

Vicente's poison frog (*Oophaga vicentei*) in the wild: calling activity, bioacoustics and diet

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Table 1. Air temperature records at the three study sites. Values are maximum, minimum and mean temperatures recorded during the study.

Study Site	T min (°C)	Mean T (°C)	T max (°C)
Loma Grande	21.69	24.69	27.28
Isleta	22.46	25.57	30.92
Alto Ortiga	23.89	29.58	34.81

Table 2. Variations in advertisement call parameters in five populations of *Oophaga vicentei*. Mean $\pm$ SD (range; N)

Trait	Isleta	Loma Grande	Alto Ortiga
Temperature	24.595 $\pm$ 1.883 (22.25-29.5; 21)	24.433 $\pm$ 1.474 (22.1-26; 6)	24.333 $\pm$ 1.606 (22-27.5; 9)
Call duration (s)	0.162 $\pm$ 0.048 (0.089-0.263; 21)	0.179 $\pm$ 0.065 (0.106-0.259; 6)	0.166 $\pm$ 0.021 (0.13-0.196; 9)
Call interval (s)	0.228 $\pm$ 0.048 (0.155-0.361; 21)	0.227 $\pm$ 0.06 (0.146-0.305; 6)	0.22 $\pm$ 0.04 (0.165-0.282; 9)
Calls/call bout	71.028 $\pm$ 35.483 (33-187; 18)	141 $\pm$ 130.503 (47-290; 3)	81.571 $\pm$ 32.878 (43-138; 7)
Call bout duration (s)	29.659 $\pm$ 16.785 (13.944-89.327; 19)	53.885 $\pm$ 48.98 (21.072-110.186; 3)	32.182 $\pm$ 11.237 (16.856-51.919; 7)
Call bout rate (#call/call bout dur)	2.413 $\pm$ 0.421 (1.47-3.379; 18)	2.564 $\pm$ 0.305 (2.23-2.829; 3)	2.512 $\pm$ 0.353 (1.844-2.8; 7)
Calls/2s	5.55 $\pm$ 0.605 (5-7; 20)	5 $\pm$ 0.707 (4-6; 5)	5.667 $\pm$ 0.5 (5-6; 9)
Call bout interval (s)	137.338 $\pm$ 136.597 (10.552-452.691; 12)	34.844 $\pm$ 13.922 (25-44.688; 2)	84.303 $\pm$ 102.05 (23.669-261.605; 5)
Low Freq (Hz)	5122.708 $\pm$ 536.041 (4247.425-6905.56; 21)	4866.832 $\pm$ 397.949 (4286.44-5379.95; 6)	5021.95 $\pm$ 206.228 (4784.74-5469.04; 9)
High Freq (Hz)	6303.658 $\pm$ 1176.876 (1352.33-7417.8; 21)	6143.715 $\pm$ 309.039 (5641.05-6503.24; 6)	6156.247 $\pm$ 333.734 (5811.38-6887.91; 9)
Max Freq (Hz)	5853.467 $\pm$ 229.505 (5400.9-6309.24; 21)	5673.273 $\pm$ 253.426 (5262.71-5981.91; 6)	5547.193 $\pm$ 247.866 (5307.94-6104.67; 9)

Trait	Donoso	Cerro Narices	Overall
Temperature	23.65 $\pm$ 0.354 (23.4-23.9; 2)	22.33 $\pm$ 0.948 (21.66-23; 2)	24.352 $\pm$ 1.709 (21.66-29.5; 40)
Call duration (s)	0.172 $\pm$ 0.02 (0.157-0.186; 2)	0.25 $\pm$ 0.084 (0.191-0.31; 2)	0.17 $\pm$ 0.049 (0.089-0.31; 40)
Call interval (s)	0.428 $\pm$ 0.072 (0.377-0.479; 2)	0.296 $\pm$ 0.09 (0.233-0.36; 2)	0.24 $\pm$ 0.067 (0.146-0.479; 40)
Calls/call bout	30.367 $\pm$ 1.367 (29.4-31.333; 2)	43 $\pm$ 0.471 (42.667-43.333; 2)	75.601 $\pm$ 51.314 (29.4-290; 32)
Call bout duration (s)	24.158 $\pm$ 8.785 (17.947-30.37; 2)	23.244 $\pm$ 7.669 (17.821-28.667; 2)	31.675 $\pm$ 19.825 (13.944-110.186; 33)
Call bout rate (#call/call bout dur)	1.335 $\pm$ 0.429 (1.032-1.638; 2)	1.953 $\pm$ 0.624 (1.512-2.394; 2)	2.353 $\pm$ 0.485 (1.032-3.379; 32)
Calls/2s	3.75 $\pm$ 0.354 (3.5-4; 2)	4 $\pm$ 1.414 (3-5; 2)	5.329 $\pm$ 0.808 (3-7; 38)
Call bout interval (s)	27.518 $\pm$ 2.532 (25.728-29.308; 2)	60.01 $\pm$ 40.558 (31.33-88.689; 2)	100.622 $\pm$ 114.594 (10.552-452.691; 23)
Low Freq (Hz)	4700 $\pm$ 0 (4700-4700; 2)	4700 $\pm$ 0 (4700-4700; 2)	5019.385 $\pm$ 442.915 (4247.425-6905.56; 40)
High Freq (Hz)	6600 $\pm$ 0 (6600-6600; 2)	6600 $\pm$ 0 (6600-6600; 2)	6276.133 $\pm$ 873.239 (1352.33-7417.8; 40)
Max Freq (Hz)	5820.675 $\pm$ 141.969 (5720.288-5921.062; 2)	5473.532 $\pm$ 320.637 (5246.807-5700.257; 2)	5736.89 $\pm$ 266.763 (5246.807-6309.24; 40)

