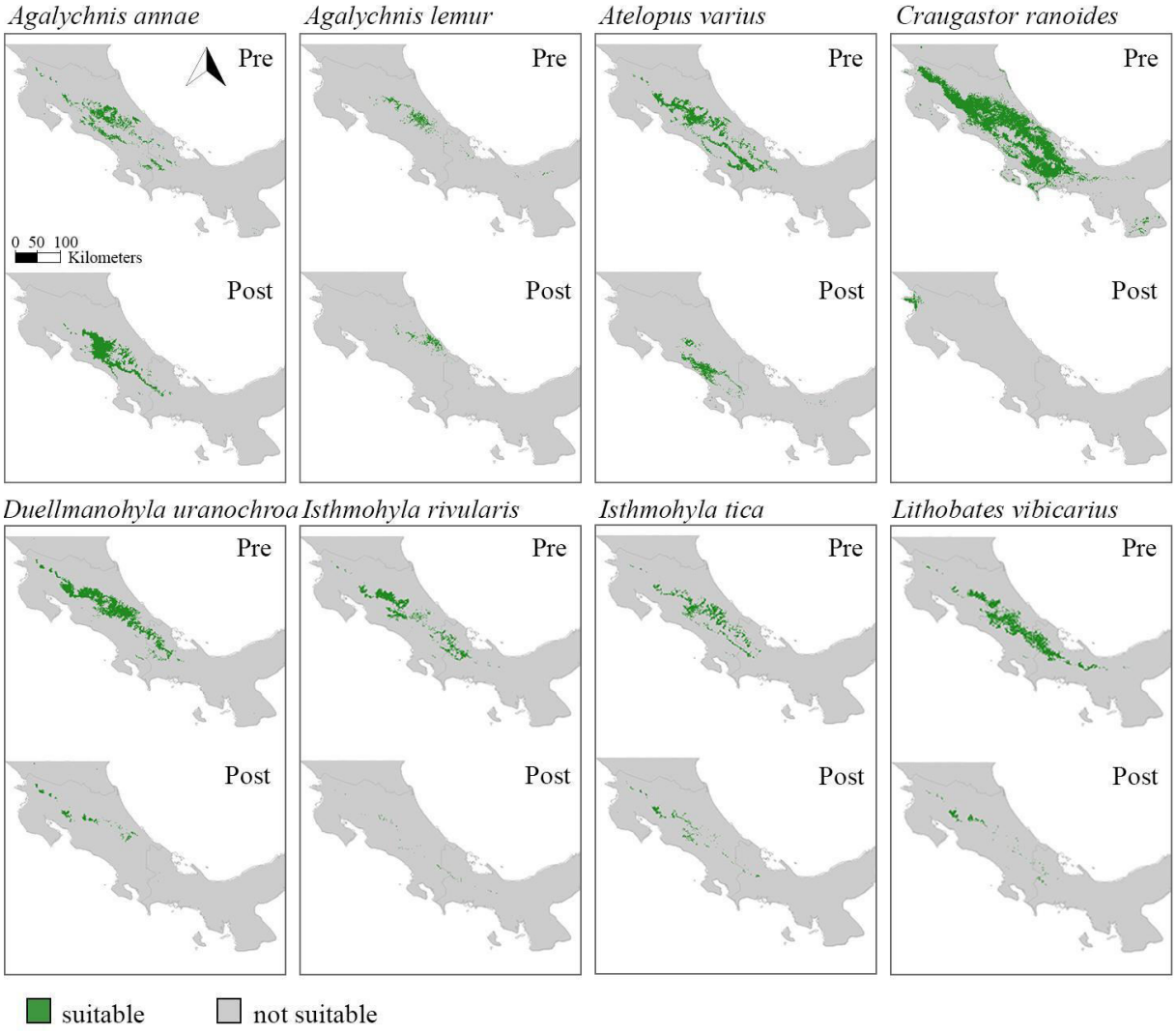


Figure 6: Binary maps based on the maximum TSS threshold and showing the predicted suitable areas for each of the species studied. Maps show separately the prediction for pre-decline and post-decline periods. Green pixels indicate climatically suitable areas, whereas grey areas represent unsuitable conditions.

I found pronounced interspecific differences in the spatial extent and configuration of climatically suitable areas between the pre- and post-decline periods. For seven of the eight species, post-decline climatic suitability is markedly more restricted and fragmented, with large portions of historically suitable areas no longer predicted as suitable (Fig. 6). In contrast, *A.*

annae is the exception showing a larger post-decline suitability pattern, consistent with the increase in predicted suitable area.

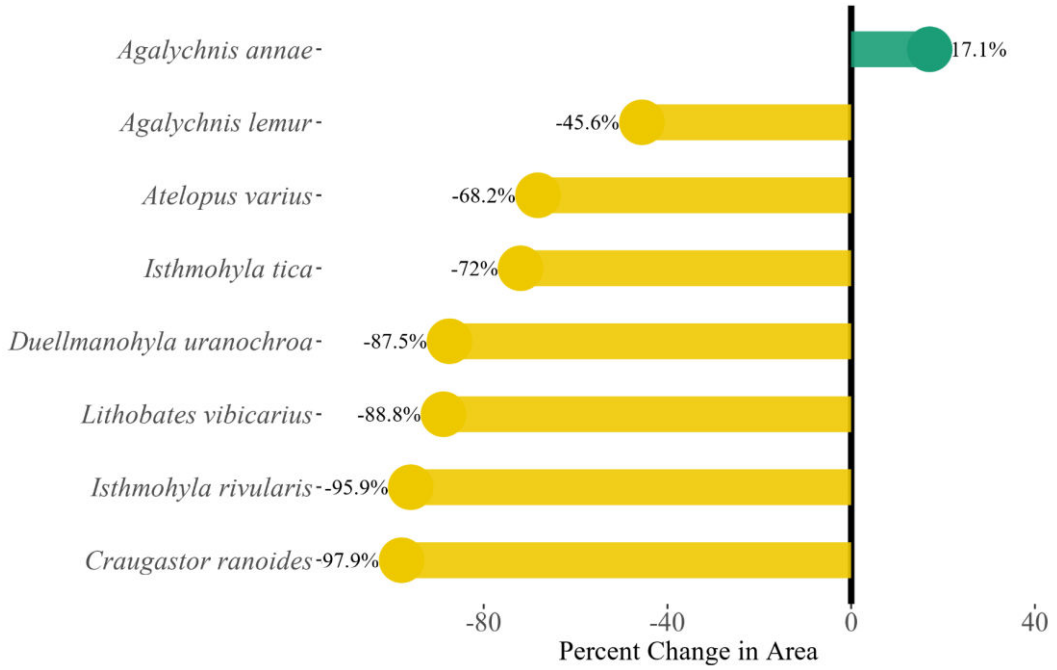


Figure 7: Change in predicted suitable area between pre- and post-decline periods.

Across species, the predicted suitable area decreased in seven of eight cases, indicating widespread contractions of current realized niches, and only *A. annae* showed an increase. Together, these results summarize the magnitude and direction of suitability changes suggested by the spatial projections and provide the basis for subsequent analyses of range dynamics and persistence.

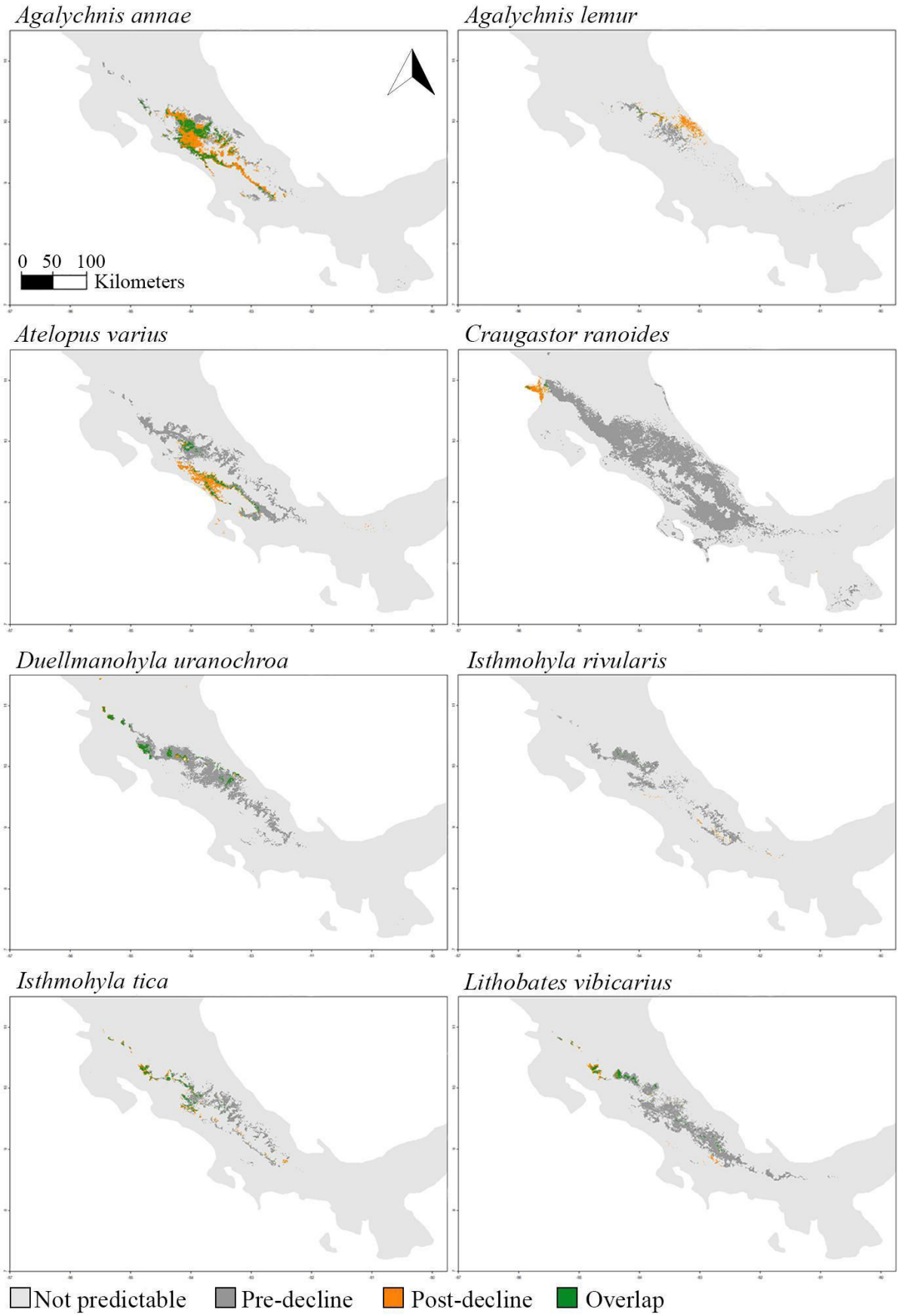


Figure 8: Spatial comparison of binary ensemble predictions illustrating changes in climatic suitability between pre-decline and post-decline periods for the eight focal species. Light grey areas indicate locations not predicted as suitable in either period, grey areas represent suitability

restricted to the pre-decline period, orange areas indicate suitability restricted to the post-decline period, and green areas represent overlap where suitability is predicted in both periods.

Changes in climatic suitability are dominated by loss of historically suitable areas (pre-only; light grey) across most species, whereas areas predicted suitable in both periods (overlap; green) are generally limited to small, spatially clustered refugial zones (Fig. 8). Post-decline-only suitability (orange) is sparse in most taxa and, where present, occurs mainly adjacent to or within the broader historical suitability envelope rather than representing a clear spatial displacement. Similar to Fig 6., *A. annae* shows comparatively extensive overlap and noticeable post-decline-only areas, consistent with its net increase in predicted suitable area (Fig. 7).

3.2 Climate dynamics: Niche Margin Index and Centroid of Occupied Environmental Space

3.2.1 Niche Margin Index analyses

Across species, niche-space patterns were heterogeneous (Fig. 9). In some species, post-decline occurrences remain concentrated within the central portion of the pre-decline niche envelope, consistent with climatic continuity. In other species, post-decline records are restricted to smaller subsets of environmental space and are closer to the niche boundary, indicating a stronger climatic constraint in the post-decline period.

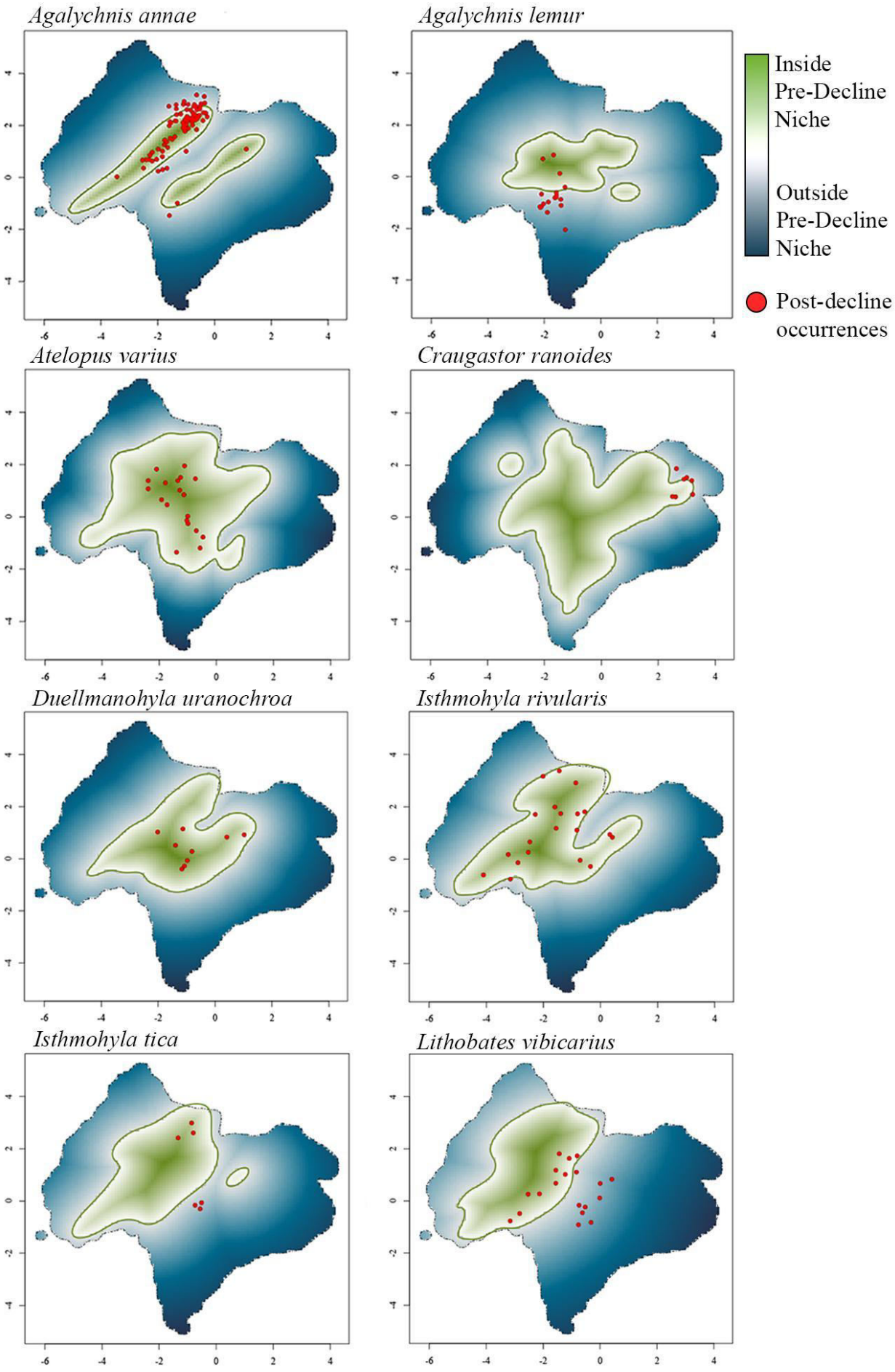

Agalychnis annae
Agalychnis lemur
Atelopus varius
Craugastor ranoides
Duellmanohyla uranochroa
Isthmohyla rivularis
Isthmohyla tica
Lithobates vibicarius
Inside Pre-Decline Niche
Outside Pre-Decline Niche
Post-decline occurrences

Figure 9: Niche Margin Index (NMI) in climatic PCA space for the eight focal species. PC1 and PC2 are the first two PCA axes of the bioclimatic predictors. Colours indicate NMI relative to the pre-decline niche (positive = inside; negative = outside). The green contour delineates the pre-decline niche and red points indicate post-decline occurrences.

To summarize these patterns across species, I examined the distribution of post-decline NMI values and grouped occurrences into three categories: outside the historical niche (NMI < 0), near-margin conditions (0–0.5), and core niche conditions (≥ 0.5). Species differed not only in central tendency but also in the spread of NMI values (Fig. 8). Species whose post-decline points span a broader range of NMI values indicate persistence across a wider portion of the historical climatic niche, whereas species with points concentrated near the lower NMI range appear restricted to more marginal conditions.

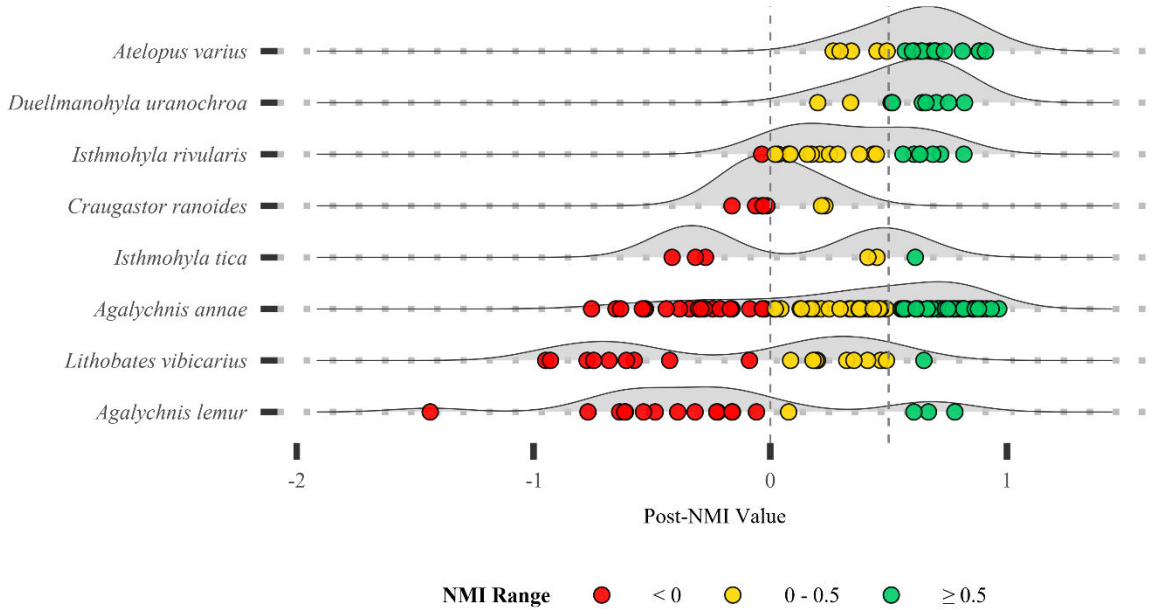


Figure 10: Distribution of post-decline Niche Margin Index (NMI) values across the eight study species. Points represent individual post-decline occurrence records, jittered vertically; ridgelines show the density of NMI values per species. Colors indicate NMI categories (< 0, 0–0.5, ≥ 0.5). Vertical dashed lines mark NMI = 0 and NMI = 0.5.

NMIs reveal contrasting patterns across species, ranging from niche conservatism to pronounced niche shifts. Clear niche conservatism is observed in *A. varius* and *D. uranochroa*, whose post-decline occurrences fall largely within the historical climatic niche. *Isthmohyla rivularis* shows a similar pattern, although some occurrences are located toward the margins of the historical niche.

In contrast, strong niche shifts are evident in *A. lemur*, *C. ranoides*, and *L. vibicarius*, where most post-decline occurrences fall outside the historical climatic niche. *Agalychnis annae* exhibits an intermediate pattern, with most occurrences still within the historical niche but a subset occupying novel conditions. *Isthmohyla tica* also shows a mixed pattern, with one population remaining within the historical niche (rather near its margins) and another clearly occurring outside of it, indicating a partial niche shift.

3.2.2 Centroid of Occupied Environmental Space

I quantified niche overlap and climatic niche dynamics between the historical (pre-decline) and contemporary (post-decline) distributions of each species using the COUE framework implemented in ecospat (Broennimann et al., 2012; Di Cola et al., 2017). The COUE analysis revealed pronounced differences in climatic niche dynamics among the focal species (Table 5, Fig. 10). Across species, post-decline niches showed high levels of niche stability combined with varying degrees of niche unfilling, indicating that large portions of the historically occupied climatic space are no longer used despite remaining available. Niche expansion was generally limited and remained below 12% for all species.

Table 5: Metrics of the COUE analysis: Shown are the proportions of niche expansion, stability, and unfilling between pre- and post-decline climatic niches for the species for which COUE metrics could be calculated.

Species	Expansion	Stability	Unfilling
Agalychnis annae	0.040	0.960	0.096
Agalychnis lemur	0.000	1.000	0.637
Atelopus varius	0.007	0.993	0.305
Craugastor ranoides	0.034	0.966	0.877
Duellmanohyla uranochroa	0.084	0.916	0.420
Isthmohyla rivularis	0.114	0.886	0.013
Lithobates vibicarius	0.096	0.904	0.260

The strongest niche unfilling was observed in *Craugastor ranoides*, whereas species such as *Agalychnis annae* and *Atelopus varius* retained a comparatively high proportion of their historical niche. Overall, the COUE results indicate that post-decline persistence is predominantly characterized by contraction within the historical climatic niche rather than by expansion into novel climatic conditions.

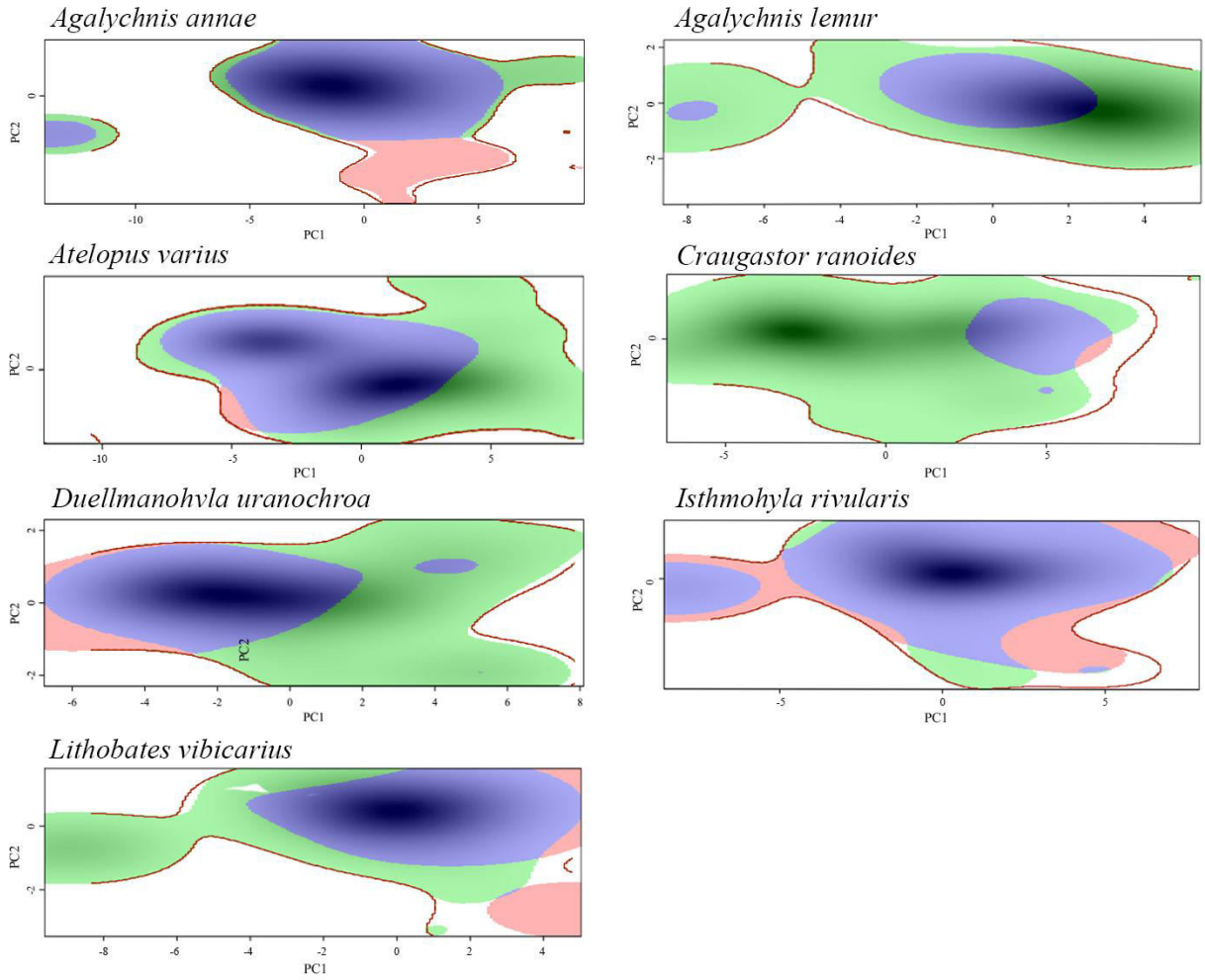


Figure 11: Climatic niche dynamics (COUE analysis) in PCA environmental space. PC1 and PC2 are the first two PCA axes of the bioclimatic predictors. Kernel density surfaces depict the climatic niche of pre-decline (green) and post-decline (blue) occurrences; red indicates niche expansion (post-only conditions) and green-only areas indicate unfilling (pre-only conditions).

Strong niche conservatism is evident in *A. lemur* and *A. varius*, which show near-complete stability and substantial unfilling with virtually no expansion, indicating persistence within a reduced portion of the historical climatic niche. A similar pattern is observed in *D. uranochroa*, which exhibits high stability alongside moderate unfilling and low expansion, suggesting contraction within the historical niche with only limited redistribution into adjacent environmental space. A comparable but slightly more variable pattern is found in *L. vibicarius*, where moderate unfilling and low expansion indicate partial contraction with some shift toward marginal conditions. In contrast, *C. ranoides* shows extreme niche unfilling with only limited expansion, indicating a severe contraction of its historical niche. Occurrences post-decline are mostly within the historical climatic niche but are displaced towards the margins, indicating a displacement of the niche core, and thus a directional niche shift within the historical niche.

Agalychnis annae shows a unique pattern of high stability, low unfilling, and limited expansion. Within the COUE framework, it exhibits only a slight shift in environmental space, with post-decline occurrences extending marginally toward warmer and drier conditions along the main PCA axis (PC1). However, niche equivalency and similarity tests do not indicate significant divergence, suggesting minor redistribution within the historical niche rather than expansion into novel climatic conditions. Finally, *I. rivularis* displays a relatively high stability with little unfilling but relatively high expansion, suggesting a more balanced dynamic, combining persistence in the historical niche and some use of adjacent or novel environmental conditions. In summary, COUE results suggest strong niche conservatism in *A. lemur*, *A. varius*, and *D. uranochroa*, whereas niche shifts are observed in *C. ranoides* and *I. rivularis*. *Agalychnis annae* and *L. vibicarius* show intermediate patterns or weak niche shifts.

