



Habitat dioramas and sense of place:
Factors linked to visitors' feelings about
the natural places portrayed in dioramas

Diorama Research Project
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Abstract

This research investigated ways in which habitat dioramas contribute to visitors' development of Sense of Place. Visitors' responses to dioramas at the Field Museum (Chicago) and Denver Museum of Nature and Science were studied, using observations, interviews, and a Diorama Sense of Place survey instrument. Although observations revealed few conversations about the places depicted in the dioramas, other data revealed that dioramas inspired memories and connections to place. A complex set of factors contributed to visitors' feelings of Place Bondedness. Visitors expressed the strongest connections to places that felt most familiar to them—even if they had not visited them previously.

Introduction

This report uses a narrow definition of the term *diorama*, based on Wonders' (2003) definition: "Habitat dioramas are museum exhibits of stuffed animals set in an imitation of their natural environment" (p. 89). The scholarship on dioramas and diorama halls suggests that place is an important aspect of habitat dioramas. Curators and preparators spend significant time and effort planning and creating the places in which mounted animal specimens are placed (e.g., Anderson, 2000; Holmes, 2009; Wonders, 1991). Yet research on the extent to which dioramas help visitors connect to the places depicted is limited. In this report, we present findings for an exploratory study which investigated whether habitat dioramas contributed to visitors' development of sense of place.

This research was undertaken as part of the Oakland Museum of California's (OMCA) *Hotspot California* project. With support from the National Science Foundation, OMCA transformed its existing Natural Sciences Gallery into an exhibition that highlights the potential of habitat dioramas to engage the public in environmental issues. The *Hotspot California* exhibition showcases actual California locations with high biological diversity, places which are threatened by complex environmental issues. Its revised interpretation emphasizes the personal connections that people develop to these places. The diorama research study, completed prior to the opening of the new exhibition, was conducted at two of OMCA's partner sites: Field Museum in Chicago and Denver Museum of Nature and Science.

Defining Sense of Place

Sense of place is a popular but complex concept addressed within many academic disciplines, including psychology, geography, anthropology, and architecture. Noting that each field often defines the term too narrowly based on its individual discipline, Ardoin (2004, 2006) attempted to map the multi-dimensional nature and range of factors contributing to developing a connection with places. She defined sense of place as a term that "describes the complex cognitive, affective, and evaluative relationships people develop with social and ecological communities." The concept's four dimensions include:

- The *Biophysical Dimension* of place, which describes the physical and biological environment as the context within which sense of place develops. Sense of place can develop with either outdoor (natural) or built environments.
- The *Psychological Dimension* of place, which works on the individual level. Three place-centered psychological concepts that have been studied: a) *Place identity*, which “includes the environment as an important factor in developing self-concept” (p. 115); b) *Place dependence*, which relies on places to support individuals’ goals and desired activities; and c) *Place attachment*, which refers to the bond that individuals feel to a place. It starts with the psychological (place identity and dependence dimensions) but moves beyond to include socio-cultural components such as experiences shared with families and communities.
- *The Socio-cultural Dimension*, which recognizes that the meanings that create a sense of place are created through culturally specific social interactions and practices. Individuals function within societies, which include “cultural and symbolic elements [that] sustain society’s views of and beliefs related to place” (p. 116).
- *The Political Economic Dimensions* of place, which recognizes that political entities (such as states) are situated within a physical place and that any place is not isolated but rather connected in many ways to other places.

Several studies suggest that developing a strong sense of place can lead to environmentally responsible behaviors. Some research (Kudryavtsev, et al., 2012) supports this view. Sense of place can be developed not only through extended experience with a particular place (for example, living in or visiting a place over a long period) but potentially also through indirect means—even to places individuals have not visited. For example, individuals may express a sense of attachment to the Amazon Rainforest or the Grand Canyon even if they have never been there. These feelings may derive from indirect experiences, such as watching documentaries, reading stories, looking at photographs, or other means. Thus, it is possible that sense of place can be developed through more interpretive experiences (such as diorama museum experiences) that may, in turn, lead to positive environmental behaviors.

Connections to Place in Dioramas

In their literature review of visitor outcomes at dioramas, Gyllenhaal, Garibay, and Schaefer (2010) noted some, albeit limited, findings indicating that some visitors are aware of or connected to the places shown in habitat dioramas when interviewed after their diorama experiences. The review incorporated contributions from a number of literatures, including:

- Evaluation and research studies conducted either specifically with habitat dioramas; in diorama halls prior to, during, or after their renovations; or in complex exhibitions that included at least some dioramas. These included both published and unpublished studies.
- Published reports describing research projects completed in diorama-based exhibitions. These evaluation and research studies represent a range of methodologies conducted using a variety of research methods.
- To put the diorama-related literature in context, the synthesis also included many published and unpublished studies about learning and other outcomes of diorama experiences, some conducted in museums and some in other settings.

When all sources are considered, the authors consulted more than 200 studies, of which 189 were cited in the report and its appendices (Table 1).

Table 1. Literature Cited in the Diorama Outcomes Literature Review

Research about or within dioramas and diorama halls	22
Evaluations of dioramas and diorama halls	48
Scholarship about dioramas and diorama halls (did not involve visitor research)	14
Research/evaluation in other (non-diorama) exhibits	57
Research, evaluation, scholarship in non-exhibit settings	34
Research/scholarship on learning related to museum settings (to help define the outcomes)	14
Total	189

The literature review found that a large number of learning-related outcomes have been ascribed to the diorama experience in museums. Some claims about diorama outcomes have been well supported by research and evaluation; others have not. The outcomes that were investigated in the review are listed in Table 2). The authors made a conscious effort to adopt terms used in the diorama literature.

Table 2. Outcomes Ascribed in the Literature to the Diorama Experience

Emotional Outcomes	<ul style="list-style-type: none"> Feel excitement, awe, wonder Feel immersed, feel psychological flow Feel restored, refreshed, relaxed Feel disgusted, repulsed, fearful, sad
Attitudinal Outcomes	<ul style="list-style-type: none"> Develop appreciation, value Develop positive conservation attitudes Develop caring attitude towards nature Develop interest, curiosity, motivation
Cognitive Outcomes	<ul style="list-style-type: none"> Become aware Internalize a mental model Gain knowledge, facts, identifications Understand concepts, explanations Develop inquiry and science processes skills
Other Outcomes	<ul style="list-style-type: none"> Retain complex memories Reflect on or develop new perspectives Learn about/cement bonds with family/social group Work on personal identity, e.g., related to science/conservation Declare an intention to act or actually change behavior Develop a sense of place Develop a sense for a particular time

Table 3 arranges the outcomes of diorama experiences by the relative strength of the evidence for them—either strong evidence or some evidence. In a few cases, we found no literature in which the outcomes had been studied. (For summaries of the findings for each outcome, see [Appendix A](#).)

Table 3. Relative Strength of Evidence for Outcomes Ascribed to the Diorama Experience

Key:

Strong evidence	Some evidence	Not studied
		NS

Outcome	Strength of Evidence	
	Traditional diorama halls	Renovated diorama halls
Feel immersed, feel psychological flow		
Gain knowledge, facts, identifications		
Understand concepts, explanations		
Develop inquiry and science processes skills		
Retain complex memories		
Feel disgusted, repulsed, fearful, sad		
Feel restored, refreshed, relaxed		
Reflect on or develop new perspectives		
Feel excitement, awe, wonder		
Develop appreciation, value		
Develop positive conservation attitudes		
Develop caring attitude towards nature		
Develop interest, curiosity, motivation		
Internalize a mental model		
Develop a sense of place		
Develop a sense for a particular time		
Learn about/cement bonds with family/social group		NS
Declare an intention to act or actually change behavior	NS	
Become aware	NS	NS
Work on personal identity, e.g., related to science/ conservation	NS	NS

Sense of Place Outcome

Note that the literature review classified the outcome “*Develop a Sense of Place*” as having limited evidence in the literature to support that it occurs within diorama halls. The available evidence suggests that dioramas that depict familiar natural areas seem to stimulate visitors’ pre-existing sense of place. For instance, in studies of the dioramas at the Chicago Academy of Sciences (Perry, Garibay, and Edington, 1996; Fialkowski et al., 1992), visitors recognized that the dioramas represented real places in the Chicago region and discussed connections between the dioramas and the real places—especially those they remembered from previous experiences. At the Oakland Museum of California’s dioramas in the Natural Sciences Gallery, Garibay (2008a) found that visitors seemed to have developed, or were developing, relationships with the wild places depicted in the dioramas. Two-thirds of respondents, for example, gave answers suggesting that they recognized that the Gallery was California-specific; some recalled places they had visited that were specifically depicted in the dioramas or similar places they were reminded of as they viewed certain habitat dioramas:

Yosemite. I visited there before and really enjoyed it. This gallery certainly reminds me of there.

It made me think of my childhood and traveling to the Redwoods and to the water. I felt nostalgic.

The study also asked visitors about the extent to which they were able to personally connect to natural places portrayed in the Gallery. While most visitors agreed that they felt connected to these places, repeat visitors to the Gallery provided significantly higher ratings than first-time visitors. Nearly 60% of visitors indicating feeling a connection said this was because they had been to that specific place, seen an animal or plant portrayed in the diorama, or had an interest or memory relating to these places.

I love the coasts, the Redwoods. I used to be a backpacker so I recognize a lot of the places.

I've been to a lot of these places and I don't know all the animals, but I see some I've always had questions about and I think, "Oh, I've seen that bird before."

[It was] reminiscent of growing up in the Great Plains.

Thus, visitors in both studies made links between habitat dioramas and places that had meaning to them. This suggests that two aspects of senses of place may have been at play, as defined by Ardoin (2004, 2006): (1) understandings of the physical and biological environments shown in the dioramas (Ardoin’s Biophysical Dimension of place), and (2) place attachment, the bond that individuals felt for the places shown in the dioramas (Ardoin’s Psychological Dimension of place).

Other respondents in the OMCA sample, however, thought of the Natural Sciences Gallery in more general terms—as “nature” or as places where animals live, rather than as natural places that might hold personal meaning for *them*. Responses from the “non-visitors” to OMCA’s Natural Science Gallery—those who participated

in the study but who rarely, if ever, had been to OMCA before— did not see the Gallery as depicting specific places (Garibay, 2008a).

While [non-visitor] participants clearly saw the Gallery as depicting nature and animal habitats, very few mentioned that these were California-specific places. Of course, on some level, [these] visitors likely knew that these were supposed to be California habitats, but what is more important here is that this is not something they recalled about the Gallery. Instead, what was most memorable for them is that it depicts nature and wildlife rather than nature in California. In other words, the Gallery seems to portray nature—at least in respondents' minds—in a somewhat generic manner and location. (Garibay, 2008a p. 5).

Thus, while some evidence exists that dioramas can stimulate visitors' pre-existing sense of place—especially for frequent museum visitors—it is not known the extent to which dioramas help visitors develop their sense of place, especially for places where they've never been. Although the sense of place outcome seems like a useful lens to view the diorama experience, more research specific to dioramas is needed.

Study Focus and Design

Given that sense of place has rarely been studied in diorama experiences, this exploratory research focused on a basic but poorly understood question: *What role does sense of place play in visitors' experiences with habitat dioramas?*

More specifically, do visitors experience feelings or connections for the places they view in diorama halls? If so, do they experience stronger feelings for some diorama places? How do visitors' feelings about place affect their experiences at habitat dioramas, and what roles might place-related feelings play in the outcomes of their diorama experience? And finally, what factors contribute to visitor's feelings of place bondedness, and what role can museums play in initiating or deepening visitors' feelings for the places portrayed in dioramas?

In order to answer these questions, the research team reviewed a number of sense-of-place measures to determine whether they could be adapted to a museum context.

Measuring Sense of Place

Several valid and reliable scales exist to measure sense of place. In our review of available instruments that measure sense of place and related constructs (e.g., visitors' general feelings about the natural environment), we identified 11 studies that could potentially be adapted for our research. (These studies are listed in [Appendix B.](#)) Our criteria for selecting a final instrument included that the scale reflected the complexity of the sense of place concept, that it was not too long, and that it could be generalized across multiple places/dioramas.

We selected a scale developed by Hammitt, Kyle, & Oh (2009), which included question items developed in earlier sense-of-place studies. The items were grouped into five aspects measuring sense of place which the authors collectively termed *Place Bondedness*:

- *Place identity* — individual's personal identity in relation to the physical environment
- *Place dependence* — perceived strength of association between a person and a specific place
- *Place familiarity* — pleasant memories, attribute and cognitive meanings, and environmental images
- *Place belongingness* — feeling of affiliation with place, a social bond where people feel as though they are connected and hold "membership" with an environment
- *Place rootedness* — strong and focused bond that "in its essence means being completely at home"

Hammit, Kyle, and Oh developed three versions of the instrument, each shorter than the previous version. (These were tested and validated with campers and fishermen who used a particular river in Tennessee.) The Full Model included all questions for all five dimensions, the Parsimonious Model included all five dimensions but fewer questions for each, and the Partial Model included only two dimensions (Place Identity and Place Dependence) but included all questions for those two dimensions. To test the predictive validity of the three Place Bonding models, the authors compared model scores for two groups of recreational users (campers and fishermen) and found that:

The differences in predictive validity of the three models were not great. As a consequence, it is difficult to recommend convincingly which model is best to use. Because the five dimensions, 15-item parsimonious model was as predictive as the full model, we would recommend the parsimonious model over the full model. When deciding between the parsimonious and partial models, one has to ask if the 7% (campers) and 3% (anglers) gain in prediction of the parsimonious model over the partial model is advantageous enough to use it over the partial model (p. 68).

