Conservation Biology

Contributed Paper

Two-Stage Recovery of Amphibian Assemblages Following Selective Logging of Tropical Forests

GILBERT BAASE ADUM,* MARKUS PETER EICHHORN,† WILLIAM ODURO,* CALEB OFORI-BOATENG,*‡ AND MARK-OLIVER RÖDEL§

*Department of Wildlife and Range Management Faculty of Renewable Natural Resources, CANR, KNUST, Kumasi, Ghana
†School of Biology, The University of Nottingham, University Park, Nottingham NG7 2RD, United Kingdom
‡Forestry Research Institute of Ghana, KNUST, P.O. Box 63, Kumasi, Ghana
§Museum für Naturkunde, Berlin, Leibniz Institute for Research on Evolution and Biodiversity, Invalidenstrasse 43, 10115 Berlin, Germany

Abstract: *There is a lack of quantitative information on the effectiveness of selective-logging practices in ameliorating effects of logging on faunal communities. We conducted a large-scale replicated field study in 3 selectively logged moist semideciduous forests in West Africa at varying times after timber extraction to assess post logging effects on amphibian assemblages. Specifically, we assessed whether the diversity, abundance, and assemblage composition of amphibians changed over time for forest-dependent species and those tolerant of forest disturbance. In 2009, we sampled amphibians in 3 forests (total of 48 study plots, each 2 ha) in southwestern Ghana. In each forest, we established plots in undisturbed forest, recently logged forest, and forest logged 10 and 20 years previously. Logging intensity was constant across sites with 3 trees/ha removed. Recently logged forests supported substantially more species than unlogged forests. This was due to an influx of disturbance-tolerant species after logging. Simultaneously Simpson's index decreased, with increased in dominance of a few species. As time since logging increased richness of disturbance-tolerant species decreased until 10 years after logging when their composition was indistinguishable from unlogged forests. Simpson's index increased with time since logging and was indistinguishable from unlogged forest 20 years after logging. Forest specialists decreased after logging and recovered slowly. However, after 20 years amphibian assemblages had returned to a state indistinguishable from that of undisturbed forest in both abundance and composition. These results demonstrate that even with low-intensity logging (≤3 trees/ha) a minimum 20-year rotation of logging is required for effective conservation of amphibian assemblages in moist semideciduous forests. Furthermore, remnant patches of intact forests retained in the landscape and the presence of permanent brooks may aid in the effective recovery of amphibian assemblages.*

Keywords: faunal recovery, frogs, Ghana, logged forest, reduced-impact logging

Recuperación de Ensambles de Anfibios en Dos Etapas Después de la Tala Selectiva de Bosques Tropicales

Resumen: *Existe una carencia de información cuantitativa sobre la efectividad de prácticas de tala selectiva en la disminución de los efectos de la tala sobre comunidades de fauna. Realizamos un estudio de campo replicado a gran escala en 3 bosques húmedos semideciduos talados selectivamente en África Occidental en diferentes tiempos después de la extracción de madera para evaluar los efectos posteriores a la tala sobre ensambles de anfibios. Específicamente, evaluamos si la diversidad, abundancia y composición del ensamble de anfibios cambiaron en el tiempo en las especies dependientes del bosque y en las tolerantes a la perturbación del bosque. En 2009 muestreamos anfibios en 3 bosques (un total de 48 parcelas de estudio, de 2 ha cada una) en el suroeste de Ghana. En cada bosque, establecimos parcelas en bosque no perturbado, bosque recientemente talado y bosque talado 10 y 20 años antes. La intensidad de la tala fue constante en los sitios, con la remoción de 3 árboles/ha. Los bosques recientemente talados soportaron sustancialmente mas especies que los bosques no talados. Estos se debió a la afluencia, después de la tala, de especies tolerantes*

email adumgilbert@gmail.com
Paper submitted December 1, 2011; revised manuscript accepted August 11, 2012.

DOI: 10.1111/cobi.12006

a la perturbación. Simultáneamente, el índice de Simpson decreció debido a la reducción en la dominancia de unas cuantas especies. A medida que incrementó el tiempo desde la tala, la riqueza de especies tolerantes a la perturbación decreció hasta 10 años después de la tala cuando su composición fue indistinguible de la composición de los bosques no talados. El índice de Simpson incrementó con el tiempo desde la tala y fue indistinguible del bosque no talado 20 años después de la tala. Los especialistas de bosque decrecieron después de la tala y se recuperaron lentamente. Sin embargo, después de 20 años los ensambles de anfibios habían regresado a un estado no distinguible de los de bosque no perturbado, tanto en abundancia como composición. Estos resultados demuestran que aun con tala de baja intensidad (≤3) árboles/ha), se requiere una rotación de 20 años mínimo para la conservación efectiva de los ensambles de anfibios en bosques húmedos semideciduos. Más aun, los parches remanentes de bosques intactos en el paisaje y la presencia de arroyos permanentes pueden ayudar a la recuperación efectiva de los ensambles de anfibios.

Palabras Clave: Bosque talado, extracción de madera de impacto reducido, Ghana, ranas, recuperación de fauna

Introduction

Logging remains the most significant threat to tropical forests and contributes substantially to its continued degradation (Meijaard et al. 2005; FAO 2010). It is estimated that of the remaining 9 million km^2 of primary forest worldwide 50,000–70,000 km^2 are logged annually, and this figure could be higher because illegal logging activities often go unnoticed or undocumented (Hansen & Treue 2008). At these rates, by the year 2050 only about 10% of extant, undisturbed forests may remain (Sodhi & Ehrlich 2010). Already, even by the most generous estimates, West Africa retains only about 1.5% of its primary forest, and most of these have been logged to some degree (Norris et al. 2010).

What now remains in West African countries, and perhaps represents the future of most tropical countries, are forests regenerating after logging (Sodhi & Ehrlich 2010; Gibson et al. 2011; Edwards et al. 2012). Although the conservation value of these regenerating tropical forests is recognized (Vandermeer & Perfecto 1997; Gascon et al. 1999), more studies are required to fully understand recovery of faunal communities within them (Edwards et al. 2009, 2010). With a few exceptions, researchers focusing on amphibian recovery after logging have not considered the time required for the diversity or assemblages to recover to their former state. Fredericksen and Fredericksen (2004) and Vallan et al. (2004) concluded there was either no change or that communities recovered within 1–4 years following selective logging. In contrast, Ernst et al. (2006) found that recovery of amphibian communities in humid evergreen forests in Guyana, South America, and Ivory Coast, West Africa, did not occur even 30 years after selective logging ceased. Although patterns of assemblage composition have been analyzed, usually ecologically distinct groups were combined as a single entity, which treats all taxonomic species as equivalent. This practice can lead to obscured cause-and-effect relations because, for example, different amphibian groups have different responses to anthropogenic disturbance (Ernst & Rödel 2005, 2006, 2008), which can lead to spurious results when combined in multicommunity analyses (Jost et al. 2011). In such studies, it is, therefore, important to treat particular amphibian groups separately to accurately detect trends in diversity metrics (Ernst & Rödel 2008). We selected West African leaf-litter frogs as models because they are especially sensitive to alterations of forest structure (Ernst & Rödel 2005; Ernst et al. 2006; Ofori-Boateng et al. 2012).

We conducted large-scale, replicated field studies in 3 West African forests. We determined differences in diversity and abundance of amphibians and amphibian assemblage composition (forest-dependent species characteristic of intact forests versus species tolerant of disturbance) over time in logged and unlogged sites. In systems with low levels of natural disturbance, species richness typically increases following disturbance as disturbance-tolerant species colonize the area (Connell 1978). Species richness levels are, however, largely determined by the numbers of uncommon species and can disguise changes in the evenness of communities. We, therefore, expected to see a rise in species richness with disturbance and a decrease in the value of diversity indices that incorporate relative abundance because a smaller number of species would become dominant (Hill 1973; Magurran 1988). Given the large changes expected in species composition, we could not predict potential effects of logging on overall amphibian abundance. In terms of assemblage structure, we hypothesized that forest-dependent species decline following initial disturbance due to unfavorable microclimatic conditions. In general, logged forests comprise a partly open canopy and contain roads and trails used to transport logs. Because roads may act as conduits for disturbance-tolerant species, we assumed nonforest species would invade and establish in opened forest habitats (Meijaard et al. 2005; Hillers et al. 2008; Furlani et al. 2009). Conversely, because recovering forests tend to resemble mature forests over time, the microclimatic conditions that once favored disturbance-tolerant species diminish and make these species unable to cope with the change (Vallan 2002), whereas forest-dependent species may recover.

Our study represents an advance because we simultaneously considered 3 different logging concessions with a number of stands of known time since timber extraction, replicated both within and among concessions. We sought to assess the ability of amphibian assemblages to recover in logged forests and to evaluate the efficacy of reduced-impact logging in maintaining such assemblages.

Methods

Study Area

We worked in 3 commercially logged forest reserves (FRs) in the tropical forest region of southwestern Ghana: Suhuma Forest Reserve, Krokosua Hills, and Sui River (Fig. 1). All 3 reserves are moist, semideciduous forest (Hawthorne & Abu-Juam 1995). Trees in this forest type are generally taller (50–60 m) than those of other Ghanaian forest types. Annual rainfall is 1200–1800 mm (Hall & Swaine 1981). There are 2 rainfall peaks, one between May and June and the other between September and October, and the dry season is from November to March. Suhuma FR is 359 km^2, Krokosua Hills is 481.7 km^2, and Sui River is 333.9 km^2. Large areas of the reserves have been logged and are still being logged. All 3 reserves have an undulating topography with steep slopes (Hawthorne & Abu-Juam 1995). Krokosua Hills and Sui River FRs had the highest levels of disturbance to vegetation. The degraded areas were larger than in Suhuma and were characterized by highly compacted soil and secondary growth, often dominated by the invasive Siam weed (*Chromolaena odorata*) (Ernst et al. 2008; Adum et al. 2011).

Logging History

We obtained data on logging histories from the Ghana Forestry Commission. All 3 forests were subjected to similar felling strategies of selective logging, including recent slight modifications to reduced-impact logging. Logging intensity was constant across all sites with 3 trees/ha removed. A 40-year felling cycle has also been in force, at least within the 20 years preceding our study.

Logging concessions were subdivided into compartments within the confines of which selective-logging activities were carried out. Different compartments within a concession were logged in different years. The size of a standard compartment was 128 ha. We established sampling plots in 12 compartments on the basis of their logging histories. There were 4 compartments in each concession: recently logged (<2 years), with logging ongoing in neighboring areas; logged 10 (L10) or 20 years (L20) before our study; and unlogged (i.e., never commercially logged). Unlogged areas were all allocated for future logging. We established 4 2-ha plots within each logging-history category and had 48 plots in the 3 forests. Thus, the study area in each forest was 32 ha (96 ha total). To minimize spatial autocorrelation, all plots were separated by at least 1.8 km (Ernst & Rödel 2005; Hillers et al. 2008).

Sampling Methods

We (G.B.A. and 2 assistants) surveyed amphibians during daylight from January through December 2009 in wet and dry seasons. We visited each plot 5 times with a constant sampling intensity of 3 h/visit for a total of 720 h of sampling. The average time between visits to plots was 2 months. We sampled species occurrence by visually scanning the vegetation and ground and by lifting objects such as rocks, logs, and debris while listening for calls (Rödel & Ernst 2004). Frogs that were seen were captured and sexed and their body lengths were measured. To allow for evaluation of correct species determination in the field, we collected 2 individuals of each species, euthanized them in chlorobutanol solution, and preserved them in 75% ethanol. We deposited vouchers in the Wildlife Museum of the Kwame Nkrumah University of Science and Technology, Ghana, and in the Museum für Naturkunde, Berlin, Germany.

We assigned each species to 1 of 2 broad habitat groups on the basis of Rödel and Ernst (2004), Ernst et al. (2006), Hillers et al. (2008), Penner et al. (2011), Ofori-Boateng et al. (2012), and references cited in these publications. Forest specialists were species dependent on relatively undisturbed forest habitats. Nonforest specialists (henceforth disturbance tolerant) were defined as species that predominantly occur in savanna-like habitats but also colonize disturbed (opened) forest and farmbush (i.e., shrubby secondary growth).

Statistical Analyses

We calculated species' detectability to assess whether systematic variation in our ability to find particular species may have biased our results. For each species across all 5 visits to any single plot, we used a maximum-likelihood estimator (for details see Wintle et al. 2004).