4. Discussion

Despite repeatedly documented amphibian declines globally and particularly in tropical montane regions, it remains insufficiently resolved to what extent post-decline persistence reflects shifts in climatic niche space versus contraction within historically occupied conditions. This thesis addressed this gap by integrating SDM-based projections with niche margin analyses and COUE-derived niche dynamics to evaluate whether contemporary occurrences indicate climatic stability, marginal persistence, or species expansion into novel environmental space in response to the drivers of decline.

Across the eight focal species, the results reveal consistent overall trends: predicted suitable areas generally declined, except for *A. annae*, post-decline occurrences frequently occupied reduced subsets of the historical climatic niche, and niche dynamics were predominantly characterized by stability combined with unfilling rather than by expansion. Together, these findings suggest that post-decline persistence is more often associated with contraction within historically suitable climatic conditions than with shifts into novel environments.

4.1 Agalychnis annae

Agalychnis annae is the only focal species showing an increase, but post-decline persistence remains mostly centered within the historical climatic core and does not represent a large-scale geographic redistribution. This aligns with a niche conservatism dynamic with partial niche broadening during the species' post-decline recovery. This species has high ecological plasticity as an arboreal pond-breeder inhabiting fragmented and human-modified landscapes, with small

standing water bodies and surrounding vegetation (Hidalgo-Mora et al., 2021; H. Hoffmann, 2006; Savage, 2002). In Costa Rica, *A. annae* is frequently reported from peri-urban environments, gardens, coffee plantations, and modified riparian corridors, indicating a comparatively high tolerance to habitat alteration (García-Rodríguez et al., 2012; Hidalgo-Mora et al., 2021; Savage, 2002; Zumbado-Ulate et al., 2021). Its strong association with coffee agro-ecosystems is reflected in the common name "Rana de cafetal" (Coffee plantation frog) and human activity could even increase persistence opportunities relative to stream-dependent montane species (Hidalgo-Mora et al., 2021). Additionally, successful use of artificial containers in urban environments as breeding or foraging sites has been documented, further highlighting behavioral and habitat plasticity (Zumbado-Ulate et al., 2021). In addition, some contemporary populations may reflect human-mediated translocations rather than natural range expansion; however, this has not been fully confirmed for this species.

However, *A. annae* clustering patterns likely reflect not only ecological processes but also changes in the socio-ecological context of species detection. Many recent records originate from densely populated regions of the Central Valley, where observer presence and reporting effort are likely higher. For species that tolerate modified habitats and occur near human settlements, increases in observer density can strongly influence apparent distribution patterns. Spatial sampling biases in opportunistic and citizen-science datasets are widely recognized and may substantially shape inferred distributional trends (Boakes et al., 2010; Cretois et al., 2021; Isaac & Pocock, 2015; Meyer et al., 2016). Thus, the current pattern probably reflects a combination of climatic contraction toward core areas and increased detection probability in human-dominated landscapes. Nevertheless, even spatially biased records from previously undocumented areas represent genuine occurrences.

Demographic evidence indicates that persistence in human-modified landscapes may not imply long-term population stability. A study of a remnant population in the Central Valley found low annual survival, pronounced seasonality in reproductive activity, and small population sizes, suggesting that adults rarely survive beyond a single year (Arguedas et al., 2022). Similar life-history patterns – characterized by short lifespan and extended breeding activity – have been reported for other tropical anurans (Sinsch & Dehling, 2017) and have previously been suggested for *A. annae* (H. Hoffmann, 2006; Kubicki, 2004). Periods of inactivity during dry conditions further reflect adaptation to seasonal environments. High reproductive output reinforces this pattern: females can produce large clutches and reproduce repeatedly within a breeding season (Savage, 2002). Together with environmental variability, these traits position

A. annae toward the “fast” end of the fast–slow life-history continuum (Oli, 2004), implying rapid turnover and strong reliance on successful annual recruitment.

Disease dynamics may also help explain observed spatial and climatic patterns. *Agalychnis annae* declined during the chytridiomycosis-associated collapse in Costa Rica, and Bd infection has been detected in remnant populations (De León et al., 2019). Experimental studies have shown that Bd growth is highly sensitive to temperature gradients, performing optimally under moderate temperatures and showing decreased viability at higher temperatures (Piotrowski et al., 2004). Consistent with this mechanism, distribution models for Bd in Costa Rica identify warmer and seasonally drier regions – such as the Central Valley – as areas of reduced pathogen suitability and potential climatic refugia (Puschendorf et al., 2009).

The ability to survive in anthropogenic habitats seems higher in *A. annae* compared to other species, but this type of environment exposes A. annae to more threats, including water contamination and habitat fragmentation (Hamer & McDonnell, 2008). In this respect, the strengthening of the central niche and the weakening of some peripheral regions show that resilience can be achieved in the presence of limited favorable conditions rather than a general restoration process. In this case, it is necessary to conduct pathogen tests for further research (Arguedas et al., 2022).

4.2 Agalychnis lemur

Despite post-decline detections, *Agalychnis lemur* shows a pronounced decrease of 45.6% in its realized niche. This suggests that recent records do not represent a broad-scale recovery but rather persistence within a restricted portion of the species' historical range. This species is strongly associated with humid lowland and premontane forests and is generally absent from heavily modified or urbanized habitats (IUCN SSC Amphibian Specialist Group, 2020b; Savage, 2002). The historic distribution spans humid premontane zones and the lower portions of the lower montane belt, predominantly along the Caribbean versant from northwestern Costa Rica to western Panama, with more disjunct records on the Pacific slope (Savage, 2002). The species primarily inhabits undisturbed premontane wet forest and rainforest and occurs only marginally in lower montane wet forest types (Savage, 2002). Consequently, it is particularly sensitive to deforestation, forest fragmentation, and degradation of breeding habitats (IUCN SSC Amphibian Specialist Group, 2020b; Zumbado-Ulate et al., 2021).

Like *A. annae*, *A. lemur* is a prolonged breeder (Donnelly & Guyer, 1994). Its skin shows relatively low evaporative water loss (J. E. Young et al., 2005), suggesting a certain tolerance to warmer and drier conditions. Additionally, some studies indicate that the species may be more resistant to Bd than many other anurans (Woodhams et al., 2006). Nevertheless, the recovery of populations may be limited by several additional factors. The most important threats are inbreeding in small remnant populations, collection pressure, and chytridiomycosis, which may further limit recovery even where climatic conditions remain suitable (Zumbado-Ulate et al., 2021). Furthermore, the co-occurrence of several populations in the central Caribbean region may be partially due to reintroduction efforts in the early 2000s (Zumbado-Ulate et al., 2021) and current records may not solely represent natural recolonization.

Given the species' reliance on intact humid forest habitats, conservation priorities should include protecting remaining climatic refugia, maintaining or restoring connectivity among forest patches, enforcing existing legal protections, and conducting targeted surveys in areas predicted to remain suitable across time periods (Figs. 7–8). Without such measures, the long-term persistence of *A. lemur* is likely to remain precarious despite occasional post-decline records.

4.3 Atelopus varius

Atelopus varius disappeared between 1984 and 1996, leading to the temporary assumption that it had become extinct in Costa Rica (García-Rodríguez et al., 2012; La Marca et al., 2005). Fortunately, *A. varius* was later rediscovered (Ryan et al., 2005) in the South Pacific region of Costa Rica (Barrio-Amorós & Abarca, 2016; González-Maya et al., 2013) and has more recently also been documented in other sites in that region including the Alexander Skutch Biological Corridor (Jiménez-Monge et al., 2019).

Atelopus varius was widely considered extinct in Costa Rica for more than a decade following its disappearance in the late 1980s and early 1990s, before a surviving population was rediscovered in 2004 (García-Rodríguez et al., 2012; Pounds & Crump, 1994). Therefore, *A. varius* is considered a "Lazarus species", defined as a taxon that reappears after being presumed extinct (Barrio Amoros et al., 2021). Subsequent work has reinforced the extreme rarity of surviving populations. In 2021, of 169 historical localities recorded in the University of Costa Rica database, only seven populations were known to persist (Barrio Amoros et al., 2021).

Atelopus varius can be considered a K-strategist, characterized by a relatively long lifespan, slow growth, and late sexual maturity (Crump & Pounds, 1985; La Marca et al., 2005; Muths

et al., 2011; Pianka, 1970). In such long-lived species, population dynamics largely depend on adult survival, while recruitment from immature individuals replenishes the population (Gatgens García, 2025). When recruitment remains low, populations may become particularly vulnerable to collapse during mortality events because losses cannot be compensated effectively (Gatgens García, 2025; Lampo et al., 2012).

One major threat to adult survival is Bd. Captive populations of *A. varius* maintained under Bd-free conditions demonstrate that survival is possible in the absence of the pathogen (Lewis et al., 2019), reinforcing the conclusion that chytridiomycosis was a primary driver of the decline. However, thermal conditions may locally reduce pathogen performance. Analyses of individual body temperatures show that a small proportion of animals can reach temperatures exceeding the upper thermal limit for Bd development (Murphy et al., 2011; Piotrowski et al., 2004), which could potentially reduce infection risk in some microhabitats.

However, the rediscovery of the species has also made humans pay more attention to them. The surviving groups became the target of wildlife lovers and tourists who wanted to see and take pictures of these eye-catching toads. The presence of humans in their habitat is a risk as well as direct contact with the animal that does not have biosecurity measures to prevent the spread of diseases. Both activities are prohibited by the laws of Costa Rica regarding wildlife (Barrio Amoros et al., 2021).

In conclusion, it can be said that *A. varius* is an example of a species that has managed to survive despite a drastic decline and has only localized populations. Conservation measures must include the protection of the surviving groups, biosecurity measures, protection against illegal handling, and maintenance of captive assurance colonies. Otherwise, the species' long-term survival is highly doubtful.

4.4 Craugastor ranoides

Craugastor ranoides exhibits the most extreme reduction in realized niche among all species analyzed in this study, indicating an almost complete loss of climatically suitable habitat. Temporal patterns of occurrence records show a marked collapse during the decline period, followed by only very sparse post-decline detections highly restricted to the driest conditions of the species' geographic range.

Historically, *C. ranoides* was distributed across lowland and premontane areas of northwestern Costa Rica and adjacent regions, occurring in a variety of Pacific-slope habitats (Savage, 2002). During the 1990s and early 2000s, the species gradually disappeared from most of the country

and was considered “potentially extinct” in Costa Rica (Puschendorf et al., 2005; Sasa & Solórzano, 1995). Persistence was reported only from the tropical dry forest of the Santa Elena Peninsula (Guanacaste), where elevated temperatures and low precipitation were hypothesized to mitigate the effects of chytridiomycosis (Puschendorf et al., 2005).

One potential explanation is post-decline movement of populations from neighboring areas such as the Cordillera Volcánica de Guanacaste toward the Santa Elena Peninsula in response to epizootic outbreaks of Bd. However, given the short time frame available for such dispersal (approximately 15 years), this scenario is considered unlikely (Granados-Martínez et al., 2021). Notably, at least one pre-decline record exists near the Santa Elena Peninsula (Sasa & Solórzano, 1995), suggesting that *C. ranoides* may have historically occurred there at low densities. Consequently, the apparent post-decline expansion is more plausibly explained by limited survey effort in the periphery of its known distribution, resulting in truncated reconstruction of the niche in the pre-decline period, rather than true range expansion.

The contraction of the species’ range has effectively pushed *C. ranoides* into extremely warm and dry climatic conditions characteristic of tropical dry forest (Janzen, 1988). Although the species is considered highly susceptible to Bd (Puschendorf, 2009), multiple studies indicate that local environmental conditions in the Santa Elena Peninsula – mean annual temperatures exceeding 27°C and annual precipitation below 1,500 mm – may constrain Bd infection and transmission. Bd prevalence in this region is among the lowest reported, with only a single positive sample detected despite extensive screening (Zumbado-Ulate et al., 2014). Similar low prevalence has been reported in other environments outside the climatic core of Bd (Puschendorf et al., 2011; Rowley et al., 2013; Swei et al., 2011), supporting the interpretation that hot and dry environments may function as disease refugia.

Persistence in such marginal environments may represent substantial long-term risks in terms of the species’ population dynamics. For example, metapopulation theory predicts elevated extinction risk in remnant populations confined to sink habitats at the margins of a species’ range, where environmental conditions are suboptimal relative to the historical core (Marsh & Trenham, 2001; Vucetich & Waite, 2003). Species experiencing extreme range contractions often exhibit reduced resilience to additional stressors, loss of fitness, and erosion of genetic diversity (Holt et al., 2009; Martínez-Freiría et al., 2016). Furthermore, the reproductive ecology of *C. ranoides* remains unknown, limiting assessment of population viability (Zumbado-Ulate et al., 2011).

Overall, *C. ranoides* represents an extreme case of near-complete loss of its realized niche, with persistence largely confined to climatically marginal refugia. The tropical dry forest of the Santa Elena Peninsula harbors the only clearly supported core refugial population and is therefore of exceptional conservation importance (Janzen, 1986, 1988). Even though the area is already protected, the long-term persistence of *C. ranoides* depends on maintaining the ecological integrity of this ecosystem.

4.5 Duellmanohyla uranochroa

For *Duellmanohyla uranochroa,* I found a strong reduction (-87.5%) in the predicted area between the pre- and post-decline periods. Interpretation of these patterns is complicated by the limited ecological knowledge available for *D. uranochroa*. Although males are relatively easy to detect acoustically during the breeding season, the reproductive ecology of the species remains poorly understood (Savage, 2002). Historical ecological descriptions indicate that *D. uranochroa* is characteristically associated with stream environments in premontane wet forests and rainforests, and only marginally occurs in lower montane wet forest systems (Savage, 2002).

Chytridiomycosis has been suggested as a potential driver of decline in *Duellmanohyla uranochroa*; however, empirical evidence remains limited. Bd has not been conclusively detected in this species (De León et al., 2019), and field studies from La Fortuna, Panama, reported predominantly negative screening results in both adults and tadpoles, with individuals appearing healthy (Hertz et al., 2018). Notably, examined tadpoles lacked keratinized mouthparts (Hertz et al., 2018), a condition associated with Bd infection in other species (Knapp & Morgan, 2006), which may reduce detectable pathogen loads and lead to false-negative results (McMahon & Rohr, 2015). Consequently, the role of Bd in this species remains uncertain.

However, the restricted distribution pattern following the decline of *D. uranochroa* is of great significance. While many of the remaining populations reside in regions designated as protected areas, these regions have been subjected to various activities such as deforestation, illegal settlement, unauthorized tourism, and poaching, among others, due to poor surveillance mechanisms (Chaves-Acuña et al., 2020). The lack of adequate ecological information and unresolved disease dynamics, together with anthropogenic pressures, underscore the importance of carrying out monitoring programs, increased screening efforts for Bd, and further research into the reproductive biology of the species.

4.6 Istmohyla rivularis

Isthmohyla rivularis exhibits a strong post-decline reduction in realized niche, with predicted area decreasing by approximately 95.6% between the pre- and post-decline periods. This species has been historically associated with humid premontane and lower montane slopes of the Tilarán, Central, and Talamanca ranges, as well as adjacent regions of western Panama, typically occurring between approximately 1,210 and 2,040 m above sea level (Savage, 2002). The species is most frequently observed along or within clear stream systems in premontane and lower montane wet forests and rainforests, indicating a strong dependence on high-elevation, riparian habitats (Savage, 2002).

Dramatic declines affected *I. rivularis* and it was presumed extinct following widespread amphibian losses in the late 1980s (Nadkarni & Wheelwright, 2000). The species was subsequently rediscovered in 2007, confirming the persistence of at least one relict population (Jiménez et al., 2019). This pattern places *I. rivularis* among the group of Central American amphibians that reappeared after prolonged absence (García-Rodríguez et al., 2012). The species' restriction to specialized montane stream habitats likely increases its sensitivity to environmental change and may partly explain the pronounced reduction in its realized niche. Interpretation of post-decline persistence is further complicated by the limited ecological information available for this species. *Isthmohyla rivularis* is among the least studied of the focal taxa. This lack of information constrains the ability to assess population viability and to identify the dominant drivers shaping post-decline persistence.

Limb malformations in *I. rivularis* (Hedrick & Cossel, 2014) are a particular concern. Malformations can decrease individual fitness and recruitment, and such issues can have a disproportionate effect on small and re-emerging populations (Hayes et al., 2010). Malformations have been associated with various stressors in amphibians, including contaminants, parasites, and disease interactions, but the causes of malformations in *I. rivularis* are unknown (Hedrick & Cossel, 2014). Given the extremely limited distribution and low abundance of this species, even low frequencies of malformations could have negative consequences for population persistence.

My results indicate that *I. rivularis* persists as a relict species confined to a small number of climatically suitable sites. Its affinity for high-elevation, stream-associated habitats probably increases its sensitivity to environmental change. Coupled with its drastically reduced range, low abundance, and presence of limb malformations, this specialization emphasizes the

precarious status of the species. Targeted monitoring, focused surveys in predicted suitable habitats, and investigations of the drivers of malformations are thus critical to assess and support its long-term persistence.

4.7 Istmohyla tica

Isthmohyla tica was discovered only in the late 1950s (Starrett, 1966). The species was widely distributed in the mountainous regions of Costa Rica and was considered relatively common at several known sites (Savage, 2002). However, *I. tica* experienced a dramatic decline, with the last confirmed observation in Costa Rica dating to 1995 (García-Rodríguez et al., 2012). By the mid-2000s, *I. tica* was considered possibly extinct (Leenders, 2016). Subsequent reports from Panama and the Monteverde region in the early 2010s confirmed persistence at a small number of sites, but did not indicate recovery at the regional scale (Hertz et al., 2012; Leenders, 2016).

Recent observations complicate this narrative by demonstrating that *I. tica* can persist in landscapes that are more altered than previously assumed. While the species is usually reported from primary or only lightly disturbed forests (Leenders, 2016), individuals have also been documented in agro-ecosystems dominated by coffee plantations, particularly in the Zona de los Santos. In these areas, frogs were observed in narrow riparian forest remnants, secondary vegetation, and pasture edges, often in close proximity to coffee plants and human settlements (Hidalgo-Mora et al., 2022). These findings suggest a degree of ecological plasticity that may allow persistence in anthropogenically modified environments, provided that small forest patches and riparian vegetation are maintained.

However, persistence in such landscapes does not imply security. Many known remnant populations of *I. tica* and other endangered amphibians are located within areas nominally under private or state protection but are still affected by illegal activities such as logging, squatting, illegal tourism, and poaching, exacerbated by limited resources for effective surveillance (Chaves-Acuña et al., 2020; Zumbado-Ulate et al., 2021).

For my analysis, COUE metrics could not be calculated reliably and are therefore not reported. This is due to the extremely low number of post-decline occurrence records and their highly restricted distribution in climatic space, which prevents robust kernel density estimation and meaningful quantification of niche overlap. Consequently, climatic niche dynamics for *I. tica* are assessed using complementary approaches (SDMs and NMI) rather than COUE metrics.

From a conservation perspective, the occurrence of *I. tica* in coffee-dominated landscapes highlights both risks and opportunities. Although some agricultural practices harm amphibians,

other agricultural activities do not seem to cause problems. It is important to identify agricultural practices that do not interfere with the survival of amphibians (Hidalgo-Mora et al., 2022). Threatened species in the agroecological landscape also provide incentives for conservation, through raising the awareness of farmers or increasing the value of agricultural products produced using more ecological practices. Under these circumstances, *I. tica* can become a flagship species for biodiversity coffee cultivation. Persistence in the long term may rely on maintaining riparian vegetation, sustainable agricultural practices in relation to amphibians, and monitoring small populations.

4.8Lithobates vibicarius

Lithobates vibicarius exhibits one of the most severe post-decline reductions in realized niche among all focal species. The species is a cold-adapted, high-elevation ranid associated with cool, moist montane environments, occurring at elevations of up to approximately 2,700 m (Savage, 2002). Its restriction to high-elevation habitats places it among the most elevation-constrained taxa in this study.

Montane amphibians have repeatedly been shown to experience particularly severe declines during chytridiomycosis outbreaks, often with limited recovery once populations collapse (Lips et al., 2006; Pounds et al., 2006; Skerratt et al., 2007). Climatic conditions at high elevations are especially favorable for the persistence and transmission of Bd, likely contributing to the disproportionate impact on *L. vibicarius*. More broadly, montane systems are characterized by high levels of endemism and ecological specialization, but also by heightened vulnerability to environmental change and disease dynamics, resulting in reduced resilience and limited recovery potential (García-Rodríguez et al., 2025).

From empirical studies of relict populations in Costa Rica, it is evident that *L. vibicarius* experiences moderate levels of infection (about 31.8%), but the infection level intensifies with decreasing temperature, indicating how cold montane conditions can contribute to the amplification of the disease (Whitfield et al., 2017). Besides, habitat disturbance can impact the interactions between host species and their pathogens by affecting the composition of the skin microbiome, which consists of potentially pathogen-inhibitory bacteria. It might be the case that the abundance of antifungal microorganisms increases for the individuals living in disturbed areas; however, whether or not it provides protection against Bd remains to be established (R. R. Jiménez et al., 2020).

As far as reproduction is concerned, *L. vibicarius* is known to breed in diverse small lentic or slow-flowing aquatic microhabitats, such as shallow ponds, puddles, seeps, and backwaters of streams (Savage, 2002). This reliance on localized aquatic microhabitats may further constrain dispersal and recolonization following population declines.

From a conservation perspective, *L. vibicarius* appears to persist, if at all, as a high-elevation relict species confined to a drastically reduced climatic envelope. The apparent shift of modeled suitability toward lower elevations should therefore not be interpreted as recovery potential, but rather as a residual signal following the loss of its montane core distribution. Given its narrow ecological tolerance, ongoing disease pressure, and increasing climatic instability in montane regions, long-term persistence will likely depend on targeted monitoring, disease surveillance, and strict protection of remaining high-elevation refugia.

4.9 Cross-species synthesis

Across the eight focal species, the dominant pattern is a strong post-decline reduction in realized niche, indicating that most taxa have not fully recovered despite occasional recent detections. Seven species show net losses in predicted suitable area, ranging from moderate contraction (*Agalychnis lemur*, −45.6%; *Atelopus varius*, −68.2%) to extreme collapse (*Craugastor ranoides*, −97.9%; *Isthmohyla rivularis*, −95.9%; *Lithobates vibicarius*, −88.8%; *Duellmanohyla uranochroa*, −87.5%; *Isthmohyla tica*, −72%). Only *Agalychnis annae* shows an apparent gain (+17.7%). These cross-species outcomes suggest that amphibian declines are driven by interacting proximate drivers rather than a single uniform cause (Gunderson et al., 2025; Skerratt et al., 2007; Stuart et al., 2004).

Differences in persistence appear to be partly structured by habitat use and life-history strategies. Disturbance-tolerant or more flexible species (notably *A. annae*, and to some extent *I. tica*) can persist in fragmented forests or agro-ecosystems, including coffee landscapes and peri-urban environments (Hidalgo-Mora et al., 2021, 2022; Zumbado-Ulate et al., 2021). Notably, two of the pond-associated species in this study (*A. annae* and *A. lemur*) show comparatively weaker declines or signs of persistence, suggesting that the use of lentic or semi-permanent breeding habitats may buffer populations against collapse. This pattern likely interacts with reproductive strategy, as these species exhibit more r- to intermediate life histories, potentially allowing higher recruitment rates and greater capacity to compensate for disease-induced mortality.

Nonetheless, relatively lower levels of decline or even persistence of *I. tica* despite its r-to-K reproductive strategies demonstrate that reproductive strategy cannot be regarded as the main determinant of species persistence. Although *I. tica* can occur in human-modified landscapes, its persistence appears more constrained than that of *A. annae*. This difference is likely linked not only to its narrower realized niche but also to its consistently higher elevational distribution. By occupying higher elevations, *I. tica* is more frequently associated with environmental conditions that favor Bd, whereas *A. annae* spans a broader elevational gradient and more readily exploits anthropogenic habitats. As a result, *A. annae* may more often occur in parts of environmental space that reduce pathogen performance, while *I. tica* remains more restricted to conditions that facilitate disease persistence.

In contrast, several forest- and stream-associated species (e.g., *D. uranochroa*, *I. rivularis*, *A. lemur*, *L. vibicarius*) remain restricted to a small number of remnant sites, consistent with strong sensitivity to habitat degradation and limited opportunity for recolonization once populations are lost (Savage, 2002).

Several cases also suggest that persistence is facilitated by environmental conditions that reduce pathogen pressure rather than by recovery within the former range core. As Ben Scheele (2017) suggests, spatial variation in environmental conditions may mediate disease impacts by constraining pathogen performance in some areas of the landscape, allowing populations to persist in small refugial environments. The persistence of *C. ranoides* in the hot–dry Santa Elena Peninsula, where Bd prevalence is extremely low (Puschendorf et al., 2005; Zumbado-Ulate et al., 2014), is an example of such a refugial dynamic.

The hypothesis that invasive pathogens generally contract species toward their realized niche cores rather than margins (Scheele et al., 2023, 2025) cannot be confirmed with my results. While some taxa show post-decline occupancy largely nested within their historical realized niche, consistent with niche conservatism (e.g., *Atelopus varius*, *Duellmanohyla uranochroa*), most species (e.g., *Agalychnis lemur*, *Craugastor ranoides*, *Isthmohyla tica*, *Lithobates vibicarius*) exhibit shifts toward marginal or previously unoccupied portions of their niches. This suggests that pathogen-driven declines may not only reduce niche breadth but can also reorganize realized niches in species-specific ways.

Importantly, ecological and life-history information remains limited for several focal taxa, particularly *D. uranochroa* and *I. rivularis*, for which key aspects of reproductive biology and population dynamics are still poorly understood. This lack of data constrains the ability to

robustly link life-history traits to persistence patterns and highlights a critical need for further research.

From a perspective of conservation and management, all focal species are protected at the national scale within Costa Rica by means of the "Ley de Conservación de la Vida Silvestre" (Law No. 7317; enacted in 1992), as this piece of legislation bans the capture, possession, killing, and utilization for commercial purposes of any native wildlife species in the absence of permission from an official entity (Ley 7317, 1992; Sistema Nacional de Áreas de Conservación (SINAC), 2018). At the international scale, legal protection depends on individual species and is especially relevant to the regulation of wildlife trade. Species involved in, or potentially involved in, international animal trade, such as *A. lemur* and *A. varius*, fall into the category requiring CITES regulations (CITES Secretariat, 2025). Nonetheless, it should be acknowledged that legal instruments currently available primarily affect issues related to exploitation and cannot alleviate threats to animal populations emphasized by the current analysis (e.g., habitat alteration and disease) (Skerratt et al., 2007; Stuart et al., 2004).

