Bioacoustics of two cloud forest ecosystems in Ecuador compared to a lowland rainforest with special emphasis on singing cricket species

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ABSTRACT

Sound recordings in three neotropical forest ecosystems have been carried out to compare the diversity of sound producing insects, especially crickets (Gryllidae). The montane study site Reserva Otonga is characterized to be poor of singing species compared to the lowland study site San Pablo. All singing cricket species found in Reserva Otonga belong to one single subfamily (Phalangopsinae) while other subfamilies (Trigonidiinae, Eneopterinae, rich in singing species in the lowland) are missing completely. These results are discussed on the background of different climatic factors at the study sites.

INTRODUCTION

Tropical lowland rainforests are the most diverse land biota on earth (ERWIN, 1982, 1983; STORCK, 1988; WILSON, 1992). Especially the number of insect species living in these forests seems to succeed the number of all animal species described yet.

Investigations in montane tropical forests show that animal and especially insect species richness decline with the altitude of the study sites. TERBOURGH (1977) showed this for neotropical bird species by preparing an elevation gradient in the Andes of Peru. The number of species he had found in his investigation declined with rising altitude. This effect was most obvious for insectivore birds.

HEBART found similar results for moth communities in montane Papua New Guinea: Species richness decreased with rising altitude. JANZEN (1973 a, b) studied the arthropod fauna of different sites in Costa Rica. Depending on the lowland reference site he chose for the comparison arthropod diversity was highest at mediate highs around 1500 m or in the lowland. Sound is used by many animal species as a method of communication. Especially in forest habitats and for nocturnal activity acoustical signaling seems to be advantageous for long distance communication. In insects mainly Orthoptera (crickets, katydids, grasshoppers) and Homoptera (cicadas) have developed the ability of sound production and reception and

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established systems of acoustical communication. Since every habitat has its typical composition of signaling insect species, biotic sound can be used for characterization of that habitat. If the specific song of a species is known it can be used as an indicator for further studies about the singing species (presence/absence, time of activity, seasonality).

The family Gryllidae (Orthoptera, Ensifera) is found in moderate and tropical climates throughout the world with highest species richness in the tropics. Faunistic investigations on crickets of montane tropical forests are rare. OTTE (1994) described the Hawaiian fauna including montane cricket species. Almost all species found in Hawaiian montane forests belong to the subfamilies Oecanthinae and Trigonidiinae.

Most adult male cricket species produce sound with their forewings during sexual behavior. Songs produced by different species differ in their time patterns and the frequencies generated. Since cricket songs show to be highly species specific they can be used as means of access for faunistic studies in the field. RIEDE (1993, 1996, 1997) used recordings of insect sounds to characterize insect communities of tropical forests in Ecuador and Borneo. In his work he utilized cricket songs as indicators of the occurrence of cricket species without collecting these species and without any taxonomic description.

NISCHK and OTTE (in prep.) "tried to close this gap by detailing the species-composition of cricket communities as well as the diversity of their calling songs and sound production in two tropical forest ecosystems." Since one of these ecosystems was a neotropical lowland forest (located in the Amazonian lowland of Ecuador) and the other was the cloud forest Otonga their work made possible to compare cricket faunas of the two ecosystems.

The study presented here wants to describe how singing insects (especially crickets) form the ambient sound structure of a neotropical cloud forest. In a comparison to a lowland rainforest it will be pointed out that differences in the sound composition directly show differences of insect communities occurring at the study sites.

METHODS

Sound recording and collecting

If possible cricket songs were recorded in field and the singing males were collected afterwards. In other cases flying crickets were attracted to a 12 V lamp with high UV radiation and songs were taped in captivity afterwards. Both methods made possible to match a particular song to a specimen.

More recordings were made at all times of the day in all study sites. Later they were analyzed in search for additional calling songs. They were taken in counts for comparison of the species richness of the study sites.

Sound recording and analysis

A portable DAT-Recorder (Sony TCD-D7) and Sennheiser microphones ME 67 and MKE 2-60 with pre-amplifier K6 were used for sound recordings.

Sound analysis was performed using Soundscope 8/ 1.44 (GWI-Instruments) software on an Apple Macintosh Power Book 5300. A Fast Fourier Transform generated by the software allowed to create oscillograms, sonograms and amplitude spectra of the recordings up to 22 kHz sound frequency. These features were used to measure song parameters like pulse duration, pulse rate and carrier frequency of the songs and to create figures for documentation purposes.

Systematics: Description of species

Not all species found in the study sites are determined, and several are not yet described. This work is still going on and is carried out by Daniel Otte, Academy of Natural Sciences, Philadelphia and Laure Desutter-Grandcolas, Musée National de Histoire Naturelle, Paris. A description of ten new species (subfamily Phalangopsinae) is in preparation (OTTE & NISCHK, in prep.). If these species are mentioned here the names proposed by Daniel Otte will be used although the descriptions are not published yet. Two new species from the lowland study site, *Anaxipha bradephona* and *A. tachephona* (Trigonidiinae) have already been described by Laure Desutter-Grandcolas (DESUTTER-GRANDCOLAS & NISCHK, 2000).

All species not determined yet but appearing in this work will be named with provisory names that include abbreviations of subfamily and study site, e.g. PhalOtLP2 (second phalangopsine species at the study sites Otonga and Las Pampas).

Study sites

All collections and recordings were made at three study sites in three different forests in Ecuador.

a) Reserva Otonga, province Cotopaxi (0°25´S,79°01´W)

For a characterization of the study site see Nowicki (this volume, p. 115). All studies were made near the Universidád Católica field station at an altitude of 2000 m.

b) Las Pampas

For comparisons to a second montane location at lower altitude a small area with forestal vegetation near Otonga was chosen. It is located nearby to the small community Las Pampas at an altitude of about 1400 m. In contrast to Otonga this study site is located below the cloud zone. Due to the lower altitude temperatures are higher and humidity seems to be much lower. Less epiphytic plants especially mosses are found at this site.

c) San Pablo de Kantesiya, province Sucumbíos (0°15´S 76°27´W)

San Pablo de Kantesiya is a small Indian village in the Siona-Secoya territory. It is located at the Rio Aguarico in the eastern lowlands of Ecuador. This region belongs to the northwestern part of the Amazonian lowlands. In contrast to surrounding land, the 20000 ha territory is still covered with tropical rainforest. There are anthropogenous impacts on the forest such as shifting agriculture, selective forestry and hunting. This results in a mosaic of primary and secondary forests of different ages.

RESULTS

Insect sounds at the study site Otonga

Comparison to the lowland study site San Pablo

Orthoptera and Cicada are the main sources of insect sounds at Otonga. Like in tropical lowland forests cicada dominate during daytime, Orthoptera during nighttime (Fig. 2). The most obvious difference to the lowland is a much lower acoustic activity, especially during the night (Figures 1, 4). This could be the consequence of a lower density of calling individuals and/or a lower calling activity of single individuals. Acoustic activity differs not only in quantity but also in frequency composition: In the lowland study site a broad frequency range from 2 – 10 kHz is saturated by singing cricket males (Fig. 4). At Otonga only lower frequencies (2 – 4 kHz) are produced by singing crickets (Fig. 1). Since cricket males use species specific narrow frequency bands (carrier frequency) for signaling, the lack of higher frequencies is a direct indicator for a different species composition. Further analysis of taped cricket songs showed that only four different cricket songs can be heard at Otonga (Fig. 5). Furthermore all singing species collected at the study site belong to one single subfamily (Phalangopsinae). Low carrier frequencies (and low pulse rates) seem to be characteristic for singing phalangopsid cricked species. Higher frequencies (5 – 10 kHz) missing at Otonga but being very prominent in San Pablo are typical for small species belonging to the subfamily Trigonidiinae. Not a single singing representative of that taxon could be found at Otonga. Sound composition could be used as an fast access to show differences of cricket communities (here: species richness and composition) at different study sites.

