Ecological Coexistence: A Nature Retreat and Education Center on Rattlesnake Key, Terra Ceia, Florida

Richard F. Peterika
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Ecological Coexistence:

A Nature Retreat and Education Center

on Rattlesnake Key, Terra Ceia, Florida

by

Richard F. Peterika

A thesis submitted in partial fulfillment
of the requirements for the degree of
Master of Architecture
School of Architecture and Community Design
College of Visual and Performing Arts
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Dedication

To all of my family and all of my friends
Acknowledgments

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Abstract

Ecological Coexistence
A Sustainable Nature Retreat and Education Center on Rattlesnake Key, Terra Ceia, Florida

Richard F. Peterika

ABSTRACT

Applied ecology has been used to design communities around the world; however suburban neighborhoods in west central Florida do not usually utilize existing or potential ecological function as a modeling parameter or success measure.

Since the end of the great depression, developments in the Tampa Bay Area have displaced many wetland and upland natural communities. Private ownership and development of sensitive natural lands have restricted their use and hampered the functional longevity of important ecological systems in this area. These displaced areas have historically functioned as habitat for many types of animal life, have passively conveyed nutrient loads, and have facilitated the succession of organisms. They have also been used as recreational opportunities for local residents and visitors, children and adults.

Applied ecological design usually occurs at a community or master plan scale, or separately at a singular building level, but rarely both simultaneously. This design proposal was the investigation and formation of an ecocentric architectural design methodology for coastal environments; from master plan to conceptual building design. The scope was the synthesis of a recreational tourism facility with the existing ecological communities of Rattlesnake Key, a barrier island in northwest Manatee County, Florida. The program included an ecological education center, where visitors could learn about their relationship with the ecological communities present on the island, and a group of cabins, where inhabitants could interact with each other and the surrounding natural communities intimately.

Master planning strategies were outlined using extensive ecological mapping overlays, in-
field observation, and feasibility analysis. Building forms, means of construction, and structural systems were created by integrating biomimicry methods, habitat restoration techniques, and sustainable practices into a programmed, built environment.

The results of the investigation were a series of physical models and graphic representations of spaces that manifest the sensitive relationship between human inhabitance and ecological function; where both processes coexist and support the longevity and persistence of one another through habitat creation. By analyzing the existing ecological functions present on a site, a designer could propose a typology that strengthens the relationship between man and his environment; where development is no longer displacement.
Site Analysis

“Nature is a process and value, exhibiting both opportunities and limitations to human use.”
-Ian McHarg
Rattlesnake Key, Florida was chosen as the main site early on in the thesis investigation, so the main function of the site analysis phase of research was to create a map of the different ecological communities present on the island. The researcher expected to use this map in a majority of the site planning and architectural decisions. In order to accomplish this task, the researcher needed to understand how to interpret discrete biotic and abiotic factors present on the site. Biotic, meaning of or related to life, factors are living factors, including animals, fungi, and bacteria. Abiotic, meaning not alive, are non-living factors that affect living organisms. These factors include temperature, soil, and climate. Together, the two factors create a system, or ecosystem; a community of living and nonliving things considered as a unit (Online). In order to graphically represent these factors, the researcher collected applicable map and written data from online resources, textbooks, and life experience.

**Data Collection**

Data collection was the first step towards the creation of an ecology map of Rattlesnake Key. Five layers of biotic and abiotic information were compiled to create the ecology map: textual research, soils, topography, aerial photography, and in-field observations.

The main resource used in mapping and understanding what communities may exist on the island was the 26 Ecological Communities of Florida, a booklet assembled
by the Florida Chapter Soil and Water Conservation Society (SWCS) and first printed in 1985. The booklet contains a chapter on each of the 26 ecological communities that exist in Florida. Each ecology is described in terms of soil types, vegetation and animals that are found in the community, and environmental value as a natural system. The slope, drainage capability, and texture of soils dictate how nutrients are made available to plants and animals, so certain soils can be used as an indicator for an appropriate community type. Knowledge of what plants and animals that exist in an ecological community is valuable for aerial analysis and field investigations. Certain trees, such as red mangroves, serve as clues that this area may be one ecology type, as opposed to another. Sabal palms may grow near the coast, in a certain ecological community, so if they appear to delineate a border on an aerial, that maybe the boundary between two communities. Environmental value is a community’s intrinsic suitability for all prospective land uses (McHarg, 105). A beach would not be suitable for raising cattle, but may be very valuable for recreational use – and even more valuable for wildlife use.

Above Figure 16: Rattlesnake Key Ecology Map (author graphic)
Soil surveys for each Florida County were compiled by the United States Department of Agriculture Natural Resources Conservation Service and are available free online. Each survey lists all of the soil types that exist within a certain county, the physical characteristics of each type, and maps the general locations of all of the different types. Topography for the site was found on Microsoft Terraserv-USA, an online mapping resource. Aerial photography was gathered from Google Earth and from the Manatee County Soil Survey. The soil survey uses a much older aerial photograph from 1958, when compared with a modern aerial, 40+ years of site change can be imagined. In-field observations were conducted to verify information gather from the other layers, document points of premium value (environmental or land use), and to experience the architectural nature of each ecology type.

Above  
Figure 17: Soil Types (author graphic)

Below  
Figure 18: Ecological Communities as defined by soil types (author graphic)
Processes as Values