5. Conclusions

Overall, the results show that rediscovery is largely decoupled from recovery once evaluated in the geographic and climatic spaces. Post-decline occurrences are predominantly associated with a marked reduction and fragmentation of predicted suitable area, which reflects restricted contemporary climatic niches. Only *Agalychnis annae* departs from this pattern by showing a relative increase in predicted suitability and a denser post-decline suitability configuration, consistent with either genuine persistence in a broader set of environments or stronger modern detectability in human-dominated landscapes. For the remaining species, the dominant picture is not range-wide rebound but localized survival in restricted areas, supporting the conclusion that Costa Rica's "Lazarus" patterns mostly reflect relict persistence rather than broad-scale recovery.

With respect to the niche dimension, my findings do not support the idea that post-decline persistence generally represents contraction into the climatic core of the historical niche (Scheele et al., 2023, 2025). While some species show post-decline occurrences largely nested within historical climatic space (consistent with niche stability and high overlap), several focal taxa display a different signal: post-decline records frequently occur closer to niche margins or outside the climatic envelope represented by pre-decline occurrences, indicating that persistence can be associated with marginal conditions and/or niche shifts rather than core

tracking. In this sense, the results emphasize that post-decline climatic responses are heterogeneous, and that the pathway to persistence is not uniform across taxa.

The climatic-refugia perspective emerging from this work is therefore twofold. First, refugia are often expressed as small, spatially clustered overlap zones where suitability is predicted in both periods; these areas represent the most robust candidates for long-term persistence because they are supported by both historical and contemporary climatic suitability. Second, for some species, persistence may also be linked to atypical or marginal refugia – areas that may not represent historical niche cores but could reduce disease pressure or buffer other stressors, as suggested by the persistence of *Craugastor ranoides* in hot–dry environments. Together, these patterns indicate that identifying refugia for decline-affected amphibians should not rely exclusively on "core" niche assumptions, but instead combine overlap-based stability signals with targeted evaluation of marginal sites that may function as disease- or microclimate-mediated safe havens.

From a conservation standpoint, the main implication is that management should prioritize places, not just species lists: (i) the limited overlap zones that repeatedly emerge as suitable across time, (ii) the few confirmed post-decline localities that represent relict populations, and (iii) additional high-suitability areas highlighted by SDMs as candidates for undiscovered persistence. Because several species persist at very low detectability and in few sites, these areas should be the focus of standardized monitoring, pathogen surveillance, and habitat-protection measures. More broadly, the thesis underscores that legal protection alone is unlikely to secure recovery if the key drivers of decline (disease and habitat constraints) remain unaddressed; instead, persistence will depend on safeguarding and managing the small set of landscapes that still provide viable climatic and environmental conditions.

Finally, this study highlights clear priorities for future work: validating predicted refugial zones through targeted surveys, strengthening inference on niche change with additional post-decline records (especially for taxa with extremely sparse contemporary data), and integrating microclimate, land use, and disease data to test whether marginal refugia reflect true climatic shifts or local buffering mechanisms. In sum, by linking rediscovery patterns to climatic suitability and niche dynamics, this thesis provides a framework for translating scattered post-decline observations into spatially explicit conservation guidance for Costa Rica's most threatened anurans.

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Annex

Species	Sample Size	Period	Type	Metric Evaluation	Cutoff	Sensitivity
Agalychnis annae	107	all	Ensemble	BOYCE	466	98
Agalychnis annae	107	all	Ensemble	TSS	451	99
Agalychnis annae	92	post	Ensemble	BOYCE	486	96,512
Agalychnis annae	92	post	Ensemble	TSS	494	96,512
Agalychnis annae	15	pre	Ensemble	BOYCE	679	92,857
Agalychnis annae	15	pre	Ensemble	TSS	535	100
Agalychnis annae	107	all	Models	TSS	485	100
Agalychnis annae	107	all	Models	ROC	493,5	100
Agalychnis annae	107	all	Models	KAPPA	980	45,333
Agalychnis annae	107	all	Models	BOYCE	437	100
Agalychnis annae	107	all	Models	TSS	415	100
Agalychnis annae	107	all	Models	ROC	415	100
Agalychnis annae	107	all	Models	KAPPA	415	100
Agalychnis annae	107	all	Models	BOYCE	294	100
Agalychnis annae	107	all	Models	TSS	486	97,333
Agalychnis annae	107	all	Models	ROC	491,5	97,333
Agalychnis annae	107	all	Models	KAPPA	950	42,667
Agalychnis annae	107	all	Models	BOYCE	543	96
Agalychnis annae	107	all	Models	TSS	374	100
Agalychnis annae	107	all	Models	ROC	375	100
Agalychnis annae	107	all	Models	KAPPA	889	56
Agalychnis annae	107	all	Models	BOYCE	599	89,333
Agalychnis annae	107	all	Models	TSS	727	100
Agalychnis annae	107	all	Models	ROC	731	100
Agalychnis annae	107	all	Models	KAPPA	889	92
Agalychnis annae	107	all	Models	BOYCE	680	100
Agalychnis annae	107	all	Models	TSS	426,5	100
Agalychnis annae	107	all	Models	ROC	425	100
Agalychnis annae	107	all	Models	KAPPA	426,5	100
Agalychnis annae	107	all	Models	BOYCE	286	100
Agalychnis annae	107	all	Models	TSS	711	100
Agalychnis annae	107	all	Models	ROC	711	100
Agalychnis annae	107	all	Models	KAPPA	909	78,667
Agalychnis annae	107	all	Models	BOYCE	656	100
Agalychnis annae	107	all	Models	TSS	657	100
Agalychnis annae	107	all	Models	ROC	661,5	100
Agalychnis annae	107	all	Models	KAPPA	960	76
Agalychnis annae	107	all	Models	BOYCE	608	100
Agalychnis annae	107	all	Models	TSS	575	97,333
Agalychnis annae	107	all	Models	ROC	582,5	97,333
Agalychnis annae	107	all	Models	KAPPA	959	62,667
Agalychnis annae	107	all	Models	BOYCE	670	94,667
Agalychnis annae	107	all	Models	TSS	400	100
Agalychnis annae	107	all	Models	ROC	399	100

Agalychnis annae	107	all	Models	KAPPA	400	100
Agalychnis annae	107	all	Models	BOYCE	246	100
Agalychnis annae	107	all	Models	TSS	558	98,667
Agalychnis annae	107	all	Models	ROC	560	98,667
Agalychnis annae	107	all	Models	KAPPA	925	64
Agalychnis annae	107	all	Models	BOYCE	511	98,667
Agalychnis annae	107	all	Models	TSS	333	100
Agalychnis annae	107	all	Models	ROC	336,5	100
Agalychnis annae	107	all	Models	KAPPA	889	68
Agalychnis annae	107	all	Models	BOYCE	662	88
Agalychnis annae	107	all	Models	TSS	484	98,667
Agalychnis annae	107	all	Models	ROC	492,5	98,667
Agalychnis annae	107	all	Models	KAPPA	949	65,333
Agalychnis annae	107	all	Models	BOYCE	589	96
Agalychnis annae	107	all	Models	TSS	426	100
Agalychnis annae	107	all	Models	ROC	427	100
Agalychnis annae	107	all	Models	KAPPA	426	100
Agalychnis annae	107	all	Models	BOYCE	291	100
Agalychnis annae	107	all	Models	TSS	399	98,667
Agalychnis annae	107	all	Models	ROC	407,5	98,667
Agalychnis annae	107	all	Models	KAPPA	938	61,333
Agalychnis annae	107	all	Models	BOYCE	458	97,333
Agalychnis annae	107	all	Models	TSS	505	93,333
Agalychnis annae	107	all	Models	ROC	512,5	93,333
Agalychnis annae	107	all	Models	KAPPA	899	56
Agalychnis annae	107	all	Models	BOYCE	518	92
Agalychnis annae	107	all	Models	TSS	343	100
Agalychnis annae	107	all	Models	ROC	349	100
Agalychnis annae	107	all	Models	KAPPA	969	53
Agalychnis annae	107	all	Models	BOYCE	607	97
Agalychnis annae	107	all	Models	TSS	420	100
Agalychnis annae	107	all	Models	ROC	421	100
Agalychnis annae	107	all	Models	KAPPA	420	100
Agalychnis annae	107	all	Models	BOYCE	276	100
Agalychnis annae	107	all	Models	TSS	568	97
Agalychnis annae	107	all	Models	ROC	576,5	97
Agalychnis annae	107	all	Models	KAPPA	946	57
Agalychnis annae	107	all	Models	BOYCE	547	97
Agalychnis annae	107	all	Models	TSS	303	100
Agalychnis annae	107	all	Models	ROC	310,5	100
Agalychnis annae	107	all	Models	KAPPA	899	62
Agalychnis annae	107	all	Models	BOYCE	563	92
Agalychnis annae	107	all	Models	TSS	8	98
Agalychnis annae	107	all	Models	ROC	8,5	98
Agalychnis annae	107	all	Models	KAPPA	233	52
Agalychnis annae	107	all	Models	BOYCE	40	91
Agalychnis annae	107	all	Models	TSS	420	100
Agalychnis annae	107	all	Models	ROC	418	100
Agalychnis annae	107	all	Models	KAPPA	420	100

Agalychnis annae	107	all	Models	BOYCE	290	100
Agalychnis annae	107	all	Models	TSS	6	99
Agalychnis annae	107	all	Models	ROC	10,5	99
Agalychnis annae	107	all	Models	KAPPA	207	55
Agalychnis annae	107	all	Models	BOYCE	32	89
Agalychnis annae	107	all	Models	TSS	12	87
Agalychnis annae	107	all	Models	ROC	15,5	85
Agalychnis annae	107	all	Models	KAPPA	119	52
Agalychnis annae	107	all	Models	BOYCE	560	0
Agalychnis annae	92	post	Models	TSS	424	100
Agalychnis annae	92	post	Models	ROC	425	100
Agalychnis annae	92	post	Models	KAPPA	980	40,625
Agalychnis annae	92	post	Models	BOYCE	671	95,312
Agalychnis annae	92	post	Models	TSS	409	100
Agalychnis annae	92	post	Models	ROC	409	100
Agalychnis annae	92	post	Models	KAPPA	409	100
Agalychnis annae	92	post	Models	BOYCE	261	100
Agalychnis annae	92	post	Models	TSS	417	98,438
Agalychnis annae	92	post	Models	ROC	419	98,438
Agalychnis annae	92	post	Models	KAPPA	922	62,5
Agalychnis annae	92	post	Models	BOYCE	623	90,625
Agalychnis annae	92	post	Models	TSS	343	96,875
Agalychnis annae	92	post	Models	ROC	352,5	96,875
Agalychnis annae	92	post	Models	KAPPA	889	68,75
Agalychnis annae	92	post	Models	BOYCE	536	92,188
Agalychnis annae	92	post	Models	TSS	758	100
Agalychnis annae	92	post	Models	ROC	761,5	100
Agalychnis annae	92	post	Models	KAPPA	970	75,385
Agalychnis annae	92	post	Models	BOYCE	707	100
Agalychnis annae	92	post	Models	TSS	421	100
Agalychnis annae	92	post	Models	ROC	420	100
Agalychnis annae	92	post	Models	KAPPA	421	100
Agalychnis annae	92	post	Models	BOYCE	274	100
Agalychnis annae	92	post	Models	TSS	703	98,462
Agalychnis annae	92	post	Models	ROC	715	98,462
Agalychnis annae	92	post	Models	KAPPA	955	69,231
Agalychnis annae	92	post	Models	BOYCE	662	98,462
Agalychnis annae	92	post	Models	TSS	626	100
Agalychnis annae	92	post	Models	ROC	628,5	100
Agalychnis annae	92	post	Models	KAPPA	949	83,077
Agalychnis annae	92	post	Models	BOYCE	572	100
Agalychnis annae	92	post	Models	TSS	696	96,875
Agalychnis annae	92	post	Models	ROC	698	96,875
Agalychnis annae	92	post	Models	KAPPA	959	67,188
Agalychnis annae	92	post	Models	BOYCE	643	96,875
Agalychnis annae	92	post	Models	TSS	407	100
Agalychnis annae	92	post	Models	ROC	409	100
Agalychnis annae	92	post	Models	KAPPA	407	100
Agalychnis annae	92	post	Models	BOYCE	255	100

Agalychnis annae	92	post	Models	TSS	576	95,312
Agalychnis annae	92	post	Models	ROC	579	95,312
Agalychnis annae	92	post	Models	KAPPA	933	67,188
Agalychnis annae	92	post	Models	BOYCE	722	90,625
Agalychnis annae	92	post	Models	TSS	626	93,75
Agalychnis annae	92	post	Models	ROC	630,5	93,75
Agalychnis annae	92	post	Models	KAPPA	879	81,25
Agalychnis annae	92	post	Models	BOYCE	626	93,75
Agalychnis annae	92	post	Models	TSS	394	100
Agalychnis annae	92	post	Models	ROC	395	100
Agalychnis annae	92	post	Models	KAPPA	979	41,538
Agalychnis annae	92	post	Models	BOYCE	338	100
Agalychnis annae	92	post	Models	TSS	396,5	100
Agalychnis annae	92	post	Models	ROC	397	100
Agalychnis annae	92	post	Models	KAPPA	396,5	100
Agalychnis annae	92	post	Models	BOYCE	240	100
Agalychnis annae	92	post	Models	TSS	495	96,923
Agalychnis annae	92	post	Models	ROC	500,5	96,923
Agalychnis annae	92	post	Models	KAPPA	930	66,154
Agalychnis annae	92	post	Models	BOYCE	701	90,769
Agalychnis annae	92	post	Models	TSS	535	93,846
Agalychnis annae	92	post	Models	ROC	536	93,846
Agalychnis annae	92	post	Models	KAPPA	909	61,538
Agalychnis annae	92	post	Models	BOYCE	590	92,308
Agalychnis annae	92	post	Models	TSS	464	100
Agalychnis annae	92	post	Models	ROC	466,5	100
Agalychnis annae	92	post	Models	KAPPA	959	66,279
Agalychnis annae	92	post	Models	BOYCE	616	96,512
Agalychnis annae	92	post	Models	TSS	410,5	100
Agalychnis annae	92	post	Models	ROC	411	100
Agalychnis annae	92	post	Models	KAPPA	410,5	100
Agalychnis annae	92	post	Models	BOYCE	253	100
Agalychnis annae	92	post	Models	TSS	430	98,837
Agalychnis annae	92	post	Models	ROC	431	98,837
Agalychnis annae	92	post	Models	KAPPA	938	60,465
Agalychnis annae	92	post	Models	BOYCE	788	89,535
Agalychnis annae	92	post	Models	TSS	475	95,349
Agalychnis annae	92	post	Models	ROC	478	95,349
Agalychnis annae	92	post	Models	KAPPA	909	67,442
Agalychnis annae	92	post	Models	BOYCE	599	93,023
Agalychnis annae	92	post	Models	TSS	15	95,349
Agalychnis annae	92	post	Models	ROC	22,5	95,349
Agalychnis annae	92	post	Models	KAPPA	160	65,116
Agalychnis annae	92	post	Models	BOYCE	38	84,884
Agalychnis annae	92	post	Models	TSS	405,5	100
Agalychnis annae	92	post	Models	ROC	404	100
Agalychnis annae	92	post	Models	KAPPA	405,5	100
Agalychnis annae	92	post	Models	BOYCE	258	100
Agalychnis annae	92	post	Models	TSS	6	98,837

Agalychnis annae	92	post	Models	ROC	7,5	98,837
Agalychnis annae	92	post	Models	KAPPA	194	61,628
Agalychnis annae	92	post	Models	BOYCE	27	88,372
Agalychnis annae	92	post	Models	TSS	12	91,86
Agalychnis annae	92	post	Models	ROC	16,5	91,86
Agalychnis annae	92	post	Models	KAPPA	106	60,465
Agalychnis annae	92	post	Models	BOYCE	554	0
Agalychnis annae	15	pre	Models	TSS	495	90
Agalychnis annae	15	pre	Models	ROC	500	90
Agalychnis annae	15	pre	Models	KAPPA	495	90
Agalychnis annae	15	pre	Models	BOYCE	50	90
Agalychnis annae	15	pre	Models	TSS	332,5	100
Agalychnis annae	15	pre	Models	ROC	335	100
Agalychnis annae	15	pre	Models	KAPPA	332,5	100
Agalychnis annae	15	pre	Models	BOYCE	103	100
Agalychnis annae	15	pre	Models	TSS	745	100
Agalychnis annae	15	pre	Models	ROC	749,5	100
Agalychnis annae	15	pre	Models	KAPPA	902	60
Agalychnis annae	15	pre	Models	BOYCE	695	100
Agalychnis annae	15	pre	Models	TSS	717	100
Agalychnis annae	15	pre	Models	ROC	723,5	100
Agalychnis annae	15	pre	Models	KAPPA	717	100
Agalychnis annae	15	pre	Models	BOYCE	671	100
Agalychnis annae	15	pre	Models	TSS	495	100
Agalychnis annae	15	pre	Models	ROC	500	100
Agalychnis annae	15	pre	Models	KAPPA	495	100
Agalychnis annae	15	pre	Models	BOYCE	50	100
Agalychnis annae	15	pre	Models	TSS	342,5	100
Agalychnis annae	15	pre	Models	ROC	344	100
Agalychnis annae	15	pre	Models	KAPPA	342,5	100
Agalychnis annae	15	pre	Models	BOYCE	124	100
Agalychnis annae	15	pre	Models	TSS	652	100
Agalychnis annae	15	pre	Models	ROC	653	100
Agalychnis annae	15	pre	Models	KAPPA	973	18,182
Agalychnis annae	15	pre	Models	BOYCE	811	90,909
Agalychnis annae	15	pre	Models	TSS	788	100
Agalychnis annae	15	pre	Models	ROC	793	100
Agalychnis annae	15	pre	Models	KAPPA	879	90,909
Agalychnis annae	15	pre	Models	BOYCE	743	100
Agalychnis annae	15	pre	Models	TSS	495	90
Agalychnis annae	15	pre	Models	ROC	500	90
Agalychnis annae	15	pre	Models	KAPPA	495	90
Agalychnis annae	15	pre	Models	BOYCE	50	90
Agalychnis annae	15	pre	Models	TSS	322,5	100
Agalychnis annae	15	pre	Models	ROC	321	100
Agalychnis annae	15	pre	Models	KAPPA	322,5	100
Agalychnis annae	15	pre	Models	BOYCE	88	100
Agalychnis annae	15	pre	Models	TSS	739	100
Agalychnis annae	15	pre	Models	ROC	740	100

Agalychnis annae	15	pre	Models	KAPPA	877	60
Agalychnis annae	15	pre	Models	BOYCE	690	100
Agalychnis annae	15	pre	Models	TSS	667	100
Agalychnis annae	15	pre	Models	ROC	672,5	100
Agalychnis annae	15	pre	Models	KAPPA	667	100
Agalychnis annae	15	pre	Models	BOYCE	617	100
Agalychnis annae	15	pre	Models	TSS	495	100
Agalychnis annae	15	pre	Models	ROC	500	100
Agalychnis annae	15	pre	Models	KAPPA	495	100
Agalychnis annae	15	pre	Models	BOYCE	50	100
Agalychnis annae	15	pre	Models	TSS	325,5	100
Agalychnis annae	15	pre	Models	ROC	326	100
Agalychnis annae	15	pre	Models	KAPPA	325,5	100
Agalychnis annae	15	pre	Models	BOYCE	97	100
Agalychnis annae	15	pre	Models	TSS	654	100
Agalychnis annae	15	pre	Models	ROC	662,5	100
Agalychnis annae	15	pre	Models	KAPPA	950	27,273
Agalychnis annae	15	pre	Models	BOYCE	755	90,909
Agalychnis annae	15	pre	Models	TSS	636	100
Agalychnis annae	15	pre	Models	ROC	642,5	100
Agalychnis annae	15	pre	Models	KAPPA	697	90,909
Agalychnis annae	15	pre	Models	BOYCE	590	100
Agalychnis annae	15	pre	Models	TSS	495	92,857
Agalychnis annae	15	pre	Models	ROC	500	92,857
Agalychnis annae	15	pre	Models	KAPPA	495	92,857
Agalychnis annae	15	pre	Models	BOYCE	50	92,857
Agalychnis annae	15	pre	Models	TSS	321,5	100
Agalychnis annae	15	pre	Models	ROC	321	100
Agalychnis annae	15	pre	Models	KAPPA	321,5	100
Agalychnis annae	15	pre	Models	BOYCE	94	100
Agalychnis annae	15	pre	Models	TSS	504	100
Agalychnis annae	15	pre	Models	ROC	511,5	100
Agalychnis annae	15	pre	Models	KAPPA	927	35,714
Agalychnis annae	15	pre	Models	BOYCE	752	92,857
Agalychnis annae	15	pre	Models	TSS	657	100
Agalychnis annae	15	pre	Models	ROC	663,5	100
Agalychnis annae	15	pre	Models	KAPPA	727	92,857
Agalychnis annae	15	pre	Models	BOYCE	608	100
Agalychnis annae	15	pre	Models	TSS	0	100
Agalychnis annae	15	pre	Models	ROC	0,5	100
Agalychnis annae	15	pre	Models	KAPPA	93,5	28,571
Agalychnis annae	15	pre	Models	BOYCE	449	0
Agalychnis annae	15	pre	Models	TSS	316,5	100
Agalychnis annae	15	pre	Models	ROC	317	100
Agalychnis annae	15	pre	Models	KAPPA	316,5	100
Agalychnis annae	15	pre	Models	BOYCE	84	100
Agalychnis annae	15	pre	Models	TSS	5	85,714
Agalychnis annae	15	pre	Models	ROC	7,5	85,714
Agalychnis annae	15	pre	Models	KAPPA	58	35,714

Agalychnis annae	15	pre	Models	BOYCE	141	14,286
Agalychnis annae	15	pre	Models	TSS	1	100
Agalychnis annae	15	pre	Models	ROC	1,5	100
Agalychnis annae	15	pre	Models	KAPPA	8	28,571
Agalychnis annae	15	pre	Models	BOYCE	107	0
Agalychnis lemur	46	all	Ensemble	BOYCE	399	85,714
Agalychnis lemur	46	all	Ensemble	TSS	302	100
Agalychnis lemur	22	post	Ensemble	BOYCE	636	83,333
Agalychnis lemur	22	post	Ensemble	TSS	291	100
Agalychnis lemur	24	pre	Ensemble	BOYCE	757	33,333
Agalychnis lemur	24	pre	Ensemble	TSS	391	95,833
Agalychnis lemur	46	all	Models	TSS	495	70,968
Agalychnis lemur	46	all	Models	ROC	500	70,968
Agalychnis lemur	46	all	Models	KAPPA	495	70,968
Agalychnis lemur	46	all	Models	BOYCE	50	70,968
Agalychnis lemur	46	all	Models	TSS	335	100
Agalychnis lemur	46	all	Models	ROC	334	100
Agalychnis lemur	46	all	Models	KAPPA	335	100
Agalychnis lemur	46	all	Models	BOYCE	117	100
Agalychnis lemur	46	all	Models	TSS	383	96,774
Agalychnis lemur	46	all	Models	ROC	390,5	96,774
Agalychnis lemur	46	all	Models	KAPPA	909	19,355
Agalychnis lemur	46	all	Models	BOYCE	338	96,774
Agalychnis lemur	46	all	Models	TSS	391	90,323
Agalychnis lemur	46	all	Models	ROC	397,5	90,323
Agalychnis lemur	46	all	Models	KAPPA	960	6,452
Agalychnis lemur	46	all	Models	BOYCE	549	67,742
Agalychnis lemur	46	all	Models	TSS	495	93,75
Agalychnis lemur	46	all	Models	ROC	500	93,75
Agalychnis lemur	46	all	Models	KAPPA	495	93,75
Agalychnis lemur	46	all	Models	BOYCE	50	93,75
Agalychnis lemur	46	all	Models	TSS	330	100
Agalychnis lemur	46	all	Models	ROC	332	100
Agalychnis lemur	46	all	Models	KAPPA	330	100
Agalychnis lemur	46	all	Models	BOYCE	149	100
Agalychnis lemur	46	all	Models	TSS	620	96,875
Agalychnis lemur	46	all	Models	ROC	627,5	96,875
Agalychnis lemur	46	all	Models	KAPPA	876	62,5
Agalychnis lemur	46	all	Models	BOYCE	575	96,875
Agalychnis lemur	46	all	Models	TSS	705	84,375
Agalychnis lemur	46	all	Models	ROC	708,5	84,375
Agalychnis lemur	46	all	Models	KAPPA	846	65,625
Agalychnis lemur	46	all	Models	BOYCE	651	84,375
Agalychnis lemur	46	all	Models	TSS	495	80,645
Agalychnis lemur	46	all	Models	ROC	500	80,645
Agalychnis lemur	46	all	Models	KAPPA	495	80,645
Agalychnis lemur	46	all	Models	BOYCE	50	80,645
Agalychnis lemur	46	all	Models	TSS	351	100
Agalychnis lemur	46	all	Models	ROC	352	100

Agalychnis lemur	46	all	Models	KAPPA	351	100
Agalychnis lemur	46	all	Models	BOYCE	157	100
Agalychnis lemur	46	all	Models	TSS	530	93,548
Agalychnis lemur	46	all	Models	ROC	530,5	93,548
Agalychnis lemur	46	all	Models	KAPPA	906	29,032
Agalychnis lemur	46	all	Models	BOYCE	478	93,548
Agalychnis lemur	46	all	Models	TSS	520	90,323
Agalychnis lemur	46	all	Models	ROC	522,5	90,323
Agalychnis lemur	46	all	Models	KAPPA	830	51,613
Agalychnis lemur	46	all	Models	BOYCE	736	61,29
Agalychnis lemur	46	all	Models	TSS	495	68,75
Agalychnis lemur	46	all	Models	ROC	500	68,75
Agalychnis lemur	46	all	Models	KAPPA	495	68,75
Agalychnis lemur	46	all	Models	BOYCE	50	68,75
Agalychnis lemur	46	all	Models	TSS	341	100
Agalychnis lemur	46	all	Models	ROC	339	100
Agalychnis lemur	46	all	Models	KAPPA	341	100
Agalychnis lemur	46	all	Models	BOYCE	145	100
Agalychnis lemur	46	all	Models	TSS	393	93,75
Agalychnis lemur	46	all	Models	ROC	401,5	93,75
Agalychnis lemur	46	all	Models	KAPPA	877	25
Agalychnis lemur	46	all	Models	BOYCE	390	93,75
Agalychnis lemur	46	all	Models	TSS	288	100
Agalychnis lemur	46	all	Models	ROC	295,5	100
Agalychnis lemur	46	all	Models	KAPPA	802	43,75
Agalychnis lemur	46	all	Models	BOYCE	579	65,625
Agalychnis lemur	46	all	Models	TSS	495	83,333
Agalychnis lemur	46	all	Models	ROC	500	83,333
Agalychnis lemur	46	all	Models	KAPPA	495	83,333
Agalychnis lemur	46	all	Models	BOYCE	50	83,333
Agalychnis lemur	46	all	Models	TSS	344	100
Agalychnis lemur	46	all	Models	ROC	344	100
Agalychnis lemur	46	all	Models	KAPPA	344	100
Agalychnis lemur	46	all	Models	BOYCE	138	100
Agalychnis lemur	46	all	Models	TSS	359	100
Agalychnis lemur	46	all	Models	ROC	362,5	100
Agalychnis lemur	46	all	Models	KAPPA	885	38,095
Agalychnis lemur	46	all	Models	BOYCE	342	100
Agalychnis lemur	46	all	Models	TSS	675	69,048
Agalychnis lemur	46	all	Models	ROC	681,5	69,048
Agalychnis lemur	46	all	Models	KAPPA	794	54,762
Agalychnis lemur	46	all	Models	BOYCE	633	69,048
Agalychnis lemur	46	all	Models	TSS	5	83,333
Agalychnis lemur	46	all	Models	ROC	5,5	83,333
Agalychnis lemur	46	all	Models	KAPPA	35	45,238
Agalychnis lemur	46	all	Models	BOYCE	222	0
Agalychnis lemur	46	all	Models	TSS	344	100
Agalychnis lemur	46	all	Models	ROC	344	100
Agalychnis lemur	46	all	Models	KAPPA	344	100

