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Anurans of the municipality of Barão de Monte Alto, state of Minas Gerais, southeastern Brazil

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Abstract: We present a list of the anuran amphibians from municipality of Barão de Monte Alto, state of Minas Gerais, southeastern Brazil. This region is part of the remaining Atlantic Forest and the studied environments are represented by forest patches and open habitats. We recorded 29 anuran species, many of these typical and/or endemic to the Atlantic Forest. None of the species registered was considered under threat of extinction in state, national or international red-lists. It is worth noting, however, the presence of the tree frogs *Dendropsophus pseudomeridianus*, the first record of this species in the state of Minas Gerais, and *D. bipunctatus,* marking its expanded distribution in various locations of Minas Gerais. The present list examines zoogeography and conservation of anurans in the Brazilian southeast and broadens the knowledge of the anuran fauna in this region.

Key words: amphibians; anuran fauna; Atlantic Forest; inventory; new records

INTRODUCTION

Global biodiversity has changed rapidly as a complex response to various environmental alterations caused by human activities (Vitouseck et al. 1997). Intact ecosystems have continuously been degraded, and the greatest threat to biodiversity is habitat loss (Balmford et al. 2002; Metzger et al. 2008). Accordingly, loss and degradation of suitable habitats are some of the factors most responsible for the global decline of amphibian populations (Brooks et al. 2002; Gardner et al. 2007).

The Atlantic Forest located in eastern South America is considered one of the richest and most threatened ecoregions of the planet, making it a priority area for the development of effective biodiversity conservation policies (Myers et al. 2000; Mittermeier et al. 2004).

The lowland semideciduous forest within the Atlantic Forest is considered one of the most threatened forest formations and has been diminished by agricultural expansion, urbanization, structural expansion and hydroelectric power plants since the early 20th century, with its remaining vegetation covering less than 8% of the original area (SOS Mata Atlântica e Instituto Nacional de Pesquisas Espaciais 1997). The Zona da Mata region in southeastern Minas Gerais state was reduced to about 6% of native forest by the 1980s (Fonseca 1985). Due to this high degree of devastation, many typical forest species are restricted to the few protected areas or remaining fragments (Bertoluci 1998) and much of the local biodiversity may already no longer exist in the region (Ribon et al. 2003).

Knowledge of local anuran fauna is essential for the establishment of management plans and conservation efforts towards existing species, as well as for a better understanding of biogeography and ecology (Eterovick et al. 2005; Lips et al. 2005). In the tropics, there are several gaps in the knowledge of geographical distribution of species, with many areas of considerable size where no records were generated (Lawler et al. 2006; Cole et al. 2014). For many amphibians in Brazil there is little information about geographic distribution, natural history, life history and ecology, making it difficult to understand current trends and possible population declines (Silvano and Segalla 2005).

Studies of amphibians in the state of Minas Gerais are regionalised and usually performed near major research centres (Nascimento et al. 2009). Although there is still no specific effort to build inventory, there are records of approximately 200 species of amphibians in Minas Gerais (Drummond et al. 2009). The greatest diversity of amphibians in the state is concentrated in the Atlantic Forest, where about 150 species of the 458 known from the biome (Haddad et al. 2013) occur in the remaining lowland forest areas on the banks of large rivers, upland forests, and highland regions (Nascimento et al. 2009).

The mountainous regions of southeastern Brazil are identified as priority areas for conservation (Cruz and

Feio 2007). In general, studies of amphibians undertaken in the Atlantic Forest of Minas Gerais include the highland ranges of Mantiqueira and Espinhaço in areas located 1000 m above sea level (Nascimento et al. 2005, 2009), where the rate of endemism for amphibians is high (Cruz and Feio 2007). Most protected areas (UCs) in Minas Gerais are in high elevation areas, resulting in some negligence in the protection of the few forest fragments of lowland areas; these areas may harbour a great diversity that is not being protected. Several studies on amphibians in lowland areas have already been made, documenting important records and even describing new species (e.g., Feio and Caramaschi 1995, 2002; Feio et al. 1998, 1999; Feio and Ferreira 2005; Santana et al. 2010; Caramaschi et al. 2012; Assis et al. 2013) implying great biological value in these areas.

This study aimed to inventory the anuran species in the municipality of Barão de Monte Alto, and discuss aspects of geographic distribution, taxonomy and conservation status of the species.

MATERIALS AND METHODS

Study site

We conducted this study in the municipality of Barão de Monte Alto (21°14′42″ S, 042°14′16″ W, WGS84), Zona da Mata region, southeast part of the state of Minas Gerais (MG), Brazil (Figure 1). The 198.313 km^2 area (IBGE 2016) is located in the valley of the Paraíba do Sul River, with elevations ranging from 132 to 700 m between the Serra da Mantiqueira and Serra do Mar mountain ranges, within the Atlantic Forest, located in Zona da Mata of Minas Gerais. Despite a high environmental degradation in the region caused by agricultural activities, there remain fragments of native vegetation in good condition, with the potential to harbour a wide range of vertebrates species. Those fragments are not protected areas, and the majority are privately owned. However, no data are available about the fauna of this region. The climate is megathermal, with Aw climate "Tropical with dry winter" (Alvares et al. 2014), with an average annual rainfall of 1,287 mm and