Three measures of diversity were calculated following the recommendations of Tuomisto (2010) and Hill (1973). We estimated species richness with the bias-corrected version of the Chao1 estimator (Chao 2005) and the exponential of Shannon's entropy (H) with the Horvitz–Thompson estimator and sample-coverage method (Chao & Shen 2003). We calculated the inverse of Simpson's diversity (D) with a maximum-likelihood estimator (Magurran 1988). Following Hill (1973), we interpreted exp(H) as equivalent to the number of common species and $1/D$ as the number of highly abundant species. We considered species richness to reflect the number of rare or uncommon species. These 3 estimates

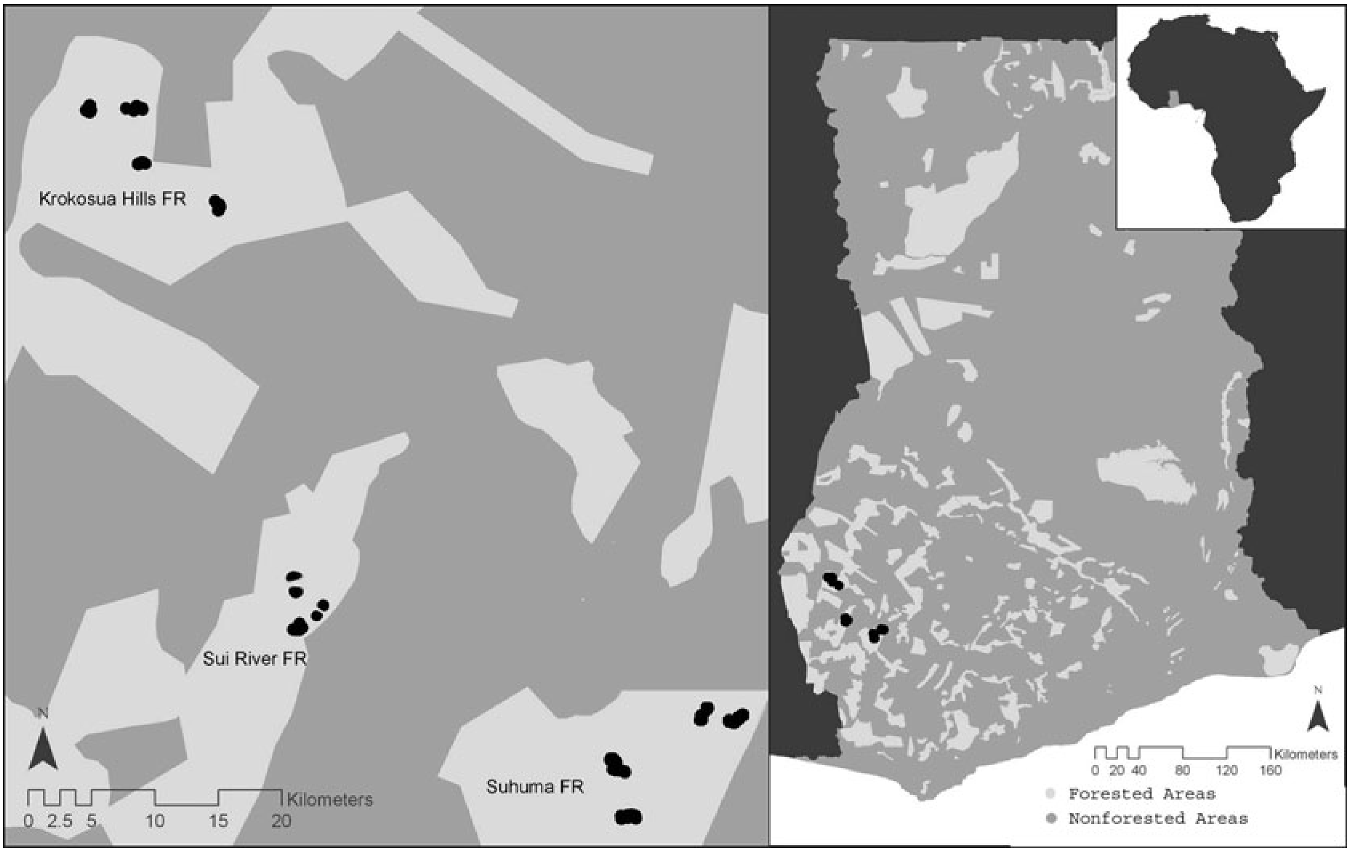


Figure 1. Locations of study sites within Ghana (right map) and forest reserves (FR), Krokosua Hills, Sui River, and Suhuma, and exact locations of amphibian sampling sites (dots) in these forests (left map).

scale linearly and allow for direct statistical comparisons between assemblages (Hill 1973). Because they reflect number equivalents, we regarded them as "true" diversity (Jost 2006, 2007). Diversity statistics were calculated in SPADE (Chao & Shen 2010). Statistics by site are presented in tables, whereas statistics per plot were used in comparative analyses.

We compared assemblage structures among logging regimes with nonmetric multidimensional scaling (NMDS) via the Bray–Curtis similarity index in CAP (Henderson & Seaby 2007). For comparative purposes, we conducted an analysis of similarities (ANOSIM) (see Supporting Information for full details). All assemblage analyses were run for the whole community as well as separately for disturbance-tolerant and forest specialists, respectively. All other analyses were conducted in R 2.15.0 (R Development Core Team 2012). We used multivariate analysis of variance (MANOVA) to test for variation in species composition between sites, with time since logging as a nested effect within sites. We used a posteriori contrasts to identify significant differences among logging histories or concessions. Statistical results are presented on the basis of minimum adequate models with grouping of factor levels where appropriate.

Results

We recorded 8267 individuals of 24 anuran species (Supporting Information). Eleven were forest-dependent species, and 13 were disturbance-tolerant species. Three forest species, Krokosua Squeaker (*Arthroleptis krokosua*), Western long-fingered frog (*Cardioglossa occidentalis*), and snouted ridged frog (*Ptychadena longirostris*), were recorded only in logged areas. Other forest species recognized as threatened by IUCN, including Villier's puddle frog (*Phrynobatrachus villiersi*; vulnerable) and Ivory Coast frog (*Hylarana occidentalis*; endangered) were found in nearly equal numbers in both logged and unlogged forests (Supporting Information). In contrast, we recorded species that naturally occur in savanna, such as flat-backed toad (*Amietophrynus maculatus*), African toad (*Amietophrynus regularis*), African tiger frog (*Hoplobatrachus occipitalis*), and Accra puddle frog (*Phrynobatrachus latifrons*) only in logged forests.

Detectability across species was on average 28%. Although there was significant variability among species in their detectability ($F_{23,127} = 15.4, p < 0.001$), there was no overall difference among sites ($F_{2,127} = 1.1, p = 0.336$) or logging histories nested within sites ($F_{9,127} = 1.1,$

Table 1. Characteristics of amphibian communities in unlogged or recently logged forests and 10 or 20 years postlogging in 3 concessions.[a]

Time since logging	Location	n	S_{obs}	$\hat{S}$ (CI)[b]	exp(H) (CI)	1/D (CI)
Unlogged	Suhuma	725	10	11.0 (10.1–24.0)	5.67 (2.95–8.39)	4.82 (4.25–5.38)
Unlogged	Krokosua	692	11	11.0	5.92 (3.61–8.22)	4.69 (4.19–5.19)
Unlogged	Sui	671	11	11.0	6.20 (3.82–8.57)	4.90 (4.42–5.38)
Recently logged	Suhuma	728	15	15.0	4.33 (3.88–4.79)	2.30 (1.70–2.91)
Recently logged	Krokosua	832	15	15.0	5.29 (4.80–5.78)	2.89 (2.42–3.35)
Recently logged	Sui	758	19	19.0	5.04 (2.82–7.27)	2.50 (1.96–3.04)
10 years	Suhuma	556	12	12.0	4.91 (4.42–5.39)	3.02 (2.54–3.50)
10 years	Krokosua	469	16	16.0	3.98 (3.48–4.48)	2.27 (1.53–3.00)
10 years	Sui	602	13	13.0	5.48 (4.97–5.99)	3.41 (2.94–3.88)
20 years	Suhuma	938	12	12.5 (12.0–20.3)	6.14 (3.24–9.04)	5.31 (4.74–5.88)
20 years	Krokosua	471	11	11.5 (11.0–19.3)	4.39 (2.14–6.65)	2.97 (2.31–3.63)
20 years	Sui	825	14	14.0	6.49 (3.75–9.22)	5.16 (4.63–5.68)

[a]*Key: n, abundance, and S_{obs}, observed species richness, are for overall collections at each site; $\hat{S}$, estimated species richness; exp(H), exponential of Shannnon's entropy H; 1/D, inverse of Simpson's diversity index; CI, confidence interval.*
[b]*Confidence intervals are intractable when $S_{obs} = \hat{S}$.*

$p = 0.382$). No significant interactions among these main effects occurred, indicating that individual species were equally likely to be recorded in all sampling locations. Thus, we concluded our data on amphibian assemblages were unlikely to be systematically biased. Sampling was nearly complete for all sites as shown by the close correspondence between observed and estimated species richness (Table 1).

Diversity Patterns

The observed species richness differed among sites with different logging histories ($F_{9,36} = 2.70$, $p = 0.02$). Recently logged forests contained a greater number of species (Fig. 2a). The observed species richness did not differ among concessions ($F_{2,36} = 0.54$, $p = 0.59$). Estimated species richness was slightly higher in recently logged forests, although the effect was not significant ($F_{9,36} = 2.04$, $p = 0.06$). Estimated species richness did not differ among concessions ($F_{2,36} = 0.46$, $p = 0.64$). The exponent of Shannon entropy (exp[H]) did not differ with time since logging ($F_{9,36} = 0.64$, $p = 0.76$) or among concessions ($F_{2,36} = 2.34$, $p = 0.11$). There were, however, significant differences in diversity between logged and unlogged sites as measured by the inverse of Simpson's index ($1/D$) ($F_{9,36} = 2.68$, $p = 0.02$). This measure of diversity increased as time since logging increased (Fig. 2b). Significant location effects occurred ($F_{2,36} = 3.53$, $p = 0.04$); Krokosua had lower diversity than either Suhuma or Sui (Tukey's HSD, $p < 0.05$).

Abundance Patterns

Overall abundance of amphibians was unaffected by logging ($F_{9,36} = 2.02$, $p = 0.07$) or concession ($F_{2,36} = 1.52$, $p = 0.23$). There were no overall differences in abundance of disturbance-tolerant species among concessions ($F_{2,36} = 2.00$, $p = 0.14$) or logging histories ($F_{9,36} = 0.06$ (Fig. 2c), although abundance of disturbance-tolerant species was substantially lower in sites logged 10 years previously than in recently logged sites. Abundance of forest-dependent amphibians differed significantly among concessions ($F_{2,36} = 12.66$, $p < 0.001$); Krokosua contained fewer individuals than Suhuma (Tukey's HSD, $p < 0.05$). There were also significant differences among logging treatments ($F_{9,36} = 13.36$, $p < 0.001$). Abundance of forest-dependent species was significantly lower in recently logged forests and forests logged 10 years previously relative to abundance in forests logged 20 years previously or unlogged. There was an approximate 2-fold increase in abundance of forest-dependent amphibians from 10 to 20 years postlogging (Fig. 2d).

Assemblage Analyses

The NMDS analyses of all amphibians extracted 2 main components (2D stress = 0.15). There were significant differences among the logging histories (MANOVA $F_{6,39} = 3.61$, $p = 0.003$) (Fig. 3a), which suggests a gradient of recovery as time since logging increased. A posteriori contrasts indicated there was no difference in species composition between unlogged forests and forests surveyed 20 years after timber extraction. All other comparisons among logging histories were significant. There was no variation in overall amphibian composition among concessions ($F_{2,39} = 1.62$, $p = 0.18$).

The NMDS analyses for disturbance-tolerant species again extracted 2 components (2D stress = 0.14). Composition of disturbance-tolerant species differed significantly among logging histories ($F_{3,42} = 4.17$, $p = 0.001$; Fig. 3b), although in this case the effect was driven by a distinct assemblage occurring in recently logged forests. There was no variation in disturbance-tolerant species among recovering or intact forests. The pattern, therefore, suggests that this fraction of the assemblage reverted to baseline levels 10 years after logging (cf. Fig. 2c). There were no differences among concessions ($F2_{,42} = 1.33$, $p = 0.27$).

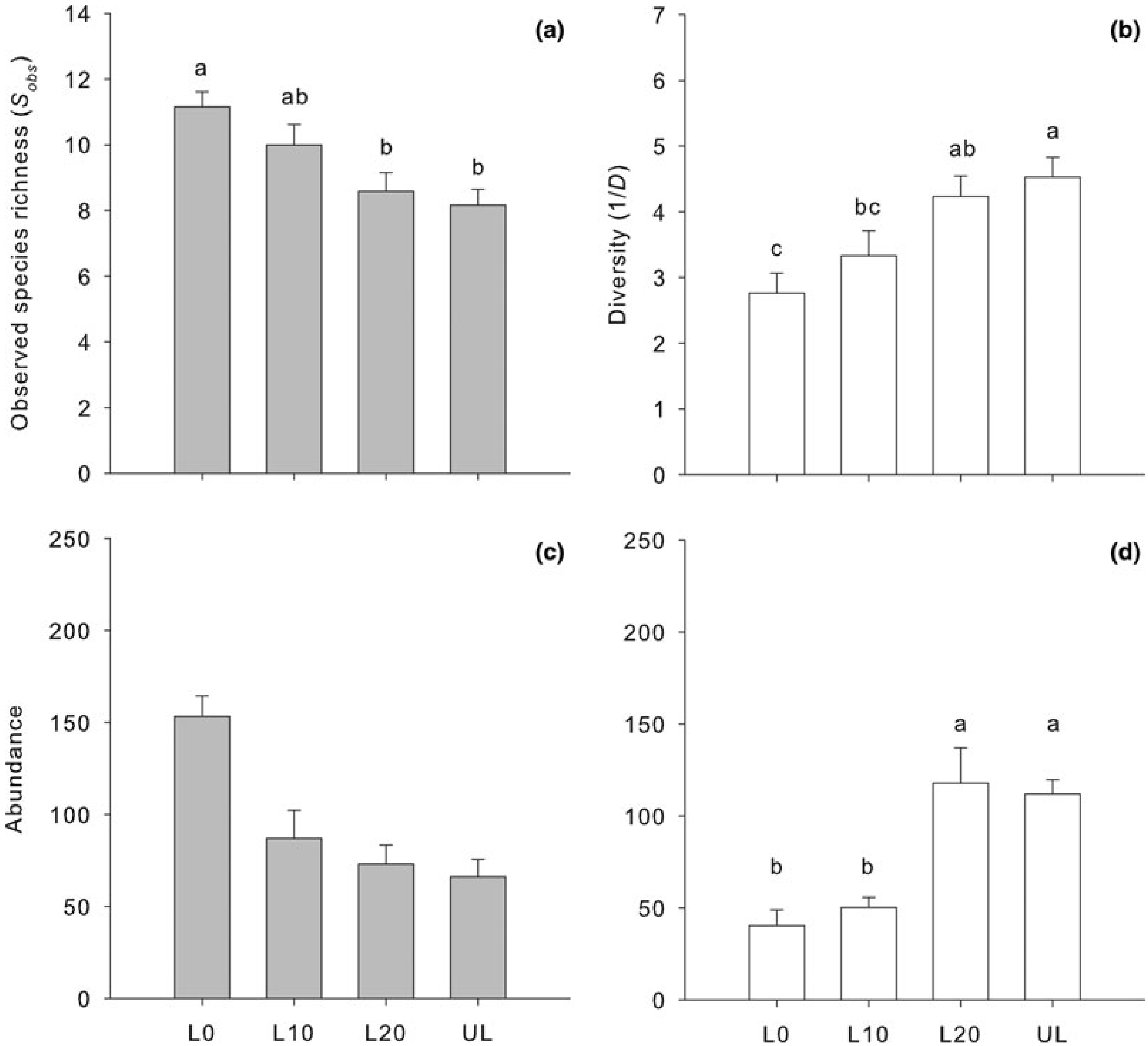


Figure 2. Characteristics of amphibian communities in forests that were logged recently (L0), logged 10 (L10), and 20 (L20) years previously, or unlogged (UL): mean (SE) (a) observed species richness (S_{obs}) per plot, (b) Simpson's diversity (1/D) per plot, and overall abundance of amphibian community fractions of either (c) disturbance-tolerant species or (d) forest-dependent species. Bars with different letters indicate significant differences (Tukey's HSD, $p < 0.05$).