Agalychnis lemur	46	all	Models	BOYCE	157	100
Agalychnis lemur	46	all	Models	TSS	7	73,81
Agalychnis lemur	46	all	Models	ROC	7,5	73,81
Agalychnis lemur	46	all	Models	KAPPA	40	23,81
Agalychnis lemur	46	all	Models	BOYCE	172	2,381
Agalychnis lemur	46	all	Models	TSS	7	73,81
Agalychnis lemur	46	all	Models	ROC	7,5	73,81
Agalychnis lemur	46	all	Models	KAPPA	24	38,095
Agalychnis lemur	46	all	Models	BOYCE	124	0
Agalychnis lemur	22	post	Models	TSS	495	100
Agalychnis lemur	22	post	Models	ROC	500	100
Agalychnis lemur	22	post	Models	KAPPA	495	100
Agalychnis lemur	22	post	Models	BOYCE	50	100
Agalychnis lemur	22	post	Models	TSS	332	100
Agalychnis lemur	22	post	Models	ROC	330	100
Agalychnis lemur	22	post	Models	KAPPA	332	100
Agalychnis lemur	22	post	Models	BOYCE	104	100
Agalychnis lemur	22	post	Models	TSS	745	100
Agalychnis lemur	22	post	Models	ROC	756,5	100
Agalychnis lemur	22	post	Models	KAPPA	873,5	76,923
Agalychnis lemur	22	post	Models	BOYCE	700	100
Agalychnis lemur	22	post	Models	TSS	707	100
Agalychnis lemur	22	post	Models	ROC	715,5	100
Agalychnis lemur	22	post	Models	KAPPA	980	46,154
Agalychnis lemur	22	post	Models	BOYCE	662	100
Agalychnis lemur	22	post	Models	TSS	929	100
Agalychnis lemur	22	post	Models	ROC	930,5	100
Agalychnis lemur	22	post	Models	KAPPA	929	100
Agalychnis lemur	22	post	Models	BOYCE	878	100
Agalychnis lemur	22	post	Models	TSS	344,5	100
Agalychnis lemur	22	post	Models	ROC	347	100
Agalychnis lemur	22	post	Models	KAPPA	344,5	100
Agalychnis lemur	22	post	Models	BOYCE	139	100
Agalychnis lemur	22	post	Models	TSS	638	100
Agalychnis lemur	22	post	Models	ROC	642	100
Agalychnis lemur	22	post	Models	KAPPA	946	57,143
Agalychnis lemur	22	post	Models	BOYCE	768	92,857
Agalychnis lemur	22	post	Models	TSS	869	100
Agalychnis lemur	22	post	Models	ROC	874,5	100
Agalychnis lemur	22	post	Models	KAPPA	980	57,143
Agalychnis lemur	22	post	Models	BOYCE	824	100
Agalychnis lemur	22	post	Models	TSS	495	84,615
Agalychnis lemur	22	post	Models	ROC	500	84,615
Agalychnis lemur	22	post	Models	KAPPA	495	84,615
Agalychnis lemur	22	post	Models	BOYCE	50	84,615
Agalychnis lemur	22	post	Models	TSS	366,5	100
Agalychnis lemur	22	post	Models	ROC	365	100
Agalychnis lemur	22	post	Models	KAPPA	366,5	100
Agalychnis lemur	22	post	Models	BOYCE	179	100

Agalychnis lemur	22	post	Models	TSS	667	100
Agalychnis lemur	22	post	Models	ROC	667,5	100
Agalychnis lemur	22	post	Models	KAPPA	905	69,231
Agalychnis lemur	22	post	Models	BOYCE	750	92,308
Agalychnis lemur	22	post	Models	TSS	747	100
Agalychnis lemur	22	post	Models	ROC	755,5	100
Agalychnis lemur	22	post	Models	KAPPA	980	61,538
Agalychnis lemur	22	post	Models	BOYCE	698	100
Agalychnis lemur	22	post	Models	TSS	495	85,714
Agalychnis lemur	22	post	Models	ROC	500	85,714
Agalychnis lemur	22	post	Models	KAPPA	495	85,714
Agalychnis lemur	22	post	Models	BOYCE	50	85,714
Agalychnis lemur	22	post	Models	TSS	332	100
Agalychnis lemur	22	post	Models	ROC	334	100
Agalychnis lemur	22	post	Models	KAPPA	332	100
Agalychnis lemur	22	post	Models	BOYCE	135	100
Agalychnis lemur	22	post	Models	TSS	748	100
Agalychnis lemur	22	post	Models	ROC	753	100
Agalychnis lemur	22	post	Models	KAPPA	948	35,714
Agalychnis lemur	22	post	Models	BOYCE	699	100
Agalychnis lemur	22	post	Models	TSS	707	100
Agalychnis lemur	22	post	Models	ROC	716,5	100
Agalychnis lemur	22	post	Models	KAPPA	990	28,571
Agalychnis lemur	22	post	Models	BOYCE	662	100
Agalychnis lemur	22	post	Models	TSS	495	88,889
Agalychnis lemur	22	post	Models	ROC	500	88,889
Agalychnis lemur	22	post	Models	KAPPA	495	88,889
Agalychnis lemur	22	post	Models	BOYCE	50	88,889
Agalychnis lemur	22	post	Models	TSS	359	100
Agalychnis lemur	22	post	Models	ROC	359	100
Agalychnis lemur	22	post	Models	KAPPA	359	100
Agalychnis lemur	22	post	Models	BOYCE	186	100
Agalychnis lemur	22	post	Models	TSS	651	100
Agalychnis lemur	22	post	Models	ROC	657,5	100
Agalychnis lemur	22	post	Models	KAPPA	961	33,333
Agalychnis lemur	22	post	Models	BOYCE	736	88,889
Agalychnis lemur	22	post	Models	TSS	727	100
Agalychnis lemur	22	post	Models	ROC	727,5	100
Agalychnis lemur	22	post	Models	KAPPA	970	61,111
Agalychnis lemur	22	post	Models	BOYCE	860	72,222
Agalychnis lemur	22	post	Models	TSS	6	100
Agalychnis lemur	22	post	Models	ROC	7,5	100
Agalychnis lemur	22	post	Models	KAPPA	120,5	33,333
Agalychnis lemur	22	post	Models	BOYCE	284	5,556
Agalychnis lemur	22	post	Models	TSS	363	100
Agalychnis lemur	22	post	Models	ROC	364	100
Agalychnis lemur	22	post	Models	KAPPA	363	100
Agalychnis lemur	22	post	Models	BOYCE	172	100
Agalychnis lemur	22	post	Models	TSS	4	77,778

Agalychnis lemur	22	post	Models	ROC	1,5	100
Agalychnis lemur	22	post	Models	KAPPA	69	33,333
Agalychnis lemur	22	post	Models	BOYCE	339	0
Agalychnis lemur	22	post	Models	TSS	7	88,889
Agalychnis lemur	22	post	Models	ROC	7,5	88,889
Agalychnis lemur	22	post	Models	KAPPA	41	55,556
Agalychnis lemur	22	post	Models	BOYCE	214	0
Agalychnis lemur	24	pre	Models	TSS	495	72,222
Agalychnis lemur	24	pre	Models	ROC	500	72,222
Agalychnis lemur	24	pre	Models	KAPPA	495	72,222
Agalychnis lemur	24	pre	Models	BOYCE	50	72,222
Agalychnis lemur	24	pre	Models	TSS	326,5	100
Agalychnis lemur	24	pre	Models	ROC	328	100
Agalychnis lemur	24	pre	Models	KAPPA	326,5	100
Agalychnis lemur	24	pre	Models	BOYCE	111	100
Agalychnis lemur	24	pre	Models	TSS	514	94,444
Agalychnis lemur	24	pre	Models	ROC	517,5	94,444
Agalychnis lemur	24	pre	Models	KAPPA	890	27,778
Agalychnis lemur	24	pre	Models	BOYCE	463	94,444
Agalychnis lemur	24	pre	Models	TSS	445	88,889
Agalychnis lemur	24	pre	Models	ROC	453,5	88,889
Agalychnis lemur	24	pre	Models	KAPPA	766	44,444
Agalychnis lemur	24	pre	Models	BOYCE	696	50
Agalychnis lemur	24	pre	Models	TSS	495	100
Agalychnis lemur	24	pre	Models	ROC	500	100
Agalychnis lemur	24	pre	Models	KAPPA	495	100
Agalychnis lemur	24	pre	Models	BOYCE	50	100
Agalychnis lemur	24	pre	Models	TSS	329,5	100
Agalychnis lemur	24	pre	Models	ROC	331	100
Agalychnis lemur	24	pre	Models	KAPPA	329,5	100
Agalychnis lemur	24	pre	Models	BOYCE	92	100
Agalychnis lemur	24	pre	Models	TSS	497	100
Agalychnis lemur	24	pre	Models	ROC	502,5	100
Agalychnis lemur	24	pre	Models	KAPPA	914	55,556
Agalychnis lemur	24	pre	Models	BOYCE	740	88,889
Agalychnis lemur	24	pre	Models	TSS	626	88,889
Agalychnis lemur	24	pre	Models	ROC	626,5	88,889
Agalychnis lemur	24	pre	Models	KAPPA	918	50
Agalychnis lemur	24	pre	Models	BOYCE	751	72,222
Agalychnis lemur	24	pre	Models	TSS	495	77,778
Agalychnis lemur	24	pre	Models	ROC	500	77,778
Agalychnis lemur	24	pre	Models	KAPPA	495	77,778
Agalychnis lemur	24	pre	Models	BOYCE	50	77,778
Agalychnis lemur	24	pre	Models	TSS	308	100
Agalychnis lemur	24	pre	Models	ROC	310	100
Agalychnis lemur	24	pre	Models	KAPPA	308	100
Agalychnis lemur	24	pre	Models	BOYCE	77	100
Agalychnis lemur	24	pre	Models	TSS	572	94,444
Agalychnis lemur	24	pre	Models	ROC	579,5	94,444

Agalychnis lemur	24	pre	Models	KAPPA	909	33,333
Agalychnis lemur	24	pre	Models	BOYCE	858	33,333
Agalychnis lemur	24	pre	Models	TSS	626	83,333
Agalychnis lemur	24	pre	Models	ROC	627,5	83,333
Agalychnis lemur	24	pre	Models	KAPPA	845	27,778
Agalychnis lemur	24	pre	Models	BOYCE	581	83,333
Agalychnis lemur	24	pre	Models	TSS	495	72,222
Agalychnis lemur	24	pre	Models	ROC	500	72,222
Agalychnis lemur	24	pre	Models	KAPPA	495	72,222
Agalychnis lemur	24	pre	Models	BOYCE	50	72,222
Agalychnis lemur	24	pre	Models	TSS	312	100
Agalychnis lemur	24	pre	Models	ROC	313	100
Agalychnis lemur	24	pre	Models	KAPPA	312	100
Agalychnis lemur	24	pre	Models	BOYCE	79	100
Agalychnis lemur	24	pre	Models	TSS	454	94,444
Agalychnis lemur	24	pre	Models	ROC	463,5	94,444
Agalychnis lemur	24	pre	Models	KAPPA	872	11,111
Agalychnis lemur	24	pre	Models	BOYCE	555	83,333
Agalychnis lemur	24	pre	Models	TSS	320	100
Agalychnis lemur	24	pre	Models	ROC	320,5	100
Agalychnis lemur	24	pre	Models	KAPPA	934	5,556
Agalychnis lemur	24	pre	Models	BOYCE	882	5,556
Agalychnis lemur	24	pre	Models	TSS	495	79,167
Agalychnis lemur	24	pre	Models	ROC	500	79,167
Agalychnis lemur	24	pre	Models	KAPPA	495	79,167
Agalychnis lemur	24	pre	Models	BOYCE	50	79,167
Agalychnis lemur	24	pre	Models	TSS	316	100
Agalychnis lemur	24	pre	Models	ROC	318	100
Agalychnis lemur	24	pre	Models	KAPPA	316	100
Agalychnis lemur	24	pre	Models	BOYCE	85	100
Agalychnis lemur	24	pre	Models	TSS	454	100
Agalychnis lemur	24	pre	Models	ROC	462,5	100
Agalychnis lemur	24	pre	Models	KAPPA	895	25
Agalychnis lemur	24	pre	Models	BOYCE	418	100
Agalychnis lemur	24	pre	Models	TSS	424	91,667
Agalychnis lemur	24	pre	Models	ROC	429,5	91,667
Agalychnis lemur	24	pre	Models	KAPPA	886	20,833
Agalychnis lemur	24	pre	Models	BOYCE	660	54,167
Agalychnis lemur	24	pre	Models	TSS	3	83,333
Agalychnis lemur	24	pre	Models	ROC	3,5	83,333
Agalychnis lemur	24	pre	Models	KAPPA	86,5	8,333
Agalychnis lemur	24	pre	Models	BOYCE	128	0
Agalychnis lemur	24	pre	Models	TSS	317	100
Agalychnis lemur	24	pre	Models	ROC	318	100
Agalychnis lemur	24	pre	Models	KAPPA	317	100
Agalychnis lemur	24	pre	Models	BOYCE	81	100
Agalychnis lemur	24	pre	Models	TSS	5	79,167
Agalychnis lemur	24	pre	Models	ROC	5,5	79,167
Agalychnis lemur	24	pre	Models	KAPPA	47,5	20,833

Agalychnis lemur	24	pre	Models	BOYCE	94	0
Agalychnis lemur	24	pre	Models	TSS	1	100
Agalychnis lemur	24	pre	Models	ROC	1,5	87,5
Agalychnis lemur	24	pre	Models	KAPPA	27	8,333
Agalychnis lemur	24	pre	Models	BOYCE	73	0
Atelopus varius	85	all	Ensemble	BOYCE	516	87,952
Atelopus varius	85	all	Ensemble	TSS	320	98,795
Atelopus varius	20	post	Ensemble	BOYCE	859	47,368
Atelopus varius	20	post	Ensemble	TSS	400	100
Atelopus varius	65	pre	Ensemble	BOYCE	575	87,692
Atelopus varius	65	pre	Ensemble	TSS	590	87,692
Atelopus varius	85	all	Models	TSS	337	98,387
Atelopus varius	85	all	Models	ROC	346	98,387
Atelopus varius	85	all	Models	KAPPA	922	35,484
Atelopus varius	85	all	Models	BOYCE	649	88,71
Atelopus varius	85	all	Models	TSS	374	100
Atelopus varius	85	all	Models	ROC	376	100
Atelopus varius	85	all	Models	KAPPA	374	100
Atelopus varius	85	all	Models	BOYCE	210	100
Atelopus varius	85	all	Models	TSS	382	100
Atelopus varius	85	all	Models	ROC	382,5	100
Atelopus varius	85	all	Models	KAPPA	881	35,484
Atelopus varius	85	all	Models	BOYCE	484	96,774
Atelopus varius	85	all	Models	TSS	464	93,548
Atelopus varius	85	all	Models	ROC	469,5	93,548
Atelopus varius	85	all	Models	KAPPA	888	38,71
Atelopus varius	85	all	Models	BOYCE	437	93,548
Atelopus varius	85	all	Models	TSS	369	98,387
Atelopus varius	85	all	Models	ROC	371,5	98,387
Atelopus varius	85	all	Models	KAPPA	896	45,161
Atelopus varius	85	all	Models	BOYCE	644	85,484
Atelopus varius	85	all	Models	TSS	386	100
Atelopus varius	85	all	Models	ROC	387	100
Atelopus varius	85	all	Models	KAPPA	386	100
Atelopus varius	85	all	Models	BOYCE	207	100
Atelopus varius	85	all	Models	TSS	413	100
Atelopus varius	85	all	Models	ROC	413,5	100
Atelopus varius	85	all	Models	KAPPA	883	38,71
Atelopus varius	85	all	Models	BOYCE	401	100
Atelopus varius	85	all	Models	TSS	513	90,323
Atelopus varius	85	all	Models	ROC	520,5	90,323
Atelopus varius	85	all	Models	KAPPA	795	58,065
Atelopus varius	85	all	Models	BOYCE	552	87,097
Atelopus varius	85	all	Models	TSS	361	98,387
Atelopus varius	85	all	Models	ROC	370	98,387
Atelopus varius	85	all	Models	KAPPA	873	58,065
Atelopus varius	85	all	Models	BOYCE	684	87,097
Atelopus varius	85	all	Models	TSS	361	100
Atelopus varius	85	all	Models	ROC	360	100

Atelopus varius	85	all	Models	KAPPA	361	100
Atelopus varius	85	all	Models	BOYCE	173	100
Atelopus varius	85	all	Models	TSS	447	98,387
Atelopus varius	85	all	Models	ROC	404,5	100
Atelopus varius	85	all	Models	KAPPA	861	53,226
Atelopus varius	85	all	Models	BOYCE	579	90,323
Atelopus varius	85	all	Models	TSS	509	95,161
Atelopus varius	85	all	Models	ROC	513,5	95,161
Atelopus varius	85	all	Models	KAPPA	709	77,419
Atelopus varius	85	all	Models	BOYCE	503	95,161
Atelopus varius	85	all	Models	TSS	317	96,825
Atelopus varius	85	all	Models	ROC	317,5	96,825
Atelopus varius	85	all	Models	KAPPA	942	23,81
Atelopus varius	85	all	Models	BOYCE	641	85,714
Atelopus varius	85	all	Models	TSS	380,5	100
Atelopus varius	85	all	Models	ROC	382	100
Atelopus varius	85	all	Models	KAPPA	380,5	100
Atelopus varius	85	all	Models	BOYCE	223	100
Atelopus varius	85	all	Models	TSS	339	100
Atelopus varius	85	all	Models	ROC	343,5	100
Atelopus varius	85	all	Models	KAPPA	928	17,46
Atelopus varius	85	all	Models	BOYCE	608	84,127
Atelopus varius	85	all	Models	TSS	443	88,889
Atelopus varius	85	all	Models	ROC	448,5	88,889
Atelopus varius	85	all	Models	KAPPA	745	65,079
Atelopus varius	85	all	Models	BOYCE	561	80,952
Atelopus varius	85	all	Models	TSS	697	86,747
Atelopus varius	85	all	Models	ROC	698	86,747
Atelopus varius	85	all	Models	KAPPA	903	44,578
Atelopus varius	85	all	Models	BOYCE	652	86,747
Atelopus varius	85	all	Models	TSS	389	100
Atelopus varius	85	all	Models	ROC	391	100
Atelopus varius	85	all	Models	KAPPA	389	100
Atelopus varius	85	all	Models	BOYCE	243	100
Atelopus varius	85	all	Models	TSS	454	95,181
Atelopus varius	85	all	Models	ROC	391,5	97,59
Atelopus varius	85	all	Models	KAPPA	875	36,145
Atelopus varius	85	all	Models	BOYCE	401	95,181
Atelopus varius	85	all	Models	TSS	483	90,361
Atelopus varius	85	all	Models	ROC	492,5	90,361
Atelopus varius	85	all	Models	KAPPA	744	67,47
Atelopus varius	85	all	Models	BOYCE	570	85,542
Atelopus varius	85	all	Models	TSS	6	92,771
Atelopus varius	85	all	Models	ROC	13,5	86,747
Atelopus varius	85	all	Models	KAPPA	86	32,53
Atelopus varius	85	all	Models	BOYCE	191	1,205
Atelopus varius	85	all	Models	TSS	366	100
Atelopus varius	85	all	Models	ROC	366	100
Atelopus varius	85	all	Models	KAPPA	366	100

Atelopus varius	85	all	Models	BOYCE	210	100
Atelopus varius	85	all	Models	TSS	11	87,952
Atelopus varius	85	all	Models	ROC	12,5	87,952
Atelopus varius	85	all	Models	KAPPA	124	18,072
Atelopus varius	85	all	Models	BOYCE	242	2,41
Atelopus varius	85	all	Models	TSS	9	91,566
Atelopus varius	85	all	Models	ROC	9,5	91,566
Atelopus varius	85	all	Models	KAPPA	22	62,651
Atelopus varius	85	all	Models	BOYCE	162	0
Atelopus varius	20	post	Models	TSS	495	85,714
Atelopus varius	20	post	Models	ROC	500	85,714
Atelopus varius	20	post	Models	KAPPA	495	85,714
Atelopus varius	20	post	Models	BOYCE	50	85,714
Atelopus varius	20	post	Models	TSS	329	100
Atelopus varius	20	post	Models	ROC	328	100
Atelopus varius	20	post	Models	KAPPA	329	100
Atelopus varius	20	post	Models	BOYCE	98	100
Atelopus varius	20	post	Models	TSS	609	100
Atelopus varius	20	post	Models	ROC	612	100
Atelopus varius	20	post	Models	KAPPA	959	21,429
Atelopus varius	20	post	Models	BOYCE	557	100
Atelopus varius	20	post	Models	TSS	363	100
Atelopus varius	20	post	Models	ROC	371,5	100
Atelopus varius	20	post	Models	KAPPA	968	35,714
Atelopus varius	20	post	Models	BOYCE	598	85,714
Atelopus varius	20	post	Models	TSS	495	85,714
Atelopus varius	20	post	Models	ROC	500	85,714
Atelopus varius	20	post	Models	KAPPA	495	85,714
Atelopus varius	20	post	Models	BOYCE	50	85,714
Atelopus varius	20	post	Models	TSS	333	100
Atelopus varius	20	post	Models	ROC	332	100
Atelopus varius	20	post	Models	KAPPA	333	100
Atelopus varius	20	post	Models	BOYCE	100	100
Atelopus varius	20	post	Models	TSS	674	100
Atelopus varius	20	post	Models	ROC	683,5	100
Atelopus varius	20	post	Models	KAPPA	905	57,143
Atelopus varius	20	post	Models	BOYCE	632	100
Atelopus varius	20	post	Models	TSS	636	100
Atelopus varius	20	post	Models	ROC	640,5	100
Atelopus varius	20	post	Models	KAPPA	919	64,286
Atelopus varius	20	post	Models	BOYCE	743	92,857
Atelopus varius	20	post	Models	TSS	495	92,857
Atelopus varius	20	post	Models	ROC	500	92,857
Atelopus varius	20	post	Models	KAPPA	495	92,857
Atelopus varius	20	post	Models	BOYCE	50	92,857
Atelopus varius	20	post	Models	TSS	331,5	100
Atelopus varius	20	post	Models	ROC	333	100
Atelopus varius	20	post	Models	KAPPA	331,5	100
Atelopus varius	20	post	Models	BOYCE	107	100

Atelopus varius	20	post	Models	TSS	695	100
Atelopus varius	20	post	Models	ROC	697,5	100
Atelopus varius	20	post	Models	KAPPA	952	21,429
Atelopus varius	20	post	Models	BOYCE	642	100
Atelopus varius	20	post	Models	TSS	727	92,857
Atelopus varius	20	post	Models	ROC	727,5	92,857
Atelopus varius	20	post	Models	KAPPA	919	57,143
Atelopus varius	20	post	Models	BOYCE	671	92,857
Atelopus varius	20	post	Models	TSS	495	60
Atelopus varius	20	post	Models	ROC	500	60
Atelopus varius	20	post	Models	KAPPA	495	60
Atelopus varius	20	post	Models	BOYCE	50	60
Atelopus varius	20	post	Models	TSS	321	100
Atelopus varius	20	post	Models	ROC	320	100
Atelopus varius	20	post	Models	KAPPA	321	100
Atelopus varius	20	post	Models	BOYCE	87	100
Atelopus varius	20	post	Models	TSS	682	100
Atelopus varius	20	post	Models	ROC	687	100
Atelopus varius	20	post	Models	KAPPA	906	33,333
Atelopus varius	20	post	Models	BOYCE	639	100
Atelopus varius	20	post	Models	TSS	424	100
Atelopus varius	20	post	Models	ROC	427,5	100
Atelopus varius	20	post	Models	KAPPA	969	20
Atelopus varius	20	post	Models	BOYCE	553	93,333
Atelopus varius	20	post	Models	TSS	495	84,211
Atelopus varius	20	post	Models	ROC	500	84,211
Atelopus varius	20	post	Models	KAPPA	495	84,211
Atelopus varius	20	post	Models	BOYCE	50	84,211
Atelopus varius	20	post	Models	TSS	324	100
Atelopus varius	20	post	Models	ROC	325	100
Atelopus varius	20	post	Models	KAPPA	324	100
Atelopus varius	20	post	Models	BOYCE	95	100
Atelopus varius	20	post	Models	TSS	608	100
Atelopus varius	20	post	Models	ROC	608,5	100
Atelopus varius	20	post	Models	KAPPA	966	15,789
Atelopus varius	20	post	Models	BOYCE	556	100
Atelopus varius	20	post	Models	TSS	565	94,737
Atelopus varius	20	post	Models	ROC	573,5	94,737
Atelopus varius	20	post	Models	KAPPA	979	31,579
Atelopus varius	20	post	Models	BOYCE	517	94,737
Atelopus varius	20	post	Models	TSS	4	94,737
Atelopus varius	20	post	Models	ROC	4,5	94,737
Atelopus varius	20	post	Models	KAPPA	81	21,053
Atelopus varius	20	post	Models	BOYCE	181	0
Atelopus varius	20	post	Models	TSS	321	100
Atelopus varius	20	post	Models	ROC	323	100
Atelopus varius	20	post	Models	KAPPA	321	100
Atelopus varius	20	post	Models	BOYCE	94	100
Atelopus varius	20	post	Models	TSS	3	100

