UNIVERSIDADE ESTADUAL DE SANTA CRUZ-UESC
DEPARTAMENTO DE CIÊNCIAS BIOLÓGICAS – DCB
PROGRAMA DE PÓS-GRADUAÇÃO EM ZOOLOGIA

KARIS ITCHEL TUÑÓN VALDÉS

COMPARAÇÃO DA EFICIÊNCIA DE MÉTODOS DE AMOSTRAGENS EM ANFÍBIOS DA SERRAPILHEIRA NO PARQUE ESTADUAL DA SERRA DO CONDURU (PESC), SUL DA BAHIA, BRASIL

ILHÉUS – BAHIA
2017

KARIS ITCHEL TUÑÓN VALDÉS

COMPARAÇÃO DA EFICIÊNCIA DE MÉTODOS DE AMOSTRAGENS EM ANFÍBIOS DA SERRAPILHEIRA NO PARQUE ESTADUAL DA SERRA DO CONDURU (PESC) SUL DA BAHIA, BRASIL

Dissertação apresentada à Universidade Estadual de Santa Cruz, como parte das exigências para obtenção do título de Mestre em Zoologia.

Área de concentração: Zoologia Aplicada

Orientador: Prof. Dr. Mirco Solé
Co-orientador: Prof. Dr. Victor Goyannes Dill Orrico

ILHÉUS – BAHIA
2017

T926 Tuñón Valdés, Karis Itchel.

Comparação da eficiência de métodos de amostragens em anfíbios da serrapilheira no Parque Estadual da Serra do Conduru (PESC), sul da Bahia, Brasil / Karis Itchel Tuñón Valdés. – Ilhéus, BA: UESC, 2017.

32 f.: il.

Orientador: Mirco Solé.

Dissertação (Mestrado) – Universidade Estadual de Santa Cruz. Programa de Pós-graduação em Zoologia.

Inclui referências.

1. Anuro – Parque Estadual da Serra do Conduru (BA). 2. Amostragem. 2. Armadilhas para animais. 3. Biodiversidade – Mata Atlântica. I. Título.

CDD 597.8

KARIS ITCHEL TUÑÓN VALDÉS

COMPARAÇÃO DA EFICIÊNCIA DE MÉTODOS DE AMOSTRAGENS EM ANFÍBIOS DA SERRAPILHEIRA NO PARQUE ESTADUAL DA SERRA DO CONDURU (PESC) SUL DA BAHIA, BRASIL

Dissertação apresentada à Universidade Estadual de Santa Cruz, como parte das exigências para obtenção do título de Mestre em Zoologia.

Ilhéus, 16 de março de 2017

____

Prof. Dr. Mirco Solé
UESC/DCB
(Orientador)

____

Prof. Dr. Euvaldo Marciano-Jr
UESC/DCB

____

Prof. Dr. Daniel Loebmann
FURG/ICB

Para Eredia.

AGRADECIMENTOS

A Débora Rocha Cruz pela parceria, mas principalmente pela amizade.

A meus orientadores Mirco Solé e Victor Dill.

Ao PPGZOO pela oportunidade.

Às funcionárias Lindomar e Larissa, ás estagiárias Kacia e Aline e o Prof. Anibal Oliveira pela ajuda brindada resolvendo as burocracias.

Ao Laboratório de Zoologia de Vertebrados, professores e estudante pela força e apoio.

Ao PESC e seus funcionários pela ajuda sempre oferecida durante as estadias no Parque.

Aos colegas que ajudaram nas saídas de campo: Leandro Oliveira, Camila Souza, Ícaro Menezes, Michelle Pazmiño, Tanja Laaser, Iuri del Rei, Gabriel Novaes, Leildo Carilo e Marina Farulo.

Ao Setor de Transporte da UESC, em especial ao motorista Hermes.

A Carla Santana Cassini, Iuri Ribeiro Dias e Euvaldo Júnior pela colaboração na identificação das espécies.

Aos amigos: Gean, Raissa, Quezia, Analu, Rafael, Thaissa e Rafaela, pela amizade e o amor.

A CAPES, GCUB e OEA pela bolsa de estudos e a oportunidade.

RESUMO

Nós testamos quatro métodos diferentes de amostragem de anuros de serrapilheira no Parque Estadual da Serra do Conduru (PESC) no Sudeste da Bahia, Brasil, esperando poder revelar qual deles seria o mais eficiente. Os métodos testados foram: método do quadrante, transecto, armadilha de queda em disposição lineal e armadilha de queda em disposição radial. Concluímos que para amostragens de anfíbios de serrapilheira o método mais eficiente dos quatro é a armadilha de queda em disposição em linha. Também, comparando as campanhas realizadas durante o dia e a noite, utilizando os métodos de quadrante e transecto, concluímos que amostrar durante o dia nesta região não é recomendável.

ABSTRACT

We tested four different sampling methods for leaf litter frogs at the State Park of Serra do Conduru (PESC) in the South of Bahia, Brazil, aiming to find out which of them is more efficient. The tested methods were: plot, transect, pitfall array in line and pitfall in radial array. We conclude that for leaf litter frogs the most efficient of all four is the pitfall array in line. Also, comparing the campaign during the day and night of plot and transect methods we conclude that sampling during the day in this region is not recommended.

SUMÁRIO

FOLHA DE ROSTO…………………………………………………...…………. 2
FOLHA DE APROVAÇÃO.. 3
DEDICATORIA... 4
AGRADICIMENTOS.. 5
RESUMO... 6
ABSTRACT... 7
INTRODUÇÃO GERAL... 9
REVISÃO DE LITERATURA.. 12
ARTIGO... 14
CONCLUSÕES.. 26
REFERÊNCIAS BIBILOGRÁFICAS... 27

INTRODUÇÃO GERAL

A Mata Atlântica esteve conectada no passado com outras florestas da América do Sul, seguido por períodos de isolamento, o que resultou num intercâmbio biótico que permitiu a especiação geográfica (PRUM, 1988; SILVA et al., 2004). A Mata Atlântica Brasileira está entre os 25 "hotspots" de biodiversidade do planeta, ocupando o quarto lugar de endemismo de plantas e vertebrados (MYERS et al., 2000), porém está entre um dos mais ameaçados (MYERS et al., 2000; SILVA e CASTELETI, 2003). A região da Mata Atlântica originalmente se estendia ao logo de 17 estados do Brasil (92% do total) e nos países de Paraguai e Argentina (GIRAUDO, 2003; HUANG et al. 2007; RIBEIRO et al., 2009). Segundo os resultados de RIBEIRO et al. (2009) a Mata Atlântica Brasileira atualmente está reduzida a um 11,73% de sua cobertura original, e o que resta se encontra baixo uma alta pressão antrópica e correndo riscos de extinção (MORELLATO e HADDAD, 2000). Embora a Mata Atlântica Brasileira seja uma das regiões da América do Sul com maior número de áreas protegidas (GALINDO-LEAL e CÂMARA, 2003), a maioria das espécies ameaçadas de extinção no Brasil pertence a este bioma (TABARELLI et al., 2003).

A biota endêmica da Mata Atlântica não se distribui homogeneamente, a composição de espécies varia amplamente entre regiões e por isso foi dividida em sub-regiões biogeográficas: Brejos Nordestinos, Pernambuco, Diamantina, São Francisco, Bahia, Florestas de Interior, Florestas de Araucária e Serra do Mar (SILVA e CASTELETI, 2003). Para fins de planejamento e conservação, no Brasil, foram estabelecidos sete corredores ecológicos, dois deles na Mata Atlântica: o Corredor Central da Mata Atlântica e o Corredor da Serra do Mar (MINISTÉRIO DO MEIO AMBIENTE, 2006).

O Corredor Central cobre aproximadamente o 75% da biorregião Bahia (AGUIAR et al., 2005). A biorregião Bahia é um centro de endemismo de aves (SILVA et. al., 2004), mamíferos (COSTA, 2000) e anfíbios (CARNAVAL et al., 2009) já que serviu como refúgio climático durante a última glaciação, o que promoveu a diversificação de espécies não só de vertebrados, mas também de outros organismos como plantas e borboletas (CARNAVAL e MORITZ, 2008).