Once the ecology map had been created, further site studies could be conducted through overlay analysis. This technique is clearly described in Ian McHarg’s book Design with Nature. He originally mapped distinct ecological processes, historical features, geologic features, slope, habitat, and tidal inundation among many other factors. These factors were mapped in tones of gray from most to least, or reversed when necessary, and printed on transparencies. A group of relevant factors for each prospective land use, such as scenic value (land) or active recreation suitability, was assembled and then photographed. The resulting image was a value gradient that incorporated all of the necessary factors. Processes, reconstituted as values, indicated the areas intrinsically suitable for each of the land uses considered. The researcher used this technique to first select three different development area options, and then narrow down the three options to one focus area. This area became the main region studied for the remainder of the thesis investigation. The researcher used color-coding in the transparent overlays, but reconfiguration of the color scheme could allow simple translation to a monochromatic map.
The overlay analysis phase of research had two stages. The first stage mapped ecological conditions by using different combinations of the biotic and abiotic factors gathered previously with the ecology map. Planning factors, such as flood line elevation, existing zoning, and future land use were also included in this stage. The ecological conditions mapped were: Vegetative Density, Wetlands and Uplands, Invasive Species Potential, Sensitivity and Shade. The researcher felt each of these conditions were important to chart because he expected that they would translate directly into development feasibility. Vegetative Density was a condition defined by the actual density of living or nonliving plant material. Upland communities are more supportive of inhabitation and circulation, but are also more rare on the island, so preservation is a concern. Wetlands require more effort and resources to inhabit, but some of the wetland communities on the island are abundant. Invasive Species Potential shows ecological communities that have a high probability of containing invasive plant types. If so, human development could displace this invasive community and begin to help return the island to it’s original ecological state. Sensitivity outlines the ability for a certain community to heal itself if displaced or impacted. A mangrove fringe can heal very quickly because of a readily available seed source and specific tidal location. A High marsh/salt barren community would not heal itself nearly as fast, because it is so dependent on extreme high tides and millimeters of water. Shade shows where a good percentage of the trees in a certain community create a comfortable, shady canopy.

The second stage used all of the previously compiled data, including that of first stage, to extract another iteration of analysis. This stage marked the point where the ecological conditions

\[\text{Above Figure 20: Stage One (author graphic)}\]
and characteristics were valued in terms of recreational use and development. These land use conditions were: Comfort, Access, Boat Circulation, Pedestrian Circulation, and Disturbed Lands. The researcher choose these land use categories were chosen because they embodied the essential requirements for remote development. What land can I walk on? What areas are accessible by boat? By kayak? What areas should remain in preservation?

While conducting the in-field observation, the wild nature of the site became somewhat overwhelming. The researcher had to trailblaze through thick vegetation and muddy tidal flats, so when a clear, firm sandy path was found, it was used to its fullest potential. The research also acquired a sense of place during the in-field observation. Sounds, views, and smells even began to give clues towards ecological community recognition.
Once the second stage of overlay analysis was completed the researcher had enough information to choose three development sites on the island. All of the sites were located on the west coast of the island, due to proximity of upland communities and to the waters and prevailing breezes of Tampa Bay. Navigability on land and water was more feasible and a significant amount of lands with invasive species potential, valued as a location for beneficial displacement, was on the west coast. The ecological communities on this coast also had a high shade potential, a physical comfort value, as opposed to the interior of the island, which had a low shade potential and was verified as uncomfortable during the in-field observation.

The researcher also used the compiled data to begin to analyze the ecological conditions in section. The researcher created a cross-sectional drawing showing the sectional qualities of a coastal system. Information from the two stages of analysis were then overlain onto the section drawing.
Site Selection

The three sites chosen were essentially the northern and southern tips of the west coast of the island, and the center of the coast. The researcher named the sites Ed’s Key Pass, Terra Ceia Point, and Rock Point, respectively. Ed’s Key Pass, also called Little Miguel Pass, was on the northern tip of the coast and was directly adjacent to a deep navigable channel (approximately 10’-15’) located between Rattlesnake Key and Ed’s Key, a much smaller barrier island. Rock Point was at the center of the west coastline at the mouth of Critical Creek, a small creek that went through to Critical Bayou on the east side of the island. Terra Ceia Point, the most southern point of the island, was almost a separate island itself, separated from the main island by two creek crossings. Terra Ceia Point was ultimately chosen as the focus area for the remainder of the thesis investigation due to its proximity to Terra Ceia Bay. Ferry access was envisioned to be available from Snead Island to the south.
While humans require a high degree of shelter from the sun, coastal ecologies rely on the sun for photosynthesis, transpiration, and evaporation. A balance of “sunlight to shade” can be achieved by decreasing the solar footprint of proposed structures and by increasing the usability of existing natural spaces that shall be preserved.

Ecological architecture should be analyzed in the following ways:

- Potential light barriers
- Disintegration of mass
- Enlarged ecology map
- Sensitivity shade
- Sunlight wind ecological section
- Invasives

![Enlarged Ecology Map](image)
Precedence Studies

Three American Institute of Architects Committee on the Environment (AIA/COTE) Top Ten Green Projects were used as case studies on the architectural expression of sustainable practices. The projects were the Government Canyon Visitor Center in Helotes, Texas, the World Birding Center Headquarters in Mission, Texas, both designed by Lake|Flato Architects, and the Pocono Environmental Education Center, designed by Bohlin Cywinski Jackson. All three projects won an AIA/COTE Top Ten Green Building Award, which acknowledges projects that display a strong level of sustainable design excellence. The AIA/COTE published reports on all three projects, which have been included in Appendix *****. These reports provided critical site, design, and performance data on each project, as well as architectural drawings, photographs, and diagrams.

Each study was essentially a reconstruction of each building in the form of a schematic Sketchup model. The models were created using the scaled architectural graphics and photographs that each project’s report included. The plans, sections, and elevations of each building were transposed into AutoCAD 2007 linework and were then imported into Google Sketchup 6 for schematic modeling. Photographs were used as visual references of form, void, and intent. Once the schematic volume was created, topography and site plan information was added in the form of a graphic overlay, if available. A representative birds-eye view of each model was then exported to Adobe Photoshop. This program was used to create a series of rendered diagrams described different relationships between sustainable systems and architectural form.

None of the graphic diagram studies revealed any empirical data, but the reports provided precedent for program element sizing parameters and plan relationships.
Water Conveyance

100% of the roof stormwater runoff is conveyed or collected by the large metal roofs of The Government Canyon Visitor’s Center. The researcher decided that this building utilized two different formal strategies to relate water conveyance to the built form: carving and folding. The shed-like roofs on either of the two “wings,” were obliquely carved to create a biased gutter. This carving also formed the programmed spaces beneath either roof, which created two semi-triangular volumes. The main exterior exhibition hall was enclosed by a roof that seemed to fold, as opposed to carve. Water was directed by the angled meeting of two planes, or by the edge of one plane.
Rainwater was collected from the roofs and stored in partially exposed, underground concrete cisterns, located. A solar-powered pump then lifts the stored groundwater to a storage-tank tower located above the outdoor classroom. Overflow controls allow excess water to bubble up from the ground, similar to the artesian springs found in this area. The exposed concrete cisterns became the visual terminus of the three building forms, and were located adjacent to the main entry of the facility. This helped to recognize the sustainable functions that the building is emulating. The structures and walks were also raised slightly to allow for water flow underneath the building, as well as cooling breezes.