Atelopus varius	20	post	Models	ROC	3,5	100
Atelopus varius	20	post	Models	KAPPA	94	21,053
Atelopus varius	20	post	Models	BOYCE	83	21,053
Atelopus varius	20	post	Models	TSS	2	94,737
Atelopus varius	20	post	Models	ROC	2,5	94,737
Atelopus varius	20	post	Models	KAPPA	28	31,579
Atelopus varius	20	post	Models	BOYCE	109	0
Atelopus varius	65	pre	Models	TSS	576	95,833
Atelopus varius	65	pre	Models	ROC	582,5	95,833
Atelopus varius	65	pre	Models	KAPPA	953	22,917
Atelopus varius	65	pre	Models	BOYCE	527	95,833
Atelopus varius	65	pre	Models	TSS	327	100
Atelopus varius	65	pre	Models	ROC	328	100
Atelopus varius	65	pre	Models	KAPPA	327	100
Atelopus varius	65	pre	Models	BOYCE	137	100
Atelopus varius	65	pre	Models	TSS	538	97,917
Atelopus varius	65	pre	Models	ROC	538,5	97,917
Atelopus varius	65	pre	Models	KAPPA	857	68,75
Atelopus varius	65	pre	Models	BOYCE	484	97,917
Atelopus varius	65	pre	Models	TSS	343	97,917
Atelopus varius	65	pre	Models	ROC	351,5	97,917
Atelopus varius	65	pre	Models	KAPPA	869	47,917
Atelopus varius	65	pre	Models	BOYCE	491	91,667
Atelopus varius	65	pre	Models	TSS	583	93,878
Atelopus varius	65	pre	Models	ROC	583,5	93,878
Atelopus varius	65	pre	Models	KAPPA	948	12,245
Atelopus varius	65	pre	Models	BOYCE	542	93,878
Atelopus varius	65	pre	Models	TSS	338	100
Atelopus varius	65	pre	Models	ROC	342	100
Atelopus varius	65	pre	Models	KAPPA	338	100
Atelopus varius	65	pre	Models	BOYCE	154	100
Atelopus varius	65	pre	Models	TSS	483	95,918
Atelopus varius	65	pre	Models	ROC	485,5	95,918
Atelopus varius	65	pre	Models	KAPPA	916	22,449
Atelopus varius	65	pre	Models	BOYCE	489	93,878
Atelopus varius	65	pre	Models	TSS	545	91,837
Atelopus varius	65	pre	Models	ROC	548,5	91,837
Atelopus varius	65	pre	Models	KAPPA	898	32,653
Atelopus varius	65	pre	Models	BOYCE	518	91,837
Atelopus varius	65	pre	Models	TSS	523	93,878
Atelopus varius	65	pre	Models	ROC	530,5	93,878
Atelopus varius	65	pre	Models	KAPPA	868	59,184
Atelopus varius	65	pre	Models	BOYCE	620	87,755
Atelopus varius	65	pre	Models	TSS	349,5	100
Atelopus varius	65	pre	Models	ROC	351	100
Atelopus varius	65	pre	Models	KAPPA	349,5	100
Atelopus varius	65	pre	Models	BOYCE	152	100
Atelopus varius	65	pre	Models	TSS	465	97,959
Atelopus varius	65	pre	Models	ROC	468	97,959

Atelopus varius	65	pre	Models	KAPPA	798	71,429
Atelopus varius	65	pre	Models	BOYCE	455	97,959
Atelopus varius	65	pre	Models	TSS	431	97,959
Atelopus varius	65	pre	Models	ROC	438,5	97,959
Atelopus varius	65	pre	Models	KAPPA	681	81,633
Atelopus varius	65	pre	Models	BOYCE	416	97,959
Atelopus varius	65	pre	Models	TSS	423	91,837
Atelopus varius	65	pre	Models	ROC	431,5	91,837
Atelopus varius	65	pre	Models	KAPPA	904	42,857
Atelopus varius	65	pre	Models	BOYCE	609	85,714
Atelopus varius	65	pre	Models	TSS	343	100
Atelopus varius	65	pre	Models	ROC	345	100
Atelopus varius	65	pre	Models	KAPPA	343	100
Atelopus varius	65	pre	Models	BOYCE	155	100
Atelopus varius	65	pre	Models	TSS	286	100
Atelopus varius	65	pre	Models	ROC	290,5	100
Atelopus varius	65	pre	Models	KAPPA	855	44,898
Atelopus varius	65	pre	Models	BOYCE	557	87,755
Atelopus varius	65	pre	Models	TSS	434	89,796
Atelopus varius	65	pre	Models	ROC	439,5	89,796
Atelopus varius	65	pre	Models	KAPPA	725	61,224
Atelopus varius	65	pre	Models	BOYCE	607	77,551
Atelopus varius	65	pre	Models	TSS	677	87,692
Atelopus varius	65	pre	Models	ROC	677,5	87,692
Atelopus varius	65	pre	Models	KAPPA	902	44,615
Atelopus varius	65	pre	Models	BOYCE	634	87,692
Atelopus varius	65	pre	Models	TSS	357	100
Atelopus varius	65	pre	Models	ROC	355	100
Atelopus varius	65	pre	Models	KAPPA	357	100
Atelopus varius	65	pre	Models	BOYCE	160	100
Atelopus varius	65	pre	Models	TSS	476	95,385
Atelopus varius	65	pre	Models	ROC	476,5	95,385
Atelopus varius	65	pre	Models	KAPPA	871	47,692
Atelopus varius	65	pre	Models	BOYCE	482	93,846
Atelopus varius	65	pre	Models	TSS	474	90,769
Atelopus varius	65	pre	Models	ROC	477,5	90,769
Atelopus varius	65	pre	Models	KAPPA	746	69,231
Atelopus varius	65	pre	Models	BOYCE	562	84,615
Atelopus varius	65	pre	Models	TSS	8	90,769
Atelopus varius	65	pre	Models	ROC	9,5	90,769
Atelopus varius	65	pre	Models	KAPPA	99	12,308
Atelopus varius	65	pre	Models	BOYCE	196	1,538
Atelopus varius	65	pre	Models	TSS	335	100
Atelopus varius	65	pre	Models	ROC	335	100
Atelopus varius	65	pre	Models	KAPPA	335	100
Atelopus varius	65	pre	Models	BOYCE	140	100
Atelopus varius	65	pre	Models	TSS	6	90,769
Atelopus varius	65	pre	Models	ROC	7,5	90,769
Atelopus varius	65	pre	Models	KAPPA	77	23,077

Atelopus varius	65	pre	Models	BOYCE	163	3,077
Atelopus varius	65	pre	Models	TSS	8	90,769
Atelopus varius	65	pre	Models	ROC	7,5	90,769
Atelopus varius	65	pre	Models	KAPPA	15	70,769
Atelopus varius	65	pre	Models	BOYCE	200	0
Craugastor ranoides	69	all	Ensemble	BOYCE	612	51,562
Craugastor ranoides	69	all	Ensemble	TSS	309	76,562
Craugastor ranoides	10	post	Ensemble	BOYCE	941	100
Craugastor ranoides	10	post	Ensemble	TSS	990	100
Craugastor ranoides	59	pre	Ensemble	BOYCE	364	82,143
Craugastor ranoides	59	pre	Ensemble	TSS	311	89,286
Craugastor ranoides	69	all	Models	TSS	495	60,417
Craugastor ranoides	69	all	Models	ROC	500	60,417
Craugastor ranoides	69	all	Models	KAPPA	495	60,417
Craugastor ranoides	69	all	Models	BOYCE	50	60,417
Craugastor ranoides	69	all	Models	TSS	329	100
Craugastor ranoides	69	all	Models	ROC	330	100
Craugastor ranoides	69	all	Models	KAPPA	329	100
Craugastor ranoides	69	all	Models	BOYCE	184	100
Craugastor ranoides	69	all	Models	TSS	350	97,917
Craugastor ranoides	69	all	Models	ROC	355,5	97,917
Craugastor ranoides	69	all	Models	KAPPA	870	16,667
Craugastor ranoides	69	all	Models	BOYCE	416	89,583
Craugastor ranoides	69	all	Models	TSS	511	72,917
Craugastor ranoides	69	all	Models	ROC	519,5	72,917
Craugastor ranoides	69	all	Models	KAPPA	772	18,75
Craugastor ranoides	69	all	Models	BOYCE	917	0
Craugastor ranoides	69	all	Models	TSS	495	77,083
Craugastor ranoides	69	all	Models	ROC	500	77,083
Craugastor ranoides	69	all	Models	KAPPA	495	77,083
Craugastor ranoides	69	all	Models	BOYCE	50	77,083
Craugastor ranoides	69	all	Models	TSS	364	100
Craugastor ranoides	69	all	Models	ROC	364	100
Craugastor ranoides	69	all	Models	KAPPA	364	100
Craugastor ranoides	69	all	Models	BOYCE	192	100
Craugastor ranoides	69	all	Models	TSS	602	91,667
Craugastor ranoides	69	all	Models	ROC	606,5	91,667
Craugastor ranoides	69	all	Models	KAPPA	886	20,833
Craugastor ranoides	69	all	Models	BOYCE	570	91,667
Craugastor ranoides	69	all	Models	TSS	667	64,583
Craugastor ranoides	69	all	Models	ROC	669,5	64,583
Craugastor ranoides	69	all	Models	KAPPA	685	58,333
Craugastor ranoides	69	all	Models	BOYCE	648	66,667
Craugastor ranoides	69	all	Models	TSS	495	31,25
Craugastor ranoides	69	all	Models	ROC	500	31,25
Craugastor ranoides	69	all	Models	KAPPA	495	31,25
Craugastor ranoides	69	all	Models	BOYCE	50	31,25
Craugastor ranoides	69	all	Models	TSS	355,5	100
Craugastor ranoides	69	all	Models	ROC	354	100

Craugastor ranoides	69	all	Models	KAPPA	355,5	100
Craugastor ranoides	69	all	Models	BOYCE	148	100
Craugastor ranoides	69	all	Models	TSS	396	93,75
Craugastor ranoides	69	all	Models	ROC	499,5	87,5
Craugastor ranoides	69	all	Models	KAPPA	739	39,583
Craugastor ranoides	69	all	Models	BOYCE	452	87,5
Craugastor ranoides	69	all	Models	TSS	366	87,5
Craugastor ranoides	69	all	Models	ROC	366,5	87,5
Craugastor ranoides	69	all	Models	KAPPA	674	35,417
Craugastor ranoides	69	all	Models	BOYCE	532	58,333
Craugastor ranoides	69	all	Models	TSS	495	58,333
Craugastor ranoides	69	all	Models	ROC	500	58,333
Craugastor ranoides	69	all	Models	KAPPA	495	58,333
Craugastor ranoides	69	all	Models	BOYCE	50	58,333
Craugastor ranoides	69	all	Models	TSS	345,5	100
Craugastor ranoides	69	all	Models	ROC	347	100
Craugastor ranoides	69	all	Models	KAPPA	345,5	100
Craugastor ranoides	69	all	Models	BOYCE	180	100
Craugastor ranoides	69	all	Models	TSS	405	91,667
Craugastor ranoides	69	all	Models	ROC	412,5	91,667
Craugastor ranoides	69	all	Models	KAPPA	899	12,5
Craugastor ranoides	69	all	Models	BOYCE	434	87,5
Craugastor ranoides	69	all	Models	TSS	369	91,667
Craugastor ranoides	69	all	Models	ROC	369,5	91,667
Craugastor ranoides	69	all	Models	KAPPA	665	50
Craugastor ranoides	69	all	Models	BOYCE	915	0
Craugastor ranoides	69	all	Models	TSS	495	48,438
Craugastor ranoides	69	all	Models	ROC	500	48,438
Craugastor ranoides	69	all	Models	KAPPA	495	48,438
Craugastor ranoides	69	all	Models	BOYCE	50	48,438
Craugastor ranoides	69	all	Models	TSS	354,5	100
Craugastor ranoides	69	all	Models	ROC	357	100
Craugastor ranoides	69	all	Models	KAPPA	354,5	100
Craugastor ranoides	69	all	Models	BOYCE	180	100
Craugastor ranoides	69	all	Models	TSS	496	85,938
Craugastor ranoides	69	all	Models	ROC	502,5	85,938
Craugastor ranoides	69	all	Models	KAPPA	806	25
Craugastor ranoides	69	all	Models	BOYCE	490	85,938
Craugastor ranoides	69	all	Models	TSS	450	81,25
Craugastor ranoides	69	all	Models	ROC	465,5	79,688
Craugastor ranoides	69	all	Models	KAPPA	695	29,688
Craugastor ranoides	69	all	Models	BOYCE	912	0
Craugastor ranoides	69	all	Models	TSS	7	81,25
Craugastor ranoides	69	all	Models	ROC	7,5	78,125
Craugastor ranoides	69	all	Models	KAPPA	42	28,125
Craugastor ranoides	69	all	Models	BOYCE	163	0
Craugastor ranoides	69	all	Models	TSS	328,5	100
Craugastor ranoides	69	all	Models	ROC	330	100
Craugastor ranoides	69	all	Models	KAPPA	328,5	100

Craugastor ranoides	69	all	Models	BOYCE	174	100
Craugastor ranoides	69	all	Models	TSS	8	84,375
Craugastor ranoides	69	all	Models	ROC	9,5	79,688
Craugastor ranoides	69	all	Models	KAPPA	65	10,938
Craugastor ranoides	69	all	Models	BOYCE	210	0
Craugastor ranoides	69	all	Models	TSS	5	87,5
Craugastor ranoides	69	all	Models	ROC	5,5	82,812
Craugastor ranoides	69	all	Models	KAPPA	14	26,562
Craugastor ranoides	69	all	Models	BOYCE	59	0
Craugastor ranoides	10	post	Models	TSS	495	100
Craugastor ranoides	10	post	Models	ROC	500	100
Craugastor ranoides	10	post	Models	KAPPA	495	100
Craugastor ranoides	10	post	Models	BOYCE	50	100
Craugastor ranoides	10	post	Models	TSS	309	100
Craugastor ranoides	10	post	Models	ROC	307	100
Craugastor ranoides	10	post	Models	KAPPA	309	100
Craugastor ranoides	10	post	Models	BOYCE	93	100
Craugastor ranoides	10	post	Models	TSS	942	100
Craugastor ranoides	10	post	Models	ROC	940,5	100
Craugastor ranoides	10	post	Models	KAPPA	942	100
Craugastor ranoides	10	post	Models	BOYCE	889	100
Craugastor ranoides	10	post	Models	TSS	949	100
Craugastor ranoides	10	post	Models	ROC	951,5	100
Craugastor ranoides	10	post	Models	KAPPA	949	100
Craugastor ranoides	10	post	Models	BOYCE	896	100
Craugastor ranoides	10	post	Models	TSS	495	100
Craugastor ranoides	10	post	Models	ROC	500	100
Craugastor ranoides	10	post	Models	KAPPA	495	100
Craugastor ranoides	10	post	Models	BOYCE	50	100
Craugastor ranoides	10	post	Models	TSS	337,5	100
Craugastor ranoides	10	post	Models	ROC	336	100
Craugastor ranoides	10	post	Models	KAPPA	337,5	100
Craugastor ranoides	10	post	Models	BOYCE	133	100
Craugastor ranoides	10	post	Models	TSS	784	100
Craugastor ranoides	10	post	Models	ROC	780	100
Craugastor ranoides	10	post	Models	KAPPA	936	83,333
Craugastor ranoides	10	post	Models	BOYCE	903	83,333
Craugastor ranoides	10	post	Models	TSS	990	100
Craugastor ranoides	10	post	Models	ROC	993,5	100
Craugastor ranoides	10	post	Models	KAPPA	990	100
Craugastor ranoides	10	post	Models	BOYCE	941	100
Craugastor ranoides	10	post	Models	TSS	495	100
Craugastor ranoides	10	post	Models	ROC	500	100
Craugastor ranoides	10	post	Models	KAPPA	495	100
Craugastor ranoides	10	post	Models	BOYCE	50	100
Craugastor ranoides	10	post	Models	TSS	343,5	100
Craugastor ranoides	10	post	Models	ROC	344	100
Craugastor ranoides	10	post	Models	KAPPA	343,5	100
Craugastor ranoides	10	post	Models	BOYCE	141	100

Craugastor ranoides	10	post	Models	TSS	955	100
Craugastor ranoides	10	post	Models	ROC	955	100
Craugastor ranoides	10	post	Models	KAPPA	975	83,333
Craugastor ranoides	10	post	Models	BOYCE	909	100
Craugastor ranoides	10	post	Models	TSS	980	100
Craugastor ranoides	10	post	Models	ROC	985,5	100
Craugastor ranoides	10	post	Models	KAPPA	980	100
Craugastor ranoides	10	post	Models	BOYCE	932	100
Craugastor ranoides	10	post	Models	TSS	495	100
Craugastor ranoides	10	post	Models	ROC	500	100
Craugastor ranoides	10	post	Models	KAPPA	495	100
Craugastor ranoides	10	post	Models	BOYCE	50	100
Craugastor ranoides	10	post	Models	TSS	336	100
Craugastor ranoides	10	post	Models	ROC	336	100
Craugastor ranoides	10	post	Models	KAPPA	336	100
Craugastor ranoides	10	post	Models	BOYCE	121	100
Craugastor ranoides	10	post	Models	TSS	882	100
Craugastor ranoides	10	post	Models	ROC	881	100
Craugastor ranoides	10	post	Models	KAPPA	962	83,333
Craugastor ranoides	10	post	Models	BOYCE	835	100
Craugastor ranoides	10	post	Models	TSS	970	100
Craugastor ranoides	10	post	Models	ROC	970,5	100
Craugastor ranoides	10	post	Models	KAPPA	970	100
Craugastor ranoides	10	post	Models	BOYCE	914	100
Craugastor ranoides	10	post	Models	TSS	495	100
Craugastor ranoides	10	post	Models	ROC	500	100
Craugastor ranoides	10	post	Models	KAPPA	495	100
Craugastor ranoides	10	post	Models	BOYCE	50	100
Craugastor ranoides	10	post	Models	TSS	324,5	100
Craugastor ranoides	10	post	Models	ROC	325	100
Craugastor ranoides	10	post	Models	KAPPA	324,5	100
Craugastor ranoides	10	post	Models	BOYCE	112	100
Craugastor ranoides	10	post	Models	TSS	853	100
Craugastor ranoides	10	post	Models	ROC	854,5	100
Craugastor ranoides	10	post	Models	KAPPA	973	62,5
Craugastor ranoides	10	post	Models	BOYCE	800	100
Craugastor ranoides	10	post	Models	TSS	949	100
Craugastor ranoides	10	post	Models	ROC	951,5	100
Craugastor ranoides	10	post	Models	KAPPA	970	87,5
Craugastor ranoides	10	post	Models	BOYCE	905	100
Craugastor ranoides	10	post	Models	TSS	495	37,5
Craugastor ranoides	10	post	Models	ROC	500	37,5
Craugastor ranoides	10	post	Models	KAPPA	495	37,5
Craugastor ranoides	10	post	Models	BOYCE	50	37,5
Craugastor ranoides	10	post	Models	TSS	317,5	100
Craugastor ranoides	10	post	Models	ROC	317	100
Craugastor ranoides	10	post	Models	KAPPA	317,5	100
Craugastor ranoides	10	post	Models	BOYCE	125	100
Craugastor ranoides	10	post	Models	TSS	0	100

Craugastor ranoides	10	post	Models	ROC	4,5	100
Craugastor ranoides	10	post	Models	KAPPA	180	62,5
Craugastor ranoides	10	post	Models	BOYCE	155	62,5
Craugastor ranoides	10	post	Models	TSS	6	100
Craugastor ranoides	10	post	Models	ROC	7,5	100
Craugastor ranoides	10	post	Models	KAPPA	113	50
Craugastor ranoides	10	post	Models	BOYCE	304	0
Craugastor ranoides	59	pre	Models	TSS	495	54,762
Craugastor ranoides	59	pre	Models	ROC	500	54,762
Craugastor ranoides	59	pre	Models	KAPPA	495	54,762
Craugastor ranoides	59	pre	Models	BOYCE	50	54,762
Craugastor ranoides	59	pre	Models	TSS	361	100
Craugastor ranoides	59	pre	Models	ROC	362	100
Craugastor ranoides	59	pre	Models	KAPPA	361	100
Craugastor ranoides	59	pre	Models	BOYCE	183	100
Craugastor ranoides	59	pre	Models	TSS	408	95,238
Craugastor ranoides	59	pre	Models	ROC	409,5	95,238
Craugastor ranoides	59	pre	Models	KAPPA	877	16,667
Craugastor ranoides	59	pre	Models	BOYCE	420	92,857
Craugastor ranoides	59	pre	Models	TSS	322	100
Craugastor ranoides	59	pre	Models	ROC	324,5	100
Craugastor ranoides	59	pre	Models	KAPPA	667	38,095
Craugastor ranoides	59	pre	Models	BOYCE	933	0
Craugastor ranoides	59	pre	Models	TSS	495	66,667
Craugastor ranoides	59	pre	Models	ROC	500	66,667
Craugastor ranoides	59	pre	Models	KAPPA	495	66,667
Craugastor ranoides	59	pre	Models	BOYCE	50	66,667
Craugastor ranoides	59	pre	Models	TSS	357,5	100
Craugastor ranoides	59	pre	Models	ROC	357	100
Craugastor ranoides	59	pre	Models	KAPPA	357,5	100
Craugastor ranoides	59	pre	Models	BOYCE	161	100
Craugastor ranoides	59	pre	Models	TSS	556	92,857
Craugastor ranoides	59	pre	Models	ROC	558,5	92,857
Craugastor ranoides	59	pre	Models	KAPPA	918	21,429
Craugastor ranoides	59	pre	Models	BOYCE	544	92,857
Craugastor ranoides	59	pre	Models	TSS	540	90,476
Craugastor ranoides	59	pre	Models	ROC	542,5	90,476
Craugastor ranoides	59	pre	Models	KAPPA	912	11,905
Craugastor ranoides	59	pre	Models	BOYCE	866	16,667
Craugastor ranoides	59	pre	Models	TSS	495	52,381
Craugastor ranoides	59	pre	Models	ROC	500	52,381
Craugastor ranoides	59	pre	Models	KAPPA	495	52,381
Craugastor ranoides	59	pre	Models	BOYCE	50	52,381
Craugastor ranoides	59	pre	Models	TSS	354	100
Craugastor ranoides	59	pre	Models	ROC	356	100
Craugastor ranoides	59	pre	Models	KAPPA	354	100
Craugastor ranoides	59	pre	Models	BOYCE	158	100
Craugastor ranoides	59	pre	Models	TSS	392	95,238
Craugastor ranoides	59	pre	Models	ROC	393,5	95,238

Craugastor ranoides	59	pre	Models	KAPPA	894	9,524
Craugastor ranoides	59	pre	Models	BOYCE	380	95,238
Craugastor ranoides	59	pre	Models	TSS	340	92,857
Craugastor ranoides	59	pre	Models	ROC	344,5	92,857
Craugastor ranoides	59	pre	Models	KAPPA	733	38,095
Craugastor ranoides	59	pre	Models	BOYCE	572	61,905
Craugastor ranoides	59	pre	Models	TSS	495	66,667
Craugastor ranoides	59	pre	Models	ROC	500	66,667
Craugastor ranoides	59	pre	Models	KAPPA	495	66,667
Craugastor ranoides	59	pre	Models	BOYCE	50	66,667
Craugastor ranoides	59	pre	Models	TSS	323	100
Craugastor ranoides	59	pre	Models	ROC	323	100
Craugastor ranoides	59	pre	Models	KAPPA	323	100
Craugastor ranoides	59	pre	Models	BOYCE	122	100
Craugastor ranoides	59	pre	Models	TSS	465	88,095
Craugastor ranoides	59	pre	Models	ROC	467,5	88,095
Craugastor ranoides	59	pre	Models	KAPPA	886	16,667
Craugastor ranoides	59	pre	Models	BOYCE	428	88,095
Craugastor ranoides	59	pre	Models	TSS	358	97,619
Craugastor ranoides	59	pre	Models	ROC	360,5	97,619
Craugastor ranoides	59	pre	Models	KAPPA	679	45,238
Craugastor ranoides	59	pre	Models	BOYCE	542	61,905
Craugastor ranoides	59	pre	Models	TSS	495	62,5
Craugastor ranoides	59	pre	Models	ROC	500	62,5
Craugastor ranoides	59	pre	Models	KAPPA	495	62,5
Craugastor ranoides	59	pre	Models	BOYCE	50	62,5
Craugastor ranoides	59	pre	Models	TSS	344	100
Craugastor ranoides	59	pre	Models	ROC	346	100
Craugastor ranoides	59	pre	Models	KAPPA	344	100
Craugastor ranoides	59	pre	Models	BOYCE	173	100
Craugastor ranoides	59	pre	Models	TSS	471	87,5
Craugastor ranoides	59	pre	Models	ROC	478,5	87,5
Craugastor ranoides	59	pre	Models	KAPPA	871	19,643
Craugastor ranoides	59	pre	Models	BOYCE	434	89,286
Craugastor ranoides	59	pre	Models	TSS	395	89,286
Craugastor ranoides	59	pre	Models	ROC	356,5	96,429
Craugastor ranoides	59	pre	Models	KAPPA	715	33,929
Craugastor ranoides	59	pre	Models	BOYCE	368	91,071
Craugastor ranoides	59	pre	Models	TSS	5	87,5
Craugastor ranoides	59	pre	Models	ROC	5,5	83,929
Craugastor ranoides	59	pre	Models	KAPPA	40	19,643
Craugastor ranoides	59	pre	Models	BOYCE	110	0
Craugastor ranoides	59	pre	Models	TSS	357	100
Craugastor ranoides	59	pre	Models	ROC	356	100
Craugastor ranoides	59	pre	Models	KAPPA	357	100
Craugastor ranoides	59	pre	Models	BOYCE	179	100
Craugastor ranoides	59	pre	Models	TSS	7	82,143
Craugastor ranoides	59	pre	Models	ROC	7,5	82,143
Craugastor ranoides	59	pre	Models	KAPPA	49	17,857

Craugastor ranoides	59	pre	Models	BOYCE	102	1,786
Craugastor ranoides	59	pre	Models	TSS	4	87,5
Craugastor ranoides	59	pre	Models	ROC	4,5	83,929
Craugastor ranoides	59	pre	Models	KAPPA	13	28,571
Craugastor ranoides	59	pre	Models	BOYCE	51	0
Duellmanohyla uranochroa	42	all	Ensemble	BOYCE	471	94,737
Duellmanohyla uranochroa	42	all	Ensemble	TSS	514	94,737
Duellmanohyla uranochroa	12	post	Ensemble	BOYCE	808	55,556
Duellmanohyla uranochroa	12	post	Ensemble	TSS	310	100
Duellmanohyla uranochroa	30	pre	Ensemble	BOYCE	486	93,333
Duellmanohyla uranochroa	30	pre	Ensemble	TSS	436	96,667
Duellmanohyla uranochroa	42	all	Models	TSS	626	100
Duellmanohyla uranochroa	42	all	Models	ROC	630,5	100
Duellmanohyla uranochroa	42	all	Models	KAPPA	868	82,143
Duellmanohyla uranochroa	42	all	Models	BOYCE	760	89,286
Duellmanohyla uranochroa	42	all	Models	TSS	351,5	100
Duellmanohyla uranochroa	42	all	Models	ROC	354	100
Duellmanohyla uranochroa	42	all	Models	KAPPA	351,5	100
Duellmanohyla uranochroa	42	all	Models	BOYCE	171	100
Duellmanohyla uranochroa	42	all	Models	TSS	521	100
Duellmanohyla uranochroa	42	all	Models	ROC	529,5	100
Duellmanohyla uranochroa	42	all	Models	KAPPA	895	35,714
Duellmanohyla uranochroa	42	all	Models	BOYCE	715	89,286
Duellmanohyla uranochroa	42	all	Models	TSS	444	92,857
Duellmanohyla uranochroa	42	all	Models	ROC	449,5	92,857
Duellmanohyla uranochroa	42	all	Models	KAPPA	929	25
Duellmanohyla uranochroa	42	all	Models	BOYCE	410	92,857
Duellmanohyla uranochroa	42	all	Models	TSS	747	100
Duellmanohyla uranochroa	42	all	Models	ROC	753,5	100