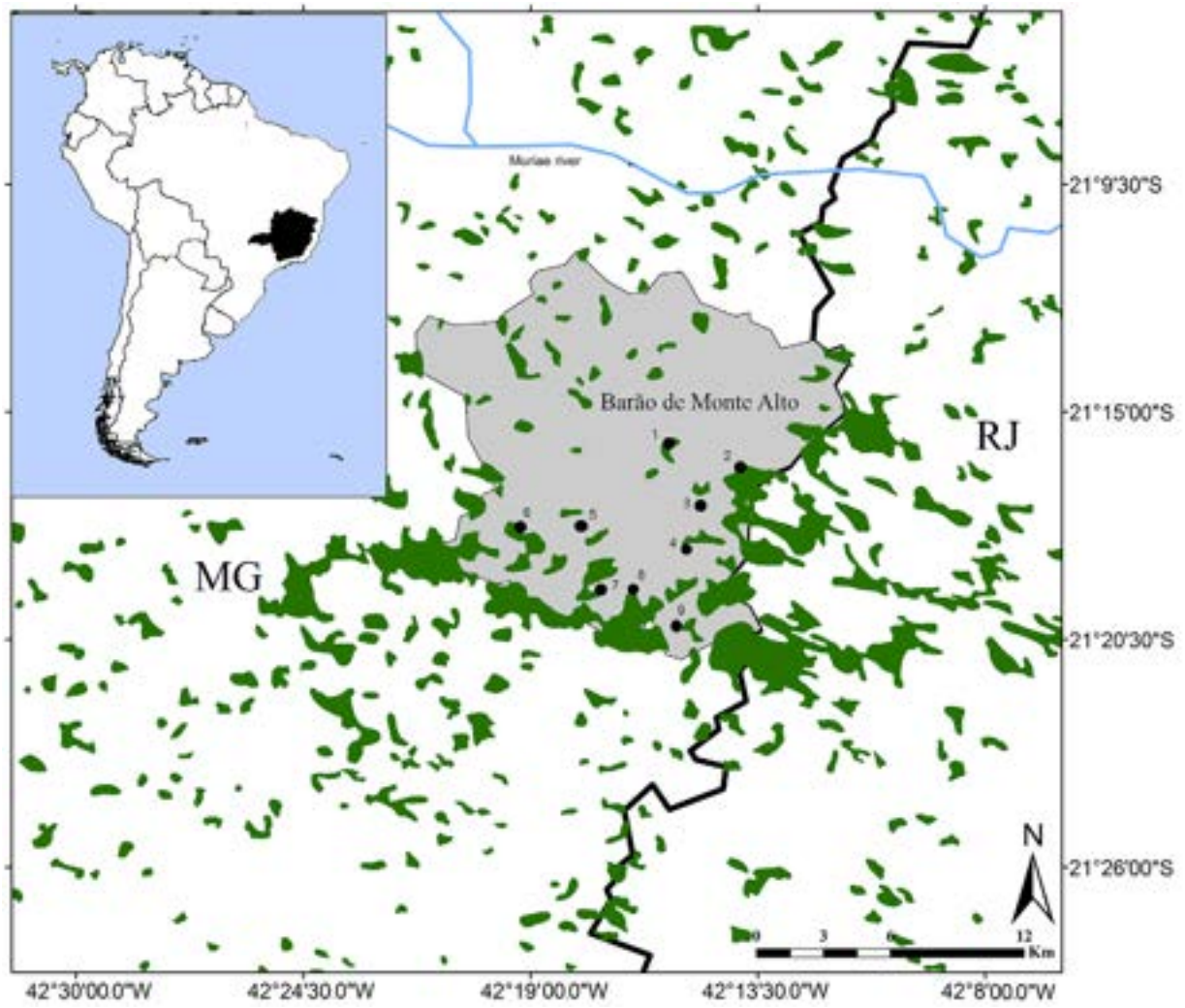

Figure 1. municipality of Barão de Monte Alto (gray), State of Minas Gerais (black), Brazil with the locations of the main sample points (black circles). Blue lines: watersheds; green polygons: Atlantic Forest fragments (SOS Mata Atlântica and Instituto Nacional de Pesquisas Espaciais). (1) Paulo Pond, (2) Temporary Stream and Marsh – TSM; (3) Three ponds; (4) Waterfall; (5) Dam Zé 1; (6) Dam Zé 2; (7) Marsh and Permanent Pond – MPP; (8) Temporary Marsh and Pond – TMP; (9) Odilon Pond.

Table 1. Sampling points in the municipality of Barão de Monte Alto, State of Minas Gerais, Brazil.

Points	Coordinates	Environments	Description Environments
1	21°15′55.50″ S, 042°15′32.90″ W	Pond Paulo	Pond in pasture area
2	21°16′29.30″ S, 042°14′05.40″ W	Temporary Stream and Marsh (TSM)	Stream and marsh in forest area preserved
3	21°17′17.00″ S, 042°14′38.90″ W	Three ponds	Pond in pasture area
4	21°18′06.30″ S, 042°15′09.20″ W	Waterfall	Waterfall with riparian forest preserved
5	21°17′43.20″ S, 042°17′46.90″ W	Dam Zé 1	Dam with riparian forest preserved
6	21°17′45.80″ S, 042°19′02.70″ W	Dam Zé 2	Dam in pasture area
7	21°19′28.60″ S, 042°17′13.20″ W	Marsh and Permanent Pond (MPP)	Marsh and pond in secondary forest area
8	21°19′20.70″ S, 042°16′23.10″ W	Temporary Marsh and Pond (TMP)	Marsh and pond in secondary forest area
9	21°20′08.10″ S, 042°15′27.60″ W	Pond Odilon	Pond in pasture area

average annual temperature of 22.6°C (Köppen 1948). On the outskirts of the city of Barão de Monte Alto, the Muriaé River is one of the largest and most important tributaries of the Paraíba do Sul River, which makes the region an important recharge area for this basin.