These results were encouraging, because we knew we needed a short instrument to use with causal museum visitors.

Of course, the Hammitt, Kyle, & Oh (2009) instrument's scales were developed for respondents who were known users of a particular place's natural resources. Clearly, for this study, some questions had to be reworded or dropped because they were not appropriate for a survey whose respondents may or may not have visited one specific place and who may or may not be familiar with it from the media or other sources. For example, the place dependence questions focused on ways an individual used a particular natural area (e.g., "Trout fishing in the Chattooga is more important to me than trout fishing in any other river").

The final instrument developed for this study included 11 questions (in the form of statements) taken or adapted from the Hammit, et al. instrument. These statements asked respondents their level of agreement with a

statement using a 1–5 (strongly disagree to strongly agree) scale. To give a flavor for the scale, some of the statements follow:

“I feel like I belong at this place.”

“This place is very special to me.”

“I feel connected to the place shown in this diorama.”

“If I visited this place, I would feel like I was part of it.”

“I identify strongly with this place.”

To account for visitors’ non-place-related feelings for the natural places portrayed in dioramas, the team used the Connectedness to Nature scale developed by Mayer & Frantz (2004). This scale was designed to measure respondents’ levels of emotional connection to the natural world. Mayer & Frantz (2004) described five studies that assessed the validity and reliability of the scale. As with the Place Bondedness scale, the Connectedness to Nature scale was shortened and the questions slightly reworded for use with visitors in a museum diorama hall setting. As with Place Bondedness, the scale consisted of statements with which respondents rated their agreement 1 (strongly disagree) to 5 (strongly agree). To give a flavor for the scale, some of the statements follow:

“I think of the natural world as a community to which I belong.”

“I often feel disconnected from nature.”

The instrument also included questions about familiarity with the place depicted in the diorama (e.g., “I feel very familiar with the place shown in this diorama”), prior visitation to that specific place, or to places that look similar to the one portrayed.

The instrument was then piloted. During the pilot phase we also included observations of the respondent groups in the diorama halls, followed by post-visit interviews to triangulate our findings and gain a deeper understanding of the nature of visitors’ experiences (such as the extent to which visitors attended to and talked about place at the dioramas). Pilot phase investigations took place at the *Nature Walk* diorama exhibition in the Field Museum, described and illustrated in [Appendix C](#), and at the *Explore Colorado* dioramas at the Denver Museum of Nature and Science (DMNS) in its *Explore Colorado* diorama exhibition, described and illustrated in [Appendix D](#). We conducted 24 observations (13 of those groups were interviewed) using purposive sampling to obtain as broad as possible a range of groups (e.g., families, adult only groups, locals vs. tourists, range of ages).

After the pilot study, we added questions to the Dioramas and Sense of Place instrument to address important aspects of visitors’ experiences identified during observations and interviews and key outcomes visitors took away from their experiences. (We termed these scales “intensity of experience” and “depth of outcomes,” respectively.) These scales, rated 1–5, included statements such as:

“This diorama brought back memories of my own outdoor experiences.”

“I imagined what it would be like to visit the place shown in this diorama.”

“I learned a lot about this place by looking at the diorama.”

“Viewing this diorama made me feel like I want to visit this place sometime soon.”

Additionally, interview results suggested that respondents’ feelings about places depicted in the dioramas might be influenced by their discomfort with certain aspects of that habitat (insects, snakes, icy landscapes). To account for potential non-place-specific factors that might affect visitors’ responses to dioramas, we developed the Preferences for Outdoor Experiences scale, inspired by two existing scales: Bixler and Floyd’s (1999) Disgust Sensitivity Scale (which attempts to measure respondents’ preferences for, or aversion to, outdoor aspects such as mosquitoes, mud, and cold) and Simmons’ (1994a, 1994b) scales for his studies on adult and children’s preferences for various landscapes (e.g., rural vs. urban nature scenes). Examples of statements (using 1–5 ratings as with the scales described above) are:

“I enjoy visiting wild places that have lots of insects and spiders.”

“My favorite outdoor places have broad lawns, formal gardens, and neatly trimmed shrubs.”

The final instrument included seven scales (38 questions) to measure Place Bondedness, aspects and potential outcomes of the diorama experience, and a range of possible contributing factors such as visitation, familiarity, connectedness to nature, and preferences for outdoor experiences. The seven scales are discussed in more depth, and all of the questions are listed, in [Appendix E](#). The full instrument is assembled in [Appendix F](#).

In the second phase of the study, the final version of the survey instrument was administered to large samples at the Field Museum’s *Nature Walk* and DMNS’ *Explore Colorado*. The total sample for phase two was 633 randomly selected adult respondents (305 collected at DMNS and 328 at the Field Museum).

Diorama Selection

To determine which dioramas to use in the study, the team had to decide which aspects of place to focus on, whether dioramas of places visitors might have first-hand familiarity with or “iconic” places that might be recognizable to visitors even had they not visited. In the end, we chose a bit of both, selecting five dioramas at each site. The Field Museum included three dioramas that represented local (Chicago Lakefront) or regional places (Illinois Marsh in Lake County, Iron County Woods in Northern Michigan) and two depicting iconic places (Grand Canyon and the Amazon Rainforest in Brazil). The five Field Museum dioramas are illustrated in Appendix G. At DMNS we used a similar strategy, choosing dioramas representing a range of local-to-regional, elevation-related life zones (from short-grass prairie to mountain-top tundra) and also including the iconic Sonoran Desert diorama (although it depicted a habitat in Arizona, not Colorado). The specific dioramas included were Mesa Verde National Park, San Juan Mountains, Pawnee National Grasslands, Loveland Pass, and Arizona Desert (Superstition Mountains). These are illustrated in [Appendix H](#).

Sample

Demographic characteristics of the Phase 2 samples from the two museums are listed in [Appendix I](#). At both museums, female respondents outnumbered males 58% to 42%. Some demographic characteristics of the Phase 2 samples seemed to be influenced by the presence of a popular traveling exhibition about pirates at DMNS during data collection. For instance, 60% of the Field Museum respondents were in groups that did not include children, whereas 72% of the DMNS respondents groups included children. The most frequent age range at the Field Museum was 18-29 (38%), whereas the most frequent group at DMNS was the 30s (36%).

Perhaps because most of the Field Museum surveys were collected during the summer, only 20% of Field Museum respondents were from the Chicago metropolitan area, and 63% of Field Museum visitors said they had never seen the *Nature Walk* dioramas before. In the DMNS sample (collected in the spring), 34% were from the Denver metropolitan area, and only 20% were seeing the *Explore Colorado* dioramas for the first time. Race/ethnicity data skewed heavily towards Caucasian (82% at Field Museum and 89% at DMNS). Some two-thirds of both museum samples were college graduates and a quarter of the sample held postgraduate degrees.

Analysis

Observations and interviews conducted during the pilot phase were analyzed using content and thematic analysis. For the sense of place instrument, basic summary statistics were calculated and compared, including mean and median values for each question for each diorama. Scores for the subsets of scales were also calculated for each diorama. These summary statistics were compared, using tables of data and histograms that displayed mean scores for each diorama. To explore the relationships among the variables that might contribute to respondents' Place Bondedness scores, regression analyses were conducted on both answers to individual questions and overall scale scores. Scatter plots of the data were compared visually and R^2 values calculated and compared in tabular form.

Results

Recognizing Place at Dioramas

One interesting finding of the pilot study was that some respondents did not realize that the dioramas represented specific geographic places. Respondents seemed more focused on the animals than on any specific place they might represent. Although respondents talked amongst themselves about many aspects of the dioramas, place played a secondary role in most of these conversations. When place did emerge, it was often mentioned to establish a setting for a story, discussion, or lesson about an animal depicted in a diorama. Stories were often based on personal or shared memories of encounters with that kind of animal, often in their everyday lives, like a possum in the alley or a mud puppy encountered during a fishing trip. The places mentioned in these stories were usually similar places (or places with similar animals) rather than the specific place represented in the diorama. Parents often used these conversations to remind their children about things they had experienced or learned about that kind of animal.

Most of the engagements observed (in both family and all-adult groups) during the pilot phase tended to fit the pattern of engagement described by Tunnicliffe (2005). She identified four levels of interpretation and usage of the dioramas:

1. *Locate.* Visitors first locate items within the diorama, based on their own observations and assisted by labels if they are available.
2. *Identify by name the located object.* Identifications may come from the observer, companions, or labels if they are available.
3. *Describe form, function, and behavior.* Visitors frequently describe the items they have identified, noting attributes like size, shape, and color, and perhaps discuss the function of a feature or the behavior implied by an animal's pose.
4. *Interpret.* Visitors may interpret what they've seen, using abstract terms to relate the exhibit to concepts, raising questions, or even philosophizing about what they've seen.

At both Field Museum and Denver, the diorama labels did a good job of supporting Tunnicliffe's first two levels of interpretation, inspiring respondents to look for animals pictured in the labels and identifying what they found. Adults and some older children read more of the in-depth labels than other respondents; therefore, the interpretation helped them reach engagement levels 3 and 4. Caregivers in family groups, however, rarely read labels in depth. Although family discussions sometimes took them to levels 3 and 4, they reached these levels based on their own observations, interests, and prior knowledge.

When respondents did discuss place, they often tended to focus on *habitat* rather than the specific location depicted in the diorama. For example, when asked how they recognized where the dioramas were set, respondents said they recognized it as much or more from the animals and plants and diorama scenes as from the labels. Even when they read the labels, respondents' place recognition mostly came from what they knew about where the animals lived, the background paintings, plants, and landscapes. Perhaps because they focused

so much on habitats, respondents were often reminded of places with similar animals, plants, and physical features—they were reminded of other places they knew about or had experienced with similar habitats. For instance, the Amazon Rainforest diorama inspired some respondents to think of similar tropical and subtropical scenes they had experienced in Costa Rica, Florida, or even Houston, Texas. The Michigan woods diorama inspired memories of woods experienced elsewhere in the Midwest and as far away as Oregon.

Although the pilot study observations revealed few conversations about place, the written surveys and interviews revealed that the dioramas inspired memories, thoughts, and feelings about place that went unexpressed as the group explored the exhibition. For many respondents, emotions were just beneath the surface and did not emerge until the interview. Memories were, in turn, connected to people in respondents' lives and to events such as vacations, childhood explorations in nature, or even encounters with animals. These findings are congruent with earlier studies (Garibay, 2008a, 2008b) suggesting that place served as a backdrop to the stories and memories. As noted earlier, these memories were sometimes shared at the dioramas but more often did not surface until the interview.

Interviews also revealed interesting connections with both the closest and farthest places from Chicago and Denver. At the Field Museum, those respondents from the Chicago area lived close enough to Lake Michigan to visit it regularly (or at least saw it fairly often). They all had memories of the Lake and expressed some level of connection to Chicago's Lakefront. In the DMNS sample, the Loveland Pass diorama (although not immediately adjacent to the city) seemed to represent a similar community-wide experience; it was a familiar place that respondents had either visited (e.g., to hike or ski) or driven through when heading west through the Rockies.

At the other extreme, some visitors expressed connections to places very far from Chicago or Denver. This was the case for the Amazon Rainforest among respondents at the Field Museum. There were indications that respondents were familiar with this place from school or the media and perhaps were influenced by the overall ecological concern for the rainforest's future. Although the Grand Canyon was much closer to Chicago than the Amazon (and more respondents had been there), interviews revealed that it too had a sort of iconic status even with those who had not yet visited. In the Denver sample, the Arizona Desert diorama seemed to be similarly iconic, which may explain why it was the only non-Colorado diorama in that exhibition.

Observation and interview data suggested that place played an important role in many individuals' experiences in diorama halls, although sometimes these connections were not necessarily apparent in conversations at the dioramas. Additionally, place in habitat dioramas seemed to have both geographic and ecological components:

- 1) Geographic place is the geographic location depicted in the diorama, which may or may not be apparent to visitors. Findings suggested that plants, animals, and landscape features can make a diorama look and feel familiar even if visitors have never been to that geographic location.

2) Ecological place is the more general habitat portrayed (on which visitors were more apt to focus). Although ecological places can be defined scientifically (Beech-Maple Forest), visitors often connected to them in a more personal or vernacular sense. For example, while the diorama's creators might have intended to depict a specific type of forest, visitors might be reminded of other woodland areas that were personally meaningful.

Furthermore, visitors' connections to place seemed to fall into four not necessarily exclusive categories: personal place, shared place, community place, and "touchstone" place. These could be plotted as concentric circles, with personal place at the center.

