**FISH TRAPS AND BASKETS IN THE PRE-COLUMBIAN AMAZON**

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**Introduction**

The medium in which objects from the past are represented will always affect the way the artist and the audience can perceive them. Each medium has its advantages and disadvantage, but the potential of a three dimensional model in theory is an accurate reconstruction of the object in question that can take into account the physicality of the piece in its original environment. By paying attention to material components used, size, design, usage, and other factors, an artistic rendering of objects in three-dimensional digital space can come close to a realistic experience for the viewer. Digitalization of the past places those experiencing the rendering into a space that minimizes what is left up to the imagination, and therefore left to potential misinterpretation.

However, representation of the past in digital space has its limitations like any other medium. Technological constraints of the present all but guarantee that models built today will not be as photorealistic as they could potentially be if modeled in the future. While modeling the people of the past —along with their actions, movements, and tools— is possible, these models are limited by the time and budgetary constraints of the project. While the potential for accuracy in a three dimensional model is far greater than that of a sketch by comparison, digitalization is also much more restricted by the scope and context of the project. Given unlimited time and resources, digital tools give the modern scholar power to create complex and detailed representations of life in the past based on findings in the present. The lack of such conditions, however, do not invalidate a model in the sense of historical accuracy. Instead the constraints and context of the chosen form of representation should be open for scrutiny by all in order to ensure that the message behind the model in regards to the people it represents is clearly visible to the viewer.

**Goals**

The goal of this project was to create models of various kinds of fish traps, baskets, and other fishing tools used by the pre-Columbian indigenous peoples in the Baures region of South America (Erickson and Balée, 2006:260). After modeling these objects, motion capture would be used to produce animations of aspects of everyday use of the objects by 3D digital humans. These models and animated activities would then be brought into a larger digital environment with models of fish weirs and fish ponds of the Baures region (Figure 1, Brinkmeier 2007:11).

**Fishing and Fisheries of the Bolivian Amazon**

Fish weirs were an important part of food cultivation in the Pre-Columbian Baures region was they allowed for easy harvesting of fish during both the dry and rainy seasons. “Dense networks of zigzag structures cover the savanna between the larger linear causeways and canals that divide the savanna into roughly rectilinear blocks. Based on the form, location, and associations of these structures, my col-leagues and I are convinced that they functioned as fish weirs during the rainy season. The weirs are similar to those reported for indigenous groups throughout Amazonia. The weirs, combined with the larger causeways, would have impounded a thin sheet of water over a large area. The openings would have allowed excess water to flow across the savanna” (Erickson, 2006: 260). Weirs were used to captures a large variety of fish adapted to shallow waters, but the most common for harvest was the buchere.

“Fish associated with the fish weirs and ponds of the BHC and modern road ditches throughout the Bolivian Amazon include buchere, yallu, cunaré, palometa, sábalo, and bentón. The most common is the buchere, a small armored catfish that migrates into the wetland margin each year” this was deemed impractical given time constraints (Erickson i.p.).

**Fish Traps and Fish Baskets**

Fish weir traps like the ones probably found in Baures —made from plant fibers or bamboo and placed at the critical points of earthworks— were in common use by fishing cultures throughout the world (*31-48-358*, *P1022A*, *82-7-231*. Penn Museum Object Database 2016) (Figures 2, 3, and 4). These traps were made from sticks and fibers gathered from the local environments where they were constructed, so the specific designs and set-ups vary from place to place. However, the basic function was simple and similar throughout fishing cultures all over the world. Fish traveling downstream would be funneled into these basket traps, making their way through a small opening in the front of the trap which is designed to ensure that once the fish are inside the trap they cannot exit. “Common throughout the world, fish weirs are fences made of wood, brush, basketry, or stones that extend across bodies of water. Baskets or nets are placed in openings to trap migrating fish. In contrast to the simple ephemeral structures described ethnographically for rivers and shallow lakes, the fish weirs of the BHC are permanent earthen features covering more than 550km (squared). Dense networks of low linear segments of earthen ridges zigzag across the seasonally inundated savannas between forest islands. Funnel-like openings, located where the earthwork changes direction, were used to trap fish” (Erickson, 2009: 34).

**Process**

The first step in the process of creating three dimensional models was choosing the proper reference objects and images, and ensuring that they were contextually appropriate for use. The Penn Museum Online Object Database proved useful in locating fish traps and baskets from cultures all over the world for use as reference images in modeling.