A CONSERVATION INTERNATIONAL DO BRASIL et al. (2000) resumia que em conjunto o grupo de vertebrados de mamíferos, aves, répteis e anfíbios que ocorrem na Mata Atlântica somavam 1.810 espécies das quais 389 eram endêmicas, abrigando cerca de um 7% das espécies desse grupo de vertebrados conhecidas no mundo naquele momento. HEYER et al. (1994) indicou a importância de saber a composição dos grupos de vertebrados das regiões no mundo para saber o estado de conservação e realizar monitoramento ao longo do tempo. Dos vertebrados, os anfíbios são o grupo mais ameaçado (HOFFMAN et al., 2010). STUART et al. (2004) mencionam que entre as principais causas do declínio dos anfíbios no mundo está a perda de hábitat, exploração da terra e "declínios enigmáticos", seguidas pelas mudanças climáticas e doenças emergentes (BURROWES et al., 2004; LIPS et al., 2005; POUNDS, 2001; POUNDS et al., 2006).

Desde o ano 2000, quando a Conservation International do Brasil considerava 389 espécies endêmicas de vertebrados para a Mata Atlântica, este número tem aumentado muito, precisamente pelo aumento de estudos e a realização de listas de espécies (ex. COSTA e BÉRNILS, 2014; SEGALLA et al., 2016). Só de anfíbios o Brasil é o país com maior riqueza de espécies (1080 espécies em SEGALLA et al., 2016) e o bioma da Mata Atlântica alberga 543 espécies, das quais 472 (88%) são endêmicas (HADDAD et al., 2013). As técnicas e os métodos de amostragens devem ser testados para que os estudos de campo feitos em curtos períodos de tempo, seja para consultorias ou pesquisas, sejam eficientes na hora de fazer levantamento de riquezas de espécies ou diversidade e composição de comunidades e espécies de um determinado lugar (HEYER, 1994).

Os tipos de amostragem podem ser classificados em aqueles de busca ativa e busca passiva. A busca ativa costuma ser mais efetiva para coletar espécies de diferentes tipos de hábitat (SCHMIDT, 2003), em quanto as técnicas de busca passiva diminuem a polarização do coletor, porém geralmente estão focadas em um subgrupo da fauna total (RIBEIRO-JUNIOR et al., 2008). Os métodos de busca ativa mais utilizadas no Brasil para amostragem de herpetofauna são o método do quadrante e o método do transecto (ex. DIAS et al., 2014; GIARETTA, 1999; SILVANO e PIMENTA, 2003; OLIVEIRA, 2013; ALLMON, 1991). Já os métodos de busca passiva mais utilizados são as armadilhas de queda e as do tipo funil (ex. BRUSCAGIN et al., 2014). Tem sido feitos estudos focando na padronização de cada tipo de método: quadrante (ROCHA et al., 2001) e armadilhas de queda (CECHIN e MARTINS, 2000; MENDES et al. 2015)

Apesar da existência de vários manuais tentando padronizar métodos de amostragem de herpetofauna (ex. ANGULO et al., 2006; PERU-MINISTERIO DEL

AMBIENTE, 2015) a efetividade deles varia muito dependendo dos tipos de hábitat (RIBEIRO-JUNIOR et al., 2008).

O local escolhido para executar o estudo de Comparação da Eficiência de Métodos de Amostragens em anfíbios de serrapilheira foi o Parque Estadual da Serra do Conduru (PESC), localizado no estado da Bahia-Brasil. O PESC se encontra inserido no Corredor Central da Mata Atlântica, nos municípios de Ilhéus, Itacaré e Uruçuca e está na lista das Áreas Protegidas-Áreas Prioritárias para a conservação da biodiversidade da Mata Atlântica (CONSERVATION INTERNATIONAL DO BRASIL et al., 2000).

REVISÃO DE LITERATURA

Existe uma falta de estudos padronizando métodos de amostragem que possam ser comparados sem reservas, especialmente quando são conduzidos em diferentes partes do mundo (RÖDEL e ERNST, 2004). Entre as tentativas de padronização de métodos de amostragem estão o de LIPS e REASER (2001) na região da América Latina; HOWELL (2002) no continente Africano; RÖDEL e ERNST (2004) para as regiões tropicais no mundo; STRAIN e RAESLY (2012) nas regiões planas costeiras dos EUA.
Cada país também faz esforços para otimizar e sugerir as melhores técnicas de amostragem e monitoramento da fauna (ex. Perú: PERÚ-MINISTÉRIO DO AMBIENTE, 2015; México: TESSARO e GONZÁLEZ, 2011), porém DA SILVA e CASTELETI (2005) mencionam que para monitorar a biodiversidade, devem ser definidos indicadores para cada sub-região e não se tratar como um bioma todo. Por isso, ainda dentro do Brasil, se continuam fazendo estudos testando quais métodos são mais uteis segundo a finalidade da pesquisa.

Entre os métodos de amostragem passivo mais usados estão as armadilhas de queda com cerca guia ou não, e as armadilhas de tipo funil, e são usados para captura de vertebrados tanto de pequenos mamíferos como de anfíbios e repteis (ex. BRUSCAGIN et al., 2014; PARDINI, 2004; PIMENTA, 2005). Por isso têm-se realizado estudos para avaliar quais das disposições de armadilhas de queda seriam as mais eficientes. GREENBERG et al. (1994) comparou entre as armadilhas de queda e as de tipo funil de uma e duas entradas qual era a mais eficiente, encontrando que a armadilha de queda era a mais eficiente na hora de capturar. Porém, GREENBERG et al. (1994) achou resultados similares entre os três métodos estimando abundancia.

CECHIN e MARTIN (2000) avaliaram a eficiência na captura de anfíbios e répteis com diferentes volumes de baldes, quantidade de baldes por armadilha e tipos de cerca guia. Porém, por terem feito as amostragens em três regiões com condições ambientais completamente diferentes uma da outra, e em cada lugar terem utilizado diferentes disposições de armadilhas sem apresentar curvas de rarefação de espécies, o estudo não pode ser comparado com outros. As curvas de rarefação são o método proposto para comparar riqueza de espécies quando as amostras têm tamanhos diferentes e são feitas por métodos diferentes (GOTELLI e COLWELL, 2001; KRAKER-CASTAÑEDA e CÓBAR-CARRANZA, 2011).

RIBEIRO-JÚNIOR et al. (2008) realizaram uma das primeiras e mais efetivas comparações entre métodos ativos e passivos, e a eficácia dos métodos em diferentes tipos de paisagens de uma floresta tropical, apresentando os resultados em curvas de rarefação. Em outro contexto, MENDES et al. (2005) num estudo teórico comparou compararam a eficiência de captura entre as disposições de armadilhas de queda, entre disposição radial e lineal, encontrando mais eficiente a lineal e comparando os resultados teóricos também em curvas de rarefação.

Dos métodos de busca ativa, o transecto e variações ao transecto (CRUMP e SCOTT, 1994) é um dos mais usados para amostragem de anfíbios, geralmente complementado com outros métodos de busca ativa como são os quadrantes (RIBEIRO-JÚNIOR et al., 2008) e até mesmo os encontros oportunistas que tem sido relatado por fazer a diferencia nas procuras de anfíbios quando o objetivo é a realização de lista de espécies (DIAS et al., 2014; RIBEIRO-JÚNIOR et al., 2008). Sendo o método do quadrante outro dos métodos ativos mais utilizados no Brasil, sobre todo quando se estuda anfíbios de serrapilheira (ex. GIARETTA et al., 1999; OLIVEIRA et al., 2013), também há estudos comparando os tamanhos e técnicas a seguir. Os quadrantes podem fazer remoção de serrapilheira ou não como o testado por ROCHA et al. (2001), que compararam as diferenças entre riqueza, abundancia e densidade resultante utilizando quadrantes pequenos com remoção de serrapilheira e quadrantes grandes. ROCHA et al. (2001) acharam diversidade similar entre métodos, porém estimações de biomassa e abundancia menor no quadrante pequeno comparado com o grande. A remoção da serrapilheira resulta no dano do microambiente que se estuda (RÖDEL e ERNST, 2004), por isso não se sugere a utilização desta técnica.

Pela falta de estudos que além de proporcionar resultados que comparem a efetividade de captura e amostragem, também proporcionem dados sobre diversidade em estudos feitos em curtos períodos de tempo, nas diferentes regiões e estudos que comparem a efetividade de métodos de amostragem ainda são validos e necessários.