The species listed here occur in different types of habitats, such as streams, swamps, ponds, secondary forest, fields and temporary aquatic environments, all of these sites located in privately owned areas (Figure 2A–D). We tried to sample the widest range of environments in areas with different vegetation types (Table 1).

Data collection

We conducted monthly surveys of data collection, for four consecutive days each during the rainy season of 2013–2014 (October to March) and three days each during the rainy season of 2014–2015 (October to March), totalling 42 days. The collectors worked in pairs, for a total of about 180 hours of field time, a sampling effort of 90 h/person. For the purposes of standardisation of sampling effort and to avoid the possible variation of daily variation in water parameters, the order of the sampled environments was chosen randomly at the start of sampling in each survey. Inventory methods followed the 'complete species inventories', 'visual encounter surveys' and 'audio strip transects' found in Heyer et al. (1994). Vocalisations were registered using a digital recorder (Olympus DM 420) with built-in microphone.

Voucher specimens were collected under permits from the Instituto Chico Mendes de Conservação da

Figure 2. Some sampled environments in the municipality of Barão de Monte Alto, State of Minas Gerais, Brazil. **A:** Pond in open area, **B:** Stream in open area; **C:** Temporary marsh and **D:** Stream in forest area.

Biodiversidade (ICMBio No. 40744–1 and 40744–2). Specimens were photographed, euthanised in 5% xylocaine solution, fixed in 10% formalin, preserved in 70% alcohol and deposited in the herpetological collection of the Museu de Zoologia João Moojen at Universidade Federal de Viçosa (MZUFV) (Appendix 1). Species identification was based on morphological and acoustic characters reported in the literature, and comparison with material in the collection of MZUFV. We analysed the calls with Raven Pro 1.5 for Windows (Bioacoustics Research Program 2014) using the following parameters: call duration, notes/call, range of frequency (kHz) and dominant frequency (kHz). Terminology of spectral parameters of the calls followed Gerhardt et al. (2007).

The Red List of Threatened Species of the International Union for Conservation of Nature (IUCN 2015) was consulted to obtain the conservation status of each species. The Red List of animal species threatened with extinction in the state of Minas Gerais (Drummond et al. 2009) and the Red list of Brazilian fauna threatened with extinction (MMA 2014) were also consulted. Taxonomy followed the most recent list of Brazilian Amphibians (Segalla et al. 2014).

Data analysis

Regarding distributions of D*endropsophus pseudomeridianus* (Cruz, Caramaschi & Dias 2000) and *D. bipunctatus* (Spix 1824), we reviewed the known distribution and new records in Minas Gerais through literature surveys, field trips, visits to museum collections (MZUFV, MNRJ, LZV and MCNAN) and searches for information in computerised collections, e.g., SpeciesLink (2015) (Figures 3 and 4).

To determine the efficiency of the sampling effort, we performed an accumulation curve with 1,000 randomisations generated from the data matrix (presence-absence) for every night of observation. We used the species richness estimator Bootstrap to determine the expected richness of amphibians (Colwell and Coddington 1994; Colwell 2013), with a confidence interval (CI) of 95%. This analysis was performed using EstimateS v.9.0.0 (Gotelli and Colwell 2001).

RESULTS

We found 29 anuran species, in 14 genera and nine families: Bufonidae (1; Figure 5A), Brachycephalidae (1), Craugastoridae (1; Figure 5B), Cycloramphidae (1; Figure 5C), Hylidae (16; Figures 5D–H; Figures 6A–H and Figure 7A), Microhylidae (1), Leptodactylidae (6; Figure 7B–D), Odontophrynidae (1; Figure 7E) and Ranidae (1; Figure 7F) (Table 2). The Hylidae accounted for 53% of the total species richness found.

We also report new localities for the distribution of *Dendropsophus bipunctatus* in Minas Gerais and the first record of *D. pseudomeridianus* for Minas Gerais. The record of *D. bipunctatus* from the municipality of Marliéria represents the most inland record of this species, 680 km southwest of the type locality in the municipality of Ilhéus in the state of Bahia (Figure 4). Our record of *D. pseudomeridianus* for Minas Gerais extends

Figure 3. Map showing the known distribution of *Dendropsophus pseudomeridianus* (Cruz, Caramaschi & Dias 2000) in southeastern Brazil. The gray color gradients represent elevation. State abbreviations: ES, Espírito Santo; MG, Minas Gerais; RJ, Rio de Janeiro. Type locality: Seropédica (star); literature records (circle); new records (white circle with black dot). 1 – Barão de Monte Alto–MG, 2 – São João da Barra–RJ, 3 – Quissamã–RJ; 4 – Carapebus–RJ; 5 – Macaé–RJ; 6 – Casimiro de Abreu–RJ; 7 – Maricá–RJ; 8 – Itaboraí–RJ; 9 – Guapimirim–RJ.

