5-2022

Anthropology in 3D: The Use of Photogrammetry in the Preservation and Dissemination of Ethnographic Art

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To Mom, Dad, Grace, Eric, and Nana for helping me become the person I always wanted to be

History of Photogrammetry

Archaeology, inherently, is a destructive endeavor. Those working to excavate a site remove artifacts from their contexts and sometimes even annihilate potentially precious sources of data that are either too expensive, impractical, or, at the time of excavation, impossible to study. For archaeologists, therefore, knowing the context of these artifacts is central to the discerning of information as the context of the excavated area is limited to what was recorded on-site by the excavator (Howland et al. 2014). From as early as the 1950s, standards in archaeological recording have improved dramatically, with recent developments in technology allowing for the digital recreation of archaeological circumstances (Howland et al. 2014). Digital Photogrammetry, also known simply as 3D modeling, is one such method that has grown over the past 15 years as one of the biggest technological improvements to archaeological documentation techniques (Dostal and Yamafune 2018). Digital photogrammetry involves photographing an object from multiple angles, anywhere from dozens to hundreds to even thousands of times depending on the project and then using 3D modeling software that aligns these photos at various landmarks to create a 3D model (Medina et al. 2020).

Despite this seemingly recently developed technology photogrammetry is a technique that was first developed in the 19th century when French colonel Aime Laussedat began to experiment in topographical mapping using photographs in 1851 and took the first aerial photograph in 1858 (Marín-

Buzón et al. 2021). Early photogrammetry, in this sense, was based around perspective intersections, or the art of creating a 2D surface, a photograph, of an area in order to give the correct impression of its height, width, depth, and spatial relationship (Marín-Buzón et al. 2021). One of the first practical results of aerial photogrammetry or mapping occurred in 1911 when Italian captain Cesare Tardivo created a mosaic of Venice made of photographs taken from a balloon. Tardivo would go on in 1913 to create a 1:4000 scale mosaic of Benghazi in Libya with photographs taken from an airplane. The first (recorded) use of photogrammetry in an archaeological survey was in 1962 with "The Teotihuacan Mapping Project" (Marín-Buzón et al. 2021).

Photogrammetry's use in archaeology and other general scientific research was sparse until around 1980, with one study yielding just over 700 search results on photogrammetry from 1980-2019, of which 26%, or roughly 182, of the results were related to the social sciences (Marín-Buzón et al. 2021). Although the research into the field of photogrammetry is still relatively new, the use of photogrammetry as a cultural heritage preservation tool is indispensable.

Photogrammetry in Archaeology and Cultural Heritage

Photogrammetry, as it is practiced today, uses highly specialized techniques and technologies in order to create an accurate 3D model of an archaeological site or artifact. Digital photography associated with the development of image processing and its automation has made these techniques widely attractive for various applications (Marín-Buzón et al. 2021). Much of the early archaeological uses of photogrammetry consisted of aerial photogrammetry in which a large area of land is analyzed. Two early examples of vertical photogrammetry include the aforementioned Teotihuacan Mapping Project in 1962 and the discovery of Celtic fields in Himmerland (Denmark) in 1970 (Marín-Buzón et al. 2021).

Photogrammetric methods are not limited to aerial or terrestrial contexts. The invention of the pressure regulator, or Aqua-Lung, in the 1950s enabled scuba divers to reach underwater sites, providing the opportunity to study wrecks and sunken ships (Drap 2012). The first experiments with underwater photogrammetry for archaeology began in the 1960s, a decade before vertical photogrammetry became widely seen as a documentation technique (Drap 2012). Underwater photogrammetry and its principles do not differ from that of terrestrial or aerial photogrammetry, but certain elements such as the refraction of the diopter water-glass, the diopter being a unit of refractive power, must be taken into account. The important advantage to keep in mind when using underwater photogrammetry is its simplicity of implementation

and the diversity of potential results such as 3D measurements on the object and 3D reconstruction (Drap 2012).

Photogrammetry, while serving a crucial role in archaeology, also serves to preserve and document cultural heritage in various ways. One of the most famous and controversial examples of this is the reconstruction of Palmyra's Arch of Triumph. After being intentionally being destroyed by the Islamic State in 2015, a massive project was conducted in order to recreate and preserve the arch for future generations. The project was overseen by the Institute of Digital Archaeology (IDA), a joint undertaking funded by Dubai's Museum of the Future, the University of Oxford, and Harvard University. The IDA created a digital model constructed from around one hundred photographs, all of which were taken by volunteers. The final model was sent to TorArt, a company that specializes in robotic sculpting, and was erected in London's Trafalgar Square in April 2016 (Elias 2019). The reconstruction of the Palmyra is an amazing example of the possibilities photogrammetry has for both archaeology and cultural heritage preservation, but, as is the case with many other artifacts and sites around the world, the Palmyra's reconstruction has also brought with it significant controversy. This controversy will be discussed later, but photogrammetry's use as a cultural heritage preservation technique cannot be overlooked.

Today, the two most common types of photogrammetry techniques include laser scanning, which creates a 3D model through external tracking of

the 3D position of a laser sight, and computerized tomography (CT) scanning, which uses penetrating waves that capture an image in 2D slices which are then layered into a 3D model (Medina et al. 2020). Both techniques provide accurate depictions of artifacts that can later be used for research and preservative purposes; however, as is with most other photogrammetric techniques, the main issue archaeologists and cultural heritage preservationists face is the cost of photogrammetry hardware and software.

Despite the wide range of possibilities for new methods, of which many in archaeology are aware of, many do not necessarily have easy access to the appropriate resources needed to skillfully and consistently apply these techniques (Porter et al. 2016). This can be attributed to the costs traditionally associated with 3D scanning, which include both the money needed to purchase a 3D scanner and the time needed to learn how to utilize the machinery and software properly (Porter et al. 2016). Some research has been devoted to compiling a cost-effective photogrammetry set-up that is easy to use, such as those conducted by Porter et al. (2016) and Medina et al. (2020), but 3D artifact documentation and dissemination of 3D data still remain on the brink of becoming truly mainstream practices (Porter et al. 2016).

The photogrammetry rig used in this project was established by Porter et al. (2016) in order to photograph and model smaller objects, but the system used in this project has been adjusted to photograph and model the larger artifacts. The process used in this project, modeled off of the Porter et al. (2016)

study, is a close-range photogrammetric modeling set-up which works by finding reference points on digital images taken from multiple angles and then determining the relative position of these points in 3D space via triangulation. More about the rig and the process carried out will be discussed later in this essay.

Photogrammetry in Institutions

Photogrammetry has been widely applied in museums, mainly in the digitization of artifacts for the purpose of documentation or digital display (Howland et al. 2014). This increase in digitization and photogrammetry yields more information for researchers and creates connections between specimens across museums, with the key goal being the creation of tools that facilitate mass digitization while also providing the highest quality data (Medina et al. 2020). Museums have also begun to use photogrammetry to create photo-realistic digital and physical replicas of artifacts for exhibitions and virtual museums. “Treasures of Vietnamese Archaeology and Culture” is one example in which various cultural heritage artifacts from different Vietnamese museums, none of which had been displayed outside of Vietnam, were digitized in 2015 and shown for the first time in Germany from 2016 to 2018 (Marín-Buzón et al. 2021).