Comparison of Sampling Method Efficiency for Leaf Litter Amphibians in the State Park of Serra do Conduru (PESC) South of Bahia, Brazil.

Karis I. Tuñón-Valdés, Débora R. Cruz, Victor G. D. Orrico & Mirco Solé

Laboratório de Zoologia de Vertebrados, Departamento de Ciências Biológicas, Universidade Estadual de Santa Cruz. Rodovia Jorge Amado, Km 16, 45662-900 Salobrinho, Ilhéus, Bahia, Brasil. E-mail: karistunon@gmail.com

ABSTRACT. We tested four different sampling methods for leaf litter frogs at the State Park of Serra do Conduru (PESC) in the South of Bahia, Brazil, aiming to find out which of them is more efficient. The tested methods were: plot, transect, pitfall array in line and pitfall in radial array. We conclude that for leaf litter frogs the most efficient of all four is the pitfall array in line. Also, comparing the campaign during the day and night of plot and transect methods we conclude that sampling during the day in this region is not recommended.
KEY WORDS. Atlantic Forest, drift fences, pitfall traps, plot.

RESUMO. Comparação da Eficiência de Métodos de Amostragens em Anfíbios da Serrapilheira no Parque Estadual da Serra do Conduru (PESC) Sul da Bahia, Brasil. Nós testamos quatro métodos diferentes de amostragem de anuros de serrapilheira no Parque Estadual da Serra do Conduru (PESC) no Sudeste da Bahia, Brasil, esperando poder revelar qual deles seria o mais eficiente. Os métodos testados foram: método do quadrante, transecto, armadilha de queda em disposição lineal e armadilha de queda em disposição radial. Concluímos que para amostragens de anfíbios de serrapilheira o método mais eficiente dos quatro é a armadilha de queda em disposição em linha. Também, comparando as campanhas realizadas durante o dia e a noite, utilizando os métodos de quadrante e transecto, concluímos que amostrar durante o dia nesta região não é recomendável.
PALABRAS CHAVES. Armadilhas de queda, linha de intercepção, Mata Atlântica, método de quadrante.

INTRODUCTION

A great loss in amphibian populations has been recorded in the last decades (LIPS et al. 2005, PIMENTA et al. 2005). STUART et al. (2004) indicated that the three main causes for amphibian decline are habitat loss, overuse of land, and enigmatic declines (probably due to disease and climate change). Due to the large geographic scale of the country, the different types of ecosystems, and the large number of amphibian species, very little is known about the declines of amphibians in Brazil (ETEROVICK et al. 2005).

Therefore, to know whether or not a decline in populations and species in Brazil is happening, and to separate normally occurring population fluctuations from declines, long-term monitoring projects are crucial. But field studies performed during short periods are also necessary because they help to fill gaps in the distribution of the species and to highlight areas that due to high species diversities may be suitable for long-term monitoring. For this reason, the techniques and methods of sampling must be tested so that field studies done in short periods of time, either for consulting or for research, are effective when surveying species richness or diversity, and the composition of populations and species of a particular place.

In Brazil there are already studies on the ecology of litter frogs (GIARETTA et al. 1999) specifically from the Atlantic Forest (BRUSCAGIN et al. 2014, OLIVEIRA et al. 2013). There are also studies evaluating widely used sampling techniques as drift fences (MENDES et al. 2015), pitfall traps (CECHIN & MARTINS 2000, RIBEIRO-JÚNIOR et al. 2008) and the method of plot (ROCHA et al. 2001). Each one of them focused only on an exclusive type of method. Previous studies focused in the type of array of pitfall, the size of bucket, the use or not of drift fence, the size of plot, but none of them tested and comparted de results between different types of methods, passive and active, focusing in the same region and substrate. None of them were executed in this specific region of the Atlantic Forest. RÖDEL & ERNST (2004) pointed out the lack of studies that could be compared without reservations.

The State Park of Serra do Conduru (PESC) in the south of Bahia is located within the Atlantic Forest, which is considered one of the two main biodiversity hotspots of the planet (MYERS et al. 2000) and which is home to more than half of amphibian species in Brazil (HADDAD et al. 2013). There is no information about the richness, diversity and abundance of frogs of the PESC.

We compared the differences of diversity, abundance and richness between four litter sampling methods, expecting that pitfalls would be the most efficient to trap amphibians since they focus only on that substrate. Also, we tried to discover if the pitfall in line array is indeed more efficient than a radial array to sample leaf litter frogs. Finally, we wanted to know if within the active methods, it would be advantageous to realize diurnal campaigns like it is done in other regions of the Atlantic Forest.

MATERIAL AND METHODS

The State Park of Serra do Conduru (PESC) is located in northeastern Brazil, in the south of the State of Bahia, in the municipalities of Itacaré, Uruçuca and Ilhéus. The climate is the Af type of KÖPPEN (1936), situated in a climatic strip that normally has a relative air humidity above 80%, a monthly mean temperature that varies from 20 to 26°C with an annual mean temperature of 24°C and an annual precipitation above 1,300 mm (SÁ et al. 1982). The vegetation of the PESC is classified as southern Bahian wet forest (GOUVÊA et al. 1976). It is a primary forest with a homogeneous canopy with few emerging species, and is characterized by its complete stratification (JARDIM 2003).

We sampled during 40 not consecutive days, between the months of June to December of 2016. We set up four sampling points, each constituted of four different arrays of leaf-litter frog sampling methods: transect, plot, pitfall in line and radial or Y pitfall.

Transect. Each transect had a length of 25 m and was sampled through visual observation by two persons looking 1 m to each side (right and left) parting from the middle of the transect, during 15 minutes. The samplings were performed during the morning between 06.00 and 12.00 hours, and during the night between 18.00 and 22.00 hours.

Plot. The plots had an area of 25 m^2, investing a sampling time of 15 min each time, with an effort of two persons. The samplings were made during the morning between 06.00 and 12.00 hours, and during the night between 18.00 and 22.00 hours.

Both, transect and plot were made with the help of a wood stick to search between the leaf litter.

Pitfalls traps. Each arrange of pitfall traps (in line and radial) had an arrange with four 60-l buckets, connected by 8 m of drift fence (50 cm high), each line ending with another 2 m of drift fence summarizing a total of 16 buckets for each arrange of pitfall traps (Figure 1). Pieces of styrofoam were placed inside the buckets to avoid the drowning of the organisms in case of flood during the rains. The buckets stayed open during the 40 days we remained at the PESC.

Some reptiles and amphibians were collected in order to register the herpetofauna of the locality and deposited at the Herpetological Collection (MZUESC) of the State University of Santa Cruz (UESC). The identification of each sampled organism was made with the help of specialists of the Laboratory of Zoology of Vertebrates of the UESC.

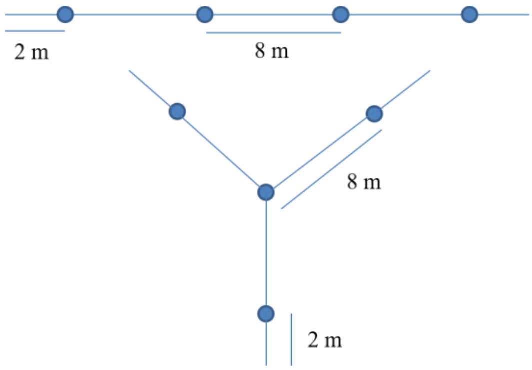

Figure 1. Pitfall arrays: linear (above) and radial (below). The circles represent the buckets interspaced by eight meters along the drift fences (figure adapted from MENDES et al. 2015).

The graphics and analysis were made with the program PAST version 2.17c. Rarefaction curves were built to compare the richness. We compared the differences between some diversity indexes: Shannon's entropy index, Effective number as true diversity and Simpson's index of diversity. We did this with all the sampled species and only considering leaf litter frogs. Because research aims are not always abundance and species richness, we also compared the similarity and others indexes of diversity.

RESULTS

A total of 131 individuals belonging to eight families, 16 genera and 18 species were sampled. The most abundant species were *Physalaemus camacan* Pimenta, Cruz & Silvano, 2005; *Rhinella hoogmoedi* Caramaschi & Pombal, 2006 and *Stereocyclops incrassatus* Cope, 1870 "1869" (Table 1).