Figure 4. Map showing the known distribution of *Dendropsophus bipunctatus* (Spix 1824) in eastern Brazil. The gray color gradients represent elevation. State abbreviations: BA, Bahia; ES, Espírito Santo; MG, Minas Gerais; RJ, Rio de Janeiro; SP, State of São Paulo. Type locality: Ilhéus (star); literature records (circle); new records for the State of Minas Gerais (white circle with black dot). 1 – Salto da Divisa, 2 – Marliéria, 3 – Orizânia, 4 – Barão de Monte Alto, 5 – Cataguases, 6 – Itamarati–de–Minas, 7 – Goianá, 8 – Pirapetinga, 9 – Volta Grande, 10 – Além Paraíba, 11 – Chiador.

the distribution approximately 230 km northeast from the type locality (Figure 3). The specimens were collected in a pond in pasture (21°27′59″ S, 042°23′50″ W, 560 m) at Point 1.

DISCUSSION

The anuran fauna in Barão de Monte Alto represents 6.5% of the estimated total of 459 species of the Atlantic Forest biome (Haddad et al. 2013) and 15% of the estimated total of 200 species recorded in Minas Gerais (Nascimento et al. 2009). Among the recorded species, 18 are endemic to the Atlantic Forest (Haddad et al. 2013) and among all sampling sites, *Dendropsophus branneri* (Cochran 1948), *D. minutus* (Peters 1872) and *Hypsiboas albopunctatus* (Spix 1824) were the most frequently encountered, and *Adenomera marmorata* (Steindachner 1867) and *Ischnocnema* sp. were the least, with a single record each.

Among the species encountered, we noted a high number of generalist and widely distributed species, such as *Dendropsophus minutus, D. elegans* (Wied-Neuwied 1824), *Elachistocleis cesarii* (Miranda Ribeiro 1920), *Hypsiboas albopunctatus, Leptodactylus fuscus* (Schneider 1799), *L. latrans* (Steffen 1815), *Physalaemus cuvieri* Fitzinger 1826 and *Scinax fuscovarius* (A. Lutz 1925) (Feio et al. 1998; Feio and Ferreira 2005; Frost 2016). Most of these species occur mainly in open areas (Feio and Ferreira 2005). Although some species exhibit close relationship with rainforest habitat, such as *Dendropsophus branneri* and *Hypsiboas faber* (Wied-Neuwied 1821), they are also considered generalists, and can be found in anthropogenic areas (Feio and Ferreira 2005). *Rhinella ornate* (Spix 1824), *Dendropsophus branneri*, *D. elegans*, and *Scinax fuscovarius* were found in areas of high anthropogenic impact, such as urban areas close to residences. Nevertheless, species dependent on forested areas, such as *Ischnocnema* sp. and *Procerathophrys boiei* (Wied-Neuwied 1825), were encountered only within forest fragments. We recorded two species typical of lowland habitats: *Dendropsophus branneri* and *Hypsiboas albomarginatus* (Spix 1824) (Feio et al. 1998, Santana et al. 2010). These species range from northern Rio de Janeiro state, through the Rio Paraíba valley to the region of the High Muriaé River (Santana et al. 2010).

Compared to other areas of the Atlantic Forest in Minas Gerais (Table 3), the richness of amphibians in the study area can be considered high, taking into account the size of the area, the sampling period and the great environmental degradation affecting the region. The Hylidae had the highest species diversity, similar to other locations near the study area (e.g., Santana et al. 2010; Moura et al. 2012). The predominance of ecological generalist species in the study area suggests an great amount of degradation around the forest remnants we surveyed.

The accumulation curve does not show a tendency to asymptote, and the estimated richness for the

Table 2. List of anurans species recorded for the municipality of Barão de Monte Alto, State of Minas Gerais between 2013–2015, with information on their distribution in sampling points.

Taxon	Sampling points
Bufonidae	
Rhinella ornata (Spix 1824)	2, 3, 5, 7 and 8
Brachycephalidae	
Ischnocnema sp. (*I. guentheri* series)	8
Craugastoridae	
Haddadus binotatus (Spix, 1824)	2, 5 and 8
Cycloramphidae	
Thoropa miliaris (Spix, 1824)	2, 3, 4, 6, 7 and 8
Hylidae	
Dendropsophus bipunctatus (Spix, 1824)	1 and 7
Dendropsophus branneri (Cochran, 1948)	1, 2, 3, 4, 5, 6, 7, 8 and 9
Dendropsophus decipiens (Lutz, 1925)	7
Dendropsophus elegans (Wied-Neuwied, 1824)	1, 2, 3, 5, 6, 7, 8 and 9
Dendropsophus minutus (Peters, 1872)	1, 2, 3, 4, 5, 6, 7, 8 and 9
Dendropsophus pseudomeridianus (Cruz, Caramaschi & Dias, 2000)	2
Hypsiboas albomarginatus (Spix 1824)	1, 3, 4, 6, 7 and 8
Hypsiboas albopunctatus (Spix, 1824)	1, 2, 3, 4, 6, 7, 8 and 9
Hypsiboas faber (Wied Neuwied, 1821)	1, 2, 3, 5, 6, 7, 8 and 9
Hypsiboas pardalis (Spix, 1824)	2, 4, 5, 7, 8 and 9
Hypsiboas polytaenius (Cope, 1870 [1869])	2, 4, 7 and 8
Hypsiboas semilineatus (Spix, 1824)	1, 2, 3, 6, 7, 8 and 9
Phyllomedusa rohdei (Mertens, 1926)	1, 2, 3, 5, 7 and 9
Scinax crospedospilus (Lutz, 1925)	7 and 8
Scinax eurydice (Bokermann, 1968)	9
Scinax fuscovarius (Lutz, 1925)	2 and 7
Microhylidae	
Elachistocleis cesarii (Schneider, 1799)	2
Leptodactylidae	
Adenormera marmorata (Steindachner, 1867)	2
Leptodactylus fuscus (Schneider, 1799)	1, 3, 7, 8 and 9
Leptodactylus labyrinthicus (Spix, 1824)	8
Leptodactylus latrans (Steffen, 1815)	1, 2, 3, 5, 6, 7, 8 and 9
Leptodactylus spixi (Heyer, 1983)	3 and 8
Physalaemus cuvieri (Fitzinger, 1826)	2, 3, 4, 7 and 8
Odontophrynidae	
Proceratophrys boiei (Wied-Neuwied, 1825)	2
Ranidae	
Lithobates catesbeianus (Shaw, 1802)	2

