Winterthur/University of Delaware Program in Art Conservation

Conservation Examination Report and Treatment Proposal

Owner: Penn Museum
Accession #: ACP 1933.3, 19857
Object: Mask

Artist/Maker: Artist, once known
Place of Origin: Japan
Period: Edo Period (uncertain), Meiji Period (uncertain)

Object Date: 1800 - 1897
Materials: Wood (gymnosperm, hinoki cypress?), lacquer, metallic leaf
Dimensions: 23 x 16.5 x 9 cm (H x W x D, overall)

Distinguishing Marks: *Kakihan/kao* (書き判 / 花押) signature on the back of the mask.

Reason for Treatment: Stabilization for storage and display.

Examined By: Daisy Diamond (Graduate Fellow, Winterthur/University of Delaware Program in Art Conservation [WUDPAC], Class of 2026)

Consulted:
Lara Kaplan (Objects Conservator and Affiliated Assistant Professor, WUDPAC)
Lauren Fair (Conservator and Lab Head for Objects Conservation, Assistant Director of Conservation, and Affiliated Associate Professor; WUDPAC)
Kathy Gillis (Elizabeth Terry Seaks Senior Furniture Conservator and Affiliated Assistant Professor, WUDPAC)
Stephen Lang (Keeper of the Asian Collection, Penn Museum)
Julie Lawson (Elin Danien Conservator, Penn Museum)

Proposal Date: 10/14/2024

Description

Overall

This dark red lacquered wood mask portrays an angular face with a snub nose and two large, upwards facing tusks on either side of four rectangular teeth on the top jaw. The lower jaw includes smaller teeth and two smaller upwards facing tusks. The features are symmetrical vertically. Carved curvilinear recesses emphasize the furrowed forehead as well as creases near the jaw and eyelids. The eyes and nostrils have carved holes of 1-1.5 cm, and gouged regions of negative space in the mouth distinguish the upper and lower jaw.

Surface

The lacquer is composed of multiple layers, beginning with a white, fine-grained, and evenly applied approximately 0.10-cm ground layer with no visible fibrous material. A thin red-orange, slightly translucent layer covers the ground and a dark red, evenly-applied lacquer layer follows (fig. 1). Hand painted individual black and white layered lines compose the eyebrows and mustache; and a golden metallic coating covers the teeth, eyes, and tusks (figs. 2-4). A finishing layer is not detectable with visible inspection alone. However, there is a slight glossy sheen to the surface.

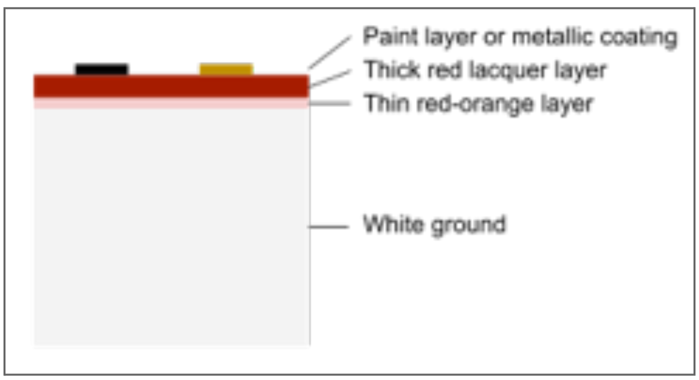

Figure 1. Approximate cross section illustration of lacquer layer.

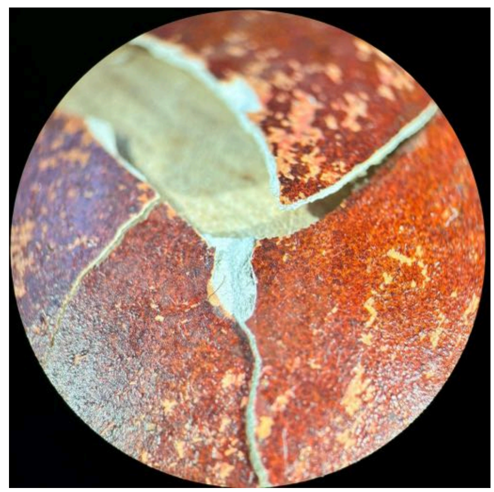

Figure 2. Lacquer layers visible in central forehead crack, 100x magnification.

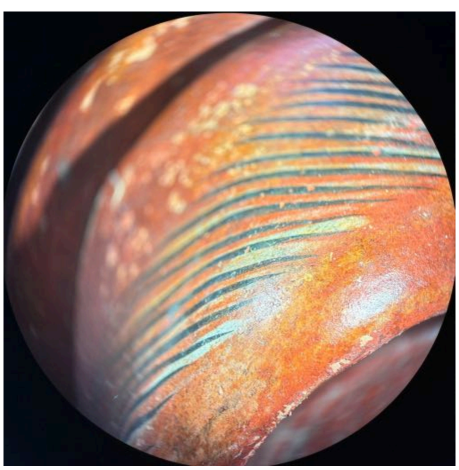

Figure 3. Hand painted black and white lines, proper right (PR) eyebrow, 64x magnification.

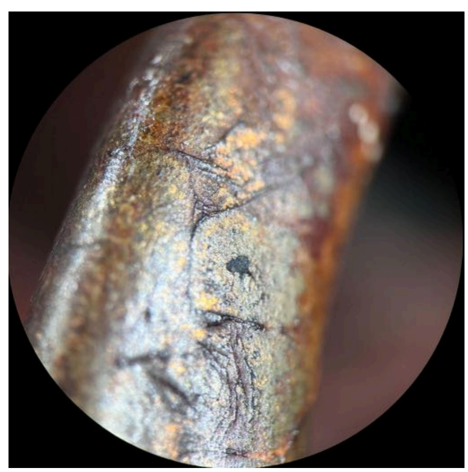

Figure 4. Metallic coating, PR tusk, 160x magnification.

Substrate

The wood is carved from a single block with a thickness ranging from approximately 0.5 to 6 cm. The wood is light brown with visible growth rings and no discernable vessels or resin canals (fig. 5). The absence of these qualities indicates a gymnosperm species, potentially the hinoki cypress (see “Materials and Manufacture” for additional information). The grain is oriented horizontally with the mask with radial and tangential cuts dependent on the slope of the mask. The reverse of the mask does not appear to have lacquer applied. Chisel marks are visible on the back, as well as in areas of loss on the front. There are two 0.3 cm holes near the back edge of the mask in line with the eyebrows, where string was likely formerly attached. The signature kakihan/kao (書き判 / 花押) is burned into the upper proper left (PL) of the back of the mask (see “Significance and Cultural Context” and “Appendix I: Glossary” for additional information). There is a dark, smooth material with an apparent weave structure applied to the center of the back of the mask and surrounded by a darkened substrate (fig. 6).

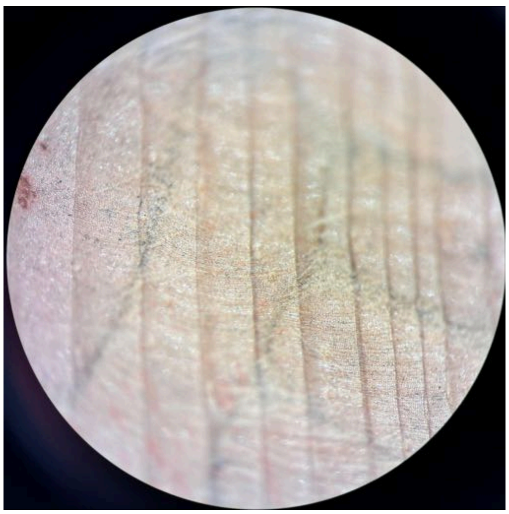

Figure 5. Gymnosperm, 160x magnification, back of mask.

Figure 6. Dark applied material, back of mask.

Significance and Cultural Context

This mask would have been worn on the front of the face and is thought to be part of a *Bugaku* (舞楽) dance ensemble. Bugaku is a traditional Japanese court dance that draws on influences throughout Asia. As described by Japanese art historian Kyōtarō Nishikawa through a translation by Monica Bethe, performances like Bugaku were early cultural imports to Japan “[d]ue to the Confucian precept that musical harmony fostered political harmony and thus was indispensable to court functions” (1978, 20). Bugaku dates back as early as 500 C.E. and is accompanied by orchestral court music, *Gagaku* (雅楽), consisting of percussion and wind instruments. The progression from slow and simple music and dances to fast and climatic ones is known as *jo-ha-kyū*. Later Japanese dances and drama, such as *Nō* and *Kabuki,* are built upon this fundamental jo-ha-kyū theory. The story elements of these performances are often more abstract: over time, associated narratives sometimes became more varied and contradictory. Now, the story elements are perceived more as a “mood of the dance,” rather than plot summary (Bethe and Nishikawa 1978, 13-15, 19).

Bugaku dancers wear complex ensembles consisting of brilliant garments and elaborate headgear. Masks are an important component, since the characters they represent are activated by a “roll of the head [that] brings the mask to life” (Bethe and Nishikawa 1978, 13). Variance in expression and facial structure of the masks evokes the emotional state of the dance (Bethe and Nishikawa 1978, 15, 19, 31-32). Exaggerated expressions with stylized, dimensional wrinkles and flesh are common; however, forms can vary from quiet human faces to bestial characters.

Powerful masks such as ACP 1933.3 are featured in dynamic dances performed towards the end of the jo-ha-kyū sequence. One such example, *Nasori*, is a likely candidate for the type of dance this mask was used in.[1] Performed as early as the eighth century, Nasori is a victory dance and includes quick, free-flowing movements emulating two dragons at play and is still performed to this day (Bethe and Nishikawa 1978, 34, 113, 125).[2] Nasori masks were often danced by two as a partner dance. Its widespread popularity resulted in paintings of the performance and many examples of the mask, some with movable eyes (*dougan*, 動眼), a dangling chin, and tufts of animal hair (figs. 7-9) (Bethe and Nishikawa 1978, 114, 125; JAANUS 2024). ACP 1933.3 is somewhat unusual as it doesn't have a separate chin piece and is red, while other Nasori masks are typically blue or green.

Figure 7. "Bugaku mask of the Nasori type" (舞楽面　納蘇利). 17th century (Edo period). Image courtesy MFA Boston (11.6117).

Figure 8. Selection of "Bugaku Dance: Nasori" (納曾利図), Tanaka Totsugen (1767–1823). Early 19th century (Edo period). Image courtesy MFA Boston (11.4818).

Figure 9. Nasori (dance of the right) performed at Gagaku Theater, Imperial Palace, Tokyo. Image courtesy Masatarō 1971, 14.

Bugaku was placed under government protection during the Edo period and older masks were carefully copied, reviving painting and carving techniques used in the Heian period. Because Bugaku masks have (or had) active use-value, wear and tear or repairs and replacements of historic significance may be evident (Appelbaum 1987, 11; Bethe and Nishikawa 1978, 16). For example, sometimes flaked coloring was repainted, interior inscriptions erased from sweat were re-written, and dancers re-carved the interior of masks to fit contours of their face more comfortably (Bethe and Nishikawa 1978, 142). Inscriptions are frequently made on Bugaku masks and include the date, name of the sculptor, name of the client, name of the mask, the number of dancers in the piece, and/or the date or repair. Typically, inscriptions are written on the back with black sumi ink if unlacquered or red lacquer or paint if there is a *kataji* priming (see: Materials and Manufacture). Less commonly, inscriptions are incised and then painted over (Bethe and Nishikawa 1978, 152). ACP 1933.3 has a kakihan/kao (書き判 / 花押) signature on the back of the mask that would benefit from

[1] ACP 1933.3 was previously described as a mask for "bungaku" depicting "Kan Joraku" (likely referring to Bugaku and Genjouraku, 還城楽), but the Nasori designation seems more likely following additional research (Stephen Lang, email message to author, October 3, 2024).

[2] In 1971, choreographer and dance scholar Carl Wolz compiled research from an extensive study of *Bugaku*, including notions of the basic positions and movements of Nasori (120-146). He described dances with Labanotation, a notation system used to describe direction, spatial orientation, duration, temporal patterns, and dynamic quality of movement as prevalent in dances across cultures.

investigation by someone with expertise in Japanese dance masks. This kakihan/kao is similar to ones on other masks in the Penn Museum Collection (Stephen Lang, email message to author, October 3, 2024).

This mask was purchased from G. T. Marsh & Co., a company founded in 1876 specializing in the sale of Japanese Art in San Francisco, by Mrs. Phoebe A. Hearst. Mrs. Hearst was a collector and philanthropist of art, archaeology, and anthropology. She subsequently donated this Bugaku mask alongside at least fifteen other examples to the Penn Museum in 1897.

Materials and Manufacture

The wooden substrates of Bugaku masks could be carved from a single block of wood (*ichiboku*) or pieced together in sections (*warihagi*). Varieties of Japanese cypress, *hinoki*, were standard for masks after the Nara period, though provincial masks used more varied woods, including *hō* (*Magnolia hypoleuca*), *katsura* (*Cercidiphyllum japonicum*), and *kaya* (*Torreya nucifera*). During carving, the back and front are simultaneously shaped with corresponding concavities on both sides. Curved chisels are used to gouge out the back and slightly rounded carving knives thin the mask and smooth the surface, as evidenced by the tool marks on the back of the mask. Holes are gouged at the eyes, nostrils, and mouth with potentially similar methods (Bethe and Nishikawa 1978, 16, 142, 144).