Photogrammetric technology is not limited to preserving cultural heritage objects but also cultural heritage locations. In order to preserve the original, a highly accurate replica of Altamira Cave was created by the National Archaeology Museum in Madrid, Spain using only 28 pairs of photographs in order to graph the cave paintings with great precision (Marín-Buzón et al. 2021). One final example which was mentioned earlier in this essay, is the recreation of Palmyra's Arch of Triumph. After its destruction in 2015 at the hands of ISIS, the IDA created three, twenty-foot replica models of the arch from roughly one hundred photographs and erected the models in New York, London, and Dubai. This project was the first of its kind, recreating a large-scale monument using 3D printing technology (Elias 2019; Khunti 2018). The utilization of photogrammetric techniques in institutions to document and preserve cultural heritage material is crucial in providing the public with easy access to otherwise damaged, protected, or inaccessible sites. Furthermore, despite its profound importance, photogrammetric documentation, and display, as we will see in cases such as the Arch of Triumph, has brought about ethical and contextual concerns.

Ethical Concerns for the Display of Cultural Material

Photogrammetric methods have the capacity to preserve cultural heritage and sites for public enjoyment and research analysis for both present and

future generations. However, if not carried out properly, these projects have the potential to do more harm than good. Palmyra's Arch of Triumph, while a great example of the positive implications of 3D modeling in cultural heritage preservation, is also a prime example of the negative effects a project can have on a community if not carried out and presented properly. The reconstruction of Palmyra's Arch of Triumph, while serving as a positive example, also failed to obey basic ethical principles applied to preservation and presentation of artifacts and heritage sites including honest accounts of history, ownership(s) and rights to heritage, ensuring an authentic presentation and experience of the heritage, and guaranteeing accessibility to the public (Khunti 2018).

To start, the ancient city of Palmyra was the center of immense human suffering and loss of life. Four hundred citizens were killed by ISIS during their ten-month occupation of the site and afterwards became the home of the Assad regime's most brutal political prisons (Khunti 2018). The reconstruction of the Arch of Triumph was not used as an acknowledgement of this human loss by the countries involved in its construction – the UAE, Great Britain, the United States – but as a response to the suffering of the Syrian people, detracting from the fact that none of these countries actually pledged to actively improve the conflict (Khunti 2018).

Essentially, the reconstructed arches were used as a token response to the conflict in Palmyra, which in turn prevented escalation of public pressure to increase refugee intake, of which there was little in all three countries

(Khunti 2018). The IDA also received criticism for not acknowledging the actions of the Assad regime, which built its most brutal prison camp at Palmyra and ordered several airstrikes over the location during its ISIS occupation. This lack of acknowledgement inflicts harm to the people and heritage of Palmyra by downplaying the actions of the Assad regime as "not so bad" or "not as evil as ISIS." This censored narrative is not only unethical for not honestly condemning all groups involved in the destruction of Palmyra's heritage, but it also enables the Assad regime to reinforce their oppressive in Palmyra without international intervention (Khunti 2018).

Apart from the failure to fully acknowledge the human suffering in the area, the project's use of photogrammetry can be described as, to put it blatantly, atrocious. The project to rebuild the arch utilized roughly one hundred low-resolution photographs, all of which were taken by untrained tourists. As a result, the so-called replica of the Palmyra arch was nothing like the original. The inaccurate reconstruction may not be noticeable to the lay public, but to those whom the arch was an important heritage site, the reconstructed arch was anything but an authentic and accurate reconstruction (Elias 2019; Khunti 2018).

Finally, the accessibility of the arch to the public, or the lack thereof, and further negative portrayals of the replica became major sources for ethical concerns. The replica's portrayal in London, New York, and Dubai furthered Syrian claims to their own heritage, not only because of the locations the arch

was exhibited but also because of the language used to describe the arch (Khunti 2018). All three countries exhibited the arch as a product of a shared human history, or as Roger Michel, the head director of the IDA, put it, "our past is their past" (Khunti 2018). This proclaimed idea of shared human history, although thoughtful, lacks considerable meaning when all three nations the replica visited did little to actively alleviate the Syrian conflict.

The manner in which the replica was displayed was also constraining and unethically denied the public access to the replica. In London, the arch was unapproachable and could not be walked under, touched, or engaged with. In New York, an invited group of two dozen guests in suits received reserved seating and a better view of the arch than any member of the general public (Khunti 2018). Furthermore, the IDA has not uploaded a digitized 3D model of the arch online, which all digital heritage has an ethical responsibility to be in order to increase its accessibility (Khunti 2018). Through not making their arch data available online, the IDA has been accused of "digital colonialism," whereby an organization has seized a patent of a historical object or site. By withholding the patent of the reconstructed arch, the IDA's act of "digital colonialism" does not allow Syrian people access to their own heritage (Khunti 2018).

Palmyra's arch was the first large-scale monument recreated using 3D modeling techniques and the future use of this technology in cultural heritage preservation and artifact documentation should not be ignored. However, 3D

modeling in archaeological and cultural heritage preservation projects should abide by the basic ethical principles applied to preservation and presentation of original artifacts and heritage sites. By failing to actively provide a solution to the Syrian conflict while professing "a shared human history," conducting digital colonialism and restricting public access to the physical and digital replica, and constructing a replica that is not authentic, the reconstruction of Palmyra's arch is a both a story of the overwhelming good photogrammetry can do, as well as the overwhelming harm it can inflict.

As we turn our discussion to the artifacts that will be digitized in this project, I should take this time to explain how this project is different from the Palmyra arch project and in what ways this project will avoid similar ethical dilemmas. There are two main differences between these projects that set them apart. The first is accessibility. This project, once completed, will be available to the public for free on Sketch Fab. The final products will not be withheld for solely private or restricted viewing. The second distinction is the acquisition of the artifacts being modeled. These artifacts were created for the purpose of being sold in Papua New Guinea's tourism industry. The artifacts themselves were modeled after real Sepik River cultural material with the purpose of being sold and shared abroad. The origins of the collection and how the artifacts were acquired will be discussed in-depth in following sections. I assert that by providing appropriate and satisfactory amounts of background data to place these in artifacts in their cultural contexts and by providing free, unrestricted

online access to the public, this project maintains its goal of preserving cultural heritage in an ethical manner.

Ideally, the interpretations and display on Sketchfab would be done in consultation with Sepik River tribes or the national museums of Papua New Guinea. Many scholars in recent times have taken issue with the lack of indigenous consultation in the display of art and artifacts in museums (Mattehs 2018). Consultation with tribes from the Sepik River on the display and interpretation can be something that is pursued by the Anthropology department in the future.

Origins of the Collection

The collection housed at the Grand Valley State University Anthropology Department that was photographed and modeled for this project consists of twelve cultural items from Papua New Guinea's tourism trade. The items that make up this collection are based off of cultural objects that would have been used in tribal rituals along the Sepik River or served other culturally significant positions. Figure 1 depicts a map of the region with the village of origin for some artifacts circled. The collection was given to the GVSU Anthropology Department by James Hummel in 2010 and contains the following items:

Figure 1: Map of the Middle Sepik River region. Villages marked with blue dots are areas of origin for some of these artifacts. Most of the artifacts come from this area.

