

# Understanding Graphic Maps at the Bronx Zoo

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## ABSTRACT

Zoos frequently use geographic maps and science terms to educate visitors about animal habitats. There is, however, very little about visitors' ability to interpret these mapping conventions. This study sought to discover how easily adult visitors to the Bronx Zoo were able to identify two continents and countries on maps, and their interpretation of the term "range." The results showed that although a majority of visitors could identify both South America and Asia from the continent outline alone, 28% of visitors could only identify one or both continents when viewing a map of the full hemisphere. Additionally, 10% were unable to identify a continent from any of the maps provided. Graphic representation of an animal range was better understood than the term "range" though a large percentage of the participants still did not understand the information. These findings suggest a need to revise maps in exhibit labels to improve visitor comprehension. Such changes would include showing at least a hemisphere-level view, specifically identifying or labeling countries, and replacing the term range with more accessible language.

## BACKGROUND

American zoos seek to educate their visitors about environmental conservation issues through animal exhibition. Within these exhibitions, designers rely significantly on graphic maps and geographic terminology to communicate information to visitors. Additionally, because a map is only one part of a larger set of conservation messages, the map is often reduced to an outline or shape with a minimal amount of text. Creators of this signage often assume that visitors have a certain degree of geographic literacy to correctly interpret the information represented by these maps. The accuracy of this assumption, however, has been tested very little. One goal of this study was to test this assumption, to understand how well most zoo visitors are able to identify geographic locations on several versions of outline maps commonly used in zoo exhibits. A second goal was to assess whether visitors understand the concept

of animal "range" and the graphic representation commonly used to indicate range on a map. This term is frequently found on exhibit signs and/or is graphically represented through a shaded area on an outline map, as in Figure 1.

Although maps are commonly used to deliver information about the world or region to the general public, science educators have expressed concern that experience with information presented in visual-spatial ways, such as maps, is being neglected in American classrooms (Mathewson, 1999). Furthermore, a lack of such experience with maps may have negative effects, not only on the understanding of geographic information, but also on the acquisition of abstract concepts of spatial relationships (Uttal, 2000). In reviewing this literature, we became concerned that this spatial comprehension

deficit may be more widespread in the public than previously reported and that this lack of map comprehension was limiting the ability of zoo maps to convey conservation information in the zoo.

Little research has been done in museum or zoo settings to determine visitors' ability to correctly interpret the geographic information presented on maps. Assessment of the general public's geographic literacy has been performed by the National Geographic



Figure 1. Typical species identification label, including range map.

Society in 1988 and in 2002 (Leary, 1989; National Geographic Education Foundation, 2002). These studies have shown very low geographic literacy among young Americans (ages 18–24). On average, young Americans were only able to identify 6.9 out of 16 countries and global locations in 1988 and 7.3 out of 16 in 2002. Despite this, museums and zoos continue to use maps to present geographic information about wildlife and global conservation issues.

An earlier front-end study was conducted at the Prospect Park Zoo (Werntz and Fraser, 2002), which was concerned with visitor understanding of animal coloration as a survival strategy. Some unpublished data from that study gave the impression that some zoo visitors do not understand range maps on exhibit labels. To explore the supposition that some zoo guests have difficulty interpreting maps, a pilot study on map literacy was conducted at the Bronx Zoo by interviewing 40 visitors. Of the 40 visitors interviewed, the main finding was that almost half could not recognize the outline of South America. The results of this pilot study prompted the development of the present research, designed to more comprehensively assess adult zoo visitors' ability to identify a continent and country on an outline map, and explore their understanding of the terminology and graphic representation of animal range.

## METHOD

To gain a clearer understanding of what graphic information is required to convey animal range information, we developed two measures. One set of evaluations concerned geographic literacy, and included determining how well zoo visitors recognized unlabeled continents either in isolated

outline or otherwise embedded in larger geographic contexts. We also measured visitors' ability to identify a specific country on the continent map. A second set of measures was about "range," namely, visitors' ability to define the term or locate it when displayed as a shaded area on a map.

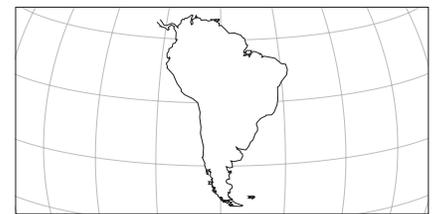
### Participants and Interviewers

Eighty-five visitors to the Bronx Zoo were surveyed by trained docents in March 2005. Participants were selected opportunistically by interviewers stationed at non-exhibit areas on zoo grounds. Demographic information was collected at the end of the survey, including age, level of schooling, gender, and group composition. The study participants included 45 men and 40 women, evenly distributed across age groups and closely approximating the average zoo visitor demographic profiles. (See Appendix for the standardized interview protocol). The interviewers were 14 adult docents from the Bronx Zoo who were trained to adhere to a standardized procedure in administering and scoring the surveys.