Assemblages of forest-dependent amphibians (NMDS 2D stress = 0.08) differed significantly among logging histories ($F2{,}_{44} = 7.14$, $p < 0.001$) (Fig. 3c) but did not differ significantly between recently logged forests and forests 10 years after logging or between unlogged forests and forests 20 years after logging. This indicated that 20 years after logging the composition of forest-dependent species had returned to a state that was indistinguishable from unlogged forest. Assemblages of forest-dependent species varied among concessions ($F1{,}_{44} = 7.14$, $p = 0.002$) because of the overall difference in this fraction of the amphibian assemblage in Krokosua. The analyses conducted with ANOSIM had qualitatively identical results (Supporting Information).

Discussion

Our results provide insight into the recovery of amphibian assemblages following logging as we conducted sampling at known times since the most recent felling took place. We found that recovery occurred in 2 phases: an initial reduction in disturbance-tolerant species followed by eventual recovery of forest-dependent species.

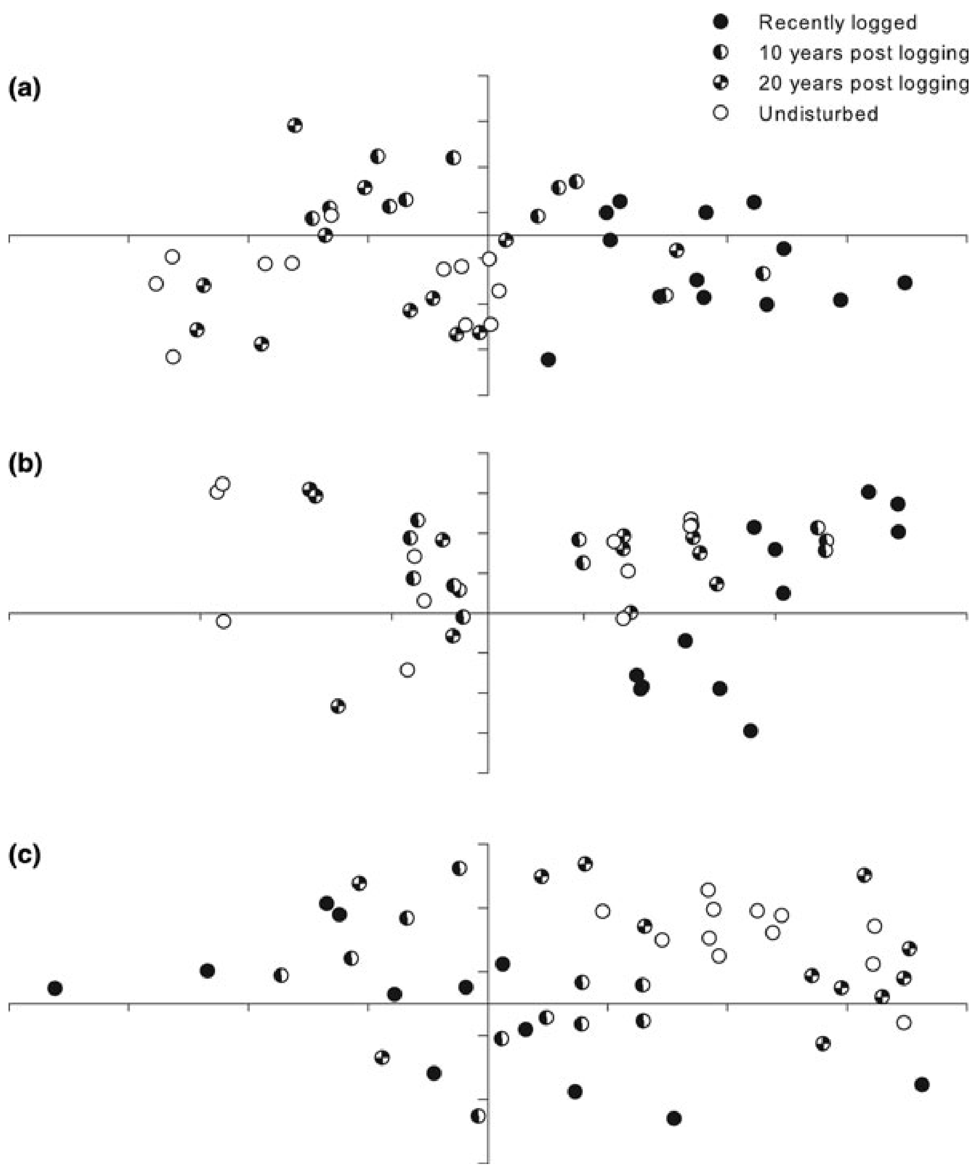


Figure 3. Nonmetric multidimensional scaling plots of amphibian communities for (a) all species combined, (b) disturbance-tolerant species, and (c) forest-dependent species.

Sites with different logging histories varied markedly in species richness, and the number of species in recently logged forests were substantially higher than in unlogged forests. This is mostly due to an influx of disturbance-tolerant species following the opening of the forests. Simpson's index of diversity, by contrast, increased with time since logging, which indicates that species richness and abundance relations returned to a prelogging state 20 years after logging. When considered alongside the reduction in species richness and stability of Shannon's Index, this implies that within the community there was a reduction in the dominance of a small number of highly abundant species over time. Such a pattern is common across a wide range of taxonomic groups (Wright & Muller-Landau 2006) because disturbance enables colonization of species not normally found in intact forests and decreases the evenness of communities.

By splitting the assemblage into 2 groups with respect to forest specialization, we could discern how each group responded relative to the overall response to logging of the entire anuran assemblage. Species characteristic of disturbed areas increased around 50% in overall abundance after logging, and the composition of this fraction of the community was markedly altered. It reverted to baseline levels 10 years after logging. Forest-dependent species were dramatically reduced in number after logging and this led to an approximately 3-fold numerical dominance by disturbance-tolerant species. The forest-dependent species took longer to recover, but 20 years after logging their abundance and composition had returned to a state indistinguishable from that of undisturbed forest.

One explanation for the observed patterns is that the forest-dependent species remained present in logged forests, albeit in a community dominated by disturbance-tolerant species such as some toads (*A. maculatus, A. regularis),* puddle frogs (*Phyrnobatrachus latifrons, Phrynobatrachus calcaratus*), tiger frogs (*H. occipitalis*), and ridged frogs (*Ptychadena bibroni, Ptychadena longistroris*). Vallan et al. (2004) also recorded a shift in species composition 4 years after logging in a tropical rainforest in eastern Madagascar; species characteristic of pristine forests were numerically dominated by species adapted to disturbed forests. A similar shift was observed in forest fragments older than 10 years in Taï National Park, Ivory Coast (Hillers et al. 2008), which is located within the same ecoregion as our study site.

At all our logged sites, 3 trees/ha were removed, and this low level of removal may account for the effective recovery of amphibian assemblages within 20 years. In Guyana and Ivory Coast, amphibian assemblages did not recover to their former levels 30 years after logging when 19.5 trees/ha were removed or when an unknown number of trees were removed, respectively (Ernst & Rödel 2005; Ernst et al. 2006). Such differences in recovery rates could result from differences in the ecological requirements of the frogs and the particular forest type (Ofori-Boateng et al. 2012). The studies in Guyana and Ivory Coast considered entire frog assemblages (Ernst et al. 2006) and took place in humid evergreen forests (Ernst & Rödel 2005; Ernst et al. 2006). Results of some studies in Southeast Asia, although conducted in intensively logged forests, were consistent with our results. Twenty years after logging at a removal level of approximately 41 trees/ha in twice-logged forests, sites harbored over 75% of dung beetle and bird species that occur in unlogged forests (Edwards et al. 2010). In another study, where logging intensity was 27 trees/ha, 15 years after logging species richness and diversity of birds in a rehabilitated forest were similar to species richness and diversity in an unlogged forest, and they were higher in both these sites than in a forest left to recover through natural processes (Edwards et al. 2009). Furthermore, species richness and diversity of 11 taxonomic groups of more than 2500 species, including amphibians, were comparable in logged forest and primary forest 19 years after logging (Berry et al. 2010).

A growing body of evidence suggests that many species can persist after timber extraction (Gibson et al. 2011; Edwards et al. 2012; Putz et al. 2012). Our results are consistent with this theory and provide evidence that selectively logged forests retain many of their species. Furthermore, the recovery of the original assemblage occurred within 20 years, the average rotation time for these forests. Thus, current felling strategies seem compatible with the conservation of amphibian communities in West African semideciduous forests, at least when they are based on very low logging intensities (≤3 trees/ha). However, there is evidence that logging in Ghanaian forests on a 20-year rotation is not sustainable for timber production, and rotations exceeding 40 years are required (Hawthorne et al. 2012). There is no information on the effects of successive harvesting on amphibians, and future surveys will be required to ensure that successive rotations do not have a cumulative impact. At present repeat harvesting has only occurred in a small proportion of Ghana's forests.

Another landscape feature that potentially aided in the recovery of amphibian assemblages is the small geographic distance between forests of different logging histories (including unlogged) (Lindenmayer et al. 2012) and in particular the presence of permanent brooks that traverse both logged and unlogged forests. The species we recorded comprised a large subset of forest- and stream-dependent species and included the puddle frogs *Phrynobatrachus liberiensis*, *Phrynobatrachus alleni*, *Phrynobatrachus annulatus, Phrynobatrachus plicatus*, *P. villiersi*, and *H. occidentalis*. In addition, apart from squeaker frogs (*Arthroleptis* sp.), which currently is a species complex that cannot be distinguished, 2 stream-dependent frogs, Peter's puddle frog (*Phrynobatrachus calcaratus*) and white-lipped Frog (*Hylarana albolabris*), were the most commonly recorded disturbance-tolerant species in both logged and unlogged areas. These 2 species require high humidity and often live close to rivers. Based on these observations and those of other studies (Fredericksen & Fredericksen 2004; Ficetola et al. 2008), we suggest these brooks or streams facilitated migration of species between logged and unlogged forest. This facilitated movement may have enhanced the recovery of amphibian assemblages.

Tropical forest managers, governments, and conservation biologists have been grappling with the issue of designing logging practices that are compatible with conservation and sustainable timber production. Of particular interest has been determining an optimum period that allows natural regeneration to occur after logging (Chapman & Chapman 2004; Sodhi & Ehrlich 2010). Most logging rotations are established without prior knowledge of the resilience of forest communities (Sodhi & Ehrlich 2010). Our results show that for effective management of amphibian assemblages in logged forests, concessions should be managed on a minimum 20-year rotation.

Furthermore, parameters such as low logging intensity (≤3 trees/ha), remnant patches of intact forests retained in the landscape, and presence of permanent brooks should be considered because they may aid in the recovery of amphibian assemblages. Because there is a shift toward habitat generalists during the first 10 years following logging, this period should be considered critical for the protection of forest specialists because any additional ecological threats could delay the recovery of species. Loss of genetic diversity has been reported in amphibian populations 3–9 years following logging (Curtis & Taylor 2004). Nevertheless, our results show that, although sensitive to disturbance, forest-dependent frog species are able to recover if forests are left undisturbed long enough and may be useful indicators of the resilience of amphibian communities (Rödel & Ernst 2004; Rödel et al. 2005). That Adum et al. (2011) recorded the highest number of the endangered endemic forest species *A. krokosua* since its discovery further underscores the conservation value of logged forests for some forest species. These discoveries are positive indications that logged forests can play a significant role in safeguarding the habitats of some forest species. Overall, we see hope for the future of conservation in West African forests that have been subjected to defaunation, especially in the last 2 decades. At least some portion of the surviving fauna can apparently recover when forests are subsequently left undisturbed. This therefore adds to the case for preserving logged forests alongside undisturbed forests.

Acknowledgments

This project has been funded by the Department for Environment, Food and Rural Affairs Darwin Initiative, which draws on the wealth of biological diversity expertise within the United Kingdom to help protect and enhance biological diversity around the world. It received special assistance from the following people of the Zoological Society of London Wildlife Wood Project: C. Ransom, N. Kumpel, and N. Dauphiné. In Ghana, research was supported by the Ghana Forestry Commission, Kwame Nkrumah University of Science and Technology, University of Ghana (especially L. Holbech and N. Annorbah), John Bitar and Company, and Logs and Lumber. Additional funding for field work was provided respectively by Trobenbos Ghana and BirdLife International in collaboration with Ghana Wildlife Society. G.B.A. obtained a grant from the Cambridge Student Conference on Conservation Science to prepare the manuscript. We also thank J. Penner for helping with the map of the study sites. Finally, we thank the Tropical Biology Association (especially R. Trevelyan) and K. Kriger for providing useful comments. Collection of voucher specimens followed the standard protocol provided by McDiarmid (1994).

Supporting Information

The full data set of amphibian collections from 3 logging concessions in Ghana (Appendix S1) and results of ANOSIM of amphibian assemblages (Appendix S2) are available online. The authors are solely responsible for the content of these materials. Queries (other than absence of the material) should be directed to the corresponding author.

Literature Cited

Adum, G. B., C. Ofori-Boateng, W. Oduro, and M.-O. Rödel. 2011. Rediscovery of the Giant West African Squeaker, *Arthroleptis krokosua* Ernst, Agyei & Rödel, 2008 (Amphibia: Anura: Arthroleptidae) in two forests of south-western Ghana with observations on the species' variability and habitat preferences. Zootaxa **2744:**34–38.

Berry, N. J., O. L. Philips, S. L. Lewis, J. K. Hill, D. P. Edwards, C. V. Khen, N. A. Tawatao, M. Maryati, R. C. Ong, and K. C. Hamer. 2010. The high value of logged tropical forests: lessons from northern Borneo. Biodiversity and Conservation **19:**985–997.

Chao, A. 2005. Species estimation and applications. 2nd edition. Encyclopedia of statistical sciences. Wiley, New York.