Spirit masks (Figures 2 & 3): These spirit masks, or *Mwai* masks, represent the spirit of a specific ancestor and are kept in the village cult house. Used in ceremonies, it allows communication with the clan spirits. One mask (Figure 1) is from Kandangai village while the other mask (Figure 2) is from Angriman village. The style of the *Mwai* mask in Figure 2 is common in Kandangai, where carvers make these large, bold masks. It is also common for these masks to have protruding eyes set with white shell.

Figure 2 (Left): Spirit Mask from Kandangai village. The elongated nose and tongue signify strength and virility.

Dimensions for the mask in Figure 2: 49” x 18” x 8”

Dimensions for the mask in Figure 3: 47” x 20” x 10”

Figure 3: Spirit Mask from Angriman village.

Male Ancestral Figure (Figure 4): Made of painted wood with a woven skirt, tribal ancestor figures such as this would have been kept in the spirit house, leaning against a wall at an angle. They are believed to enshrine the spirits of their ancestors and are regarded with great respect and reverence. Other figures are kept by direct descendants in their own houses as family heirlooms. The ancestral figure depicted in Figure 4 was produced in the Mindimbit village for which there is an Upper and Lower village. Carving occurs in both villages, however the larger, upper village does the majority of the carving.

Figure 4: Ancestral figure believed to enshrine the spirits of ancestors and are highly respected and revered.

Dimensions: 45” x 12” x 10”

Woven mask (Figure 5): Not much is known about this woven mask besides that it was used in ceremonies. It is comprised of colored bush fibers woven together with feathers adorning the top of the mask.

Dimensions: 11” x 24” x 10”

Substitute head (Figure 6): Wooden head used in ceremonies. Solid wood carving with a pole and base to stand on. Headhunting was once a common and important aspect of riverine tribe religion and culture. In Iatmul communities, men could not marry without having successfully returning from a raid with a trophy or the head of an enemy warrior. This widely practiced activity led to an incessant cycle of revenge attacks, ambushes, and raids between communities which was brought to an end in the mid-1920s by the Australian civil administration (Howarth 2015).

Figure 5: Woven Mask used in ceremonies. This artifact is open to considerably more research as little is known about it.

Figure 6: Substitute wooden head used in ceremonies. Replaced real heads after Australian colonization.

Dimensions: 9” x 6” x 4”

Female Gable Carving (Figure 7): Known as a *mbwatnggowi*. As a symbol of rebirth, the primal woman figurine sits in the upper story of the men’s ceremonial house above the ladder to enter the area where all of the sacred cult objects are stored. The figurine

sits with splayed legs, thus, one can only reach the sacred objects and the upper floor between the legs of the figurine. (Corbin 2002; Craig 2010).

Dimensions: 23” x 23” x 7”

Figure 7 (Below): Gable woman figurine that sits at the top of the ladder leading to sacred objects.

Steering Paddle (Figure 8): A steering paddle made of carved wood. Used to steer canoes.

Dimensions: 41” x 5.5” x 1”

Bilum (Figure 9): A bilum made in the Kabwum Morobe Province and is comprised of woven material. Bilum had different uses depending on its style and the gender of the individual making it.

Dimensions: 26” x 10” x 1”

Figure 8 (Left): Steering paddle used to steer canoes. The river acts as a central part of social and economic life, so canoes are used often to traverse it.

Figure 9 (Right): A bilum. These bags had multiple uses that were determined by the crafter’s gender and the style it was made.

Belt (Figure 10) and **boar tusk necklace** (Figure 11): The belt and necklace are made of bush fiber cordage and adorned with various shells, with the necklace also being adorned with boar tusks. Shells, especially pearl shells, were extremely rare for villages living inland and therefore valued as important items of wealth. These shells also held significant religious and ceremonial significance, especially with "…belief systems centered around cycles of procreation, fertility, and growth" (Wilson 2014).

Figure 11 (Right): Boar tusk necklace used in gift exchange. The shells were highly valued by inland tribes and were typically seen as highly valuable.

Dimensions for belt: 36" x 7.5" x 1"

Dimensions for necklace: 19" x 8" x 1"

Figure 10 (Left): Belt made of bush fiber cordage and adorned with shells.

Pendant (Figure 12): This pendant was made as a form of traditional jewelry. Made of bush fiber cordage and made in the shape of a human face with shell eyes, this object would have been used in gift exchanges as well as payment for a bride price.

Dimensions: 19" x 8" x 1"

Figure 12: Pendant made in the shape of a human face. This object was once decorated with clay and shells which have now fallen off.

Skull Rack (Figure 13): Skull racks were used to display the heads of ancestors as well as enemies defeated in raids; however, it is likely that the majority of skulls placed on these racks were those of ancestors (Crispin 2015). According to the Iatmul, for all beings, the head is the most sacred body part. The head was also linked to fertility, where the human head is compared to how the head of a yam is the growing point of the tuber (Hauser-Schäublin 1994). These racks would be used to display the heads of "big men" from other villages; however, big men from the home village would also be placed on the skull rack. This is because, in societies such as the Abelam, the heads placed on these racks stood for a whole category of people (Hauser-Schäublin 1994). After Australia took control of Papua New Guinea following WWI, the acts of human skull portrayal and headhunting were forbidden, and the presence of human skulls was gradually replaced by substitute wooden ones. This skull rack was produced in Angoram village, a village in the Eastern Sepik region that

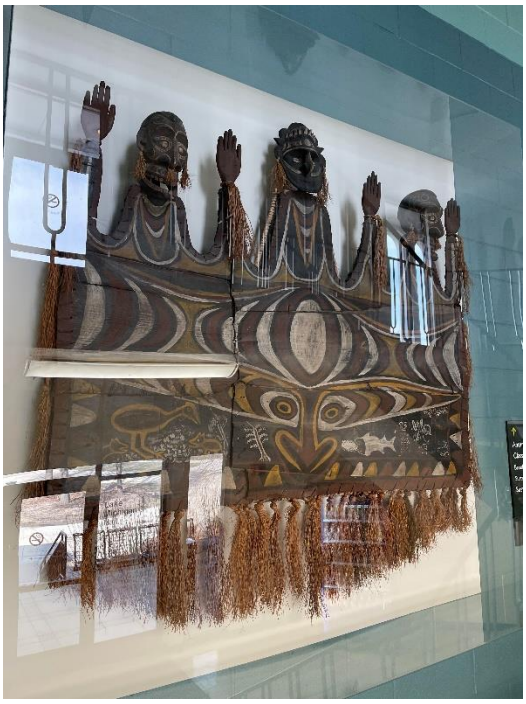

Figure 13: Skull rack that currently hangs in the North stairwell in Lake Michigan Hall. The artifact is protected by a Plexiglas case which was removed during photographing.

was once one of the first stops for tourists traversing the river. It was here that visitors got their first glimpse at the products the Sepik had to offer.

Dimensions: 60” x 60” x 7”

The History of Collecting Oceanic Art

The history of collecting Oceanic art from Papua New Guinea is a tumultuous one. In 1884, Germany asserted colonial control over New Guinea, christening it Kaiser Wilhelmsland. Initial German interest focused on collecting artifacts and forced native labor on plantations. In 1909, one German museum director compared the Sepik to the Friedrichstrasse, a popular shopping district in Berlin (Silverman 2018). Archival photographs suggest that, by the start of World War One, Sepik peoples were essentially greeting every European with artifacts and art in hand. Reproduced works were most likely traded for metal tools and the riverine peoples began making regular use of these tools as well as European clothing. This, however, does not mean there wasn’t any conflict, as sometimes the art and artifacts were taken by force (Silverman 2018; Silverman 1999).