Lacquer has been produced from the sap of Anacardiaceae family trees in East and Southeast Asia for thousands of years, with the earliest examples originating in China and later examples produced in China, Japan, Korea, Thailand, Burma, Cambodia, Laos, and Vietnam.[3] The importance of lacquer in Japan is evident in its wide range of uses since the Jomon period (4000 to 400 BCE); including bows and arrows, bowls, combs, and goblets in the earliest examples and jewelry, pottery jars, plates, armor, vessels, and non-wooden substrates in later examples (Webb 20003; Kuraku 1985, 45). Lacquers polymerize through enzyme-catalyzed oxidation, which results in cross-linked, glossy films (Williams 2008, 8; Webb 2000, 1; Schellmann, 2011, p. 38).

The finishing and painting of the lacquer layer on Bugaku masks wass typically completed in three stages: priming, painting, and coloring. Priming was completed to harden, smooth, and preserve the substrate. Nishikawa describes the process:

> "The hard prime (*kataji*) can be of many kinds, although it is usually made of *sabi urushi*, which is obtained by mixing fine wheat flour with lacquer and then adding *tonoko* (a powder made from impure clay). In some cases, in order to strengthen the surface further, the mask is pasted over with hemp cloth, using lacquer as a binding agent, before the *sabi urushi* is painted on. Such primings are applied to both the front and the back surfaces of the mask, though at times the cloth layer is applied only to the back to protect it from abrasion by the dancer's face" (1978, 145).

After the ground was established, the back may have been finished with a layer of black or brown lacquer and the front was coated with preparatory layers of smooth, sanded down kaolin. A final application of earth pigments could cover the surface, potentially followed by polishing to accentuate smooth surfaces. Details, such as hair, may have been applied with black lacquer. For the eyes, teeth, and tusks of Nasori masks, gold leaf was typically applied over a coat of a special lacquer that acts as a binding layer (Bethe and Nishikawa 1978, 145; Kuraku 1985, 47). Metallic layers have also been created with powders and foil (Webb 2000, 47). The methods used to create Bugaku masks employ similar carving, priming, painting, and inscription techniques as Heian and Kamakura period Buddhist, Shintō, and secular portrait sculptures (Bethe and Nishikawa 1978, 16, 142).

[3] The major types of Anacardiaceae polymers are commonly referred to as *urushi*, *laccol* and *thitsi* from *Toxicodendron vernicifluum* (formerly *Rhus verniciflua*), *Toxicodendron succedaneum* (formerly *Rhus succedanea*) and *Gluta usitata* (formerly *Melanorrhoea usitata*). Urushi is most commonly used for Japanese lacquer (Veenhoven et al. 2023, 4).

Condition

Summary

The lacquer layer of the mask is in poor, unstable structural condition and fair aesthetic condition with losses, delamination, and cracking associated with dimensional distortion (fig. 10). The wooden substrate is in good aesthetic and structurally stable condition.

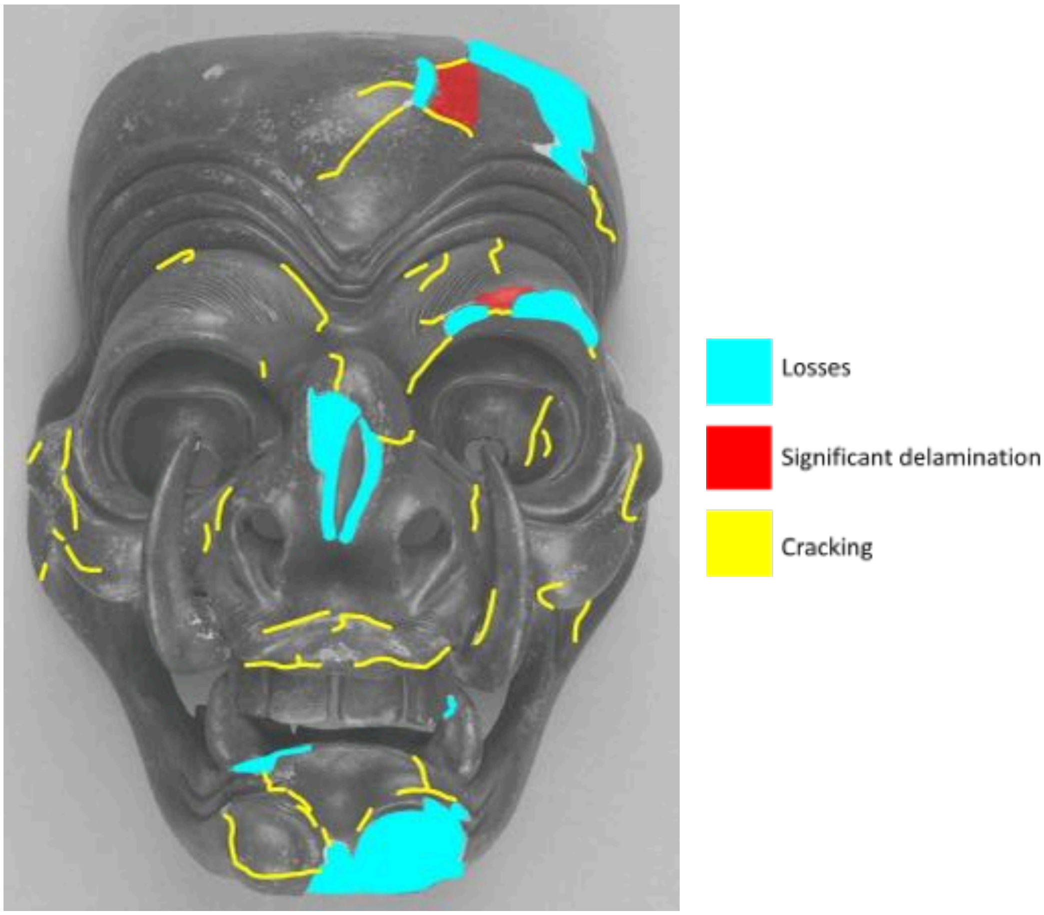

Figure 10. Condition diagram, overall front.

Surface

In seven prominent areas of the mask, there are losses to the lacquer layers ranging from 0.5 to 5 cm in length. The abrasion and losses on the nose of this mask is consistent with commonly observed damage to masks. Delamination occurs along cracks at the interface between the wooden substrate and white lacquer layer with dimensional distortion resulting in 0.1-0.3 cm gaps. The bright red and thin red-orange lacquer layers are well-adhered to the white ground layer. The dimensional distortion is most prominent in the two forehead losses. Delaminating layers are also unable to lie flat due to the shrinkage of the wooden support at the PR eyebrow. Generally, the lacquer layer is still somewhat flexible when gentle pressure is applied; however, the lacquer layer is vulnerable to mechanical damage since there is still overall embrittlement and a high risk of introducing new cracks. Overall surface cracks range from 0.5 to 5 cm. The central forehead loss and associated cracks are consistent with radial cracking from impact. Cracks around the base of the PR tusk may have been initiated when the wooden tusk substrate was loose.

Chemical degradation has occurred in the lacquer layer, likely resulting in increased susceptibility to damage. Photooxidation and thermal degradation of lacquer result in decreased polymer degree of polymerization, increased water solubility, fading, and fine network crack formations (Webb 2000, 54). The outer red lacquer layer has microscopic cracking patterns that generally are stable, but with some areas of loss consistent with abrasion or overcleaning potentially related to these increased sensitivities.

The metallic applied coating is in good condition, with some areas of tenting and darkening, potentially related to a corrosion product (fig. 4). This darkening can be considered a patina of the object, consistent with its lifespan and age (Webb 2000, 67). There are several small translucent white inclusions with a waxy appearance on the metallic surfaces (fig. 11). In most areas of abrasion, only the outermost red layer is absent and the translucent orange-red layer is still present. In contrast, areas of metallic coating have complete loss that reveals the ground layer in areas of abrasion in addition to abrasion to the translucent orange-red layer (fig. 12).

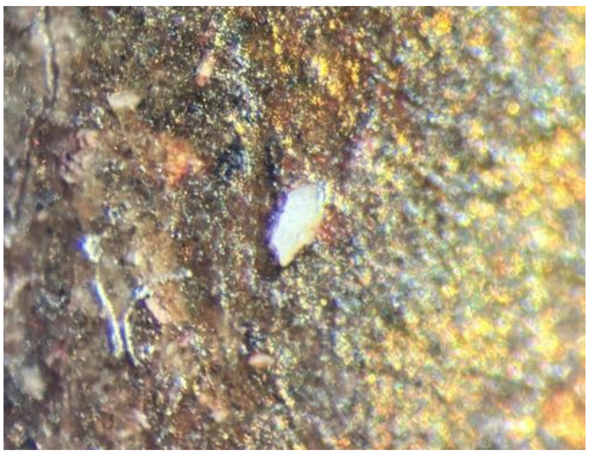

Figure 11. White inclusion, left tusk, 400x magnification.

Figure 12. Abrasion in the metallic coating to the white ground area, left tusk, 64x magnification.

There is not notable overall soiling, but some recessed areas of the front have minor grime. 5-10 small, white fibers are snagged within the lacquer layer, likely from a cotton swab used in prior conservation treatments. A small stain with a tideline is present on the upper PL of the forehead. Additionally on the forehead, there is an applied sticker which reads "5670/boc." (fig. 13). This sticker may be related to the sale of this mask by G.T. Marsh & Co. and was likely applied pre-1900. As this adhesive is aged and lacquer becomes more sensitive over time, attempts to remove this sticker would likely damage the surface. One previously detached ½ cm lacquer flake on the chin is re-adhered at an askew angle.

Figure 13. Applied sticker and tideline stain on the lacquer layer. Adhesive residue with associated darkening on the wooden substrate.

Substrate

The wooden substrate has undergone dimensional changes over time as the loss of bound water resulted in shrinkage. Since the lacquer layers change dimension at a different rate from the wood, stress at the interface causes delamination and impacts the re-alignment of lacquer to the substrate (Webb 2000, 54). On the front, visible through losses in the lacquer layer, there are adhesive residues on the wood potentially from prior treatment on the PL of the chin, PR of the nose, and at the upper center of the forehead. These residues darken the wood, accentuating a non-uniform appearance. Tusks described as loose in the 1980s are stable at present.

Losses, checks, and surface residues are present on the back of the wooden substrate. A minor chip, approximately 1 x 0.5 cm, is present on the upper PR of the back of the mask. There are three checks on the back consisting of a 2 cm meandering check on the upper PL, a 2.5 cm meandering check on the PL upper lip, and a 1 cm check on the PL lower set of teeth. There is an applied black accession number “19857” between the nose and mouth of the back with no barrier layer notable in visible or UV light. There are additionally two stickers layered on top of each other, with the most outer one hand-labeled with a black “b” or upside-down “2.” Additionally, there is historic evidence of use in the form of residues and stains (fig. 14).

Figure 14. Historic evidence of use in the form of residues and stains.

UV Examination

Under UV examination, the lacquer layer applied to the front of the mask has variable fluorescence (see Appendix III: Before Treatment Photography, fig. 21). In select regions, a darker red fluorescence corresponds to the thin red-orange layer and a white-purple fluorescence corresponds with the thick red lacquer layer (see fig. 1). However, this trend is inconsistent and difficult to interpret. It may be related to lacquer degradation, effects of surface soiling, and/or previous treatment such as consolidation, inpainting, or a coating. It is worth noting that lacquer objects produced in Asia typically fluoresce with increasing intensity in proportion to the extent of photodegradation (Webb 2011). The adhesive on the exposed wood on the chin fluoresces a pale, opaque orange. The adhesive on the exposed wood of the forehead fluoresces translucent blue-gray.

This indicates different adhesives were applied following losses. The applied metallic layers absorb UV light and the dark painted lines on the eyebrows fluoresce a translucent blue-gray. The wooden substrate visible on the back of the mask has select areas of fluorescence. The exposed wood appears a pale orange. The darker central area absorbs UV light and fluoresces orange-red. Some areas of residue or repair material fluoresce bright white, particularly in the nose, PL cheek, and PR of the mouth.

Previous Treatment

This mask was cleaned with a gentle brush and 1:1 deionized (DI) water and ethanol and consolidated with 1:1 methyl cellulose and gelatin in 3:2 ethanol and water at the Penn Museum in the 1980s. Results from available records are summarized below (table 1). Conservation treatments completed on similar masks at the Penn Museum are detailed in "Appendix II: Penn Museum Treatment Records (Related Masks)."

Table 1. Penn Museum Treatment summaries.

Year	Observations	Treatment
1981	All three lacquer layers were noted to be brittle and delaminating. Covered in dirt and grime. Tusks loose.	Gentle brush cleaning resulted in small losses.
1983	Red paint and ground were noted as somewhat soluble in water and ethanol. The "varnished top paint layer" was stable. Tested consolidation adhesives with brush application: 1. Methyl cellulose in water; 2. Equal parts methyl cellulose and gelatin in 1:1 ethanol and water; 3. Equal parts methyl cellulose and gelatin in 3:2 ethanol and water.	Consolidated all of the mask with 1:1 methyl cellulose and gelatin in 3:2 ethanol and water. Tacked down delaminating flakes with a heated spatula at 100°C. Lifted flakes were noted to not flatten, but adhere well. Cleaned surface with 1:1 DI water and ethanol with swabs. Paint was noted to be water-soluble and not much dirt was removed. Consolidated areas were affected by cleaning and needed to be re-consolidated.
1989	Similar to the 1981 condition. Some flakes out of place. Ground layer was noted to be lifting more.	None.