Table 3. Number of anurans species recorded in some areas of Atlantic Forest in the State of Minas Gerais. * Protected areas.

Locality	No. of species	Time	Reference
Barão de Monte Alto	29	2 years	Present work
Serra Negra	47	2 years	M.O. Neves (unpubl. data)
Ibitipoca	41	~20 years	Cruz et al. 2009
Juiz de Fora	45	Unknown	Neves et al. (unpubl. data)
Cataguases	55	7 years	C.L. Assis (unpubl. data)
APA Pedra Dourada*	46	2 years	C.P. Neves (unpubl. data)
Serra do Brigadeiro*	58	10 years	Moura et al. 2012
High Muriaé River region	41	3 years	Santana et al. 2010
Rio Novo	20	2 months	Feio and Ferreira 2005
Northeastern Minas Gerais	30	2 years	Feio and Caramaschi 2002
Parque Estadual do Rio Doce*	38	> 5 years	Feio et al. 1998

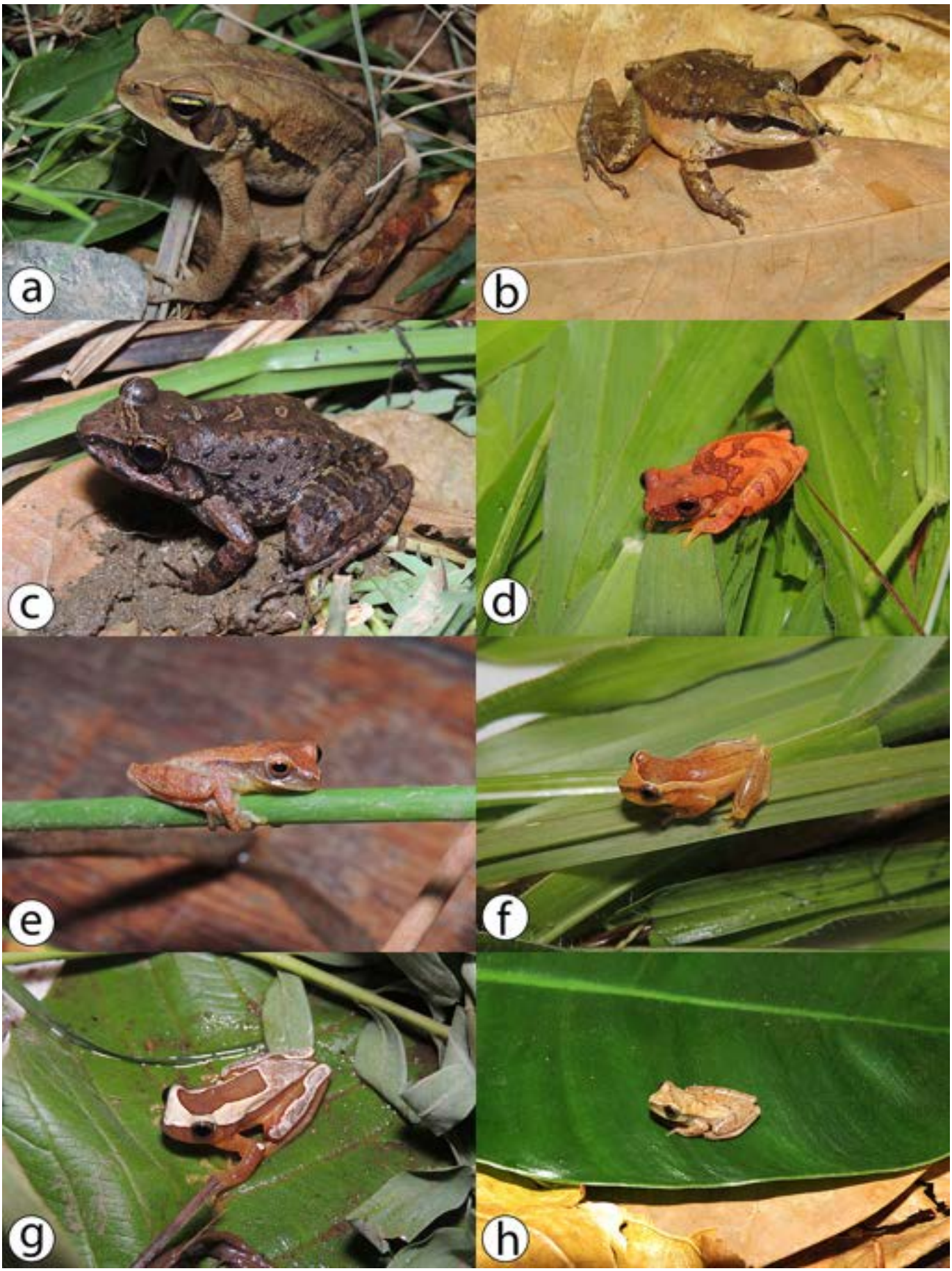

Figure 5. Anuran species found in the municipality of Barão de Monte Alto, State of Minas Gerais, Brazil. **A:** *Rhinella ornata* (Spix 1824), **B:** *Haddadus binotatus* (Spix 1824), **C:** *Thoropa miliaris* (Spix 1824), **D:** *Dendropsophus bipunctatus* (Spix 1824), **E:** *Dendropsophus branneri* (Cochran 1948), **F:** *Dendropsophus decipiens* (A. Lutz 1925), **G:** *Dendropsophus elegans* (Wied-Neuwied 1824) and **H:** *Dendropsophus pseudomeridianus* (Cruz, Caramaschi & Dias 2000).

Figure 6. Anuran species found in the municipality of Barão de Monte Alto, State of Minas Gerais, Brazil. **A:** *Hypsiboas albomarginatus* (Spix 1824), **B:** *Hypsiboas albopunctatus* (Spix 1824), **C:** *Hypsiboas faber* (Wied-Neuwied 1821), **D:** *Hypsiboas polytaenius* (Cope 1870[1869]), **E:** *Hypsiboas semilineatus* (Spix 1824), **F:** *Phyllomedusa rohdei* Mertens 1926, **G:** *Scinax crospedospilus* (A. Lutz 1925) and **H:** *Scinax eurydice* (Bokermann 1968).