Table 3. Classification of the items found in the stomach content of the 27 males *O. vicentei*. In parenthesis the number of individuals sampled at each population.

	Loma Grande (10)	isleta (8)	Alto Ortiga (9)
Order	Hymenoptera, Sarcophagales, Trombidiformes, Coleoptera, Thysanoptera, Isopoda	Hymenoptera, Sarcophagales, Diptera, Trombidiformes, Coleoptera, Thysanoptera, Araneae	Hymenoptera, Sarcophagales, Diptera, Trombidiformes, Coleoptera, Thysanoptera, Araneae
Suborder	Apocrita, Oribatida, Prostigmata, Polyphaga	Apocrita, Oribatida, Nematocera, Prostigmata	Apocrita, Oribatida, Nematocera, Prostigmata, Polyphaga
Family	Formicidae, Curculionidae,	Formicidae, Mimariidae, Chironomidae, Ceratopogonidae, Salticidae	Formicidae, Ceratopogonidae, Staphylinidae, Salticidae
Genus	<i>Solenopsis</i> , <i>Crematogaster</i> , <i>Tapinoma</i>	<i>Solenopsis</i> , <i>Crematogaster</i> , <i>Tapinoma</i>	<i>Solenopsis</i> , <i>Crematogaster</i> , <i>Tapinoma</i>

Table 4. Values of Levins normal (B) and standardised (Bstd) niche breadth indexes of the three studied populations