*Exterior and Interior*

More than half of the facility consists of roofed, exterior spaces. 3,228 sq. ft of porch space also doubles as usable area, and the 1,500 sq. ft
The exhibit space is only a screened room. Large, movable wall panels help the main exhibit space adapt to the harsh Texas climate.

*Supplemental Information*

The siting and orientation of the buildings was parallel with the edge of the Balcones Escarpment fault line, which delineates the edge between preserved and developed areas. The building became a physical marker, materializing a natural edge that would have otherwise been invisible to a casual site visitor.
Water Conservation and Use

Though interior space was minimized to save material and energy, metal roof was maximized over exterior walkways and porches to collect as much water as possible. Sectionally, the roof was semicircular channel that directed water to either side, equally. Since the site was located in a historic river-delta habitat, no hierarchy was put on the expression of rainwater conveyance; only maximum collection was required. The periodic flooding that once occurred on site, which was prevented by levee construction, now had to be mitigated with roof runoff. The location of rainwater storage system seemed to be related to scale of the wildlife garden created between and around the facility structures. Since the rainwater was used to create wetland ecology over the entire site, water needed to be available anywhere on the site. The rainwater was
also used for rainwater guzzlers, natural pools, and water seeps, which were designed to meet the differing needs of specific migratory mammal, birds, and butterfly species (American Institute of Architects, The).

**Exterior and Interior Space**

The large structural arches define all the of the facilities program spaces, whether interior or exterior. Most of the circulation paths are exterior spaces. The long, thin plan scheme also keeps users in close proximity with the landscape restoration gardens located throughout the entire site. Covered walkways between each building bar keep users comfortable as they experience the different habitat creation strategies made available through stringent native plantings and wildlife water features.
Supplemental Information

The facility is located in the Bentsen-Rio Grande Valley State Park, and is a convergence point of over 500 migratory bird species. The facility also incorporated a two-story observation tower and bird blinds to provide unique opportunities for visitors to view “valley specialties,” birds known to exist nowhere else in the United States.
Adaptability

The main activity space located on the south side of the building serves both as a sustainable feature and as the most important program space in the facility. The orientation and angle of the roof provide for passive solar heating in the winter, embodied in a grand scale that supports the multi-functional use of the activity space. The roof of this space was made large enough to provide porches on either side of the main space allowed for overflow seating and outdoor program elements during the warmer months; the busiest time of year for the facility.

Supplemental Information

The facility was located on previously cleared land, which existed in a forest of oaks,
conifers, and a well-developed understory. This location minimized site disturbance, which became an important consideration in the site analysis in Rattlesnake Key.
Conclusions

The researcher intended to conduct an ecological mapping study on each of the sites, similar to the method used in the site analysis of Rattlesnake Key. Unfortunately, the same information was not available for all of the sites, or the quality of the information available did not suffice for even casual analysis. The researcher also realized that if the information were able, an entirely new set of ecological systems would have needed to be researched and understood. Rattlesnake Key consisted of four different Floridian ecologies, and further research into these three case studies have required comprehension of Texas and Pennsylvanian ecological systems. The scope of this analysis went beyond the intents of the envisioned study. Also, the scale of ecological mapping does not lend itself well to sites that exist primarily in one ecological system.

Although many sustainable elements can be incorporated into the architectural design of a building, some elements are too sensitive to be included. The intent of these buildings was to provide recreational and education opportunities to visitors, while supporting or enhancing the natural ecological processes that can or do exist on the site. These processes can sometimes include human intervention, but in some cases, humans are best kept at a safe distance from certain preserved areas. For example, the Government Canyon facility defines an edge where human development must be halted, because the hydrologic conditions of the site are necessary to all inhabitants of the region, man and beast, and they must be preserved. The migratory birds that can be viewed at the World Birding Center do not necessarily “want” to be viewed, so to these birds, our presence must be transparent or camouflaged. If humans were able to view these birds at a distance that a zoo may provide, then focus of the facility shifts from

Above Figure 39: Government Canyon Visitor Center Site Plan (Source: AIA/COTE)
habitat creation or migration corridor support, to exhibition. This would most likely displace the birds that the facility was designed to exhibit. Further architectural design in sensitive ecological systems should maintain a high degree of sustainable practice implementation and it must also provide preservation areas to protect the sensitive communities that the facility visitors intend to experience.
Program Analysis
The goal of this thesis is to create a facility that restores and enhances the existing ecological function of Rattlesnake Key through human involvement.

Unfortunately, human involvement has not always led to restoration. In the 1950s, Manatee County proposed a mosquito ditching effort on many barrier islands and wetland areas in the region. Appendix 4 shows a letter describing the actual work effort. In a telephone discussion with Mark Latham, Director of the Manatee County Mosquito Control District, the researcher learned a number of reasons for the mosquito ditching effort; and the subsequent results. During the 1950s, Manatee County officials decided to try and thwart the spread of malaria by changing the ecological system that breeds mosquito larvae: standing pools of water. It was assumed that if the mosquitoes, the main transmitter of malaria, and the mosquito larva population was reduced, the spread of malaria would be controlled. In order to do this, a series of channels or ditches were dug in wetland areas that facilitated mosquito propagation. The ditches were dug to allow tidal influence on inland areas, so the tides could flush out standing pools and fish could travel upstream to consume larvae during high tides. As the ditches were being dug, the dredged earth was deposited on either side of the ditch, creating series of approximately 4’ mounds, called spoil piles, on either side of the ditch.

When maintained properly, the mosquito ditches are very successful at mosquito abatement. Unfortunately, no maintenance has occurred on Rattlesnake Key since the ditches were originally dug. The ditches that used to convey fish and tides have become stagnant, due to colonizing mangrove communities. The
mangrove roots stifle water flow and the ditches eventually become standing pools of water. The ditches that once served to assist in controlling mosquito populations now have become mosquito brooding habitats themselves. Also, the spoil piles on either side of the ditches have become hosts to invasive species, such as Brazilian pepper, which displace the natural upland plants on the island.