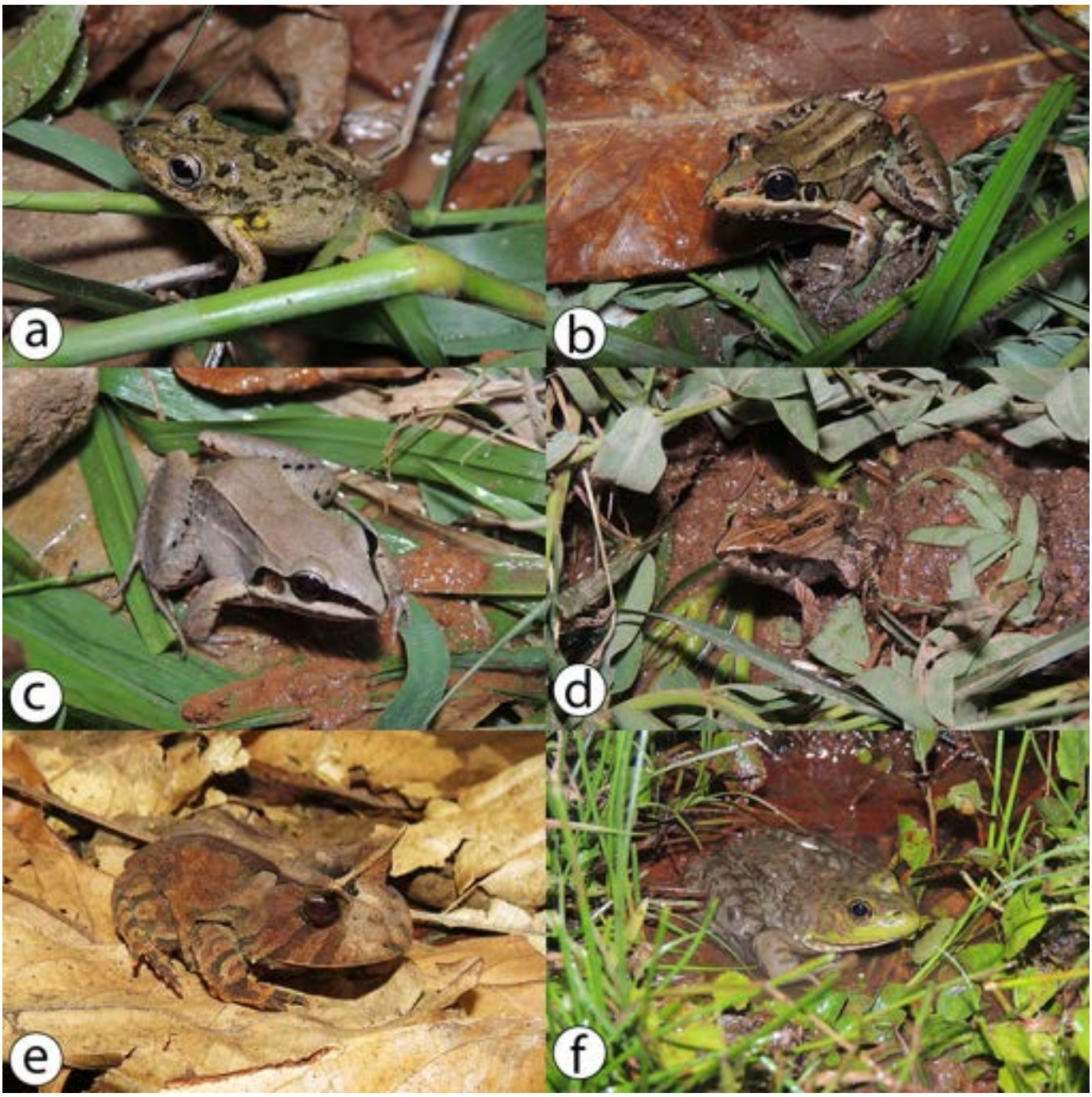

Figure 7. Anuran species found in the municipality of Barão de Monte Alto, State of Minas Gerais, Brazil. **A:** *Scinax fuscovarius* (A. Lutz 1925), **B:** *Leptodactylus latrans* (Steffen 1815), **C:** *Leptodactylus spixi* Heyer 1983, **D:** *Physalaemus cuvieri* Fitzinger 1826, **E:** *Proceratophrys boiei* (Wied-Neuwied 1824) and **F:** *Lithobates catesbeianus* (Shaw 1802)**.**

municipality was 31 species (Figure 8). The Bootstrap index uses data of all species collected to estimate the total richness, not only limited to rare species. Despite the estimated richness suggesting two more species for the region, the sampling seems adequate. Nevertheless, it is important to highlight that accumulation curves rarely stabilize, especially in tropical environments (Santos 2004). We expect that more species may be found with additional surveys in the area. We did not sample diurnally, nor during winter/dry season; additional species may be discovered during these periods.

None of the recorded anuran species are included in the Red List of endangered species of the IUCN (2015), Brazil (MMA 2014) or the state of Minas Gerais (Feio et al. 2008; Drummond et al. 2009). *Leptodactylus labyrinthicus* (Spix 1824) is presumably considered endangered in the state of Rio de Janeiro. According to Caramaschi et al. (2000) this species was abundant in the past but has become very rare in places where they were previously found. In this study abundance was low; only one individual was found.

The taxon *Ischnocnema* sp. (of the *I. guentheri* group)

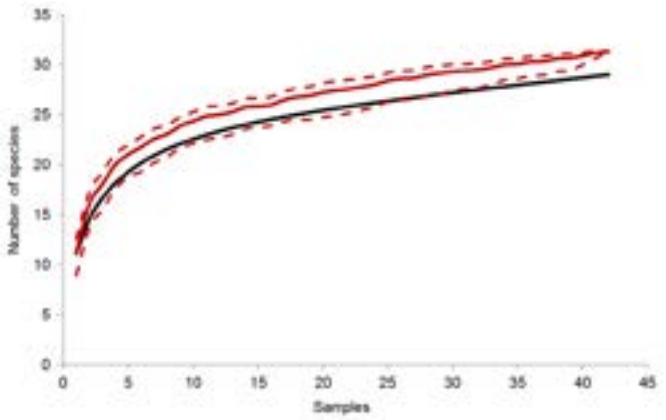

Figure 8. Accumulation curve for anurans sampled at the municipality of Barão de Monte Alto, state of Minas Gerais, southeastern Brazil. Black line represents the accumulation curves, red line represents species estimates based on Bootstrap and red dashed lines represents its interval of confidence.

