PARTIAL REPORT

Monitoring the Effects of Climate Change of a Threatened Mountaintop Amphibian Population

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Project Update: July 2015

Project summary

Crossodactylodes species are small-sized bromeliad frogs endemic to highlands at Atlantic Rain Forest in Brazil. *Crossodactylodes itambe* (the target species of this project) is a new species that occurs in an area smaller than 10km^2 and above 1800m, at low temperatures and in a single species of bromeliad. It is found at Pico do Itambe State Park, located at Espinhaço Range – a transitional area between hotspots biomes. Species is probably affected by climate change and bromeliad-collecting. This project is supported by six guidelines established by the National Action Plan for amphibian conservation at south Espinhaço Range. Project aims are:

1. Determinate detection probabilities and site occupancy of *Crossodactylodes itambe*
2. Implement a monitoring program for target species and investigate the influence of climate covariates on species occupancy
3. Model species distribution and search for new populations on mountaintops within the Espinhaço Range
4. Improve environmental knowledge and get stakeholders involved to species conservation and habitat protection

No changes will be needed in the proposed activities and all objectives will be concluded by the end of the project.

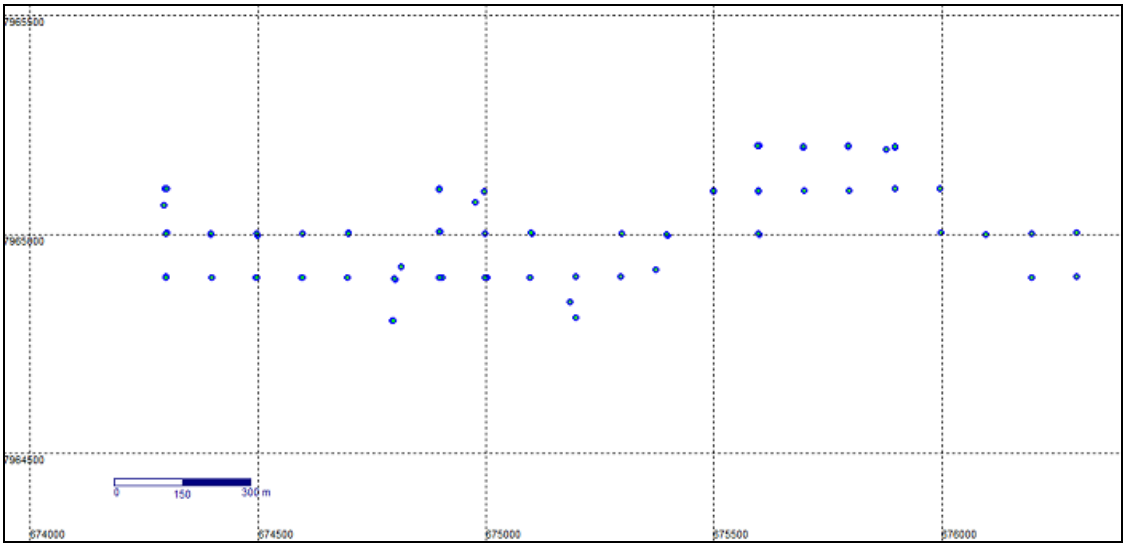
ACTIVITIES DEVELOPED

- We have all legal documents to sample species data and work in the protected area, including licenses and permits, risk assessments and ethical forms.
- We implemented for the first time the monitoring protocol suggested by previous research. In this project, bromeliads are considered as sampling sites, since our target species (*Crossodactylodes itambe*) is restricted to this plant. Bromeliads are distributed among the elevation range categories: 47 bromeliads were marked at high altitude, 48 were tagged at the medium and additional 48 at the low gradient (total of 143 sampling sites). Each marked bromeliad received a tag with an identification number.