Handling Notes

Gloves are imperative during handling and treatment to protect the highly moisture-sensitive lacquer surfaces. Hand oils are destructive to lacquer as finger and handprints can etch into lacquer surfaces (Williams and Strahan 2008, 111, 231, 240). Additionally, gloves reduce hygroscopic and abrasive dust and grime deposits.
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Purpose of Treatment

The purpose of this treatment is to stabilize the delaminating lacquer for display and handling. This will reduce the risk of further damage due to the brittleness and vulnerable edges of the lacquer layer. Additionally, this structural treatment will help re-establish aesthetic legibility by decreasing the visual prominence of condition concerns. To maintain educational value, minimal aesthetic compensation will be pursued to preserve the visibility of lacquer layers.

Treatment Proposal

1. **Carry out pre-treatment examination and photo documentation** (*completed, 2 hours*).

2. **Conduct additional analysis to further clarify degradation concerns and preservation approaches** (*est. 5 hours*).
    - Evaluate the applicability of conducting pyrolysis-gas chromatography-mass spectrometry (Py-GC-MS) to establish whether lacquer has been used in the formulation of the ground coating. The Py-GC-MS results will inform treatment, as grounds formed without lacquer are typically weaker (Webb 2000, 25). This will additionally identify the lacquer species, drying oils, and additives.
    - Conduct X-radiography to evaluate stability and shrinkage of the wooden substrate.

3. **Complete gentle surface cleaning in areas of loose dust and debris** (*est. 1 hour*).
    - Use a hake brush, cosmetic sponge, or air blower after evaluating efficacy and presence of fine scratches under a microscope (Williams 2008, 31).

4. **Reattach delaminating lacquer** (*est. 15 hours*).
    - If necessary, locally humidify and flatten lacquer layers with damp blotter paper suspended near the surface to align lifting lacquer in plane with the wooden substrate. Ensure relative humidity is not so high that moisture accumulates on the surface. The lacquer has a memory and tends to curl back to the original position or break if layers are delaminating significantly (Webb 2000, 79).
    - Conduct solubility testing on the white ground layer to inform adhesive selection for consolidation and materials for completing fills. Solvents will only be used as conservatively as possible as the solubility and stability of photo-oxidized lacquer layers results in significant material sensitivity (Julie Lawson, email message to author, November 13th, 2024).
        - Test DI water, 3:1 DI water:ethanol, 1:1 DI water:ethanol, ethanol, acetone, and Shellsol D38.[4]
    - Select a compatible matte adhesive following testing. Options could include:
        - 15-25% Paraloid B-72 (in ethanol, acetone, etc.) or isinglass (in water).
        - If the ground layer is determined to have no lacquer content from Py-GC-MS or is determined to be dry and powdery, a stronger consolidant or wetting agent could be used. Stronger consolidants could include hide glue or Paraloid B-48N.[5] Wetting agents, such as ethanol, would aid penetration. Ethanol can be brushed or injected into the ground prior to adhesive application with injection underneath flaking layers.
        - Any squeeze out should be removed immediately to prevent staining and only small areas should be consolidated at a time. If too much adhesive is applied at once, the substrate could swell, the lacquer could soften, or surface staining could occur (Webb 2000, 80-83).
    - Apply controlled pressure when adhering lacquer layers into position. A potential restraint method could be flexible sticks braced against a frame to provide clamping pressure with the Japanese *shimbari* technique (Bainbridge et al. 2015, 65).

5. **Reattach extant lacquer fragments as possible** (*est. 4 hours*).
    - Use aforementioned adhesives and methods. Consider varied weighting techniques, as less pressure may be required to reattach fully detached fragments.
    - If possible, reverse the adhesive used on the askew fragment on the chin and reattach it in plane.

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[4] For Paraloid B-72 in more quickly evaporating solvents (i.e. acetone and ethanol), the resin remains closer to the bond interface and develops tack more quickly, which can be useful for adhering delaminating lacquer. However, these polar solvents also pose risks to degraded lacquer (Williams 2008, 35).

[5] However, the higher molecular weight and stoichiometry of B-48N makes it more rigid and difficult to reverse than B-72 or other PVA resins. Paraloid B-72 diluted in the slow-evaporating xylene would also provide good penetration for these porous ground layers (Williams 2008, 35).

6. **Selectively apply a barrier coat to seal exposed areas of the wooden substrate** (*est. 1 hour*).
    - Conduct testing of 5-15% Paraloid B-72 in varied solvents (ethanol, acetone, etc.) to evaluate efficacy and extent of substrate darkening.

7. **If deemed necessary and in consolidation with the curator, complete fills and inpainting** (*est. 15 hours*).
    - Tented or lifted lacquer that cannot be flattened due to substrate shrinkage could be supported with a fill of Paraloid B-72 and microballoons.
        - The following combinations could be tested: 40-50% B72 in 1:1 acetone and ethanol or 10% Klucel G in ethanol, one part resin to two parts microballoons by volume (Webb 2000, 90).
    - Evaluate appropriate fill materials and approaches. For larger areas of exposed wood, the fill must not be overly hard, dense, or rigid. Plaster, polyester, and epoxy would cause additional stress to the lacquer as the substrate changes with humidity fluctuations and becomes loose, often cleaving original surrounding lacquer with it. The aforementioned seal would be a sufficient barrier layer. The approach to fills could include the following:
        - 6-8% PVA AYAF[6] with calcium carbonate in deionized water or a low molecular weight poly(vinyl alcohol) with a high degree of hydrolysis (Webb 2000; 66, 87-91; Williams 2008, 35).
        - Removable fills could minimize solvent contact and be more highly reversible (Julie Lawson, email message to author, November 13th, 2024). Potential options could include Paraloid B-72 putty or cast films or Klucel G with an Asian paper barrier layer. Bulking agents could include paper pulp, fumed silica, kaolin, or glass microballoons.
    - Complete inpainting of fills with Golden Fluid Acrylics and Acrysol WS-24 or other conservation grade materials to match the gloss, color, and translucency of the lacquer.

8. **Complete post-treatment photodocumentation and treatment report** (*est. 6 hrs*).

Total estimated time: 53 hrs

Daisy Diamond Daisy Diamond **Date:** 12/2/2024

Conservation Student, WUDPAC

Lara Kaplan Lara Kaplan **Date** 12/4/2024

Supervising Conservator, WUDPAC

Julie Lawson [See email approval from 12/2/2024] **Date:** 12/2/2024

Elin Danien Conservator, Penn Museum

[6] The relatively lower T_g of PVA AYF in comparison to other acrylic resins results in a more flexible film at room temperature with no notable difference in flexibility. Additionally PVA resins are more readily reversed in solvents (Williams 2008, 35).

Conservation Treatment Report

Additional Observations

Although described as lacquer, the red applied colorant raised some questions for conservators and conservation scientists due to the bright white color of the ground layer (Asian lacquers often have more coarse and brown ground layers) and the depth of the red color (Maria João Petisca, personal communication, April 4th, 2025; and Catherine Matsen, personal communication, February 21, 2025). Future investigation with Py-GC/MS of the applied colorant would be helpful for clarifying the material understanding and associated vocabulary of this mask. Due to time constraints, Py-GC/MS of the colorant layer was not possible as part of this treatment.

Additionally, the staining at the chin and forehead are consistent with sweat stains on similar masks and indicate that this mask was actually used, and not necessarily created for export. However, during the late Edo period, westerners began purchasing Japanese cultural heritage and export objects did become more common (Linsly Boyer, personal communication, January 16th, 2025).

Treatment Summary

Structural integrity and aesthetic legibility was improved following treatment. The mask was cleaned with dry methods, exposed wood was sealed with tengucho paper and Butvar B-98. Lifting lacquer was consolidated with rabbit skin glue with the shimbari method. Reversible fills were created from bulked Paraloid B-72 and Flügger. Fills were inpainted with Gamblin Conservation Colors and QOR watercolors.

Treatment Steps

1. **Carried out pre-treatment examination and photo documentation (2 hours).**
2. **Conducted additional research prior to beginning treatment (6 hours).**
   - Conducted consultations with Jennifer McGough, Ancient Egypt and Nubia Galleries Project Conservator at the University of Pennsylvania Museum of Archaeology and Anthropology (January 14th, 2025), and Linsly Boyer, Associate Objects Conservator at the Museum of Fine Arts Boston (January 16th, 2025), greatly informed the treatment protocol. These conversations were particularly informative for constructing and employing a shimbari set-up (refer to “Appendix Appendix VII: Shimbari for Lacquer Consolidation” for additional information).
   - Visited the Penn Museum to visually examine similar Bugaku masks, some of which had previously been consolidated and losses were filled: 19856, 19858, 19864, 19868, 19870, 19863, and 19869 (November 15th, 2024).
     - This was particularly helpful for evaluating different fill approaches completed in the past on similar masks in the collection. There were three approaches to the extent of aesthetic integration of fills: some masks had white fills that were entirely non-integrated (fig. 15), some had solid color fields that bridged materials (fig. 16), and some had extensive color and texture inpainting attempts (fig. 17). These approaches were occasionally used in combination on different regions of the same object (fig. 16-17). Some fills exhibited lifting and cracking.
     - Stephen Lang, Keeper of the Asian Collection at the Penn Museum, stated that the white fills and extensively integrated inpainting approaches were visually distracting. He suggested pursuing solid color fields as a more subtle, but easily identifiable approach that would not require potentially problematic speculative inpainting required for matching texture and surface

variation. Gradients for visual integration were determined to be appropriate (Stephen Lang, email communication, April 30 and May 14, 2025).

Figure 15. Non-integrated fills on Penn Museum 19868.

Figure 16. Minimally integrated solid color inpainting on Bugaku mask 19858.

Figure 17. Extensively integrated inpainting on Bugaku mask 19858.

- Conducted a consultation with Jeff Kaplan, Interdisciplinary Artist and Dance Historian (November 14th, 2024), to learn more about the history of Bugaku and the preservation of performance (refer to "Appendix VIII: Self-Reflexive Report Reflections" for additional information).

3. **Conducted additional analysis to further clarify degradation concerns and preservation approaches. Refer to "Appendix V: Pyrolysis Gas Chromatography Mass Spectrometry (Py-GCMS)" and "Appendix VI: X-Radiography" for instrument specifications, results, and interpretation (6 hrs).**

   - Py-GC/MS indicated that no lacquer was present in the ground layer in the two samples analyzed. Additionally, drying oils composed the majority of the sample. Blood and glue were also detected as adhesive materials. Variance between the two samples is not statistically significant .

   - With X-radiography, the grain structure of the wood and woven material can be visualized for greater depth. While exposure to X-rays can disrupt the accuracy of Carbon-14 dating or radiocarbon dating techniques, these methods cannot distinguish between objects made in more recent history such as the 1700s-present (Curnow 2021, 18).

4. **Completed gentle surface cleaning with a hake brush, air blower, and cosmetic sponge[7] (0.5 hours).**

   - Barely any dirt was removed from the front of the mask, with the exception of gray dust reduced from the exposed wood in areas of loss.

   - On the back of the mask, gray dust was also reduced from the non-lacquered surfaces. In areas with evidence of use or dark applied material, cleaning included only one pass with the cosmetic sponge to maintain evidence of use. Three passes of the cosmetic sponge were used on other areas of exposed wood.

[7] Marketed as a make-up applicator, these soft sponges, made of non-latex polyurethane foam, are ideal for safely removing dust and dirt from fragile surfaces. Spot tests performed in 2015 showed the sponges in the objects lab at the time were insoluble in 10% KOH, indicating a polyurethane ether. Available from Qosmedix.

5. Reduced adhesive residue (0.5 hours).

- Following solubility testing of acetone, ethanol, isopropanol, and deionized (DI) water, the forehead adhesive residue was reduced with acetone and the chin adhesive residue was reduced with ethanol with swabs (fig. 18). This was completed to make the exposed wood have a more consistent surface for fills and to minimize the likelihood of inconsistent warping due to different moisture permeation potentials.

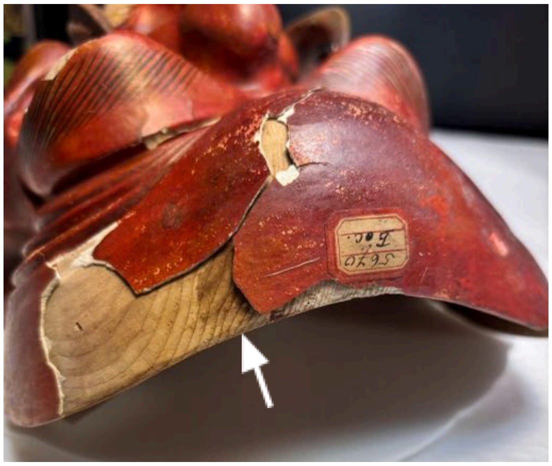

Figure 18. Before and after reducing adhesive residue on the forehead. Note: photographs were taken under varied lighting conditions.

6. Applied a paper and adhesive barrier layer in areas of loss to seal the exposed wood and improve fill reversibility (6 hours).

- **Solvent and adhesive testing**: Conducted solubility testing of acetone, ethanol, and DI water with micro swabs. Acetone and ethanol caused no change to the exposed wood, red colorant, or metallic colorant. However, if applied with movement of the swab, the red colorant temporarily became slightly soluble. DI water caused slight blanching of the red colorant. Minimizing solvent exposure to the red colorant was confirmed to be essential, however, the surface did exhibit greater stability than previously anticipated. Conducted testing of 10% Paraloid B-72[8] in ethanol and in acetone (w/v) as well as 10% Butvar B-98[9] in ethanol (w/v) to evaluate efficacy and extent of substrate darkening. Butvar B-98 caused the least darkening.