could not be identified to species level. The *I. guentheri* species complex has high morphological similarity but has not yet been described at species level, diagnosable through advertisement calls and molecular data (Gehara et al. 2013). Other species in this study are species complexes that are under investigation, such as *Adenomera marmorata* (Fouquet et al. 2014), *Dendropsophus minutus* (Gehara et al. 2014), *Phyllomedusa rohdei* (Faivovich et al. 2010) and the study area lies within the hybridization zone between *Rhinella crucifer* (Wied-Neuwied 1821) and *Rhinella ornata* (Thomé et al. 2012).

Only one specimen of the American bullfrog *Lithobates catesbeianus* (Shaw 1802) was recorded, in a disturbed area near an abandoned frog farm. This species has great potential to become invasive in environments into which it is introduced (Kats and Ferrer 2003; Kiesecker 2003; Ficetola et al. 2007). Due to its high environmental plasticity and fertility, and especially its feeding habits, *L. catesbeianus* is considered one of the 100 worst invasive species in the world (Lowe et al. 2000). Frogs with strongly aquatic habits seem to suffer the effects of invasive bullfrogs more intensely (Werner et al. 1995; Pearl et al. 2004).

New records

Some of the species found in the municipality of Barão de Monte Alto represent relevant distribution records. The occurrence of *Dendropsophus pseudomeridianus* is the first record for Minas Gerais (Figure 3). The distribution of *D. pseudomeridianus* was previously defined as the lowland regions of the state of Rio de Janeiro (Cruz and Caramaschi 2000). In 2008 the species was recorded in the southern state of Espírito Santo (Silva et al. 2008). Recently Silveira et al. (2011) recorded it other locations in Rio de Janeiro.

Species typical of coastal areas favor the low elevations of river valleys and disperse to inland areas of the continent, as observed in inland portions of the Doce (Feio et al. 1998, 1999), Jequitinhonha (Feio and Caramaschi 1995, 2002) and Paraíba do Sul river basins (Feio and Ferreira 2005; Santana et al. 2010). *Dendropsophus pseudomeridianus* was known only from lowland areas of the coasts of Rio de Janeiro and Espírito Santo (Silva et al. 2008; Silveira et al. 2011), and this record is in agreement with this distribution pattern, in the valley of the Muriaé river, a tributary of Paraíba do Sul watershed.