**Schematic Master Plan**

The researcher did not consider this island to be a pristine wetland system, which might require protection from any and all human intervention, due to the mosquito ditches present onsite. Human involvement on Rattlesnake Key could assist in mosquito ditch maintenance and conversion, creating kayak trails in the ditches or trails on the spoil piles. From these initial ideas, the researcher brainstormed on what uses could exist on the island. These uses needed to offer some degree of ecological restoration or enhancement, along with some degree of human use and enjoyment. Restoration could be achieved by returning an impacted area to its natural state, by filling in ditches and replanting with appropriate wetland plants. Enhancement could be achieved by creating more biodiversity in an impacted system, by leaving ditches in place, removing invasive species, creating trails.
and replanting with associated upland plants. These enhanced areas would not be natural, they are essentially man-made, but they would operate in a natural way. Ecological function is very specific in terms of soil structure, hydrology, air quality, and a number of factors, but not necessarily specific in terms of location. The researcher assumed that if similar ecological conditions could be mimicked elsewhere on the island, then a man-made ecosystem could exist there.

The concept of enhancement became a main focus in program analysis for the facility and master plan of Terra Ceia Point. Through quick studies of similar preserves such as Everglades National Park and Brooker Creek Nature Preserve, the researcher chose the following elements as necessary program items: kayak trails, mangrove chickees, nature trails, a trail outpost, an on observation tower, a passive education center, cabins, a ranger station and a scenic shoreline trail. Two parti studies were created to diagram how these program elements
interfaced with the island itself as well as the surrounding and penetrating water bodies.

**Conceptual Master Plan**

Once the topography map, ecological map, and the two stages of site analysis were factored into the schematic master plan, a second iteration of the plan was created. Revisions to the program elements included the concept of cabin clusters, beach pavilions, the ecological education center, and island pavilion, mangrove chickees, the observation tower, a maintenance yard, and a ranger station. The cabin clusters included a set of three to four cabins, a restroom and shower facility, a group meeting and dining area, and all necessary boardwalks to structures.

**Mangrove Chickees**

A kayak-friendly coastal camping perch located throughout the bay and interior coastline. Tent area, kayak storage, and green restroom facility. Each chickee is approx. 100 sq. ft.

**Observation Tower**

Provides long, elevated view of the entire island and surrounding context. Approx. 900 sq. ft.

**Maintenance Yard**

Storage and maintenance area for island services. Services can include mosquito ditch clearing/draining, invasive species removal and disposal.

**Ranger Station**

Gateway point for most users. Facility can consist of short-term ranger quarters, ranger office, medical office, kayak and pontoon boat rental, cabin reservations, pavilion reservations, chickee reservations. The station is 2 story. Approx. 2,500 sq. ft.

*Above Figure 44: Schematic Site Program Elements 2 (author graphic)*
Schematic Master Plan (author graphic)
Building Program Analysis

Keeping the theory of reuse in mind, the researcher used the three precedence studies, Government Canyon Visitor Center, World Birding Center Headquarters, and Pocono Environmental Education Center to extract program sizes and relationships. Each precedent study was broken down into groups of interior and exterior spaces. Each group showed the net floor area per use and the percentage of gross floor area. A group of data for occupant use was also shown. The comparisons between the different studies were then compiled and evaluated with a separate data group. The exterior programmed floor area was evaluated in relationship to the total floor area. Office area per employee was calculated, as well as exhibition space per visitor. Information gather from this table, as well as information provided over the telephone from administrators at Caladesi Island Nature Preserve (Dunedin, Florida) allowed the researcher to create a table of prospective program elements and sizes.

<table>
<thead>
<tr>
<th>Education Center and Cabin Cluster Program</th>
</tr>
</thead>
</table>

### World Birding Center Headquarters

<table>
<thead>
<tr>
<th>Element</th>
<th>Area (sf)</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exhibition</td>
<td>4,900</td>
<td>38%</td>
</tr>
<tr>
<td>Office</td>
<td>2,100</td>
<td>16%</td>
</tr>
<tr>
<td>Cafeteria</td>
<td>800</td>
<td>6%</td>
</tr>
<tr>
<td>Classrooms</td>
<td>1,800</td>
<td>14%</td>
</tr>
<tr>
<td>Bookstore</td>
<td>1,200</td>
<td>9%</td>
</tr>
</tbody>
</table>

### Government Canyon Visitor Center

<table>
<thead>
<tr>
<th>Element</th>
<th>Area (sf)</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exterior SF</td>
<td>37,500</td>
<td>288%</td>
</tr>
<tr>
<td>Exterior SF/Total SF</td>
<td>140</td>
<td>1%</td>
</tr>
<tr>
<td>Office Space/Employee (sf)</td>
<td>140</td>
<td>1%</td>
</tr>
<tr>
<td>Exhibition Space/Visitor</td>
<td>280</td>
<td>7%</td>
</tr>
</tbody>
</table>

### Pocono Environmental Education Center

<table>
<thead>
<tr>
<th>Element</th>
<th>Area (sf)</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activity Hall</td>
<td>3,680</td>
<td>47%</td>
</tr>
<tr>
<td>Office</td>
<td>490</td>
<td>6%</td>
</tr>
<tr>
<td>Kitchen/Prep</td>
<td>1,850</td>
<td>24%</td>
</tr>
<tr>
<td>Classrooms</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>Gift Shop</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>(2) Porch</td>
<td>1,980</td>
<td></td>
</tr>
</tbody>
</table>