- Our monitoring design consisted of a four surveys of six nights each, during dry and wet seasons. Occupancy data was sampled on 22 to 28 February 2015; 14 to 20 March 2015 (both wet season); and 08 to 15 March 2015; 01 to 10 May 2015 (both dry season).
- During each survey, sampling sites were visited at night using flashlights (species is not detectable during the day) and target species were sampled by two teams with visual encounter survey. All sampling sites are surveyed in a single night and every night is considered as an independent event. Adults, juveniles and tadpoles are being considered as evidence of species presence at a site (all of them, very distinctive and easily identified).

- We successfully recorded sampling histories for all four surveys we made, which is species presence/absence data to be analyzed in the future. We are also accounting for presence and absence of water and invertebrates, as well as time of survey and water temperature and pH. All these data will be considered as occupancy and detectability covariates in future analysis. We sampled bromeliad features as covariates (size and volume), measurements of daily temperature and humidity, and air and water temperature at each site. A meteorological station is keeping records of climatic variables.
- Density of bromeliads is suspected to be an important covariate influencing species occupancy at study site. To estimate bromeliad density at study site, we sampled data during a four-day field work on February 2015. Sampling units were randomly selected based on a map and were placed 100 m apart from each other, where we placed a circle of 6 meters diameter. Quadrates were not feasible to perform due to landscape conditions.

- The total area encompassed by each circle was 28.26 m2 and we had a total of 43 sampling units (showed on map).



- We have already concluded field expeditions to record new bromeliad occurrence data and model target species distribution in the future. This model will generate a map with

potential sites that species might occur and will guide future expeditions to search for new populations.

- For every record of new occurrence, we recorded substrate type, predominated vegetation type (Cerrado physiognomy), altitude, date, team members and location. To confirm bromeliad occurrence at each site we took samples of leaves and flowers (under license) and sampled material are in a registered collection for further analysis.

- We sampled bromeliad occurrence data on four field expeditions: 19 to 21February 2015, 02nd March 2015, 30th March to 01st April 2015, 15 to 17 April 2015.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- We were able to record several bromeliad species of the genera *Vriesea* which will be useful in the models for occurrence predictions of *C. itambe*. We recorded bromeliads in different altitudes and several substrates.

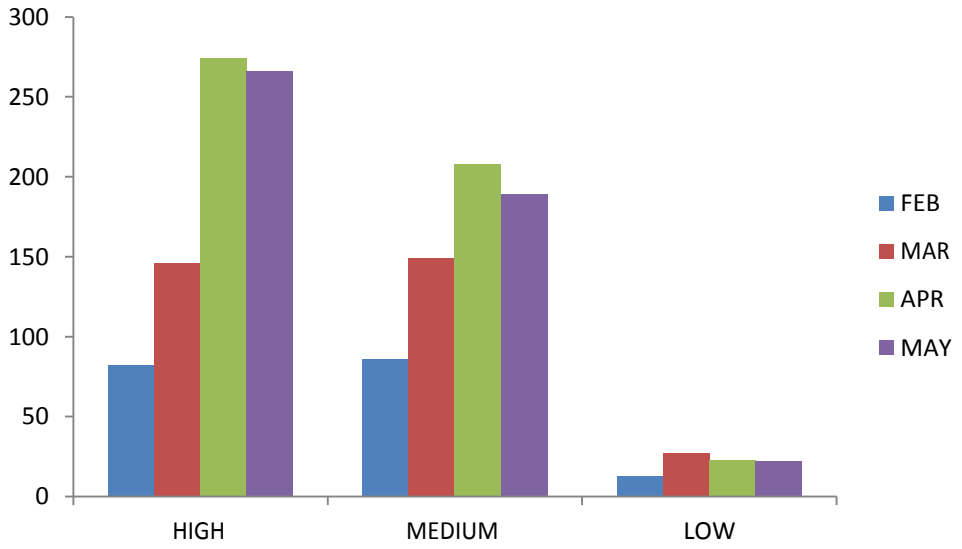
SUMMARY OF RESULTS

- We sampled an area of approximately 1215 m^2. The density of bromeliads at study area is remarkable, especially at higher altitudes. Overall bromeliad density at sampling area is 14 individuals per 100 m^2 – high and medium gradients with 18 and 28 bromeliads per 100 m^2, respectively, and low gradient with only 4 individuals per 100 m^2. In future analysis, bromeliad density will be used to estimate population size of target species, *Crossodactylodes itambe*, at study area.

