



A Descriptive Habitat Model for the Cayos Cochinos *Boa constrictor* on Cayos Cochinos Menor, Honduras

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ABSTRACT

The Cayos Cochinos *Boa constrictor* (CCB) is an endangered and endemic species of *Boa constrictor* which inhabits a chain of islands located off the north coast of Honduras. The goal of this research is to develop a habitat model within a geographic information systems (GIS) framework for the CCB on the second largest island in the Cayos Cochinos chain, Cayos Cochinos Menor. A suite of existing geospatial data, including environmental variables such as temperature, humidity, precipitation recorded by a 94 operative temperature models (OTM) across the island, and CCB capture data were prepared for use in a GIS. Inverse Distance Weighted, a method of spatial interpolation, was used to generate surfaces for temperature by season. CCB captures were separated by season then overlaid with the corresponding temperature surface to identify the characteristics of CCB habitat on the island. Results indicate that the CCBS are impacted by the climate of the island; habitat use varies during wet and dry seasons. The results from this research will be used to develop a predictive 3-D habitat model for CCBS on Cayos Cochinos Menor. The model will be tested and refined in the field in fall of 2010.

INTRODUCTION & STUDY AREA

The Cayos Cochinos *Boa constrictor* (CCB) is an endangered and endemic species of *Boa constrictor* which inhabits a chain of islands located off the north coast of Honduras. The Cayos Cochinos, dubbed "diamonds in the rough", is an archipelago with 13 smaller coral cays lying 30 kilometers northeast of La Ceiba on the northern Honduran coast (15 58' N, 86 28' W). The Cayos Cochinos islands were designated as a Marine Natural Monument in 2003 by the Honduran government because of their biologically rich marine and island environments; almost 500 km² are protected. The CCB is restricted to the two largest islands in the Cayos Cochinos chain. The CCBS exhibit morphological and color differences from mainland populations, likely related to thermal and dietary limits imposed by the island's ecology. The CCB is a top predator and feeds primarily on lizards (iguanas), small mammals (agoutis), and birds (Bermingham et al. 1998). *Boa constrictors* are unique organisms because they are ectothermic animals which rely on the temperature of the environment and their thermoregulatory responses for survival. Because the CCB's survival is dependent on external temperatures, a possible movement or migration could occur throughout a day as a response to changing of temperature gradients in the environment.

The goal of this project is to develop and analyze a habitat model within a geographic information systems (GIS) framework for the CCB on the second largest island in the Cayos Cochinos chain, Cayos Cochinos Menor. Several specific objectives are involved in reaching this goal:

- 1) to prepare and process existing geospatial data collected on both the physical geography of the island as well as the CCBS themselves;
- 2) research existing GIS habitat models for ectothermic organisms;
- 3) develop a descriptive habitat model for CCB on Cayos Cochinos Menor based on temperature



METHODS

- Existing geospatial data were organized and imported into a geodatabase in ArcGIS software.
- Databases of the X and Y locations of the CCB captures and OTM stations were mapped.
- The coordinate systems of the data were determined and all data sets were re-projected into the same coordinate systems (UTM Zone 16 N NAD 83).
- A total of 94 OTMs were placed on the island by project collaborators. These OTMs recorded temperatures every 90 minutes through most of 2006. These data, over 750,000 individual temperature readings, were averaged in Microsoft Excel by 4 seasons. The seasons are as follows: 12/1-1/31, 2/1-6/15, 6/16-9/1, and 9/2-11/31.
- Geostatistical Analyst, was used to spatially interpolate temperature values by season. Spatial interpolation is a process by which geostatistics are used to predict values for unknown locations across the study area based on the locations of known values. IDW and kriging were compared with error analysis and validation; results suggested the best results were achieved with IDW. Though the RMSE for IDW was slightly higher, the output was better defined and smoother.
- The capture locations of the CCBS were separated by season and then converted to raster in order to overlay them with the temperature rasters. CCBS have not yet been captured during season 4.
- Raster calculator was used to determine the temperature of the CCB locations.
- The temperature of the CCB locations were then compared using regression analysis to the temperature of the boas to determine if the CCBS are thermoregulating.