The presence of *Dendropsophus bipunctatus* also represents an important record for the species. According to Carvalho-e-Silva and Verdade (2010) this species occurs in the coastal region of eastern Brazil from Pernambuco to Rio de Janeiro, but according to Izechsohn and Carvalho-e-Silva (2002) *D. bipunctatus* occurs only from Bahia to Rio de Janeiro. In comparison with the distribution map provided by the IUCN, our records considerably extend the occurrence of *D. bipunctatus*.

The presence of species typical of coastal areas and lowlands demonstrates a certain degree of similarity between species composition between coastal and inland forest areas. This reinforces the importance of forests for the preservation of amphibians of the Atlantic Forest in southeastern Brazil.

Conservation of native anurans

During this study we noted some threats to biodiversity in Barão de Monte Alto, with possible direct and indirect impact on the amphibian fauna of the region caused by exploitation activities: removal of native wood from forest areas, cattle using the fields as pasture and removal of native vegetation for subdivisions and monoculture farming. Some of expected consequences of forest removal are reduction of suitable habitats for some species, immersion of forest fragments in non-forest areas, habitat isolation, and increased edge effects (Murcia 1995; Marsh and Pearman 1997). These factors can negatively affect population's persistence of some species in remaining patches (Fahrig 2003; Vieira et al. 2009).

Finally, we emphasise the need to increase the number of studies in the remaining secondary forests of the lowlands of the Atlantic Forest in Brazil, which have continuously become fragmented and deforested (Becker et al. 2007), generating isolated populations which can result in population declines and species extinction (Bradford et al. 1993; Blaustein et al. 1994b; Dupuis 1997; Lips et al. 2005). New occurrence data, improving the understanding of species geographic distributions, population dynamics such as local extinctions and increased abundance of population may be better understood, facilitating the management and conservation of frogs in these fragments.

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APPENDIX

Specimens of anurans collected at the municipality of Barão de Monte Alto, State of Minas Gerais, Brazil.

Adenomera marmorata – MZUFV: 15780, *Dendropsophus bipunctatus* – (MZUFV: 4479 – 83, 5483 – 87, 7199, 13427 – 28, 14820 – 28, 14918 – 20, 15496 – 02, 15787), (MNRJ: 15496 – 502, 37238, 43645

– 46, 56957 – 58, 78210), (LZV 662A – 63A), (MCNAN: 4848 – 55); *Dendropsophus branneri* – MZUFV: 13917 – 22, 14800 – 02, 14950, 15789, 15808, 15809; *Dendropsophus decipiens* – MZUFV: 14817 – 19, 15791; *Dendropsophus elegans* – MZUFV: 13908 – 10, 14807, 14906, 14925; *Dendropsophus minutus* – MZUFV: 13926, 13927, 13930, 13931, 13933, 14803, 14804, 14836; *Dendropsophus pseudomeridianus* – (MZUFV: 14931 – 35, 15788, 15790), (ZUFRJ: 6757, 6759, 7128, 11063), (MNRJ: 52417 – 18, 52425, 52458 – 61, 52465 – 68, 52557 – 60, 52570 – 77); *Elachistocleis cesarii* – MZUFV: 14922; *Haddadus binotatus* – MZUFV: 14816, 15034, 15035, 15782, 15783, 15803, 15804; *Hypsiboas albomarginatus* – MZUFV: 14838 – 40, 14945, 15784; *Hypsiboas albopunctatus* – MZUFV: 13905 – 07, 14797, 14836, 14837, 14951, 14952; *Hypsiboas faber* – MZUFV: 13894, 14928; *Hypsiboas pardalis* – MZUFV: 13902 – 04, 14946, 15806, 15807; *Hypsiboas polytaenius* – MZUFV: 14949, 15802; *Hypsiboas semilineatus* – MZUFV: 13896, 13897, 14798, 14799, 14813, 14910 – 15, 14944, 15785, 15786; *Ischnocnema sp.* – MZUFV: 15781; *Leptodactylus fuscus* – MZUFV: 13911 – 16, 14908, 14921; *Leptodactylus latrans* – MZUFV: 13934 – 42, 14909, 14937 – 43; *Leptodactylus spixi* – MZUFV: 14841 – 46, 15043; *Lithobates catesbeianus* – MZUFV: 15987 ; *Phyllomedusa rohdei* – MZUFV: 13898 – 901, 14810, 14927; *Physalaemus cuvieri* – MZUFV: 13889 – 91, 13923, 14847 – 49, 14923, 14924, 14926, 14929, 14947; *Proceratophrys boiei* – MZUFV: 15031, 15765 – 69, 15801; *Rhinella ornata* – MZUFV: 13895, 14816, 14829, 14830, 14917, 15032, 15033, 15800; *Scinax crospedospilus* – MZUFV: 14805, 14806, 14808, 14809, 15037, 15038, 15805; *Scinax eurydice* – MZUFV: 14953, 14954; *Scinax fuscovarius* – MZUFV: 13892, 14905, 15036; *Thoropa miliaris* – MZUFV: 13893, 14831 – 35, 14907, 14948, 15030, 15770 – 79, 15797 – 99.