Chao, A., and T. J. Shen. 2003. Nonparametric estimation of Shannon's index of diversity when there are unseen species in sample. Environmental and Ecological Statistics **10:**429–443.

Chao, A., and T. J. Shen. 2010. SPADE (species prediction and diversity estimation). National Tsing Hua University, Taiwan. Available from http://chao.stat.nthu.edu.tw (accessed May 2012).

Chapman, C. A., and L. J. Chapman. 2004. Unfavorable successional pathways and the conservation value of logged tropical forest. Biodiversity and Conservation **13:**2089–2105.

Connell, J. H. 1978. Diversity in tropical rain forests and coral reefs. Science **199:**1302–1310.

Curtis, J. M. R., and E. B. Taylor. 2004. The genetic structure of coastal giant salamanders (*Dicamptodon tenebrosus*) in a managed forest. Biological Conservation **115:**45–54.

Edwards, D. P., F. A. Ansell, A. H. Ahmad, R. Nilus, and K. C. Hamer. 2009. The value of rehabilitating logged rainforest for birds. Conservation Biology **23:**1628–1633.

Edwards, D. P., T. D. Larsen, F. A. Ansell, W. W. Hsu, M. A. Derhe, K. C. Hamer, and D. S. Wilcove. 2010. Degraded lands worth protecting: the biological importance of Southern Asia's repeatedly logged forests. Proceedings of the Royal Society B **278:**82–90.

Edwards, D. P, P. Woodcock, F. A. Edwards, T. H. Larsen, W. W. Hsu, S. Benedick, and D. S. Wilcove. 2012. Reduced-impact logging and biodiversity conservation: a case study from Borneo. Ecological Applications **22:**561–571.

Ernst, R., and M.-O. Rödel. 2005. Anthropogenically induced changes of predictability in tropical anuran assemblages. Ecology **86:**3111–3118.

Ernst, R., and M.-O. Rödel. 2006. Community assembly and structure of tropical leaf-litter anurans. Ecotropica **12:**113–129.

Ernst, R., and M.-O. Rödel. 2008. Patterns of community composition in two tropical tree frog assemblages: separating spatial structure and environmental effects in disturbed and undisturbed forests. Journal of Tropical Ecology **24:**111–120.

Ernst, R., K. E. Linsenmair, and M.-O. Rödel. 2006. Diversity erosion beyond the species level: dramatic loss of functional diversity after selective logging in two tropical amphibian communities. Biological Conservation **133:**143–155.

Ernst, R., A. C. Agyei, and M.-O. Rödel. 2008. A new giant species of *Arthroleptis* (Amphibia: Anura: Arthroleptidae) from the Krokosua Hills Forest Reserve, south-western Ghana. Zootaxa **1697:**58–68.

Food and Agriculture Organization (FAO). 2010. Global forest resources assessment 2010: main report. FAO, Rome.

Ficetola, G. F., D. Furlani, G. Colombo, and F. De Bernardi. 2008. Assessing the value of secondary forest for amphibians: *Eleutherodactylus* frogs in a gradient of forest alteration. Biodiversity and Conservation **17:**2185–2195.

Fredericksen, N. J., and T. S. Fredericksen. 2004. Impacts of selective logging on amphibians in a Bolivian tropical humid forest. Forest Ecology and Management **191:**275–282.

Furlani, D., G. F. Ficetola, G. Colombo, M. Ugurlucan, and F. De Bernardi. 2009. Deforestation and the structure of frog communities in the Humedale Terraba-Sierpe, Costa Rica. Zoological Science **26:**197–202.

Gascon, C., E. T. Lovejoy, O. R. J. Bierregaard, J. R. Malcolm, H. L. Vasconcelos, W. F. Laurance, B. Zimmerman, M. Tocher, and S. Borges. 1999. Matrix habitat and species richness in tropical forest remnants. Biological Conservation **91:**223–229.

Gibson, L., et al. 2011. Primary forests are irreplaceable for sustaining tropical biodiversity. Nature **478:**378–383.

Hall, J. B., and M. D. Swaine. 1981. Distribution and ecology of vascular plants in a tropical rain forest: forest vegetation in Ghana. Geobotany. Volume **1**. Junk Publishers, The Hague, Netherlands.

Hansen, C. P., and T. Treue. 2008. Assessing illegal logging in Ghana. International Forestry Review **10:**573–590.

Hawthorne, W. D., and M. Abu-Juam. 1995. Forest protection in Ghana, with particular reference to vegetation and plant species. International Union for Conservation of Nature, Cambridge, United Kingdom.

Hawthorne, W. D., D. Sheil, V. K. Agyeman, M. Abu-Juam, and C. A. M. Marshall. 2012. Logging scars in Ghanaian high forest: towards improved models for sustainable production. Forest Ecology and Management **271:**27–36.

Henderson, P. A., and R. M. H. Seaby. 2007. Community analysis package 4.0. Pisces Conservation, Lymington, United Kingdom.

Hill, M. O. 1973. Diversity and evenness: a unifying notation and its consequences. Ecology **54:**427–431.

Hillers, A., M. Veith, and M.-O. Rödel. 2008. Effects of forest fragmentation and habitat degradation on West African leaf-litter frogs. Conservation Biology **22:**762–772.

Jost, L. 2006. Entropy and diversity. Oikos **113:**363–375.

Jost, L. 2007. Partitioning diversity into independent alpha and beta components. Ecology **88:**2427–2439.

Jost, L., A. Chao, and R. L. Chazdon. 2011. Compositional similarity and β (beta) diversity. Pages 66–84 in A. E. Magurran and B. J. McGill, editors. Biological diversity: frontiers in measurement and assessment. Oxford University Press, Oxford, United Kingdom.

Lindenmayer, D. B., et al. 2012. A major shift to the retention approach for forestry can help resolve some global forest sustainability issues. Conservation Letters: DOI:10.1111/j.1755-263X.2012.00257.x.

Magurran, A. E. 1988. Ecological diversity and its measurement. Princeton University Press, Princeton, New Jersey.

McDiarmid, R. W. 1994. Preparing amphibians as scientific specimens. Pages 289–297 in W. R. Heyer, M. A. Donnelly, R. W. McDiarmid, L.-A. C. Hayek, and M. S. Foster, editors. Measuring and monitoring biological diversity. Standard methods for amphibians. Smithsonian Institution Press, Washington D.C.

Meijaard, E., et al. 2005. Life after logging: reconciling wildlife conservation and production forestry in Indonesian Borneo. Center for International Forestry Research, Bogor, Indonesia.

Norris, K., A. Asase, B. Collen, J. Gockowksi, J. Mason, B. Phalan, and A. Wade. 2010. Biodiversity in a forest-agriculture mosaic—the changing face of West African rainforests. Biological Conservation **143:**2341–2350.

Ofori-Boateng, C., W. Oduro, S. K. Oppong, G. B. Adum, A. Hillers, K. Norris, and M.-O. Rödel. 2012. Differences in the effects of selective logging on amphibian assemblages in three West African forest types. Biotropica DOI:10.1111/j.1744-7429.2012.00887.x.

Penner, J., M. Wegmann, A. Hillers, M. Schmidt, and M.-O. Rödel. 2011. A hotspot revisited – a biogeographical analysis of West African amphibians. Diversity and Distributions **17:**1077–1088.

Putz, F. E., et al. 2012. Sustaining conservation values in selectively logged tropical forests: the attained and the attainable. Conservation Letters DOI:10.1111/j.1755-263X.2012.00242.x.

R Development Core Team. 2012. R: a language and environment for statistical computing. R Foundation for Statistical Computing, Vienna.

Rödel, M.-O., and R. Ernst. 2004. Measuring and monitoring amphibian diversity in tropical forests. An evaluation of methods with recommendations for standardization. Ecotropica **10:**1–14.

Rödel, M.-O., A. C. Agyei, G. Marlon, A. D. Leache, R. E. Diaz, M. K. Fujita, and R. Ernst. 2005. The amphibians of the forested parts of south-western Ghana. Salamandra **41:**107–127.

Sodhi, N. S., and P. R. Ehrlich. 2010. Conservation biology for all. Oxford University Press, Oxford, United Kingdom.

Tuomisto, H. 2010. A consistent terminology for quantifying species diversity? Yes, it does exist. Oecologia **164:**853–860.

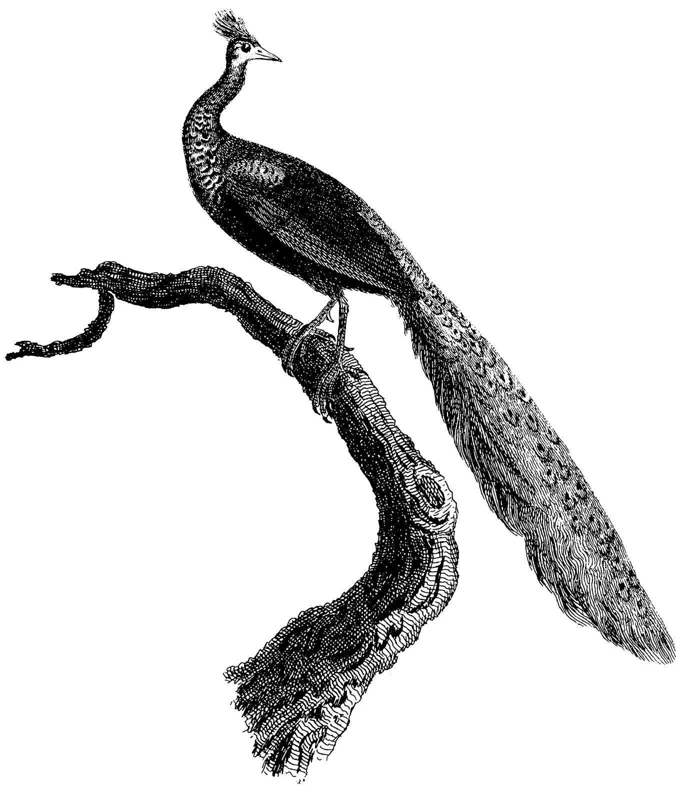
Vallan, D. 2002. Effects of anthropogenic environmental changes on amphibian diversity in the rainforests of eastern Madagascar. Journal of Tropical Ecology **18:**725–742.

Vallan, D., F. Andreone, and V. H. Raherisoa. 2004. Does selective wood exploitation affect amphibian diversity? The case of An'Ala, a tropical rainforest in eastern Madagascar. Oryx **38:**410–417.

Vandermeer, J. A., and I. Perfecto. 1997. The agroecosystem: a need for the conservation biologist's lens. Conservation Biology **11:** 1–3.

Wintle, B. A., M. A. McCarthy, K. M. Parris, and M. A. Burgman. 2004. Precision and bias of methods for estimating point survey detection probabilities. Ecological Applications **14:**703–712.

Wright, S. J., and H. C. Muller-Landau. 2006. The future of tropical forest species. Biotropica **38:**287–301.



Supporting Information

Appendix S1. Full dataset of amphibian collections from Suhuma Forest Reserve (H), Krokosua Hills Forest Reserve (K) and Sui River Forest Reserve (S) in Ghana: Species, Geographic Distribution, Habitat Association and IUCN Red List Categories.

Geographic Distribution: A = distributed also outside West Africa, EG = Endemic to Ghana, WA = only in West Africa, west of the Cross River, UG = endemic to the Upper Guinean forest zone (rain forest west of the Dahomey Gap); Habitat Association: FS = forest specialist; DT = degradation-tolerant species. IUCN Red list Category: EN = endangered; VU = vulnerable; NT = near-threatened, LC = least concern (not threatened), NE = not evaluated, (VU) = proposed threatened status as vulnerable.

Logging Histories (UL = unlogged; L0 = recently logged; L10 = ten years post-logging; L20 = twenty years post-logging).

Appendix S2. Results of ANOSIM of amphibian assemblages.

An analysis of similarity (ANOSIM) was conducted as a complement to the NMDS analyses as presented in the Results. This grouped samples according to the *a priori* hypothesis that they would differ among logging histories. ANOSIM calculates a test statistic *R* which scales from -1 to 1. An *R* of 1 signifies that the most similar samples are grouped together, whereas an *R* of 0 indicates that similarities among samples are completely mixed and unrelated to the grouping factor. Significance was assessed by comparison of the observed value of *R* against 1000 values generated via random permutations of the group assignment. Note that since it is not possible within an ANOSIM design to test for a nested effect of logging history within locations, there is expected to be a higher rate of Type 1 errors than the analysis as presented in the Results. A separate set of analyses were therefore required to test the hypothesis that there would be differences among concessions.

When analysing the full amphibian dataset, there was support for the grouping of samples by logging history ($R = 0.399$, $p = 0.001$).When assessing individual groups, there was no support for separating unlogged forests from those which had been logged 20 years previously ($R = 0.104$, $p = 0.063$). All other comparisons were significant ($p < 0.01$).

Those amphibian species identified as degradation-tolerant significantly varied among logging histories ($R = 0.185$, $p = 0.001$), with the recently-logged forest separated from recovering or unlogged sites ($p < 0.01$ for all comparisons), with no differences among the remaining groups. This implies that this component of the amphibian assemblage had recovered to its previous state after 10 years. Among forest-dependent amphibians there was once again significant support for grouping by logging history ($R = 0.357$, $p = 0.001$). In this case there was no difference between recently-logged forests and those which had been recovering for 10 years ($R = 0.035$, $p = 0.204$), but all other comparisons were significant ($p < 0.01$).

The results obtained via ANOSIM are therefore qualitatively identical to those as shown in the Results, with the exception that the assemblage of forest-dependent amphibians has not completely recovered by 20 years to the same level as unlogged forests, though the trajectory remains in this direction. Given the propensity for a greater Type 1 error rate in this analysis, a more conservative interpretation is warranted.

Finally, in separate tests for grouping according to concession, for all amphibians combined there was significant overall support ($R = 0.060$, $p = 0.004$) driven largely by a difference between Krokosua and Suhuma ($R = 0.121$, $p = 0.018$). No other significant differences among concessions were detected. There were no differences between concessions in the composition of degradation-tolerant amphibian species ($R = -0.035$, $p = 1.000$). For forest-dependent species, significant differences among concessions occurred ($R = 0.144$, $p = 0.001$), driven by separation between Krokosua and both Sui River ($R = 0.204$, $p = 0.004$) and Suhuma ($R = 0.235$, $p = 0.002$). These results concur qualitatively with those shown through NMDS.