During and after World War One, the Australian military occupied the region. At this point, Sepik artists began selling their wares to missionaries, patrols, travelers, anthropologists, and museums, and the selling of Sepik art was becoming substantial source of income for the region by the mid-1960s.

This process entered a new phase in the 1970s when Papua New Guinea became an independent nation and was further exposed to tourism (Silverman 1999). Tourism in the 1970s and 80s saw an abundance of art collectors and tourists. Reaching the Sepik villages such as Tambunum via the Melanesian Tourist Service's houseboats and steamships, these collectors and tourists sought to purchase Sepik art as images of the mysterious and "natural," "primitive" other (Silverman 1999). Business continued until the Melanesian Tourist Service sold its vessel, the *Melanesian Discoverer*, in 2006. Since then, not many tourist boats regularly venture the river. After the collapse of tourism in the region, many villages such as Tambunum now face extreme hardship, feeling is if they have lost their traditional ways of life as well as feelings of abandonment by their government. The locals have also begun to turn their backs on the river. Once seen as the source of life and death and the center of their cosmology, the river is now only seen as a destructive force that is slowly eroding away everyday life both figuratively and literally (Silverman 2018).

Art of the Sepik River

Traditional Sepik River art was influenced by the environment in which the artists lived and was viewed in terms of the everyday interaction between people and the supernatural world. The art of the Sepik, as a representation of the spiritual environment that encapsulates these riverine people, adorns not

only sculptures and spirit masks but also mundane items ranging from weapons, canoe equipment, and pots, to hooks used to hang food as a protective measure from rats (Wardwell 1971). The decoration of mundane objects served as a constant reminder of the presence of the supernatural and its potential involvement in everyday life, not just in religious rituals.

The art of the Sepik is incredibly inventive in its use of so many varied materials: pig tusks; feathers; worked and polished shells; clay; human, animal, and fish bones, hair, and teeth; wood; fur and skins of opossums and flying foxes; fiber and a vibrant palette of ochres (Howarth 2015). The dominant expression of traditional Sepik art is best characterized as non-naturalistic, dramatic, and complex surface ornamentation, whether carved or painted, serves to accentuate the mass of the sculpture. This method, perhaps, represents a subconscious attempt by the artist to include the dynamic properties of the environment around them (Wardwell 1971). Most artifacts from the Sepik are decorated with curved or painted lines, a common motif used to represent the waves of the Sepik River, which is central to Sepik River religious practices. “Many of the two dimensional patterns, at first, appear to be symmetrical; however, a subtle asymmetry can be discerned. Combined with imaginative use of negative space, sculptures depict additional interaction between mass and void, an expression of building the land out of the river” (Silverman 2018; Wardwell 1971). The art of the Sepik also does not represent totemic spirits; they are the spirits, with the ornamented art object being a

"body" animated by the totem's "soul," the wood carving being akin to "bones," and the decoration is "skin" (Silverman 1999).

Another dominant motif in Sepik River art is the human form. This form is commonly conceived with an enlarged head, elongated torso, and shortened limbs. Human figures also frequently stood in unbalanced poses or with the weight unevenly distributed in the feet (Wardwell 1971). The reasoning for this uneven footing, perhaps, stems from an uneasy existence with the Sepik River, which attempts, through earthquakes and floods, to engulf the land that has been built around it. These human figures would also occasionally be given elongated noses, a sign of strength and virility, and are often combined with figures of birds and other animals, decorated with shell, feathers, fur, and paint. These anamorphic traits run parallel with the constant spiritual presence, with which the people of the Sepik are in continuous contact. The common material used in human sculptures such as masks and statues is wood; however, before and during early contact, human skulls, acquired through headhunting and restored in clay and paint were once common (Dinerman 1981).

The crocodile is another important motif amongst Sepik River art and ritual. Crocodiles were mainly associated with masculinity. According to Iatmul myth, the world was created by a primordial crocodile that swam everything into being from the river, with the river being associated with femininity. Additionally, life on the Sepik River was dominated by men's societies, and

most of the art was created for use in the elaborate ceremonies and initiations associated with them. (Howarth 2015; Dinerman 1981). Young males going through cult initiation would pass through a screen made to look like this primordial beast, entering as children and emerging as adults reborn into a reconstituted world (Howarth 2015; Dinerman 1981).

Development of Art for the Tourism Trade

Traditional riverine art and art made for the tourism industry share many commonalities as well as differences. The tourism industry fostered "mechanical reproduction" in the form of crocodile-shaped napkin rings and naturalistic snakes, birds, and frogs. "These objects have, in the relatively narrow sense, an expressive meaning, drawing on elements of the socionatural world in an attempt to achieve a perceived Western aesthetic desire" (Silverman 1999). The overwhelming presence of crocodiles in traditional art has carried over to tourism art, so much so that the crocodile, or *pukpuk* in the native language of Tok Pisin, serves as the riverine mascot of Pan-Sepik identity, adorning the provincial flag, clothing, woodwork, and more. Women of the region also sell colorful beaded bracelets that proclaim 'PS Pukpuk,' short for 'Pikinini Sepik Pukpuk' or 'Sepik Crocodile Child' (Silverman 2018). Another phrase 'Pikinini Sepik' (abbreviated to 'PS') or 'Sepik Child' is also commonly portrayed. This reference is also indicative of the riverine people's worldview,

which declares that they are, literally, born of the river, making the Sepik their mother (Silverman 2018).

The creation, or replication in this case, of Sepik ritual art also carried over from traditional art forms; however, there exists a major religious distinction between the replicas and the originals. Traditional ritual *sacra* – masks, dance costumes, figures, bamboo flutes, etc. – as mentioned before, are the spirits they represent and not just mere representations. *Sacra* produced for tourists are devoid of totemic souls and names and were not carved by the traditionally responsible tribe members. Moreover, if a man sees a totemic spirit in a dream, he cannot sell the totem and must instead place it in the cult house. Other objects, such as bullroarers – long, narrow, and flat wooden objects that are whirled on twine to produce a roaring sound – cannot be (re)produced because they can never be glimpsed by women (Silverman 1999).

Carved objects created for the tourism industry typically reflect local interpretations of Western taste and take on three main forms to convey messages of collective identity. First, tourist art conforms to styles that are largely indigenous to individual villages. The Sepik, however, as the unifying element of the region, historically allowed for trade and intercommunication between these villages which caused some diffusion of artistic style (Silverman 1999; Wardwell 1971). Skirts covering genitalia is one potential reflection of Sepik people's interpretations of Western taste.

Second, the people of the Sepik region are known as "Sepiks" and identify as such. The vernacular term for the river is Avatset, a compound of the words 'bone' (*ava*) and 'lake' (*tset*), with the name 'Sepik' being an ethno-regional designation from the early colonial era. The Sepiks do not identify as 'Avatset people'; they are simply Sepiks (Silverman 2018; Silverman 1999). This view of local identity reflects a desire for the Sepiks to be a part of the ever-changing Western world, which is depicted in the reproduced art and the adoption of "mechanical reproduction" or the mass production of identical copies of art using technological means.