Because we tested active methods that not only focused on leaf litter frogs, we present rarefaction curves considering all the species found using the four methods (Fig 2a, 2c, 2e, 2g and 3a) and considering only leaf litter frogs (Fig 2b, 2d, 2f, 2h and 3b). In both cases, each method separately did not reach the stability of the curve. Neither of the 18 individuals presented as 'Juvenile not identified' in Table 1, were included in the calculation of the curves.

Viewing the species accumulation curve in one graphic (Fig 3a) it looks like transect and pitfall in line were very similar because they sampled similar richness of species, therefore when only considering the leaf litter frogs (Fig 3b) a huge difference appears between the pitfall in line and the rest of the methods.

Drawing on of the dataset we had, we made the accumulation of species curve mixing an active with a passive method (Fig 4). Taking as reference the Fig 3 we only used the pitfall in line as the representative of the passive method. We did it considering all the species founded (Fig 4a and 4c) and only leaf litter frogs (Fig 4b and 4d). Considering all the sampled species (Fig 4a), even though the curve didn't reach stability, the mix of Transect plus Pitfall in line got more sampled species. When only considering leaf litter frogs there were not much differences in both of the combinations.

Table 1. Anurans recorded at PESC using the tested sampling methods (T: transect, P: plot, L: line pitfall, Y: radial pitfall). *Juvenile not identified probably *Pristimantis*, *Allobates* or *Physalaemus* species, they were too young to be identified and were not take in count in the total of species.

Family Species	T	P	L	Y	**Total number of individuals**
Aromobatidae					
Allobates olfersioides	4	2	3		**9**
Bufonidae					
Frostius erythrophthalmus	1				**1**
Rhinella hoogmoedi	1	3	19	9	**32**
Craugastoridae					
Haddadus binotatus		1			**1**
Pristimantis vinhai	3	2	1	1	**7**
Hylidae					
Ololygon argyreornata	5				**5**
Ololygon strigilata	2				**2**
Phyllodytes aff luteolus	2				**2**
Scinax gr ruber	1				**1**
Scinax sp.	3				**3**
Trachycephalus mesophaeus			1		**1**
Leptodactylidae					
Leptodactylus latrans			1		**1**
Physalaemus camacan	2	3	12	8	**25**
Microhylidae					
Chiasmocleis schubarti			2	2	**4**
Stereocyclops incrassatus			12		**12**
Odontophrynidae					
Macrogenioglottus alipioi		1	2	1	**4**
Proceratophrys renalis			1	1	**2**
Phyllomedusidae					
Phyllomedusa burmeisteri		1			**1**
Juvenile (not identified)*	3	1	12	2	**18**
Total number of species	10	7	10	6	
Total number of individuals	**27**	**14**	**66**	**24**	**131**
Percentage of the total number of individuals (%)	20.61	10.69	50.38	18.32	

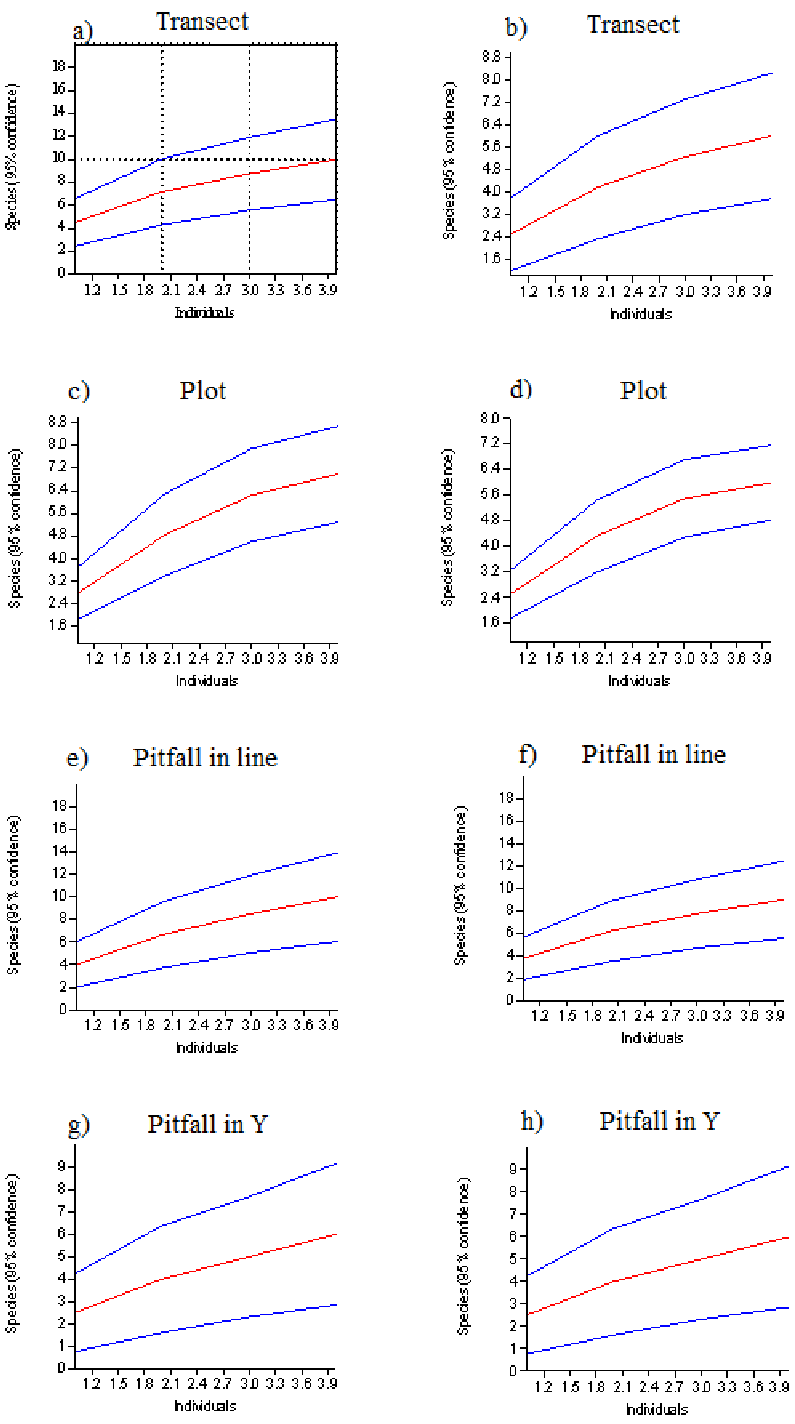

Figure 2. Rarefaction curve of Species vs Individuals for each tested method. a, c, e g: considering all found species; b, d, f, h: considering only leaf litter frogs.

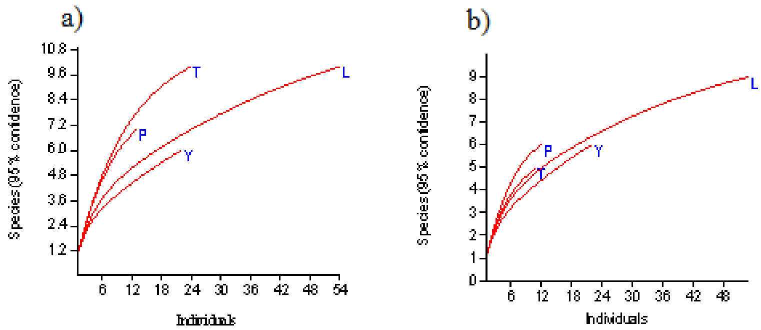

Figure 3. Species accumulation curve for each method: a) with all the species found and b) only considering leaf litter frogs (T: Transect, P: Plot, L: Pitfall in Line, Y: Radial Pitfall).