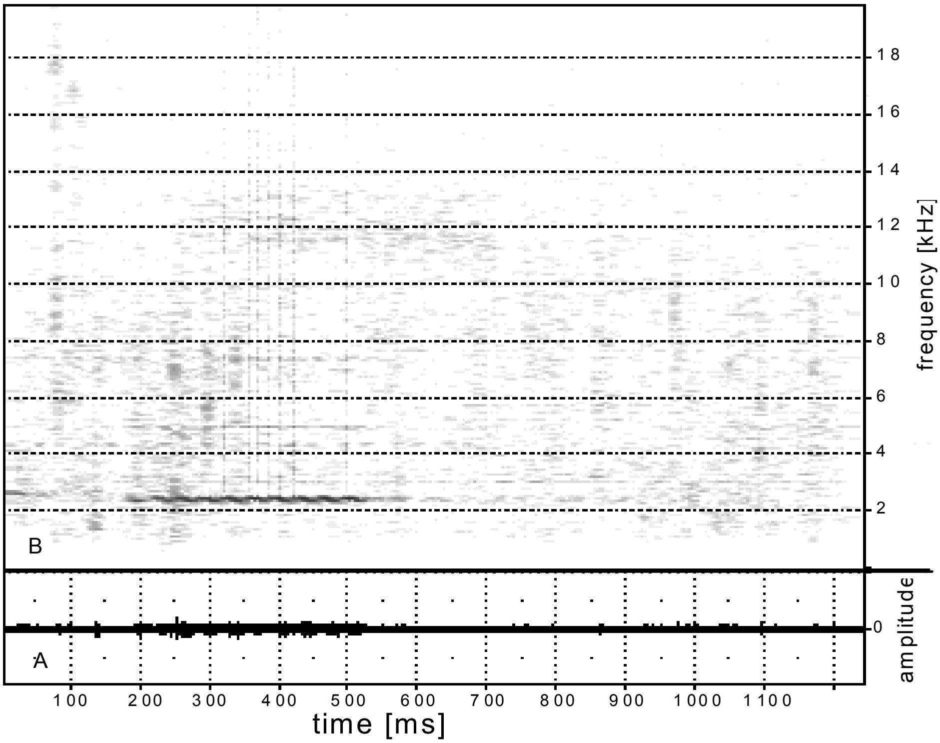
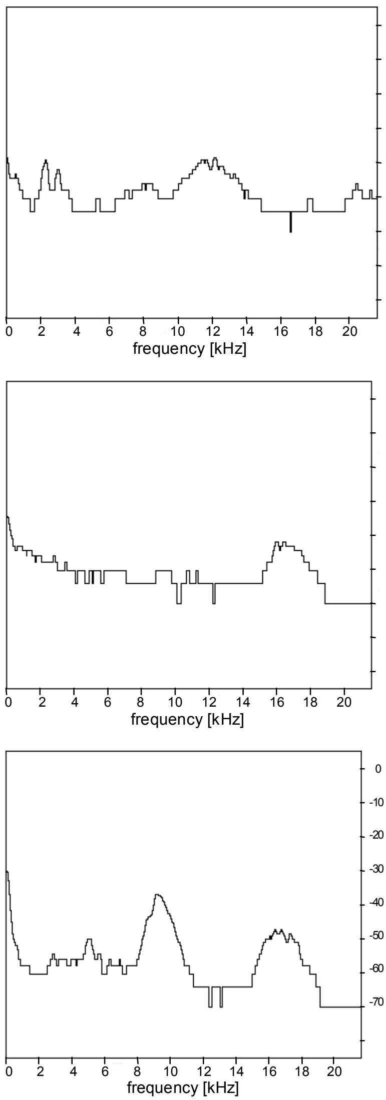


Fig. 1: Oscillogram (A) and sonogram (B) of a recording at the study site Otonga (19 h). Bioacoustic activity is low. Periods of silence are interrupted by only a few singing insects (here: *Aclodes hypoxyros*, Orthoptera: Gryllidae: Phalangopsinae).

Comparison to study site Las Pampas

At the montane study site Las Pampas located 600 m lower than Otonga, overall intensity of biotic sound was much higher. During nighttime a continuos noise produced by singing crickets could be heard (Fig. 3). Abundance of singing individuals seems to be higher than at Otonga although higher cricket frequencies above 5 kHz are still lacking. All cricket songs present at Otonga are found at Las Pampas, too. Seven additional cricket songs could be taped although the duration of the studies here was much shorter and the area is smaller. Two of the additional species could be collected. One belongs to the subfamily Eneopterinae, the other to the subfamily Gryllinae. Five out of ten songs could not be matched to a singing individual. In Table 1 and Fig. 6 they are listed as ethospecies. Both species richness and the number of taxa are still lower than in the megadiverse lowland rainforest of San Pablo.



8 p.m.

11 a.m. - cicadas

11a.m. + cicadas

Fig. 2: Frequency spectrograms of recordings (duration: 5 s) at different times (study site: Otonga, 2000 m). Cicada songs of two species dominate during daytime (8 – 11 kHz and 15 – 19 kHz). This is most obvious, when a chorus of cicadas is active (+cicadas). At night overall sound activity is much lower that it is in the lowland study site San Pablo. Frequencies typical for cricket songs are seldom except of a few peaks between 3 to 5 kHz. A broad frequency band of higher intensity (10 – 14 kHz) is produced by a nocturnal cicada species (see also figures 32, 33).

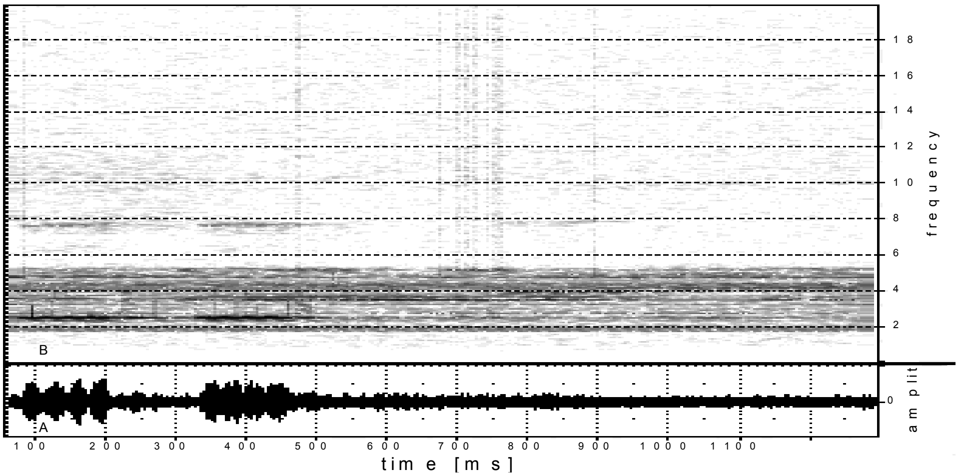


Fig. 3: Oscillogram (A) and sonogram (B) of a recording in Las Pampas (1400 m) at 7 p.m. Biotic sound sources can be seen as dark traces between 2–5 kHz. Cricket males sing in this frequency band. The absence of phases of silence shows a higher density of singing individuals compared to the higher study site Las Pampas. In contrast to the lowland study site San Pablo frequencies between 5–10 kHz are missing. These higher frequencies are produced there by male crickets of the subfamily Trigonidiinae.

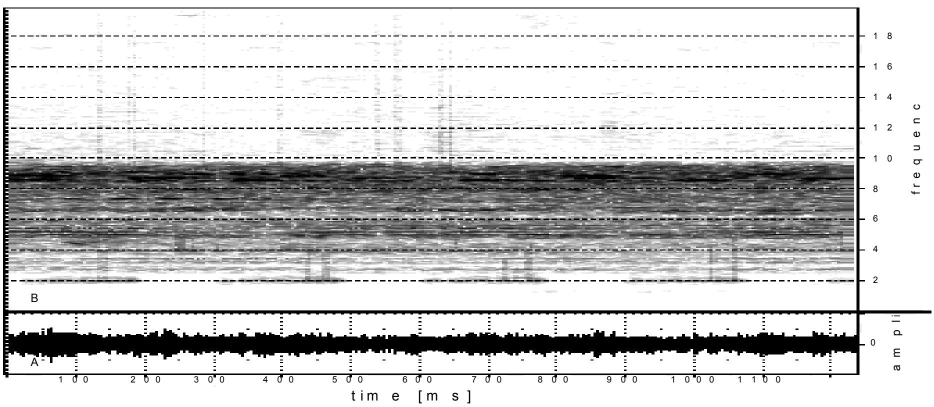


Fig. 4: Oscillogram (A) and sonogram (B) of a recording (19 h) in San Pablo. Biotic sound activity is high in the frequency range between 2 and 10 kHz. This continuos noise is produced by singing cricket males. Crickets use very narrow frequency bands for their signals visible as a pattern of narrow traces in the sonogram.