Finally, Papua New Guinea ethnicity is also evident in tourist art, particularly in carvings of the national emblem (Figure 14). Carvers, instead of simply replicating the symbol, create numerous variations, rendering the national ethnicity in a local, village-based idiom. The diversity and number of these carvings, accompanied by an increase in frequency of accompanying Christian and biblical slogans represents another dimension of emergent identity (Silverman 1999). The presence of the national symbol of New Guinea and Christian and biblical slogans is indicative of the Sepiks' desire to be a part of the rest of the world, a desire that, after the decline in the

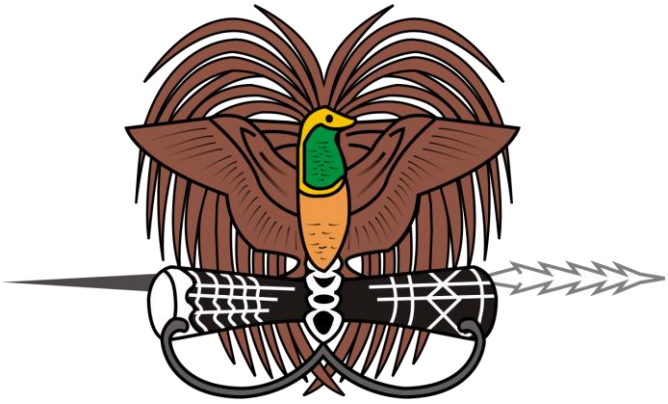

Figure 14: The national symbol of Papua New Guinea depicts a Bird of Paradise over a traditional ceremonial spear and Kundu drum

tourism industry, has not only grown but has caused many to turn their back on the river that gave their people life.

Ethnographic Analysis of the Sepik River Tribes

The Sepik River is known for its wide variations in art, language, culture, and people. Because of its varying and complex social, cultural, and religious aspects as well as their isolated and interlocking meanings, providing an accurate and in-depth ethnography of the region presents a unique challenge. Nonetheless, what this section attempts to deliver is just that, or, at the very least, provide readers with an overview of the region and the people living there.

At a length of 1,146 km (712 miles), the Sepik River is the largest river on the island of New Guinea and is central to the social life, economy, culture, and religion of the people who call its banks home. Traditionally, the Sepik acted as a catalyst for trade and intercommunication between the various groups of the region (Wardwell 1971). These interactions, with transactions of items such as weapons, ornaments, and pottery, led to some diffusion of artistic style along the river; however, "…ceremony, dance, song, oral tradition and other such cultural traits and certain objects…were copied and incorporated into the paraphernalia of groups…making it hard to localize and study Sepik art from the standpoint of regional style" (Wardwell 1971).

The people of the Sepik subsist on agricultural crops such as taro, sago, yams, bananas, and coconuts while also subsisting on fish and both wild and domesticated pigs (Klein 1989). Approximately 300,000 people live in dozens of tribes throughout the region. Each of these villages is an autonomous, self-contained social group; however, interaction between the villages is frequent (Klein 1989).

Traditionally, life on the Sepik was male-dominated. Most of traditional art, in fact, is associated with male initiation rituals and ceremonies (Wardwell 1971). Each village is independent and lacks a formal political leader. Instead, men compete for influence and prestige through means such as shamanic ability, debating skills, possession of esoteric lore, skill in sorcery or magic, and control over rights in land, women, and the loyalty of other men (Dinerman 1981). As mentioned before, headhunting was also an important aspect in riverine culture. Success in warfare and raiding, evident by the taking of an enemy's head, was the mark of an important man (Howarth 2015; Dinerman 1981).

Crocodiles were also a crucial part of Sepik River belief. Crocodiles, or *ngwail* as they are called in Iatmul (Iatmul is the name of a cultural group and its language), are believed to hold up the land that floats on the Sepik River, from which the world started (Dinerman 1981). Fully initiated males in riverine tribes, who were often viewed as crocodiles, "are regarded as those who uphold, maintain, and defend the world, keeping it from disintegration and chaos"

(Dinerman 1981). In this context, the land and men, or masculinity, were one of the same, and, as we shall see, this belief is still upheld today. However, the atmosphere surrounding this belief does not bring pride, but failure today.

Alternate to the masculine qualities of the land, the Sepik River is the embodiment of femininity. According to myth, all life came from the river, similar to the birthing process, and this life continues to be held up by the men who create the ground humanity stands on. The river's perceived fecundity is also said to know no bounds. "The river endures as a principle schema for organizing reality into a fluid state of female flow that men seek to stabilize through their labors" (Silverman 2018).

The lives of the people of the Sepik, unfortunately, are today filled with a sense of neglect and failure. After the *Melanesian Discoverer* was sold in 2006, few tourists have visited the Sepik looking for the art that was once highly sought after. The main Iatmul village of Tambunum, a village in the Middle Sepik region and once one of the most popular tourist sites on the river containing more than 130 houses, is now an unkempt village with only 77 lodgings left. The rest were swallowed by the river (Silverman 2018). The impact of their economic position, combined with the figurative and literal deterioration of the social and physical ground in which they live, has all but crippled the population. It should be noted here that a part of this has to do with the Sepiks' perception of themselves. On one hand, the Sepiks are classically sociocentric; on the other, the Sepiks are also associated with

egocentric selfhood (Silverman 2005). Sepiks see personhood as how they relate to the world around them. Social relations define the person; however, the Sepiks also believe that the desires of the heart have a sense of autonomy that cannot be violated (Silverman 2005). The combination of the decline in tourism, the lack of 'basic services' provided by the provincial government, and the destruction of their ground by the river, has left the Sepiks with a sense of failure, not just from the world around them, but failure in themselves (Silverman 2018).

Due to these failures, some Sepiks have moved inland, abandoning the river that was once central to their way of life. The people of Tambunum are one such group that was considering abandoning their home. To them, this is seen as an absolute defeat due to their traditional view of the inland tribes as being dirty and impoverished because they did not have the river (Silverman 2018). However, due to the presence of logging companies who pay the inland tribes for logging on their land, the inland tribes have begun to be viewed in competing lights. The inland tribes are still looked down on as dirty "new money" peoples, while at the same time, envied for their relations with the outside world. This envy, and the mere thought of abandoning the river, has led many in Tambunum and elsewhere to feel nothing but failure (Silverman 2018). The Sepiks today still sport the title of "Sepiks"; however, at the same time, these people wish to be something else, something "better".

Catalogue – Setup and Methods

The methodology used to complete this project was modeled off of the methodology used in the Porter et al. (2016) study; however, this study was used on lithic artifacts which had no hanging or loose parts. Therefore, the setup changed from artifact to artifact depending on what we felt would give us the best results (Figure 15). The method of photographing the artifacts was the same as the one used in the Porter et al. (2016) study. The artifact would be placed on a turntable that was covered in a green screen. The camera would be positioned on an adjustable stand in line with the artifact and the artifact would be photographed in 30° increments starting at 0°. It was important that the neither the camera nor the artifact changed positions in regard to one another. If either object moved further or closer, the alignment process would be unable to align the photographs properly.

Figure 15: Photography setup used for this project in GVSU's Lake Michigan Hall.

Once the artifact was rotated 360°, the camera was raised a few inches, adjusted to fit the entire artifact in frame, and the process would begin again using 30° increments, starting at 10°. Once the artifact was rotated a full 360° (back to 10°), the camera was raised again, adjusted, and another round of

photos were taken with the artifact starting at 20°. Depending on the size and shape of the artifact, more pictures were taken to ensure full coverage of the artifact.