Duellmanohyla uranochroa	42	all	Models	KAPPA	929	68,966
Duellmanohyla uranochroa	42	all	Models	BOYCE	698	100
Duellmanohyla uranochroa	42	all	Models	TSS	360	100
Duellmanohyla uranochroa	42	all	Models	ROC	360	100
Duellmanohyla uranochroa	42	all	Models	KAPPA	360	100
Duellmanohyla uranochroa	42	all	Models	BOYCE	177	100
Duellmanohyla uranochroa	42	all	Models	TSS	785	96,552
Duellmanohyla uranochroa	42	all	Models	ROC	792,5	96,552
Duellmanohyla uranochroa	42	all	Models	KAPPA	886	65,517
Duellmanohyla uranochroa	42	all	Models	BOYCE	741	96,552
Duellmanohyla uranochroa	42	all	Models	TSS	476	100
Duellmanohyla uranochroa	42	all	Models	ROC	478,5	100
Duellmanohyla uranochroa	42	all	Models	KAPPA	960	41,379
Duellmanohyla uranochroa	42	all	Models	BOYCE	429	100
Duellmanohyla uranochroa	42	all	Models	TSS	495	100
Duellmanohyla uranochroa	42	all	Models	ROC	500	100
Duellmanohyla uranochroa	42	all	Models	KAPPA	495	100
Duellmanohyla uranochroa	42	all	Models	BOYCE	50	100
Duellmanohyla uranochroa	42	all	Models	TSS	323	100
Duellmanohyla uranochroa	42	all	Models	ROC	324	100
Duellmanohyla uranochroa	42	all	Models	KAPPA	323	100
Duellmanohyla uranochroa	42	all	Models	BOYCE	97	100
Duellmanohyla uranochroa	42	all	Models	TSS	453	100
Duellmanohyla uranochroa	42	all	Models	ROC	461,5	100
Duellmanohyla uranochroa	42	all	Models	KAPPA	904	46,429
Duellmanohyla uranochroa	42	all	Models	BOYCE	408	100
Duellmanohyla uranochroa	42	all	Models	TSS	686	92,857

Duellmanohyla uranochroa	42	all	Models	ROC	695,5	92,857
Duellmanohyla uranochroa	42	all	Models	KAPPA	888	39,286
Duellmanohyla uranochroa	42	all	Models	BOYCE	643	92,857
Duellmanohyla uranochroa	42	all	Models	TSS	495	89,655
Duellmanohyla uranochroa	42	all	Models	ROC	500	89,655
Duellmanohyla uranochroa	42	all	Models	KAPPA	495	89,655
Duellmanohyla uranochroa	42	all	Models	BOYCE	50	89,655
Duellmanohyla uranochroa	42	all	Models	TSS	337	100
Duellmanohyla uranochroa	42	all	Models	ROC	336	100
Duellmanohyla uranochroa	42	all	Models	KAPPA	337	100
Duellmanohyla uranochroa	42	all	Models	BOYCE	135	100
Duellmanohyla uranochroa	42	all	Models	TSS	386	100
Duellmanohyla uranochroa	42	all	Models	ROC	390,5	100
Duellmanohyla uranochroa	42	all	Models	KAPPA	858	62,069
Duellmanohyla uranochroa	42	all	Models	BOYCE	577	89,655
Duellmanohyla uranochroa	42	all	Models	TSS	354	96,552
Duellmanohyla uranochroa	42	all	Models	ROC	356,5	96,552
Duellmanohyla uranochroa	42	all	Models	KAPPA	747	68,966
Duellmanohyla uranochroa	42	all	Models	BOYCE	446	89,655
Duellmanohyla uranochroa	42	all	Models	TSS	433	100
Duellmanohyla uranochroa	42	all	Models	ROC	434	100
Duellmanohyla uranochroa	42	all	Models	KAPPA	896	76,316
Duellmanohyla uranochroa	42	all	Models	BOYCE	606	92,105
Duellmanohyla uranochroa	42	all	Models	TSS	350,5	100
Duellmanohyla uranochroa	42	all	Models	ROC	349	100
Duellmanohyla uranochroa	42	all	Models	KAPPA	350,5	100
Duellmanohyla uranochroa	42	all	Models	BOYCE	161	100

Duellmanohyla uranochroa	42	all	Models	TSS	632	94,737
Duellmanohyla uranochroa	42	all	Models	ROC	636,5	94,737
Duellmanohyla uranochroa	42	all	Models	KAPPA	918	26,316
Duellmanohyla uranochroa	42	all	Models	BOYCE	586	94,737
Duellmanohyla uranochroa	42	all	Models	TSS	414	94,737
Duellmanohyla uranochroa	42	all	Models	ROC	414,5	94,737
Duellmanohyla uranochroa	42	all	Models	KAPPA	778	65,789
Duellmanohyla uranochroa	42	all	Models	BOYCE	608	84,211
Duellmanohyla uranochroa	42	all	Models	TSS	4	92,105
Duellmanohyla uranochroa	42	all	Models	ROC	5,5	92,105
Duellmanohyla uranochroa	42	all	Models	KAPPA	67	36,842
Duellmanohyla uranochroa	42	all	Models	BOYCE	392	0
Duellmanohyla uranochroa	42	all	Models	TSS	355,5	100
Duellmanohyla uranochroa	42	all	Models	ROC	355	100
Duellmanohyla uranochroa	42	all	Models	KAPPA	355,5	100
Duellmanohyla uranochroa	42	all	Models	BOYCE	163	100
Duellmanohyla uranochroa	42	all	Models	TSS	12	92,105
Duellmanohyla uranochroa	42	all	Models	ROC	13,5	92,105
Duellmanohyla uranochroa	42	all	Models	KAPPA	73	23,684
Duellmanohyla uranochroa	42	all	Models	BOYCE	144	5,263
Duellmanohyla uranochroa	42	all	Models	TSS	4	89,474
Duellmanohyla uranochroa	42	all	Models	ROC	4,5	86,842
Duellmanohyla uranochroa	42	all	Models	KAPPA	12	60,526
Duellmanohyla uranochroa	42	all	Models	BOYCE	187	0
Duellmanohyla uranochroa	12	post	Models	TSS	495	100
Duellmanohyla uranochroa	12	post	Models	ROC	500	100
Duellmanohyla uranochroa	12	post	Models	KAPPA	495	100

Duellmanohyla uranochroa	12	post	Models	BOYCE	50	100
Duellmanohyla uranochroa	12	post	Models	TSS	330,5	100
Duellmanohyla uranochroa	12	post	Models	ROC	331	100
Duellmanohyla uranochroa	12	post	Models	KAPPA	330,5	100
Duellmanohyla uranochroa	12	post	Models	BOYCE	97	100
Duellmanohyla uranochroa	12	post	Models	TSS	639	100
Duellmanohyla uranochroa	12	post	Models	ROC	643,5	100
Duellmanohyla uranochroa	12	post	Models	KAPPA	848	66,667
Duellmanohyla uranochroa	12	post	Models	BOYCE	761	83,333
Duellmanohyla uranochroa	12	post	Models	TSS	606	100
Duellmanohyla uranochroa	12	post	Models	ROC	609,5	100
Duellmanohyla uranochroa	12	post	Models	KAPPA	747	83,333
Duellmanohyla uranochroa	12	post	Models	BOYCE	689	83,333
Duellmanohyla uranochroa	12	post	Models	TSS	495	85,714
Duellmanohyla uranochroa	12	post	Models	ROC	500	85,714
Duellmanohyla uranochroa	12	post	Models	KAPPA	495	85,714
Duellmanohyla uranochroa	12	post	Models	BOYCE	50	85,714
Duellmanohyla uranochroa	12	post	Models	TSS	334	100
Duellmanohyla uranochroa	12	post	Models	ROC	334	100
Duellmanohyla uranochroa	12	post	Models	KAPPA	334	100
Duellmanohyla uranochroa	12	post	Models	BOYCE	99	100
Duellmanohyla uranochroa	12	post	Models	TSS	597	100
Duellmanohyla uranochroa	12	post	Models	ROC	603	100
Duellmanohyla uranochroa	12	post	Models	KAPPA	930	28,571
Duellmanohyla uranochroa	12	post	Models	BOYCE	755	85,714
Duellmanohyla uranochroa	12	post	Models	TSS	727	100
Duellmanohyla uranochroa	12	post	Models	ROC	735,5	100

Duellmanohyla uranochroa	12	post	Models	KAPPA	859	85,714
Duellmanohyla uranochroa	12	post	Models	BOYCE	806	85,714
Duellmanohyla uranochroa	12	post	Models	TSS	495	85,714
Duellmanohyla uranochroa	12	post	Models	ROC	500	85,714
Duellmanohyla uranochroa	12	post	Models	KAPPA	495	85,714
Duellmanohyla uranochroa	12	post	Models	BOYCE	50	85,714
Duellmanohyla uranochroa	12	post	Models	TSS	311	100
Duellmanohyla uranochroa	12	post	Models	ROC	310	100
Duellmanohyla uranochroa	12	post	Models	KAPPA	311	100
Duellmanohyla uranochroa	12	post	Models	BOYCE	67	100
Duellmanohyla uranochroa	12	post	Models	TSS	581	100
Duellmanohyla uranochroa	12	post	Models	ROC	581,5	100
Duellmanohyla uranochroa	12	post	Models	KAPPA	798	85,714
Duellmanohyla uranochroa	12	post	Models	BOYCE	751	85,714
Duellmanohyla uranochroa	12	post	Models	TSS	454	100
Duellmanohyla uranochroa	12	post	Models	ROC	454,5	100
Duellmanohyla uranochroa	12	post	Models	KAPPA	918	42,857
Duellmanohyla uranochroa	12	post	Models	BOYCE	733	85,714
Duellmanohyla uranochroa	12	post	Models	TSS	495	100
Duellmanohyla uranochroa	12	post	Models	ROC	500	100
Duellmanohyla uranochroa	12	post	Models	KAPPA	495	100
Duellmanohyla uranochroa	12	post	Models	BOYCE	50	100
Duellmanohyla uranochroa	12	post	Models	TSS	338,5	100
Duellmanohyla uranochroa	12	post	Models	ROC	340	100
Duellmanohyla uranochroa	12	post	Models	KAPPA	338,5	100
Duellmanohyla uranochroa	12	post	Models	BOYCE	101	100
Duellmanohyla uranochroa	12	post	Models	TSS	692	100

Duellmanohyla uranochroa	12	post	Models	ROC	694,5	100
Duellmanohyla uranochroa	12	post	Models	KAPPA	839,5	42,857
Duellmanohyla uranochroa	12	post	Models	BOYCE	647	100
Duellmanohyla uranochroa	12	post	Models	TSS	717	100
Duellmanohyla uranochroa	12	post	Models	ROC	723,5	100
Duellmanohyla uranochroa	12	post	Models	KAPPA	717	100
Duellmanohyla uranochroa	12	post	Models	BOYCE	671	100
Duellmanohyla uranochroa	12	post	Models	TSS	495	100
Duellmanohyla uranochroa	12	post	Models	ROC	500	100
Duellmanohyla uranochroa	12	post	Models	KAPPA	495	100
Duellmanohyla uranochroa	12	post	Models	BOYCE	50	100
Duellmanohyla uranochroa	12	post	Models	TSS	316	100
Duellmanohyla uranochroa	12	post	Models	ROC	317	100
Duellmanohyla uranochroa	12	post	Models	KAPPA	316	100
Duellmanohyla uranochroa	12	post	Models	BOYCE	83	100
Duellmanohyla uranochroa	12	post	Models	TSS	758	100
Duellmanohyla uranochroa	12	post	Models	ROC	760,5	100
Duellmanohyla uranochroa	12	post	Models	KAPPA	898	44,444
Duellmanohyla uranochroa	12	post	Models	BOYCE	707	100
Duellmanohyla uranochroa	12	post	Models	TSS	616	100
Duellmanohyla uranochroa	12	post	Models	ROC	620	100
Duellmanohyla uranochroa	12	post	Models	KAPPA	717	88,889
Duellmanohyla uranochroa	12	post	Models	BOYCE	563	100
Duellmanohyla uranochroa	12	post	Models	TSS	0	100
Duellmanohyla uranochroa	12	post	Models	ROC	1,5	100
Duellmanohyla uranochroa	12	post	Models	KAPPA	23	55,556
Duellmanohyla uranochroa	12	post	Models	BOYCE	168	0

Duellmanohyla uranochroa	12	post	Models	TSS	314	100
Duellmanohyla uranochroa	12	post	Models	ROC	317	100
Duellmanohyla uranochroa	12	post	Models	KAPPA	314	100
Duellmanohyla uranochroa	12	post	Models	BOYCE	111	100
Duellmanohyla uranochroa	12	post	Models	TSS	3	100
Duellmanohyla uranochroa	12	post	Models	ROC	3,5	100
Duellmanohyla uranochroa	12	post	Models	KAPPA	33,5	44,444
Duellmanohyla uranochroa	12	post	Models	BOYCE	59	0
Duellmanohyla uranochroa	12	post	Models	TSS	0	100
Duellmanohyla uranochroa	12	post	Models	ROC	0,5	100
Duellmanohyla uranochroa	12	post	Models	KAPPA	8	11,111
Duellmanohyla uranochroa	12	post	Models	BOYCE	56	0
Duellmanohyla uranochroa	30	pre	Models	TSS	495	86,364
Duellmanohyla uranochroa	30	pre	Models	ROC	500	86,364
Duellmanohyla uranochroa	30	pre	Models	KAPPA	495	86,364
Duellmanohyla uranochroa	30	pre	Models	BOYCE	50	86,364
Duellmanohyla uranochroa	30	pre	Models	TSS	342	100
Duellmanohyla uranochroa	30	pre	Models	ROC	342	100
Duellmanohyla uranochroa	30	pre	Models	KAPPA	342	100
Duellmanohyla uranochroa	30	pre	Models	BOYCE	134	100
Duellmanohyla uranochroa	30	pre	Models	TSS	414	100
Duellmanohyla uranochroa	30	pre	Models	ROC	417,5	100
Duellmanohyla uranochroa	30	pre	Models	KAPPA	916	27,273
Duellmanohyla uranochroa	30	pre	Models	BOYCE	751	81,818
Duellmanohyla uranochroa	30	pre	Models	TSS	374	95,455
Duellmanohyla uranochroa	30	pre	Models	ROC	382,5	95,455
Duellmanohyla uranochroa	30	pre	Models	KAPPA	697	68,182

Duellmanohyla uranochroa	30	pre	Models	BOYCE	392	90,909
Duellmanohyla uranochroa	30	pre	Models	TSS	768	100
Duellmanohyla uranochroa	30	pre	Models	ROC	775	100
Duellmanohyla uranochroa	30	pre	Models	KAPPA	949	60,87
Duellmanohyla uranochroa	30	pre	Models	BOYCE	725	100
Duellmanohyla uranochroa	30	pre	Models	TSS	344	100
Duellmanohyla uranochroa	30	pre	Models	ROC	346	100
Duellmanohyla uranochroa	30	pre	Models	KAPPA	344	100
Duellmanohyla uranochroa	30	pre	Models	BOYCE	164	100
Duellmanohyla uranochroa	30	pre	Models	TSS	733	100
Duellmanohyla uranochroa	30	pre	Models	ROC	731	100
Duellmanohyla uranochroa	30	pre	Models	KAPPA	844	82,609
Duellmanohyla uranochroa	30	pre	Models	BOYCE	677	100
Duellmanohyla uranochroa	30	pre	Models	TSS	636	100
Duellmanohyla uranochroa	30	pre	Models	ROC	636,5	100
Duellmanohyla uranochroa	30	pre	Models	KAPPA	758	95,652
Duellmanohyla uranochroa	30	pre	Models	BOYCE	707	95,652
Duellmanohyla uranochroa	30	pre	Models	TSS	495	90,909
Duellmanohyla uranochroa	30	pre	Models	ROC	500	90,909
Duellmanohyla uranochroa	30	pre	Models	KAPPA	495	90,909
Duellmanohyla uranochroa	30	pre	Models	BOYCE	50	90,909
Duellmanohyla uranochroa	30	pre	Models	TSS	323	100
Duellmanohyla uranochroa	30	pre	Models	ROC	322	100
Duellmanohyla uranochroa	30	pre	Models	KAPPA	323	100
Duellmanohyla uranochroa	30	pre	Models	BOYCE	97	100
Duellmanohyla uranochroa	30	pre	Models	TSS	531	100
Duellmanohyla uranochroa	30	pre	Models	ROC	537,5	100

Duellmanohyla uranochroa	30	pre	Models	KAPPA	876	45,455
Duellmanohyla uranochroa	30	pre	Models	BOYCE	689	90,909
Duellmanohyla uranochroa	30	pre	Models	TSS	505	95,455
Duellmanohyla uranochroa	30	pre	Models	ROC	508,5	95,455
Duellmanohyla uranochroa	30	pre	Models	KAPPA	767	77,273
Duellmanohyla uranochroa	30	pre	Models	BOYCE	455	95,455
Duellmanohyla uranochroa	30	pre	Models	TSS	495	86,957
Duellmanohyla uranochroa	30	pre	Models	ROC	500	86,957
Duellmanohyla uranochroa	30	pre	Models	KAPPA	495	86,957
Duellmanohyla uranochroa	30	pre	Models	BOYCE	50	86,957
Duellmanohyla uranochroa	30	pre	Models	TSS	338,5	100
Duellmanohyla uranochroa	30	pre	Models	ROC	339	100
Duellmanohyla uranochroa	30	pre	Models	KAPPA	338,5	100
Duellmanohyla uranochroa	30	pre	Models	BOYCE	133	100
Duellmanohyla uranochroa	30	pre	Models	TSS	460	95,652
Duellmanohyla uranochroa	30	pre	Models	ROC	462,5	95,652
Duellmanohyla uranochroa	30	pre	Models	KAPPA	938	21,739
Duellmanohyla uranochroa	30	pre	Models	BOYCE	554	91,304
Duellmanohyla uranochroa	30	pre	Models	TSS	405	95,652
Duellmanohyla uranochroa	30	pre	Models	ROC	412,5	95,652
Duellmanohyla uranochroa	30	pre	Models	KAPPA	717	78,261
Duellmanohyla uranochroa	30	pre	Models	BOYCE	671	78,261
Duellmanohyla uranochroa	30	pre	Models	TSS	495	96,667
Duellmanohyla uranochroa	30	pre	Models	ROC	500	96,667
Duellmanohyla uranochroa	30	pre	Models	KAPPA	495	96,667
Duellmanohyla uranochroa	30	pre	Models	BOYCE	50	96,667
Duellmanohyla uranochroa	30	pre	Models	TSS	344	100

Duellmanohyla uranochroa	30	pre	Models	ROC	343	100
Duellmanohyla uranochroa	30	pre	Models	KAPPA	344	100
Duellmanohyla uranochroa	30	pre	Models	BOYCE	137	100
Duellmanohyla uranochroa	30	pre	Models	TSS	477	100
Duellmanohyla uranochroa	30	pre	Models	ROC	481,5	100
Duellmanohyla uranochroa	30	pre	Models	KAPPA	933	23,333
Duellmanohyla uranochroa	30	pre	Models	BOYCE	678	93,333
Duellmanohyla uranochroa	30	pre	Models	TSS	354	96,667
Duellmanohyla uranochroa	30	pre	Models	ROC	355,5	96,667
Duellmanohyla uranochroa	30	pre	Models	KAPPA	798	66,667
Duellmanohyla uranochroa	30	pre	Models	BOYCE	419	90
Duellmanohyla uranochroa	30	pre	Models	TSS	3	96,667
Duellmanohyla uranochroa	30	pre	Models	ROC	3,5	96,667
Duellmanohyla uranochroa	30	pre	Models	KAPPA	56	40
Duellmanohyla uranochroa	30	pre	Models	BOYCE	279	0
Duellmanohyla uranochroa	30	pre	Models	TSS	328,5	100
Duellmanohyla uranochroa	30	pre	Models	ROC	329	100
Duellmanohyla uranochroa	30	pre	Models	KAPPA	328,5	100
Duellmanohyla uranochroa	30	pre	Models	BOYCE	126	100
Duellmanohyla uranochroa	30	pre	Models	TSS	6	93,333
Duellmanohyla uranochroa	30	pre	Models	ROC	5,5	93,333
Duellmanohyla uranochroa	30	pre	Models	KAPPA	93	23,333
Duellmanohyla uranochroa	30	pre	Models	BOYCE	176	0
Duellmanohyla uranochroa	30	pre	Models	TSS	2	93,333
Duellmanohyla uranochroa	30	pre	Models	ROC	2,5	93,333
Duellmanohyla uranochroa	30	pre	Models	KAPPA	38	10
Duellmanohyla uranochroa	30	pre	Models	BOYCE	179	0
Isthmohyla rivularis	59	all	Ensemble	BOYCE	675	85,714

Isthmohyla rivularis	59	all	Ensemble	TSS	328	100
Isthmohyla rivularis	22	post	Ensemble	BOYCE	742	75
Isthmohyla rivularis	22	post	Ensemble	TSS	368,5	100
Isthmohyla rivularis	37	pre	Ensemble	BOYCE	592	78,378
Isthmohyla rivularis	37	pre	Ensemble	TSS	339	100
Isthmohyla rivularis	59	all	Models	TSS	464	100
Isthmohyla rivularis	59	all	Models	ROC	463,5	100
Isthmohyla rivularis	59	all	Models	KAPPA	979	35,714
Isthmohyla rivularis	59	all	Models	BOYCE	517	97,619
Isthmohyla rivularis	59	all	Models	TSS	367,5	100
Isthmohyla rivularis	59	all	Models	ROC	367	100
Isthmohyla rivularis	59	all	Models	KAPPA	367,5	100
Isthmohyla rivularis	59	all	Models	BOYCE	179	100
Isthmohyla rivularis	59	all	Models	TSS	547	97,619
Isthmohyla rivularis	59	all	Models	ROC	546,5	97,619
Isthmohyla rivularis	59	all	Models	KAPPA	923	45,238
Isthmohyla rivularis	59	all	Models	BOYCE	492	97,619
Isthmohyla rivularis	59	all	Models	TSS	384	100
Isthmohyla rivularis	59	all	Models	ROC	391,5	100
Isthmohyla rivularis	59	all	Models	KAPPA	828	69,048
Isthmohyla rivularis	59	all	Models	BOYCE	464	97,619
Isthmohyla rivularis	59	all	Models	TSS	758	100
Isthmohyla rivularis	59	all	Models	ROC	759,5	100
Isthmohyla rivularis	59	all	Models	KAPPA	970	64,286
Isthmohyla rivularis	59	all	Models	BOYCE	707	100
Isthmohyla rivularis	59	all	Models	TSS	389	100
Isthmohyla rivularis	59	all	Models	ROC	389	100
Isthmohyla rivularis	59	all	Models	KAPPA	389	100
Isthmohyla rivularis	59	all	Models	BOYCE	212	100
Isthmohyla rivularis	59	all	Models	TSS	745	100
Isthmohyla rivularis	59	all	Models	ROC	750,5	100
Isthmohyla rivularis	59	all	Models	KAPPA	946	66,667
Isthmohyla rivularis	59	all	Models	BOYCE	696	100
Isthmohyla rivularis	59	all	Models	TSS	687	100
Isthmohyla rivularis	59	all	Models	ROC	694	100
Isthmohyla rivularis	59	all	Models	KAPPA	929	80,952
Isthmohyla rivularis	59	all	Models	BOYCE	644	100
Isthmohyla rivularis	59	all	Models	TSS	495	88,095
Isthmohyla rivularis	59	all	Models	ROC	500	88,095
Isthmohyla rivularis	59	all	Models	KAPPA	495	88,095
Isthmohyla rivularis	59	all	Models	BOYCE	50	88,095
Isthmohyla rivularis	59	all	Models	TSS	344	100
Isthmohyla rivularis	59	all	Models	ROC	347	100
Isthmohyla rivularis	59	all	Models	KAPPA	344	100
Isthmohyla rivularis	59	all	Models	BOYCE	149	100
Isthmohyla rivularis	59	all	Models	TSS	640	97,619
Isthmohyla rivularis	59	all	Models	ROC	646,5	97,619
Isthmohyla rivularis	59	all	Models	KAPPA	925	59,524
Isthmohyla rivularis	59	all	Models	BOYCE	593	97,619

Isthmohyla rivularis	59	all	Models	TSS	424	100
Isthmohyla rivularis	59	all	Models	ROC	428,5	100
Isthmohyla rivularis	59	all	Models	KAPPA	758	83,333
Isthmohyla rivularis	59	all	Models	BOYCE	572	95,238
Isthmohyla rivularis	59	all	Models	TSS	495	92,857
Isthmohyla rivularis	59	all	Models	ROC	500	92,857
Isthmohyla rivularis	59	all	Models	KAPPA	495	92,857
Isthmohyla rivularis	59	all	Models	BOYCE	50	92,857
Isthmohyla rivularis	59	all	Models	TSS	348	100
Isthmohyla rivularis	59	all	Models	ROC	348	100
Isthmohyla rivularis	59	all	Models	KAPPA	348	100
Isthmohyla rivularis	59	all	Models	BOYCE	149	100
Isthmohyla rivularis	59	all	Models	TSS	594	97,619
Isthmohyla rivularis	59	all	Models	ROC	596,5	97,619
Isthmohyla rivularis	59	all	Models	KAPPA	899	47,619
Isthmohyla rivularis	59	all	Models	BOYCE	543	97,619
Isthmohyla rivularis	59	all	Models	TSS	515	100
Isthmohyla rivularis	59	all	Models	ROC	522	100
Isthmohyla rivularis	59	all	Models	KAPPA	848	66,667
Isthmohyla rivularis	59	all	Models	BOYCE	473	100
Isthmohyla rivularis	59	all	Models	TSS	423	100
Isthmohyla rivularis	59	all	Models	ROC	430,5	100
Isthmohyla rivularis	59	all	Models	KAPPA	968	39,286
Isthmohyla rivularis	59	all	Models	BOYCE	373	100
Isthmohyla rivularis	59	all	Models	TSS	369,5	100
Isthmohyla rivularis	59	all	Models	ROC	369	100
Isthmohyla rivularis	59	all	Models	KAPPA	369,5	100
Isthmohyla rivularis	59	all	Models	BOYCE	184	100
Isthmohyla rivularis	59	all	Models	TSS	566	98,214
Isthmohyla rivularis	59	all	Models	ROC	571,5	98,214
Isthmohyla rivularis	59	all	Models	KAPPA	912	58,929
Isthmohyla rivularis	59	all	Models	BOYCE	553	98,214
Isthmohyla rivularis	59	all	Models	TSS	434	100
Isthmohyla rivularis	59	all	Models	ROC	439,5	100
Isthmohyla rivularis	59	all	Models	KAPPA	899	58,929
Isthmohyla rivularis	59	all	Models	BOYCE	500	98,214
Isthmohyla rivularis	59	all	Models	TSS	4	96,429
Isthmohyla rivularis	59	all	Models	ROC	1,5	100
Isthmohyla rivularis	59	all	Models	KAPPA	121	44,643
Isthmohyla rivularis	59	all	Models	BOYCE	319	14,286
Isthmohyla rivularis	59	all	Models	TSS	369,5	100
Isthmohyla rivularis	59	all	Models	ROC	369	100
Isthmohyla rivularis	59	all	Models	KAPPA	369,5	100
Isthmohyla rivularis	59	all	Models	BOYCE	187	100
Isthmohyla rivularis	59	all	Models	TSS	6	91,071
Isthmohyla rivularis	59	all	Models	ROC	1,5	100
Isthmohyla rivularis	59	all	Models	KAPPA	113	48,214
Isthmohyla rivularis	59	all	Models	BOYCE	15	85,714
Isthmohyla rivularis	59	all	Models	TSS	5	98,214