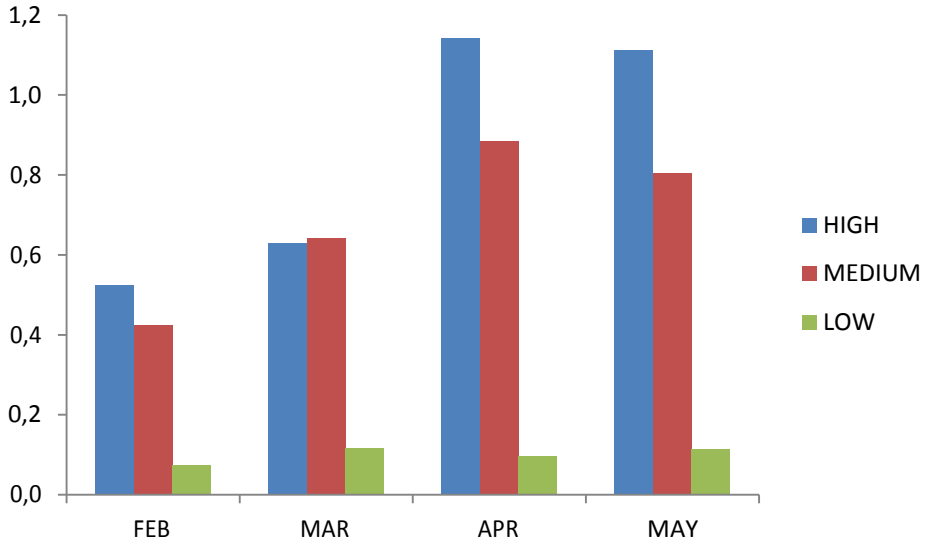
BROMELIAD DENSITY PER GRADIENT				
GRADIENT	**NUMBER OF BROMELIAD**	**N SAMPLING UNITS**	**SAMPLED AREA**	**DENSITY/10m^2**
HIGH	65	13	367.4	1.8
MEDIUM	79	10	282.6	2.8
LOW	21	20	565.2	0.4
TOTAL	**165**	**43**	**1215.2**	**1.4**

- Our survey effort was 336 hours, accounting for 6 nights and four surveys (seven hours each night and two teams). Considering all surveys and sampling nights we made a total of 2607 observations (visits) accounting for species presence and absence at 143 sites, resulting in 711 positive observations (presence of one or more adult, tadpole and/or juvenile).

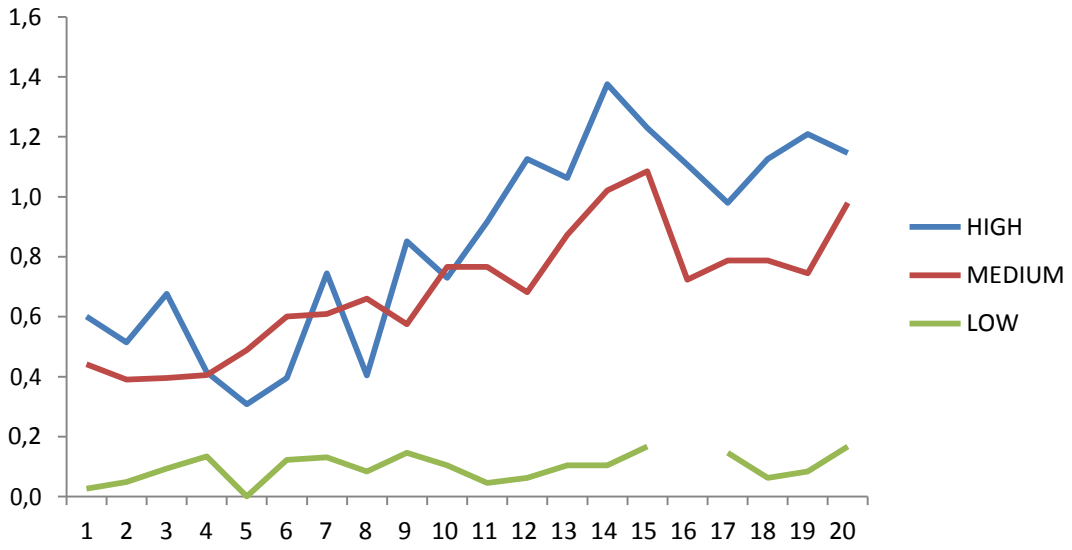
- Based on our sampling effort, each site was visited about 18 times, but only 3.6 visits were needed to record species at a specific site. If we exclude the lower gradient (with few presence records), the number of visits needed to truly sample the species at each site drops to 2.7.
- During four months of surveys, HIGH and MEDIUM gradients accounted for most of the records (total n=768 and n=632, respectively), with LOW gradient showing few records of adults, tadpoles and juveniles (n=85, total).