- **Applied paper barrier layer with 10% Butvar B-98 (w/v) in ethanol**: Cut untoned long-fibered mulberry paper (tengucho)[10] to the shape of the losses with the use of a Mylar[11] template. By attaching the paper as a barrier layer with Butvar B-98 with a small brush at an angle, it was possible to apply a barrier layer to the first few millimeters of wood underneath delaminating layers adjacent to the exposed wood (fig. 19).

[8] Clear colorless thermoplastic acrylic resin composed of an ethyl methacrylate (70%) and methyl acrylate (30%) copolymer. Previously manufactured by Rohm & Haas, now produced by The Dow Chemical Co. and available from conservation suppliers.
[9] Polyvinyl butyral resin, soluble in alcohols, acetone, and aromatic hydrocarbons. Manufactured by Solutia Inc.; available from conservation suppliers.
[10] Strong, stable hand- or machine-made papers made of long bast fibers (e.g. paper mulberry). Comes in several thicknesses, opacities, fiber types and lengths, etc. Available from Hiromi Paper, Inc. (http://store.hiromipaper.com/) or conservation suppliers.
[11]

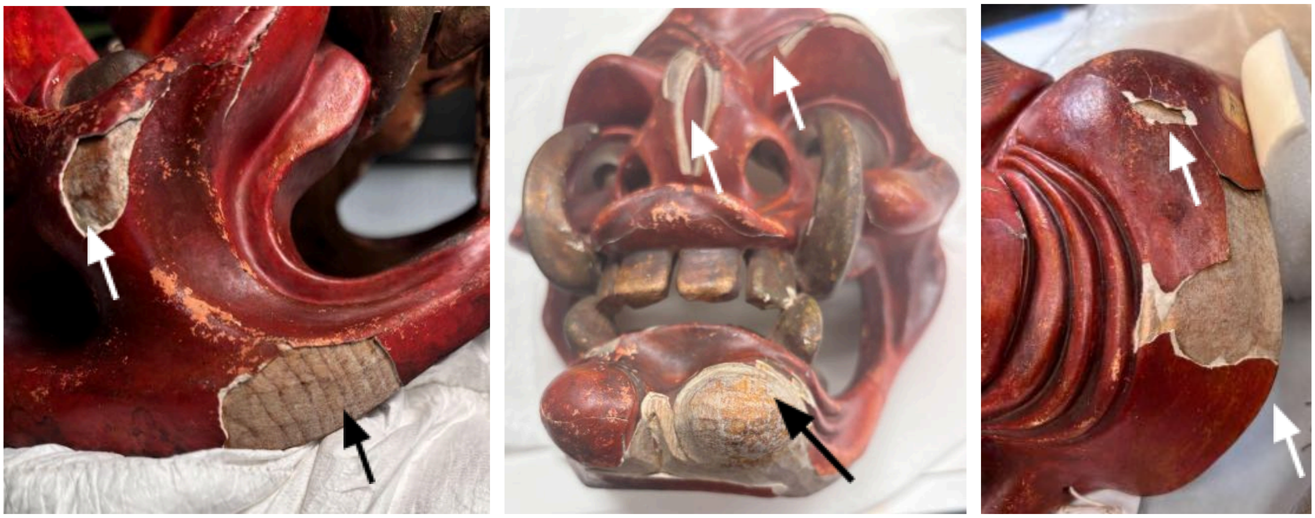

Figure 19. Paper barrier layers applied with 10% Butvar B-98 in ethanol.

7. **Reattached delaminating lacquer. See "Appendix VII: Shimbari for Lacquer Consolidation" for preliminary research based on consultations and literature review (25 hours, active; 10 days passive).**

    - **Prepared a shimbari set-up**: A wooden frame was prepared with the assistance of Rick Starr, Furniture Conservation Volunteer at the Winterthur Museum (figs. 20-21). The frame was created from pine wood with angled inserts to allow for bendable, perpendicular rods to be placed at curved surfaces. Extensions on either end were added for clamping. Rods of varied thickness were prepared from 1.5 and 2 mm carbon fiber rods[12] with Parafilm M[13] on either end for friction against the frame, as an accessible alternative to end caps. Although counterintuitive, testing has shown that the length of the rod and the thickness of the diameter have a greater impact on the force imparted, rather than the degree to which the rod is bent (Hausdorf, Hutchins, and Hagelskamp 2021, 3). Pressure pads were prepared from P-565 silicone[14] to allow for viewing of the object surface during shimbari. Barrier layers were prepared from 0.3 mil Mylar.

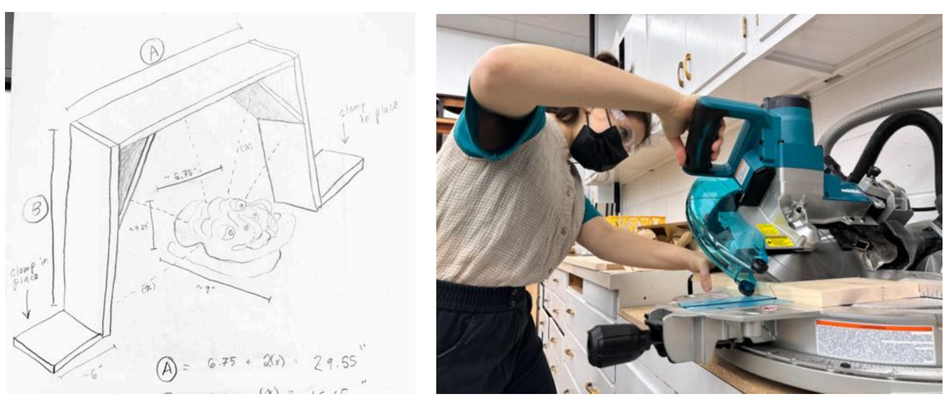

Figure 20. Shimbari frame design sketch (left). Cutting wood for the frame (right).

[12] Lightweight black rod (variable diameter) that consists of unidirectionally-oriented carbon fibers run through a resin bath and heated dies to make them extremely strong longitudinally. High stiffness to weight ratio with high linear strength due to the orientation of the carbon fibers and tight outer diameter (OD) tolerances.
[13] Registered trademark for a stretchable plastic film composed primarily of polyolefins and paraffin wax without any added plasticizers; insoluble to water and ethanol and resistant to alkalis and acids for up to 48 hours. Manufactured by American Can Co; available from major chemical suppliers.
[14] P-565 is a transparent, two component, addition reaction, platinum catalyzed silicone rubber. It is designed to remain water-clear. Although P-565 has very good physical properties for an unfilled system, it is not designed as a mold-making rubber, rather, it is used as the article. It has a work time of 1.5 hours, cure time of 16-18 hours. Manufactured by Silicones, Inc.

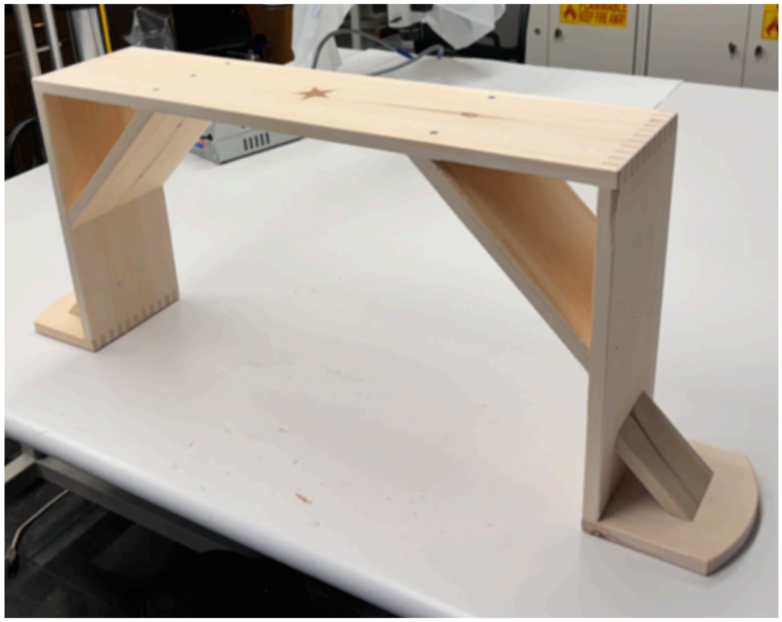

Figure 21. Completed shimbari frame.

- **Tested methods to relax lacquer**: A drop of warm deionized water was applied to the exposed ground layer approximately 15 minutes before beginning consolidation with shimbari. This successfully relaxed the delaminating layer without causing damage to the colorant or ground (Linsly Boyer, personal communication, January 16th, 2025).

- **Applied adhesive**: Following testing, a drop of ethanol was applied with a small brush to decrease the surface tension and improve the penetration ability. 5% rabbit skin glue in DI water (w/v) was warmed in a double boiler, to 50-55°C, and applied with a syringe under delaminating layers (Umney 2008, 569). The warm adhesive application additionally may help relax embrittled layers for shimbari (Linsly Boyer, personal communication, January 16th, 2025).

- **Shimbari clamping**: Following practice of using the shimbari set up with non-collections objects, adhesive was applied to the Bugaku mask and dried under pressure for 24 hours with the shimbari set up (fig. 22-23). This was repeated in nine locations, with some areas requiring two to three rounds of shimbari. In each area of delaminating lacquer, a Mylar barrier layer and silicone pressure pad was placed underneath gentle pressure applied with perpendicular rods. The pressure held the rods in place.

- In four areas, despite taking due caution, a crack was created, resulting in a fully detached fragment in two areas (fig. 24). Although non-desirable, cracks are not completely unexpected for this process. These cracks were consolidated. The large detached fragment from the forehead was reattached following consolidation of the surrounding areas. The detached fragment at the lower center of the mask was not reattached, as this fragment appeared to be incorrectly attached to this area previously, presenting a snag risk and no clear orientation for returning it to this location. It is kept in a bag associated with the object.

- **Clamping**: The delamination at the bottom and top of the lip was more suitably addressed by Berna Multi-Clamps[15] with P-565 silicone pressure pads and mylar barrier layers (fig. 22).

[15] Consists of a carbon fiber beam on which two polycarbonate clamping jaws with silicone rubber tips slide. Available in multiple sizes from Conservation Support Systems.

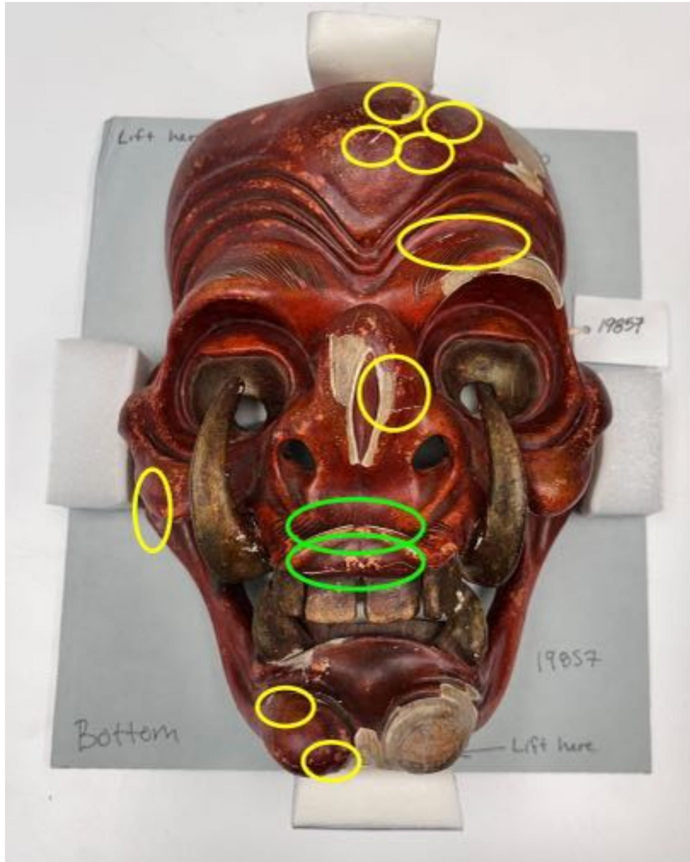

Figure 22. Areas of adhesive application and consolidation. Yellow indicates areas where shimbari was performed. Green indicates areas consolidated with Berna Multi-Clamps.

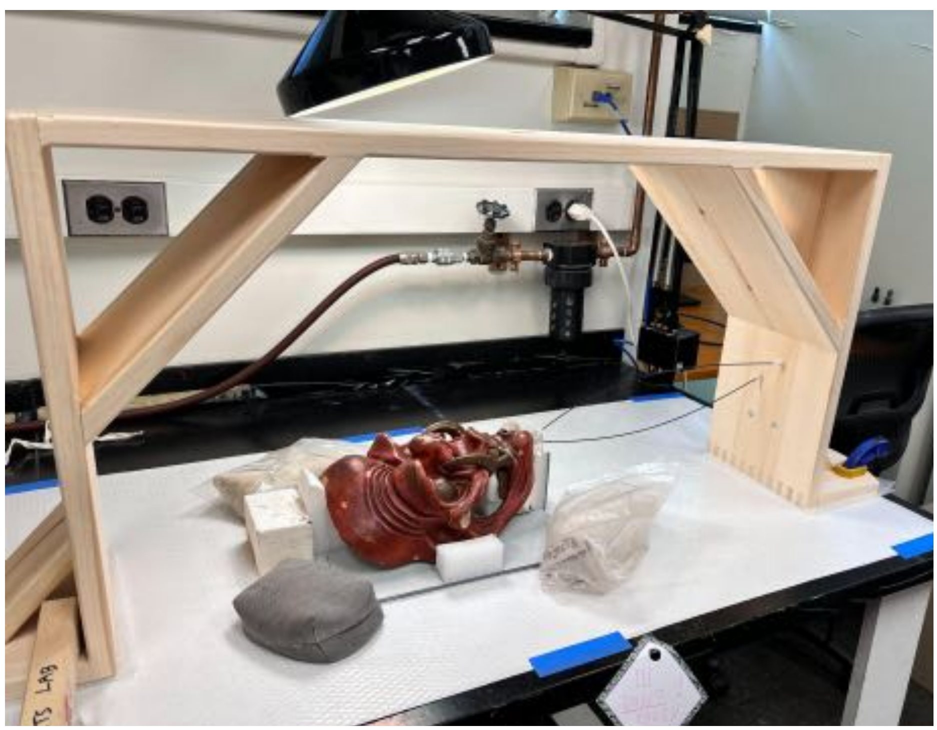

Figure 23. Shimbari consolidation set up.