	N	B	Bstd
Loma Grande	10	2.02	0.64
Isleta	8	1.95	0.46
Alto Ortega	9	1.99	0.63

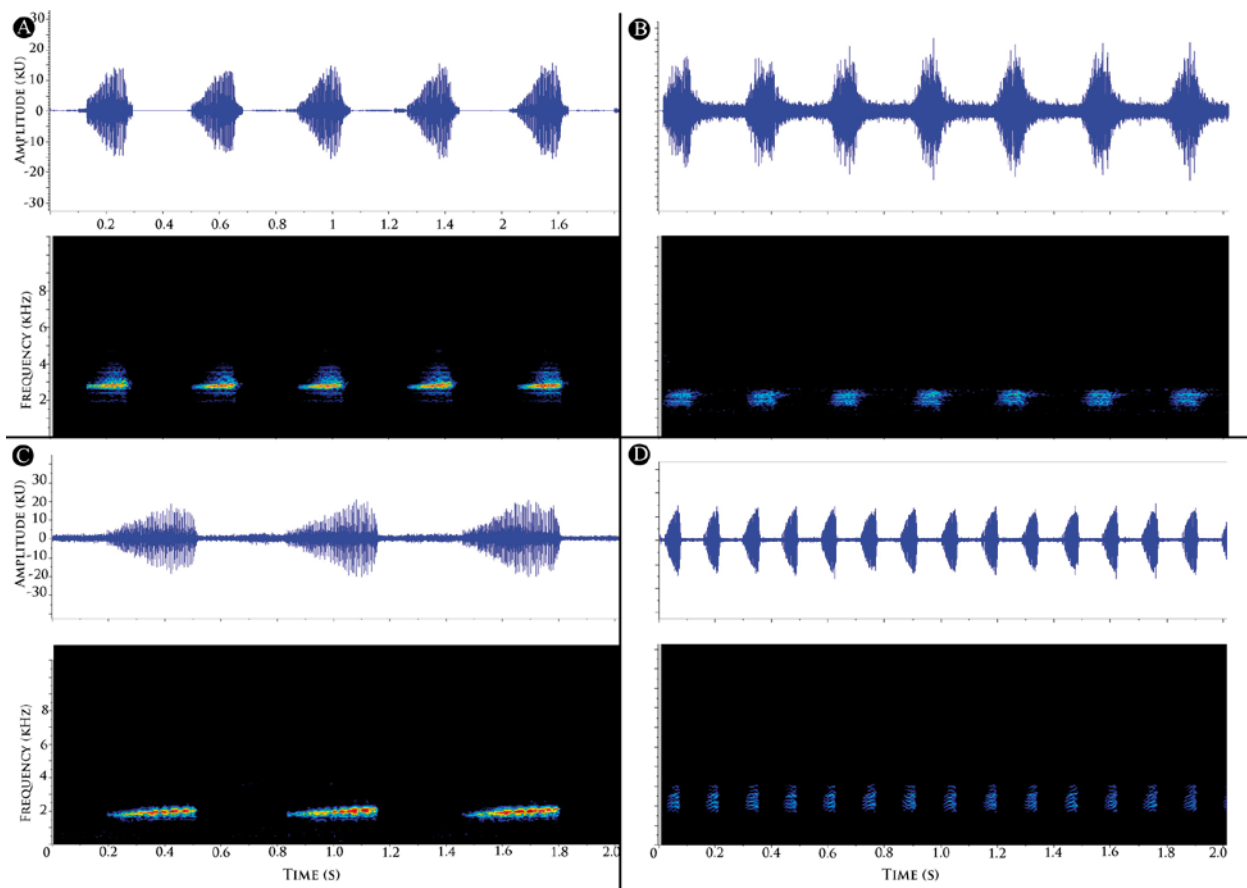


Figure 1. Oscillograms (above) and spectrograms (below, only dominant frequency is shown) of the advertisement calls for the species of *Oophaga* spp. from Central and Western Panama; **A)** *O. vicentei*, Loma Grande, Santa Fe; **B)** *O. arborea*, Reserva Forestal Fortuna, Chiriquí; **C)** *O. granulifera*, El Chorogo, Chiriquí; **D)** *O. pumilio*, Changuinola, Bocas del Toro.

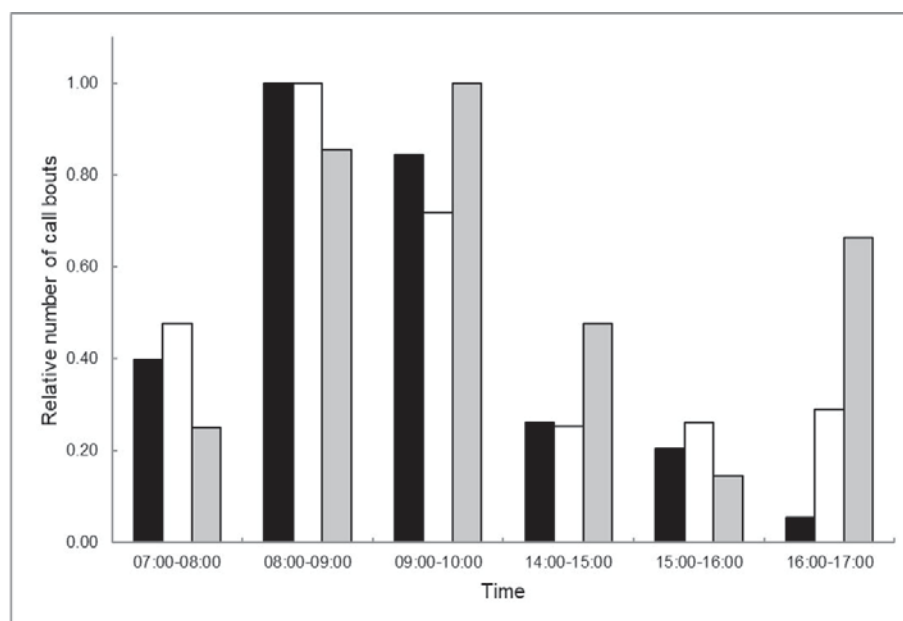


Figure 2. Relative calling activity for three populations of *O. vicentei* along six time periods. Black bars (Isleta; on the Pacific slope), white bars (Alto Ortega; on the Caribbean slope) and grey bars (Loma Grande; on the continental divide).