The background was covered with a second green screen and the area was well lit in order to prevent any shadows. The camera used was a Nikon 3000 DSLR. The flash was disabled, and shutter speed and aperture were adjusted to provide optimal results.

Once the photographs were taken, they were moved into the Agisoft Metashape program. Here, photos went through a masking process, where anything that was unwanted in the final product was “masked out”. Once this was finished, the photos went through a batch process where they were aligned, a dense cloud and mesh were created, and a texture was produced. For each step:

Aligning Photos: In the alignment step, the photos are aligned, providing the program with an idea of what each angle of an object looks like and where it resides compared to the other photos. This also creates a Point Cloud. The quality was set to the highest setting. The two settings “Exclude Stationary Tie Points” and “Adaptive Camera Model Fitting” were selected. The “Remove Stationary Tie Points” setting removed any stationary object in the background from the final model, making masking easier. “Adaptive Camera Model Fitting” helps in adjusting

the parameters of photos to fit the final model. This is used when objects are taken from different angles at different heights. “Exclude Stationary Tie Points” was turned off for the skull rack, which was not rotated during photography.

Dense Cloud: Creates a dense point cloud from the calculated exterior and interior image orientation parameters. Depth maps are calculated for the overlapping image pairs considering their relative exterior and interior orientation parameters estimated with bundle adjustment. Multiple pairwise depth maps generated for each camera are merged together into combined depth map, using excessive information in the overlapping regions to filter wrong depth measurements. Default settings were used, and the quality was set to mild.

Build Mesh: Creates a polygonal mesh using the Dense Cloud and Point Cloud or based on depth maps. Used Default Settings with the quality set to mild. With the skull rack, additional Mesh was inserted between the heads and hands. To fix this, the Mesh was built using depth maps instead of the Dense Cloud. Since there was nothing in this area to begin with, no additional texture was added to this area. Also with the skull rack, the setting “Use Strict Volumetric Masking” was used. This setting removed anything that was masked out, even if

it was in one photo. This is helpful when a large number of pictures are used and when the final model has additional background you want removed. However, because the setting is so strict, great care has to be taken when masking because if any part of the artifact is masked, that portion will be removed.

Build Texture: Creates a texture for the object to give it that "life-like" quality, adding and blending the colors of the object based off of the Point Cloud, Dense Cloud, Mesh, and the light values of these points. The quality was set to high, and the "Hole Filling" and "Ghosting Filter" settings were turned on. "Hole Filling", as the name suggests, helped fill in any additional holes in the model that lacked sufficient data. "Ghosting Filter" was turned on in situations where objects included thin structures or moving objects, which would typically fail to be reconstructed as a part of the model.

Once a model finished processing and looked good, it was uploaded from Metashape to the Sketchfab website with appropriate cultural information. Objects with hanging material, such as the pendant, the boar tusk necklace, and the bilum, were difficult to photograph due to movement of these hanging materials, which would move if the green screen was shifted during rotation.

The belt, Mai masks, and skull rack were special cases. In order to view the inside of the belt and to keep the handing shells in (roughly) the same place, the belt was wrapped around a piece of metal and attached to fishing lines from a turntable (Figure 16). The turntable was rotated, and time was taken between each rotation in order to wait for the belt to stop swaying.

The Mai masks only had their faces photographed. Due to the shape, conditions, and weight of the masks, placing them on their face would have irreparably damaged the objects. Therefore, only the face was photographed.

The skull rack currently hangs in the North stairwell of Lake Michigan Hall, located on Grand Valley State University's Allendale campus. Due to the size of the skull rack and the size of our setup, the skull rack was left on the wall.

Figure 16: Alexander Spindler photographs the shell belt. A turntable is hung upside down with the belt attached by strings

Results and Issues

The project resulted in five completed models created and uploaded to Sketchfab with appropriate cultural information and one incomplete model.

The incomplete model, *Mwai* mask 2, has a model created on Agisoft Metashape; however, the model requires a bit more processing before it can be considered completed. For now, an incomplete 3D model of this object is uploaded to Sketchfab as an example for what these models look like during production.

This project was one of trial and error. Due to the uniqueness of each object, the photography process for each artifact had to also be unique in terms of setup for lights, camera position, and camera settings. Some objects that were taller, such as the ancestral figure and gable statue, saw us placing the camera tripod on top of boxes as to photograph the top of the object.

Although there is no "required" number of photos for a model, the general rule of thumb is to take as many as possible from as many different angles as possible. However, sometimes, even with a considerable number of photos, Metashape has a hard time distinguishing hanging features. Figure 17 shows a failed model of the shell belt and what results from this issue. In some photos, the hanging Conidae shells that adorn the belt line up with each other. This confuses the program, making it believe the

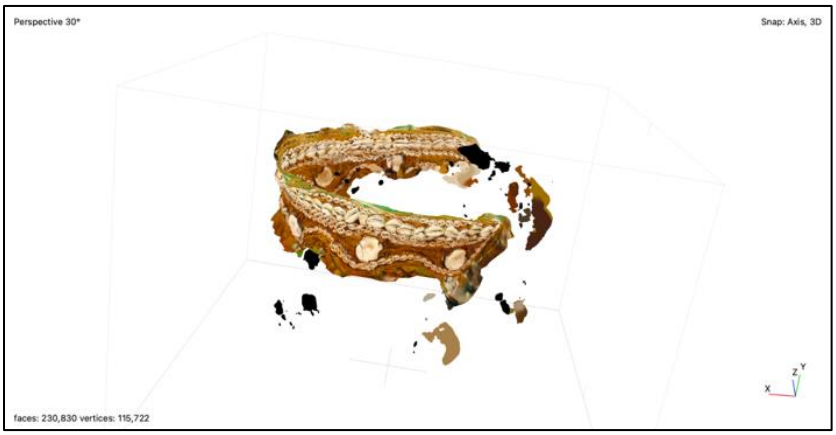

Figure 17: Screenshot of the Metashape file for the shell belt. A combination of inadequate photos and an alignment of the shell strands produces a model somewhat like this

two strands are the same, resulting in one strand in the 3D model possessing multiple strands in one spot. Markers can be added to alleviate some of these misconceptions and differentiate strands from one another; however, when they line up and the markers are next to each other on seemingly the same strand, the program continues to be confused and the same result occurs. Adjusting settings to try and fix this issue ultimately resulted in the removal of the strands by Metashape altogether. In the future, items like the shell belt with hanging parts will have to have extra care taken to ensure enough overlap in the photos as well as a lack of overlap between the strands.

Items such as the pendant also proved to be challenging. The cord of the object could be easily moved during rotation due to any minor shift in the green screen underneath it. Due to the software's general distain for any movement between the object, the camera, and the camera zoom during photography, this resulted in multiple cords showing up in the final model. Again, when attempting to fix this issue, the program simple removed the cord all together (Figure 18). This goes to show how important it is that neither the object nor the camera should move during the photography process. To fix this issue, in future attempts, the cord could be attached in some safe fashion to the green screen to prevent, or limit to an acceptable degree, movement of the cord. It should also be noted that modeling of the pendant was attempted alone. Having assistance with rotating the object is also recommended when photographing.