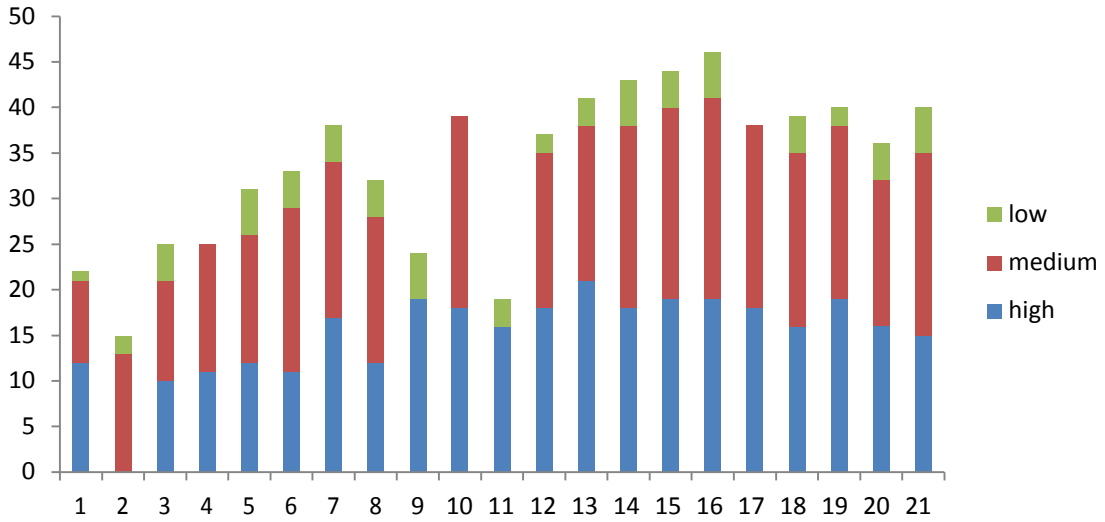
- The month with highest records was APRIL, with a mean number of 101 individuals, followed by May (n=95), March (n=54) and February (n=30).
- The relative abundance of individuals was higher in April and May, for all gradients. The HIGH gradient had the highest abundance, except in March when the MEDIUM gradient had slightly difference overcoming the relative abundance at the highest gradient. Relative abundance at LOW gradient was almost constant through all surveyed months.



- The relative abundance of individuals accounted for each sampling occasion (i.e., each night of survey) also show a higher estimate for the HIGH and MEDIUM gradients, with the lowest gradient showing a constant record of adults, tadpoles and juveniles. The peak recorded on occasions 14 and 15 were made during April 2015.