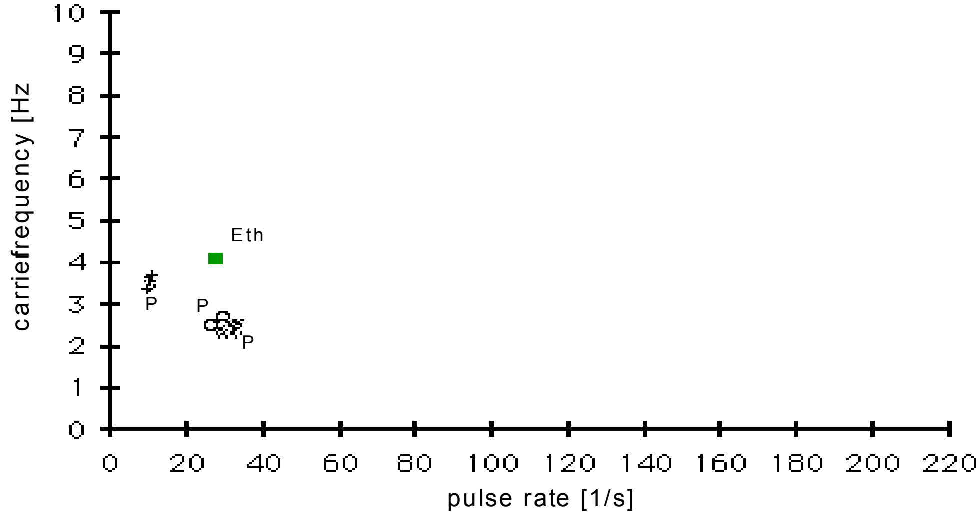


Fig. 5: Song parameters carrier frequency and pulse rate of cricket songs recorded at Otonga (2000 m). P: Subfamily Phalangopsinae, Eth: species not identified (ethospecies).

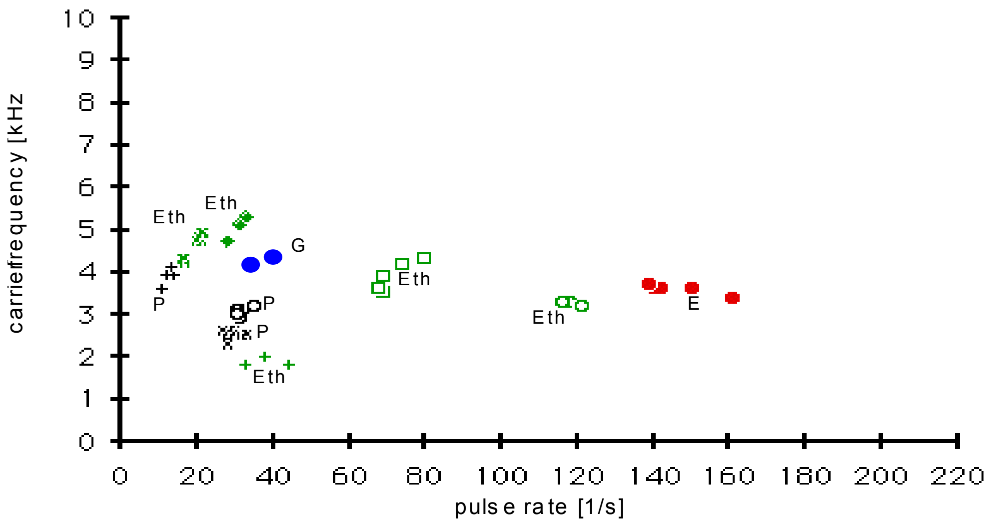


Fig. 6: Song parameters carrier frequency and pulse rate of cricket songs recorded in Las Pampas (1400 m). P: Subfamily Phalangopsinae, E: Eneopterinae, G: Gryllinae, Eth: species not identified (ethospecies).

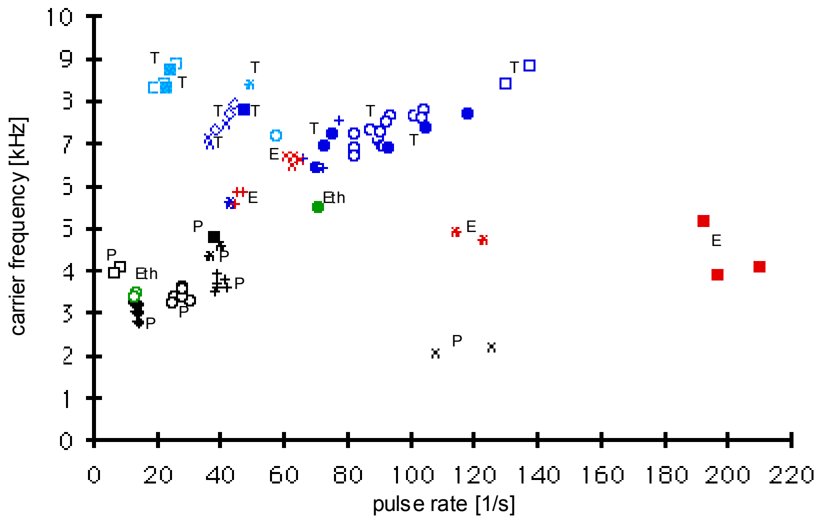


Fig. 7: Song parameters carrier frequency and pulse rate of cricket songs recorded during night in San Pablo (200-300 m). P: Subfamily Phalangopsinae, E: Eneopterinae, T: Trigonidiinae, Eth: species not identified (ethospecies).

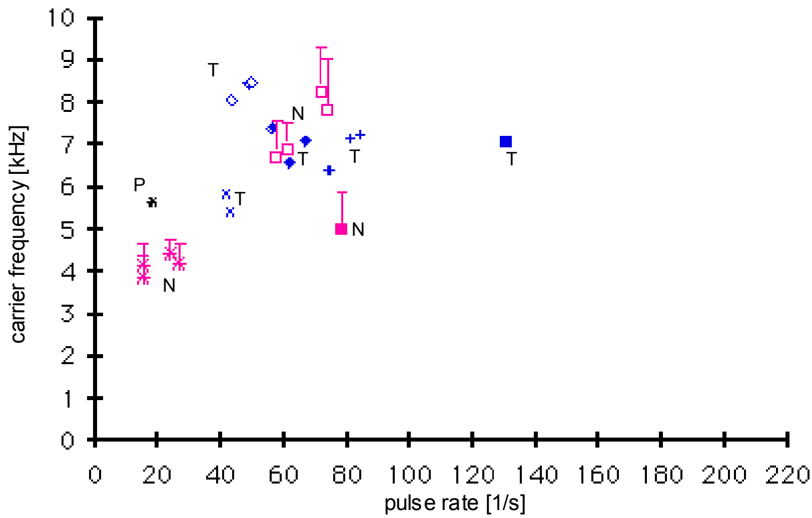


Fig. 8: Song parameters carrier frequency and pulse rate of cricket songs recorded during daytime in San Pablo (200-300 m). P: Subfamily Phalangopsinae, T: Trigonidiinae, N: Nemobiinae. Vertical bars: range of frequency modulated pulses.

Table 1: Number of singing cricket species found in the study sites.