Species	Amietophrynus maculatus	Amietophrynus regularis	Amietophrynus togoensis	Arthroleptis krokosua	Arthroleptis sp*	Cardioglossa occidentalis	Hoplobatrachus occipitalis	Hylarana albolabris	Hylarana occidentalis	Hyperilous concolor	Leptopelis spiritusnoctis	Leptopelis occidentalis	Phrynobatrachus tokba	Phrynobatrachus latifrons	Phrynobatrachus alleni	Phrynobatrachus annulatus	Phrynobatrachus calcaratus	Phrynobatrachus liberiensis	Phrynobatrachus plicatus	Phrynobatrachus villiersi	Ptychadena aequiplicata	Ptychadena bibroni	Ptychadena longirostris	Ptychadena mascareniensis
Family	Bufonidae	Bufonidae	Bufonidae	Arthroleptidae	Arthroleptidae	Arthroleptidae	Ranidae	Ranidae	Ranidae	Hyperoliidae	Arthroleptidae	Arthroleptidae	Phrynobatrachidae	Phrynobatrachidae	Phrynobatrachidae	Phrynobatrachidae	Phrynobatrachidae	Phrynobatrachidae	Phrynobatrachidae	Phrynobatrachidae	Ptychadenidae	Ptychadenidae	Ptychadenidae	Ptychadenidae
Geographical Distribution	A	A	WA	EW	UG	UG	WA	A	A	UG	WA	UG	WA	UG	UG	A	UG	WA	UG	UG	A	A	WA	A
Habitat Association	DT	DT	FS	FS	DT	FS	DT	DT	FS	DT	DT	FS	DT	DT	FS	FS	DT	FS	FS	FS	FS	DT	DT	DT
IUCN Red List Category	LC	LC	NT	EN	LC	NE (VU)	LC	LC	EN	LC	LC	NT	LC	LC	NT	EN	LC	NT	LC	VU	LC	LC	LC	LC
ULH1	0	0	6	0	39	0	0	0	1	0	0	0	0	0	27	20	5	28	31	1	7	0	0	0
ULH2	0	0	1	0	76	0	0	0	0	0	0	0	0	0	30	34	1	13	14	0	0	0	0	0
ULH3	0	0	0	0	99	0	0	0	0	0	0	0	0	0	42	23	0	17	59	0	0	0	0	0
ULH4	0	0	0	0	20	0	0	0	0	0	0	0	0	0	49	28	1	13	21	0	19	0	0	0
L0H1	2	0	0	0	70	0	8	8	0	2	10	0	0	0	9	12	3	3	11	0	1	7	0	0
L0H2	0	0	2	0	87	0	10	5	0	2	7	0	0	0	13	10	9	0	14	0	2	2	0	0
L0H3	0	0	0	0	187	0	2	0	0	0	2	0	0	0	3	20	0	9	8	0	8	5	0	0
L0H4	1	0	0	0	127	0	0	3	0	0	1	2	0	0	5	8	6	2	20	0	0	0	0	0
L10H1	0	0	3	0	38	0	0	1	0	1	1	0	0	0	11	20	2	1	17	0	5	0	0	0
L10H2	0	0	0	0	43	0	0	2	0	0	2	0	0	0	8	15	5	1	14	0	11	3	0	0
L10H3	0	0	0	0	154	0	0	7	0	1	3	0	0	0	20	10	2	6	20	0	13	1	0	0
L10H4	0	0	0	0	67	0	0	0	0	0	4	0	0	0	5	13	1	2	11	0	10	2	0	0

Species	Amietophrynus maculatus	Amietophrynus regularis	Amietophrynus togoensis	Arthroleptis krokosua	Arthroleptis sp*	Cardioglossa occidentalis	Hoplobatrachus occipitalis	Hylarana albolabris	Hylarana occidentalis	Hyperilous concolor	Leptopelis spiritusnoctis	Leptopelis occidentalis	Phrynobatrachus tokba	Phrynobatrachus latifrons	Phrynobatrachus alleni	Phrynobatrachus annulatus	Phrynobatrachus calcaratus	Phrynobatrachus liberiensis	Phrynobatrachus plicatus	Phrynobatrachus villiersi	Ptychadena aequiplicata	Ptychadena bibroni	Ptychadena longirostris	Ptychadena mascareniensis
L20H1	0	0	5	0	42	1	0	0	1	0	0	0	0	0	49	57	2	32	20	0	21	2	0	0
L20H2	0	0	2	0	78	0	0	0	0	0	0	6	0	0	25	30	0	2	50	0	14	0	0	0
L20H3	0	0	2	0	102	0	0	0	0	0	0	2	0	0	30	49	4	4	67	0	27	0	0	0
L20H4	0	0	0	0	28	0	0	0	0	0	0	0	0	0	57	34	0	6	58	0	29	0	0	0
ULK1	0	0	0	0	39	0	0	7	0	0	0	0	0	0	27	20	5	8	4	0	7	0	0	0
ULK2	0	0	4	0	76	0	0	8	0	0	0	0	0	0	30	23	1	13	14	0	17	1	0	0
ULK3	0	0	2	0	99	0	0	2	0	0	0	0	1	0	22	23	0	17	78	0	5	1	0	0
ULK4	0	0	0	0	20	0	0	1	0	0	0	0	0	0	5	28	1	13	70	0	0	0	0	0
L0K1	2	3	0	0	70	0	8	8	0	3	6	0	0	0	9	12	3	3	102	0	0	7	0	0
L0K2	0	2	0	0	87	0	20	19	0	2	7	0	0	4	13	10	9	0	0	0	0	12	10	0
L0K3	3	0	0	0	187	0	2	0	0	2	2	0	0	0	3	6	0	0	0	0	0	18	2	0
L0K4	1	0	0	0	127	0	3	11	0	0	1	0	0	3	5	8	6	2	0	0	0	7	2	0
L10K1	0	1	0	0	38	0	0	1	0	1	1	0	0	2	11	20	2	1	0	0	0	2	2	0
L10K2	2	1	0	0	43	0	2	2	0	0	2	0	0	0	8	15	5	1	0	0	2	3	0	0
L10K3	0	0	2	0	154	0	0	11	0	3	3	0	0	0	20	10	2	6	0	0	0	2	0	0
L10K4	0	0	0	0	67	0	0	0	0	0	0	0	0	0	5	13	1	2	0	0	0	0	0	0
L20K1	2	0	0	0	42	0	0	0	0	0	3	0	0	0	20	27	10	2	1	0	1	3	0	0
L20K2	0	0	0	0	78	0	0	0	0	0	1	0	0	0	25	30	0	2	0	0	3	2	0	0
L20K3	0	0	0	0	102	0	0	0	0	0	0	0	1	0	0	20	24	4	0	0	8	4	0	0
L20K4	0	0	0	0	28	0	0	0	0	0	0	0	0	0	13	8	0	6	0	0	0	1	0	0
ULS1	0	0	0	0	39	0	0	0	1	0	0	0	0	0	27	20	21	8	31	0	7	0	0	0
ULS2	0	0	2	0	76	0	0	2	0	0	0	0	0	0	30	14	17	13	14	0	7	6	0	0

Species	Amietophrynus maculatus	Amietophrynus regularis	Amietophrynus togoensis	Arthroleptis krokosua	Arthroleptis sp*	Cardioglossa occidentalis	Hoplobatrachus occipitalis	Hylarana albolabris	Hylarana occidentalis	Hyperilous concolor	Leptopelis spiritusnoctis	Leptopelis occidentalis	Phrynobatrachus tokba	Phrynobatrachus latifrons	Phrynobatrachus alleni	Phrynobatrachus annulatus	Phrynobatrachus calcaratus	Phrynobatrachus liberiensis	Phrynobatrachus plicatus	Phrynobatrachus villiersi	Ptychadena aequiplicata	Ptychadena bibroni	Ptychadena longirostris	Ptychadena mascareniensis
ULS3	0	0	1	0	99	0	0	1	0	0	0	0	0	0	42	23	0	17	25	0	5	1	0	0
ULS4	0	0	2	0	20	0	0	0	0	0	0	0	0	0	29	28	10	13	20	0	0	0	0	0
L0S1	2	0	0	0	70	0	8	8	0	3	6	0	0	0	9	12	3	3	0	0	9	7	0	0
L0S2	0	0	0	0	87	0	6	19	0	2	7	0	0	3	13	10	9	0	0	0	2	12	3	0
L0S3	3	3	0	0	187	0	11	0	0	0	2	2	0	0	3	11	0	0	8	0	8	0	0	4
L0S4	0	0	1	0	127	0	0	0	0	0	1	0	0	0	0	8	6	2	20	0	21	17	0	0
L10S1	0	0	3	0	38	0	0	1	0	1	1	0	0	0	11	20	2	1	17	0	23	12	0	0
L10S2	2	0	0	0	43	0	0	2	0	0	2	0	0	0	8	15	5	1	18	0	11	0	0	0
L10S3	0	0	0	0	154	0	0	9	0	3	3	0	0	0	20	10	2	6	20	0	13	5	0	0
L10S4	0	0	2	0	67	0	0	0	0	0	0	0	0	0	5	13	1	2	0	0	30	0	0	0
L20S1	0	0	0	4	42	0	0	0	0	0	0	0	0	0	20	27	2	2	20	0	1	2	0	0
L20S2	0	0	0	5	78	0	0	0	0	0	1	0	0	0	25	30	25	2	50	0	34	1	0	0
L20S3	0	0	2	4	102	0	0	0	0	0	0	0	1	0	30	20	12	4	67	0	40	0	0	0
L20S4	0	0	0	0	28	0	0	2	0	0	1	0	0	0	13	11	21	6	65	2	21	2	0	0

Site	Treatment	Plot	Visit number	Species	Amietophrynus maculatus	Amietophrynus regularis	Amietophrynus togoensis	Arthroleptis krokosua	Arthroleptis sp*	Cardioglossa occidentalis	Hoplobatrachus occipitalis	Hylarana albolabris	Hylarana occidentalis	Hyperilous concolor	Leptopelis spiritusnoctis	Leptopelis occidentalis	Phrynobatrachus tokba	Phrynobatrachus latifrons	Phrynobatrachus alleni	Phrynobatrachus annulatus	Phrynobatrachus calcaratus	Phrynobatrachus liberiensis	Phrynobatrachus plicatus	Phrynobatrachus villiersi	Ptychadena aequiplicata	Ptychadena bibroni	Ptychadena longirostris	Ptychadena mascareniensis
				Family	Bufonidae	Bufonidae	Bufonidae	Arthroleptidae	Arthroleptidae	Arthroleptidae	Ranidae	Ranidae	Ranidae	Hyperoliidae	Arthroleptidae	Arthroleptidae	Phrynobatrachidae	Phrynobatrachidae	Phrynobatrachidae	Phrynobatrachidae	Phrynobatrachidae	Phrynobatrachidae	Phrynobatrachidae	Phrynobatrachidae	Ptychadenidae	Ptychadenidae	Ptychadenidae	Ptychadenidae
				Geographical Distribution	A	A	WA	EW	UG	UG	WA	A	A	UG	WA	UG	WA	UG	UG	A	UG	WA	UG	UG	A	A	WA	A
				Habitat Association	DT	DT	FS	FS	DT	FS	DT	DT	FS	DT	DT	FS	DT	DT	FS	FS	DT	FS	FS	FS	FS	DT	DT	DT
				IUCN Red List Category	LC	LC	NT	EN	LC	NE	LC	LC	EN	LC	LC	NT	LC	LC	NT	EN	LC	NT	LC	VU	LC	LC	LC	LC
Site	**Treatment**	**Plot**	**Visit number**	**Date**																								
Suhuma	Unlogged	1	1	30/5/2009	0	0	6	0	7	0	0	0	0	0	0	0	0	0	2	0	0	6	6	0	1	0	0	0
Suhuma	Unlogged	1	2	06.02.2009	0	0	0	0	8	0	0	0	0	0	0	0	0	0	5	0	3	11	2	0	6	0	0	0
Suhuma	Unlogged	1	3	22/6/2009	0	0	0	0	18	0	0	0	1	0	0	0	0	0	13	3	0	8	14	1	0	0	0	0
Suhuma	Unlogged	1	4	29/9/2009	0	0	0	0	5	0	0	0	0	0	0	0	0	0	7	12	2	3	9	0	0	0	0	0
Suhuma	Unlogged	1	5	12.11.2009	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0
Suhuma	Unlogged	2	1	30/5/2009	0	0	0	0	25	0	0	0	0	0	0	0	0	0	5	3	0	3	2	0	0	0	0	0
Suhuma	Unlogged	2	2	06.02.2009	0	0	0	0	6	0	0	0	0	0	0	0	0	0	5	11	0	7	9	0	0	0	0	0
Suhuma	Unlogged	2	3	22/6/2009	0	0	1	0	10	0	0	0	0	0	0	0	0	0	13	12	1	1	1	0	0	0	0	0
Suhuma	Unlogged	2	4	29/9/2009	0	0	0	0	3	0	0	0	0	0	0	0	0	0	5	2	0	2	2	0	0	0	0	0
Suhuma	Unlogged	2	5	12.11.2009	0	0	0	0	32	0	0	0	0	0	0	0	0	0	2	6	0	0	0	0	0	0	0	0
Suhuma	Unlogged	3	1	30/5/2009	0	0	0	0	20	0	0	0	0	0	0	0	0	0	13	3	0	1	3	0	0	0	0	0
Suhuma	Unlogged	3	2	06.02.2009	0	0	0	0	17	0	0	0	0	0	0	0	0	0	4	5	0	3	12	0	0	0	0	0
Suhuma	Unlogged	3	3	22/6/2009	0	0	0	0	8	0	0	0	0	0	0	0	0	0	20	13	0	10	28	0	0	0	0	0