RESULTS

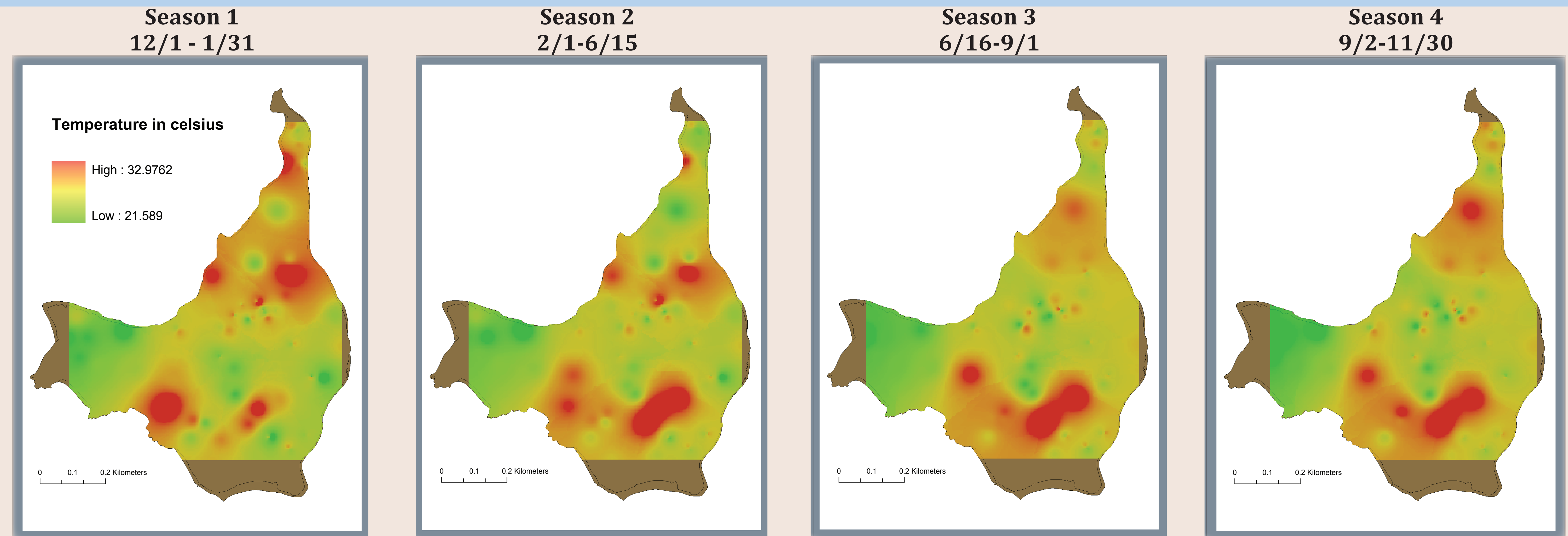


Figure 1. Temperature range based by season

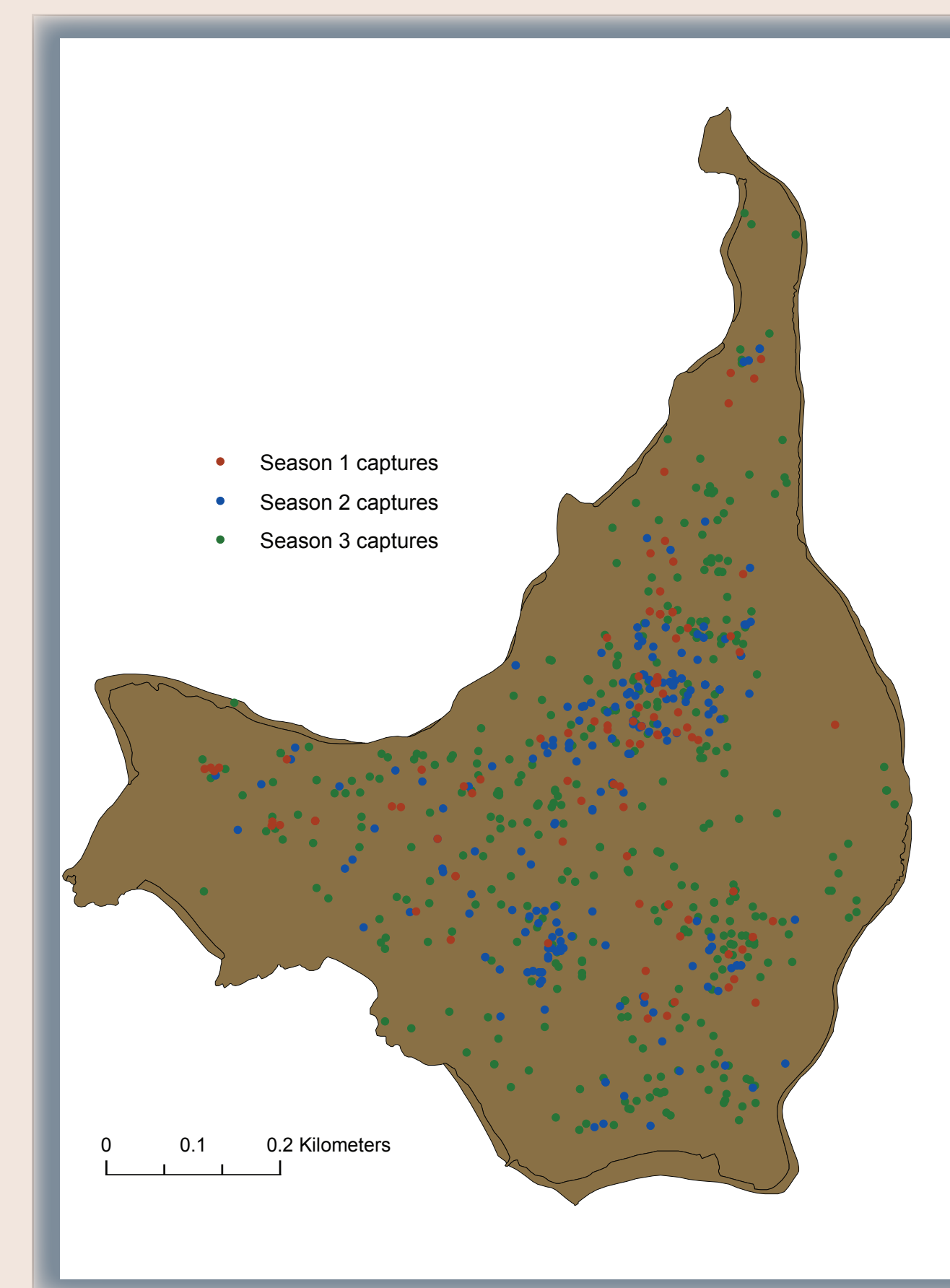


Figure 2. Location of *Boa constrictors* based by season



DISCUSSION

The inverse distance weighted (IDW) spatial interpolation method generated surfaces which illustrate the variability of temperature on the island. The temperature on the island for all four seasons ranges from 32.9762 C° to 21.589 C° (Figure 1). The eastern end of the island, the windward side, is cooler by at least 5 C° than the leeward side. There are two patches on the island which are consistently warmer than the majority of the island; one in the south end of the island and the other on the leeward peninsula. The CCB captures for each season were compared to the temperature values (resulting from the IDW) for the corresponding season. The counts of CCBS (Figure 2) for each temperature were tallied and shown in Table 1 and plotted in Figure 4. The total range of environmental temperature for the CCB captures is from 22 C° to 31 C°. Figure 4 illustrates the strong seasonal variability in the environmental temperature of CCB habitat. In season 2 CCB captures are located at lower temperatures (22 C° to 24 C°) while during season 1 CCBS are found at slightly warmer temperatures, and are in the warmest locations during season 3.

The regression analysis (Table 2) compared the internal temperature of the CCBS at the time of capture to the environmental temperature for the corresponding season. The low R² value indicates that the CCB body temperature is not specifically correlated to the environmental temperature alone. This result is surprising because CCBS are ectothermic organisms which are dependent on external temperatures for body temperature regulation. One reason for the lower than expected R² value is that the CCBS may be thermoregulating; other environmental factors may explain this behavior. Project collaborators have suggested that humidity may also play a large role, along with temperature, in the thermoregulatory response of the CCBS. For example, higher humidity levels may allow the boas to inhabit areas of higher temperature than they would be able to if the humidity was low. The aggregation of the temperature data (averaged for all months in each season) to the four seasons may also influence the analysis. There may be considerable variation in temperature during the four seasons used in this preliminary analysis. In future research, we will break down each season into two week periods and compare the CCB captures for those time periods to the finer resolution temperature data. The temperature maps were queried for each season to identify the areas of suitable temperature based on the captures for the corresponding season (Figure 3). Table 1 summarized the percentages of all CCB captures by temperature. The majority of the island is within the suitable temperature range of the CCBS throughout most of the year. Several small patches of cooler and warmer temperatures are not suitable during the entire year. Although the majority of the island is within a suitable temperature range; the CCBS are clearly not using this entire range. Again, we think humidity levels play a large role in the thermoregulatory responses of the CCBS. The variability within seasons may also influence this analysis. Our future research will attempt to address both of these issues.