- *Personal place* – A person's own memories of places they have been.
- *Shared place* – Places that members of a group have been to together and of which they share memories.
- *Community place* – When many members of a community visit or use a place regularly, it becomes a "shared" by a larger group (e.g., Chicago's Lakefront). Community places are defined within restricted geographic regions.
- *Iconic place* – Members of a larger community, perhaps a state or a nation, share some common ways in which they connect to place, even a place they have not visited (e.g., the Amazon Rainforest, the Grand Canyon, or the Arizona Desert). These places have some shared meaning, perhaps due to media coverage, learning about it in school, or their status as part of national patrimony (e.g., the Grand Canyon or Yosemite could fit this last category).

Quantifying Sense of Place at Dioramas

We attempted to measure the extent to which visitors experienced sense of place at habitat dioramas using the instrument described previously in the Measuring Sense of Place section. We adopt the term "Place Bondedness" from Hammitt, Kyle, & Oh (2009) to describe connections to place.

Overall, diorama experiences did stimulate measurable Place Bondedness for respondents. Feelings of Place Bondedness, however, differed by diorama; some dioramas stimulated higher scores than others (Fig. 1). For example, in the DMNS data, the mean Place Bondedness score for the Arizona desert was 2.5 out of 5 while the Loveland Pass mean score was 3.5. Scores for the Field Museum dioramas showed a similar range, from 2.3 for the Amazon Rainforest to 3.3 for the Michigan Woods.

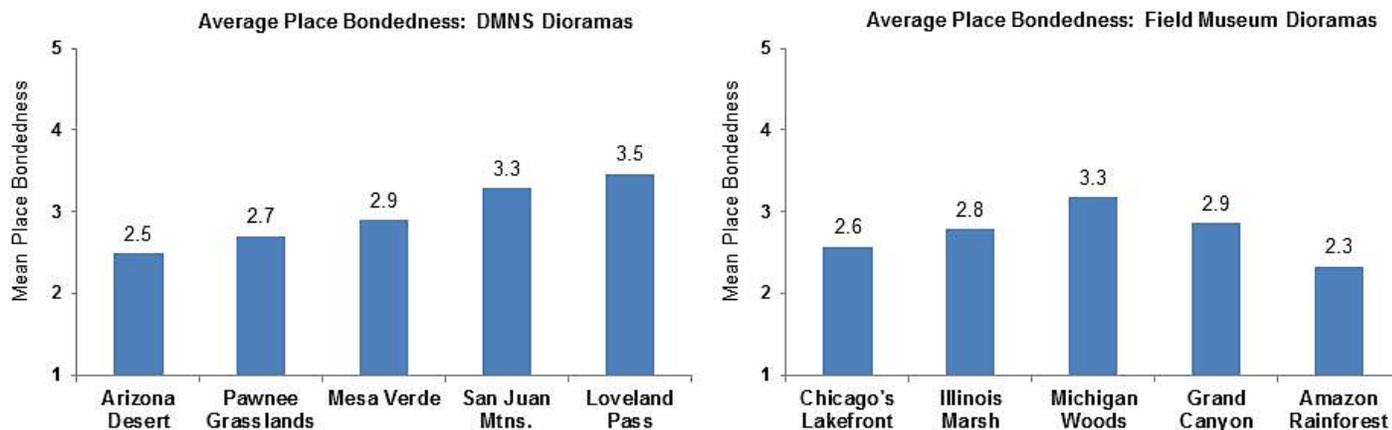


Figure 1. Average Place Bondedness by diorama for the two study sites (Denver Museum of Nature and Science on the left and Field Museum on the right).

Relationship to Connectedness to Nature

Some initial concern existed among the researchers that although we were attempting to measure place-related feelings at dioramas, we might instead be measuring visitors' more general feelings of connection to the natural world. Regression analysis indicated that, in some cases, a positive relationship existed between feelings of Place Bondedness and Connectedness to Nature. We examined both visitors' overall average Place Bondedness scores and the average values for each diorama. For visitors' average scores (Fig. 2), a positive relationship existed between DMNS visitors' overall feelings of Place Bondedness and their Connectedness to Nature scores ($R^2 = .027$). Thus, Connectedness to Nature in the DMNS data accounted for about a quarter of the variance in averaged Place Bondedness within the sample. A positive but much weaker correlation existed between averaged Place Bondedness and Connectedness to Nature for the Field Museum sample ($R^2 = .12$). Data suggest that, in general, visitors who felt stronger connections to the natural world were, overall, somewhat more likely to bond with natural places; other factors, however, were in play.

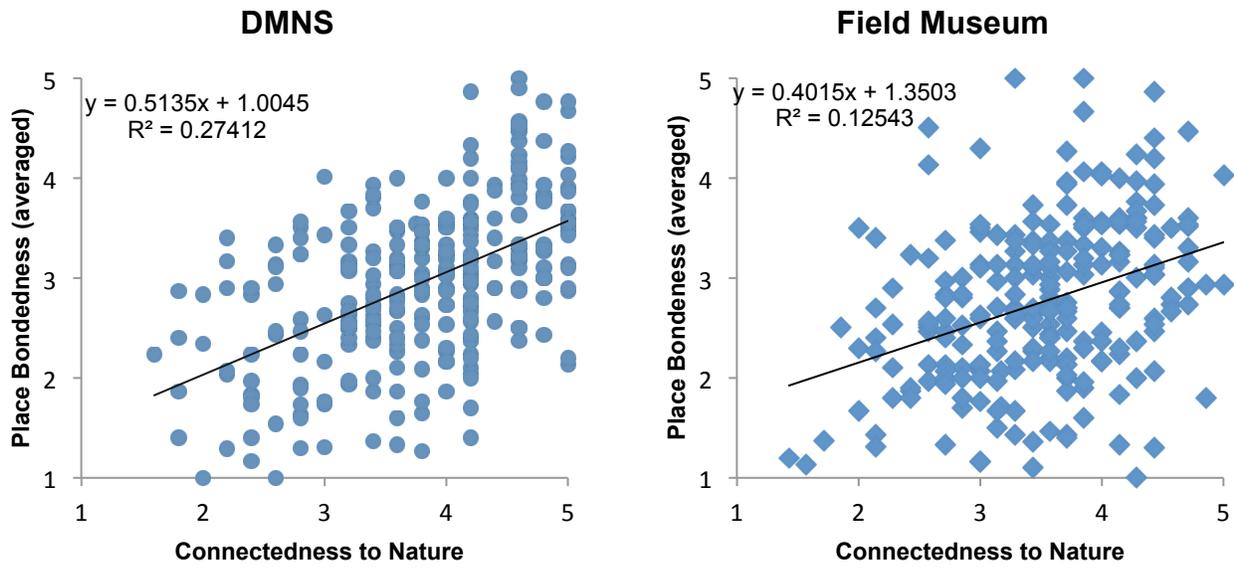


Figure 2. Scatter plots of Place Bondedness versus Connectedness of Nature scores for individual respondents. (DMNS on the left and Field Museum on the right).

Additionally, when data were disaggregated by individual dioramas the positive relationship between Connectedness to Nature and Place Bondedness was weak at nine of the ten dioramas in the study (Table 4). In the DMNS sample, the correlation was strongest for Loveland Pass ($R^2 = .24$) and weakest for the Arizona Desert ($R^2 .05$). In the Field Museum sample, Connectedness to Nature was a negligible factor ($R^2 .02$ or below for any diorama). Thus, Place Bondedness for individual dioramas at the Field Museum was almost completely independent of respondents' overall Connectedness to Nature. At DMNS there was a somewhat stronger relationship for four of the five DMNS dioramas, but most of the feelings of Place Bondedness must be explained by other factors. The rest of the analysis examines those factors.

Table 4. Place Bondedness versus Connectedness to Nature Correlations (R^2 values) by Diorama (DMNS dioramas above, Field Museum dioramas below)

<i>Independent</i>	<i>Dependent</i>	Arizona Desert	Pawnee Grasslands	Mesa Verde	San Juan Mtns.	Loveland Pass
Connectedness to Nature	Place Bondedness	0.05	0.10	0.17	0.18	0.24
<i>Independent</i>	<i>Dependent</i>	Chicago Lakefront	Illinois Marsh	Michigan Woods	Grand Canyon	Amazon Rainforest
Connectedness to Nature	Place Bondedness	0.01	0.02	0.01	0.04	0.02

Place of Residence, Prior Visitation, and Familiarity with Place

Respondents’ feelings of Place Bondedness varied according to where they lived (Table 5). For example, in the Field Museum data, mean scores for the Chicago Lakefront diorama were higher for Chicago area residents (3.4) than for all other respondents in the sample (2.4). These differences may have to do with frequency of visitation. Chicago area residents, for example, were more likely to have visited Chicago’s Lakefront more often. It’s also interesting to consider that, during the pilot study, the Lakefront was recognized as a community place for Chicago residents. In the DMNS sample, Colorado residents were more likely to have visited Loveland Pass (averaged visitation 3.8) and expressed somewhat greater Place Bondedness (3.5) for this classic Colorado location than did the non-resident sample (averaged visitation 2.9, familiarity 3.3, Bondedness 3.2). Loveland Pass may be a “community place” for Colorado residents but might also be iconic for those outside the state.

Table 5. Place Bondedness and Averaged Visitation by Place of Resident for Individual Dioramas (Field Museum dioramas above, DMNS dioramas below)

		Chicago Lakefront	Illinois Marsh	Michigan Woods	Grand Canyon	Amazon Rainforest
Chicago area residents	Place Bondedness	3.4	3.3	3.3	3.0	2.4
All other respondents	Place Bondedness	2.4	2.7	3.2	2.8	2.3
Chicago area residents	Visitation (averaged)	3.9	3.3	3.0	2.1	1.5
All other respondents	Visitation (averaged)	2.2	2.4	2.6	2.0	1.3
Chicago area residents	Familiarity	4.2	3.9	3.8	3.0	2.5
All other respondents	Familiarity	2.7	2.9	3.5	2.9	2.3

		Arizona Desert	Pawnee Grasslands	Mesa Verde	San Juan Mtns.	Loveland Pass
Colorado residents	Place Bondedness	2.5	2.7	2.9	3.3	3.5
All other respondents	Place Bondedness	2.4	3.0	2.8	3.3	3.2
Colorado residents	Visitation (averaged)	2.2	2.4	2.8	3.0	3.8
All other respondents	Visitation (averaged)	2.0	2.4	2.4	2.5	2.9
Colorado residents	Familiarity	2.5	2.9	3.1	3.5	3.9
All other respondents	Familiarity	2.6	3.3	2.9	3.2	3.3

While expressions of Place Bondedness tended to be stronger when visitors had some real-world experience with the place portrayed in a diorama, respondents did not need to have visited the depicted area to show measurable Place Bondedness. As an example, looking across all five DMNS dioramas, correlations for averaged visitation to the place depicted in the diorama and averaged Place Bondedness had an R² of .78 while correlation for

averaged visitation to a similar place and averaged Place Bondedness had an R^2 of .65 (Fig. 3). In other words, it did not seem to matter much whether visitors' real-world experiences were with the exact same place or with a place that looked similar; visiting either one affected their Place Bondedness.

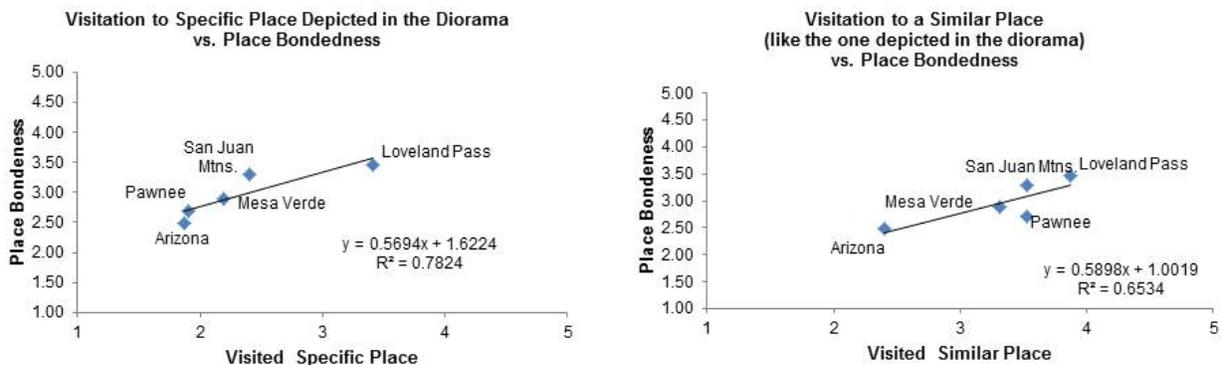


Figure 3. Relationships between Place Bondedness and Visitation at Denver Museum of Nature and Science for two types of Visitation: Visiting the specific place shown in the diorama (left) and visiting a place that seemed, to the visitor, similar (right).

Corresponding correlations for the Field Museum data were lower than those for DMNS for visitation to specific place $R^2=.20$ and of comparable value for visitation to similar place $R^2=.74$ (Fig. 4). The lower correlation of visitation to specific place may be in part because Field Museum respondents were much less likely to have visited the specific places depicted in the dioramas, even those close to Chicago. On the other hand, Field Museum respondents were more likely to have visited places *similar* to the ones portrayed in the dioramas, including marshes, woods, and shorelines in other parts of the Midwest, subtropical habitats that reminded them of the Amazon Rainforest, and steep-sided Midwestern canyons reminiscent of Grand Canyon. Therefore, both the absolute values for visitation and the correlations were higher between Place Bondedness and visiting a similar place.