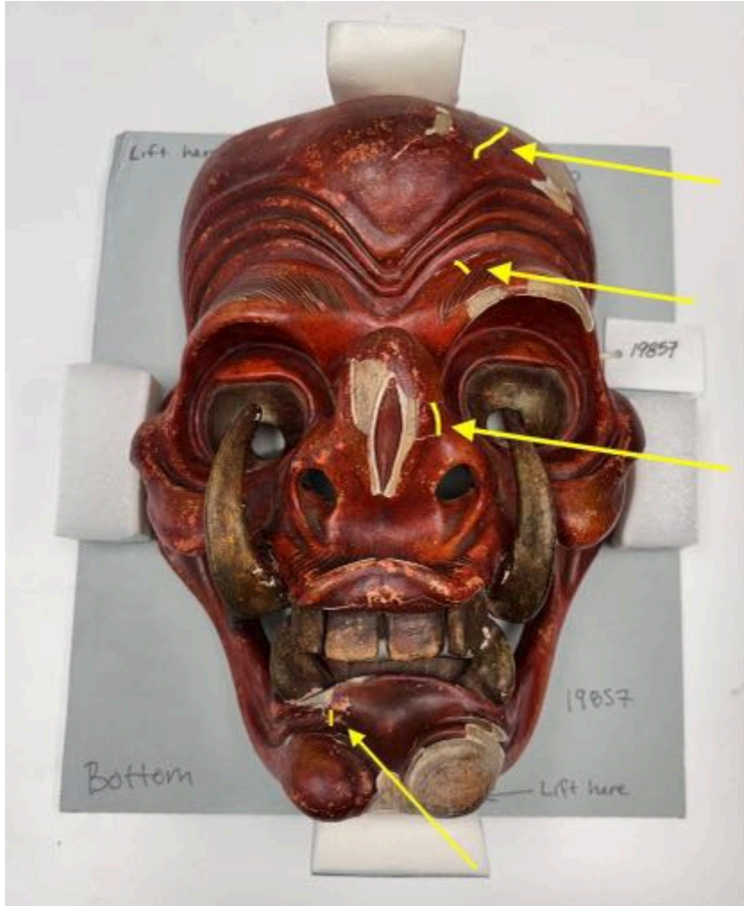

Figure 24. Crack locations propagated during consolidation.

8. Reattached two extant fragments (1 hour active, 1 day passive).

- Both fragments were reattached with 5% rabbit skin glue[16] in DI water (w/v) applied over a pass of ethanol as a leading solvent. The fragment from the forehead that was created during consolidation was reattached with shimbari clamping. The previously detached tusk associated with the proper left tusk was reattached and pressure was maintained during drying with Berna Multi-Clamps, P-565 silicone pressure pads, and Mylar barrier layer (fig. 25).

Figure 25. Before (left), during (center), and after (right) reattaching the tusk fragment and completing the small fill and inpainting.

[16] Traditional animal skin glue made from de-polymerized collagen. Prepared in a double boiler and used while warm.

9. **Completed fills in areas of loss (13 hours).**

 - **Bulked B-72 fills:** Tested fill methods with 60g Paraloid B-72,[17] 35g acetone, and 5g ethanol bulked with 3M Glass Bubbles,[18] Hydrocal White Gypsum Cement,[19] marble dust,[20] and laponite[21] (fig. 26). This fill technique is based on the method established by Carolyn Riccardelli (2024). 1:1:1 3M Glass Bubbles, marble dust, and laponite were selected as the best bulking materials to match the surface texture and color of the ground layer while minimizing brittleness and bubbling. Before moving forward, inpainting tests were conducted to ensure that the fill material would be suitable for inpainting (fig. 26). These bulking agents were thoroughly mixed into the B-72 mixture, which was then rolled into flat sheets between silicone release Mylar with a rolling mill. The fills could then be cut to size in a thin layer with a Mylar template and scissors. After three days of drying, the fills were shaped with scalpels and small files. They were then finished to a smooth surface with a heat spatula (following testing) and 500 grit sandpaper. Shaping and finishing were performed while carefully avoiding surrounding original material (fig. 27).

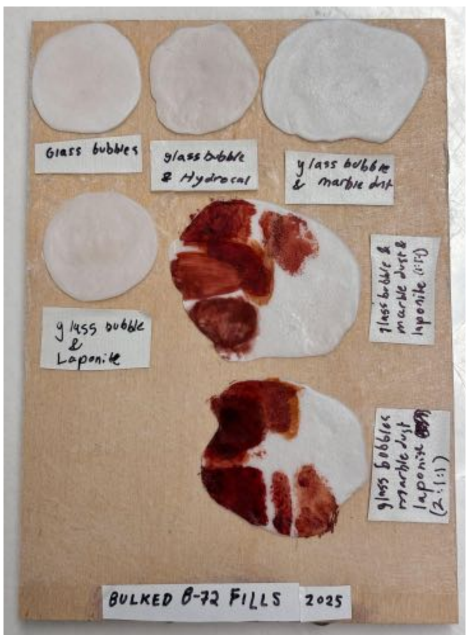

Figure 26. Bulked B-72 fill and inpainting tests on wood with a paper barrier layer attached with 10% Butvar B-98 (w/v) in ethanol.

Figure 26. Tools for shaping and finishing bulked Paraloid B-72 fills.

[17] Clear colorless thermoplastic acrylic resin composed of an ethyl methacrylate (70%) and methyl acrylate (30%) copolymer. Previously manufactured by Rohm & Haas, now produced by The Dow Chemical Co. and available from conservation suppliers.
[18] Brand name for microscopic hollow glass spheres made from a soda-lime borosilicate glass (softens above 715C) and are a common bulking agent.
[19] Plaster of paris (CAS 26499-65-0) designed for solid and hollow casting and is ideal for giftware and lamp base applications. It is compatible with numerous color pigments. Portable water between 70 °F (21 °C) and 100 °F (38 °C) should be mixed with the plaster for use. Once set and dry, the plaster has compressive strength up to 6000 psi. Manufactured by USG.
[20] Marble Dust is a superfine ground and classified 94% pure white calcium carbonate aggregate/filler <300µm.
[21] A fine white, powdered, synthetic clay which swells to produce a clear, colorless, thixotropic gel when dispersed in water.

- **Flügger[22] fills**: Small losses and gaps at the edges of bulked B-72 fills were filled with Flügger, applied with rubber tipped brushes and Casselli spatulas.[23] These fills were smoothed with a scalpel and DI water applied on a micro swab. Gaps in cracks that were propagated during shimbari were also filled.

- **Identifying fills in the future:** Documentation of fill locations is included below (fig. 27).

Figure 27. Fill locations. Additional losses were filled with Flügger in small areas of loss following this image on the PL tusk, PL upper tooth, and PR lower lip.

10. Completed inpainting of fills and cracks propagated during consolidation (16 hours).

- The extent of inpainting was determined based on the collections visit and consultation with Stephen Lang described in step 2: solid colors with slight gradients was preferable over a mimetic approach. Based on testing depicted in fig. 26, the following was determined to be the most successful material for inpainting: a priming layer with Gamblin Conservation Colors[24] solubilized with 70% isopropanol and 30% benzene followed by glazes with Golden QoR Colors[25] solubilized with ethanol (fig. 28-29). Original cracks were not inpainted. The four cracks propagated during consolidation were inpainted. Overall, the inpainting is notable if someone is searching for non-original fills. However, the losses are no longer as prominent when viewing the mask as a whole. In ultraviolet light, the fills are easily identifiable as absorbent. However, the metallic material on the eyes, tusks, and teeth also absorb ultraviolet light. The only two fills on these components are on the PL tusk and PL upper tooth.

[22] Acrylic spackle composed of calcium carbonate in a butyl methacrylate binder. Manufactured by Flügger A/S, Denmark. Available from conservation suppliers.
[23] Hand-forged steel spatulas with flexible tips.
[24] Clear, lightfast pigments bound in Laropal A-81 synthetic urea-aldehyde resin. Dry film remains soluble in mineral spirits and acetate solvents. http://www.conservationcolors.com/tds01.html
[25] Pigment bound in Aquazol and water. Manufactured by Golden Artist Colors; available at art stores and from Golden Artist Colors. Lightfast, Aquazol-based (poly(2-ethyl-2-oxazoline) paints with a high pigment load; soluble in water and polar solvents.

Figure 28. Inpainting setup.

Figure 29. Inpainting before (left) and after (right).

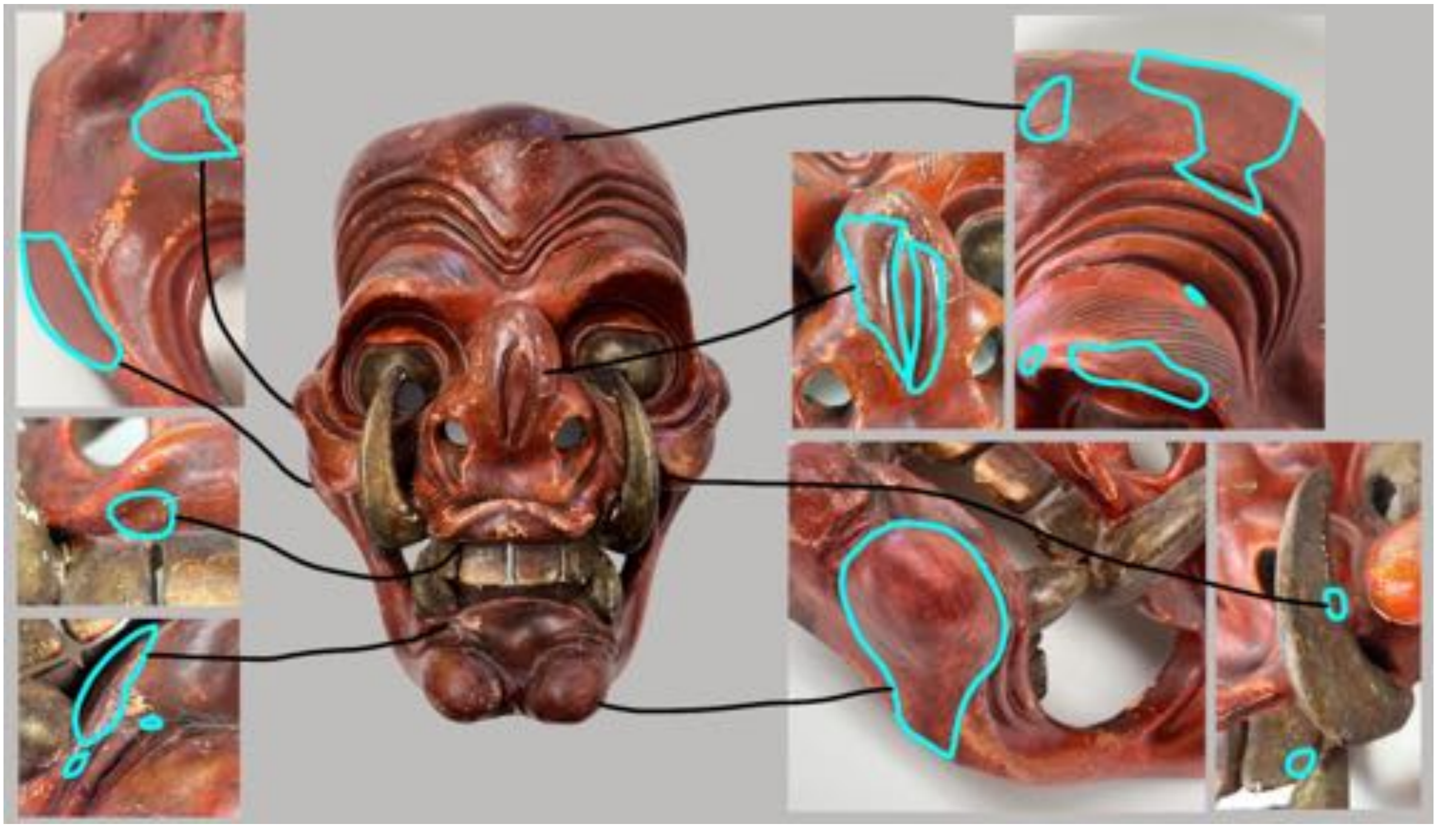

Figure 30. Fill and inpainting locations.

11. **Carried out post-treatment photodocumentation and completed the treatment report** (*3 hours*).