### Table 1: Program sizes and relationships

Above
<table>
<thead>
<tr>
<th>Cabin Groups</th>
<th>Area (sf)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cabin</strong></td>
<td></td>
</tr>
<tr>
<td>Element</td>
<td>150</td>
</tr>
<tr>
<td>Bedroom</td>
<td>150</td>
</tr>
<tr>
<td>Lavatory</td>
<td>25</td>
</tr>
<tr>
<td>Sitting Area</td>
<td>150</td>
</tr>
<tr>
<td>Porch</td>
<td>100</td>
</tr>
<tr>
<td>Stoop</td>
<td>25</td>
</tr>
<tr>
<td><strong>Bath House</strong></td>
<td></td>
</tr>
<tr>
<td>Men's WC</td>
<td>25</td>
</tr>
<tr>
<td>Men's Urinal</td>
<td>25</td>
</tr>
<tr>
<td>2 Women's WC</td>
<td>100</td>
</tr>
<tr>
<td>4 Showers</td>
<td>200</td>
</tr>
<tr>
<td><strong>Pavilion</strong></td>
<td></td>
</tr>
<tr>
<td>Golf Cart Parking</td>
<td>400</td>
</tr>
<tr>
<td>Gateway</td>
<td>25</td>
</tr>
<tr>
<td>Kitchenette</td>
<td>100</td>
</tr>
<tr>
<td>Fire Circle</td>
<td>25</td>
</tr>
<tr>
<td>Living Area</td>
<td>100</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Education Center</th>
<th>Area (sf)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Interior</strong></td>
<td></td>
</tr>
<tr>
<td>Element</td>
<td>3,000</td>
</tr>
<tr>
<td>Exhibition/Dining</td>
<td>900</td>
</tr>
<tr>
<td>Office</td>
<td>1,200</td>
</tr>
<tr>
<td>Kitchen</td>
<td>600</td>
</tr>
<tr>
<td>Osprey Platform</td>
<td></td>
</tr>
<tr>
<td><strong>Exterior</strong></td>
<td></td>
</tr>
<tr>
<td>Bat Observation Deck</td>
<td>500</td>
</tr>
<tr>
<td>Outdoor Classroom</td>
<td>1,000</td>
</tr>
<tr>
<td>Stairs/Hoist</td>
<td>1,000</td>
</tr>
<tr>
<td>Cisterns</td>
<td>14,300</td>
</tr>
</tbody>
</table>
The first guiding principle of the Sustainable Sites Initiative™ is to do no harm. “Make no changes to the site that will degrade the surrounding environment.” In accordance with this principle, the design proposal for the Rattlesnake Key Nature Retreat and Education included habitat creation for two bird species on the island: the least tern and osprey.
Least Terns

Least terns (Sternula antillarum) are the smallest North American terns, a seabird related to gulls and skimmers. They have been listed as an Endangered Species in the United States since June, 1985 (Interior Least Tern).

Least terns nest in colonies, where nests can be 10-30 feet apart or more (Texas Parks and Wildlife). Nests are an inconspicuous, unlined scrape in an open, sand area, gravely patch, or exposed flat (NASA Kennedy Space Center). The colony sites are used year after year, but sites can be abandoned if disturbed. Human disturbance is probably the most likely factor for recent declines, because the areas the birds value for nesting habitats are the same areas humans’ value for recreational activities. The birds prefer open habitat, and tend to avoid thick vegetation and narrow beaches (Texas Parks and Wildlife).

Due to loss of natural colony sites, the least terns have adapted to nesting on gravel rooftops. By 1975, 21% of the colonies along Florida’s Atlantic Coast occurred on roofs (NASA Kennedy Space Center). Unfortunately, hazards to eggs and juvenile birds exist in roof nests. Climatic factors such as wind and rain can blow eggs or chicks out of the scrapes, over the roof edge or into gutters. Rain can also wash out nests. Exposed tar can trap wandering chicks and cause them to die from exposure (NASA Kennedy Space Center). Human presence can also disturb rooftop colonies. Chicks may run off the edge and parents leave the nests exposed.
The Kennedy Space Center Environmental Program Center documented a number of requirements that roofs should meet if they are to be considered successful colony sites. Once, nesting activity occurs the rooftop should immediately become off-limits, except for emergencies. Roof repairs should not occur during nesting season, between March and July. Roofs should have a lip or parapet to prevent eggs or chicks from washing or blowing off the edge, and to deter mobile chicks from running off the edge. Shelter from predators and the sun should be provided, as well as adequate drainage to prevent washing out. The potential rooftop colony site must also be adjacent to a reliable feeding area. The terns feed mainly on fish, so fresh or saltwater must be near the colony.

During in-field observations, the researcher also noted the territorial nature of a least tern. The tern flew overhead and followed the researcher while walking along one stretch of shoreline on Rattlesnake Key. While flying, the tern let out many high pitched “kit,” and “zeep” sounds; the characteristic least tern call (Texas Parks and Wildlife). From this experience, the researcher realized that human disturbance can also occur in the form of visual presence.
The Osprey (Pandion haliaetus) is a large fish-eating raptor, reaching 24 inches in length with a six foot wingspan. The International Union for Conservation of Nature and Natural Resources lists the osprey as a species of “Least Concern,” which means that the osprey’s population status has been evaluated and it does not qualify as “near threatened.”

Ospreys create nests of sticks, driftwood, and seaweed in forks of trees, rocky outcrops, utility poles, and artificial platforms (Evans). If an osprey cannot find a nest site, they may be forced to delay breeding, so artificial posts can provide suitable sites for nest building (Chesapeake Bay Program). Nesting sites are used year after year. Experienced breeders arrive at used nest in late February or March, but less experienced osprey may spend several weeks locating a mate and a nesting site.

The researcher was interested in included osprey platforms as a habitat creation element in the Rattlesnake Key Master plan. Citizen’s United to Protect the Maurice River and Its Tributaries, Inc. (Citizen’s United), an organization involved in all aspects of watershed protection, provided a very thorough outline of platform construction and erection. Osprey platforms consist of four main elements: a platform for nesting, a perch near the platform, a pole to elevate the platform, and a wildlife guard to keep predators away from the nest. Citizens United recommends that the structures not look like telephone poles, so that the ospreys...
are discouraged from nesting on those unsafe man-made structures. Citizens United also pairs the perch with a set of “V” shaped cross braces to mimic the structure of a tree crook.

Some individuals who have erected platforms or have observed ospreys in from a viewing point have noted that the effective territory that an osprey claims in relationship to human presence is roughly 60 feet.