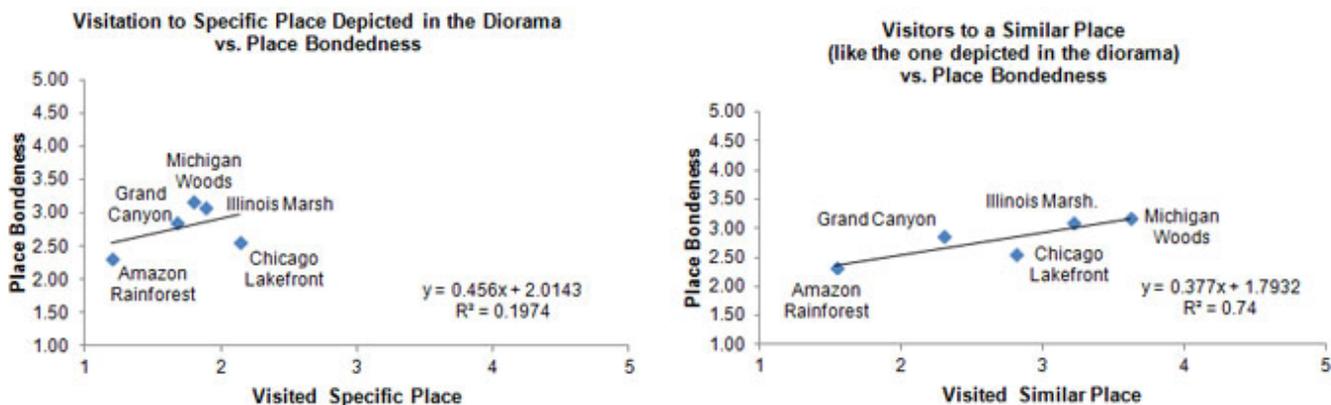


Figure 4. Relationships between Place Bondedness and Visitation at Field Museum for two types of Visitation: Visiting the specific place shown in the diorama (left) and visiting a place that seemed, to the visitor, similar (right).

Of course, these mean values do not reflect the variability in scores for individual dioramas, and thus overestimate correlations. When data are disaggregated by individual dioramas, correlations are certainly lower, but visitation still correlates positively with Place Bondedness (although the relationship is not as strong). Clearly, visitation to both specific and similar places played a role in visitors’ experiences at dioramas. As we proceeded with the analysis, we needed to decide which measure of visitation to use. Results indicated that for 9 of the 10 dioramas, a simple average of the two measures of visitation correlated more highly with Place Bondedness than either of its components (Table 6), justifying its use in these further analyses.

Table 6. Visitation and Place Bondedness Correlations (R² values) by Diorama (DMNS dioramas above, Field Museum dioramas below)

	Arizona Desert	Loveland Pass	Mesa Verde	Pawnee Grasslands	San Juan Mtns.
Visitation (specific place)	0.21	0.19	0.15	0.12	0.20
Visitation (similar place)	0.18	0.16	0.13	0.15	0.30
Visitation (average)	0.23	0.20	0.20	0.18	0.33

	Amazon Rainforest	Chicago Lakefront	Illinois Marsh	Grand Canyon	Michigan Woods
Visitation (specific place)	0.03	0.31	0.15	0.12	0.06
Visitation (similar place)	0.13	0.34	0.25	0.16	0.17
Visitation (average)	0.11	0.39	0.28	0.19	0.19

In the DMNS sample, Place Bondedness showed higher correlations with visitation to the San Juan Mountains and Arizona Desert. Loveland Pass and Mesa Verde also showed positive, although weaker, correlations, and Pawnee Grasslands’ was lower still. In the Field Museum data, Place Bondedness positively correlated with visitation for the Chicago Lakefront and Illinois Marsh, but the other three dioramas showed weaker positive correlations. That means that even after taking visitation into account, other factors also contributed to visitors’ feeling of Bondedness at individual dioramas.

While real-world experience at a place (or a place that felt similar) seemed important in establishing feelings of Place Bondedness, some respondents expressed at least some measure of Place Bondedness for places they had *never* visited but with which they still felt “familiar.” Examining the averaged scores across dioramas, Familiarity with Place highly correlated with Place Bondedness, with an astonishing R² of 0.97—perhaps in part because it is possible, through television or other media, to “get to know” a place without actually visiting it. Again, when data are disaggregated by diorama, correlations were lower but still positive (Table 7).

Table 7. Place Familiarity and Place Bondedness Correlations (R² values) by Diorama (DMNS dioramas above, Field Museum dioramas below)

	Arizona Desert	Loveland Pass	Mesa Verde	Pawnee Grasslands	San Juan Mtns.
Familiarity (with place or similar place)	0.60	0.57	0.38	0.54	0.49

	Amazon Rainforest	Chicago Lakefront	Illinois Marsh	Grand Canyon	Michigan Woods
Familiarity (with place or similar place)	0.39	0.53	0.48	0.40	0.36

Familiarity with place, in fact, was more highly correlated than were any visitation variable. Thus, while visits to the actual or a similar place account for a portion of the variation in visitors’ expressed Place Bondedness for the locations depicted in the dioramas, it is not the only factor. Place familiarity showed the strongest relationship to Place Bondedness across the full range of dioramas in the study. On average, visitors expressed stronger feelings of Bondedness for places that felt more familiar to them, even if those places were, like the Grand Canyon, and Amazon Rainforest, far from home and rarely—if ever—visited.

It seems that familiarity is likely shaped by factors other than visits to the actual places. These factors may include exposure to a place through some other mechanism—such as television, learning about it in school, or perhaps even visiting diorama halls.

Thus a complex set of factors contributed to visitors’ feelings of Place Bondedness for the places depicted in the dioramas, and their influence varied depending on which place was depicted. Findings suggest that Bondedness for the sorts of places depicted in habitat dioramas may develop through interactions between several positively related factors: visits to the place depicted, visits to places that look similar, and familiarity with place—which can be developed, in part, through indirect experience.

Intensity of Experience and Depth of Outcomes

While we did not directly observe visitors’ experiences at the dioramas, or view the outcomes of those experiences after the pilot phase, we used the Intensity of Experience and Depth of Outcomes scales in order to understand the relationship of these factors and their roles in Place Bondedness. The mean scores for Denver ([Appendix J](#)) indicate that the most intense experiences and deepest outcomes occurred at the two high-elevation dioramas, the San Juan Mountains and Loveland Pass, whereas the Pawnee Grassland diorama scored lowest on seven of the eight experience and outcome variables. At Field Museum, the high scores were more broadly distributed, but the icy Chicago Lakefront diorama scored lowest on six of the eight variables.

The regression analysis suggested that visitors’ Intensity of Experience and the Depth of Outcomes at a diorama correlated positively with their feelings of Place Bondedness for the place depicted (Table 5). It was unclear,

however, to what extent other variables, such as visitation and familiarity, also played roles in visitors' experiences with the dioramas.

At DMNS, a positive relationship existed between the average Place Bondedness score for the dioramas and the averaged scores on the Intensity of Experience scale for the dioramas ($R^2 = 0.88$) (Table 8). Respondents with higher average Place Bondedness scores for the five dioramas were also more apt to report reading about and discussing the dioramas, remembered more of their own outdoor experiences, and imagined visiting the place shown in the diorama. For the five DMNS dioramas, average Place Bondedness and average Depth of Outcomes also positively correlated ($R^2 = 0.79$), meaning that respondents with higher average Place Bondedness scores were more apt to report learning a lot about the place, wanted to visit it soon, and felt more connected to it. Average visitation, however, also positively correlated with both intensity of experience ($R^2 = 0.88$) and depth of outcomes ($R^2 = 0.70$). Additionally, place familiarity was positively correlated to intensity of experience ($R^2 = 0.81$) and depth of outcomes ($R^2 = 0.66$). The interrelationships here are all positive and it is difficult to tease out their relative effects through this sort of analysis. (Further analyses are planned as part of the OMCA research, which is to be conducted after the opening of the renovated Natural Sciences Gallery.)

Field Museum data also indicated positive relationships between Place Bondedness and respondent scores on the Intensity of Experience scale ($R^2 = 0.88$), but a very weak correlation between Place Bondedness and Depth of Outcomes ($R^2 = .06$) (Table 5). The relationship between Familiarity and Intensity of Experience showed moderate correlation ($R^2 = .39$). Furthermore, the relationships between Visitation and Depth of Outcomes and Familiarity and Depth of Outcomes were actually negative ($R^2 = .22$ and $.13$, respectively).

Table 8. Intensity of Experience and Depth of Outcomes Correlations for the Two Museums (R^2 values)

<i>Independent</i>	<i>Dependent</i>	DMNS	Field Museum
Place Bondedness	Intensity of Experience	0.88	0.88
Place Bondedness	Depth of Outcomes	0.79	0.06
Visitation (averaged)	Intensity of Experience	0.88	0.30
Visitation (averaged)	Depth of Outcomes	0.70	0.22 (-)
Familiarity	Intensity of Experience	0.81	0.39
Familiarity	Depth of Outcomes	0.66	0.13 (-)

Clearly, a nuanced explanation for the differences between the two museum data sets is necessary. It seems likely that the DMNS sample contained a robust feedback loop between Visitation and Place Bondedness. Many places depicted in the dioramas are within a day's drive for many respondents in our sample; 86% of them live in Colorado. Perhaps those who feel bonded to the real place depicted in the diorama are more likely to visit that place, which may deepen feelings of both Familiarity and Place Bondedness. There is support for this

explanation in the sense of place literature (Hammit et al., 2009). The results suggest that these relationships might be taken a step further in diorama halls, with the interrelated variables Visitation, Familiarity, and Place Bondedness exerting positive influences on visitors' experiences and outcomes at dioramas.

In comparison, the dioramas in the Field Museum sample included both regionally accessible places (in Illinois and Michigan) and places a thousand miles away or more (Grand Canyon and the Amazon) that were shown in the pilot study to be iconic locales among Field Museum visitors. What could have been a simple set of interrelationships seems confounded by the two iconic dioramas. Visitors were apparently attracted to and intrigued by these iconic places despite the fact that they had never been there and were less familiar with them than with Midwestern habitats. Therefore, in the Field Museum sample, the Depth of Outcomes relationship was reversed from what we would expect based on the DMNS sample. Field Museum visitors were more apt to report that, based on their experiences with the Amazon and Grand Canyon dioramas, they learned a lot, wanted to visit and felt more connected to these distant places, and were more apt to say that diorama was one of their favorites.

Preferences in Outdoor Experiences

Looking at average scores for the whole sample of respondents, the Preferences in Outdoor Experiences scale related weakly, at best, to the other variables in the study (Table 9). At DMNS, for example, visitors' Preference scores showed little correlation to their average Place Bondedness scores ($R^2 = .01$), a weak negative correlation to Connectedness to Nature ($R^2 = .10$), and an even weaker negative correlation to average Visitation for the five dioramas ($R^2 = .04$). At the Field Museum, the Preferences in Outdoor Experiences scale showed a weak negative correlation with Place Bondedness ($R^2 = .03$), a somewhat stronger negative correlation with Connectedness to Nature ($R^2 = .12$), and no correlation with averaged Visitation ($R^2 = .00$).

Table 9. Preferences in Outdoor Experiences Correlations for Both Sites (R^2 values)

<i>Independent</i>	<i>Dependent</i>	DMNS	Field Museum
Place Bondedness	Preferences in Outdoor Experiences	0.01	0.03
Connectedness of Nature	Preferences in Outdoor Experiences	0.10 (-)	0.12 (-)
Visitation (averaged)	Preferences in Outdoor Experiences	0.04 (-)	0.00

Since a higher score on the Preferences scale means a respondent feels *less* overall comfort with outdoor experiences, it makes sense that lower Preference scores would be associated with lower feelings of Connectedness to Nature. The very low correlations with Place Bondedness and Visitation, however, are hard to interpret. Perhaps the context in which the surveys were administered (a climate-controlled diorama hall) may have influenced responses. Dioramas might remind visitors of some outdoor discomforts, such as mosquitoes, but except for visitors with extreme phobias, this was not enough to register on the Preferences in Outdoor Experiences scale. Perhaps we chose to measure the wrong discomforts or asked the questions in the wrong

way. Either way, the Preferences in Outdoor Experience scale (at least as implemented in this study) had little predictive value.

Conclusions

This exploratory research set out to investigate the role of sense of place in visitors' experiences at habitat dioramas. Data indicated that visitors to both DMNS and the Field Museum did express feelings of Place Bondedness for the dioramas in this study. These feelings varied across the range of dioramas and between the two museums.

A complex set of factors contributed to visitors' feelings of Place Bondedness, and the effects of these factors varied depending on the place depicted at the diorama. Familiarity showed the strongest relationship to Place Bondedness, and this relationship held across the complete range of dioramas included in the study. On average, visitors expressed stronger feelings of Bondedness for places that felt more familiar to them, even if those places were—like the Grand Canyon and Amazon Rainforest—far from home and rarely, if ever, visited. This finding is encouraging because familiarity may be a factor where museums can contribute through a range of experiences (dioramas, programs) and, along with other media, help visitors become more familiar with a wide range of natural places which they may never visit.