Total treatment time: 73 hours (11 days passive)

Environmental and Handling Recommendations

A housing enclosure was previously created for this mask, which includes a removable component for minimally handling the mask outside the box (fig. 30). Although the material characterization as lacquer or paint is uncertain, the mask should only be directly handled with gloves to minimize exposure to oils, salts, and dirt. The mask is made of composite organic materials which even after treatment may swell or contract at the extremes of relative humidity. Maintain moderate and steady temperature and humidity levels, such as 70F (±2°F) and 45-55% relative humidity (±5%). Lighting levels should remain below 100 lux. If the surface is determined to be painted rather than lacquer, light levels could remain below 150 lux and not exceed. Ultraviolet light exposure should be eliminated from display environments.

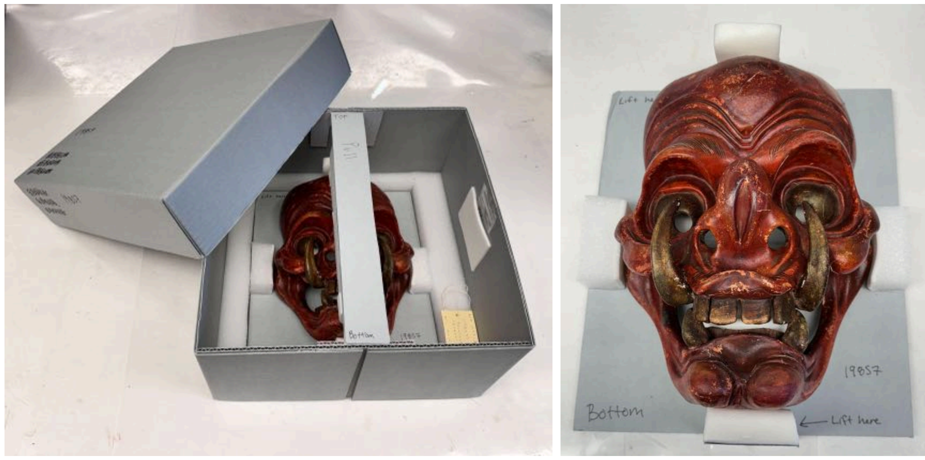

Figure 31. Housing enclosure (left) and removable component (right).

Treated By: Daisy Diamond

Report Date: May 19th, 2025

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Appendix I: Glossary

Table I-1. Glossary of terms related to 19857.

Transliteration	Japanese	Definition
Bugaku	舞楽 (Wolz 1971, 148)	Court dance (Wolz 1971, 152).
Edo period (1600-1867)	江戸時代 (Bethe and Nishikawa 1978, 182)	"The Tokugawa family that ruled in Edo (modern Tokyo) during this period established peace in the country and instituted an isolationist policy that shut Japan off from most outside influences. The Tokugawa extended their patronage to many artisans and performers, spurring a renaissance of several art forms. Conservatism led them back to Confucian precepts and the re-establishment of the central importance of music. They again put Bugaku under official protection, calling forth musicians and dancers from the temples and shrines to which they had retired four hundred years earlier. Again Bugaku, along with Nō, held a place in court functions, and masks were made with meticulous care and craftsmanship." (Bethe and Nishikawa 1978, 182).
Gagaku	雅楽 (Wolz 1971, 154)	Court music; sometimes used to refer to both music and dance and is used interchangeably with Bugaku (Wolz 1971, 154; Bethe and Nishikawa 1978, 183).
Hakudo	白土 (Bethe and Nishikawa 1978, 183)	Kaolin; "a fine white clay produced by the decomposition of feldspar and used as a base for finishing Bugaku masks and colored statues of the Nara [(641-781)] to Kamakura [(1185-1332)] periods" (Bethe and Nishikawa 1978, 183).
Jo-ha-kyū	序破急 (Bethe and Nishikawa 1978, 183)	"The underlying aesthetic theory of Bugaku: 'introduction, development, and finale,' involving a slow beginning, a quickening of pace, and a fast finish. It applies to each individual step as well as to the progression of the dance as a whole. A dance is made up of three basic movements, labeled *jo* for the opening steps to a free section; *ha* for the lengthy middle section often in eight- or four- measure units; and *kyū*, for the last movement, often danced to a two-measure unit. *Jo-ha-kyū* has been borrowed and developed by most Japanese performing arts" (Bethe and Nishikawa 1978, 183).
Kakihan/kao	書き判 / 花押 (Stephen Lang, email message to author, October 3, 2024)	Written seal mark with characters representing or accompanying the signature. An individual person's *kao* might change over time (JAANUS 2024).
Kataji	硬地 (JAANUS 2024)	"A preliminary layer of lacquer applied to the mask to reinforce and preserve the wood" (Bethe and Nishikawa 1978, 183). This is typically composed of Sabi urushi (錆漆).
Nasori	納曽利	Bugaku, *komagaku* type, right partner dance. When danced by one person, this dance is known as *Rakuson*. These masks represent frolicking

	(JAANUS 2024)	dragons, typically blue or green (Bethe and Nishikawa 1978, 184; JAANUS 2024).
Sabi urushi	錆漆 (Bethe and Nishikawa 1978, 185)	A lacquer mixture containing fine wheat flour and tonoko. Used as a priming on many Bugaku masks, particularly in the late Heian period and the Kamakura period (Bethe and Nishikawa 1978, 185; JAANUS 2024).
Tonoko	砥の粉 (Bethe and Nishikawa 1978, 185).	“A powder made from finely ground impure clay. … [It can be used] as a paste when mixed with other binding agents. It is one ingredient of *sabi urushi*” (Bethe and Nishikawa 1978, 185).

Appendix II: Penn Museum Treatment Records (Related Masks)

Masks of similar manufacturing, composition, and condition were treated at the Penn Museum in the 1980s, including 19856, 19858, 19864, 19868, and 19869. Results from available records are summarized below (table II-1).

Table II-1. Treatment summaries from the Penn Museum of similar masks.

Mask	Year	Consolidation method	Notes
19856	1980	20% Acryloid B-82 in 95/5 ethanol and water for large flakes; set in plane after drying using a heated spatula (B-82 is reversible with acetone).	● Additional testing: ○ Solvent/polyvinyl acetate (PVA) was tested, it didn't relax the paint. ○ Gelatin, heated spatula to set adhesive. Area gone over with heated spatula again after dry. ○ Some lacquer layers were water soluble. ● Losses filled with speedball Gesso and inpainted with Liquitex acrylic paint.
19858	1980-1981	20% Acryloid B-82 in 95/5 ethanol and water in large cleaved areas (5% for small flakes). It was allowed to run under the surface, dry thoroughly, and then set in plane with a tacking iron. Excess was removed with an ethanol swab.	● Paint slightly soluble in water, very soluble in acetone ● A heavy wire was used through the holes on either side of the mask to hang the work. ● Gaps filled with speedball gesso and inpainting with Liquitex acrylic and watercolor. ● Similar treatment to (19869).
19863	1982-1983	Methyl cellulose in a 3:2 mixture of ethanol and water with equal part gelatin to increase the tack. This was applied to the mask with a paint brush. Flakes were flattened with a heated spatula.	● Cleaned surface with ethanol. ● Some flakes of lacquer lifted during cleaning; re-adhered with 40% B-82 in 85% ethanol/15% water. B-82 solution was dripped under pieces, dried for 3 hours, then pressed down. ● Unable to remove excess gelatin without removing paint, so the surface became more shiny.

Appendix III: Before Treatment Photography

Figure III-1. Overall front before treatment, normal illumination.[26]

[26] Figs. III-1 and III-2 documented with Nikon D850 device, Nikon D series 60 mm focal length, f/18, exposure 1/125. Post-processing included cropping in addition to -0.20 (fig. III-1) and -0.04 (fig. III-2) exposure.

Figure III-2. Overall back before treatment, normal illumination.

Figure III-3. Top before treatment, normal illumination.[27]

Figure III-4. Lower edge before treatment, normal illumination.

[27] Figs. III-4 through III-6 documented with Nikon D850 device, Nikon D series 60 mm focal length, f/18, exposure 1/125. Post-processing included cropping and -0.45 exposure.

Figure III-5. PR before treatment, normal illumination.

Figure III-6. PL before treatment, normal illumination.

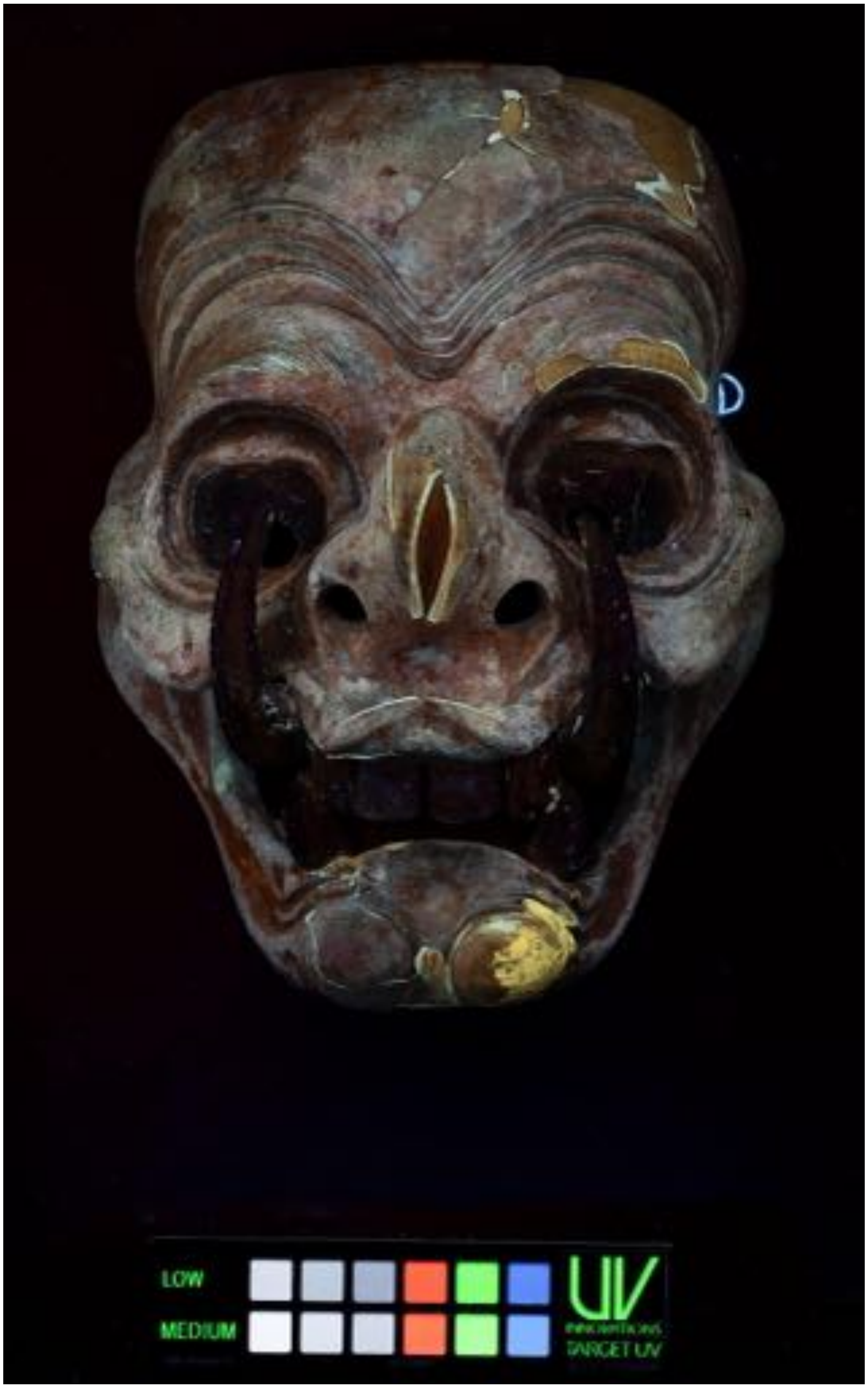

Figure III-7. Overall front before treatment, UVF.[28]

[28] Figs. III-6 and III-7 documented with Nikon D850 device, Nikon D series 60 mm focal length, f/10, exposure 10." Light wand painting with Model UVL-56 Blak-Ray® Lamp Long Wave UV 365nm, 115V, 60 Hz, 0.16 amps. Post-processing included white balancing to the top left gray.

Figure III-7. Overall back before treatment, UVF.

Appendix IV: After Treatment Photography

Figure IV-1. Overall front after treatment, normal illumination.[29]

[29] Figs. IV-1 and IV-2 documented with Nikon D850 device, Nikon D series 60 mm focal length, f/18, exposure 1/125. Post-processing included cropping, white balancing, and slight exposure adjustments.

Figure IV-2. Overall back after treatment, normal illumination.

Figure IV-3. Top after treatment, normal illumination.[30]

Figure IV-4. Lower edge after treatment, normal illumination.

[30] Figs. IV-3 through IV-6 documented with Nikon D850 device, Nikon D series 60 mm focal length, f/18, exposure 1/125. Post-processing included cropping, white balance adjustments, and slight exposure adjustments.

Figure IV-5. PR after treatment, normal illumination.

Figure IV-6. PL after treatment, normal illumination.

Figure IV-7. Overall front after treatment, UVF.[31]

[31] Figs. IV-7 and IV-8 documented with Nikon D850 device, Nikon D series 60 mm focal length, f/10, exposure 10." Light wand painting with Model UVL-56 Blak-Ray® Lamp Long Wave UV 365nm, 115V, 60 Hz, 0.16 amps. Post-processing included white balancing to the top left gray.

Figure IV-8. Overall back before treatment, UVF.