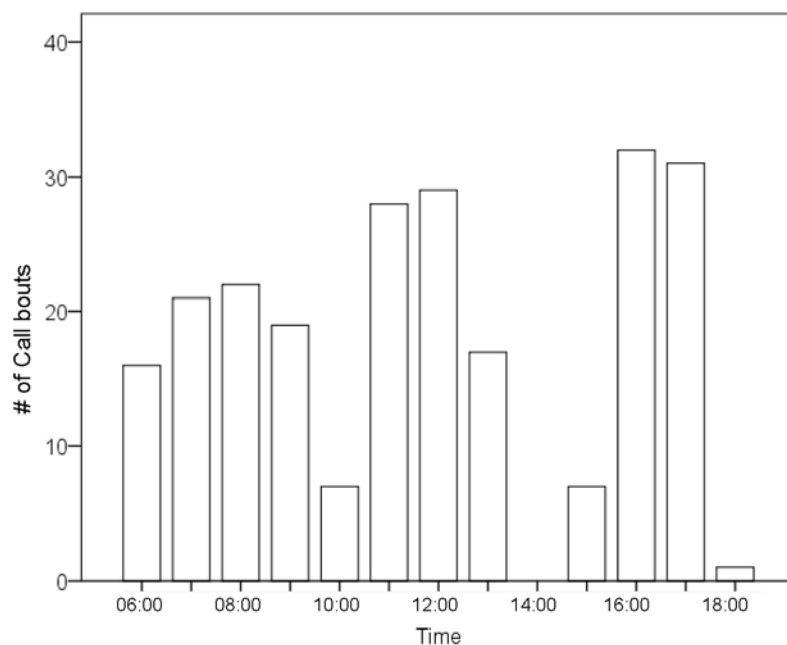


Figure 3. Calling activity of *O. vicentei* from a single male from the Loma Grande population, recorded from 06:00 h to 18:00 h.

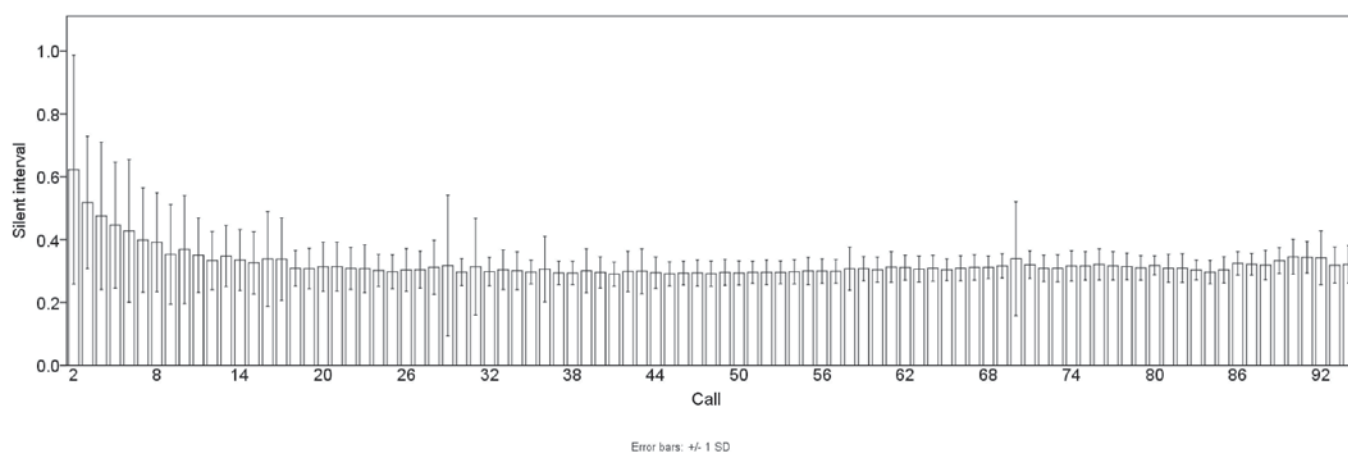


Figure 4. Call pattern of *O. vicentei*. Silent interval between calls of call bouts analysed from a single male from Loma Grande, recorded between 06:00 h to 18:00 h (0.33 SD= 0.126, 0.094-2.87, n= 6220), error Bars: +/- 1 SD. Note the large interval duration up to the 10 first calls.