	Otonga (2000 m)	Las Pampas (1400 m)	San Pablo (200 - 300 m)
Trigonidiinae	-	-	18
Phalangopsinae	3	3	8
Eneopterinae	-	1	4
Nemobiinae	-	-	2
Gryllinae		1	1
ethospecies	1	5	2
total	**4**	**10**	**35**

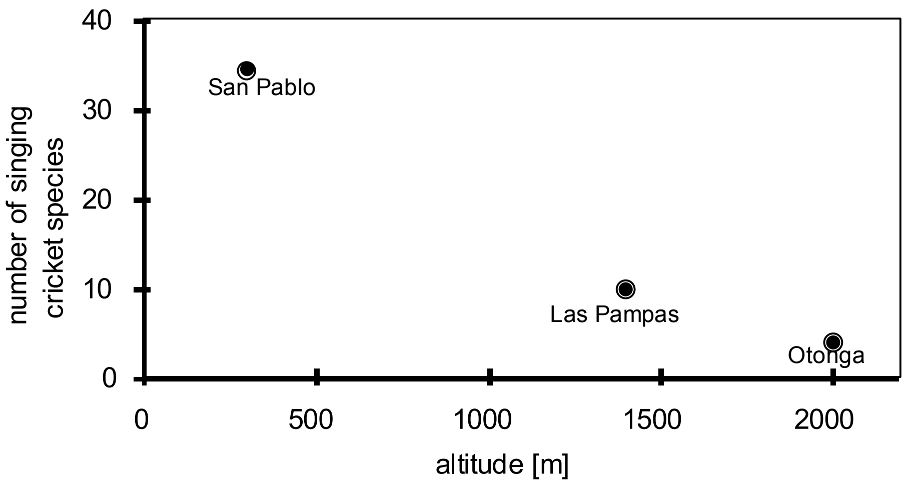


Fig. 9: The study sites San Pablo, Las Pampas and Otonga differ in the number of singing cricket species. With rising altitude of the site the number of singing species declines.

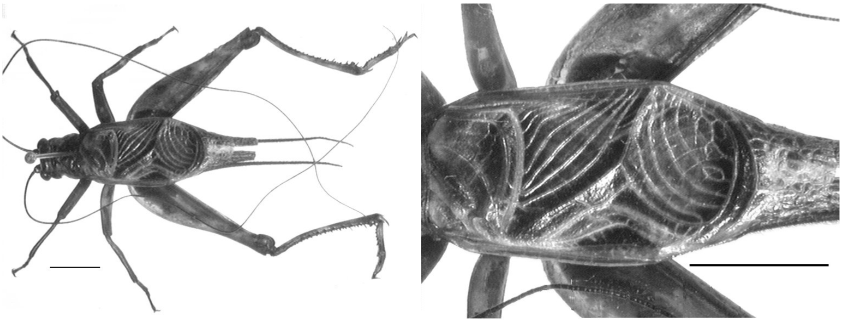
Cricket songs of the Reserva Otonga and Las Pampas:

Three cricket songs taped in the Reserva Otonga could be matched to specimens collected. All species are new, two out of the three have been described by Daniel Otte, Academy of Natural Sciences, Philadelphia (NISCHK & OTTE, in prep.) Although not published yet names suggested by Daniel Otte are used here.

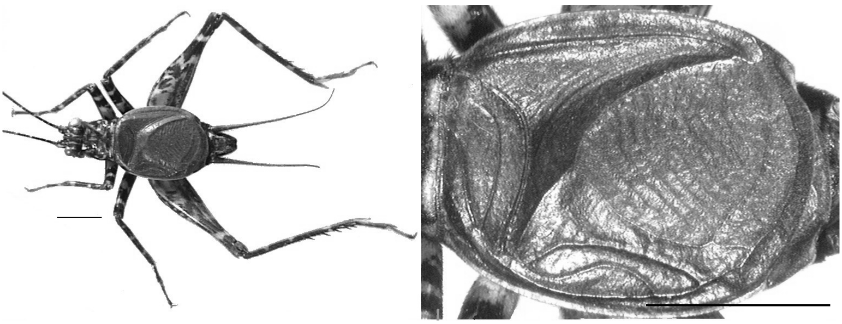
Dambachia eritheles **(NISCHK & OTTE, in prep.)**

Subfamily: Phalangopsinae

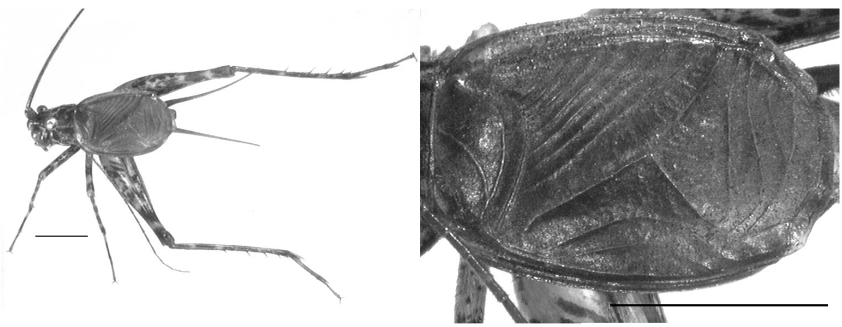
This species is the first one out of a new genus described by Daniel Otte. Males sing on tree trunks high up in the canopy. Time of activity: nocturnal. The calling song consists out of chirps of two to three pulses with long pauses between chirps. *Dambachia eritheles* was found both in Reserva Otonga and Las Pampas. Due to higher temperatures at Las Pampas, pulse rates and carrier frequencies of songs were higher than in Otonga. Since no individuals (larvae, males or females) could be found on or close to the ground this species seems to be an exclusive canopy inhabitant. This means that females must find a substrate for oviposition on branches covered with soil.



Dambachia eritheles



Species PhalOtLP2



Aclodes hypoxyros

Abb. 10: Singing species (subfamily Phalangopsinae) from Reserva Otonga/Las Pampas. Left side: habitus of adult males. Right side: dorsal view on the upper (right) forewing. Scale: 5 mm

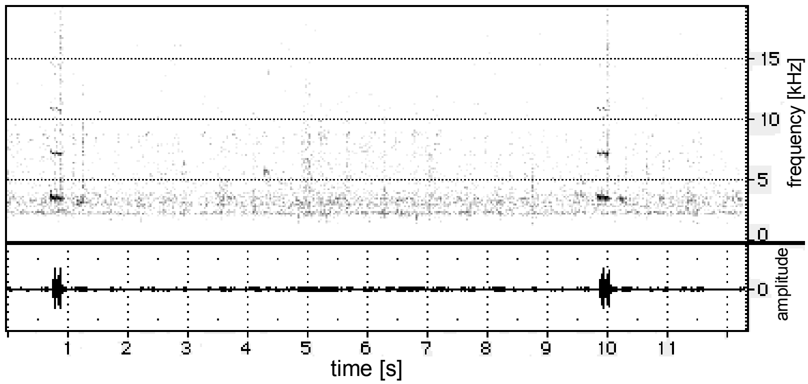


Fig. 11: Species *Dambachia eritheles*. Two chirps of the calling song. Oscillogram and sonogram. Harmonics (7,2 kHz and 11 kHz) of the carrier frequency (3,6 kHz) can be seen as traces in the sonogram.

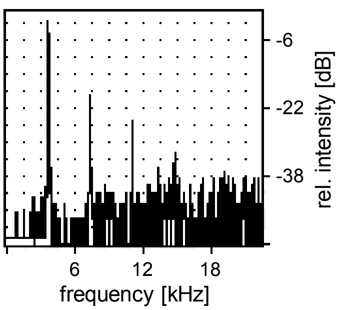


Fig. 12: Species *Dambachia eritheles*. Frequency spectrogram of a single pulse. Carrier frequency: 3,6 kHz, harmonics at 7,2 kHz and 11 kHz.

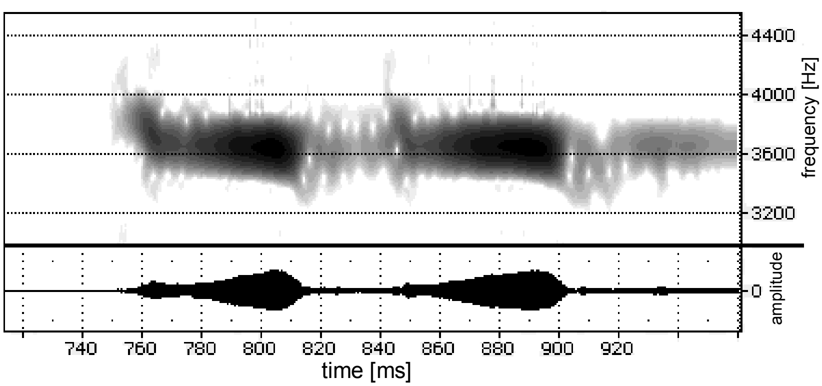


Fig. 13: Species *Dambachia eritheles*. One chirp of the calling song consists of two pulses.