When dioramas depicted places closer to home, visitation often (but not always) played a role in visitors' expressions of Place Bondedness. On average, visitors expressed stronger feelings of Bondedness for places where they had first-hand experience, whether at the exact place depicted at the diorama or a similar place of which the diorama reminded them. While visitation may *seem* beyond the reach of what diorama halls can influence, this may not be the case. Respondents in our sample indicated that they imagined what it would be like to visit the place depicted in the diorama (average ratings were DMNS=3.4 and Field=3.6, using a 1–5 scale) and provided moderately positive ratings that the experience made them feel that they wanted to visit that place soon (average ratings were DMNS=3.4 and Field=3.2). Two factors that, at least in this study, seemed less important in developing sense of place were overall feelings of connectedness to nature and visitors' feelings about the discomforts of outdoor experience.

This study was a first attempt at adapting Sense of Place and related scales developed for outdoor experiences to diorama-based ones. We hope that future studies further refine and validate the instrument. Current findings suggest, however, that Bondedness for the sorts of places depicted in habitat dioramas develops through interactions between several positively related factors, including (1) visits to a specific place depicted or similar places and (2) overall familiarity with the places portrayed in the dioramas. Furthermore, findings suggest a possible positive feedback loop among these factors. Results further suggest that visitors' experiences with

habitat dioramas contribute to all factors in this loop: they can increase familiarity with a place, inspire a desire to visit it, and directly help visitors feel more connected to it.

Finally, a most intriguing finding (especially for exhibit developers) emerged from the qualitative data in the pilot phase. While interviews revealed that respondents remembered and expressed connections to a place, they did not often share these memories and feelings with others in their group while at the dioramas. It seemed that respondents needed inspiration to talk (or write) about their connections to the places depicted. Exhibit teams might consider finding ways to help visitors talk about memories of places spurred by their diorama experience, whether they are memories of visits to the same geographic locations shown in the diorama or other place-related memories inspired by their experiences at that diorama.

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Appendices

Appendix A. Summary of Literature Review Findings

As part of this project, the Garibay Group team reviewed the literature on diorama and related museum experiences:

Gyllenhaal, E. D., Garibay, C., and Schaefer, J. (2010) *A synthesis of the literature on diorama experiences: Outcomes*. Unpublished manuscript, Oakland Museum of California, Oakland, CA.

This appendix summarizes the findings of that review regarding outcomes of the diorama experience. It also lists what the literature suggests are strengths and weaknesses of traditional habitat dioramas and how renovating dioramas can both build of dioramas' strengths and help overcome some of the weaknesses.

What We Know About Outcomes of the Diorama Experience

Feel immersed, feel psychological flow	This outcome has been studied in both traditional and renovated diorama halls. Findings suggest that renovations, such as extending the diorama into the surrounding hallways and adding multimedia, can make the immersive experience available to more visitors.
Gain knowledge, facts, identifications	Several studies suggest that the first things visitors focus on at dioramas are the location, identification, and description of the organisms portrayed.
Understand concepts, explanations	Several studies suggest families, in particular, discuss personally meaning concepts about reproduction, feeding, and defense at traditional dioramas. Studies in renovated diorama halls suggest that visitors notice, discuss, and remember concepts included in the revised labels and hands-on and multimedia displays.
Develop inquiry and science process skills	Several studies suggest that visitors use science process skills in dioramas, and that they use basic processes (like observation, identification, and communication) more often than advanced skills (like analyzing and inferring).

Retain complex memories	Several studies suggest that visitors retain memories of their diorama experiences for months or years.
Feel disgusted, repulsed, fearful, sad	Numerous studies have found that some visitors have trouble getting past their discomfort with viewing the remains of dead animals. Young children in particular may be frightened by dramatic experiences included in renovated diorama halls.
Feel restored, refreshed, relaxed	Studies in traditional diorama halls suggest that restorative feelings are more apt to be experienced by frequent museum visitors. There is some evidence that renovations can diminish the restorative experience by attracting larger, younger, and more active audiences.
Reflect	A series of studies at one museum found that reflective experiences (like imagining and reminiscing) were fairly common at traditional dioramas but happened less often when a diorama was supplemented with interactive exhibits.
Feel excitement, awe, wonder	The evidence for this outcome comes mostly from visitor responses to open-ended evaluation questions. We did not find any studies that looked specifically at awe or wonder.
Develop appreciation, value	Responses to open-ended questions suggest that some visitors <i>express</i> appreciation and values in diorama halls. We found no studies about whether/how visitors <i>develop</i> values in diorama halls.
Develop positive conservation attitudes	Responses to open-ended questions suggest that some visitors <i>express</i> positive conservation attitudes in diorama halls. We found no studies about whether/how visitors <i>develop</i> such attitudes in diorama halls.
Develop caring attitude towards nature	Responses to open-ended questions suggest that visitors <i>express</i> caring attitudes in diorama halls. We found no studies about whether/how visitors <i>develop</i> caring attitudes in diorama halls.
Develop interest, curiosity, motivation	One study looked at the development of situational interest in diorama halls. Other evidence suggests that visitors often <i>express</i> their interests through their diorama experiences.

Internalize a mental model	One study suggested that young visitors internalized a model of what they see in habitat dioramas, and that this is influenced by their existing models of the habitat portrayed. Another study found that young visitors used their existing mental models to interpret the animals they see in habitat dioramas.
Develop a sense of place	Studies suggest that visitors' existing sense of place can be stimulated by diorama experiences, but it's not clear if visitors can also develop a sense of place based on diorama experiences.
Develop a sense for a particular time	Studies in suggest that some visitors use habitat dioramas as a kind of window into the past, interpreting them as views of what nature used to look like.
Learn about/cement bonds with family/social group	Responses to open-ended questions about traditional diorama halls suggested that some parents shared their memories of earlier experiences with their children. Otherwise, this outcome has not been studied in diorama halls.
Declare an intention to act or actually change behavior	Although this outcome has not been studied specifically in diorama halls, there is evidence that, when renovated halls stressed conservation concepts, some visitors declared their intentions to engage in positive conservation behaviors.
Become aware	We have found no studies of awareness specific to dioramas.
Work on personal identity, e.g., related to science/ conservation	This outcome has not been studied in diorama halls, although it has been the subject of research and debate in museums in general. There is indirect evidence that some visitors express their ecological identities in response to open-ended questions.

Strength and Weaknesses of Traditional Habitat Dioramas

Strengths

Dioramas in traditional diorama halls can:

- provide deep and lasting experiences for many museum visitors.

- have outcomes that range from immersive and restorative experiences, to awe and wonder, to short-term and perhaps long-term interest in the natural world.
- help visitors, with their companions, build factual knowledge and personal understanding of natural places and of the animals and plants that live there.
- encourage visitor groups to talk – first about what’s in the diorama, and then about what it means.
- can unlock visitors’ imaginations, transporting them far away.
- can facilitate visitors feeling, thinking, and talking about natural places they have been and about conservation issues that are important to them.
- can stimulate visitors’ memories of places they have visited in the past and hope to visit in the future.
- can activate visitors’ ecological identities.
- can inspire visitors to express their caring feelings for natural environments and their life forms.

Weaknesses

Traditional habitat dioramas tend to:

- do little to supplement the experience of looking through the glass at static dioramas.
- be dependent on existing knowledge that visitors brought with them as they entered the museum.
- foster a limited range of emotional responses that are often based on how visitors already felt about the natural world.
- be less accessible to many visitors and to potential visitors who rarely, if ever, make it through museum doors.
- embody paradoxes such as expecting visitors to develop caring attitudes towards wildlife and wild places when museum staff killed many animals on display; and encouraging visitors to forge ecological identities by showing them are dead animals in ersatz habitats, faked with plaster and plastic, wax and paint.

Possible Benefits of Renovated Dioramas

Renovating dioramas can:

- encourage visitors to spend more time in the diorama halls.
- encourage visitors to look at more components.
- help visitors figure out what they see in the diorama.
- help visitors think deeper thoughts about what the exhibition means.
- provide a more immersive and enjoyable experience when the diorama builds out and surrounds them, although the larger crowds and increased activity may disrupt the restorative and reflective experiences that drew some visitors to diorama halls in the past.
- encourage more visitors to think about and reflect upon issues important to exhibit developers – including ecological concepts, doing science in the wild, and conservation-related issues.

Appendix B. Sense of Place and Related Instruments Included in the Literature Review

During June, 2010, the research team looked closely at 10 different instruments for measure various aspects of people's sense of place and related conservation constructs (Gyllenhaal, 2010). The instruments that the team wound up adapting for this study are in bold font.

Sense of Place

People and Lakes Survey (Stedman, 2002)

Sense of Place Survey (Bott, 2000)

Place Dependence and Place Identity Scales (Vaske & Kobrin, 2001; some questions from Williams & Roggenbuck, 1989)

Place Bonding and Experience Use History Scales (Hammitt, Kyle, & Oh, 2009)

Ecological/Environmental identity

Environmental Identity Scale (Clayton, 2003)

Environment Identity Measure (Stets & Biga, 2003; Hinds & Sparks, 2009)

Twenty Statements Test (adapted by Zavestoski, 2003, and Kempton, & Holland, 2003).

Connection to Nature

The Nature Relatedness Scale (Nisbet, Zelenski, & Murphy, 2009)

Connection to Nature (questions from a larger survey) (Guiney & Oberhauser, 2009)

The Connectedness to Nature Scale (Mayer & Frantz, 2004)

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Appendix C. *Nature Walk* at the Field Museum

Nature Walk was constructed about 20 years ago using existing dioramas, some of which are now more than 100 years old. *Nature Walk* was evaluated shortly after it was installed (Serrell, 1992):

Serrell, B. (1992). *Into the Wild. Summative evaluation. 1. Nature Walk*. Unpublished manuscript, The Field Museum of Natural History, Chicago, IL.

According to the 1992 evaluation,

Nature Walk is the visitor's first impression of the newly renovated animals halls at Field Museum. A collection of dioramas portraying different species of animals, birds, reptiles and insects in appropriate habitats, the exhibit has a meandering path that takes visitors through 46 scenes and numerous opportunities for close looking, touching, reading, and listening.

Nature Walk is meant to be an informal, fun introduction that stimulates curiosity about the animal kingdom, which is examined in detail in the other halls. The exhibit's objectives are to inspire visitors to spend time in the outdoors, to explore and make discoveries of their own, and to appreciate, value, and want to protect the environment.



Figure C-1. Entrance to *Nature Walk*.



Figure C-2. Diorama cases in *Nature Walk*. Note also the boardwalk and touchable Caiman cast.

Many of the labels on the diorama labels help visitors search for and identify the animals in the dioramas:



Figure C-3. Triangular “treasure hunt” and rail identification labels.

Although place is not a primary part of its interpretation, *Nature Walk* has a kind of place-related structure to it, in that:

- All the dioramas represent places in the Americas
- Almost all represent North American locations
- Many represent the Upper Midwest (Great Lakes States)
- Several are specific to the Chicago area

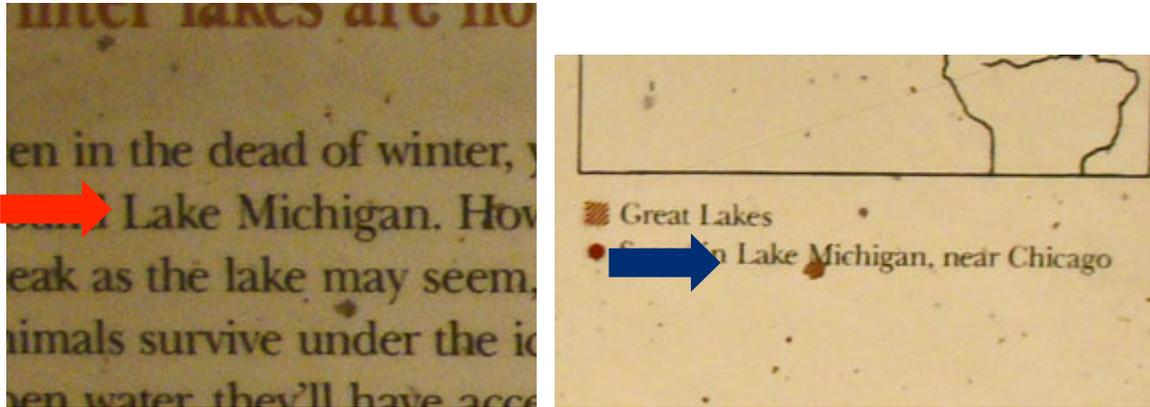
Each diorama depicts both a very specific place and the habitat that is found at that place. Habitat and the ecological interactions within that habitat tend to be the focus of the interpretive labels. The location of each diorama is identified on the main label and sometimes on other labels as well. However, place was not a major part of the interpretation of this exhibition the way it is in some other diorama (like the Chicago Academy of Science used to be, and like Denver's *Explore Colorado* is, and OMCA's *Hotspot California* will be).

The next several photos show how place is identified in the labels

The main labels for each diorama (e.g., Figs. C-4) always include a map and specific place location on the right side (blue arrows), and sometimes include additional place information on the left interpretive text (red arrows). In a few cases place is mentioned in the label's header.