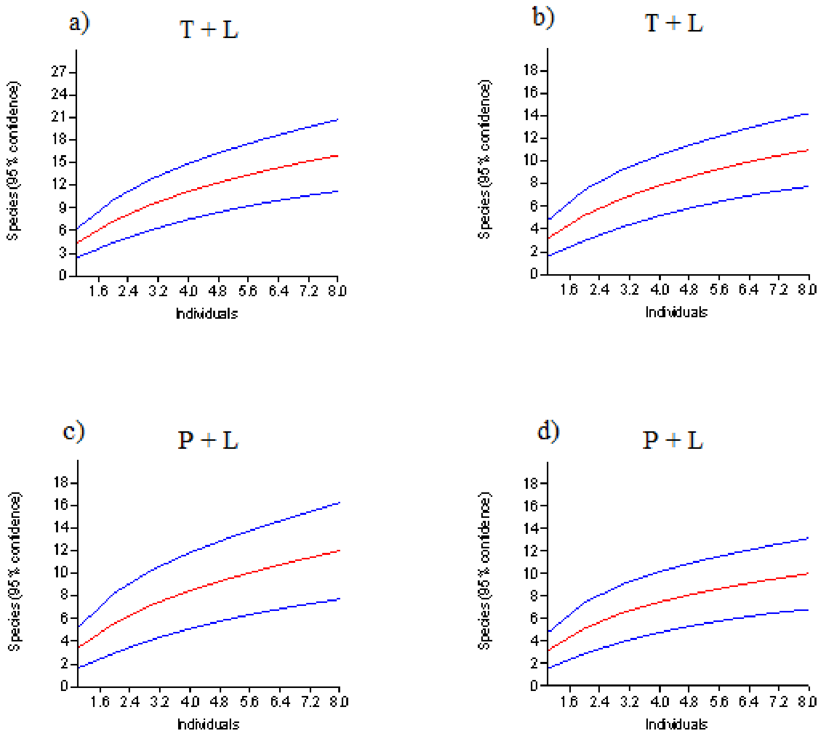

Figure 4. Species accumulation curve mixing a passive and an active method, a and c considering all found species, b and d only considering leaf litter frogs (T: Transect, P: Plot, L: Pitfall in Line).

If every method was sampling the same locality, we would expect close similarity and diversities indexes. When considering all sampled species (Fig 5a) both types of pitfalls lead to 60% similar results, but Plot and Transect only had a 30% of similarity even though they both were active methods. The results are different when only leaf litter frogs are considered (Fig 5b), Plot and Transect methods increased to a 57% of similarity and the pitfalls stayed almost the same with a 66% of similarity.

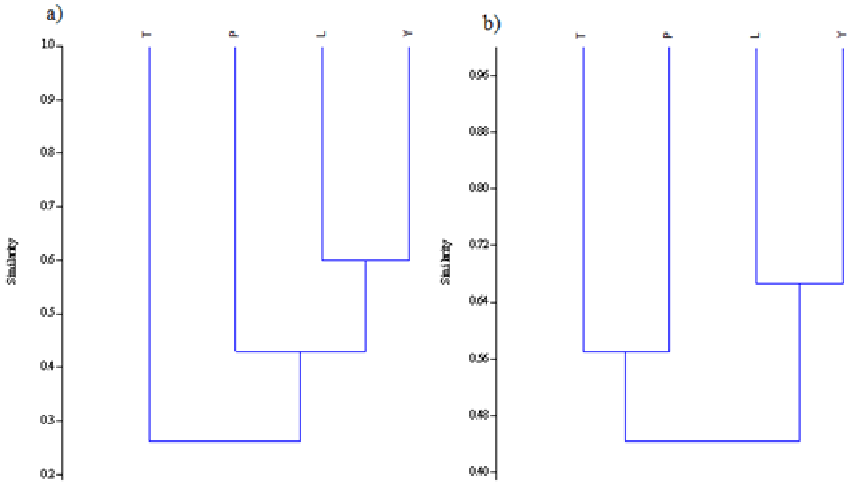

Figure 5. Cluster of Similarity according to the Jaccard's similarity index, a considering all the species and b only leaf litter frogs (T: Transect, P: Plot, L: Pitfall in Line, Y: Radial Pitfall).

The effective numbers show that when considering all the species, the transect is the method that indicates the highest diversity because it had the double of effective species than radial pitfalls. Despite the transect leading to more diverse results than pitfalls in line and the plots, the difference is not as big as when compared with the radial pitfall. When only considering leaf litter frogs the true diversity obtained with the four methods were very similar, with the radial pitfalls still being the ones that revealed less true diversity.

Table 2. Index of Shannon as entropy index, Effective number and Simpson´s diversity index 1-D. *Only considering leaf litter frogs.

Method	Shannon's Index	Effective number	Simpson's Index
Transect	2.164	8.70589167	0.8715
Plot	1.845	6.32809979	0.8284
Line Pitfall	1.736	5.67459957	0.7702
Radial Pitfall	1.373	3.94717447	0.686
Transect*	1.468	4.34054536	0.7438
Plot*	1.705	5.50138567	0.8056
Line Pitfall*	1.675	5.33879515	0.7618
Radial Pitfall*	1.373	3.94717447	0.686

Since the active samplings were performed twice a day, we present the net values (Table 3), showing that in this region diurnal sampling is not very effective.

Table 3. Absolute numbers of individuals captured using the Transect and Plot method, according to the period of the day.

Period of day	Transect (n= 27 individuals)	Plot (n= 14 individuals)
Morning	5	5
Night	22	9

DISCUSSION

Methods.

The most abundant species were *Rhinella hoogmoedi*, *Physalaemus camacan* and *Stereocyclops incrassatus*. The few times we sampled *Stereocyclops incrassatus* and *Chiasmocleis schubarti* Bokerman, 1952 it was always after a rainy day and in two localities in the proximity of temporal ponds. The sampling success probably was related to the explosive reproductive strategy shown by both species (ABRUNHOSA et al. 2006, CARAMASCHI & PIMENTA 2003).

The species that were sampled only once (Table 1) were *Frostius erythrophthalmus* Pimenta & Caramaschi, 2007; *Haddadus binotatus* (Spix, 1824); *Trachycephalus mesophaeus* (Hensel, 1867) and *Phyllomedusa burmeisteri* Boulenger, 1882. *Frostius erythrophthalmus* is a specie that we consider abundant at PESC as it was calling almost every day mostly during the night but also during the day, and still we could not sample more individuals of this species with our methods. The one that was sampled, was in a bromeliad's leaf that was on the ground. We also had two opportunistic record of this species, one was crossing the road and another was perched from a tree trunk. The toads of the genus *Frostius* have been described to lay their eggs in bromeliads (CANNATELLA 1986), and beside the leaf litter they are normally found on the leaves of bushes or bromeliads, always away from water bodies, suggesting an association with bromeliads (PIMENTA & CARAMASCHI 2007). Probably this is the motive we could not sample more specimens of this species, recommending an active search thru the vocalization of the males.

Of *Haddadus binotatus* we had a lot of opportunistic registers, and even so we only happened to sample it once. *Phyllomedusa burmeisteri* and *Trachycephalus mesophaeus* are species that are not associated to leaf litter, and as we focused on this substrate, it is not surprising that we did not sample more individuals of these species that mostly are encountered perched on shrubs or trees (ABRUNHOSA & WOGEL 2004).

Rarefaction curves in this kind of studies allow that studies made in different regions of the world or even in the same region at different times and seasons, could be compared (MENDES et al. 2015, RÖDEL & ERNST 2004, SILVEIRA et al. 2010).

Other studies have shown evidence of which kind of method was more effective, but in all those cases always evaluating only active or passive methods and not the combination of both as in this study. SZARO et al. 1988 in a study made in Arizona-USA with small mammals, recommended to not just use one kind of trap, because the results not always are comparable or conclusive.

In none of the four methods we tested the curve reached stability, even considering all the sampled species (Fig 2, Fig 3). When considering all the sampled species the Transect and the Line Pitfall (Fig 2a, 2b) tend to stabilization, as did the Line Pitfall when only considering leaf litter frogs (Fig 2f). Our results suggest increasing the number of replications in the field.