Another issue we ran into was an inability to fully photography some objects. This was due to either a lack of space in the photography setup or due to the objects condition. The *Mwai* masks are two such examples for restriction due to condition, while the skull rack and ancestral figure are excellent examples of space restrictions. Due to the shape and current conditions of both *Mwai* masks, neither could be placed on its face as it would have resulted in the damage of the artifact. The ancestral figure had issues in a different regard. The ancestral figure, while able to be photographed with the normal setup, could not be laid down to photograph the base, resulting in some missing texture on the bottom. The skull rack had similar issues; however, due to its size, it could not be photographed like the other artifacts and had to remain on the wall.

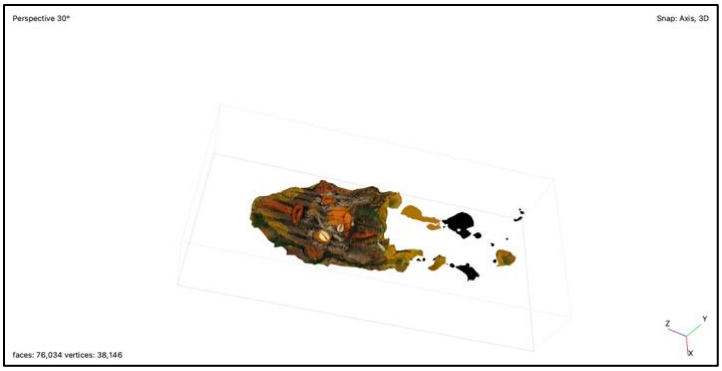

Figure 18: Movement of the cord results in multiple cords appearing in the model. Similarly, to the belt, attempting to fix this issue results in the removal of the cord altogether. This issue can only be corrected by repeating the photo process.

One final issue that we ran into was with the green screens themselves. The green screens were instrumental in providing a solid background for photography and eliminating background noise; however, the neon green color of the screen shows up in most of the models. This can be seen in Figures 16 and 17. Although this can be reduced through masking, the green will often reflect itself onto the model and will not be removable. There are two solutions

to this problem that I am proposing. The first is to attempt to provide more data for Metashape by taking additional pictures of hard to see places while providing the necessary overlap. The second proposed solution is, instead of a green screen, use white sheets to provide background. This way, any seeping into the model will not be as noticeable.

Catalog – Cultural Material

This section includes cultural information about each artifact as well as QR codes for each artifact on the GVSU page of the Sketchfab website. For each object, cultural information and dimensions are provided on the Sketchfab website. Hyperlinks for each artifact are also provided.

Substitute Wooden Head and Skull Rack: A substitute for an overmodelled skull, also known as a *midjangu* or *kaik*. These skulls were typically decorated and were often of identifiable ancestors rather than those taken in headhunting raids as trophies; however, both could receive the same treatment. This association as headhunting raid trophies is a somewhat erroneous one. It

Scan Here to View
Substitute Head

is unknown what proportion of overmodelled skulls were actual trophies, but it is more than likely that the majority held in museum collections today are either ancestral in nature or "souvenir" objects for westerners (Crispin 2015). In regard to ancestral skulls, these heads were kept by the family of the deceased and were typically displayed in the ceremonial house (*ngeko*) on painted racks or in platform-like baskets suspended from the roof of the ceremonial house's upper chamber. The presence of these skulls was important for ceremonial events of initiation, marriage, and the preparation and celebration of headhunting (Crispin 2015). Ritual skulls would be covered in a sort of clay or paste which was called *yimba*. This *yimba* was comprised of three components, each with their own symbolic bodily associations. The first ingredient, some reddish clay, represented blood. The second ingredient, lime, represented sperm. The third ingredient, *ngwaat* or Tigasso oil, represented breast milk. Once these ingredients are mixed and made into the paste, "…it [the paste] is considered a form of potent 'revitalizing flesh'

Scan Here to View Skull Rack

Scan Here to View Skull Rack In-Progress

associated with the female life force, and the skull itself is equated with the male life force due to its hardness, like wood" (Crispin 2015).

This practice came to an end when Australia took control of Papua New Guinea after WWI. Upon hearing of reports of tribal warfare, the Australian government sent a number of expeditions into the Sepik in order to demonstrate the power of the Australian military (Crispin 2015). The Australian government put an end to the use of human heads, so substitutes like the one housed at GVSU were made to represent the head.

The substitute head came with a pole and a base to stand it on. The head has no significant damage on it; however, there is a small piece of wood missing from the front of the head. The skull rack has no noticeable damage to it and currently hangs in the North stairwell of Lake Michigan Hall, located on Grand Valley State University's Allendale campus. The skull rack also has two models uploaded with one complete model and one example.

Female Gable Figure: Known as a *mbwatnggowi*. As a symbol of rebirth, the primal woman figurine sits in the upper story of the men's ceremonial house above the ladder to enter the area where all of the sacred cult objects are stored (Corbin 2002; Craig 2010). The figurine sits with splayed legs, thus, one can only reach the sacred objects and the

Scan Here to View
Female Gable Figure

upper floor between the legs of the figurine (Corbin 2002). These cult buildings, although for men, are classed as feminine "bodies". In some cases, such as the ceremonial house, or *taab*, of the Murik, was seen not as woman, but as a spirit-man (*brag*). The *taab* in this context was seen as a symbolic womb of a pregnant woman as well as a birth house (Craig 2010). A similar gable figure from Kanganaman village can be found in Corbin (2002).

The gable statue photographed has suffered substantial damage. The outside of the wood on its head has begun to deteriorate. This deterioration also exists in the lower portion of its body, which has ultimately led to the loss of the statue's right leg. For photography, the leg was temporarily reattached to the object.

Spirit (*Mwai)* Masks: Spirit, or *Mwai,* masks are imitations of totems in ceremonial occasions, appropriately called *Mwai* ceremonies. (Bateson 1932). These *Mwai* ceremonies, which were reported to have gone on for weeks, "involved several sets of players and dancers…no one would admit knowledge of who was on stage at the time" (Klein 1989). The masks also did not belong to one person but instead a lineage, clan, or moiety, who were responsible for its upkeep and safety. These masks were typically stored in

Scan Here to View Mwai Mask 1

either the cult house or the home of the patriarch of a lineage (Klein 1989). These masks were typically carved pieces of wood that were painted and adorned with grasses, reeds, flowers, feathers, shells, or clay (Howarth 2015; Klein 1989). Mwai Mask 2 is also decorated with the same wave patterns that decorate the skull rack. This stylistic similarity from two different villages with distinctly different art styles is evidence of the interaction between the villages and the impact it had on the art of the region.

Scan Here to View Mwai Mask 2

The two *Mwai* masks photographed both had received substantial damage. The larger of the two, *Mwai* Mask 1, is missing one of its eyes and a significant amount of the clay and shells that once outlined the mask. The nose on this mask is also broken and detaches from the mask with ease. The second *Mwai* mask, *Mwai* Mask 2, is also missing a significant portion of its clay and shell designs and has a substantial crack in its nose. Being in the condition they are further supports the need for digital documentation in the form of 3D modeling techniques. *Mwai* mask 2 has been uploaded as a mid-processing example.