Appendix V: Pyrolysis Gas Chromatography Mass Spectrometry (Py-GCMS)[32]

Py-GCMS was conducted to evaluate the presence of lacquer in the ground layer: grounds without lacquer are weaker, and tend to require stronger adhesives. Lacquers polymerize through an enzyme-catalysed oxidation mechanism leading to the formation of films with a high level of cross-linking, which are insoluble by most solvents and difficult to analyze. Due to the insolubility and complex structure of the lacquer films, only solid-state methods have been applied to their characterization, and the only method capable of distinguishing these materials is pyrolysis-gas chromatography/ mass spectrometry (Py-GC/MS). Two 50 mg samples of the white ground layer were collected adjacent to areas of loss (fig. V-1).

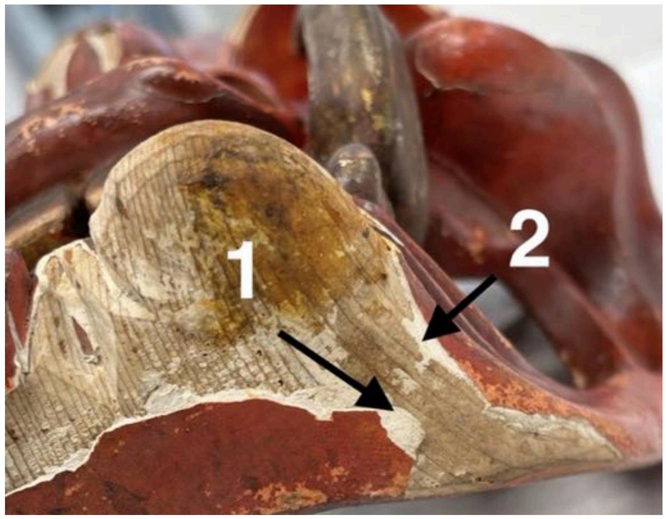

Figure V-1. Sample locations on the underside of the chin.

The majority of the compounds detected in Sample 1 correspond to a drying oil (56.3% peak area) (fig. V-2). The second-most abundant material in this sample are protein markers, specifically blood (likely used at least partially for coagulating properties) and animal glue. Catechols and acid catechols are not detected which suggests an Asian lacquer is not present in this sample. Compounds are detected that correspond to either gum benzoin, egg- and milk-derived artistic materials, or pine resin. Additional types of compounds are detected: phenols, hydrocarbons, alkylbenzenes, and webboxy compounds. The source of these compounds is uncertain. Phenols and hydrocarbons are difficult to categorize more specifically. Starch is also detected, either as an intentional additive or possibly from environmental contamination. Sample 2 was quite similar. However,

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[32] Samples were analyzed by Py-GC/MS using TMAH (tetramethylammonium hydroxide) prior to analysis; this technique is also known as THM-Py-GC/MS (thermally-assisted hydrolysis and methylation – Py-GC/MS). The rationale for this approach was to convert carboxylic acids, alcohols and phenols to more volatile products prior to analysis. Samples were placed into a 50µL stainless steel Eco-cup fitted with an Eco-stick, and 3µL of a 25% methanolic solution of TMAH (Sigma) was introduced for derivitization. An Agilent 5522UI capillary column (DB5MS 5% phenylmethylsiloxane; 20m × 180µm × 0.18µm) was used for separation with helium carrier gas set to 1.0 mL/minute. The Agilent Technologies MassHunter Workstation GC/MS Data Acquisition (version 10.0.368) software was interfaced with the Frontier Lab EGA/PY-3030D system. Samples were pyrolyzed using a single-shot method (SingleShot_SS.mtd) at 600°C for 12 seconds at 30psi. The split injector was set to 280°C with a split ratio of 10:1 and no solvent delay (9.26 psi). The GC oven temperature program was 55°C for two minutes then ramped at 10°C/minute to 325°C, followed by a ten minute isothermal period, for a total run time of 56 minutes. The MS transfer line was at 280°C, the source at 230°C and the MS quad at 150°C. The mass spectrometer was scanned from 33-550amu at a frequency of 2.9 scans per second (method URUSHI_SP30_S10_20m). Agilent MassHunter Workstation GC/MS Data Aquisition was used for sample acquisition. Data was interpreted with AMDIS software (version 2.73); the SCS_multi.csl calibration standard library was used to generate a calibration file and the data then searched against the ESCAPE1657_02April24.msl mass spectral library, both provided by the Getty Conservation Institute. Results were tabulated and interpreted with the RAdICAL report template (02April2024).

there was a higher percentage of drying oils (peak area), no phenols were detected, and no gum benzoin was detected (fig. V-3). This suggests the presence of pine resin in Sample 2.

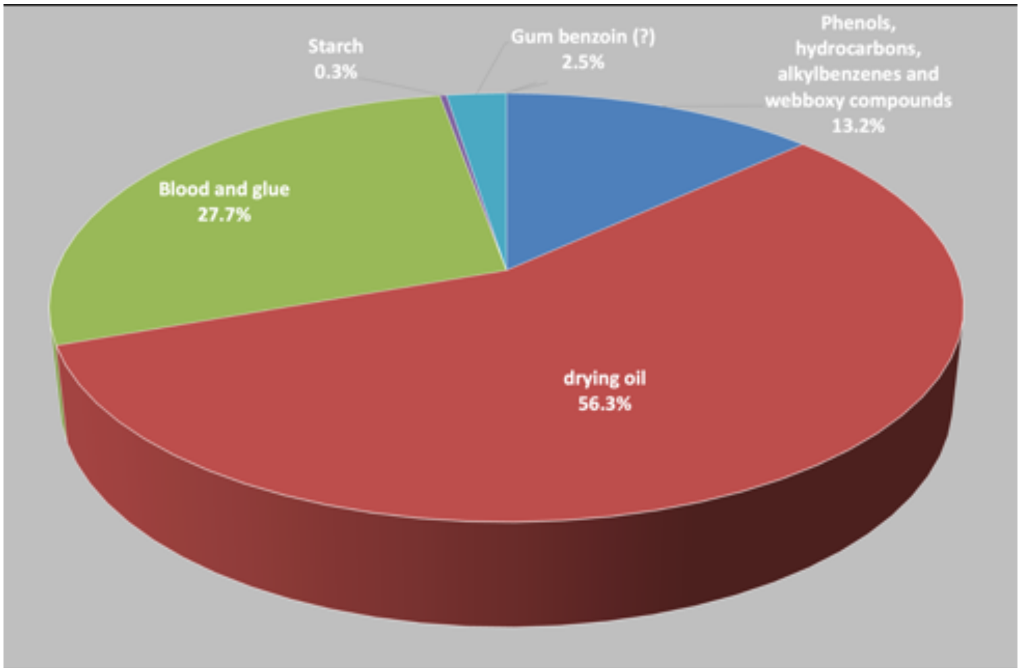


Figure V-2. Sample 1, peak area percent composition pie graph (non-quantitative, representative of sample at present rather than original composition by weight percent).

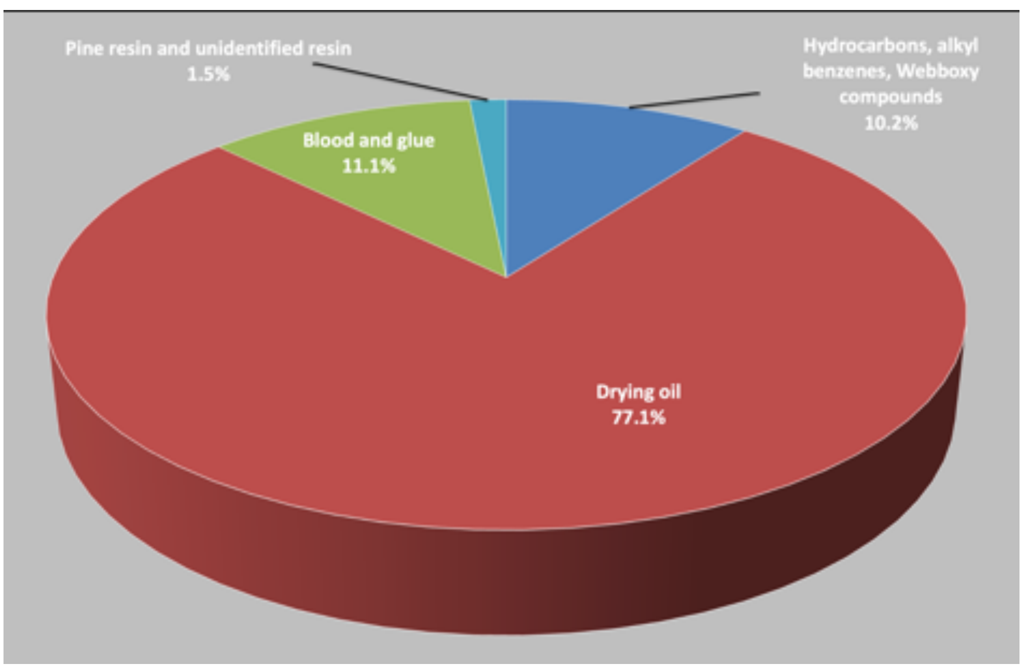


Figure V-3. Sample 2, peak area percent composition pie graph (non-quantitative, representative of sample at present rather than original composition by weight percent).

In summary, no lacquer was detected in the ground layer. The variance cannot be applied to assume statistical significance due to the limited sample collection locations and quantities. Additional analysis would be necessary to further investigate the material composition of the ground layer. Additionally, performing Py-GC/MS on the red layer would be helpful for determining whether this mask was painted or lacquered.

Appendix VI: X-Radiography[33]

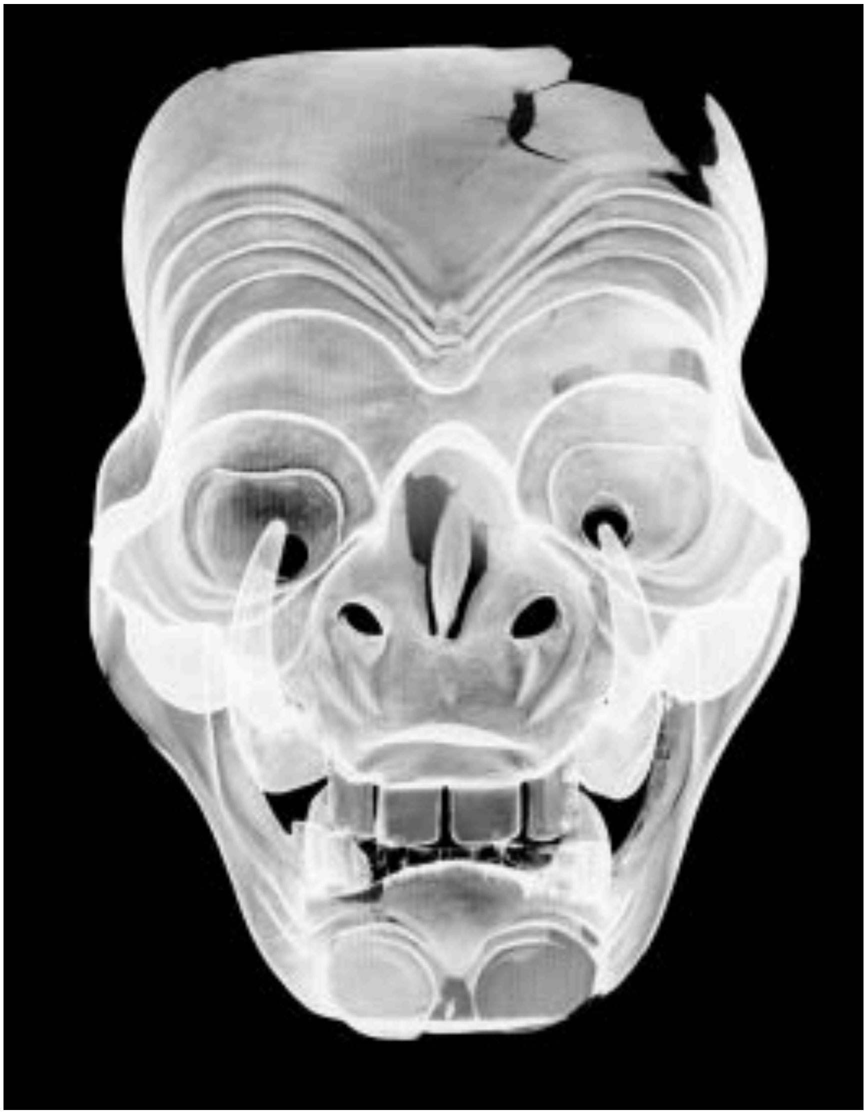


Figure VI-1. X-radiograph. Image captured in collaboration with Lauren Fair, March 2025.

[33] The mask was imaged with X-ray radiation with a Pantak-Seifert Eresco 65 MF2L with digital control (15kV, 4mA, 3mm focal spot) with an imaging plate underneath the object for an exposure time of 60 seconds. CrxVision Versatile Computed Radiography (CR) Tabletop Scanner with IPS Phosphor Imaging Plates read and digitized the latent image from the plate. The GE Rhythm Acquire software acquired scans and the GE Rhythm Review Flash! filter (GE Rhythm Review Software) was applied to optimize the brightness, contrast, and definition of Figure V-1.