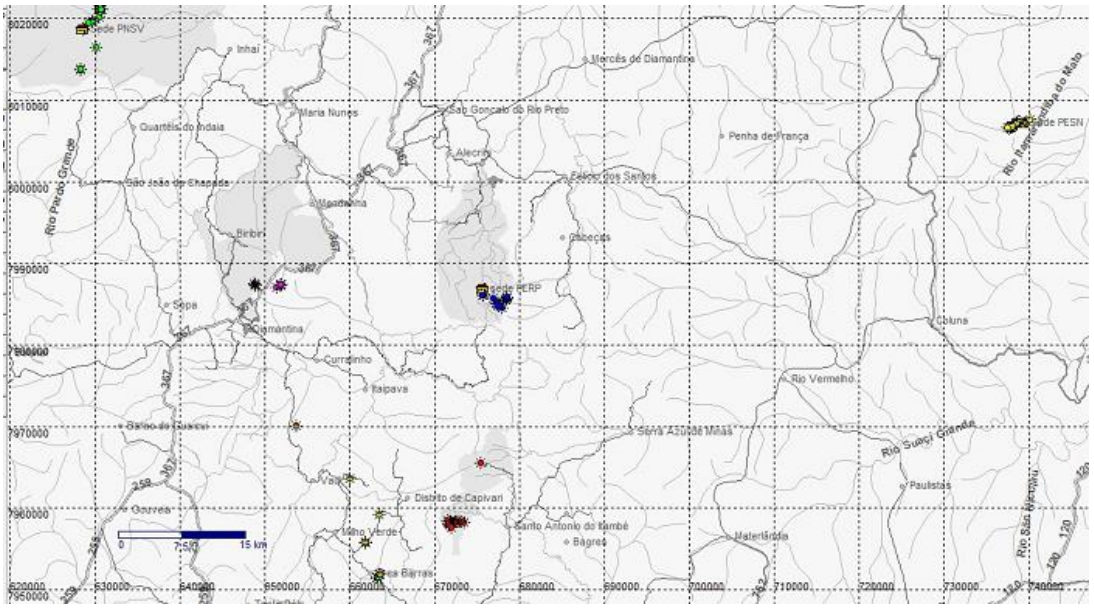
- Most of sampling sites at HIGH and MEDIUM gradient were occupied by the species, while the opposite was recorded at LOW gradient (most of sites with absences) – as we can see by the graph below (number of occupied bromeliad by each occasion, per gradient). Although we had variation in relative abundance and total number of records, the monthly naïve occupancy (available sites/occupied sites) seems to be constant trough time in all gradients. Naïve occupancy was higher in MEDIUM and HIGH gradients, as expected by previous results.



2015 OCCUPIED SITES					2015 NAIVE ψ			
MONTH	GRADIENT			**TOTAL**	GRADIENT			**TOTAL**
	HIGH	MEDIUM	LOW		HIGH	MEDIUM	LOW	
FEB	19	23	5	**47**	0,40	0,49	0,10	**0,33**
MAR	22	25	5	**52**	0,46	0,53	0,10	**0,36**
APR	28	23	5	**56**	0,58	0,49	0,10	**0,39**
MAY	24	26	5	**55**	0,50	0,55	0,10	**0,38**
TOTAL	**32**	**32**	**7**	**71**	**0,67**	**0,68**	**0,15**	**0,50**

- The number of occupied sites is remarkable and monitoring protocol is likely to be completely successful in the following years. Accounting for detectability will give us strong estimations of species occupancy, making the monitoring protocol feasible for comparison through the years (we can make estimations of extinction and colonization rates regarding specific covariates).
- We can confirm new bromeliad locations that might be used to generate the models for potential distribution of *C. itambe* – we searched for bromeliads in at least eight different