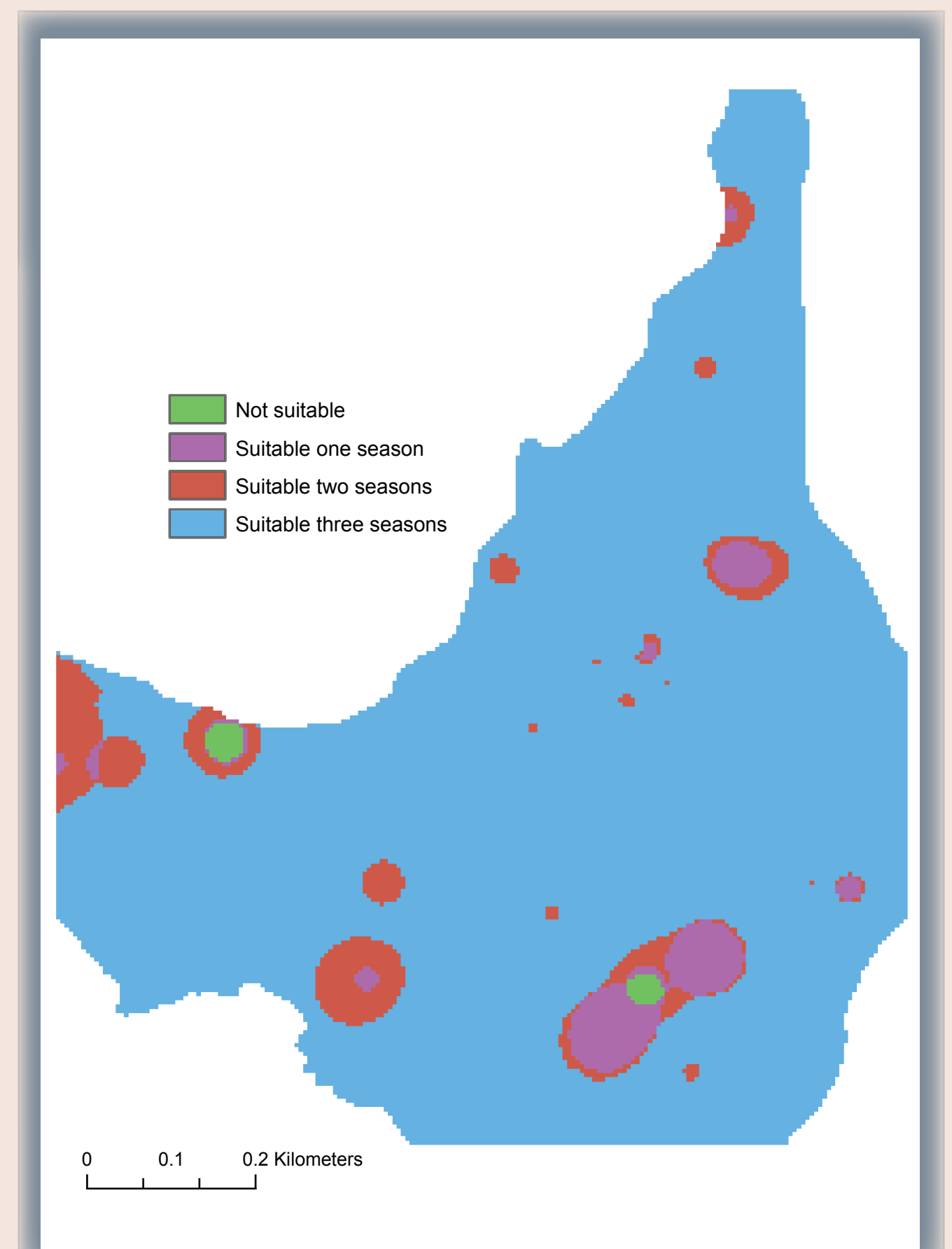


Figure 3. Suitable temperatures

Temperature C°	Season 1		Season 2		Season 3	
	Count	Percent	Count	Percent	Count	Percent
22	50	52.08	4	2.00		
23	45	46.88	25	12.50		
24	1	1.04	111	55.50	2	0.58
25			46	23.00	75	21.80
26			6	3.00	198	57.56
27			6	3.00	45	13.08
28			2	1.00	10	2.91
29					11	3.20
30					3	0.87
31						
	96		200		344	

Table 1. Snake distribution based on seasonal temperature

Dependent Variable	Independent Variable	Std. Error of Est.	B	Std. Error Beta	t	Sig.	R	R ²	
Average Temperature	Body Temperature		11.104	1.809	0.52	6.137	.000a	0.518	0.27
	Constant		2	0.665	0.073	9.114	.000a		