Above  Figure 52: Platform maintenance (Source: Online)
Below  Figure 53: Osprey Ecological Section Sketch (author graphic)
Design Proposal

“Nature is a process and value, exhibiting both opportunities and limitations to human use.”
-Ian McHarg
Schematic Design

Ecological transparency was paramount in the schematic design phase. The researcher strove to diagram, analyze, and model architectural systems that had little to no effect on the existing ecological systems present onsite. If a certain ecological community received eight hours of direct sunlight, then the architectural system that penetrated that community would be designed to provide eight hours of direct light. The same requirements pertained to wind, ground level vegetative density, and canopy coverage.

Above Figure 54: Scheme 1 North facade (author photograph)
Center Figure 55: Scheme 1 West facade (author photograph)
Below Figure 56: Ecological succession sketch diagram (author photograph)
Cabin Schemes

The first cabin design scheme was a small, unconditioned structure consisting of a small breakfast nook, kitchen, wash-basin, bedroom, and two porches. The structural system was conventional pole construction combined with a grid of smaller supporting poles, used to both mimic the nearby mangrove roots and to provide a dampen or divert the tidal force potential.
Scheme 1 was a small-scale representation of one set of concepts: irregular structure, roof water conveyance, and upland placement.

Above

Center

Below

Figure 62: Scheme 1 West facade (author photograph)
Figure 63: Scheme 1 Plan (author photograph)
Figure 64: Scheme 1 Siting (author photograph)
Scheme 2 represented the following concepts: dense irregular structure, transparent roofs and floor, and wetland placement. The colored bar in each photograph represents a specific ecological community: yellow is South Florida Coastal Strand, green is Mangrove Fringe, and blue is intertidal zone.
Scheme 3 represented the following concepts: regular structure rhythm, tensile cross-bracing dual-purposed as a skin, direct relationship to ground, and wetland placement.
Scheme 4 was a study in mangrove biomimicry; creating both regular and irregular structural system relationships with a minimal footprint. The main mass was cantilevered over a future mangrove colonization area. Interior program spaces were imagined to be unconditioned, so acquisition of prevailing breezes and advantageous shading at the appropriate elevation in relation to the adjacent mangrove mass was paramount. A tern nesting area was initially envisioned on roof.
Education Center

The first design scheme for the education center was a jungle complex optimized for views. Disorganized volumes and roof plans attempted to mimic the irregular canopy of surrounding vegetation at to avoid a harsh, unnatural human edge claimed by the buildings footprint. The roof included a conveyance system used for water collection, exhibition, and way-finding.
MAXIMIZE SUNLIGHT TO THE EARTH

While humans require a high degree of shelter from the sun, coastal ecologies rely on the sun for photosynthesis, transpiration, and evaporation. A balance of "sunlight to shade" can be achieved by decreasing the solar footprint of proposed structures and by increasing the usability of existing natural spaces that shall be preserved.

Ecological architecture should be analyzed in the following ways:

<table>
<thead>
<tr>
<th>Sun Angle Orientation</th>
<th>Ecological Shade</th>
<th>Potential Light Barriers</th>
<th>Disintegration of Mass</th>
</tr>
</thead>
</table>

Above: Figure 76: Sunlight Sensitivity notes (author photograph)
Center: Figure 77: Perspective of North facade, main gallery, and upper osprey viewing platform (author graphic)
Cabin in the mangroves

Above Figure 78: Cabins interior spaces expression (author photograph)
Below Figure 79: South facade roof for rainwater collection to cistern (author photograph)
Ecological Education Center

Above  Figure 80: Cabins Pair (author graphic)
Below  Figure 81: North Facade (author photograph)
Above  Figure 84: Rattlesnake Key Ecology Map (author graphic)
Design Solution

Master Plan Focus Area

The intention of this thesis investigation was to propose an architectural building typology that restores or enhances the surrounding natural environment through human interaction and habitat creation. The program elements incorporated included a conceptual master plan for Rattlesnake Key, an ecological education center, and ecological cabin clusters. The design objective of this thesis was to structure the process and means of human inhabitation into a supportive ecological process. Human presence could mimic the forces of the winds and the waves, not of the jackhammer and bulldozer. The design components utilized to materialize this building typology included: sensitive planning to maintain natural light, wind, tide, and rain patterns on the ground, ecological and climactic site orientation, biomimetic structural systems, remote building concepts, and habitat overlap.
The main concept considered throughout the design process is not easy to define, but it metaphorically implies that the architecture would “grow from the site.” This definition is not meant to exclude “grow with the site” or even “the site grows with or from the architecture.” The design process was generally balance of many different forces, both natural and man-made, relating the ides on habitat creation and site-sensitivity.

Some entities would argue that hands-off preservation would best serve an area such as Rattlesnake Key, but the researcher did not adhere to this mentality. He felt that if special places on Earth were to be cared for, there value must be experienced and understood. This is the reason development was proposed on a remote barrier island; because without it, human presence would be minimal, and apathy towards the island’s ecological future would be increased. The program elements were designed to showcase the physical beauty of the island, as well as educate visitors on the ecological function of the island and its parts.

The master plan was designed to minimize impacts on sensitive wetland systems, maximize comfort, facilitate circulation and transportation, and site structures for exciting views. Visitors
would get to the island by ferry and then follow a mulch path created by invasive species that have been removed and chipped.

*Cabins in the Mangroves*

The cabins primarily exist in the mangrove fringe ecological community, so the mangrove structure analogy is strongly defined. Guests would rise up to a main living area, which consists of a large common room connected to an exterior porch. These two spaces could be combined in the warmer months, by opening sliding doors and shifting furniture slightly. Diagonally above and behind the common room is the bedroom, which is accessed by a thin stairwell running along the underside of the rainwater roof. From the bedroom, a symmetrical presentation of the horizon line is composed with bed alignment and structural rhythm. Also, guests can get a periscope view of a nesting tern colony on the roof above, or look out at a proposed osprey platform island.
Figure 89: Floor Plans and Cross Section (author graphic)

Figure 90: Ecological Cross Section (author graphic)
Above  Figure 91: Least Tern roof colony (author photograph)
Below  Figure 92: Structural Detail (author photograph)
Above Figure 93: Approach/East facade (author photograph)
Ecological Education Center