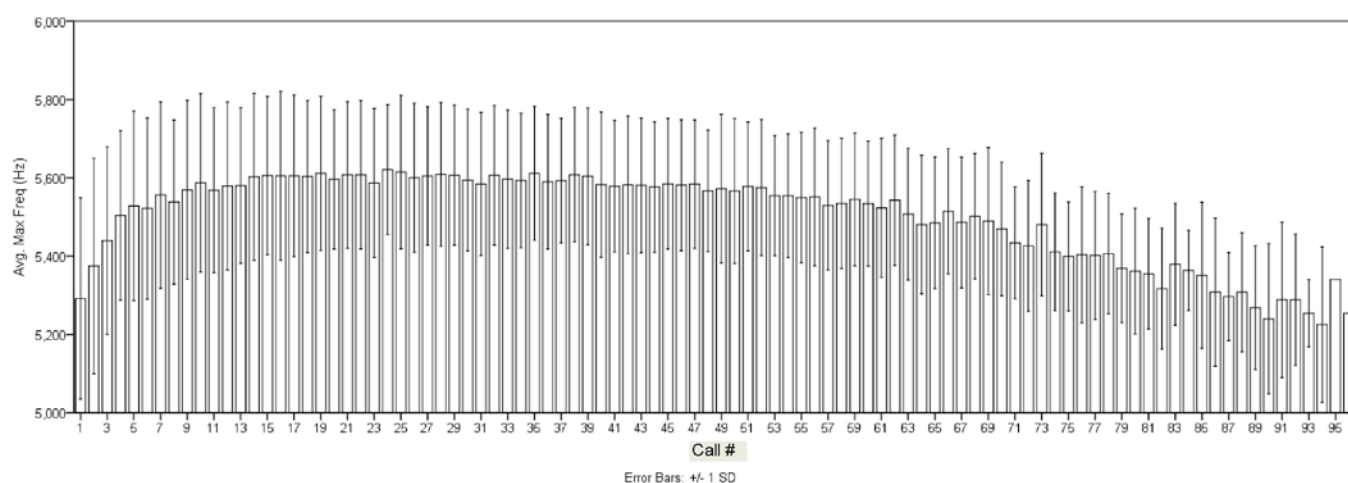


Figure 5. Call pattern of *O. vicentei* with average of dominant frequency per call, analysed from a single male from Loma Grande recorded between 06:00 h to 18:00 h (5557.152, SD= 202.30, DF= 4737.3-6220; n= 6327; CV= 4.65, Error Bars: +/- 1 SD). Call dominant frequency range in about 1482 Hz.

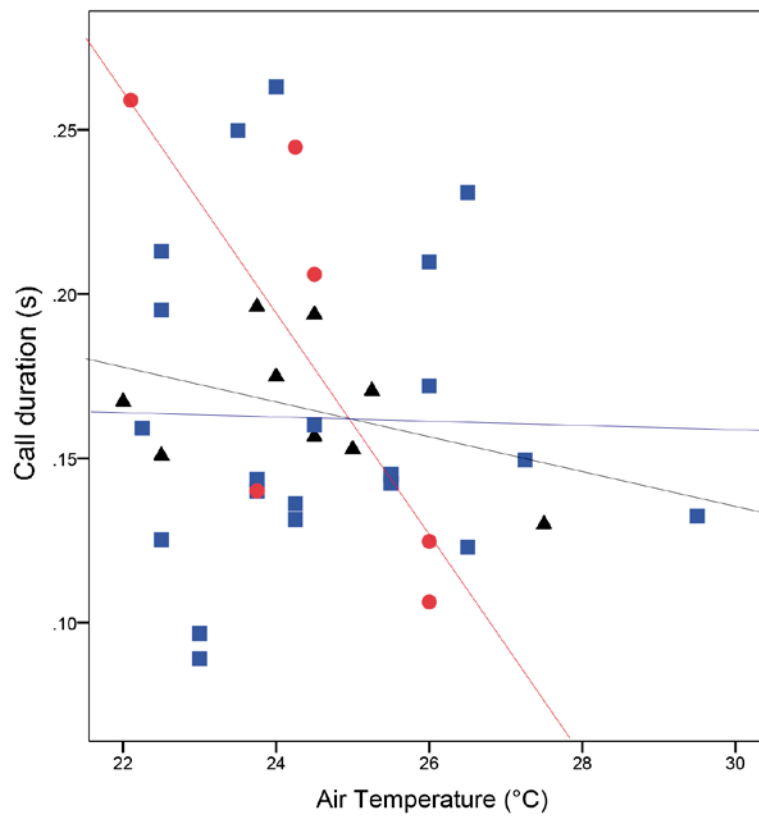


Figure 6. Interaction plot between site and air temperature on the calling behaviour of *O. vicentei*. The red circles and line represent Loma Grande; blue squares and blue line represent Isleta; the black triangles and black line represent Alto Ortega.