Table 2. Regression of snake temperature

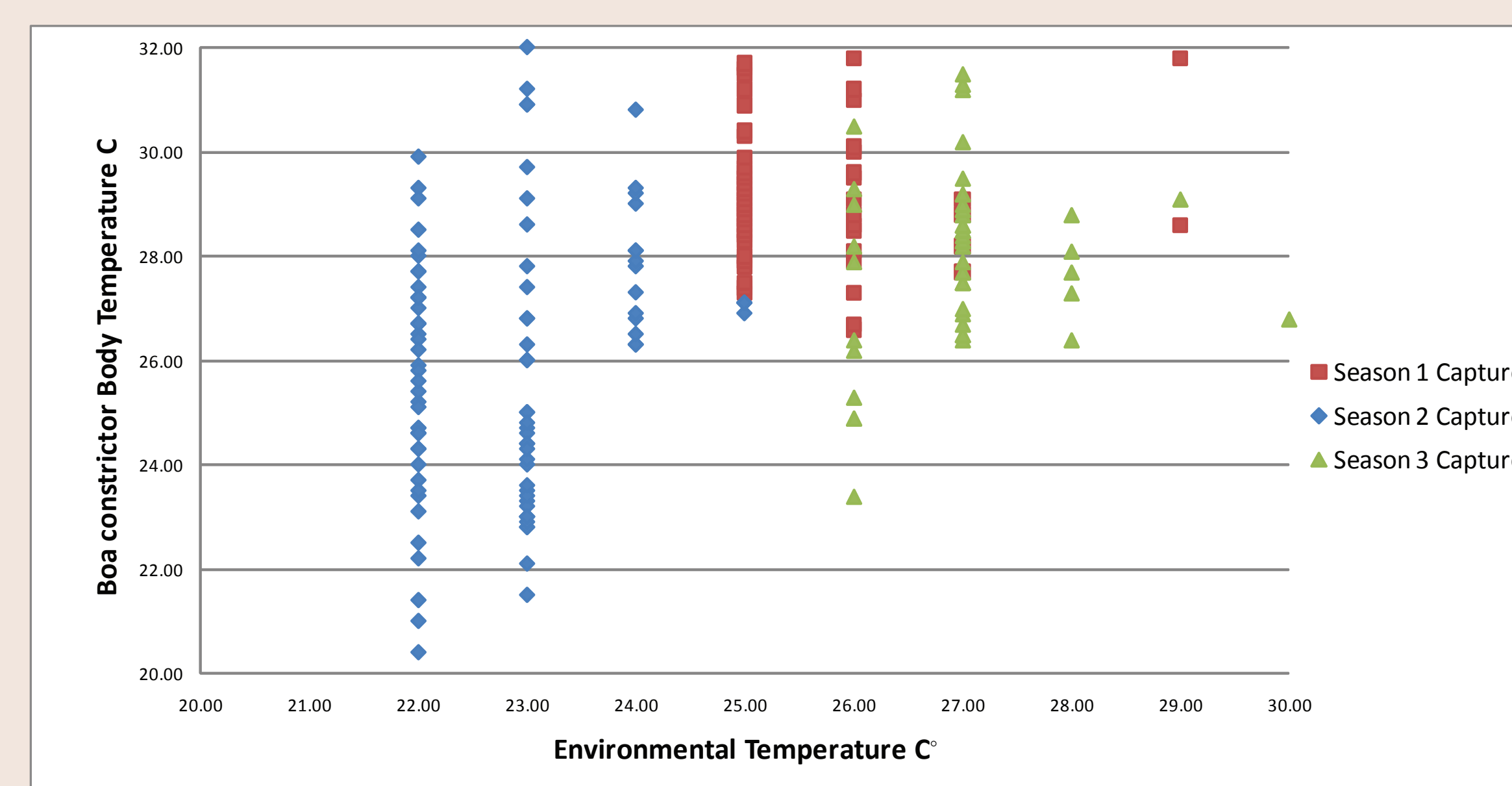


Figure 4. *Boa constrictor* internal temperature and environmental temperature correlation

FUTURE RESEARCH

In future research we will further break down the temperature data in smaller seasons (two week periods) and also separate out the OTM data by the height above the ground. We will also explore the influence of humidity on the ability of the boa constrictors to thermoregulate by spatially interpolating humidity values for the island for the seasons corresponding to the same season used for the temperature analysis. We will also include other physical variables such as elevation and vegetation in our analysis. The ultimate goal of this project is to build a descriptive habitat model for the Cayos cochinos boa constrictor using temperature, humidity and a suite of other environmental variables. We will then use the results of this model to build a predictive habitat model of boa constrictors on the Cayos Cochinos Menor. We will visit the island in November of 2010 to test and refine the predictive model. The results from this research will be used not only to further knowledge about the thermoregulatory behavior of boa constrictors but also for conservation purposes.

ACKNOWLEDGEMENTS

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