				Species	Amietophrynus maculatus	Amietophrynus regularis	Amietophrynus togoensis	Arthroleptis krokosua	Arthroleptis sp*	Cardioglossa occidentalis	Hoplobatrachus occipitalis	Hylarana albolabris	Hylarana occidentalis	Hyperilous concolor	Leptopelis spiritusnoctis	Leptopelis occidentalis	Phrynobatrachus tokba	Phrynobatrachus latifrons	Phrynobatrachus alleni	Phrynobatrachus annulatus	Phrynobatrachus calcaratus	Phrynobatrachus liberiensis	Phrynobatrachus plicatus	Phrynobatrachus villiersi	Ptychadena aequiplicata	Ptychadena bibroni	Ptychadena longirostris	Ptychadena mascareniensis
Suhuma	Unlogged	3	4	29/9/2009	0	0	0	0	3	0	0	0	0	0	0	0	0	0	3	2	0	2	9	0	0	0	0	0
Suhuma	Unlogged	3	5	12.11.2009	0	0	0	0	51	0	0	0	0	0	0	0	0	0	2	0	0	1	7	0	0	0	0	0
Suhuma	Unlogged	4	1	30/5/2009	0	0	0	0	1	0	0	0	0	0	0	0	0	0	6	5	0	1	1	0	2	0	0	0
Suhuma	Unlogged	4	2	06.02.2009	0	0	0	0	5	0	0	0	0	0	0	0	0	0	4	7	0	2	4	0	4	0	0	0
Suhuma	Unlogged	4	3	22/6/2009	0	0	0	0	3	0	0	0	0	0	0	0	0	0	21	11	0	9	11	0	0	0	0	0
Suhuma	Unlogged	4	4	29/9/2009	0	0	0	0	2	0	0	0	0	0	0	0	0	0	12	4	0	0	3	0	2	0	0	0
Suhuma	Unlogged	4	5	12.11.2009	0	0	0	0	9	0	0	0	0	0	0	0	0	0	6	1	1	1	2	0	11	0	0	0
Suhuma	L10	1	1	06.01.2009	0	0	1	0	9	0	0	1	0	0	0	0	0	0	3	5	0	0	5	0	3	0	0	0
Suhuma	L10	1	2	06.03.2009	0	0	0	0	3	0	0	0	0	0	0	0	0	0	1	2	0	0	2	0	2	0	0	0
Suhuma	L10	1	3	25/6/2009	0	0	2	0	9	0	0	0	0	0	0	0	0	0	5	7	0	1	7	0	0	0	0	0
Suhuma	L10	1	4	10.02.2009	0	0	0	0	1	0	0	0	0	0	0	0	0	0	2	3	0	0	0	0	0	0	0	0
Suhuma	L10	1	5	13/12/2009	0	0	0	0	16	0	0	0	0	1	1	0	0	0	0	3	2	0	3	0	0	0	0	0
Suhuma	L10	2	1	06.01.2009	0	0	0	0	21	0	0	0	0	0	0	0	0	0	2	2	1	1	7	0	1	0	0	0
Suhuma	L10	2	2	06.03.2009	0	0	0	0	3	0	0	0	0	0	0	0	0	0	6	0	0	0	2	0	2	0	0	0
Suhuma	L10	2	3	25/6/2009	0	0	0	0	1	0	0	2	0	0	0	0	0	0	0	8	1	0	3	0	8	0	0	0
Suhuma	L10	2	4	10.02.2009	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	1	0	0	1	0	0
Suhuma	L10	2	5	13/12/2009	0	0	0	0	18	0	0	0	0	0	2	0	0	0	0	0	3	0	1	0	0	2	0	0
Suhuma	L10	3	1	06.01.2009	0	0	0	0	39	0	0	2	0	1	1	0	0	0	4	1	2	0	2	0	1	1	0	0
Suhuma	L10	3	2	06.03.2009	0	0	0	0	17	0	0	1	0	0	0	0	0	0	5	1	0	1	8	0	3	0	0	0
Suhuma	L10	3	3	25/6/2009	0	0	0	0	15	0	0	3	0	0	0	0	0	0	6	8	0	5	6	0	2	0	0	0
Suhuma	L10	3	4	10.02.2009	0	0	0	0	27	0	0	1	0	0	0	0	0	0	1	0	0	0	1	0	4	0	0	0
Suhuma	L10	3	5	13/12/2009	0	0	0	0	56	0	0	0	0	0	2	0	0	0	4	0	0	0	3	0	3	0	0	0

				Species	Amietophrynus maculatus	Amietophrynus regularis	Amietophrynus togoensis	Arthroleptis krokosua	Arthroleptis sp*	Cardioglossa occidentalis	Hoplobatrachus occipitalis	Hylarana albolabris	Hylarana occidentalis	Hyperilous concolor	Leptopelis spiritusnoctis	Leptopelis occidentalis	Phrynobatrachus tokba	Phrynobatrachus latifrons	Phrynobatrachus alleni	Phrynobatrachus annulatus	Phrynobatrachus calcaratus	Phrynobatrachus liberiensis	Phrynobatrachus plicatus	Phrynobatrachus villiersi	Ptychadena aequiplicata	Ptychadena bibroni	Ptychadena longirostris	Ptychadena mascareniensis
Suhuma	L10	4	1	06.01.2009	0	0	0	0	8	0	0	0	0	0	1	0	0	0	2	7	0	0	4	0	6	0	0	0
Suhuma	L10	4	2	06.03.2009	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	2	0	0	1	0	1	0	0	0
Suhuma	L10	4	3	25/6/2009	0	0	0	0	19	0	0	0	0	0	0	0	0	0	3	1	0	2	4	0	1	0	0	0
Suhuma	L10	4	4	10.02.2009	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	2	0	0	0
Suhuma	L10	4	5	13/12/2009	0	0	0	0	31	0	0	0	0	0	3	0	0	0	0	3	0	0	2	0	0	2	0	0
Suhuma	L20	1	1	31/5/2009	0	0	5	0	13	0	0	0	0	0	0	0	0	0	10	0	0	0	16	0	2	0	0	0
Suhuma	L20	1	2	06.02.2009	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16	28	0	2	2	0	11	0	0	0
Suhuma	L20	1	3	24/6/2009	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	1	0	27	2	0	0	0	0	0
Suhuma	L20	1	4	30/9/2009	0	0	0	0	8	0	0	0	0	0	0	0	0	0	13	19	2	1	0	0	2	1	0	0
Suhuma	L20	1	5	18/11/2009	0	0	0	0	21	1	0	0	1	0	0	0	0	0	3	9	0	2	0	0	6	1	0	0
Suhuma	L20	2	1	31/5/2009	0	0	2	0	31	0	0	0	0	0	0	3	0	0	5	9	0	0	12	0	11	0	0	0
Suhuma	L20	2	2	06.02.2009	0	0	0	0	12	0	0	0	0	0	0	0	0	0	12	11	0	2	8	0	3	0	0	0
Suhuma	L20	2	3	24/6/2009	0	0	0	0	6	0	0	0	0	0	0	2	0	0	0	2	0	0	11	0	0	0	0	0
Suhuma	L20	2	4	30/9/2009	0	0	0	0	6	0	0	0	0	0	0	1	0	0	2	3	0	0	4	0	0	0	0	0
Suhuma	L20	2	5	18/11/2009	0	0	0	0	23	0	0	0	0	0	0	0	0	0	6	5	0	0	15	0	0	0	0	0
Suhuma	L20	3	1	31/5/2009	0	0	0	0	23	0	0	0	0	0	0	2	0	0	12	23	0	0	25	0	11	0	0	0
Suhuma	L20	3	2	06.02.2009	0	0	2	0	7	0	0	0	0	0	0	0	0	0	6	2	0	1	12	0	5	0	0	0
Suhuma	L20	3	3	24/6/2009	0	0	0	0	2	0	0	0	0	0	0	0	0	0	6	16	0	3	5	0	1	0	0	0
Suhuma	L20	3	4	30/9/2009	0	0	0	0	29	0	0	0	0	0	0	0	0	0	3	2	0	0	17	0	4	0	0	0
Suhuma	L20	3	5	18/11/2009	0	0	0	0	41	0	0	0	0	0	0	0	0	0	3	6	4	0	8	0	6	0	0	0
Suhuma	L20	4	1	31/5/2009	0	0	0	0	4	0	0	0	0	0	0	0	0	0	24	1	0	0	16	0	6	0	0	0
Suhuma	L20	4	2	06.02.2009	0	0	0	0	3	0	0	0	0	0	0	0	0	0	12	9	0	1	3	0	17	0	0	0

				Species	Amietophrynus maculatus	Amietophrynus regularis	Amietophrynus togoensis	Arthroleptis krokosua	Arthroleptis sp*	Cardioglossa occidentalis	Hoplobatrachus occipitalis	Hylarana albolabris	Hylarana occidentalis	Hyperilous concolor	Leptopelis spiritusnoctis	Leptopelis occidentalis	Phrynobatrachus tokba	Phrynobatrachus latifrons	Phrynobatrachus alleni	Phrynobatrachus annulatus	Phrynobatrachus calcaratus	Phrynobatrachus liberiensis	Phrynobatrachus plicatus	Phrynobatrachus villiersi	Ptychadena aequiplicata	Ptychadena bibroni	Ptychadena longirostris	Ptychadena mascareniensis
Suhuma	L20	4	3	24/6/2009	0	0	0	0	4	0	0	0	0	0	0	0	0	0	11	20	0	5	18	0	2	0	0	0
Suhuma	L20	4	4	30/9/2009	0	0	0	0	2	0	0	0	0	0	0	0	0	0	3	3	0	0	9	0	3	0	0	0
Suhuma	L20	4	5	18/11/2009	0	0	0	0	15	0	0	0	0	0	0	0	0	0	7	1	0	0	12	0	1	0	0	0
Suhuma	RL	1	1	06.02.2009	1	0	0	0	12	0	0	4	0	0	2	0	0	0	3	1	0	0	1	0	0	2	0	0
Suhuma	RL	1	2	06.04.2009	0	0	0	0	7	0	2	1	0	0	1	0	0	0	0	2	0	0	3	0	0	1	0	0
Suhuma	RL	1	3	23/6/2009	0	0	0	0	17	0	0	1	0	0	2	0	0	0	4	6	0	2	5	0	1	0	0	0
Suhuma	RL	1	4	10.02.2009	0	0	0	0	9	0	3	0	0	0	0	0	0	0	1	2	0	1	2	0	0	1	0	0
Suhuma	RL	1	5	12.12.2009	1	0	0	0	25	0	3	2	0	2	5	0	0	0	1	1	3	0	0	0	0	3	0	0
Suhuma	RL	2	1	06.02.2009	0	0	0	0	21	0	0	0	0	0	1	0	0	0	2	3	2	0	0	0	0	2	0	0
Suhuma	RL	2	2	06.04.2009	0	0	0	0	12	0	0	2	0	0	0	0	0	0	2	0	3	0	6	0	0	0	0	0
Suhuma	RL	2	3	23/6/2009	0	0	2	0	19	0	4	0	0	0	5	0	0	0	8	4	0	0	4	0	2	0	0	0
Suhuma	RL	2	4	10.02.2009	0	0	0	0	7	0	0	0	0	0	1	0	0	0	1	1	0	0	2	0	0	0	0	0
Suhuma	RL	2	5	12.12.2009	0	0	0	0	28	0	6	3	0	2	0	0	0	0	0	2	4	0	2	0	0	0	0	0
Suhuma	RL	3	1	06.02.2009	0	0	0	0	52	0	0	0	0	0	2	0	0	0	0	0	0	6	2	0	1	1	0	0
Suhuma	RL	3	2	06.04.2009	0	0	0	0	18	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0
Suhuma	RL	3	3	23/6/2009	0	0	0	0	23	0	0	0	0	0	0	0	0	0	3	10	0	0	0	0	7	1	0	0
Suhuma	RL	3	4	10.02.2009	0	0	0	0	33	0	0	0	0	0	0	0	0	0	0	3	0	2	2	0	0	0	0	0
Suhuma	RL	3	5	12.12.2009	0	0	0	0	61	0	2	0	0	0	0	0	0	0	0	2	0	1	4	0	0	3	0	0
Suhuma	RL	4	1	06.02.2009	1	0	0	0	30	0	0	0	0	0	0	0	0	0	0	2	2	0	5	0	0	0	0	0
Suhuma	RL	4	2	06.04.2009	0	0	0	0	24	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0
Suhuma	RL	4	3	23/6/2009	0	0	0	0	19	0	0	0	0	0	1	2	0	0	4	6	1	2	8	0	0	0	0	0
Suhuma	RL	4	4	10.02.2009	0	0	0	0	13	0	0	0	0	0	0	0	0	0	1	0	0	0	2	0	0	0	0	0