Figure C-4 A. Examples of place information in a main label panel.



Figures C-4 B and C. Close ups of the preceding label showing references to place.

Although the triangular “treasure hunt” and rail identification labels do not mention place, the Flip ID books often do on either the ID pages (Fig. C-6 A) or title page (Fig. C-6 B)



Figure C-6 A. Pages inside a flip ID book don't mention place.



Figure C-6 B. The cover of this flip ID book does specify place.

During the pilot study the research team anticipated that respondents would have trouble locating the place information on the existing labels; therefore, the team added temporary labels identifying places depicted in the dioramas (e.g., Fig. C-7).



Figure C-7. We added temporary place labels to target dioramas.

We should also note that many of the exhibit labels discussed conservation issues, especially endangered and threatened species. A few exhibits are specifically about environmental challenges, like this exhibit about oil spills (Fig. C-8).



Figure C-8. The oil spill exhibit discussed and illustrated a conservation issue.

Appendix D. *Explore Colorado* at Denver Museum of Nature and Science

This exhibition is a renovation of the museum's Mead Ecological Hall, installed in the 1930s and 1940s. It was renovated about 20 years ago, as described in Dyer (1992). This exhibit includes 10 major dioramas of natural scenes in Colorado, plus a diorama of the Arizona desert. *Explore Colorado* interpretation stresses that each diorama represents a major ecosystem and recommends viewing the dioramas in sequence, from the lowest elevation (Arizona desert) to the highest (Alpine tundra) (Dyer, 1992). Because the *Explore Colorado* presents and interprets a range of habitat dioramas for a single state, it presents some interesting parallels to the *Hotspot California* renovation at Oakland Museum of California. Each diorama is identified with both an ecological place, similar to habitats that visitors may have seen elsewhere, and a *named geographic place* that some visitors may have been to before.

Here are two key references about the renovation to Mead Hall. This reference describes the process of renovating the diorama hall, lists the dioramas (with some photos), describes and illustrates the interpretation, and briefly discusses the role of evaluation in the renovation:

Dyer, J. (1992). New life on an old hall: A prototype for restoring aging diorama halls. *Curator*, 35(4), 268-284.

Some of the evaluation data was included in this study:

Harvey, M., Girjulin, A., & Loomis, R. (1993). A virtual reality & human factors analysis of a renovated diorama hall. *Visitor studies: Theory, research and practice: Collected papers from the 1993 Visitor Studies Conference*, 6, 129-139. This paper describes a research study that took place in the renovated exhibition. Online at: http://informal.science.ideum.com/researches/VSA-a0a4p2-a_5730.pdf

Following are photos of the *Explore Colorado* hall. The hall, other than the dioramas, really is as dark as it looks in these photos.



Figure D-1. Central kiosk, with a map of Colorado and an introduction to the C. Moore persona (used in labels throughout the hall).



Figure D-2. Looking past the central kiosk to Pawnee Buttes prairie and South Platte dioramas.



Figure D-3. Looking towards Long’s Peak and other high elevation dioramas:

For examples of interpretation, here’s the Mesa Verde diorama. When possible we use the terminology from the Dyer paper (1992). These panels are pretty standard throughout the hall. The only variation is that, when dioramas are two or three windows wide, they have more sloping panels to work with:



Figure D-4. This shows the overall pattern for dioramas:
Right backlit panel has geographic place name and a C. Moore notebook page.
Left backlit panel has the ecological place name. Dyer calls it the Science Panel.

The sloping panels in front of the diorama windows include several elements:

- A center label describes the scene, its location and elevation

- The rest of the panels as drawings as identifiers for plants and animal

- Center of sloping rail/base has a unit with a pushbutton interactive called a Discovery Box.

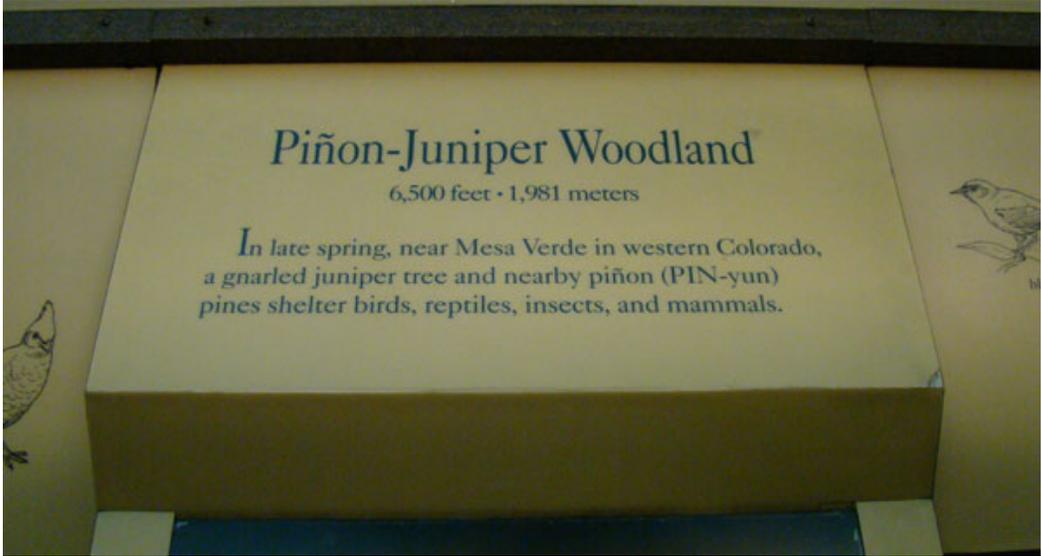


Figure D-5 A. The sloping panels in front of the diorama windows include several elements, including a center label describing the scene, its location and elevation.

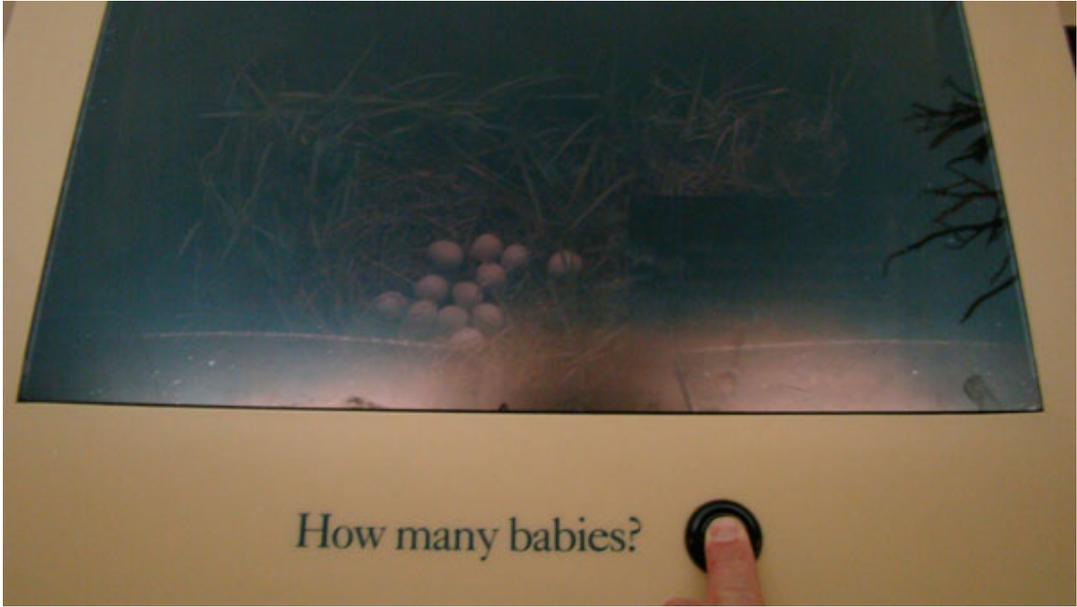


Figure D-5 B. The center of sloping rail/base has a unit with a pushbutton interactive called a Discovery Box.

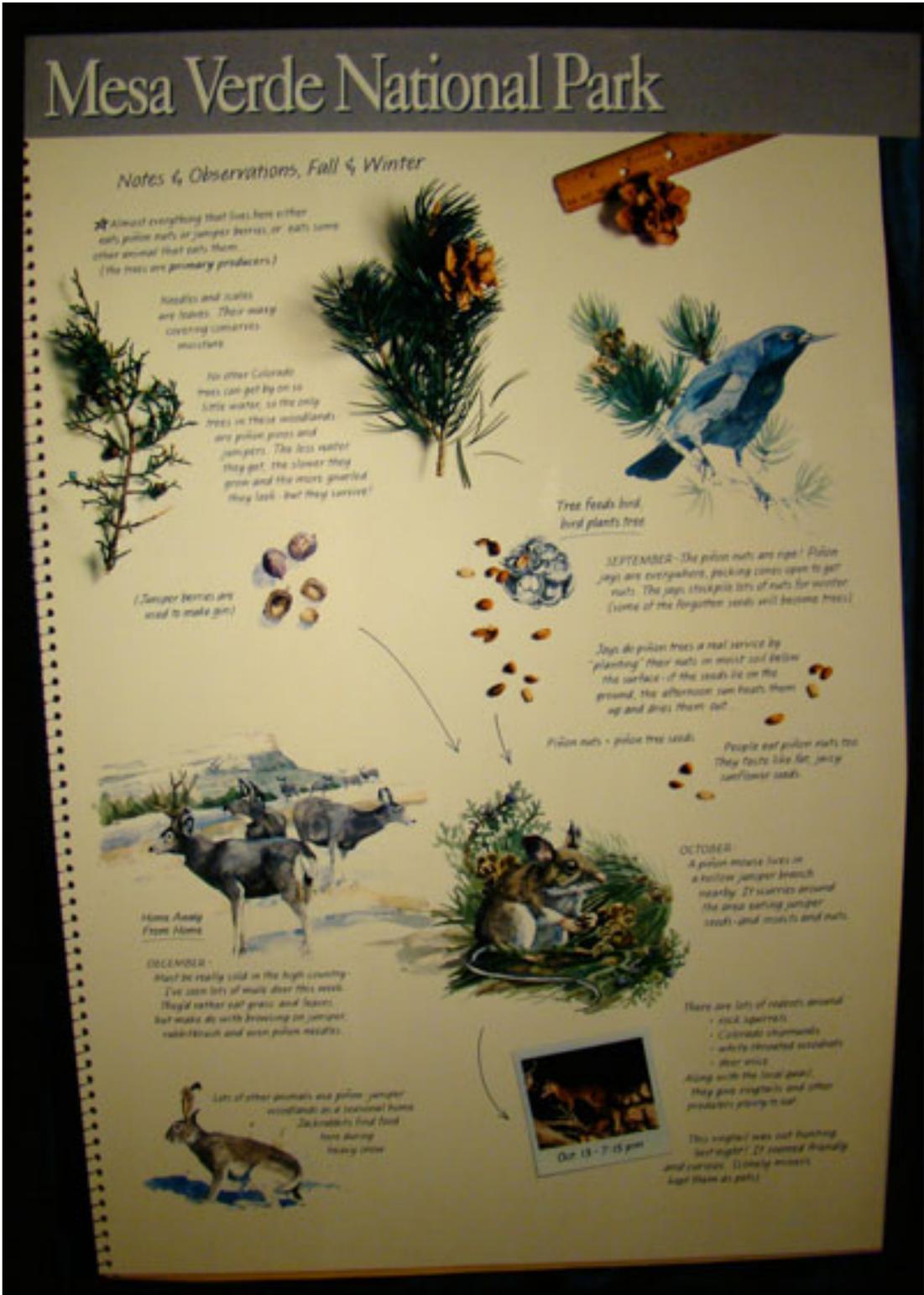


Figure D-6. Right backlit panel has geographic place name and C. Moore notebook page. The “page” is tilted on purpose.