### Map Reading

Each visitor was presented with the task of identifying on each of two sets of 11" x 17" cards first a continent, and if identified successfully, then a particular country on that continent. The first set contained outline maps of a "South American series" and the second contained maps of an "Asian series" (Figures 2 – 6). For the first series, the interviewee was shown a map of South America (Figure 2) and asked to name it. In each case the interviewer circled the continent with his or her finger to clarify which part of the map the visitor was to look at. If the visitor did not identify South America on the first card, he or she was shown the second card with the

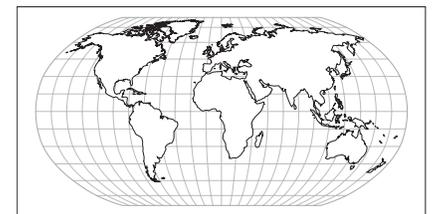
added outlines of North and Central America (Western Hemisphere) (Figure 3). If the visitor was still unable to identify the continent, he or she was shown a final card depicting the world (Figure 4). If the visitor correctly identified South America on one of these cards, the interviewer pointed to the approximate center of Brazil on that map and asked the interviewee to name the country located there. If a continent was never identified, the researcher moved on to the next series of maps



**Figure 2.** South America/Brazil Map 1 (Continent View)



**Figure 3.** South America/Brazil Map 2 (Hemisphere View). Interviewer circled the continent in question.



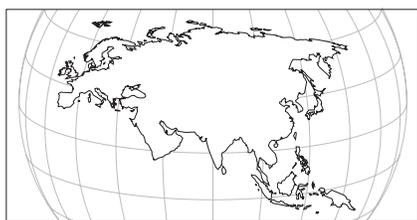
**Figure 4.** World Map. Used for both series of maps. Interviewer circled the continent in question.

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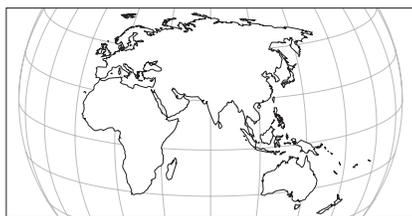
or questions. The second series used the same procedure for identifying Asia and China. The first card contained an outline map of Asia and Europe (Figure 5). The second card added Africa and Australia to that view (Figure 6). And the third card represented the world (Figure 4). All maps used a modified Goode projection with oceans removed.

### Range

After the map-reading questions, the interview was concluded by asking



**Figure 5.** Asia/China Map 1 (Continent View).



**Figure 6.** Asia/China Map 2 (Hemisphere View). Interviewer circled the continent in question.



**Figure 7.** Range Map used for interview.

one of two questions about “range.” Interviewers alternated between the two questions with consecutive interviewees. For one of these questions, 38 visitors were shown a new map of South America (Figure 7) containing a small, red shaded area, similar to the way in which animal ranges are illustrated in Bronx Zoo exhibits and scientific literature. Visitors were asked to “Look at the map of Brazil and suppose it is in front of an exhibit of Golden-headed Lion Tamarins. Can you tell me where exactly Golden-headed Lion Tamarins live?” For the other question, 43 visitors were not shown a map, but were asked, “If I say, ‘The range of Tamarins is Eastern Brazil,’ what does that mean?”

Due to procedural errors, data were discarded for two participants in the South American map series, for eleven participants in the Asia series, and for four participants answering the range question.

## RESULTS

### Map Reading

Results of map reading are illustrated in Tables 1 and 2. In all, 76 participants (92%) were able to correctly identify South America and 62 (84%) were able to correctly identify Asia. Seven participants (8%) were unable to identify South America by name and 12 participants (16%) were unable to identify Asia with the maps presented.

Analysis of the data based on how readily visitors were able to identify the maps of both continents was also performed to get a sense of the geographic literacy of the sample. Results of this analysis are illustrated in Table 3. From this, 45 visitors (63%) who were asked were able to identify both South America and Asia from

the outline of each continent alone (Map 1), showing strong geographic literacy. Seven visitors (10%) were unable to identify either continent on any of the maps shown. Between these two extremes, 20 visitors (28%) had difficulty identifying at least one of the continents by its outline alone, but were able to make a correct identification given greater context.

### Range

Of the 38 visitors shown the map that graphically represented an animal range, 23 (61%) correctly identified, through words or by pointing on the map, that the colored area on the map represented where the exhibited animal can be found in the wild. The remaining participants were unable to attribute meaning to the shaded area. Responses to the question, “Looking at this map, where do Golden-headed Lion Tamarins live?” that were scored as incorrect included the following:

- “Maybe along the river?”
- “Don’t know – rainforest?”
- “Rainforest in Brazil”
- “Don’t know”
- Visitor points to someplace other than the red spot on the map, e.g., Western Brazil.