				Species	Amietophrynus maculatus	Amietophrynus regularis	Amietophrynus togoensis	Arthroleptis krokosua	Arthroleptis sp*	Cardioglossa occidentalis	Hoplobatrachus occipitalis	Hylarana albolabris	Hylarana occidentalis	Hyperilous concolor	Leptopelis spiritusnoctis	Leptopelis occidentalis	Phrynobatrachus tokba	Phrynobatrachus latifrons	Phrynobatrachus alleni	Phrynobatrachus annulatus	Phrynobatrachus calcaratus	Phrynobatrachus liberiensis	Phrynobatrachus plicatus	Phrynobatrachus villiersi	Ptychadena aequiplicata	Ptychadena bibroni	Ptychadena longirostris	Ptychadena mascareniensis
Suhuma	RL	4	5	12.12.2009	0	0	0	0	41	0	0	3	0	0	0	0	0	0	0	0	3	0	3	0	0	0	0	0
Krokosua	Unlogged	1	1	24/6/2009	0	0	0	0	8	0	0	2	0	0	0	0	0	0	6	3	0	1	0	0	4	0	0	0
Krokosua	Unlogged	1	2	26/6/2009	0	0	0	0	3	0	0	4	0	0	0	0	0	0	5	7	0	1	0	0	3	0	0	0
Krokosua	Unlogged	1	3	23/7/2009	0	0	0	0	6	0	0	1	0	0	0	0	0	0	11	8	1	5	4	0	0	0	0	0
Krokosua	Unlogged	1	4	10.05.2009	0	0	0	0	3	0	0	0	0	0	0	0	0	0	2	1	1	0	0	0	0	0	0	0
Krokosua	Unlogged	1	5	14/12/2009	0	0	0	0	19	0	0	0	0	0	0	0	0	0	3	1	3	1	0	0	0	0	0	0
Krokosua	Unlogged	2	1	24/6/2009	0	0	0	0	12	0	0	1	0	0	0	0	0	0	2	3	0	3	1	0	4	0	0	0
Krokosua	Unlogged	2	2	26/6/2009	0	0	2	0	23	0	0	0	0	0	0	0	0	0	6	7	0	1	4	0	1	0	0	0
Krokosua	Unlogged	2	3	23/7/2009	0	0	2	0	8	0	0	7	0	0	0	0	0	0	13	9	0	5	7	0	7	0	0	0
Krokosua	Unlogged	2	4	10.05.2009	0	0	0	0	2	0	0	0	0	0	0	0	0	0	2	3	0	3	2	0	0	0	0	0
Krokosua	Unlogged	2	5	14/12/2009	0	0	0	0	31	0	0	0	0	0	0	0	0	0	7	1	1	1	0	0	5	1	0	0
Krokosua	Unlogged	3	1	24/6/2009	0	0	0	0	18	0	0	0	0	0	0	0	0	0	7	6	0	3	8	0	0	0	0	0
Krokosua	Unlogged	3	2	26/6/2009	0	0	0	0	9	0	0	0	0	0	0	0	0	0	0	2	0	2	17	0	3	0	0	0
Krokosua	Unlogged	3	3	23/7/2009	0	0	2	0	41	0	0	2	0	0	0	0	1	0	11	9	0	8	28	0	1	0	0	0
Krokosua	Unlogged	3	4	10.05.2009	0	0	0	0	21	0	0	0	0	0	0	0	0	0	1	3	0	2	16	0	1	0	0	0
Krokosua	Unlogged	3	5	14/12/2009	0	0	0	0	10	0	0	0	0	0	0	0	0	0	3	3	0	2	9	0	0	1	0	0
Krokosua	Unlogged	4	1	24/6/2009	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	7	1	1	11	0	0	0	0	0
Krokosua	Unlogged	4	2	26/6/2009	0	0	0	0	2	0	0	0	0	0	0	0	0	0	1	2	0	2	6	0	0	0	0	0
Krokosua	Unlogged	4	3	23/7/2009	0	0	0	0	6	0	0	1	0	0	0	0	0	0	4	12	0	9	32	0	0	0	0	0
Krokosua	Unlogged	4	4	10.05.2009	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	1	13	0	0	0	0	0
Krokosua	Unlogged	4	5	14/12/2009	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	3	0	0	8	0	0	0	0	0
Krokosua	L10	1	1	26/6/2009	0	0	0	0	4	0	0	0	0	0	0	0	0	0	6	11	0	0	0	0	0	0	0	0

				Species	Amietophrynus maculatus	Amietophrynus regularis	Amietophrynus togoensis	Arthroleptis krokosua	Arthroleptis sp*	Cardioglossa occidentalis	Hoplobatrachus occipitalis	Hylarana albolabris	Hylarana occidentalis	Hyperilous concolor	Leptopelis spiritusnoctis	Leptopelis occidentalis	Phrynobatrachus tokba	Phrynobatrachus latifrons	Phrynobatrachus alleni	Phrynobatrachus annulatus	Phrynobatrachus calcaratus	Phrynobatrachus liberiensis	Phrynobatrachus plicatus	Phrynobatrachus villiersi	Ptychadena aequiplicata	Ptychadena bibroni	Ptychadena longirostris	Ptychadena mascareniensis
Krokosua	L10	1	2	28/6/2009	0	0	0	0	4	0	0	0	0	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0
Krokosua	L10	1	3	22/6/2009	0	0	0	0	3	0	0	1	0	0	0	0	0	0	3	7	0	1	0	0	0	0	0	0
Krokosua	L10	1	4	10.06.2009	0	0	0	0	7	0	0	0	0	1	0	0	0	0	0	0	2	0	0	0	0	0	0	0
Krokosua	L10	1	5	15/12/2009	0	1	0	0	20	0	0	0	0	0	1	0	0	2	0	0	0	0	0	0	0	2	2	0
Krokosua	L10	2	1	26/6/2009	0	0	0	0	9	0	0	0	0	0	0	0	0	0	5	8	0	0	0	0	0	0	0	0
Krokosua	L10	2	2	28/6/2009	0	0	0	0	2	0	0	0	0	0	0	0	0	0	3	2	0	0	0	0	0	0	0	0
Krokosua	L10	2	3	22/6/2009	0	0	0	0	8	0	0	2	0	0	0	0	0	0	0	5	0	1	0	0	2	0	0	0
Krokosua	L10	2	4	10.06.2009	0	0	0	0	9	0	0	0	0	0	1	0	0	0	0	0	2	0	0	0	0	0	0	0
Krokosua	L10	2	5	15/12/2009	2	1	0	0	15	0	2	0	0	0	1	0	0	0	0	0	3	0	0	0	0	3	0	0
Krokosua	L10	3	1	26/6/2009	0	0	0	0	39	0	0	2	0	0	0	0	0	0	6	1	0	0	0	0	0	0	0	0
Krokosua	L10	3	2	28/6/2009	0	0	0	0	30	0	0	1	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0
Krokosua	L10	3	3	22/6/2009	0	0	0	0	17	0	0	5	0	0	0	0	0	0	8	6	2	4	0	0	0	0	0	0
Krokosua	L10	3	4	10.06.2009	0	0	0	0	23	0	0	2	0	0	2	0	0	0	1	0	0	2	0	0	0	2	0	0
Krokosua	L10	3	5	15/12/2009	0	0	2	0	45	0	0	1	0	3	1	0	0	0	3	2	0	0	0	0	0	0	0	0
Krokosua	L10	4	1	26/6/2009	0	0	0	0	8	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0
Krokosua	L10	4	2	28/6/2009	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Krokosua	L10	4	3	22/6/2009	0	0	0	0	13	0	0	0	0	0	0	0	0	0	5	4	0	1	0	0	0	0	0	0
Krokosua	L10	4	4	10.06.2009	0	0	0	0	11	0	0	0	0	0	0	0	0	0	0	2	0	1	0	0	0	0	0	0
Krokosua	L10	4	5	15/12/2009	0	0	0	0	25	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Krokosua	L20	1	1	25/6/2009	0	0	0	0	2	0	0	0	0	0	0	0	0	0	3	8	1	0	0	0	0	0	0	0
Krokosua	L20	1	2	27/6/2009	0	0	0	0	4	0	0	0	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0
Krokosua	L20	1	3	20/7/2009	0	0	0	0	13	0	0	0	0	0	0	0	0	0	11	11	0	2	0	0	1	0	0	0

				Species	Amietophrynus maculatus	Amietophrynus regularis	Amietophrynus togoensis	Arthroleptis krokosua	Arthroleptis sp*	Cardioglossa occidentalis	Hoplobatrachus occipitalis	Hylarana albolabris	Hylarana occidentalis	Hyperilous concolor	Leptopelis spiritusnoctis	Leptopelis occidentalis	Phrynobatrachus tokba	Phrynobatrachus latifrons	Phrynobatrachus alleni	Phrynobatrachus annulatus	Phrynobatrachus calcaratus	Phrynobatrachus liberiensis	Phrynobatrachus plicatus	Phrynobatrachus villiersi	Ptychadena aequiplicata	Ptychadena bibroni	Ptychadena longirostris	Ptychadena mascareniensis
Krokosua	L20	1	4	10.05.2009	0	0	0	0	3	0	0	0	0	0	0	0	0	0	1	4	3	0	0	0	0	1	0	0
Krokosua	L20	1	5	16/12/2009	2	0	0	0	20	0	0	0	0	0	3	0	0	0	3	3	6	0	1	0	0	2	0	0
Krokosua	L20	2	1	25/6/2009	0	0	0	0	8	0	0	0	0	0	1	0	0	0	9	5	0	0	0	0	0	0	0	0
Krokosua	L20	2	2	27/6/2009	0	0	0	0	12	0	0	0	0	0	0	0	0	0	10	3	0	0	0	0	0	0	0	0
Krokosua	L20	2	3	20/7/2009	0	0	0	0	10	0	0	0	0	0	0	0	0	0	3	17	0	2	0	0	3	0	0	0
Krokosua	L20	2	4	10.05.2009	0	0	0	0	21	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Krokosua	L20	2	5	16/12/2009	0	0	0	0	27	0	0	0	0	0	0	0	0	0	2	5	0	0	0	0	0	2	0	0
Krokosua	L20	3	1	25/6/2009	0	0	0	0	28	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	2	0	0
Krokosua	L20	3	2	27/6/2009	0	0	0	0	19	0	0	0	0	0	0	0	0	0	0	7	1	0	0	0	0	0	0	0
Krokosua	L20	3	3	20/7/2009	0	0	0	0	13	0	0	0	0	0	0	0	1	0	0	11	3	4	0	0	6	0	0	0
Krokosua	L20	3	4	10.05.2009	0	0	0	0	11	0	0	0	0	0	0	0	0	0	0	1	4	0	0	0	2	0	0	0
Krokosua	L20	3	5	16/12/2009	0	0	0	0	31	0	0	0	0	0	0	0	0	0	0	0	16	0	0	0	0	2	0	0
Krokosua	L20	4	1	25/6/2009	0	0	0	0	6	0	0	0	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0
Krokosua	L20	4	2	27/6/2009	0	0	0	0	2	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0
Krokosua	L20	4	3	20/7/2009	0	0	0	0	6	0	0	0	0	0	0	0	0	0	9	3	0	6	0	0	0	0	0	0
Krokosua	L20	4	4	10.05.2009	0	0	0	0	3	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
Krokosua	L20	4	5	16/12/2009	0	0	0	0	11	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0
Krokosua	RL	1	1	27/6/2009	0	1	0	0	16	0	2	4	0	0	0	0	0	0	2	3	0	0	12	0	0	2	0	0
Krokosua	RL	1	2	29/6/2009	0	0	0	0	13	0	2	0	0	0	0	0	0	0	2	1	0	0	19	0	0	0	0	0
Krokosua	RL	1	3	21/6/2009	0	0	0	0	5	0	0	3	0	0	0	0	0	0	4	6	0	3	39	0	0	0	0	0
Krokosua	RL	1	4	10. Jun	1	0	0	0	16	0	4	1	0	0	2	0	0	0	1	2	1	0	23	0	0	0	0	0
Krokosua	RL	1	5	15/12/2009	1	2	0	0	20	0	0	0	0	3	4	0	0	0	0	0	2	0	9	0	0	5	0	0

				Species	Amietophrynus maculatus	Amietophrynus regularis	Amietophrynus togoensis	Arthroleptis krokosua	Arthroleptis sp*	Cardioglossa occidentalis	Hoplobatrachus occipitalis	Hylarana albolabris	Hylarana occidentalis	Hyperilous concolor	Leptopelis spiritusnoctis	Leptopelis occidentalis	Phrynobatrachus tokba	Phrynobatrachus latifrons	Phrynobatrachus alleni	Phrynobatrachus annulatus	Phrynobatrachus calcaratus	Phrynobatrachus liberiensis	Phrynobatrachus plicatus	Phrynobatrachus villiersi	Ptychadena aequiplicata	Ptychadena bibroni	Ptychadena longirostris	Ptychadena mascareniensis
Krokosua	RL	2	1	27/6/2009	0	0	0	0	18	0	2	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	2	0
Krokosua	RL	2	2	29/6/2009	0	0	0	0	10	0	0	7	0	0	0	0	0	0	5	2	0	0	0	0	0	0	0	0
Krokosua	RL	2	3	21/6/2009	0	0	0	0	8	0	3	9	0	0	1	0	0	0	6	6	0	0	0	0	0	2	0	0
Krokosua	RL	2	4	10. Jun	0	0	0	0	21	0	5	0	0	0	2	0	0	0	0	0	2	0	0	0	0	0	1	0
Krokosua	RL	2	5	15/12/2009	0	2	0	0	30	0	10	3	0	2	4	0	0	4	2	1	6	0	0	0	0	10	7	0
Krokosua	RL	3	1	27/6/2009	0	0	0	0	37	0	0	0	0	0	0	0	0	0	2	2	0	0	0	0	0	4	0	0
Krokosua	RL	3	2	29/6/2009	0	0	0	0	29	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	2	0	0
Krokosua	RL	3	3	21/6/2009	0	0	0	0	42	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
Krokosua	RL	3	4	10. Jun	0	0	0	0	30	0	0	0	0	0	2	0	0	0	0	1	0	0	0	0	0	3	0	0
Krokosua	RL	3	5	15/12/2009	3	0	0	0	49	0	2	0	0	2	0	0	0	0	0	0	0	0	0	0	0	9	2	0
Krokosua	RL	4	1	27/6/2009	0	0	0	0	21	0	0	3	0	0	0	0	0	0	5	4	0	0	0	0	0	0	0	0
Krokosua	RL	4	2	29/6/2009	0	0	0	0	15	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Krokosua	RL	4	3	21/6/2009	0	0	0	0	12	0	0	6	0	0	0	0	0	0	0	4	0	2	0	0	0	0	0	0
Krokosua	RL	4	4	10. Jun	0	0	0	0	27	0	0	0	0	0	1	0	0	0	0	0	2	0	0	0	0	2	1	0
Krokosua	RL	4	5	15/12/2009	1	0	0	0	52	0	3	1	0	0	0	0	0	3	0	0	4	0	0	0	0	5	1	0
Sui	Unlogged	1	1	30/7/2009	0	0	0	0	6	0	0	0	0	0	0	0	0	0	2	2	4	2	9	0	0	0	0	0
Sui	Unlogged	1	2	08.09.2009	0	0	0	0	10	0	0	0	0	0	0	0	0	0	3	4	6	1	3	0	2	0	0	0
Sui	Unlogged	1	3	13/8/2009	0	0	0	0	2	0	0	0	1	0	0	0	0	0	12	9	8	4	12	0	5	0	0	0
Sui	Unlogged	1	4	17/11/2009	0	0	0	0	3	0	0	0	0	0	0	0	0	0	6	2	1	1	5	0	0	0	0	0
Sui	Unlogged	1	5	18/12/2009	0	0	0	0	18	0	0	0	0	0	0	0	0	0	4	3	2	0	2	0	0	0	0	0
Sui	Unlogged	2	1	30/7/2009	0	0	0	0	11	0	0	0	0	0	0	0	0	0	4	1	0	3	0	0	0	0	0	0
Sui	Unlogged	2	2	08.09.2009	0	0	0	0	15	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0	3	0	0	0