As the visitors pass under the first rainwater gateway, through an opening in the mangrove-like structural system, they would find themselves in a sheltered, ordered education center. This order is in contrast with the dense natural randomness exhibited by the ecological communities on the island. Visitors could rise to the second level and circulate to different ecological exhibition areas via exterior walkways. All of the spaces, including the exterior circulation would be defined by the mangrove structure, so the visitors would always feel some connection to the natural random form, even if not visible. The mangrove structure would also assist in structural rigidity, by creating a latticed mesh, another characteristic of mangrove roots. The main auditorium and dining area would be open to prevailing gulf breezes in the warm months, so visitors and guests could enjoy sunsets within the mangroves. During the cooler months, the dining area could be protected from wind chill with sliding plexi-glass panels. The education center also includes an administration office and lobby, where daily staff activities would be coordinated and visitor greetings would occur. The education center also has two roof systems, a metal roof system dedicated to rainwater collection, and an intensive green roof used to cultivate native plants and seagrasses for use around the island.

Above  Figure 94: Cross Section, Plans, and Ecological Plan (author graphic)
Above  Figure 95: Southwest Birds Eye View (author photograph)
Below  Figure 96: Auditorium Deck (author photograph)
Above  Figure 97:  Mangrove Viewing platform from Auditorium (author photograph)
Below   Figure 98:  Coastal Exhibition Room (author photograph)
Above  Figure 99: Interior Courtyard (author photograph)
Below  Figure 100: Bat House Viewing Platform (author photograph)
Conclusion

Each cabin cluster created habitat for eight ecologically-minded guests, four tern colonies, one osprey nesting pair and chicks, and approximately one hundred bats (a bat house was considered in schematic design phases, but omitted in conceptual design as a specific element). The education center uses all of the captured rainwater for use in freshwater guzzlers for nearby animal communities, greywater systems, and irrigation of the intensive green roof. This facility would also house some of the maintenance equipment needed to restore the natural character of the island and maintain its beauty. These outcomes revealed to the researcher that human presence on Rattlesnake Key could be beneficial. With human involvement, the island could be returned to a fully-functioning state, and visitors could enjoy its beauty; a beauty that is not necessarily natural, but one that represents the synergy of man with the land.
Works Cited


Nasa Kennedy Space Center. “Working on Roofs (Least terns and Black Skimmers).” KSC Environmental Program Branch - Natural Resources. 8 September 2008


Site Map. Atlantic Center for the Arts, New Smyrna.


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Atlantic Center for the Arts, New Smyrna.

Nasa Kennedy Space Center. “Working on Roofs (Least terns and Black Skimmers).”
KSC Environmental Program Branch - Natural Resources. 8 September 2008


“Osprey Restoration Project: Pictorial Instructions for Erecting an Osprey Platform.”
Citizens United to Protect the Maurice River and Its Tributaries, Inc., n.d.


Site Map. Atlantic Center for the Arts, New Smyrna.


Appendix 1

AIA/COTE Report Overview for the Government Canyon Visitor Center
Government Canyon Visitor Center

Overview

- Location: Helotes, TX
- Building type(s): Interpretive Center
- New construction
- 4,240 sq. feet (394 sq. meters)
- Project scope: a single building
- Rural setting
- Completed October 2005

Government Canyon Visitor Center forms the gateway to the 8,600-acre Government Canyon State Natural Area. It includes an exhibit hall, a park store, classrooms, offices, and an outdoor pavilion.

Government Canyon lies along the Balcones Escarpment on the recharge zone of the Edwards Aquifer, the sole source of drinking water for the city of San Antonio, in an area under immense development pressure. The goal of the project, a karst aquifer preserve, was to protect and restore the natural landscape while creating high-use, low-maintenance, and economical structures that reinforce the mission of the Natural Area.

This project was chosen as an AIA Committee on the Environment Top Ten Green Project for 2007. It was submitted by Lake|Flato Architects, in San Antonio, Texas. Additional project team members are listed on the “Process” screen.

Environmental Aspects

The design team aimed to minimize impacts on the landscape and fragile water resources and to do more with less. The development was concentrated to reduce landscape water usage and physical impact on the site. Extraneous space was eliminated, reducing material use, energy use, first cost, operations cost, and maintenance needs. Exhibit and circulation spaces, originally programmed as indoor spaces, were designed as sheltered and shaded outdoor spaces, accepting summer breezes but protected from north winds. These spaces are not air-conditioned, reducing conditioned space by 35% and further reducing material and energy costs.

Rainwater collected from the project roof is filtered and used for both landscape irrigation and wastewater conveyance. The gravity-flow water system is coupled with solar-powered water pumps. All stormwater runoff from parking lots is distributed through vegetated filter strips and retained on site.

The structures make extensive use of local and regional materials while evoking the historic uses of the former ranch site. The main exhibit space was built using materials and technologies traditionally used by ranchers in cattle pens and fencing, while the stone walls echo the historic stone fences found on the site.

Owner & Occupancy

- Owned and occupied by Texas Parks and Wildlife, State government
- Typically occupied by 6 people, 40 hours per person per week; and 1,173 visitors per week, 2 hours per visitor per week
Keywords

Open space preservation, Stormwater management, Water harvesting, Efficient fixtures and appliances, Efficient irrigation, Drought-tolerant landscaping, Massing and orientation, Glazing, Lighting control and daylight harvesting, Efficient lighting, Adaptable design, Recycled materials, Local materials, Certified wood, Connection to outdoors, Daylighting, Natural ventilation, Thermal comfort


Our thanks to the ENERGY STAR program of the U.S. Environmental Protection Agency, and to the U.S. Department of Energy, and to BuildingGreen, Inc. for hosting the submission and judging forms.

For more information about the AIA/COTE Top Ten Green Projects, contact AIA/COTE. For help on how to use this Web site, contact the contest hosts.

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World Birding Center Headquarters

Overview

- Location: Mission, TX
- Building type(s): Interpretive Center
- New construction
- 13,000 sq. feet (1,210 sq. meters)
- Project scope: multiple buildings
- Rural setting
- Completed January 2004

A joint effort between the Texas Parks and Wildlife Department and local communities established the World Birding Center to "significantly increase the appreciation, understanding, and conservation of birds and wildlife habitat." Many of the project’s nine sites in the lower Rio Grande Valley seek to repair or reestablish the rich natural landscape.