From the 18 species (Table 1) that were sampled with our four tested methods, the Transect and the Pitfall in Line were the two that sampled 10 species each (Fig 3). But

if we disregard the tree frogs, we only sampled five species of leaf litter frogs with transect and nine with Pitfall in Line, and the same quantity for Plot and Radial Pitfall with six species each. Within the tested methods, the Pitfall arranged in Line was the most successful sampling the largest richness of species of leaf litter frogs and abundance of individuals with 50.38% of the total of individuals sampled. So, between the two arrays of pitfalls we conclude that the line array is more efficient, coinciding with the theoretical evidence of MENDES et al. 2015 who concluded that the line array is more efficient than the radial array. Previously RIBEIRO-JÚNIOR et al. 2011 concluded that the size of the buckets did not influence in the rate of abundance and diversity when studying amphibians; that's why it was not a variable considered in our study.
Still, there were two species that were not sampled using the passive methods, so we combined the dataset of each type of active method with the dataset of the Pitfall in Line (Fig 4), and because we still did not reach the stability of the curve we could not affirm which of the active methods was more effective.
When comparing thru the Jaccard's index, the results of the pitfalls were almost the same with and without tree frogs. In both cases (Fig 5a and 5b) the two arrays of pitfall were similar in a 60-66% respectively. In the case of the active method they looked more similar when only analyzing leaf litter frogs with a 57% of similarity (Fig 5b). RÖDEL & ERNST 2004 concluded that the most effective method for sampling leaf litter frogs in the tropics could be the Transect, in a study conducted at Ivory Coast, but our results indicated that there is not difference between choosing Transect or Plot when studying leaf litter frogs. When considering leaf litter and tree frogs, the active methods were similar only in a 31%, this was expected since almost all the tree frogs were sampled thru de Transect, and with the Plot method only were sampled one species of tree frog.
Analyzing the diversity indexes, we perceived a different panorama (Table 2). If a researcher would be only focusing on sampling leaf litter frogs having only few available times to be at the field, we recommend to use the Pitfall in Line array. If the aim of the research would the richness in order to make a species list, we would suggest to use a combination of a passive and an active method. If the species list were only of leaf litter frogs we recommend the Pitfall in Line array as passive method and would leave it up to the researcher to use the Transect or Plot as active method. When the resulting species list should be of all substrate species frogs we suggest to choose the Transect as active method and the Pitfall in Line array as passive method plus the use of another sampling method like acoustic sampling.
Among the methods tested during the morning and night (Plot and Transect), we found much more individuals during the night than during the morning campaign (Table 3). ROCHA et al. (2001), sampling thrice a day at Rio de Janeiro-Brazil, also found more quantity of individuals during the night, and almost the same quantity of individuals in the campaigns of the afternoon and morning, but still a considerable number of individuals during the day campaigns. We do not recommend to do diurnal campaigns in similar regions to PESC, because it only results in increased research budget without making any difference.
Field recommendations.
Depending on the objective of the research, we point the advantages and disadvantages of each method:
Transects and plots demand the investment of a lot of time at the field during the research. When using a stick to seek among the litter, it is very important to never remove the substrate and to do not put it apart of the transect or plot, especially when the transects and plots are fixed points that need to conserve their substrate.

The pitfalls demand a big effort at the beginning, to dig the holes and install the drift fences, but it saves time during the sampling because researchers only need to look into the buckets following the norms of each country. We recommend to check out the buckets every day, because not only anurans fall into the buckets, but also reptiles and small mammals. It is extremely important to cover the buckets when not in the field and at the end of the research to remove all the traps and to fill the holes left by the buckets with substrate in order to avoid unnecessary casualties.

Finally, since none of our cumulative species curves reached stability, we also recommend to do more than 4 replications whichever would the chosen method.

Other comments.

It is important to state that our sampling region was categorized as 'Much drier than average' according to the NOAA'S National Center for Environmental Information (accessed on February 9, 2017) during the year we performed our research. This could have negatively affected the abundance and occurrence of several species of leaf litter frogs that were reported previously at PESC (PIMENTA 2005).

ACKNOWLEDGMENTS

To INEMA, PESC and their employees for the help and the facilities offered before and during the fieldwork. To Leandro Oliveira, Camila Souza, Ícaro Menezes, Michelle Pazmiño, Tanja Laaser, Iuri del Rei, Gabriel Novaes, Leildo Carilo and Marina Farulo for the help during the field work. To the drivers of the Transport Sector of the UESC, specially to Hermes. To Carla Santana Cassini, Iuri Ribeiro Dias and Euvaldo Júnior for the collaboration in the identification of some species and the discussion of this study. KTV and DRC are grateful to CAPES for the scholarships. This work is part of the project 'Diversity and richness of anurans at the State Park of Serra do Conduru, Bahia, Brazil'.

LITERATURE CITED

ABRUNHOSA PA, WOGEL H & POMBAL JP (2000) Anuran temporal occupancy in a temporary pond from the Atlantic rain forest, South-Eastern Brazil. **Herpetological Journal**, vol. 16, p. 115-122.

ABRUNHOSA PA & WOGEL H (2004) Breeding behavior of the leaf-frog *Phyllomedusa burmeisteri* (Anura-Hylidae). **Amphibia-Reptilia**, vol. 25, p. 125-135.

BRUSCAGIN RT, CONDEZ TH, DIXO M & BERTOLUCI J (2014) Diversity of leaf-litter anurans in a fragmented landscape of the Atlantic Plateau of São Paulo State, southeastern Brazil. **Journal of Natural History**, vol. 48, p. 1-16.

CANNATELLA DC (1986) A new genus of bufonid (Anura) from South America, and phylogenetic relationships of the Neotropical genera. **Herpetologica**, vol. 42, p. 197–205.

CARAMASCHI U & PIMENTA B (2003) Duas Novas Espécies de *Chiasmocleis* Méhelÿ, 1904 da Mata Atlântica do Sul da Bahia, Brasil (Amphibia, Anura, Microhylidae). **Arquivos do Museu Nacional, Rio de Janeiro**, vol. 61, p. 195-202.

CECHIN SZ & MARTINS M (2000) Eficiência de armadilhas de queda (pitfall traps) em amostragens de anfíbios e répteis no Brasil. **Revista Brasileira de Zoologia**, vol. 17, no. 3, p. 729-740.

CRUMP ML & SCOTT JR. NJ (1994) Chapter 2. Visual encounter surveys. In Measuring and monitoring biological diversity: Standard methods for amphibians. **Smithsonian Institution Press.**

ETEROVICK PC, CARNAVAL ACOQ, BORGES-NOJOSA DM, SILVANO DL, SEGALLA MV & SAZIMA I (2005) Amphibian Declines in Brazil: An Overview. **Biotropica**, vol. 37, no. 2, p. 166-179.
GIARETTA AA, FACURE KG, SAWAYA RJ, MEYER JHM & CHEMIN N (1999) Diversity and Abundance of Litter Frogs in a Montane Forest of Southeastern Brazil: Seasonal and Altitudinal Changes. **Biotropica**, vol. 31, no. 4, p. 669-674.
GOUVÊA JBS, SILVA M & HORI M (1976)1. Fitogeografia. In: **Diagnostico socioeconômico da região cacaueira**, Vol. 7, Recursos florestais, pp. 1-7. Ilhéus, Bahia, Brazil: Comissão Executiva do Plano da Lavoura Cacaueira and the Instituto Interamericano de Ciências Agricolas-OEA.
HADDAD CFB, TOLEDO LF, PRADO CPA, LOEBMANN D, GASPARINI JL & SAZIMA I (2013) **Guia dos Anfíbios da Mata Atlántica: diversidade e biologia.** Anolisbook, São Paulo, 544 pp.
JARDIM JG (2003) **Uma caracterização parcial da vegetação na região sul da Bahia, Brasil.** Corredor de Biodiversidade da Mata Atlântica do Sul da Bahia / Instituto de Estudos Sócio-Ambientais do Sul da Bahia e Conservation International do Brasil.
KÖPPEN WP (1936) **Das geographische System der Klimate.** Gebrüder Borntraeger, Berlin, 44 pp.
LIPS KR, BURROWES PA, MENDELSON JR III & PARRA-OLEA G (2005) Amphibian Population Declines in Latin America: A Synthesis. **Biotropica**, vol. 37, no. 2, p. 222-226.
MENDES DM, LEÃO RF & TOLEDO LF (2015). Drift fences in traps: theoretical evidence of effectiveness of the two most common arrays applied to terrestrial tetrapods. **Natureza & Conservação**, vol. 29, p. 1-7.
MYERS N, MITTERMEIER RA, MITTERMEIR CG, FONSECA GAB & KENT J (2000) Biodiversity hotspots for conservation priorities. **Nature**, vol. 403, p. 853-858.
NOAA’S National Center for Environmental Information. https://www.ncei.noaa.gov/ Accessed on February 9, 2017.
OLIVEIRA JCF, PRALON E, COCO L, PAGOTTO RV & ROCHA CFD (2013) Environmental humidity and leaf-litter depth affecting ecological parameters of a leaf-litter frog community in an Atlantic Rainforest area. **Journal of Natural History**. DOI:10.1080/00222933.2013.769641
PIMENTA BVS, HADDAD CFB, NASCIMENTO LB, CRUZ CAG & POMBAL JP (2005) Comment on "Status and Trends of Amphibian Declines and Extinction Worldwide". **Science,** vol. 309 (5473).
STUART SN, CHANSON JS, COX NA, YOUNG BE, RODRIGUES ASL, FISCHMAN DL & WALLER RW (2004) Status and trends of amphibians declines and extinctions worldwide. **Science**, vol. 306, p. 1783-1786.
PIMENTA B (2005) Anfíbios**.** In: Schiavetti A, Leopoldino F, Paglia A, Pinto LP (Eds) Plano de Manejo do Parque Estadual da Serra do Conduru. BAHIA/ SEMARH – Secretaria de Meio Ambiente e Recursos Hídricos, 320 pp.
PIMENTA BVS & CARAMASCHI U (2007) New species of toad, genus *Frostius* Cannatella, 1986, from the Atlantic Rain Forest of Bahia, Brazil (Amphibia, Anura, Bufonidae). **Zootaxa**, vol. 1508, p. 61-68.
RIBEIRO-JÚNIOR MA, ROSSI RV, MIRANDA CL & ÁVILA-PIRES CS (2011) Influence of pitfall trap size and design on herpetofauna and small mammal studies in a Neotropical Forest. **Zoologia**, vol. 28, no. 1, p. 80-91.
RIBEIRO-JÚNIOR MA, GARDNER TA & ÁVILA-PIRES TCS (2008) Evaluating the effectiveness of herpetofaunal sampling techniques across a gradient of habitat change in a tropical forest landscape. **Journal of Herpetology**, vol. 42 (4), p. 733-749.