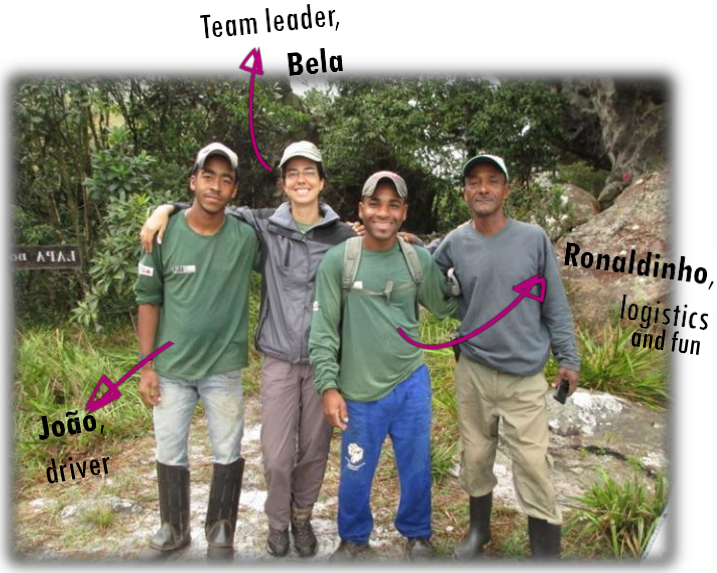
locations on surrounding mountaintops (dots showed on map are new occurrences from all expeditions). When the models as done, we will be able to select one site to search for new populations of target species in surrounding mountains and improve our knowledge on species distribution.



ACTIVITIES TO BE CONCLUDED

1. Data analysis: occupancy and distribution models (NOV 2015)
2. Awareness raising: AGO 2015
3. Final report: NOV/DEC 2015

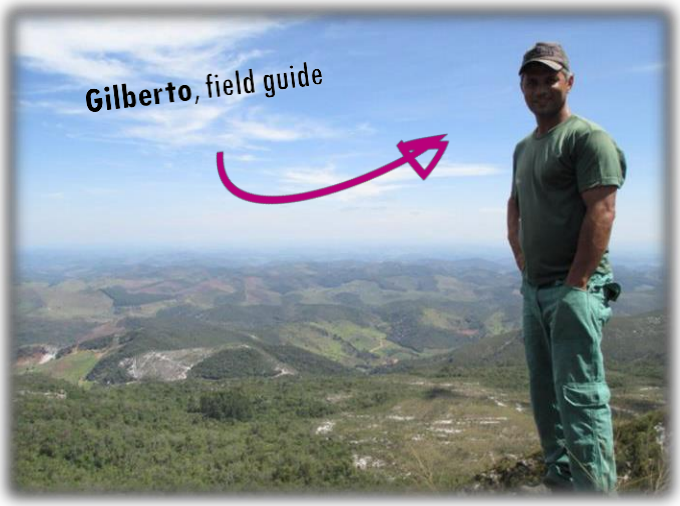
MEETOURTEAM

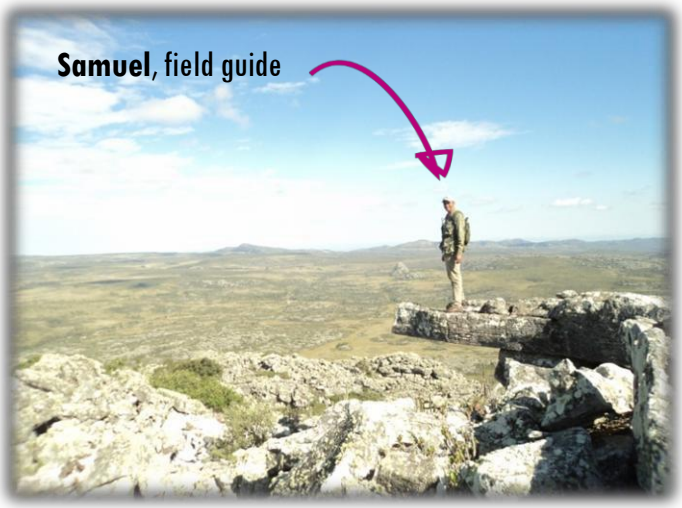



G Ferreira, research assistant + photographer


Wanderlei, park manager
Serra Negra team


Paulinha, park manager
Sempre Vivas team


Gilberto, field guide


Samuel, field guide


Patrícia, trainee


Lili, trainee
and brave as a lion


The base camp