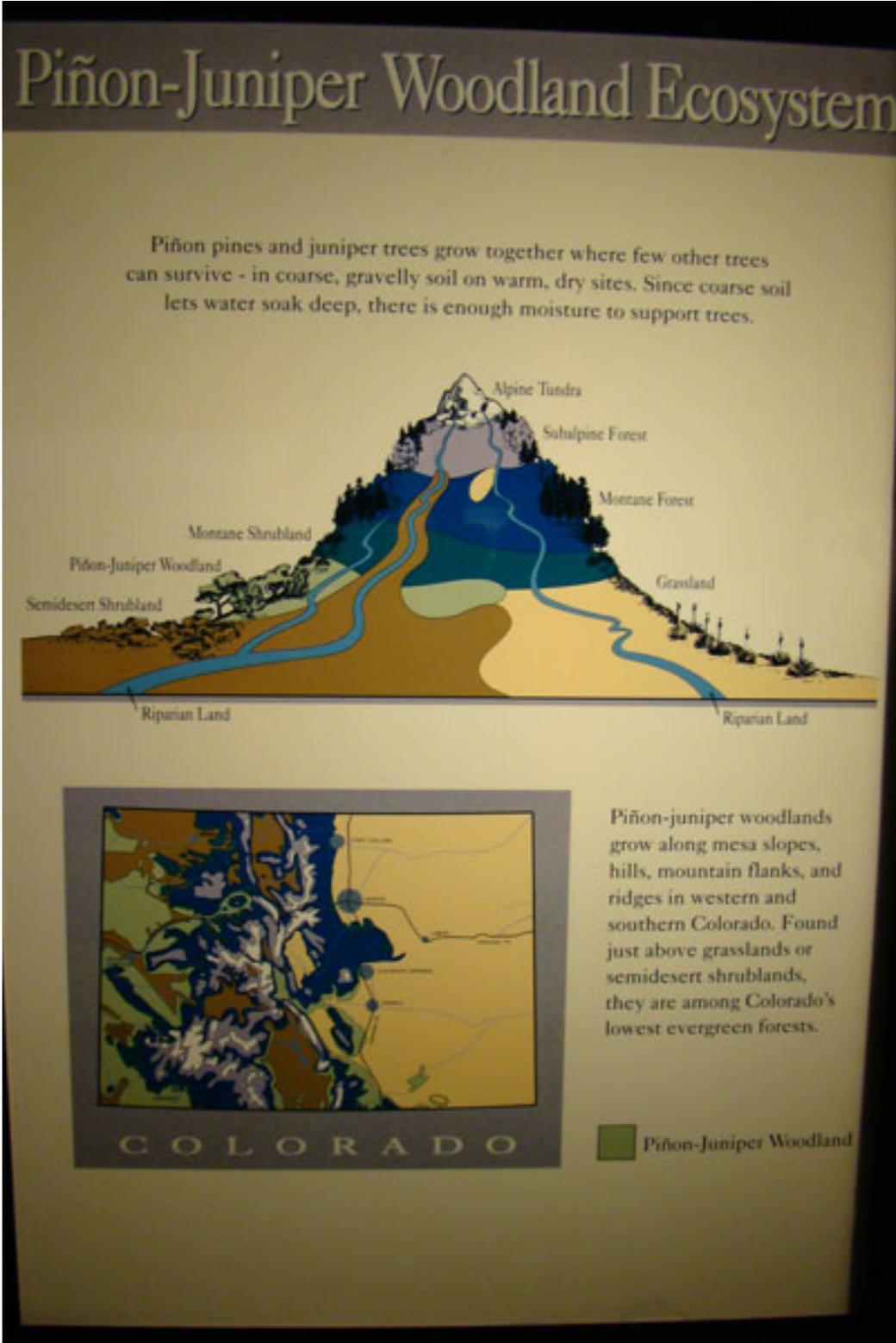


Figure D-7. Left backlit panel has the ecological place name. Dyer calls it the “Science Panel.”

Appendix E. Questions Used in the *Dioramas and Sense of Place* Instrument

This appendix explains the development of the Dioramas and Sense of Place scale. Appendix G shows the completed survey questions as they were included in the final survey.

Each museum had its own version of the survey, specific to the dioramas that visitors viewed in that diorama hall. Each survey included five pages with questions about the five target dioramas for that museum, plus two additional pages. The pictures, names, and additional information about the target dioramas used in the *Dioramas and Sense of Place* survey are in Appendices E and F. The scales that were applied for each target diorama were Visitation, Familiarity, Place Bondedness, Intensity of Experience, and Depth of Outcomes (see below). The sixth page of the survey included two additional scales: Connectedness to Nature and Preferences for Outdoor Experiences. The seventh page of the survey was for demographic-type questions (included in Appendix G).

Scales completed for each target diorama

Visitation Scale

Questions 2 through 5 represent the Hammitt *et al.* (2009) Place Familiarity dimension, which was broken into Visitation and Familiarity scales. The original Hammitt *et al.* question, “I have visited this place many times and am quite familiar with it,” and essentially became five questions, three about visitation and two about familiarity.

For the Visitation scale, respondents were asked separately if they had visited the specific place shown in that diorama or a place that looked similar to that one. They were also asked if they had visited with the specific or a similar place with members of their visiting group, since that might have an impact on their diorama experiences or outcomes. Note that the Visitation scale also serves as a museum-diorama appropriate version the Experience Use History scale develop by Hammitt et al (2009), as explained in the body of this report.

2.	How often have you visited the specific place shown in this diorama?	Never	1 time	2-3 times	4-5 times	More than 5 times
3.	How often have you visited a place that looks similar to this one?	Never	1 time	2-3 times	4-5 times	More than 5 times
4.	How often have you visited this place (or a similar one) with people who toured <i>Nature Walk</i> with you today?	Never	1 time	2-3 times	4-5 times	More than 5 times

Place Familiarity Scale

The Place Familiarity dimension of the Hammitt *et al.* (2009) scale presented a bit of a conundrum. First, it assumed that respondents had actually visited that specific place, and that was not likely to be the case for many of our respondents. Second, Place Familiarity, in the sense that seemed appropriate for our study, could be considered as much a factor that helps contribute to Place Bondedness as an aspect of Place Bondedness. Third,

because the dioramas were centered on animal mounts, there was a chance that visitors' familiarity with the animals could influence their answers to other questions on the survey. Therefore, we adapted part of a question from the Hammitt *et al* (2009) scale ("I have trout fished the Chattooga many times and I am quite familiar with it") and simplified to it "I feel very familiar with the place shown in this diorama." We added a question about familiarity with the living things in the diorama ("I feel very familiar with the animals and plants shown in this diorama"), since the pilot study suggested that visitors sometimes identified a diorama place by studying the animals it included.

		Strongly Disagree				Strongly Agree
5.	I feel very familiar with the place shown in this diorama.	1	2	3	4	5
6.	I feel very familiar with the animals and plants shown in this diorama.	1	2	3	4	5

Place Bondedness Scale

This scale probed respondents' sense of place relative to the five target dioramas at each museum. As noted earlier, it was adapted from an instrument developed in Hammitt *et al* (2009). The Dioramas and Sense of Place version incorporated questions from two of the remaining four dimensions of place: Place Belongingness (which included five questions in the original survey) and Place Identity (six questions in the original survey). The two other dimensions, Place Dependence and Place Rootness, included questions that seemed too strongly worded and two closely tied to actual experiences with that place to be appropriate in a diorama hall.

The wording of some questions was changed to fit this situation. For instance, under Place Belongingness, "I feel connected to the Chattooga" became "I feel connected to the place shown in this diorama," and "When I am at the Chattooga, I feel part of it" became "If I visited this place, I would feel like I was part of it."

		Strongly Disagree				Strongly Agree
7.	I feel connected to the place shown in this diorama.	1	2	3	4	5
8.	I feel like I belong at this place.	1	2	3	4	5
9.	This place is very special to me.	1	2	3	4	5
10.	If I visited this place, I would feel like I was part of it.	1	2	3	4	5
11.	I identify strongly with this place.	1	2	3	4	5
12.	I am very attached to this place.	1	2	3	4	5

Intensity of Experience Scale

The Intensity of Experience scale included four questions that addressed a range of experiences that we investigated through qualitative observations and interviews during Phase 1.

		Strongly Disagree				Strongly Agree
13.	This diorama brought back memories of my own outdoor experiences.	1	2	3	4	5
14.	I read most of the labels for this diorama.	1	2	3	4	5
15.	I talked about the place shown in this diorama with other members of my group.	1	2	3	4	5
16.	I imagined what it would be like to visit the place shown in this diorama.	1	2	3	4	5

Depth of Outcomes Scale

The Depth of Outcomes scale probed about three potential outcomes of the diorama experience, all related to place. The first question (17) asks about cognitive outcomes. The second and third questions (18 and 19) are more affective. The fourth question on this scale (20) is also affective, but it was about the diorama itself, not the place it represented. We included it because, during Field Museum interviews, we found somewhat contradictory evidence about which dioramas respondents preferred. Some said they enjoyed seeing dioramas that showed them new things about places they had been to before; others seemed to enjoy viewing dioramas of unfamiliar places. This seems worthy of further investigation.

		Strongly Disagree				Strongly Agree
17.	I learned a lot about this place by looking at the diorama.	1	2	3	4	5
18.	Viewing this diorama made me feel like I want to visit this place sometime soon.	1	2	3	4	5
19.	Viewing this diorama helped me feel more connected to the place it portrays.	1	2	3	4	5
20.	This is one of my favorite dioramas in the <i>Explore Colorado</i> exhibit.	1	2	3	4	5

Scales completed once by each respondent

Connectedness to Nature Scale

The Connectedness to Nature scale provided a measure of respondents' feelings of connection to the natural world. It was simplified from a scale developed in Mayer & Frantz (2004). The original scale, although fairly short

(14 questions), seemed too long to use in a museum setting. Therefore the number of was reduced to five. The research team thought that some questions (e.g., “common ‘life force’” and “I belong to the Earth”) might exclude certain visitors for the wrong reasons, so those are the ones that were dropped.

		Strongly Disagree				Strongly Agree
1.	I often feel a sense of oneness with the natural world around me.	1	2	3	4	5
2.	I think of the natural world as a community to which I belong.	1	2	3	4	5
3.	I often feel disconnected from nature.	1	2	3	4	5
4.	I often feel a kinship with animals and plants.	1	2	3	4	5
5.	I often feel that I am only a small part of the natural world around me, and that I am no more important than the grass on the ground and the birds in the trees.	1	2	3	4	5

Preferences for Outdoor Experiences Scale

The final scale tries to take into account some of non-place specific factors that may affect visitors’ responses to dioramas. Two clusters of factors came to mind:

- **Discomfort and Disgust.** There are some aspects of the outdoors that people find uncomfortable and even disgusting, like extreme heat and cold, mosquitoes, other insects, snakes, and mud. Those factors may have come into play in some respondents’ reactions to, for instance, the marsh, rainforest, and frozen lake. Bixler & Floyd (1999) developed a disgust sensitivity scale that took some aspects of this into account, but the research team saw a need to go beyond their list of disgusting features of the outdoors.
- **Untamed Nature.** The *Nature Walk* dioramas presented views of untamed nature very different than the sorts of manicured city parks that urban dwellers may be more familiar and comfortable with. If respondents’ preferred views of mowed lawns and formal gardens to the tall grass and scattered wildflowers of a prairie, that might explain why the some respondents scored the Illinois Marsh diorama low on Place Bondedness. Simmons (1994a & 1994b) investigated adults and children’s preferences for various landscape views by asking them to rate black and white photos of different rural and urban nature scenes. The research team took inspiration from her techniques, but needed to develop a scale compatible with the rest of the Dioramas and Sense of Place survey.

The scale the team developed is called the Preferences for Outdoor Experiences scale and in the survey was appended to the Connectedness to Nature scale, since it was more about the respondents’ overall preferences rather than specific to a single diorama. The questions are worded to fit into the five-point Likert scale used for the rest of the survey. These questions tried to get at some of the affect behind respondents’ outdoor preferences, but are phrased more as behavioral choices rather than as emotions or feelings. For instance, the first question did not confront respondents by asking them to admit to a fear of insects or spiders; it just gave them a chance to say

they did not enjoy being around them. Also, some of these questions were phrased so that people who avoid that sort of outdoor discomforts would strongly agree (e.g., 7, 8, 10, 11, and 12); others were phrased so that respondents who avoid discomforts would disagree with them (e.g., 6, 9, and 13). Therefore, the scale for the latter questions was reversed to produce a mean value or index of preferences for outdoor experiences.

		Strongly Disagree				Strongly Agree
6.	I enjoy visiting wild places that have lots of insects and spiders.	1	2	3	4	5
7.	I try to avoid steep hills and the edges of high cliffs.	1	2	3	4	5
8.	When the temperature is below zero, I'd rather stay indoors.	1	2	3	4	5
9.	I don't mind getting my shoes wet and muddy.	1	2	3	4	5
10.	My favorite outdoor places have broad lawns, formal gardens, and neatly trimmed shrubs.	1	2	3	4	5
11.	I try to avoid places where snakes are common.	1	2	3	4	5
12.	I would rather walk on a cleared path than hike through tall grass and weeds.	1	2	3	4	5
13.	I don't mind being active outdoors in hot and humid weather.	1	2	3	4	5

Adapting the Scales for Analysis

Most scale scores for the survey were calculated by taking the mean of a series of questions:

- **Visitation (averaged):** The mean of questions 2 and 3 on the diorama pages (visits to specific and similar places). The scale for Visitation runs from Never visited (1) to visited 5 times or more (5). Therefore a high score on this scale means respondents had visited the diorama place many times.
- **Place Familiarity:** Answer to question 5 for each diorama. The scale for Familiarity runs from Disagree Strongly (1) to Agree Strongly (5). Therefore a high score on this scale means respondents felt very familiar with the place portrayed in the diorama.
- **Place Bondedness:** Mean of questions 7 to 12 for each diorama. The scale for Place Bondedness runs from Disagree Strongly (1) to Agree Strongly (5). Therefore a high score on this scale means respondents felt a high level of bondedness for the place portrayed in the diorama.