The World Birding Center Headquarters, located in Bentsen-Rio Grande Valley State Park, was intended to form a gateway between disturbed land that was cleared for agricultural purposes some 30 years ago and more than 1,700 acres of adjacent native habitat that is being reclaimed and established as a habitat preserve.

This project was chosen as an AIA Committee on the Environment Top Ten Green Project for 2006. It was submitted by Lake|Flato Architects, in San Antonio, Texas. Additional project team members are listed on the "Process" screen.

Environmental Aspects

The design and construction theme was to do more with less. Through the process of "right sizing," the buildings were reduced to 13,000 ft², reducing first cost, material and energy use, and maintenance requirements. Structural arched panels enclose the maximum space with the least material and use 48% less steel, by weight, than traditional steel framing.

A flooded habitat demonstration garden exhibits the characteristics of the natural flooded Resaca environment and forms the focal point of the design. All landscape planting was strictly limited to species native to the region. Land surrounding the buildings is being restored to its native state and will exhibit various stages of restoration.

A 47,000-gallon rainwater collection system is utilized for irrigation and for a wildlife trough. A series of rainwater guzzlers, natural pools, and water seeps provides much-needed water for birds and butterflies. Water-efficient fixtures and waterless urinals minimize indoor potable water use.

Energy-efficiency strategies include high-efficiency, variable-speed mechanical cooling equipment; on-demand water heaters; and efficient lighting. Shielded exterior lighting protects this important night sky and migration flyway.

Owner & Occupancy

- Owned and occupied by Texas Parks and Wildlife Department, State government
- Typically occupied by 15 people, 40 hours per person per week; and 185 visitors per
week, 2 hours per visitor per week

**Keywords**


Last updated: 4/20/2006

Our thanks to the ENERGY STAR program of the U.S. Environmental Protection Agency, and to the U.S. Department of Energy, and to BuildingGreen, Inc. for hosting the submission and judging forms.

For more information about the AIA/COTE Top Ten Green Projects, contact AIA/COTE. For help on how to use this Web site, contact the contest hosts.

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Appendix 3

AIA/COTE Report Overview for the Pocono Environmental Education Center
**Pocono Environmental Education and Visitor Center**

**(Pocono Environmental Education Center)**

**Overview**

- Location: Dingmans Ferry, PA
- Building type(s): Assembly
- New construction
- 7,750 sq. feet (720 sq. meters)
- Project scope: a single building
- Rural setting
- Completed October 2005

The Pocono Environmental Education and Visitor Center is designed to reinforce the organization's mission of environmental stewardship and education.

The building is a flexible, multipurpose gathering space for dining, meetings, lectures, and other environmental learning activities. The building is designed to serve as a teaching tool for environmental education. Arriving at the site, visitors pass through a forest, cross a wetland, enter the building through an opening in the dark north wall, and cross through a bar of service spaces into the bright, daylit main room. The south-facing shed is designed to take full advantage of the warmth of the sun, cool mountain breezes, abundant natural light, and views of the forest.

This project was chosen as an AIA Committee on the Environment Top Ten Green Project for 2008. It was submitted by Bohlin Cywinski Jackson in Wilkes-Barre, Pennsylvania. Additional project team members are listed on the "Process" screen.

**Environmental Aspects**

Through careful siting, materials selection, analysis, and design of building systems, the structure outwardly expresses the principles of green design. Because it serves as a teaching tool, the building makes many of its green building strategies apparent to visitors.

The north wall at the main entrance to the building is clad in shingles cut from reclaimed tires gathered from local sources where they had been discarded. Operable windows provide natural ventilation to the main activity space, encouraging occupants to think about their own comfort and the environmental impacts of heating and cooling. South-facing windows provide passive solar gain in the winter, lowering heating costs. Overall, the building was designed to be resource and energy efficient, both from a first-cost standpoint and from an operational one due to the tight budgetary constraints of this small environmental center.

**Owner & Occupancy**

- Owned and occupied by Pocono Environmental Education Center and National Park Service, Corporation, nonprofit
- Typically occupied by 8 people, 35 hours per person per week; and 250 visitors per week, 23 hours per visitor per week

**Keywords**

Integrated team, Green framework, Simulation, Green specifications, Performance
measurement and verification, Operations and maintenance, Open space preservation, Wildlife habitat, Wetlands, Indigenous vegetation, Stormwater management, Massing and orientation, Glazing, Passive solar, Lighting control and daylight harvesting, Efficient lighting, Adaptable design, Durability, Benign materials, Salvaged materials, Recycled materials, Local materials, Connection to outdoors, Daylighting, Natural ventilation, Low-emitting materials

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For more information about the AIA/COTE Top Ten Green Projects, contact AIA/COTE. For help on how to use this Web site, contact the contest hosts.

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Appendix 4

Manatee County Mosquito Ditches Construction Proposal
PROJECT NO. 4  McGill Island

Manatee County Anti-Mosquito District

Proposed for Construction during Fiscal Year 1958-59

This project includes the entire McGill Island which is located off
the southwest tip of Terra Ceia Island on Tampa Bay. This island is
made up of mangroves and salt flats with occasional higher areas
with palms. There are a number of ponds included on the island which
flood intermittently and breed mosquitoes of various types. The soil
is sand and muck.

Mosquito larvae were observed breeding in grassy flats on the southeast
portion of the island in 1952. These were observed from the helicopter.
In 1958 Kemp and Taylor surveyed the north central part of the island
and observed numerous potential breeding areas, however the areas were
dry and no larvae were observed. An estimated 600 acres of mosquito
breeding will be improved with the construction of this project.

Both of the District's two 3/4 draglines will be used to construct
ditches and laterals as shown on the attached photostat of the area.
All main ditches are to be dug 6 to 10 feet wide, as found necessary,
and laterals to be bucket width, and all ditches dug to one foot below
mean low-water level. Estimated total length of ditches and laterals
is 75 to 80 thousand lineal feet.

Submitted by:

Robert L. Kemp
Director
June 30, 1958