Male ancestral figure: Ancestral figures were the physical embodiment of ancestral spirits, not merely representations. These figures were commonly crafted with enlarged heads, elongated torsos, and shortened limbs. These

human figures also frequently stood in unbalanced poses or with the weight unevenly distributed in the feet (Wardwell 1971). One crucial difference exists between traditional ancestral figures and those made for the tourist industry. Traditional ritual *sacra* – masks, dance costumes, figures, bamboo flutes, etc. – as mentioned before, are the spirits they represent and not mere representations. If a man sees a totemic spirit in a dream, he cannot sell the totem and must instead place it in the cult house. *Sacra* representations produced for tourists are devoid of totemic souls and names and were not carved by the traditionally responsible tribe members (Silverman 1999). Other examples of ancestral figures such as the one housed at GVSU can be found at https://www.art-pacific.com.

Scan Here to View the Male Ancestral Figure

Shell belt, boar tusk necklace, and pendant: Objects such as these were status items to Sepiks living away from the coast. The belt is made of bush fiber cordage and adorned with various shells, specifically carved pearl shells and Conidae shells (Figure 19). Shells, especially pearl shells, were extremely rare for villages living inland and therefore valued as important items of wealth. These shells also held significant religious and ceremonial significance, especially with "…belief systems centered around cycles of procreation, fertility, and growth" (Wilson 2014)

The necklace is made of similar cordage as the belt and adorned with similar shells; however, the centerpiece of this artifact is the circular boar tusk. Used similarly to shells as currency, boars' tusks also served as symbols of aggression, status symbols, and valuables (Beran 2014). Their use is illustrated from nearby contexts, such as in Humboldt Bay area, where they were a symbol of chiefly rank, and in New Britain where, when held in the mouth, made a warrior look more ferocious, like a wild boar. Contexts in the Tami Islands of the Morobe Province saw the tusks used as bride wealth (Beran 2014). These boar tusks have been found and used by people in the East Sepik Province as well as the Sepik Delta (Beran 2014).

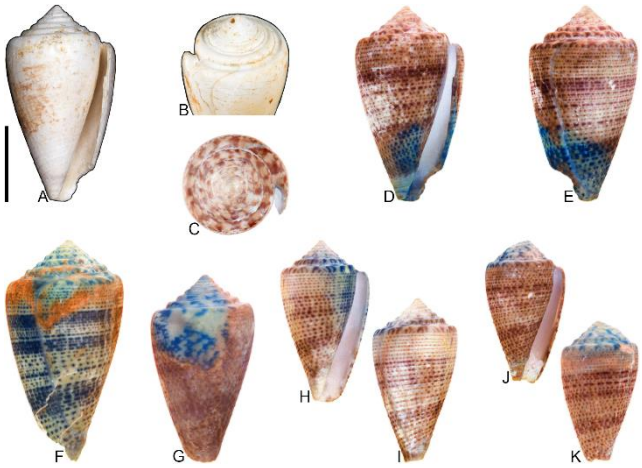

Figure 19: Conidae Shells, commonly used in Sepik art along with pearl shells

The pendant is a somewhat unique piece. Little information was found on this piece, with even fewer examples found. The piece once had clay with shell inlays adorning the forehead. Most of this has fallen off. This pendant is also missing one shell eye. This object was most likely used as a status symbol or for bride price. A similar example of both the pendant and the boar tusk necklace from the Middle Sepik Region can be found in Klein (1989).

Bilum: A flexible looped string bag, or *bilum*, are traditionally made from interconnected loops of bark fibers that were "…handspun into a virtually indestructible two-ply string" (MacKenzie 1991). The most basic form of the bilum, the mouthband bilum, is essentially a mundane, utilitarian object which is used primarily by women of PNG, although not exclusively, in everyday productive, nurturing, and reproductive tasks, such as foraging and even carriers for infants (MacKenzie 1991; Gabriel et al. 2014). Men also use bilum; however, these bilum take on elaborated forms and are used exclusively by the male cult (MacKenzie 1991). The women of Papua New Guinea dominate the production of bilums, specifically mouthband bilums, while the men hang back and rely on the product their female kin create. "In this sense men…are dependent on the technological skills of women…it is not immediately apparent whether…men acknowledge their female kin's craftsmanship… men reclassify these bilums as results of their labor" (MacKenzie 1991). The production of these bilums draws attention to the worldview of the Telefol people, a group of Mountain Ok (*Ok* meaning 'river') people who live in the West Sepik Province. The production of bilums and the type of bilum produced shows that the world of the Telefol is arranged according to sex, age, and historical factors. "The specific features on which each social group focuses to delineate types and varieties of bilum is directly correlated with their practical, every day, bilum related activities" (MacKenzie 1991).

Wicker mask – Similarly to the face pendant, the wicker mask is a somewhat unique piece with very little information on it. The rounded head is

similar to that of a yam, a common crop grown in the region. This mask may have been made to represent that of a yam, a common representation also made by many Sepiks (Crispin 2015). It was most likely used in rituals.

Steering Paddle – The canoe is the primary mode of transportation in the Sepik region, but like all things in the Sepik Region it serves a symbolic purpose as well. Today, oars are not commonly used for canoes. Instead, men affix motors to the backs of their canoes and even feel diminished if they do not possess a motor and must rely on others to haul cargo or provide transport along the river (Silverman 2018). This shift from oars to motors for canoes is telling of the Sepiks' attempt at modernity and to be a part of the outside world. The diminished feeling men receive when they do not have an oar is evidence of this. Because they require assistance from others to transport cargo by canoe, one could say they do not offer anything to others and therefore they view themselves as nothing.

Large canoes are associated with men and male personhood in terms of the memory of past warfare and in relation to the ongoing practice of carving spirits into these canoes. In contrast to large canoes, small canoes are associated with women and therefore children, food, and motherhood (Silverman 2018). All canoes, especially the larger canoes, are associated with crocodiles and crocodile spirits and men typically associate canoes with the male phallus in contrast to the feminine waters (Silverman 2018). In contemporary contexts, old canoes are cut and used as coffins. This is a

modern custom practiced by the Sepiks that can be attributed to Catholic decorum and colonial sanitary standards (Silverman 2018).

Moving Forward

This project set out to model all twelve Papua New Guinea artifacts housed at the Grand Valley State University's Anthropology Department. Due to the learning process involved with Agisoft Metashape and the photography setup as well as challenges with photographing each object, only five of the original twelve objects were fully modeled and disseminated on Sketchfab. Despite the failure to produce models of all twelve artifacts, this project adds yet another example for the importance of photogrammetry in cultural heritage preservation and dissemination. Artifacts such as these housed in university and museum archives are important sources of ethnographic and cultural information that may not be around in the distant (or near) future. Techniques such as photogrammetry are instrumental in the preservation of these artifacts and the cultures they represent.

Future students are encouraged to continue my research and to continue to model, not only the remaining Papua New Guinea artifacts, but also other artifacts housed in the GVSU Anthropology Department. These future projects will be instrumental in the development of archaeological theory and method, cultural history preservation, and the furthering of human knowledge.

Acknowledgments

I would like to thank the Grand Valley State University Anthropology Department for allowing me to conduct this project with additional thanks to Dr. Mark Schwartz and Wesley Jackson, who helped me with this project from start to finish. I would like to thank the GVSU Art Gallery for assisting us with the skull rack photography. I would like to thank the Center for Scholarly and Creative Excellence for assisting us in purchasing the Metashape software. I also want to thank my family and my friends who have supported me through all of my academic and personal endeavors.

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