Given that fish weir traps varied in size and shape, two different types were modeled in Maya software directly after the basket fish traps from Thailand and Brazil respectively (Figures 5-6). Each of these objects were built using materials available in the regions of their construction, namely bamboo and grass fibers. With that in mind, the Thailand-inspired model was constructed out of rigid cylinders connected with small twisted torus shapes to simulate bamboo tied together with grass fibers (Figure 5; Penn Museum, *82-7-231*. 2016). The Brazilian model was made with a more flexible and versatile shape to accurately represent how the reference object was made entirely from interwoven plant fibers (Figure 6; Penn Museum, *31-48-358*. 2016).

The next objects —two hand traps of varying size — modeled for the scene were fishing tools referred to as a *cóvo* (Keller, 1875: 100). these objects, a kind of hand trap, used by fishermen in fish ponds to easily trap fish and scoop them out of the water (Figures 7-8). Similar to fish weir basket traps, hand traps were used in fishing cultures all over the world. The Penn Museum online database provided many reference images of actual objects such as a hand trap similar to the ones depicted in the drawings of Bolivian fishermen made out of slices of bamboo from the Philippine Islands (Figure 9, CIVIC.1993.X.783). The object is roughly conical, with openings on the top and bottom. To catch fish, fishermen using these tools would stand still in water until a fish passed close enough that the hand trap could be thrust into the water surrounding the fish to capture it, at which point the fisherman would reach in through the hole in the top to retrieve the fish.

Modeling the cóvo was made easier due to the possession of more reference material. From similar objects from other parts of the world, and artistic representations of their counterparts in Pre-Columbian Bolivia (Figures 10 and 11, CIVIC.1993.X.783). To build models of these objects, cylinders were elongated and copied around a central point at an angle to create a large bottom and small open top to represent. The reeds are then connected by two twisted torus shapes to simulate plant fibers tying the vertical slats together. The dimensions of both hand traps were modeled in reference to illustrations depicting the tools in use by people to ensure that they would stay accurate in the context of a larger digital world when placed into the rendering of the Bolivian landscape. Each hand trap was about a foot wide at the bottom and six inches in diameter at the top. The large hand trap was about a foot and a half tall while the smaller one was a foot in height (Mercado, 1991

The final fishing object modeled was a fish basket used simply for the transfer of captured fish from water sources to other stations for cleaning, scaling and cooking. A fish basket in the Penn Museum collections from Brazil was photographed as a reference to create a fish basket model as close as possible to the objects in the ethnographic descriptions (Figure 12-13; Penn Museum, Object 31-48-346. 2016). The process of 3D modeling the basket was complicated as the level of detail required to accurately model the number of interwoven strands of grass was too demanding of the modeling software. To maintain as much accuracy as possible, the model was made with double interwoven layers of twigs, wood, and grass fibers in the center along with rounded strands creating the oval shape of the basket and the curved rigid strand tied at the sides to make the woven layers concave.

The last step in modeling the fishing objects was to populate the fish traps with fish. While a model of the buchere would be the most relevant based on archaeological research, instead, the models were populated with a generic model of a bass taken from the online archive *TF3DM.* The model from the archive was then given a reflective blue texture to contrast the solid wood textures of the basket models (umar6419, 2010).

**Motion Capture of Animated Activities**

When designing the animations associated with each of these objects, three were identified as most important. Trapping fish with the cóvo, installing fish weir traps, and harvesting fish weir traps full of fish. Motions associated with the cóvo were designed using drawn depictions of the objects in use (Figure 7). The assembly and harvesting of fish weir traps had to be inferred based on the construction and design of similar objects in the Penn Museum. Each movement was reconstructed digitally using motion capture software, which allowed an actor (Figure 15) to move through the motions the physical world and have them translate onto models on a computer. To ensure accuracy, the dimensions of fish weirs and fish ponds were measured out in the SIG Laboratory so that captured movements would translate well into the virtual digital space.

**Conclusions**

The efforts to model a wide range of fishing objects as what might have been present in Baures proved to be successful. By using actual artifacts from Penn’s collection, there was little left up to the artist’s bias and interpretation. The fish trap and basketry models will work well as objects used by 3D human models in larger virtual reality scenes, as they are accurately proportioned to human scale and made to represent a design from materials that would be readily available in the environment of Baures. Although no basketry from the region of Baures from the time period represented are preserved, the combination of similar objects from other fishing cultures around the world the interpretation of relevant artwork of the natives of Bolivia created a final product that achieves as much accuracy as can be considered possible.

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