- **Intensity of Experience.** Mean of questions 13 to 16 for each diorama. The scale for the experience questions runs from Disagree Strongly (1) to Agree Strongly (5). Therefore a high score on this scale means respondents had a more intense experience at that diorama.
- **Depth of Outcome.** Mean of questions 17 to 20 for each diorama. The scale for the outcome questions runs from Disagree Strongly (1) to Agree Strongly (5). Therefore a high score on this scale means respondents had a deeper range of outcomes at that diorama.
- **Connectedness to Nature.** After the scale for one of the questions had been reversed (# 3), calculated as the mean of questions 1 through 5 on page 6 of the survey. The scale for the connectedness questions runs from Disagree Strongly (1) to Agree Strongly (5). Therefore a high score on this scale means respondents felt a stronger overall connectedness to nature.
- **Preferences in Outdoor Experiences.** After the scale for three of the questions had been reversed (# 6, 9, and 13), calculated as the mean of questions 6 through 13 on page 6 of the survey. The scale for the preference questions runs from Disagree Strongly (1) to Agree Strongly (5). Therefore a high score on this scale means respondents felt MORE sensitive to the discomforts found in natural places.

Appendix F. Assembled Dioramas and Sense of Place instrument

Questions asked about each target diorama. (Photo and place name for diorama was displayed above the questions.):

Please circle your answers

1. Do you recall seeing this diorama during your visit?		Yes	No			
2.	How often have you visited the specific place shown in this diorama?	Never	1 time	2-3 times	4-5 times	More than 5 times
3.	How often have you visited a place that looks similar to this one?	Never	1 time	2-3 times	4-5 times	More than 5 times
4.	How often have you visited this place (or a similar one) with people who toured <i>Nature Walk</i> with you today?	Never	1 time	2-3 times	4-5 times	More than 5 times
		Strongly Disagree				Strongly Agree
5.	I feel very familiar with the place shown in this diorama.	1	2	3	4	5
6.	I feel very familiar with the animals and plants shown in this diorama.	1	2	3	4	5
7.	I feel connected to the place shown in this diorama.	1	2	3	4	5
8.	I feel like I belong at this place.	1	2	3	4	5
9.	This place is very special to me.	1	2	3	4	5
10.	If I visited this place, I would feel like I was part of it.	1	2	3	4	5
11.	I identify strongly with this place.	1	2	3	4	5
12.	I am very attached to this place.	1	2	3	4	5
13.	This diorama brought back memories of my own outdoor experiences.	1	2	3	4	5
14.	I read most of the labels for this diorama.	1	2	3	4	5
15.	I talked about the place shown in this diorama with other members of my group.	1	2	3	4	5
16.	I imagined what it would be like to visit the place shown in this diorama.	1	2	3	4	5
17.	I learned a lot about this place by looking at the diorama.	1	2	3	4	5
18.	Viewing this diorama made me feel like I want to visit this place sometime soon.	1	2	3	4	5
19.	Viewing this diorama helped me feel more connected to the place it portrays.	1	2	3	4	5
20.	This is one of my favorite dioramas in the <i>Explore Colorado</i> exhibit.	1	2	3	4	5

Questions asked only once:

Questions 1-5 comprise Connectedness to Nature scale. Questions 6 to 13 comprise Preferences for Outdoor Experiences scale.

Please circle your answers, below

		Strongly Disagree				Strongly Agree
1.	I often feel a sense of oneness with the natural world around me.	1	2	3	4	5
2.	I think of the natural world as a community to which I belong.	1	2	3	4	5
3.	I often feel disconnected from nature.	1	2	3	4	5
4.	I often feel a kinship with animals and plants.	1	2	3	4	5
5.	I often feel that I am only a small part of the natural world around me, and that I am no more important than the grass on the ground and the birds in the trees.	1	2	3	4	5
6.	I enjoy visiting wild places that have lots of insects and spiders.	1	2	3	4	5
7.	I try to avoid steep hills and the edges of high cliffs.	1	2	3	4	5
8.	When the temperature is below zero, I'd rather stay indoors.	1	2	3	4	5
9.	I don't mind getting my shoes wet and muddy.	1	2	3	4	5
10.	My favorite outdoor places have broad lawns, formal gardens, and neatly trimmed shrubs.	1	2	3	4	5
11.	I try to avoid places where snakes are common.	1	2	3	4	5
12.	I would rather walk on a cleared path than hike through tall grass and weeds.	1	2	3	4	5
13.	I don't mind being active outdoors in hot and humid weather.	1	2	3	4	5

Demographic Questions (all fit on one page in original survey):

Please share some additional information.

We want to include a broad and diverse range of visitors as participants in this survey. The following questions help us know how well we are meeting that goal.

1. How many people came with you to the museum today? _____

2. How many children are in your group? _____

3. How many times have you visited the *Explore Colorado* dioramas before today?

- never once twice three or four times five times or more

4. What is your age?

- 18 to 29 30 to 39 40 to 49 50 to 59 60 to 69 70 or older

5. What is your zip code (for U.S. residents)? [If from outside the U.S., please indicate the country you live in]

6. What is your gender? Male Female

7. What is your occupation? _____

8. What is your race/ethnic origin? (check all that apply)

- African-American
 Asian/Pacific Islander
 Caucasian
 Hispanic/Latino
 Native American
 Other: _____

9. What is highest level of education you have completed? (check one)

- Less than high school graduate
 High school graduate
 Trade or career school graduate
 Some college education
 College graduate
 Some postgraduate education
 Postgraduate degree
-

Appendix G. *Nature Walk* Dioramas Included in the Study

Marsh Birds in Lake County, Illinois



Figure G-1. Diorama of a marsh at Fox Lake, Illinois

Why this diorama was chosen for the study: There are lots of marshy habitats like this in the Chicago area, so we expected the habitat would be familiar to many respondents. Also, the smallness of the animals seemed to accentuate the place (as opposed to, for instance, dioramas dominated by several large animals of the same species). In addition, we expected that Chicago-area adults may have heard of the town “Fox Lake” even if they were not familiar with the lake it was named after. However, we weren’t sure how popular marshes were with many visitors, who might think of them as muddy, smelly, and mosquito-ridden.

White-tailed Deer in Michigan's Upper Peninsula (Summer)



Figure G-2. Diorama of White-tailed Deer in summer, Iron County, northern Michigan

Factors taken into account when choosing it: We expected that this wooded scene might look like vacation country to some visitors. Also, White-tailed deer are common and popular animals in the Chicago area. The three other dioramas in this set show the Michigan woods in all seasons, perhaps making it seem a more familiar place if you've only visited it in one season. However, the size and stance of the deer call attention to these animals, so perhaps the place itself would be less of a focus. Also, the precise place—Iron County—is probably beyond most visitors' experience.

This was one of the four White-tailed Deer seasons dioramas.

Mule Deer in Grand Canyon National Park



Figure G-3. Diorama of Mule Deer in Grand Canyon National Park, Kaibab Plateau, Arizona.

Factors taken into account when choosing it: Grand Canyon is an iconic natural place to many Americans. We expected that many Field Museum visitors have been there or hope to go there someday. However, we were concerned that the deer were big enough to partly obscure the view, and that this view of the Grand Canyon (from a smaller tributary valley) may be unfamiliar to many visitors.

Another note: This diorama is officially part of the adjacent *Messages from the Wilderness* exhibition. However, there is a large window opening into *Nature Walk* close to the White-tailed Deer four seasons dioramas.

Lake Michigan near Chicago (Winter)



Figure G-4. Diorama on a winter scene on the ice of Lake Michigan, near Chicago

Factors taken into account when choosing it: Even though Lake Michigan is only a couple of hundred yards from the Field Museum, this winter scene of the aquatic birds on the iced-over lake makes it seem pretty exotic. We anticipated that, other than gulls, the birds might be unfamiliar to many visitors. We also anticipated that some respondents might dislike the scene because it looks so cold.

Amazon Rainforest in Brazil



Figure G-5. Diorama on an Amazonian rainforest scene near Rio Branco, Brazil.

Factors taken into account when choosing it: We knew that, if we wanted to keep the study in the *Nature Walk* hall but include an exotic place, we could use this diorama. Also, rainforests are iconic tropical places for many people, although we were concerned that the scene depicted in this diorama might not seem like an iconic rainforest view to some respondents.

Appendix H. *Explore Colorado* Dioramas Included in the Study

Pinon-Juniper Woodland



Figure H-1. *Explore Colorado* Diorama: Mesa Verde National Park, Colorado. *Ecosystem*: Pinon-juniper woodland. *Elevation*: 6,500 feet - 1,980 M.

Factors taken into account when choosing it: We anticipated that the name Mesa Verde would be familiar to many visitors. This diorama also gave us an example of a relatively dry, evergreen, scrubby looking habitat.

Aspen Forest



Figure H-2. *Explore Colorado* Diorama: San Juan Mountains, Colorado. *Ecosystem*: Subalpine forest. *Elevation*: 10,000 feet - 3,048 m

Factors taken into account when choosing it: We wanted to include at least one example of a “generic” deciduous forest, analogous to the Michigan Woodland at the Field Museum.

Pawnee National Grassland



Figure H-3. *Explore Colorado Diorama*: Pawnee Buttes, Pawnee National Grasslands, Colorado. *Ecosystem*: Grassland. *Elevation*: 4,500 feet - 1,372 m.

Factors taken into account when choosing it: We wanted an example of a Great Plains short-grass prairie habitat.

Loveland Pass: Treeline



Figure H-4. *Explore Colorado* Diorama: Loveland Pass, Colorado. *Ecosystem*: Subalpine forest. *Elevation*: 11,500 feet - 3,505 m.

Factors taken into account when choosing it: We wanted an example of a high-elevation mountain habitat, and we chose this one because Interstate 70 goes over this pass, so we figured many museum visitors had been there.

Arizona Desert



Figure H-5. *Explore Colorado Diorama*: Superstition Mountains, east of Phoenix, Arizona. *Ecosystem*: Arizona uplands. *Elevation*: 2,500 feet - 762 m.

Factors taken into account when choosing it: This provided us with an example of a rather iconic desert habitat (which some visitors would probably recognize as a Sonoran-type desert).

Appendix I. Data about Respondents to Phase 2 Surveys

Demographic data:

	Field	Denver
Survey count	328	305
Refusals	67%	64%
Timing	Winter-Summer	Spring
	2011	2011
Gender		
Male	42%	42%
Female	58%	58%
Age		
18-29	38%	20%
30-39	21%	36%
40-49	23%	25%
50-59	15%	13%
60-69	2%	6%
70 or older	1%	1%
Children in group		
0	60%	28%
1	18%	21%
> 1	22%	51%
Place of residence		
Metro area	20%	34%
Same state	5%	52%
Other states	64%	14%
Other countries	12%	0.33%
Visited these dioramas before		
Never	63%	20%
Once	14%	12%
More	23%	68%
Time in diorama hall (in minutes)		
Mean	22	15
Median	18	13

	Field	Denver
Race/ethnicity		
African-American	2%	1%
Asian/Pacific Islander	7%	3%
Caucasian	82%	89%
Hispanic/Latino	7%	5%
Native American	1%	2%
Other	1%	4%
Level of education completed		
Less than high school	2%	1%
High-school graduate	7%	7%
Trade-school graduate	2%	2%
Some college	21%	21%
College graduate	34%	35%
Some postgraduate	12%	9%
Postgraduate degree	22%	26%

Appendix J. Diorama Experience and Outcome Scores for Each Diorama

For the Field Museum (n = 328):

bold = highest for that question

italics = lowest for that question

Diorama Experience/Outcome

Questions:

	Chicago Lakefront	Illinois Marsh	Michigan Woods	Grand Canyon	Amazon Rainforest
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Intensity of Experience:

Brought back memories of my outdoor experiences.	2.69	3.31	3.54	3.09	<i>2.14</i>
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I read most of the labels for this diorama.	<i>3.27</i>	3.51	3.45	3.36	3.50
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I talked about place with other members of my group.	<i>3.14</i>	3.15	3.32	3.20	3.22
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I imagined what it would be like to visit the place.	<i>3.20</i>	3.23	3.33	3.61	3.46
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Depth of Outcomes:

I learned a lot about this place.	3.18	<i>3.08</i>	<i>3.08</i>	3.13	3.31
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Made me feel like I want to visit this place.	<i>2.74</i>	2.96	3.24	3.56	3.05
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Helped me feel more connected to the place.	<i>2.98</i>	3.00	3.33	3.26	3.07
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One of my favorite dioramas in Nature Walk.	<i>2.61</i>	2.72	2.77	3.13	3.03
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For Denver (n = 305):

bold = highest for that question

italics = lowest for that question

Diorama Experience/Outcome

Questions:

	Arizona	Pawnee	Mesa	San Juan	Loveland
	Desert	Grasslands	Verde	Mountains	Pass

Intensity of Experience:

Brought back memories of my outdoor experiences.	2.85	3.08	3.37	3.68	3.93
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I read most of the labels for this diorama.	3.32	<i>3.09</i>	3.33	3.46	3.53
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I talked about place with other members of my group.	3.16	<i>2.98</i>	3.22	3.21	3.30
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I imagined what it would be like to visit the place.	3.35	<i>3.18</i>	3.39	3.54	3.67
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Depth of Outcomes:

I learned a lot about this place.	3.38	<i>3.19</i>	3.41	3.39	3.43
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Made me feel like I want to visit this place.	3.12	<i>3.01</i>	3.52	3.72	3.67
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Helped me feel more connected to the place.	3.12	<i>3.06</i>	3.43	3.56	3.26
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One of my favorite dioramas in Nature Walk.	2.87	<i>2.60</i>	2.80	3.26	3.36
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