Isthmohyla rivularis	59	all	Models	ROC	5,5	98,214
Isthmohyla rivularis	59	all	Models	KAPPA	46	28,571
Isthmohyla rivularis	59	all	Models	BOYCE	480	0
Isthmohyla rivularis	22	post	Models	TSS	495	100
Isthmohyla rivularis	22	post	Models	ROC	500	100
Isthmohyla rivularis	22	post	Models	KAPPA	495	100
Isthmohyla rivularis	22	post	Models	BOYCE	50	100
Isthmohyla rivularis	22	post	Models	TSS	325	100
Isthmohyla rivularis	22	post	Models	ROC	324	100
Isthmohyla rivularis	22	post	Models	KAPPA	325	100
Isthmohyla rivularis	22	post	Models	BOYCE	86	100
Isthmohyla rivularis	22	post	Models	TSS	602	100
Isthmohyla rivularis	22	post	Models	ROC	606	100
Isthmohyla rivularis	22	post	Models	KAPPA	953	46,667
Isthmohyla rivularis	22	post	Models	BOYCE	711	93,333
Isthmohyla rivularis	22	post	Models	TSS	687	100
Isthmohyla rivularis	22	post	Models	ROC	690	100
Isthmohyla rivularis	22	post	Models	KAPPA	949	53,333
Isthmohyla rivularis	22	post	Models	BOYCE	635	100
Isthmohyla rivularis	22	post	Models	TSS	960	100
Isthmohyla rivularis	22	post	Models	ROC	968,5	100
Isthmohyla rivularis	22	post	Models	KAPPA	960	100
Isthmohyla rivularis	22	post	Models	BOYCE	914	100
Isthmohyla rivularis	22	post	Models	TSS	345	100
Isthmohyla rivularis	22	post	Models	ROC	346	100
Isthmohyla rivularis	22	post	Models	KAPPA	345	100
Isthmohyla rivularis	22	post	Models	BOYCE	145	100
Isthmohyla rivularis	22	post	Models	TSS	835	100
Isthmohyla rivularis	22	post	Models	ROC	843,5	100
Isthmohyla rivularis	22	post	Models	KAPPA	946	80
Isthmohyla rivularis	22	post	Models	BOYCE	794	100
Isthmohyla rivularis	22	post	Models	TSS	874	100
Isthmohyla rivularis	22	post	Models	ROC	875	100
Isthmohyla rivularis	22	post	Models	KAPPA	949	86,667
Isthmohyla rivularis	22	post	Models	BOYCE	824	100
Isthmohyla rivularis	22	post	Models	TSS	495	93,333
Isthmohyla rivularis	22	post	Models	ROC	500	93,333
Isthmohyla rivularis	22	post	Models	KAPPA	495	93,333
Isthmohyla rivularis	22	post	Models	BOYCE	50	93,333
Isthmohyla rivularis	22	post	Models	TSS	326	100
Isthmohyla rivularis	22	post	Models	ROC	326	100
Isthmohyla rivularis	22	post	Models	KAPPA	326	100
Isthmohyla rivularis	22	post	Models	BOYCE	102	100
Isthmohyla rivularis	22	post	Models	TSS	774	100
Isthmohyla rivularis	22	post	Models	ROC	772,5	100
Isthmohyla rivularis	22	post	Models	KAPPA	932	53,333
Isthmohyla rivularis	22	post	Models	BOYCE	721	100
Isthmohyla rivularis	22	post	Models	TSS	646	100
Isthmohyla rivularis	22	post	Models	ROC	646,5	100

Isthmohyla rivularis	22	post	Models	KAPPA	869	73,333
Isthmohyla rivularis	22	post	Models	BOYCE	590	100
Isthmohyla rivularis	22	post	Models	TSS	495	80
Isthmohyla rivularis	22	post	Models	ROC	500	80
Isthmohyla rivularis	22	post	Models	KAPPA	495	80
Isthmohyla rivularis	22	post	Models	BOYCE	50	80
Isthmohyla rivularis	22	post	Models	TSS	329	100
Isthmohyla rivularis	22	post	Models	ROC	327	100
Isthmohyla rivularis	22	post	Models	KAPPA	329	100
Isthmohyla rivularis	22	post	Models	BOYCE	81	100
Isthmohyla rivularis	22	post	Models	TSS	654	100
Isthmohyla rivularis	22	post	Models	ROC	654,5	100
Isthmohyla rivularis	22	post	Models	KAPPA	946	40
Isthmohyla rivularis	22	post	Models	BOYCE	606	100
Isthmohyla rivularis	22	post	Models	TSS	606	100
Isthmohyla rivularis	22	post	Models	ROC	607,5	100
Isthmohyla rivularis	22	post	Models	KAPPA	859	73,333
Isthmohyla rivularis	22	post	Models	BOYCE	554	100
Isthmohyla rivularis	22	post	Models	TSS	495	80
Isthmohyla rivularis	22	post	Models	ROC	500	80
Isthmohyla rivularis	22	post	Models	KAPPA	495	80
Isthmohyla rivularis	22	post	Models	BOYCE	50	80
Isthmohyla rivularis	22	post	Models	TSS	326,5	100
Isthmohyla rivularis	22	post	Models	ROC	325	100
Isthmohyla rivularis	22	post	Models	KAPPA	326,5	100
Isthmohyla rivularis	22	post	Models	BOYCE	89	100
Isthmohyla rivularis	22	post	Models	TSS	724	100
Isthmohyla rivularis	22	post	Models	ROC	727,5	100
Isthmohyla rivularis	22	post	Models	KAPPA	952	45
Isthmohyla rivularis	22	post	Models	BOYCE	677	100
Isthmohyla rivularis	22	post	Models	TSS	586	100
Isthmohyla rivularis	22	post	Models	ROC	591	100
Isthmohyla rivularis	22	post	Models	KAPPA	869	80
Isthmohyla rivularis	22	post	Models	BOYCE	671	95
Isthmohyla rivularis	22	post	Models	TSS	4	100
Isthmohyla rivularis	22	post	Models	ROC	4,5	100
Isthmohyla rivularis	22	post	Models	KAPPA	180	20
Isthmohyla rivularis	22	post	Models	BOYCE	345	0
Isthmohyla rivularis	22	post	Models	TSS	330	100
Isthmohyla rivularis	22	post	Models	ROC	330	100
Isthmohyla rivularis	22	post	Models	KAPPA	330	100
Isthmohyla rivularis	22	post	Models	BOYCE	99	100
Isthmohyla rivularis	22	post	Models	TSS	0	100
Isthmohyla rivularis	22	post	Models	ROC	2,5	100
Isthmohyla rivularis	22	post	Models	KAPPA	77	35
Isthmohyla rivularis	22	post	Models	BOYCE	22	75
Isthmohyla rivularis	22	post	Models	TSS	3	90
Isthmohyla rivularis	22	post	Models	ROC	4,5	90
Isthmohyla rivularis	22	post	Models	KAPPA	52	10

Isthmohyla rivularis	22	post	Models	BOYCE	242	0
Isthmohyla rivularis	37	pre	Models	TSS	495	85,185
Isthmohyla rivularis	37	pre	Models	ROC	500	85,185
Isthmohyla rivularis	37	pre	Models	KAPPA	495	85,185
Isthmohyla rivularis	37	pre	Models	BOYCE	50	85,185
Isthmohyla rivularis	37	pre	Models	TSS	332,5	100
Isthmohyla rivularis	37	pre	Models	ROC	333	100
Isthmohyla rivularis	37	pre	Models	KAPPA	332,5	100
Isthmohyla rivularis	37	pre	Models	BOYCE	107	100
Isthmohyla rivularis	37	pre	Models	TSS	452	100
Isthmohyla rivularis	37	pre	Models	ROC	458,5	100
Isthmohyla rivularis	37	pre	Models	KAPPA	911	40,741
Isthmohyla rivularis	37	pre	Models	BOYCE	713	85,185
Isthmohyla rivularis	37	pre	Models	TSS	505	100
Isthmohyla rivularis	37	pre	Models	ROC	508,5	100
Isthmohyla rivularis	37	pre	Models	KAPPA	616	96,296
Isthmohyla rivularis	37	pre	Models	BOYCE	572	96,296
Isthmohyla rivularis	37	pre	Models	TSS	798	100
Isthmohyla rivularis	37	pre	Models	ROC	803	100
Isthmohyla rivularis	37	pre	Models	KAPPA	939	82,143
Isthmohyla rivularis	37	pre	Models	BOYCE	752	100
Isthmohyla rivularis	37	pre	Models	TSS	389	100
Isthmohyla rivularis	37	pre	Models	ROC	392	100
Isthmohyla rivularis	37	pre	Models	KAPPA	389	100
Isthmohyla rivularis	37	pre	Models	BOYCE	237	100
Isthmohyla rivularis	37	pre	Models	TSS	742	100
Isthmohyla rivularis	37	pre	Models	ROC	751	100
Isthmohyla rivularis	37	pre	Models	KAPPA	933	60,714
Isthmohyla rivularis	37	pre	Models	BOYCE	702	100
Isthmohyla rivularis	37	pre	Models	TSS	707	100
Isthmohyla rivularis	37	pre	Models	ROC	708	100
Isthmohyla rivularis	37	pre	Models	KAPPA	899	92,857
Isthmohyla rivularis	37	pre	Models	BOYCE	851	92,857
Isthmohyla rivularis	37	pre	Models	TSS	495	96,429
Isthmohyla rivularis	37	pre	Models	ROC	500	96,429
Isthmohyla rivularis	37	pre	Models	KAPPA	495	96,429
Isthmohyla rivularis	37	pre	Models	BOYCE	50	96,429
Isthmohyla rivularis	37	pre	Models	TSS	344	100
Isthmohyla rivularis	37	pre	Models	ROC	345	100
Isthmohyla rivularis	37	pre	Models	KAPPA	344	100
Isthmohyla rivularis	37	pre	Models	BOYCE	133	100
Isthmohyla rivularis	37	pre	Models	TSS	566	100
Isthmohyla rivularis	37	pre	Models	ROC	573,5	100
Isthmohyla rivularis	37	pre	Models	KAPPA	952	28,571
Isthmohyla rivularis	37	pre	Models	BOYCE	518	100
Isthmohyla rivularis	37	pre	Models	TSS	475	100
Isthmohyla rivularis	37	pre	Models	ROC	484,5	100
Isthmohyla rivularis	37	pre	Models	KAPPA	808	78,571
Isthmohyla rivularis	37	pre	Models	BOYCE	428	100

Isthmohyla rivularis	37	pre	Models	TSS	495	67,857
Isthmohyla rivularis	37	pre	Models	ROC	500	67,857
Isthmohyla rivularis	37	pre	Models	KAPPA	495	67,857
Isthmohyla rivularis	37	pre	Models	BOYCE	50	67,857
Isthmohyla rivularis	37	pre	Models	TSS	330,5	100
Isthmohyla rivularis	37	pre	Models	ROC	330	100
Isthmohyla rivularis	37	pre	Models	KAPPA	330,5	100
Isthmohyla rivularis	37	pre	Models	BOYCE	111	100
Isthmohyla rivularis	37	pre	Models	TSS	433	100
Isthmohyla rivularis	37	pre	Models	ROC	637	96,429
Isthmohyla rivularis	37	pre	Models	KAPPA	885	60,714
Isthmohyla rivularis	37	pre	Models	BOYCE	583	96,429
Isthmohyla rivularis	37	pre	Models	TSS	586	100
Isthmohyla rivularis	37	pre	Models	ROC	595,5	100
Isthmohyla rivularis	37	pre	Models	KAPPA	707	89,286
Isthmohyla rivularis	37	pre	Models	BOYCE	545	100
Isthmohyla rivularis	37	pre	Models	TSS	495	83,784
Isthmohyla rivularis	37	pre	Models	ROC	500	83,784
Isthmohyla rivularis	37	pre	Models	KAPPA	495	83,784
Isthmohyla rivularis	37	pre	Models	BOYCE	50	83,784
Isthmohyla rivularis	37	pre	Models	TSS	332	100
Isthmohyla rivularis	37	pre	Models	ROC	334	100
Isthmohyla rivularis	37	pre	Models	KAPPA	332	100
Isthmohyla rivularis	37	pre	Models	BOYCE	127	100
Isthmohyla rivularis	37	pre	Models	TSS	597	100
Isthmohyla rivularis	37	pre	Models	ROC	599,5	100
Isthmohyla rivularis	37	pre	Models	KAPPA	944	29,73
Isthmohyla rivularis	37	pre	Models	BOYCE	546	100
Isthmohyla rivularis	37	pre	Models	TSS	515	100
Isthmohyla rivularis	37	pre	Models	ROC	517,5	100
Isthmohyla rivularis	37	pre	Models	KAPPA	697	91,892
Isthmohyla rivularis	37	pre	Models	BOYCE	464	100
Isthmohyla rivularis	37	pre	Models	TSS	2	100
Isthmohyla rivularis	37	pre	Models	ROC	1,5	100
Isthmohyla rivularis	37	pre	Models	KAPPA	99	27,027
Isthmohyla rivularis	37	pre	Models	BOYCE	227	0
Isthmohyla rivularis	37	pre	Models	TSS	339,5	100
Isthmohyla rivularis	37	pre	Models	ROC	337	100
Isthmohyla rivularis	37	pre	Models	KAPPA	339,5	100
Isthmohyla rivularis	37	pre	Models	BOYCE	122	100
Isthmohyla rivularis	37	pre	Models	TSS	12	86,486
Isthmohyla rivularis	37	pre	Models	ROC	1,5	97,297
Isthmohyla rivularis	37	pre	Models	KAPPA	87	37,838
Isthmohyla rivularis	37	pre	Models	BOYCE	159	2,703
Isthmohyla rivularis	37	pre	Models	TSS	3	100
Isthmohyla rivularis	37	pre	Models	ROC	5,5	97,297
Isthmohyla rivularis	37	pre	Models	KAPPA	32	24,324
Isthmohyla rivularis	37	pre	Models	BOYCE	302	0
Isthmohyla tica	18	all	Ensemble	BOYCE	809	55,556

Isthmohyla tica	18	all	Ensemble	TSS	336	100
Isthmohyla tica	6	post	Ensemble	BOYCE	738	100
Isthmohyla tica	6	post	Ensemble	TSS	785	100
Isthmohyla tica	12	pre	Ensemble	BOYCE	864	58,333
Isthmohyla tica	12	pre	Ensemble	TSS	482	100
Isthmohyla tica	18	all	Models	TSS	495	92,308
Isthmohyla tica	18	all	Models	ROC	500	92,308
Isthmohyla tica	18	all	Models	KAPPA	495	92,308
Isthmohyla tica	18	all	Models	BOYCE	50	92,308
Isthmohyla tica	18	all	Models	TSS	314,5	100
Isthmohyla tica	18	all	Models	ROC	313	100
Isthmohyla tica	18	all	Models	KAPPA	314,5	100
Isthmohyla tica	18	all	Models	BOYCE	112	100
Isthmohyla tica	18	all	Models	TSS	460	100
Isthmohyla tica	18	all	Models	ROC	466,5	100
Isthmohyla tica	18	all	Models	KAPPA	889	61,538
Isthmohyla tica	18	all	Models	BOYCE	744	92,308
Isthmohyla tica	18	all	Models	TSS	343	100
Isthmohyla tica	18	all	Models	ROC	347,5	100
Isthmohyla tica	18	all	Models	KAPPA	778	76,923
Isthmohyla tica	18	all	Models	BOYCE	617	92,308
Isthmohyla tica	18	all	Models	TSS	495	100
Isthmohyla tica	18	all	Models	ROC	500	100
Isthmohyla tica	18	all	Models	KAPPA	495	100
Isthmohyla tica	18	all	Models	BOYCE	50	100
Isthmohyla tica	18	all	Models	TSS	322	100
Isthmohyla tica	18	all	Models	ROC	324	100
Isthmohyla tica	18	all	Models	KAPPA	322	100
Isthmohyla tica	18	all	Models	BOYCE	125	100
Isthmohyla tica	18	all	Models	TSS	682	100
Isthmohyla tica	18	all	Models	ROC	683	100
Isthmohyla tica	18	all	Models	KAPPA	932	57,143
Isthmohyla tica	18	all	Models	BOYCE	800	92,857
Isthmohyla tica	18	all	Models	TSS	586	100
Isthmohyla tica	18	all	Models	ROC	594,5	100
Isthmohyla tica	18	all	Models	KAPPA	909	78,571
Isthmohyla tica	18	all	Models	BOYCE	824	85,714
Isthmohyla tica	18	all	Models	TSS	495	84,615
Isthmohyla tica	18	all	Models	ROC	500	84,615
Isthmohyla tica	18	all	Models	KAPPA	495	84,615
Isthmohyla tica	18	all	Models	BOYCE	50	84,615
Isthmohyla tica	18	all	Models	TSS	329	100
Isthmohyla tica	18	all	Models	ROC	327	100
Isthmohyla tica	18	all	Models	KAPPA	329	100
Isthmohyla tica	18	all	Models	BOYCE	109	100
Isthmohyla tica	18	all	Models	TSS	579	100
Isthmohyla tica	18	all	Models	ROC	585,5	100
Isthmohyla tica	18	all	Models	KAPPA	942	23,077
Isthmohyla tica	18	all	Models	BOYCE	539	100

Isthmohyla tica	18	all	Models	TSS	404	100
Isthmohyla tica	18	all	Models	ROC	413,5	100
Isthmohyla tica	18	all	Models	KAPPA	959	38,462
Isthmohyla tica	18	all	Models	BOYCE	751	76,923
Isthmohyla tica	18	all	Models	TSS	495	92,857
Isthmohyla tica	18	all	Models	ROC	500	92,857
Isthmohyla tica	18	all	Models	KAPPA	495	92,857
Isthmohyla tica	18	all	Models	BOYCE	50	92,857
Isthmohyla tica	18	all	Models	TSS	336	100
Isthmohyla tica	18	all	Models	ROC	337	100
Isthmohyla tica	18	all	Models	KAPPA	336	100
Isthmohyla tica	18	all	Models	BOYCE	119	100
Isthmohyla tica	18	all	Models	TSS	751	100
Isthmohyla tica	18	all	Models	ROC	756	100
Isthmohyla tica	18	all	Models	KAPPA	921	64,286
Isthmohyla tica	18	all	Models	BOYCE	701	100
Isthmohyla tica	18	all	Models	TSS	414	100
Isthmohyla tica	18	all	Models	ROC	422,5	100
Isthmohyla tica	18	all	Models	KAPPA	979	28,571
Isthmohyla tica	18	all	Models	BOYCE	733	92,857
Isthmohyla tica	18	all	Models	TSS	495	83,333
Isthmohyla tica	18	all	Models	ROC	500	83,333
Isthmohyla tica	18	all	Models	KAPPA	495	83,333
Isthmohyla tica	18	all	Models	BOYCE	50	83,333
Isthmohyla tica	18	all	Models	TSS	352	100
Isthmohyla tica	18	all	Models	ROC	352	100
Isthmohyla tica	18	all	Models	KAPPA	352	100
Isthmohyla tica	18	all	Models	BOYCE	142	100
Isthmohyla tica	18	all	Models	TSS	623	100
Isthmohyla tica	18	all	Models	ROC	627,5	100
Isthmohyla tica	18	all	Models	KAPPA	884	83,333
Isthmohyla tica	18	all	Models	BOYCE	712	94,444
Isthmohyla tica	18	all	Models	TSS	667	94,444
Isthmohyla tica	18	all	Models	ROC	671,5	94,444
Isthmohyla tica	18	all	Models	KAPPA	909	55,556
Isthmohyla tica	18	all	Models	BOYCE	617	94,444
Isthmohyla tica	18	all	Models	TSS	0	100
Isthmohyla tica	18	all	Models	ROC	2,5	94,444
Isthmohyla tica	18	all	Models	KAPPA	69	44,444
Isthmohyla tica	18	all	Models	BOYCE	322	11,111
Isthmohyla tica	18	all	Models	TSS	336	100
Isthmohyla tica	18	all	Models	ROC	335	100
Isthmohyla tica	18	all	Models	KAPPA	336	100
Isthmohyla tica	18	all	Models	BOYCE	122	100
Isthmohyla tica	18	all	Models	TSS	3	94,444
Isthmohyla tica	18	all	Models	ROC	5,5	94,444
Isthmohyla tica	18	all	Models	KAPPA	106	27,778
Isthmohyla tica	18	all	Models	BOYCE	194	11,111
Isthmohyla tica	18	all	Models	TSS	5	83,333

Isthmohyla tica	18	all	Models	ROC	6,5	83,333
Isthmohyla tica	18	all	Models	KAPPA	55	16,667
Isthmohyla tica	18	all	Models	BOYCE	203	5,556
Isthmohyla tica	6	post	Models	TSS	495	100
Isthmohyla tica	6	post	Models	ROC	500	100
Isthmohyla tica	6	post	Models	KAPPA	495	100
Isthmohyla tica	6	post	Models	BOYCE	50	100
Isthmohyla tica	6	post	Models	TSS	351	100
Isthmohyla tica	6	post	Models	ROC	351	100
Isthmohyla tica	6	post	Models	KAPPA	351	100
Isthmohyla tica	6	post	Models	BOYCE	135	100
Isthmohyla tica	6	post	Models	TSS	638	100
Isthmohyla tica	6	post	Models	ROC	639,5	100
Isthmohyla tica	6	post	Models	KAPPA	847	75
Isthmohyla tica	6	post	Models	BOYCE	929	25
Isthmohyla tica	6	post	Models	TSS	949	100
Isthmohyla tica	6	post	Models	ROC	950,5	100
Isthmohyla tica	6	post	Models	KAPPA	949	100
Isthmohyla tica	6	post	Models	BOYCE	896	100
Isthmohyla tica	6	post	Models	TSS	495	100
Isthmohyla tica	6	post	Models	ROC	500	100
Isthmohyla tica	6	post	Models	KAPPA	495	100
Isthmohyla tica	6	post	Models	BOYCE	50	100
Isthmohyla tica	6	post	Models	TSS	368	100
Isthmohyla tica	6	post	Models	ROC	367	100
Isthmohyla tica	6	post	Models	KAPPA	368	100
Isthmohyla tica	6	post	Models	BOYCE	153	100
Isthmohyla tica	6	post	Models	TSS	752	100
Isthmohyla tica	6	post	Models	ROC	760,5	100
Isthmohyla tica	6	post	Models	KAPPA	945	80
Isthmohyla tica	6	post	Models	BOYCE	901	80
Isthmohyla tica	6	post	Models	TSS	949	100
Isthmohyla tica	6	post	Models	ROC	955	100
Isthmohyla tica	6	post	Models	KAPPA	949	100
Isthmohyla tica	6	post	Models	BOYCE	905	100
Isthmohyla tica	6	post	Models	TSS	495	100
Isthmohyla tica	6	post	Models	ROC	500	100
Isthmohyla tica	6	post	Models	KAPPA	495	100
Isthmohyla tica	6	post	Models	BOYCE	50	100
Isthmohyla tica	6	post	Models	TSS	326	100
Isthmohyla tica	6	post	Models	ROC	325	100
Isthmohyla tica	6	post	Models	KAPPA	326	100
Isthmohyla tica	6	post	Models	BOYCE	91	100
Isthmohyla tica	6	post	Models	TSS	791	100
Isthmohyla tica	6	post	Models	ROC	792	100
Isthmohyla tica	6	post	Models	KAPPA	791	100
Isthmohyla tica	6	post	Models	BOYCE	916	25
Isthmohyla tica	6	post	Models	TSS	899	100
Isthmohyla tica	6	post	Models	ROC	906,5	100

Isthmohyla tica	6	post	Models	KAPPA	899	100
Isthmohyla tica	6	post	Models	BOYCE	851	100
Isthmohyla tica	6	post	Models	TSS	495	100
Isthmohyla tica	6	post	Models	ROC	500	100
Isthmohyla tica	6	post	Models	KAPPA	495	100
Isthmohyla tica	6	post	Models	BOYCE	50	100
Isthmohyla tica	6	post	Models	TSS	361	100
Isthmohyla tica	6	post	Models	ROC	361	100
Isthmohyla tica	6	post	Models	KAPPA	361	100
Isthmohyla tica	6	post	Models	BOYCE	148	100
Isthmohyla tica	6	post	Models	TSS	774	100
Isthmohyla tica	6	post	Models	ROC	774,5	100
Isthmohyla tica	6	post	Models	KAPPA	893	60
Isthmohyla tica	6	post	Models	BOYCE	721	100
Isthmohyla tica	6	post	Models	TSS	929	100
Isthmohyla tica	6	post	Models	ROC	932,5	100
Isthmohyla tica	6	post	Models	KAPPA	929	100
Isthmohyla tica	6	post	Models	BOYCE	878	100
Isthmohyla tica	6	post	Models	TSS	495	100
Isthmohyla tica	6	post	Models	ROC	500	100
Isthmohyla tica	6	post	Models	KAPPA	495	100
Isthmohyla tica	6	post	Models	BOYCE	50	100
Isthmohyla tica	6	post	Models	TSS	366	100
Isthmohyla tica	6	post	Models	ROC	365	100
Isthmohyla tica	6	post	Models	KAPPA	366	100
Isthmohyla tica	6	post	Models	BOYCE	163	100
Isthmohyla tica	6	post	Models	TSS	839	100
Isthmohyla tica	6	post	Models	ROC	846	100
Isthmohyla tica	6	post	Models	KAPPA	953	66,667
Isthmohyla tica	6	post	Models	BOYCE	792	100
Isthmohyla tica	6	post	Models	TSS	889	100
Isthmohyla tica	6	post	Models	ROC	893,5	100
Isthmohyla tica	6	post	Models	KAPPA	990	66,667
Isthmohyla tica	6	post	Models	BOYCE	842	100
Isthmohyla tica	6	post	Models	TSS	34	100
Isthmohyla tica	6	post	Models	ROC	34,5	100
Isthmohyla tica	6	post	Models	KAPPA	159	66,667
Isthmohyla tica	6	post	Models	BOYCE	534	0
Isthmohyla tica	6	post	Models	TSS	367,5	100
Isthmohyla tica	6	post	Models	ROC	367	100
Isthmohyla tica	6	post	Models	KAPPA	367,5	100
Isthmohyla tica	6	post	Models	BOYCE	159	100
Isthmohyla tica	6	post	Models	TSS	10	100
Isthmohyla tica	6	post	Models	ROC	11,5	100
Isthmohyla tica	6	post	Models	KAPPA	86	66,667
Isthmohyla tica	6	post	Models	BOYCE	132	50
Isthmohyla tica	6	post	Models	TSS	0	100
Isthmohyla tica	6	post	Models	ROC	1,5	100
Isthmohyla tica	6	post	Models	KAPPA	21	50