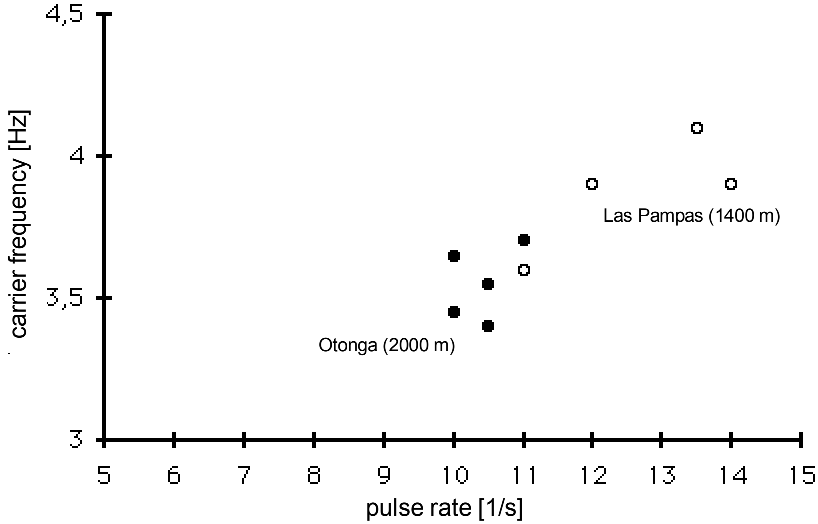


Fig. 14: Species *Dambachia eritheles*. Parameters carrier frequency and pulse rate of the calling songs of nine different individuals at Otonga (2000 m) and Las Pampas (1400 m). The lower temperatures at the higher study site Otonga had a lowering effect on carrier frequency and pulse rate of the calling songs.

Aclodes hypoxyros (NISCHK & OTTE, in prep.)

Subfamily: Phalangopsinae

This new species has been recently described by Daniel Otte. The genus *Aclodes* is found throughout the Amazon (DESUTTER-GRANDCOLAS, 1992b; NISCHK & OTTE, in prep.). *Aclodes hypoxyros* is its first representative described for montane forests. Males sing on trunks of trees up to 2 m high. The song is made up by chirps of 10 to 11 pulses. Although the parameters pulse rate and carrier frequency are very similar to those of PhalOtLP2`s calling song, the different number of pulses per chirp makes both songs easily distinguishable.

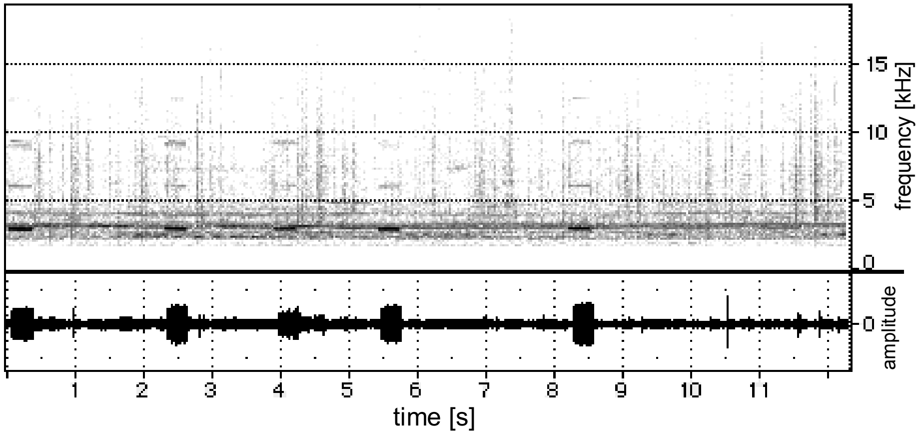


Fig. 15: Species *Aclodes hypoxyros*. Five Chirps of the calling song. Oscillogram and sonogram of a recording in Las Pampas (1400 m). The other dark traces in the oscillogram show biotic noise produced by other cricket species active at that study site.

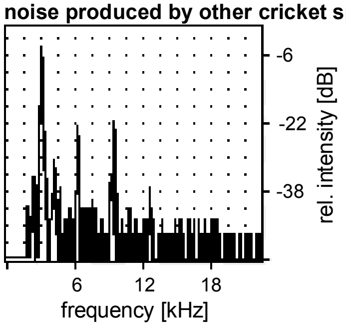


Fig. 16: Species *Aclodes hypoxyros*. Frequency spectrogram of a single pulse. Carrier frequency: 3,1 kHz, harmonics at 6,3 kHz, 9,6 kHz and 13 kHz.

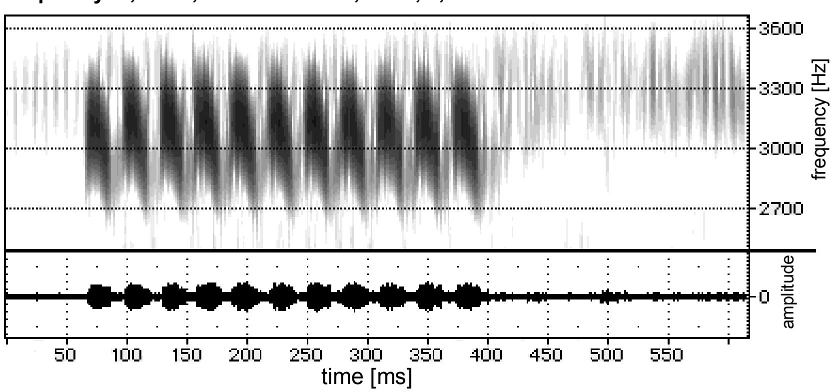


Fig. 17: Species *Aclodes hypoxyros*. One chirp of the calling song consists of eleven pulses.

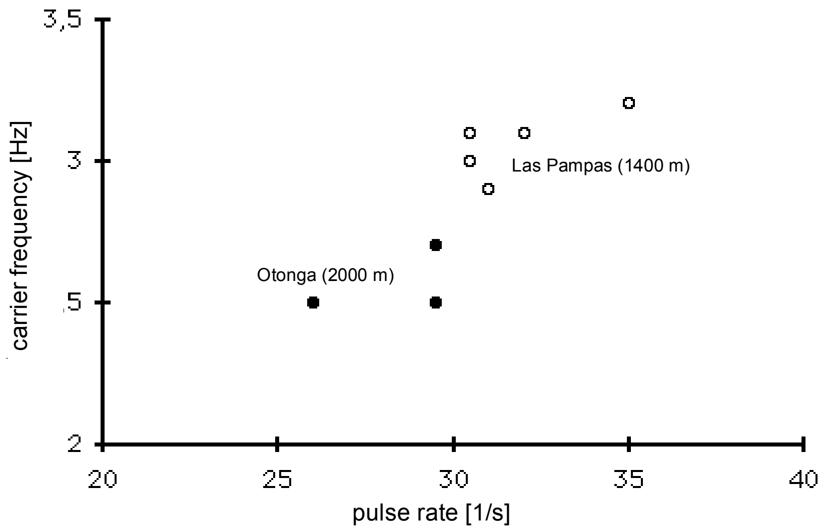


Fig. 18: Species *Aclodes hypoxyros.* Parameters carrier frequency and pulse rate of the calling songs of nine different individuals at Otonga (2000 m) and Las Pampas (1400 m). The lower temperature at the higher study site Otonga has a lowering effect on carrier frequency and pulse rate.

c) Species PhalOtLP2

Subfamily: Phalangopsinae

This new species will soon be described by Laure Desutter-Grandcolas, Musée National de la Histoire Naturelle, Paris. In personal communication she has mentioned that this species is new and also a new genus will have to be described. PhalOtLP2 is the most abundant singing cricket species in the Reserva Otonga and in Las Pampas. It can be heard all over during night time. Males sing on tree trunks up to 3 m over ground. Larvae could be found in cavities between the trunk and dead bark of old trees. Males produce a loud calling song which consists of trains of chirps made up by five pulses (carrier frequency: aprox. 2,5 kHz).