ROCHA CFD, SLUYS MV, ALVES MAS, BERGALLO HG & VRCIBRADIC D (2001). Estimates of forest flor litter frog communities: A comparison of two methods. **Austral Ecology**, vol. 26, p. 14-21.
RÖDEL MK & ERNST R (2004) Measuring and monitoring amphibian diversity in tropical forests. I. An evaluation of methods with recommendations for standardization. **Ecotropica**, vol. 10, no. 1, p. 1-14.
SÁ DF, ALMEIDA HA, SILVA LF & LEÃO AC (1982) Fatores edafo-climáticos ao zoneamento da cacaucultura no Sudeste da Bahia. **Revista Theobrama**, vol. 12 (3), p. 169-187.
SILVEIRA LF, BEISIEGEL BDM, CURCIO FF, VALDUJO PH, DIXO M, VERDADE VK, MATTOX GMT & CUNNINGHAM PTM (2010) What Use do Fauna Inventories Serve? **Estudos Avançados**, vol. 24, no. 68, p. 173-207.
STRAIN GF & RAESLY RL (2012) Amphibian Sampling Techniques along Maryland Coastal-Plain Streams. **Northeastern Naturalist,** vol. 2 (2), p. 229-248.
SZARO RC, SIMONS LH & BELFIT SC (1988) Comparative Effectiveness of Pitfalls and Live-Traps in Measuring Small Mammal Community Structure. In: Szaro, R.C., Severson, K.E.,Patton, D.R. (Eds.), **Management of Amphibians, Reptiles and Small Mammals in North America**. R.C. Proceedings of the Symposium, Flagstaff, Arizona, pp. 282–288.

AUTHOR CONTRIBUTIONS
KTV and VGDO designed the methodology; KTV and DRC conducted the samplings; KTV analyzed the data; KTV, DRC, VGDO and MS wrote the paper.

CONCLUSÕES

O método que apresentou maior abundância e riqueza de anfíbios foi o de armadilha de queda em disposição em linha com 50,38% dos indivíduos coletados e nove espécies de anfíbios de serrapilheira.

Recomendamos a escolha de métodos mistos, tanto ativo e passivo, na hora de fazer levantamento de fauna. Método ativo (transecto ou quadrante) e passivo (armadilha de queda disposição em linha) na realização de levantamento de espécies focados em anfíbios de serrapilheira. Quando o levantamento de espécies não estiver focado em um subgrupo da população, recomendamos a escolha do transecto como método de busca ativa, a armadilha em disposição em linha como método de busca passiva e complementar com outro método como as gravações das vocalizações para amostrar aquelas espécies que são mais difíceis de achar pelo coletor.

Nesta região da Mata Atlântica não recomendamos realizar amostragens diurnos por não ser vantajoso e só resultar em aumentos de gasto físico e econômico.

REFERÊNCIAS BIBLIOGRÁFICAS

AGUIAR; et al. Os Corredores Central e da Serra do Mar na Mata Atlântica brasileira. Em Mata Atlântica: biodiversidade, ameaças e perspectivas. Editores: Galindo-Leal C. e Câmara G. **Fundação SOS Mata Atlântica e Conservação Internacional**, 2003.

ALLMON, W. D. A plot study of forest floor litter frogs, Central Amazon, Brazil. **Journal of Tropical Ecology**, vol. 7, p. 503-522, 1991.

ANGULO, A. J. V; et al. Técnicas de inventario y monitoreo para los anfibios de la región tropical andina. Conservación Internacional. Serie Manuales de Campo Nº 2. **Panamericana Formas e Impresos S.A.**, Bogotá D.C. 298 pp., 2006.

BRUSCAGIN, R. T.; et al. Diversity of leaf-litter anurans in a fragmented landscape of the Atlantic Plateau of São Paulo State, southeastern Brazil. **Journal of Natural History**, vol. 48, p. 1-16, 2014.

BURROWES, P. A.; et al. Potential causes for amphibian declines in Puerto Rico. **Herpetologica**, vol. 60, no. 2, p. 141-154, 2004.

CARNAVAL, A.C.; et al. Stability predicts genetic diversity in the Brazilian Atlantic Forest hotspot. **Science**, vol. 323, p. 785–789; 2009.

CARNAVAL, A. C.; MORITZ C. Historical climate modelling predicts patterns of current biodiversity in the Brazilian Atlantic forest. **Journal of Biogeography**, vol. 35, p. 1187-1201, 2008.

CECHIN, S. Z.; MARTINS, M. Eficiência de armadilhas de queda (pitfall traps) em amostragens de anfíbios e répteis no Brasil. **Revista Brasileira de Zoologia**, vol. 17, no. 3, p. 729-740, 2000.

CONSERVATION INTERNATION DO BRASIL; et al. Avaliação e ações prioritárias para a conservação da biodiversidade da Floresta Atlântica e Campos Sulinos. **Brasília: MMA/SBF**, 2000.

COSTA, L. P.; et al. Biogeography of South American Forest Mammals: Endemism and Diversity in the Atlantic Forest. **Biotropica**, vol. 32, no. 4b, p. 872-881, 2000.

COSTA, H. C.; BÉRNILS, R. S. Répteis brasileiros: Lista de espécies. **Herpetologia brasileira**, vol. 3, no. 3, 2014.

CRUMP, M. L.; SCOTT, N. J. Standard techniques for inventory and monitoring: Visual encounter surveys. Pp. 84–92. Em W.R. Heyer, M.A. Donnelley, R.W. McDiarmid, L.C. Hayek, and M.S. Foster (Eds**.). Measuring and Monitoring Biological Diversity. Standard Methods for Amphibians,** Smithsonian Institution, Washington, DC. 364 pp.

DA SILVA, J. M. C.; CASTELETI, C. H. M. Status of the biodiversity of the Atlantic Forest of Brazil. P 43-59 em C. Galindo-Leal e I. de G. Câmara, editores. The Atlantic Forest of South America: biodiversity status, trends, and outlook. Center for Applied Biodiversity Science and Island Press, Washington, D.C. **SOS Mata Atlântica / Conservação Internacional**, 2003.