Of the 43 visitors asked to state the meaning of the word “range,” 24 (56%) correctly understood it to mean the place where the animals live, inhabit, or are found. We accepted statements that defined range as:

- “Tamarins inhabit Eastern Brazil”
- “That’s where Tamarins live”
- “That’s where you find them in the wild”
- “That’s where they are located”
- “That’s where the monkeys come from”
- “Where some things are found”.

**Table 1. Identification of South America and Brazil**

n=83	Continent Map	Hemisphere Map	World Map	Unable to Identify	Not Asked Country
S. America	55	21	0	7	
% of total	67%	25%	0%	8%	
Brazil	41	10	0	25	7
% of total	50%	12%	0%	30%	8%

**Table 2. Identification of Asia and China**

n=74	Continent Map	Hemisphere Map	World Map	Unable to Identify	Not Asked Country
Asia	59	3	0	12	
% of total	80%	4%	0%	16%	
China	47	3	0	12	12
% of total	64%	4%	0%	16%	16%

**Table 3. Geographic Literacy (n=72)**

Level of Maps on which Continents were Correctly Identified		
Both on Map 1	45	63%
One on Map 1; One on Map 2	13	18%
Both on Map 2	2	3%
One on Map 1; Couldn't identify the other	1	1%
One on Map 2; Couldn't identify the other	4	6%
Couldn't identify either	7	10%

The other 19 visitors (44%) either said they did not know what the sentence meant or incorrectly interpreted the term. Misinterpretations included association of the word with mountains, open spaces, forests, and as a measure of size.

There were no detectable effects of level of education, age group, or gender on

visitors' ability to identify continents (use of chi-square was inappropriate due to low expected frequencies).

### DISCUSSION

With regard to reading maps, a relatively large number of the participants (38% of those surveyed)

were unable to identify one or both continents by continent outline alone (i.e., on the first map). Embedding the continent outline within a hemispheric context increased comprehension, ensuring that noticeably more interviewees could make a correct identification. Displaying either continent within a world map, however,

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did not result in any further gain in recognition among those surveyed.

These data also show the variation in map reading literacy among Bronx Zoo visitors. While well over half of respondents demonstrated strong skills by identifying both continents on the first map, 10% of the sample were unable to identify either continent on any of the maps provided. As noted above, increasing map context to include the hemisphere view will aid many visitors' comprehension. However, we must also acknowledge that a segment of visitors require interpretation other than maps to obtain this information.

Visitors generally found it more difficult to identify Asia than South America. One reason might be that the Western Hemisphere map includes North America, which is commonly presented in television images with regional news. The responses of those incorrectly identifying South America suggested that without the larger geographical context of the Western Hemisphere, many visitors (19 people) confused South America with Africa. Seventeen of these visitors were able to correct their error once presented with the second map. However, this also may have been influenced by the fact that they were then aware that Africa was an incorrect response.

When reviewing the data from the Asian series of maps, we recognized the possibility that a sequence effect influenced these data. As the Asian series was always presented second, some visitors may have had a greater awareness that they were being asked to name a continent for the Asian series than they were for the South American series. However, allowing for this increased awareness of the interviewer's goal at the first card in the Asian series, the possible sequence

effect only appeared to aid a few visitors' comprehension. For future studies, the order in which series of maps are shown should be alternated in order to counter any such sequence effect.

The results presented in Tables 1 and 2 demonstrate that an individual's ability to identify a continent by its outline does not allow us to predict that he or she is aware of the location of a country within that outline. Even after correctly identifying the continent, a number of respondents were still unable to name the country when the examiner pointed to its geographic location within the continent. The latter failure occurred even though the countries (Brazil and China) are comparatively large and well-known. For example, although 92% of visitors were able to identify South America, a little more than half could also identify Brazil within that continent. We do not know what the success rate would have been for those who were unable to name the continent, had they been told the continent and given the opportunity to name the country. These success rates for identifying countries within continental maps suggest that supplemental information or alternate methods of presentation may be necessary for many visitors to comprehend this information.

The difference between identification ability for a continent and for a country may relate to the fact that these questions asked visitors to interpret two different types of information from a map. For the continent, visitors had to visually interpret the outline, while for the country, visitors had to identify the country spatially, based on its location within the continent. The results here show that understanding of these two types of information are different. There may be significant variation in individuals' ability to identify specific countries where animals are found

based on information presented in such unlabeled outline maps.