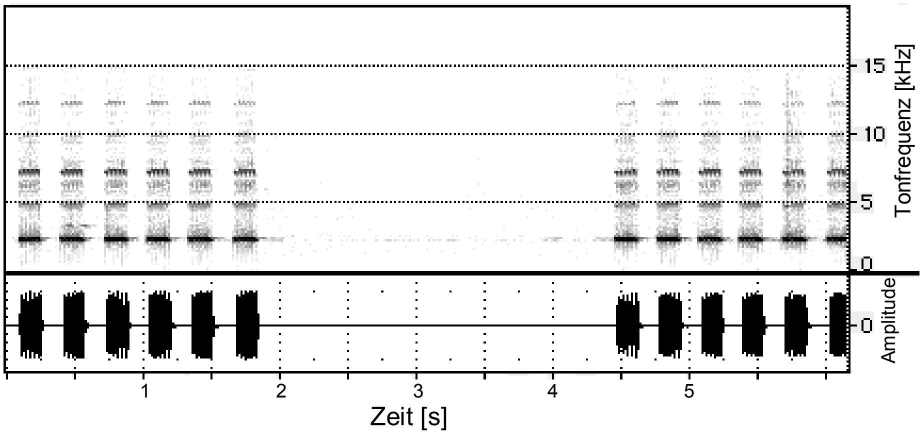


Fig. 19: Species PhalOtLP2. Two trains of chirps of the calling song.

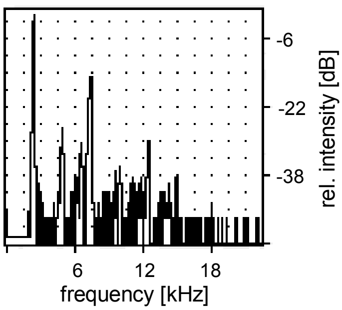


Fig. 20: Species PhalOtLP2. Frequency spectrogram of a single pulse. Carrier frequency: 2,4 kHz, harmonics at 4,9 kHz, 7,3 kHz, 9,8 kHz and 12,4 kHz.

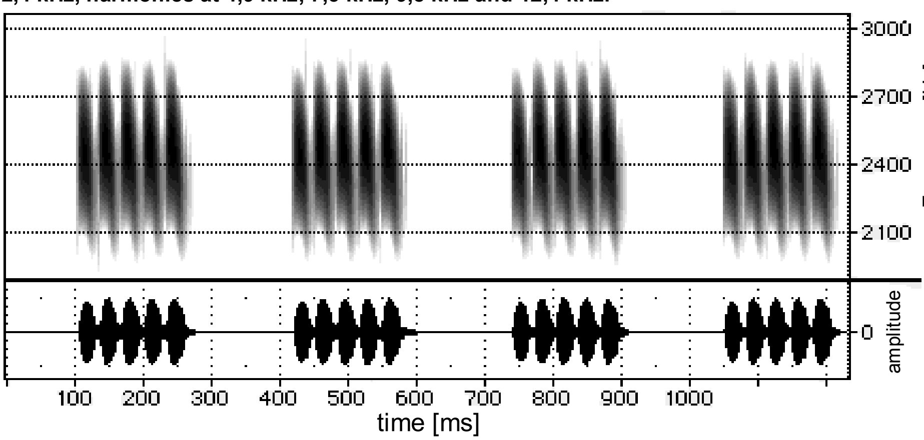


Fig. 21: Species PhalOtLP2. Four chirps of the calling song. Each chirp consists of five pulses.

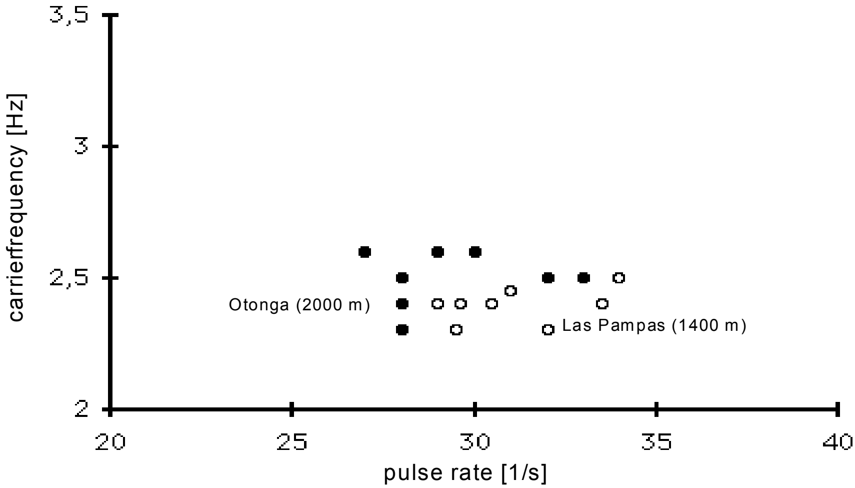


Fig. 22: Species PhalOtLP2: Parameters carrier frequency and pulse rate of the calling songs of nine different individuals at Otonga (2000 m) and Las Pampas (1400 m). The lower temperature at the higher study site Otonga has a lowering effect only on the pulse rate. The carrier frequency is independent from the ambient temperature.

Species EneopLP1

Subfamily: Eneopterinae

This species is believed to belong to the genus *Paroecanthus*. Singing males could be heard only in the lower study site Las Pampas. Adult animals of both sexes can and do fly. Males

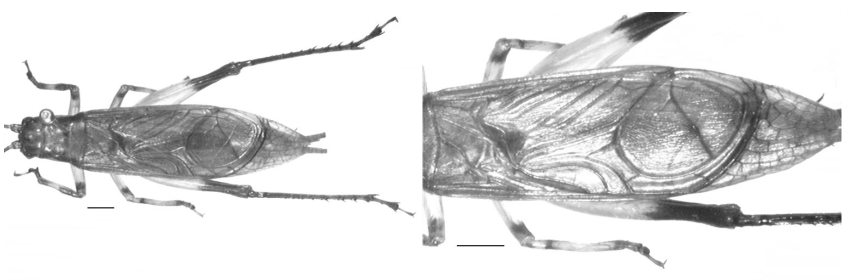


Abb. 23: Species EneopLP1 (*Paroecanthus spec.*). Left: habitus, right: upper (right) forewing. Scale: 5 mm

sing during nighttime on leaves of bushes and trees. The calling song is made up by trains of longer (40 - 70 pulses) and short (15 - 26 pulses) trills with an extremely high pulse rate (140 – 180 /s).

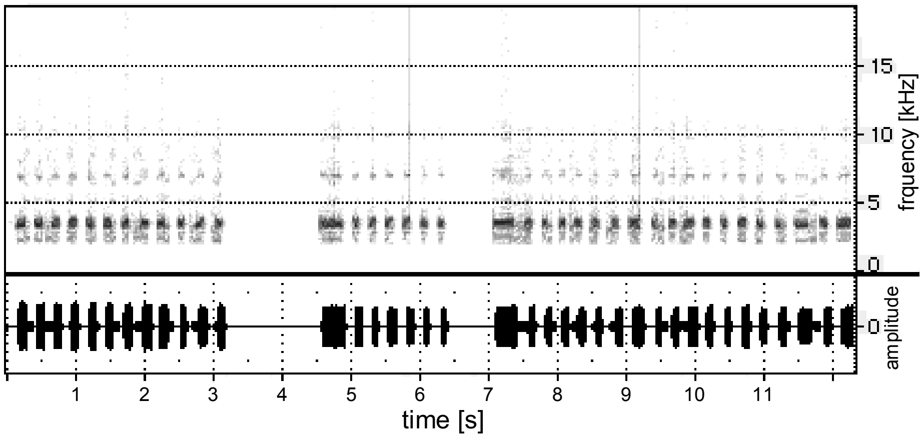


Fig. 24: Species EneopLP1 (*Paroecanthus spec.*), Las Pampas (1400 m). The calling song consists of trains of long and short trills.