				Species	Amietophrynus maculatus	Amietophrynus regularis	Amietophrynus togoensis	Arthroleptis krokosua	Arthroleptis sp*	Cardioglossa occidentalis	Hoplobatrachus occipitalis	Hylarana albolabris	Hylarana occidentalis	Hyperilous concolor	Leptopelis spiritusnoctis	Leptopelis occidentalis	Phrynobatrachus tokba	Phrynobatrachus latifrons	Phrynobatrachus alleni	Phrynobatrachus annulatus	Phrynobatrachus calcaratus	Phrynobatrachus liberiensis	Phrynobatrachus plicatus	Phrynobatrachus villiersi	Ptychadena aequiplicata	Ptychadena bibroni	Ptychadena longirostris	Ptychadena mascareniensis
Sui	Unlogged	2	3	13/8/2009	0	0	2	0	9	0	0	0	0	0	0	0	0	0	16	1	14	10	13	0	4	6	0	0
Sui	Unlogged	2	4	17/11/2009	0	0	0	0	8	0	0	0	0	0	0	0	0	0	7	9	0	0	1	0	0	0	0	0
Sui	Unlogged	2	5	18/12/2009	0	0	0	0	33	0	0	2	0	0	0	0	0	0	3	2	1	0	0	0	0	0	0	0
Sui	Unlogged	3	1	30/7/2009	0	0	0	0	21	0	0	0	0	0	0	0	0	0	5	0	0	0	1	0	0	0	0	0
Sui	Unlogged	3	2	08.09.2009	0	0	0	0	2	0	0	0	0	0	0	0	0	0	2	0	0	2	2	0	0	0	0	0
Sui	Unlogged	3	3	13/8/2009	0	0	1	0	20	0	0	1	0	0	0	0	0	0	23	16	0	15	15	0	5	0	0	0
Sui	Unlogged	3	4	17/11/2009	0	0	0	0	19	0	0	0	0	0	0	0	0	0	3	3	0	0	3	0	0	1	0	0
Sui	Unlogged	3	5	18/12/2009	0	0	0	0	37	0	0	0	0	0	0	0	0	0	9	4	0	0	4	0	0	0	0	0
Sui	Unlogged	4	1	30/7/2009	0	0	0	0	2	0	0	0	0	0	0	0	0	0	8	7	1	0	7	0	0	0	0	0
Sui	Unlogged	4	2	08.09.2009	0	0	0	0	6	0	0	0	0	0	0	0	0	0	7	11	2	3	3	0	0	0	0	0
Sui	Unlogged	4	3	13/8/2009	0	0	2	0	11	0	0	0	0	0	0	0	0	0	2	5	5	10	0	0	0	0	0	0
Sui	Unlogged	4	4	17/11/2009	0	0	0	0	1	0	0	0	0	0	0	0	0	0	7	0	2	0	6	0	0	0	0	0
Sui	Unlogged	4	5	18/12/2009	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	5	0	0	4	0	0	0	0	0
Sui	L10	1	1	08.01.2009	0	0	0	0	9	0	0	0	0	1	0	0	0	0	2	2	0	0	6	0	2	2	0	0
Sui	L10	1	2	08.07.2009	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	3	0	0	1	0	4	2	0	0
Sui	L10	1	3	08.11.2009	0	0	3	0	5	0	0	1	0	0	1	0	0	0	4	9	2	1	1	0	9	1	0	0
Sui	L10	1	4	18/11/2009	0	0	0	0	2	0	0	0	0	0	0	0	0	0	2	3	0	0	2	0	3	5	0	0
Sui	L10	1	5	18/12/2009	0	0	0	0	19	0	0	0	0	0	0	0	0	0	3	3	0	0	7	0	5	2	0	0
Sui	L10	2	1	08.01.2009	0	0	0	0	9	0	0	0	0	0	0	0	0	0	2	3	0	0	2	0	1	0	0	0
Sui	L10	2	2	08.07.2009	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	2	2	0	2	0	2	0	0	0
Sui	L10	2	3	08.11.2009	0	0	0	0	1	0	0	2	0	0	2	0	0	0	1	1	0	0	3	0	7	0	0	0
Sui	L10	2	4	18/11/2009	2	0	0	0	27	0	0	0	0	0	0	0	0	0	0	1	3	0	8	0	0	0	0	0

				Species	Amietophrynus maculatus	Amietophrynus regularis	Amietophrynus togoensis	Arthroleptis krokosua	Arthroleptis sp*	Cardioglossa occidentalis	Hoplobatrachus occipitalis	Hylarana albolabris	Hylarana occidentalis	Hyperilous concolor	Leptopelis spiritusnoctis	Leptopelis occidentalis	Phrynobatrachus tokba	Phrynobatrachus latifrons	Phrynobatrachus alleni	Phrynobatrachus annulatus	Phrynobatrachus calcaratus	Phrynobatrachus liberiensis	Phrynobatrachus plicatus	Phrynobatrachus villiersi	Ptychadena aequiplicata	Ptychadena bibroni	Ptychadena longirostris	Ptychadena mascareniensis
Sui	L10	2	5	18/12/2009	0	0	0	0	5	0	0	0	0	0	0	0	0	0	4	8	0	1	3	0	1	0	0	0
Sui	L10	3	1	08.01.2009	0	0	0	0	62	0	0	2	0	0	0	0	0	0	4	0	0	0	2	0	0	0	0	0
Sui	L10	3	2	08.07.2009	0	0	0	0	8	0	0	0	0	0	0	0	0	0	5	2	0	0	3	0	4	0	0	0
Sui	L10	3	3	08.11.2009	0	0	0	0	11	0	0	7	0	3	3	0	0	0	1	2	2	0	5	0	6	0	0	0
Sui	L10	3	4	18/11/2009	0	0	0	0	30	0	0	0	0	0	0	0	0	0	8	1	0	2	1	0	0	0	0	0
Sui	L10	3	5	18/12/2009	0	0	0	0	43	0	0	0	0	0	0	0	0	0	2	5	0	4	9	0	3	5	0	0
Sui	L10	4	1	08.01.2009	0	0	0	0	3	0	0	0	0	0	0	0	0	0	2	1	1	0	0	0	2	0	0	0
Sui	L10	4	2	08.07.2009	0	0	0	0	12	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	6	0	0	0
Sui	L10	4	3	08.11.2009	0	0	2	0	6	0	0	0	0	0	0	0	0	0	3	2	0	0	0	0	8	0	0	0
Sui	L10	4	4	18/11/2009	0	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Sui	L10	4	5	18/12/2009	0	0	0	0	39	0	0	0	0	0	0	0	0	0	0	7	0	2	0	0	13	0	0	0
Sui	L20	1	1	31/7/2009	0	0	0	0	4	0	0	0	0	0	0	0	0	0	1	1	2	0	0	0	0	0	0	0
Sui	L20	1	2	08.01.2009	0	0	0	0	2	0	0	0	0	0	0	0	0	0	3	0	0	0	3	0	0	0	0	0
Sui	L20	1	3	08.09.2009	0	0	0	5	14	0	0	0	0	0	0	0	0	0	8	16	0	0	6	0	0	0	0	0
Sui	L20	1	4	08.10.2009	0	0	0	0	3	0	0	0	0	0	0	0	0	0	2	2	0	0	2	0	0	0	0	0
Sui	L20	1	5	17/12/2009	0	0	0	0	19	0	0	0	0	0	0	0	0	0	6	8	0	2	9	0	1	2	0	0
Sui	L20	2	1	31/7/2009	0	0	0	0	3	0	0	0	0	0	0	0	0	0	6	3	6	0	4	0	4	0	0	
Sui	L20	2	2	08.01.2009	0	0	0	0	12	0	0	0	0	0	0	0	0	0	2	5	5	1	8	0	6	0	0	
Sui	L20	2	3	08.09.2009	0	0	0	2	20	0	0	0	0	0	1	0	0	0	10	7	11	1	3	0	21	0	0	
Sui	L20	2	4	08.10.2009	0	0	0	2	2	0	0	0	0	0	0	0	0	0	4	11	1	0	12	0	2	1	0	
Sui	L20	2	5	17/12/2009	0	0	0	0	41	0	0	0	0	0	0	0	0	0	3	4	2	0	23	0	1	0	0	
Sui	L20	3	1	31/7/2009	0	0	0	0	23	0	0	0	0	0	0	0	0	0	1	5	3	0	7	0	7	0	0	0

				Species	Amietophrynus maculatus	Amietophrynus regularis	Amietophrynus togoensis	Arthroleptis krokosua	Arthroleptis sp*	Cardioglossa occidentalis	Hoplobatrachus occipitalis	Hylarana albolabris	Hylarana occidentalis	Hyperilous concolor	Leptopelis spiritusnoctis	Leptopelis occidentalis	Phrynobatrachus tokba	Phrynobatrachus latifrons	Phrynobatrachus alleni	Phrynobatrachus annulatus	Phrynobatrachus calcaratus	Phrynobatrachus liberiensis	Phrynobatrachus plicatus	Phrynobatrachus villiersi	Ptychadena aequiplicata	Ptychadena bibroni	Ptychadena longirostris	Ptychadena mascareniensis
Sui	L20	3	2	08.01.2009	0	0	0	3	8	0	0	0	0	0	0	0	0	0	2	4	2	0	13	0	0	0	0	0
Sui	L20	3	3	08.09.2009	0	0	2	0	6	0	0	0	0	0	0	0	1	0	7	10	5	3	10	0	19	0	0	0
Sui	L20	3	4	08.10.2009	0	0	0	0	23	0	0	0	0	0	0	0	0	0	12	1	0	1	5	0	5	0	0	0
Sui	L20	3	5	17/12/2009	0	0	0	0	42	0	0	0	0	0	0	0	0	0	8	0	2	0	32	0	9	0	0	0
Sui	L20	4	1	31/7/2009	0	0	0	1	8	0	0	0	0	0	0	0	0	0	3	2	0	2	13	0	2	0	0	0
Sui	L20	4	2	08.01.2009	0	0	0	0	2	0	0	0	0	0	0	0	0	0	2	3	11	0	1	1	0	0	0	0
Sui	L20	4	3	08.09.2009	0	0	0	0	12	0	0	2	0	0	1	0	0	0	5	5	4	3	6	1	7	0	0	0
Sui	L20	4	4	08.10.2009	0	0	0	0	2	0	0	0	0	0	0	0	0	0	2	0	5	1	31	0	3	0	0	0
Sui	L20	4	5	17/12/2009	0	0	0	0	4	0	0	0	0	0	0	0	0	0	1	1	1	0	14	0	9	2	0	0
Sui	RL	1	1	08.02.2009	0	0	0	0	4	0	0	0	0	0	0	0	0	0	1	1	0	1	0	0	1	0	0	0
Sui	RL	1	2	08.06.2009	0	0	0	0	8	0	0	2	0	0	0	0	0	0	3	3	0	0	0	0	2	0	0	0
Sui	RL	1	3	08.12.2009	0	0	0	0	29	0	0	4	0	0	1	0	0	0	4	6	0	2	0	0	4	1	0	0
Sui	RL	1	4	18/11/2009	0	0	0	0	11	0	3	2	0	2	1	0	0	0	1	2	0	0	0	0	2	2	0	0
Sui	RL	1	5	19/12/2009	2	0	0	0	18	0	5	0	0	1	4	0	0	0	0	0	3	0	0	0	0	4	0	0
Sui	RL	2	1	08.02.2009	0	0	0	0	23	0	1	0	0	0	0	0	0	0	3	2	2	0	0	0	0	6	0	0
Sui	RL	2	2	08.06.2009	0	0	0	0	8	0	2	8	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0
Sui	RL	2	3	08.12.2009	0	0	0	0	7	0	1	11	0	0	2	0	0	3	7	6	0	0	0	0	0	0	0	0
Sui	RL	2	4	18/11/2009	0	0	0	0	12	0	0	0	0	0	1	0	0	0	2	0	4	0	0	0	0	1	0	0
Sui	RL	2	5	19/12/2009	0	0	0	0	37	0	2	0	0	2	4	0	0	0	0	0	3	0	0	0	2	5	3	0
Sui	RL	3	1	08.02.2009	0	0	0	0	33	0	2	0	0	0	0	0	0	0	0	2	0	0	0	0	2	0	0	2
Sui	RL	3	2	08.06.2009	0	0	0	0	41	0	3	0	0	0	0	0	0	0	0	3	0	0	0	0	2	0	0	0
Sui	RL	3	3	08.12.2009	0	0	0	0	31	0	4	0	0	0	2	0	0	0	3	5	0	0	2	0	4	0	0	0

				Species	Amietophrynus maculatus	Amietophrynus regularis	Amietophrynus togoensis	Arthroleptis krokosua	Arthroleptis sp*	Cardioglossa occidentalis	Hoplobatrachus occipitalis	Hylarana albolabris	Hylarana occidentalis	Hyperilous concolor	Leptopelis spiritusnoctis	Leptopelis occidentalis	Phrynobatrachus tokba	Phrynobatrachus latifrons	Phrynobatrachus alleni	Phrynobatrachus annulatus	Phrynobatrachus calcaratus	Phrynobatrachus liberiensis	Phrynobatrachus plicatus	Phrynobatrachus villiersi	Ptychadena aequiplicata	Ptychadena bibroni	Ptychadena longirostris	Ptychadena mascareniensis
Sui	RL	3	4	18/11/2009	0	0	0	0	37	0	0	0	0	0	0	0	0	0	0	1	0	0	2	0	0	0	0	2
Sui	RL	3	5	19/12/2009	3	3	0	0	45	0	2	0	0	0	0	2	0	0	0	0	0	0	4	0	0	0	0	0
Sui	RL	4	1	08.02.2009	0	0	0	0	9	0	0	0	0	0	0	0	0	0	0	2	0	0	1	0	7	0	0	0
Sui	RL	4	2	08.06.2009	0	0	0	0	20	0	0	0	0	0	0	0	0	0	0	0	2	0	2	0	2	0	0	0
Sui	RL	4	3	08.12.2009	0	0	1	0	36	0	0	0	0	0	1	0	0	0	0	3	2	2	8	0	9	3	0	0
Sui	RL	4	4	18/11/2009	0	0	0	0	21	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	2	10	0	0
Sui	RL	4	5	19/12/2009	0	0	0	0	41	0	0	0	0	0	0	0	0	0	0	2	2	0	9	0	1	4	0	0