DIAS, I. R.; et al. Amphibians of Serra Bonita, southern Bahia: a new hotpoint within Brazil's Atlantic Forest hotspot. **ZooKeys**, vol. 449, p. 105-130, 2014.

GALINDO-LEAL, C.; CÂMARA, G. **Atlantic Forest hotspots status: an overview.** Pages 3-11 em C. Galindo-Leal e I. de G. Câmara, editors. The Atlantic Forest of South America: biodiversity status, threats, and outlook. Center for Applied Biodiversity Science and Island Press, Washington, D.C., 2003.

GIARETTA, A. A.; et al. Diversity and Abundance of Litter Frogs in a Montane Forest of Southeastern Brazil: Seasonal and Altitudinal Changes. **Biotropica**, vol. 31, no. 4, p. 669-674, 1999.

GIRAUDO, A. R. 2003. **Dynamics of biodiversity loss in the Argentinean Atlantic Forest: an introduction**. P 139-140 em C. Galindo-Leal e I. de G. Câmara, editores. The Atlantic Forest of South America: biodiversity status, threats, and outlook. Center for Applied Biodiversity Science and Island Press, Washington, D.C., 2003.

GREENBERG, C. H.; NEARY, D. G.; HARRIS, L. D. A Comparisson of Herpetofaunal Sampling Effectiveness of Pitfall, Single-ended and Double-ended Funnel Traps Used with Drift Fences. **Journal of Herpetology**, vol. 28, no. 3, p. 319-324, 1994.

GOTELLI, N. J.; COLWELL R. K. Quantifying biodiversity: procedures and pitfalls in the measurement and comparison of species richness. **Ecology Letters**, vol. 4, p. 379-391, 2001.

HADDAD, C. F; et al. **Guia dos Anfíbios da Mata Atlântica: diversidade e biologia**. Anolisbook, São Paulo, 544 p., 2013.

HEYER, W. R.; et al. **Measuring and monitoring biological diversity: Standart methods for Amphibians.** Smithsonian Institution Press, Washington, 1994.

HOFFMANN, M., et al. The impact of conservation on the status of the world's vertebrates. **Science**, vol. 330(6010), p. 1503-1509, 2010.

HOWELL, K. Amphibians and reptiles: the herptiles. Pp. 17–44. Em Davis, G., (ed.) 2002. African forest biodiversity. **A field survey manual for vertebrates**. Oxford, U.K., Earthwatch Institute (Europe), 161 pp, 2002.

HUANG, C.; et al. Rapid loss of Paraguay's Atlantic forest and the status of protected areas – a landsat assessment. **Remote Sensing of Environment**, vol. 106, p. 460-466. 2007.

KRAKER-CASTAÑEDA, C.; CÓBAR-CARRANZA, A. J. Uso de rarefacción para comparación de la riqueza de especies: el caso de las aves de sotobosque en la zona de influencia del Parque Nacional Laguna Lachuá, Guatemala. **Naturaleza y Desarrollo**, vol. 9, no. 1, 2011.

LIPS, K. R.; REASER J. K. El Monitoreo de Anfibios em América Latina. Um Manual para Coordinar Esfuerzos. **The Nature Conservancy**, 1999.

LIPS, K. R.; et al. Amphibian Population Declines in Latin America: A Synthesis. **Biotropica**, vol. 37, no. 2, p. 222-226, 2005.

MENDES, D. M.; et al. Drift fences in traps: theoretical evidence of effectiveness of the two most common arrays applied to terrestrial tetrapods. **Natureza & Conservação**, vol. 29, p. 1-7, 2015.

MINISTÉRIO DO MEIO AMBIENTE, CONSERVAÇÃO INTERNACIONAL, FUNDAÇÃO SOS MATA ATLÂNTICA. O corredor central da Mata Atlântica: uma nova escala de conservação da biodiversidade. **Ministério do Meio Ambiente; Conservação Internacional**, 2006.

MORELLATO, L. P. C.; HADDAD, C. F. B. Introduction: the Brazilian Atlantic forest. **Biotropica**, vol. 32, p. 786–792, 2000.

MYERS, N.; et al. Biodiversity hotspots for conservation priorities. **Nature**, vol. 403, p. 853-858, 2000.

OLIVEIRA, J. C. F.; et al. Environmental humidity and leaf-litter depth affecting ecological parameters of a leaf-litter frog community in an Atlantic Rainforest area. **Journal of Natural History**, 2013.

PARDINI, R. Effects of forest fragmentation on small mammals in a Atlantic Forest landscape. **Biodiversity and Conservation**, vol. 3, p. 2567-2586, 2004.

PERU-MINISTERIO DEL AMBIENTE. Guía de inventario de la fauna silvestre. Ministerio del Ambiente, Dirección General de Evaluación, Valoración y Finaciamiento del Patrimonio Natural. **MINIAM,** 83 p., 2015.

PIMENTA B (2005) Anfíbios**.** Em: Schiavetti A, Leopoldino F, Paglia A, Pinto LP (Eds) Plano de Manejo do Parque Estadual da Serra do Conduru. B**AHIA/ SEMARH – Secretaria de Meio Ambiente e Recursos Hídricos**, 320 pp.

POUNDS, J. A. Climate and amphibian declines. **Nature**, vol. 410, p. 639-640, 2001.

POUNDS, J. A.; et al. Widespread amphibian extinctions from epidemic disease driven by global warming. **Nature**, vol. 403, p. 853-858, 2006.

PRUM, R. Historical relationships among avian forest areas of endemism in the neotropics. **Proceedings of the International Ornithological Congress**, vol. 19, p. 2562–2572, 1988.

RIBEIRO, M. C.; et al. The Brazilian Atlantic Forest: How much is left, and how is the remaining forest distributed? Implications for conservation**. Biological Conservation**, vol. 142, p. 1141–1153, 2009.

RIBEIRO-JÚNIOR M. A.; et al. Evaluating the effectiveness of herpetofaunal sampling techniques across a gradient of habitat change in a tropical forest landscape. **Journal of Herpetology**, vol. 42 (4), p. 733-749, 2008.

ROCHA, C. F. D.; et al. Estimates of forest floor litter frog communities: A comparison of two methods. **Austral Ecology**, vol. 26, p. 14-21, 2001.

RÖDEL M. K., ERNST R. (Measuring and monitoring amphibian diversity in tropical forests. I. An evaluation of methods with recommendations for standardization. **Ecotropica**, vol. 10, no. 1, 2004.

SCHMIDT, B. R. Count data, detection probabilities, and the demography, dynamics, distribution, and decline of amphibians. **Comptes Rendus Biologies**, vol. 326, p. 119–124, 2003.

SEGALLA, M. V.; et al. Brazilian amphibians: List of species. Sociedade Brasileira de Herpetologia. **Herpetologia Brasileira**, vol. 5, no. 2, 2016.

SILVA, J. M. C.; et al. Areas of endemism for passerine birds in the Atlantic Forest. **Global Ecology and Biogeography**, vol. 13, p. 85–92, 2004.

SILVANO, D. L.; PIMENTA, B. V. S. Diversidade e distribuição de anfíbios na Mata Atlântica do Sul da Bahia. **Diversidade e distribuição de anfíbios na Mata Atlântica do Sul da Bahia.** Prado P.I., Landau E.C., Moura R.T., Pinto L.P.S., Fonseca G.A.B., Alger K. (orgs.) Corredor de Biodiversidade na Mata Atlântica do Sul da Bahia. CD-ROM, Ilhéus, IESB/CI/CABS/UFMG/UNICAMP.

STRAIN, G. F.; RAESLY R. L. Amphibian Sampling Techniques along Maryland Coastal-Plain Streams. **Northerstern Naturalist**, vol. 19, no. 2, p. 229-248, 2012.

STUART, S. N.; et al. Status and trends of amphibians declines and extinctions worldwide. **Science**, vol. 306, p. 1783-1786, 2004.

TABARELLI, M.; et al. Challenges and Opportunities for Biodiversity Conservation in the Brazilian Atlantic Forest. **Conservation Biology**, vol. 19, no. 3, p. 695-700, 2005.

TESSARO, S. G.; GONZÁLEZ C. L. Manual de Técnicas para el estudio de la Fauna. **Universidade Autónoma de Querétaro/ Instituto de Ecología**, A. C., 2011.