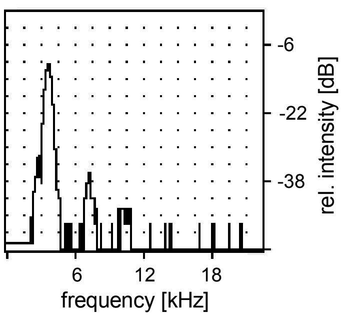


Fig. 25: Species EneopLP1 (*Paroecanthus spec.*), frequency spectrogram of a single pulse of the calling song. Carrier frequency 3,6 kHz, harmonics at 7,2 kHz and 10,4 kHz.

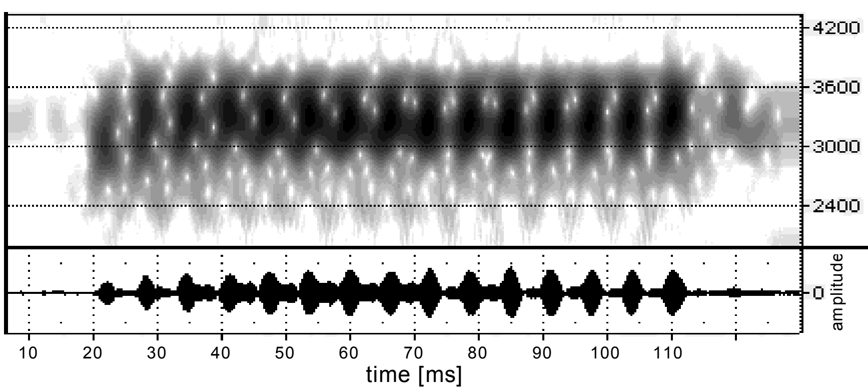


Fig. 26: Species EneopLP1 (*Paroecanthus spec.*), Las Pampas (1400 m), one short trill.

Species GryllLP1

Subfamily: Gryllinae

This undetermined species was only found in Las Pampas. Its calling song is made up by short three pulse chirps. Carrier frequency: 4200–4300 kHz.

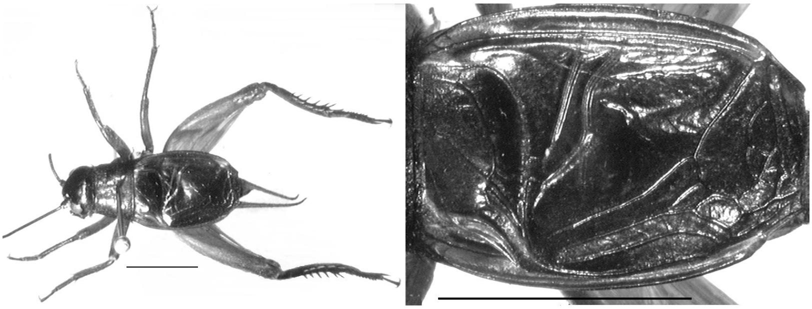


Abb. 27: Species GryllLP1. Left: habitus, right: upper (right) forewing. Scale: 5 mm.

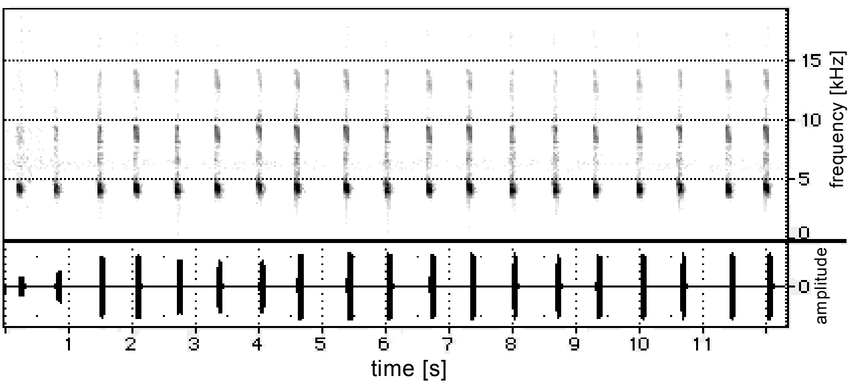


Fig. 28: Species GryllLP1, Las Pampas (1400 m). 19 chirps of the calling song.

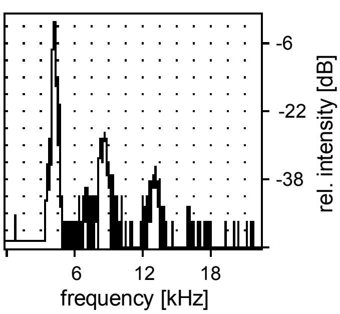


Fig. 29: Species GryllLP1. Frequency spectrogram of a single pulse. Carrier frequency: 4,3 kHz, harmonics at 8,6 kHz and 13 kHz.

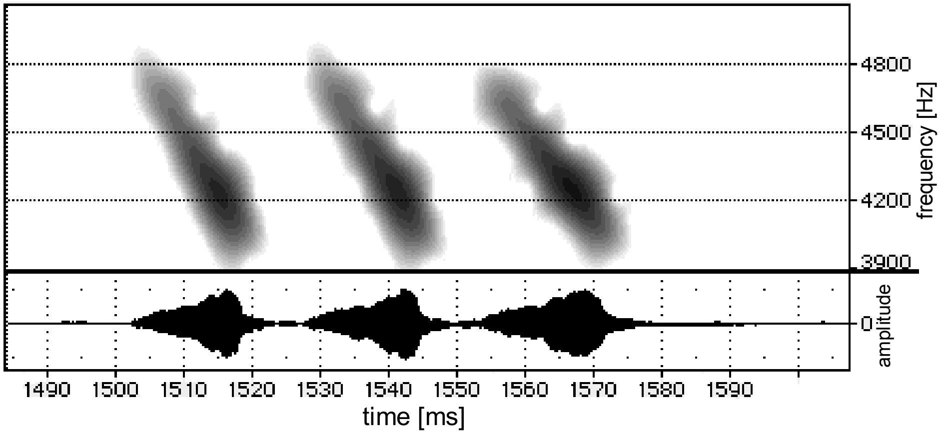


Fig. 30: Species GryllLP1, Las Pampas (1400 m). One chirp is made up by three pulses. All pulses are frequency modulated.

Mute species

Some cricket species have lost the ability to sing. Several of these mute species were found at the study sites Reserva Otonga. Results are similar to those for singing crickets looking at species richness and number of found subfamilies. Most of the mute species found in the Reserva Otonga belong to the subfamily Phalangopsinae. Some taxa abundant at the lowland study site San Pablo do not appear in the Reserva Otonga, e.g. species of the genus Aphonomorphus, subfamily Podoscirtinae.

Species PhalOtLP4

Tribe: Luzarini

Genus: *Gryllosoma* ? HEBARD, 1928a

This undetermined species can be found under leaf litter on forest ground in the Reserva Otonga and Las Pampas.

Species PhalOtLP5

This so far undetermined wingless species lives in mosses covering almost every tree branch in the Reserva Otonga. Because of their greenish color individuals are very hard to be found.

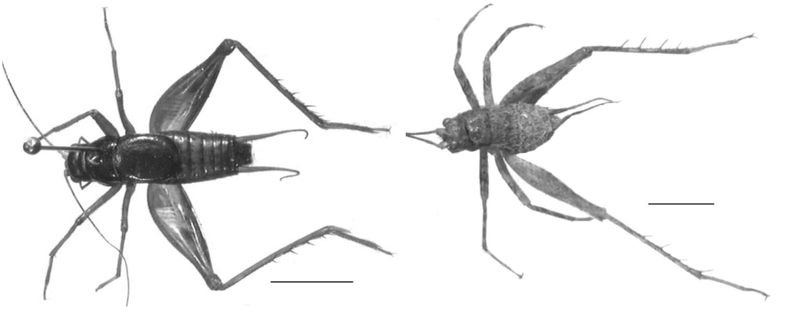


Fig. 31: Mute cricket species found in the Reserva Otonga, males. Left: PhalOtLP4 right: PhalOtLP5. Scale: 5 mm

Other singing insects

Several cicada species could be taped in Reserva Otonga. As most species heard in Otonga cicadas are active normally during daytime.