The findings regarding the term "range" and its corresponding graphic symbol further indicate the need to clarify exhibit labels. It is clear that we cannot assume most visitors will understand the use of this term in exhibit labels. With just over half of Bronx Zoo visitors correctly interpreting the term "range", we believe that zoo label writers should consider adopting simpler language descriptions to avoid confusion or misunderstanding by guests. Comparatively, it seems to be the case that the graphic representation of range on an exhibit label is somewhat easier for visitors to correctly interpret than is the word itself. Our results suggest, however, that a relatively large portion of zoo visitors do not readily understand the use of shaded areas to indicate animal habitat on graphic maps.

### CONCLUSIONS

As a result of this study, we feel zoos should reexamine their presentation of key geographical information in exhibit maps and labels. We recommend that, at a minimum and wherever possible, graphic representations of animal habitats include at least the Eastern or Western Hemisphere to orient guests to the region being presented. If space is not a concern, it may be advisable to include a full world map, although that did not aid comprehension among our visitors. Furthermore, we recommend that the use of the term "range" be considered a scientific term requiring explanation or that alternative language be employed to explain the concept, such as in the modified range map in Figure 8.

Our recommendations are based on interviews with adult visitors to the Bronx Zoo and may not be



**Figure 8. Illustration showing more clear representation of an animal's wild range.**

representative of the American population. Further study at other institutions, with larger sample sizes, may provide more accurate understanding of the challenges involved in presenting graphic representations of where animals are found in the wild.

We believe that we have uncovered evidence of a deficit in visual-spatial interpretation of graphic information that poses a significant challenge to environmental educators working in the zoo exhibit community. If visitors to zoos cannot form a spatial understanding of where wildlife conservation issues are urgent from the graphic information presented in exhibit labels, their ability to understand the complexity of habitat loss, species scale relationships and other conservation education goals may also be limited.

Redressing this deficit through the design of clear and comprehensible graphics may increase conservation education at zoos and the usefulness of exhibit labels.

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Appendix: Interview Protocol (instrument - both versions (A/1. B/2)).

## Map Range Study Ver. 1 (Updated Feb. 2005)

Interviewer \_\_\_\_\_ Loc \_\_\_\_\_ Date \_\_\_\_\_ S# \_\_\_\_\_

**Hello. I work here at the zoo. We are trying to improve things here at the zoo for visitors. Would you mind looking at several pictures and answering a couple of questions, including about yourself? Good.**

*(For any answer involving "a map, " respond, "Can you name it?"*)

### Section SAB

1. *(Show picture SAB-1) (Circle S.A. with finger) Can you tell me what this picture is of?* \_\_\_\_\_

**Correct.** *(Point to approximate center of Brazil) Can you tell me what country is here?* \_\_\_\_\_

If wrong in 1:

2. *(Show picture SAB-2) (Circle S.A. with finger) No, but now can you tell me?* \_\_\_\_\_

**Correct.** *(Point to approximate center of Brazil) Can you tell me what country is here?* \_\_\_\_\_

If wrong in 2:

3. *(Show picture SAB-3) (Circle S.A. with finger) No, Now can you tell me?* \_\_\_\_\_

**Correct.** *(Point to center of Brazil) Can you tell what country is here?* \_\_\_\_\_

### Section AC

1. *(Show picture AC-1) (Circle Asia with finger) Can you tell me what this is a picture of?* \_\_\_\_\_

**Correct.** *(Point to the center of China) Can you tell me what country is here?* \_\_\_\_\_

If wrong in 1:

2. *(Show picture AC-2) (Circle Asia with finger) No, but now can you tell me?* \_\_\_\_\_

**Correct.** *(Point to the center of China) Can you tell me what country is here?* \_\_\_\_\_

If wrong in 2:

3. *(Show picture AC-3) (Circle Asia) No, now can you tell me?* \_\_\_\_\_

**Correct.** *(Point to the center of China) Can you tell me what country is here?* \_\_\_\_\_

*(If none were correct, state: "People find these maps difficult")*

### Section A

*(Show map SAB-4) Look at the map of Brazil and suppose it is in front of an exhibit (a cage) of Golden-headed Lion Tamarins. Can you tell me where exactly Golden-headed Lion Tamarins live?* \_\_\_\_\_

### Section C. We are almost finished. I just have several questions about yourself.

1. **What year were you born?** \_\_\_\_\_

2. **Would you please indicate your level of schooling?**

Below HS Graduate

HS Graduate

Some College

College Degree

3. **Who joined you, if anyone, in your visit to the zoo today?**

Alone \_\_\_\_\_ Children \_\_\_\_\_ Adults \_\_\_\_\_ Children & Adults \_\_\_\_\_

Male \_\_\_\_\_ Female \_\_\_\_\_

**Thank you for your help.**

Notes: \_\_\_\_\_

Interviewers alternated between Section A as listed above, and Section B as follows:

If I say, "The range of Tamarins is Eastern Brazil" what does that mean? \_\_\_\_\_