Isthmohyla tica	6	post	Models	BOYCE	250	0
Isthmohyla tica	12	pre	Models	TSS	495	100
Isthmohyla tica	12	pre	Models	ROC	500	100
Isthmohyla tica	12	pre	Models	KAPPA	495	100
Isthmohyla tica	12	pre	Models	BOYCE	50	100
Isthmohyla tica	12	pre	Models	TSS	328,5	100
Isthmohyla tica	12	pre	Models	ROC	329	100
Isthmohyla tica	12	pre	Models	KAPPA	328,5	100
Isthmohyla tica	12	pre	Models	BOYCE	84	100
Isthmohyla tica	12	pre	Models	TSS	507	100
Isthmohyla tica	12	pre	Models	ROC	512,5	100
Isthmohyla tica	12	pre	Models	KAPPA	895	55,556
Isthmohyla tica	12	pre	Models	BOYCE	767	88,889
Isthmohyla tica	12	pre	Models	TSS	505	100
Isthmohyla tica	12	pre	Models	ROC	513,5	100
Isthmohyla tica	12	pre	Models	KAPPA	859	66,667
Isthmohyla tica	12	pre	Models	BOYCE	716	77,778
Isthmohyla tica	12	pre	Models	TSS	495	100
Isthmohyla tica	12	pre	Models	ROC	500	100
Isthmohyla tica	12	pre	Models	KAPPA	495	100
Isthmohyla tica	12	pre	Models	BOYCE	50	100
Isthmohyla tica	12	pre	Models	TSS	324,5	100
Isthmohyla tica	12	pre	Models	ROC	323	100
Isthmohyla tica	12	pre	Models	KAPPA	324,5	100
Isthmohyla tica	12	pre	Models	BOYCE	81	100
Isthmohyla tica	12	pre	Models	TSS	648	100
Isthmohyla tica	12	pre	Models	ROC	656,5	100
Isthmohyla tica	12	pre	Models	KAPPA	902	77,778
Isthmohyla tica	12	pre	Models	BOYCE	774	88,889
Isthmohyla tica	12	pre	Models	TSS	707	100
Isthmohyla tica	12	pre	Models	ROC	708	100
Isthmohyla tica	12	pre	Models	KAPPA	970	44,444
Isthmohyla tica	12	pre	Models	BOYCE	770	88,889
Isthmohyla tica	12	pre	Models	TSS	495	100
Isthmohyla tica	12	pre	Models	ROC	500	100
Isthmohyla tica	12	pre	Models	KAPPA	495	100
Isthmohyla tica	12	pre	Models	BOYCE	50	100
Isthmohyla tica	12	pre	Models	TSS	314	100
Isthmohyla tica	12	pre	Models	ROC	314	100
Isthmohyla tica	12	pre	Models	KAPPA	314	100
Isthmohyla tica	12	pre	Models	BOYCE	85	100
Isthmohyla tica	12	pre	Models	TSS	583	100
Isthmohyla tica	12	pre	Models	ROC	590,5	100
Isthmohyla tica	12	pre	Models	KAPPA	898	33,333
Isthmohyla tica	12	pre	Models	BOYCE	711	88,889
Isthmohyla tica	12	pre	Models	TSS	657	100
Isthmohyla tica	12	pre	Models	ROC	658,5	100
Isthmohyla tica	12	pre	Models	KAPPA	990	11,111
Isthmohyla tica	12	pre	Models	BOYCE	851	66,667

Isthmohyla tica	12	pre	Models	TSS	495	88,889
Isthmohyla tica	12	pre	Models	ROC	500	88,889
Isthmohyla tica	12	pre	Models	KAPPA	495	88,889
Isthmohyla tica	12	pre	Models	BOYCE	50	88,889
Isthmohyla tica	12	pre	Models	TSS	315	100
Isthmohyla tica	12	pre	Models	ROC	316	100
Isthmohyla tica	12	pre	Models	KAPPA	315	100
Isthmohyla tica	12	pre	Models	BOYCE	71	100
Isthmohyla tica	12	pre	Models	TSS	680	100
Isthmohyla tica	12	pre	Models	ROC	683,5	100
Isthmohyla tica	12	pre	Models	KAPPA	930	44,444
Isthmohyla tica	12	pre	Models	BOYCE	825	77,778
Isthmohyla tica	12	pre	Models	TSS	475	100
Isthmohyla tica	12	pre	Models	ROC	482,5	100
Isthmohyla tica	12	pre	Models	KAPPA	727	88,889
Isthmohyla tica	12	pre	Models	BOYCE	671	88,889
Isthmohyla tica	12	pre	Models	TSS	495	100
Isthmohyla tica	12	pre	Models	ROC	500	100
Isthmohyla tica	12	pre	Models	KAPPA	495	100
Isthmohyla tica	12	pre	Models	BOYCE	50	100
Isthmohyla tica	12	pre	Models	TSS	306	100
Isthmohyla tica	12	pre	Models	ROC	307	100
Isthmohyla tica	12	pre	Models	KAPPA	306	100
Isthmohyla tica	12	pre	Models	BOYCE	81	100
Isthmohyla tica	12	pre	Models	TSS	686	100
Isthmohyla tica	12	pre	Models	ROC	691,5	100
Isthmohyla tica	12	pre	Models	KAPPA	948	33,333
Isthmohyla tica	12	pre	Models	BOYCE	634	100
Isthmohyla tica	12	pre	Models	TSS	434	100
Isthmohyla tica	12	pre	Models	ROC	442,5	100
Isthmohyla tica	12	pre	Models	KAPPA	838	75
Isthmohyla tica	12	pre	Models	BOYCE	788	75
Isthmohyla tica	12	pre	Models	TSS	1	91,667
Isthmohyla tica	12	pre	Models	ROC	1,5	91,667
Isthmohyla tica	12	pre	Models	KAPPA	67,5	16,667
Isthmohyla tica	12	pre	Models	BOYCE	134	0
Isthmohyla tica	12	pre	Models	TSS	311	100
Isthmohyla tica	12	pre	Models	ROC	314	100
Isthmohyla tica	12	pre	Models	KAPPA	311	100
Isthmohyla tica	12	pre	Models	BOYCE	98	100
Isthmohyla tica	12	pre	Models	TSS	6	91,667
Isthmohyla tica	12	pre	Models	ROC	6,5	91,667
Isthmohyla tica	12	pre	Models	KAPPA	59	25
Isthmohyla tica	12	pre	Models	BOYCE	88	8,333
Isthmohyla tica	12	pre	Models	TSS	3	75
Isthmohyla tica	12	pre	Models	ROC	1,5	91,667
Isthmohyla tica	12	pre	Models	KAPPA	73	8,333
Isthmohyla tica	12	pre	Models	BOYCE	146	0
Lithobates vibicarius	45	all	Ensemble	BOYCE	620	88,372

Lithobates vibicarius	45	all	Ensemble	TSS	364	100
Lithobates vibicarius	20	post	Ensemble	BOYCE	842	68,421
Lithobates vibicarius	20	post	Ensemble	TSS	430	100
Lithobates vibicarius	25	pre	Ensemble	BOYCE	551	92
Lithobates vibicarius	25	pre	Ensemble	TSS	307	100
Lithobates vibicarius	45	all	Models	TSS	495	96,875
Lithobates vibicarius	45	all	Models	ROC	500	96,875
Lithobates vibicarius	45	all	Models	KAPPA	495	96,875
Lithobates vibicarius	45	all	Models	BOYCE	50	96,875
Lithobates vibicarius	45	all	Models	TSS	356	100
Lithobates vibicarius	45	all	Models	ROC	355	100
Lithobates vibicarius	45	all	Models	KAPPA	356	100
Lithobates vibicarius	45	all	Models	BOYCE	172	100
Lithobates vibicarius	45	all	Models	TSS	407	100
Lithobates vibicarius	45	all	Models	ROC	410,5	100
Lithobates vibicarius	45	all	Models	KAPPA	900	46,875
Lithobates vibicarius	45	all	Models	BOYCE	367	100
Lithobates vibicarius	45	all	Models	TSS	232	100
Lithobates vibicarius	45	all	Models	ROC	238,5	100
Lithobates vibicarius	45	all	Models	KAPPA	868	65,625
Lithobates vibicarius	45	all	Models	BOYCE	733	78,125
Lithobates vibicarius	45	all	Models	TSS	667	100
Lithobates vibicarius	45	all	Models	ROC	669	100
Lithobates vibicarius	45	all	Models	KAPPA	970	75
Lithobates vibicarius	45	all	Models	BOYCE	617	100
Lithobates vibicarius	45	all	Models	TSS	419	100
Lithobates vibicarius	45	all	Models	ROC	421	100
Lithobates vibicarius	45	all	Models	KAPPA	419	100
Lithobates vibicarius	45	all	Models	BOYCE	271	100
Lithobates vibicarius	45	all	Models	TSS	654	100
Lithobates vibicarius	45	all	Models	ROC	656	100
Lithobates vibicarius	45	all	Models	KAPPA	975	56,25
Lithobates vibicarius	45	all	Models	BOYCE	606	100
Lithobates vibicarius	45	all	Models	TSS	828	93,75
Lithobates vibicarius	45	all	Models	ROC	837	93,75
Lithobates vibicarius	45	all	Models	KAPPA	980	59,375
Lithobates vibicarius	45	all	Models	BOYCE	779	93,75
Lithobates vibicarius	45	all	Models	TSS	495	90,625
Lithobates vibicarius	45	all	Models	ROC	500	90,625
Lithobates vibicarius	45	all	Models	KAPPA	495	90,625
Lithobates vibicarius	45	all	Models	BOYCE	50	90,625
Lithobates vibicarius	45	all	Models	TSS	375	100
Lithobates vibicarius	45	all	Models	ROC	375	100
Lithobates vibicarius	45	all	Models	KAPPA	375	100
Lithobates vibicarius	45	all	Models	BOYCE	210	100
Lithobates vibicarius	45	all	Models	TSS	475	100
Lithobates vibicarius	45	all	Models	ROC	484	100
Lithobates vibicarius	45	all	Models	KAPPA	949	34,375
Lithobates vibicarius	45	all	Models	BOYCE	587	93,75

Lithobates vibicarius	45	all	Models	TSS	283	100
Lithobates vibicarius	45	all	Models	ROC	289,5	100
Lithobates vibicarius	45	all	Models	KAPPA	928	43,75
Lithobates vibicarius	45	all	Models	BOYCE	661	87,5
Lithobates vibicarius	45	all	Models	TSS	464	96,97
Lithobates vibicarius	45	all	Models	ROC	473,5	96,97
Lithobates vibicarius	45	all	Models	KAPPA	958	39,394
Lithobates vibicarius	45	all	Models	BOYCE	589	87,879
Lithobates vibicarius	45	all	Models	TSS	380	100
Lithobates vibicarius	45	all	Models	ROC	380	100
Lithobates vibicarius	45	all	Models	KAPPA	380	100
Lithobates vibicarius	45	all	Models	BOYCE	227	100
Lithobates vibicarius	45	all	Models	TSS	406	100
Lithobates vibicarius	45	all	Models	ROC	410,5	100
Lithobates vibicarius	45	all	Models	KAPPA	947	30,303
Lithobates vibicarius	45	all	Models	BOYCE	639	87,879
Lithobates vibicarius	45	all	Models	TSS	222	100
Lithobates vibicarius	45	all	Models	ROC	224,5	100
Lithobates vibicarius	45	all	Models	KAPPA	858	69,697
Lithobates vibicarius	45	all	Models	BOYCE	553	87,879
Lithobates vibicarius	45	all	Models	TSS	454	97,674
Lithobates vibicarius	45	all	Models	ROC	459	97,674
Lithobates vibicarius	45	all	Models	KAPPA	989	18,605
Lithobates vibicarius	45	all	Models	BOYCE	607	90,698
Lithobates vibicarius	45	all	Models	TSS	396	100
Lithobates vibicarius	45	all	Models	ROC	396	100
Lithobates vibicarius	45	all	Models	KAPPA	396	100
Lithobates vibicarius	45	all	Models	BOYCE	237	100
Lithobates vibicarius	45	all	Models	TSS	433	100
Lithobates vibicarius	45	all	Models	ROC	442,5	100
Lithobates vibicarius	45	all	Models	KAPPA	925	46,512
Lithobates vibicarius	45	all	Models	BOYCE	671	88,372
Lithobates vibicarius	45	all	Models	TSS	474	93,023
Lithobates vibicarius	45	all	Models	ROC	482,5	93,023
Lithobates vibicarius	45	all	Models	KAPPA	888	67,442
Lithobates vibicarius	45	all	Models	BOYCE	715	83,721
Lithobates vibicarius	45	all	Models	TSS	6	90,698
Lithobates vibicarius	45	all	Models	ROC	8,5	90,698
Lithobates vibicarius	45	all	Models	KAPPA	179	39,535
Lithobates vibicarius	45	all	Models	BOYCE	481	9,302
Lithobates vibicarius	45	all	Models	TSS	401	100
Lithobates vibicarius	45	all	Models	ROC	400	100
Lithobates vibicarius	45	all	Models	KAPPA	401	100
Lithobates vibicarius	45	all	Models	BOYCE	252	100
Lithobates vibicarius	45	all	Models	TSS	5	83,721
Lithobates vibicarius	45	all	Models	ROC	1,5	90,698
Lithobates vibicarius	45	all	Models	KAPPA	126	37,209
Lithobates vibicarius	45	all	Models	BOYCE	183	23,256
Lithobates vibicarius	45	all	Models	TSS	6	83,721

Lithobates vibicarius	45	all	Models	ROC	4,5	88,372
Lithobates vibicarius	45	all	Models	KAPPA	63	41,86
Lithobates vibicarius	45	all	Models	BOYCE	537	0
Lithobates vibicarius	20	post	Models	TSS	495	100
Lithobates vibicarius	20	post	Models	ROC	500	100
Lithobates vibicarius	20	post	Models	KAPPA	495	100
Lithobates vibicarius	20	post	Models	BOYCE	50	100
Lithobates vibicarius	20	post	Models	TSS	360	100
Lithobates vibicarius	20	post	Models	ROC	359	100
Lithobates vibicarius	20	post	Models	KAPPA	360	100
Lithobates vibicarius	20	post	Models	BOYCE	194	100
Lithobates vibicarius	20	post	Models	TSS	296	100
Lithobates vibicarius	20	post	Models	ROC	298,5	100
Lithobates vibicarius	20	post	Models	KAPPA	897	64,286
Lithobates vibicarius	20	post	Models	BOYCE	778	71,429
Lithobates vibicarius	20	post	Models	TSS	323	100
Lithobates vibicarius	20	post	Models	ROC	323,5	100
Lithobates vibicarius	20	post	Models	KAPPA	969	21,429
Lithobates vibicarius	20	post	Models	BOYCE	697	71,429
Lithobates vibicarius	20	post	Models	TSS	919	100
Lithobates vibicarius	20	post	Models	ROC	921,5	100
Lithobates vibicarius	20	post	Models	KAPPA	960	92,857
Lithobates vibicarius	20	post	Models	BOYCE	869	100
Lithobates vibicarius	20	post	Models	TSS	394	100
Lithobates vibicarius	20	post	Models	ROC	392	100
Lithobates vibicarius	20	post	Models	KAPPA	394	100
Lithobates vibicarius	20	post	Models	BOYCE	200	100
Lithobates vibicarius	20	post	Models	TSS	599	100
Lithobates vibicarius	20	post	Models	ROC	599,5	100
Lithobates vibicarius	20	post	Models	KAPPA	976	71,429
Lithobates vibicarius	20	post	Models	BOYCE	884	85,714
Lithobates vibicarius	20	post	Models	TSS	697	100
Lithobates vibicarius	20	post	Models	ROC	701,5	100
Lithobates vibicarius	20	post	Models	KAPPA	960	85,714
Lithobates vibicarius	20	post	Models	BOYCE	914	85,714
Lithobates vibicarius	20	post	Models	TSS	495	85,714
Lithobates vibicarius	20	post	Models	ROC	500	85,714
Lithobates vibicarius	20	post	Models	KAPPA	495	85,714
Lithobates vibicarius	20	post	Models	BOYCE	50	85,714
Lithobates vibicarius	20	post	Models	TSS	327,5	100
Lithobates vibicarius	20	post	Models	ROC	327	100
Lithobates vibicarius	20	post	Models	KAPPA	327,5	100
Lithobates vibicarius	20	post	Models	BOYCE	119	100
Lithobates vibicarius	20	post	Models	TSS	562	92,857
Lithobates vibicarius	20	post	Models	ROC	562	92,857
Lithobates vibicarius	20	post	Models	KAPPA	927	64,286
Lithobates vibicarius	20	post	Models	BOYCE	796	71,429
Lithobates vibicarius	20	post	Models	TSS	333	92,857
Lithobates vibicarius	20	post	Models	ROC	240,5	100

Lithobates vibicarius	20	post	Models	KAPPA	958	14,286
Lithobates vibicarius	20	post	Models	BOYCE	759	71,429
Lithobates vibicarius	20	post	Models	TSS	636	100
Lithobates vibicarius	20	post	Models	ROC	639,5	100
Lithobates vibicarius	20	post	Models	KAPPA	970	60
Lithobates vibicarius	20	post	Models	BOYCE	860	86,667
Lithobates vibicarius	20	post	Models	TSS	368,5	100
Lithobates vibicarius	20	post	Models	ROC	368	100
Lithobates vibicarius	20	post	Models	KAPPA	368,5	100
Lithobates vibicarius	20	post	Models	BOYCE	175	100
Lithobates vibicarius	20	post	Models	TSS	510	100
Lithobates vibicarius	20	post	Models	ROC	510	100
Lithobates vibicarius	20	post	Models	KAPPA	931	53,333
Lithobates vibicarius	20	post	Models	BOYCE	738	86,667
Lithobates vibicarius	20	post	Models	TSS	838	86,667
Lithobates vibicarius	20	post	Models	ROC	843	86,667
Lithobates vibicarius	20	post	Models	KAPPA	909	60
Lithobates vibicarius	20	post	Models	BOYCE	788	86,667
Lithobates vibicarius	20	post	Models	TSS	495	94,737
Lithobates vibicarius	20	post	Models	ROC	500	94,737
Lithobates vibicarius	20	post	Models	KAPPA	495	94,737
Lithobates vibicarius	20	post	Models	BOYCE	50	94,737
Lithobates vibicarius	20	post	Models	TSS	361	100
Lithobates vibicarius	20	post	Models	ROC	362	100
Lithobates vibicarius	20	post	Models	KAPPA	361	100
Lithobates vibicarius	20	post	Models	BOYCE	171	100
Lithobates vibicarius	20	post	Models	TSS	495	100
Lithobates vibicarius	20	post	Models	ROC	502,5	100
Lithobates vibicarius	20	post	Models	KAPPA	960	47,368
Lithobates vibicarius	20	post	Models	BOYCE	719	84,211
Lithobates vibicarius	20	post	Models	TSS	676	84,211
Lithobates vibicarius	20	post	Models	ROC	682	84,211
Lithobates vibicarius	20	post	Models	KAPPA	959	31,579
Lithobates vibicarius	20	post	Models	BOYCE	760	78,947
Lithobates vibicarius	20	post	Models	TSS	4	84,211
Lithobates vibicarius	20	post	Models	ROC	5,5	84,211
Lithobates vibicarius	20	post	Models	KAPPA	121	68,421
Lithobates vibicarius	20	post	Models	BOYCE	362	5,263
Lithobates vibicarius	20	post	Models	TSS	344,5	100
Lithobates vibicarius	20	post	Models	ROC	343	100
Lithobates vibicarius	20	post	Models	KAPPA	344,5	100
Lithobates vibicarius	20	post	Models	BOYCE	152	100
Lithobates vibicarius	20	post	Models	TSS	29	78,947
Lithobates vibicarius	20	post	Models	ROC	1,5	89,474
Lithobates vibicarius	20	post	Models	KAPPA	136	57,895
Lithobates vibicarius	20	post	Models	BOYCE	209	31,579
Lithobates vibicarius	20	post	Models	TSS	9	78,947
Lithobates vibicarius	20	post	Models	ROC	11,5	78,947
Lithobates vibicarius	20	post	Models	KAPPA	74	36,842

Lithobates vibicarius	20	post	Models	BOYCE	370	5,263
Lithobates vibicarius	25	pre	Models	TSS	495	88,889
Lithobates vibicarius	25	pre	Models	ROC	500	88,889
Lithobates vibicarius	25	pre	Models	KAPPA	495	88,889
Lithobates vibicarius	25	pre	Models	BOYCE	50	88,889
Lithobates vibicarius	25	pre	Models	TSS	359	100
Lithobates vibicarius	25	pre	Models	ROC	356	100
Lithobates vibicarius	25	pre	Models	KAPPA	359	100
Lithobates vibicarius	25	pre	Models	BOYCE	162	100
Lithobates vibicarius	25	pre	Models	TSS	568	100
Lithobates vibicarius	25	pre	Models	ROC	570,5	100
Lithobates vibicarius	25	pre	Models	KAPPA	925	66,667
Lithobates vibicarius	25	pre	Models	BOYCE	626	94,444
Lithobates vibicarius	25	pre	Models	TSS	495	100
Lithobates vibicarius	25	pre	Models	ROC	499,5	100
Lithobates vibicarius	25	pre	Models	KAPPA	990	27,778
Lithobates vibicarius	25	pre	Models	BOYCE	806	77,778
Lithobates vibicarius	25	pre	Models	TSS	949	100
Lithobates vibicarius	25	pre	Models	ROC	952,5	100
Lithobates vibicarius	25	pre	Models	KAPPA	949	100
Lithobates vibicarius	25	pre	Models	BOYCE	896	100
Lithobates vibicarius	25	pre	Models	TSS	354	100
Lithobates vibicarius	25	pre	Models	ROC	357	100
Lithobates vibicarius	25	pre	Models	KAPPA	354	100
Lithobates vibicarius	25	pre	Models	BOYCE	158	100
Lithobates vibicarius	25	pre	Models	TSS	522	100
Lithobates vibicarius	25	pre	Models	ROC	522,5	100
Lithobates vibicarius	25	pre	Models	KAPPA	902	73,684
Lithobates vibicarius	25	pre	Models	BOYCE	711	94,737
Lithobates vibicarius	25	pre	Models	TSS	879	100
Lithobates vibicarius	25	pre	Models	ROC	879,5	100
Lithobates vibicarius	25	pre	Models	KAPPA	919	89,474
Lithobates vibicarius	25	pre	Models	BOYCE	833	100
Lithobates vibicarius	25	pre	Models	TSS	495	84,211
Lithobates vibicarius	25	pre	Models	ROC	500	84,211
Lithobates vibicarius	25	pre	Models	KAPPA	495	84,211
Lithobates vibicarius	25	pre	Models	BOYCE	50	84,211
Lithobates vibicarius	25	pre	Models	TSS	342	100
Lithobates vibicarius	25	pre	Models	ROC	343	100
Lithobates vibicarius	25	pre	Models	KAPPA	342	100
Lithobates vibicarius	25	pre	Models	BOYCE	132	100
Lithobates vibicarius	25	pre	Models	TSS	477	100
Lithobates vibicarius	25	pre	Models	ROC	478,5	100
Lithobates vibicarius	25	pre	Models	KAPPA	962	15,789
Lithobates vibicarius	25	pre	Models	BOYCE	589	94,737
Lithobates vibicarius	25	pre	Models	TSS	475	100
Lithobates vibicarius	25	pre	Models	ROC	479,5	100
Lithobates vibicarius	25	pre	Models	KAPPA	899	63,158
Lithobates vibicarius	25	pre	Models	BOYCE	635	94,737

Lithobates vibicarius	25	pre	Models	TSS	495	84,211
Lithobates vibicarius	25	pre	Models	ROC	500	84,211
Lithobates vibicarius	25	pre	Models	KAPPA	495	84,211
Lithobates vibicarius	25	pre	Models	BOYCE	50	84,211
Lithobates vibicarius	25	pre	Models	TSS	336	100
Lithobates vibicarius	25	pre	Models	ROC	336	100
Lithobates vibicarius	25	pre	Models	KAPPA	336	100
Lithobates vibicarius	25	pre	Models	BOYCE	126	100
Lithobates vibicarius	25	pre	Models	TSS	532	100
Lithobates vibicarius	25	pre	Models	ROC	537,5	100
Lithobates vibicarius	25	pre	Models	KAPPA	915	36,842
Lithobates vibicarius	25	pre	Models	BOYCE	619	94,737
Lithobates vibicarius	25	pre	Models	TSS	444	100
Lithobates vibicarius	25	pre	Models	ROC	453	100
Lithobates vibicarius	25	pre	Models	KAPPA	889	63,158
Lithobates vibicarius	25	pre	Models	BOYCE	581	94,737
Lithobates vibicarius	25	pre	Models	TSS	495	96
Lithobates vibicarius	25	pre	Models	ROC	500	96
Lithobates vibicarius	25	pre	Models	KAPPA	495	96
Lithobates vibicarius	25	pre	Models	BOYCE	50	96
Lithobates vibicarius	25	pre	Models	TSS	340	100
Lithobates vibicarius	25	pre	Models	ROC	339	100
Lithobates vibicarius	25	pre	Models	KAPPA	340	100
Lithobates vibicarius	25	pre	Models	BOYCE	149	100
Lithobates vibicarius	25	pre	Models	TSS	767	96
Lithobates vibicarius	25	pre	Models	ROC	772	96
Lithobates vibicarius	25	pre	Models	KAPPA	975	16
Lithobates vibicarius	25	pre	Models	BOYCE	724	96
Lithobates vibicarius	25	pre	Models	TSS	455	100
Lithobates vibicarius	25	pre	Models	ROC	463,5	100
Lithobates vibicarius	25	pre	Models	KAPPA	899	68
Lithobates vibicarius	25	pre	Models	BOYCE	608	96
Lithobates vibicarius	25	pre	Models	TSS	0	100
Lithobates vibicarius	25	pre	Models	ROC	4,5	96
Lithobates vibicarius	25	pre	Models	KAPPA	377,5	24
Lithobates vibicarius	25	pre	Models	BOYCE	418	20
Lithobates vibicarius	25	pre	Models	TSS	345	100
Lithobates vibicarius	25	pre	Models	ROC	345	100
Lithobates vibicarius	25	pre	Models	KAPPA	345	100
Lithobates vibicarius	25	pre	Models	BOYCE	151	100
Lithobates vibicarius	25	pre	Models	TSS	5	84
Lithobates vibicarius	25	pre	Models	ROC	2,5	88
Lithobates vibicarius	25	pre	Models	KAPPA	108	36
Lithobates vibicarius	25	pre	Models	BOYCE	151	20
Lithobates vibicarius	25	pre	Models	TSS	5	92
Lithobates vibicarius	25	pre	Models	ROC	4,5	92
Lithobates vibicarius	25	pre	Models	KAPPA	118	20
Lithobates vibicarius	25	pre	Models	BOYCE	427	0