One so far undetermined species is calling exclusively during nighttime. To my best knowledge this kind of nocturnal activity has not been described for cicadas yet.

The males' calls consist of two phases: A train of pulses is followed by a series of pairs of additional pulses. Frequency structure of the pulses of both phases is identical: Frequencies from 9 kHz up to ultrasound are generated by singing males with an intensity maximum around 11 kHz. Cicada wings found under a branch where bats used to rest show that this nocturnal cicada species is an important prey for insectivore bats in the Reserva Otonga.

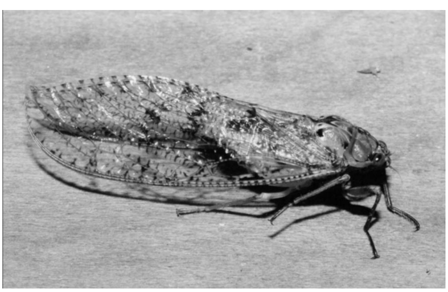


Fig. 32: So far undetermined Cicada. Males show calling activity during nighttime.

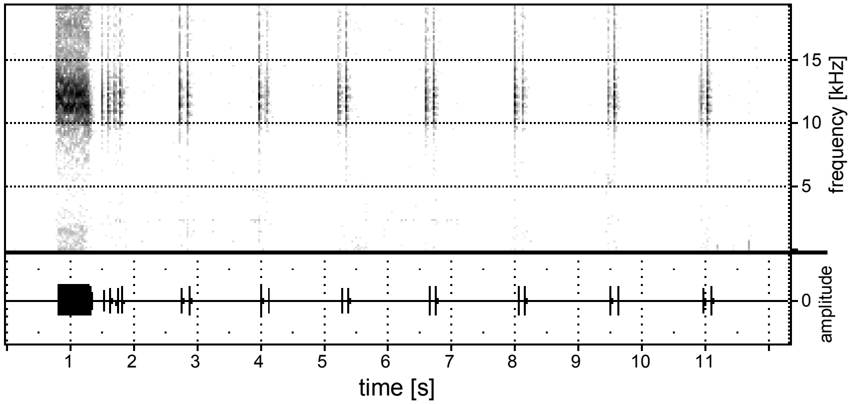


Fig. 33: Oscillogram and sonogram of the calling song of a nocturnal Cicada, Otonga. It is made up by two phases: A train of pulses is followed by nine pairs of pulses.

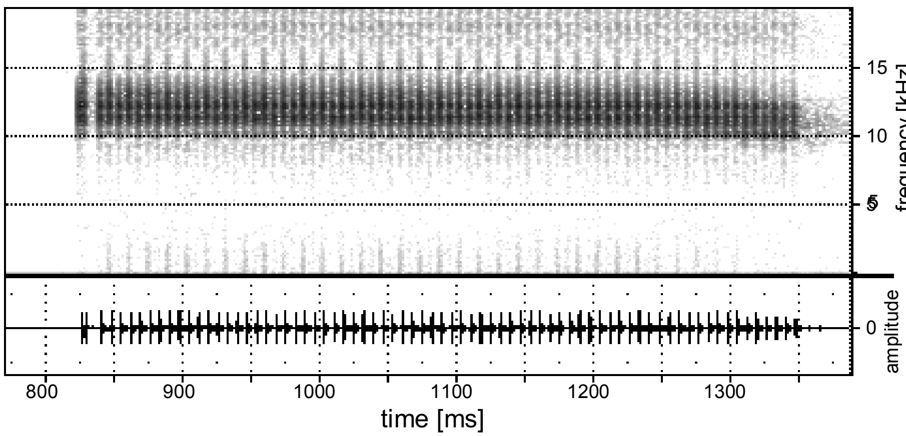


Fig. 34: Oscillogram and sonogram of a part of a call of a nocturne Cicada, Otonga. The trail of pulses in the beginning of the call is shown with higher temporal resolution. Frequencies in the range of 10 – 15 kHz are dominant.

Discussion

The studies carried out in Reserva Otonga and San Pablo have proved that bioacoustical methods can be highly useful as means of access for a rapid habitat characterization. Although study duration in Reserva Otonga was quiet short (3 weeks), it could be shown how climatic differences between the montane study site and the lowland influence the composition of cricket communities. The tropical cloud forest at an altitude of over 2000 m showed out as an extreme habitat for crickets. A poor species diversity was observed and whole taxa diverse in the tropical lowland are entirely missing. Especially the absence of representatives of the subfamily Trigonidiinae is remarkable. 18 singing trigonidiid species were found in the lowland study site San Pablo, most of them inhabitants of the forest canopy. Since the canopy in Reserva Otonga is rich in epiphytes it was believed that this high level of heterogeneity should subsequently promote high insect diversity. Regarding cricket diversity this proved not to be true.

Looking for reasons for the low cricket diversity in the cloud forest climatic factors must be regarded. During nighttime the average temperature in Reserva Otonga is about 8° C lower than in the lowland study site San Pablo. Many insect species could reach their limits with regard to development or behavior. For example flying cricket species (Trigonidiinae, Eneopterinae) are missing. All calling cricket species in Reserva Otonga are big in size with relatively thin forewings (compared to the body size). All representatives of the subfamily Trigonidiinae (missing here) are small without exception, with relatively big and thick forewings compared to the body size. Consequently calling behavior is energetically disadvantageous and maybe restricted to warm habitats. This could explain the lack of small calling cricket species of the subfamily Trigonidiinae in Reserva Otonga. Other climatic factors like humidity, seasonality or the daily change of temperature do not differ much from the lowland and cannot explain the differences in species composition.

Faunistic studies on crickets are rare for montane forest in the tropics. OTTE examined the cricket fauna of Hawaiian Islands. He found the species composition to be special because of the insularity of Hawaii. Only a few species out of the subfamilies Trigonidiinae, Oecanthinae and Nemobinae have reached Hawaii but underwent an enormous radiation on the islands. Trigonidiinae and Oecanthinae inhabit montane forests in Hawaii but only up mediate altitudes of 5000 feet (aprox. 1500 m).

Other insect taxa species rich in the tropical lowlands are missing in Reserva Otonga, too, e.g. arboral Acrididae (grasshoppers) or Isoptera (termites). Colder habitats as montane forests in the tropics and ecosystems in moderate climatic zones seem to be less optimal for many insect species and to exclude whole insect taxa. It will be important for further studies to examine how this preference of warmer climates can be explained by physiological and/or behavioral factors.

Our work shows how useful bioacoustic methods can be for ecological studies. We have provided a fast and cheap means of access for a comparison of insect communities in different ecosystems. Furthermore our studies showed out to be less invasive than destructive fogging studies using insecticides. Naturally bioacoustic field studies are limited to animals that produce sound and will not replace the other study types. But they can be helpful to find hotspots of high biodiversity and they can give rise to further faunistic studies. If a species specific song of an animal is known, opportunities for bioacoustic studies in field are even much higher. Songs can be used as an indicator for the species for further examinations about time of activity, habitat, seasonality and the range of occurrence of that single species. For example it should be highly interesting (and easily done) to carry out further examinations on the acoustic animal communities in other cloud forest sites close to Reserva Otonga in Ecuador. They could deliver more knowledge about the grade of endemism in these cloud forest habitats which are normally small and highly isolated because of their restriction to single elevations divided by zones of lower altitude.

Furthermore it will be important to include song descriptions of calling animals to the work of taxonomists as it is meanwhile normal for descriptions of new cricket species (OTTE, 1994; NISCHK & OTTE, in prep.; DESUTTER-GRANDCOLAS, 1992 a, b; DESUTTER-GRANDCOLAS & NISCHK, 2000; INGRISCH, 1997). Furthermore species databases like the Orthopteran species file (OTTE & NASKRECKI, http://viceroy.eeb.uconn.edu/orthoptera) or DORSA (**D**eutsche **Or**thopteren **Sa**mmlungen) now start to include acoustic data about species listed.

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