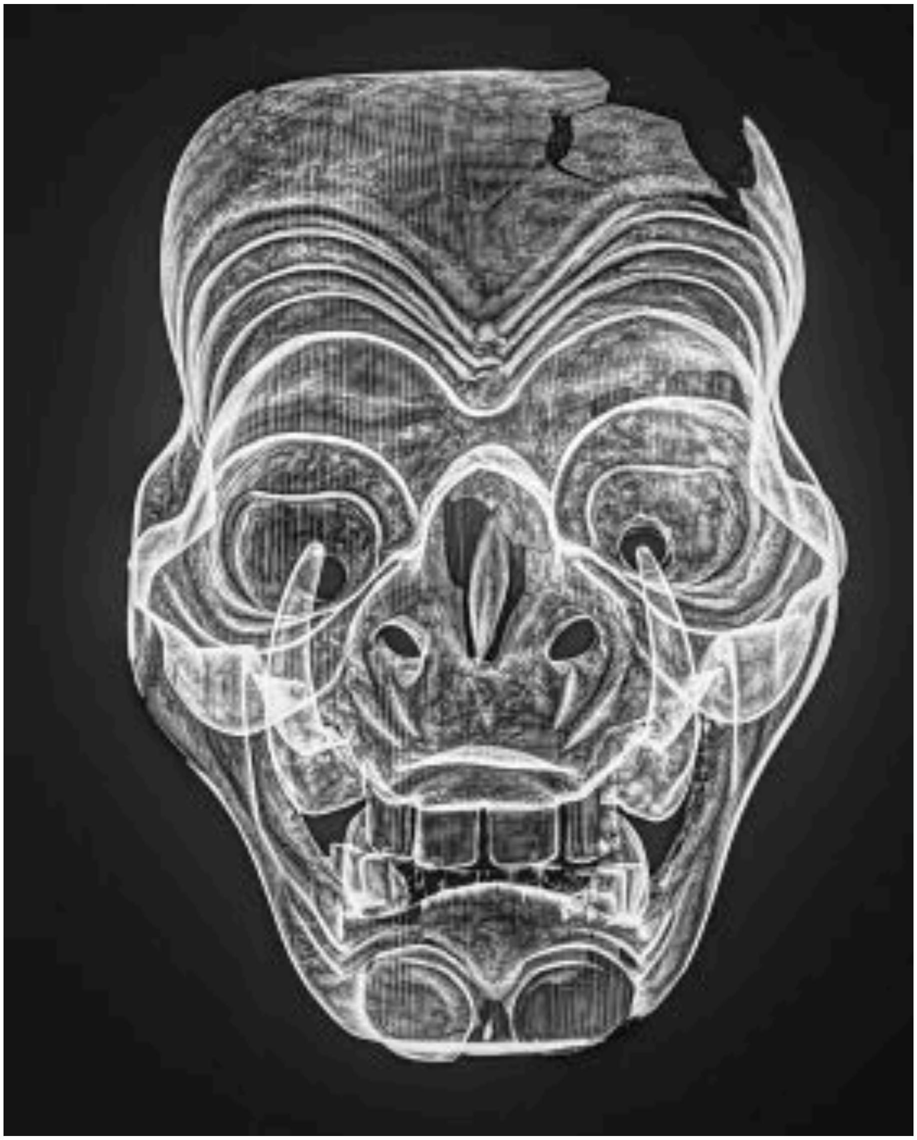


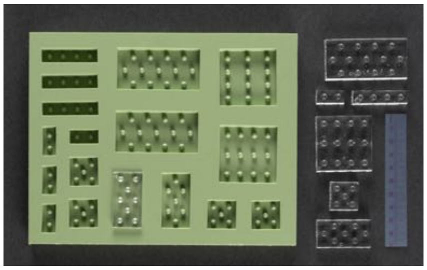
Figure VI-2. X-radiograph with GE Rhythm Review Flash! filter. Image captured in collaboration with Lauren Fair, March 2025.

Appendix VII: Shimbari for Lacquer Consolidation

This approach to shimbari applications for lacquer (or other brittle delaminating layers) consolidation was informed by consultations with Jennifer McGough and Linsly Boyer; Bainbridge et al. 2015; and Hausdorf, Hutchins, and Hagelskamp 2021 (Table VII, Figs. VII-1 through VII-4).

Table VII. Overview of materials used for the shimbari method.

Component	Material
Frame	● Wooden frame ○ Regarding dimensions, this can be a moveable "bar" rather than a frame that covers the entirety of the object (Linsly Boyer, personal communication, January 16th, 2025). ○ Corner blocks may help create more perpendicular surfaces for curved objects (Jenny McGough, personal communication, January 14th, 2025). ● Quick grip clamp with a wooden board can be used as a simplified frame (fig. VII-2).
Rods	● Fiberglass rods approach ○ Regarding thickness, thicker ones aren't flexible enough and thinner ones barely apply pressure. ○ Kite rods have rubber tips that help hold them in place with friction against the frame. ○ "Unlike wood or bamboo, which lose resilience after repeated use, fiberglass rods are more flexible, retain their resilience, and exert consistent pressure over an extended period of time. They are reusable and durable" (Hausdorf, Hutchins, and Hagelskamp 2021, 2). ● Purchase/source ○ Rounded polyvinyl end caps for friction, durability, and user safety (Hausdorf, Hutchins, and Hagelskamp 2021, 2) ○ 2.5 mm (least point pressure), 3 mm, 4 mm (most point pressure). ○ End caps (could only find PVC vinyl ones). Manufacturer: Fly Market Kites. ● Preparation ○ Cut to length with safety glasses and a respirator. Longer length rods can provide more room for positioning. Rods that are longer or have smaller diameter will impart less pressure. ○ Coating the bare fiberglass rods with a diluted polyvinyl acetate (PVA) adhesive will make them safe for handling (Bainbridge et al. 2015)
Pressure pad	● Flexible pad for three-dimensional surfaces ○ Transparent materials allow for visual access during consolidation (Hausdorf, Hutchins, and Hagelskamp 2021, 4). ○ Urethane-based rubbers with dimples for holding fiberglass rods in place, used in combination with barrier layers of fluorinated ethylene propylene (FEP), polyethylene (PE), or Mylar (Hausdorf, Hutchins, and Hagelskamp 2021, 5). ■ Silicone Inc. P-565 Platinum Clear (with 0.5 mil Mylar) ■ Smooth-on Clear Flex Series 30 (with 0.3 mil PE film) ■ Smooth-on Clear Flex Series 50 (with 0.5 mil FEP film) ■ Smooth-on Clear Flex Series 95 (with 0.5 mil Mylar)



	● Barrier layer
Adhesive	● 5% rabbit skin glue in ethanol, applied warm which helped relax the lacquer structure (Linsly Boyer, personal communication, January 16th, 2025). ● Lacquer repairs of grounds have historically used hide glues as well (Jenny McGough, personal communication, January 14th, 2025). ● Could test Paraloid B-72 in ligroin solvent (Jenny McGough, personal communication, January 14th, 2025).

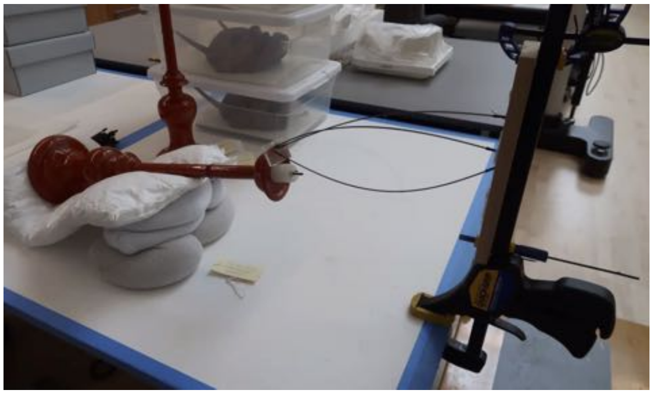


Figure VII-1. Localized approach to consolidation by adapting the shimbari method at the MFA Boston. Image courtesy Linsly Boyer.

Figure VII-2. Consolidation with shimbari using wooden skewers and carbon fiber rods at the MFA Boston. Image courtesy Linsly Boyer.

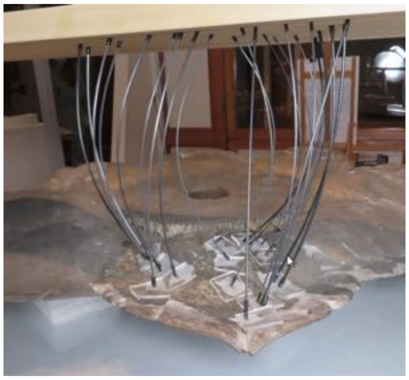


Figure VII-3. Consolidation with shimbari using wooden skewers, and carbon fiber rods at the MFA Boston. The wooden frame had slits carved that helped stabilize the rod supports. Image courtesy Linsly Boyer.

Figure VII-4. Consolidation with shimbari using wooden skewers and carbon fiber rods at the MFA Boston. Image courtesy Linsly Boyer.

Appendix VIII: Self-Reflexive Report Reflections[34]

The Conservation of Performance Objects

When I began researching this mask, I wanted to understand how to integrate the performance context into the treatment proposal. There are the material considerations, such as preserving soiling and staining deposited while the mask was in motion, on somebody's face, looked upon by an audience… The importance of maintaining this evidence through restrained cleaning of cultural heritage is well-documented. But there's also the affective presence of a performance which feels like something that is perhaps "remembered" by the materials which persisted through the performance. In a more pragmatic sense, these objects existed alongside (and brought about) narrative, emotions, and embodiment. As a mask that is held by a museum collection, the status of this mask has of course shifted over time. I wanted to push myself to understand more about the preservation of performance traditions, and how material culture factors into this sustained memory.

I was really excited to speak with Jeff Kaplan, Interdisciplinary Artist and Dance Historian with a background as a performance educator. In the beginning of our call, I shared these considerations and some of my initial ruminations, as well as hesitancy to apply these questions to a cultural practice which I am just learning about for the first time through this conservation treatment. Jeff listened thoughtfully and was quiet for a minute before responding with a single question: "have you ever worn a mask?"

This question, something so straightforward, brought me from an intellectual place to an embodied perspective. Jeff continued: "the experience of wearing a mask does something surprising. It covers your face, but it reveals something from within you. … Masks aren't fixed. They appear to transform during the act of performance." He shared about the Neutral Mask Technique, which is a theatrical method in which a performer wears a blank mask and through body language transforms the identity and emotional landscape of the performer. I realized how easy it is to project a strong emotional landscape onto this mask, given how expressive it is. But this could have been much more malleable in reality. The mask is not just a material phenomena: someone created it, wore it, and perhaps altered it.

Jeff also brought nuance to the zeitgeist of performance arts and the somewhat paradoxical notion of preserving performance, which by definition is not preservable. He stated: "if we could watch the dance from another culture or time, we wouldn't be perceiving the dance in the same way that the original audience would have interacted with it." He talked about how people "dance with an accent," and that even if someone were to re-enact a dance step-by-step from one of the many dance notation systems, i.e. labanotation, or from video documentation, those who are "fluent" in the dance would recognize many subtle differences. He elaborated that dancers in many cultures typically didn't write down instructions, they learned movements from people who have done it before. Dance is among human's oldest activities, but dance history is a much newer academic field. This made me think a lot about how the preservation of culture exists in direct relationship with the continuation of its making. We talked about the court performance context in 19th century Japan. He asked: "Who is there who's not? How did people get there? How long was the performance?" and emphasized that the dance was so much more than just the movements or the mask in isolation. It's also the garments, the music, and the audience (Jeff Kaplan, personal communication, November 14th, 2024).

This conversation left me with the following questions: What can a conservator gain from the experiential dimension of objects? Can you infer performance history from a material object? Does a dance exist independently of the dancer? Is there value in spending time with these unanswerable questions? This speculative path of inquiry may not necessarily change a single thing about how I approached the hands-on treatment of this Bugaku mask. However, I hope to continue

[34] As an Objects Conservation student at WUDPAC, I am required to complete one autoethnographic report as part of my major treatment projects. An autoethnographic process-based assessment foregrounds the personal experience and cognitive processes that impact micro-level decisions. This writing exercise is intended to increase reflexivity required to remain critical and enrich conservation documentation (Stigter 2016).

asking questions like these as a conservator, given the political history of collecting practices in Western institutions and the tendency for heritage to become flattened and static.

Treatment Reflections: Applying a Barrier Layer

It felt daunting to apply a plastic coating to a natural, porous material. This feels like a "classic" organic materials sentiment – that applying non-original synthetic materials can feel incongruous with the materials. I considered testing a shellac coating, as that would be a more natural alternative, but I was concerned about the aesthetic darkening. Ultimately, applying Butvar B-98 resulted in nearly no darkening. In hindsight, and with additional time, I would have been interested in testing more natural adhesives, such as Klucel G.

Treatment Reflections: Shimbari

I was quite hesitant to embark on using shimbari, as it's a method that I didn't have any experience with, and there is a long tradition of its practice that would be difficult to learn in a short time period. However, after discussing the benefits and limitations of the technique, Linsly and Jenny emphasized that the localized pressure is significantly better for lacquer consolidation, particularly curved surfaces. Linsly shared that she hadn't had much success using weights (personal communication, January 16th, 2025). This helped me gain confidence to learn more about shimbari and recognize this as an immense learning opportunity to expand my skillset as an aspiring objects conservator. Although my shimbari set-up was modified in many ways from a traditional set-up, this experience helped me build my confidence in learning new skills beyond the bounds of a classroom or direct mentor, as I needed to speak with conservators beyond my current network to embark on this treatment.

Overall, the shimbari technique was very successful and there are no longer lifting layers at risk of becoming damaged during handling. However, I was surprised at how variable the delaminating layers were in their response to gentle pressure, and in four areas, cracks propagated. Although my supervisor Lara reminded me that this would be entirely expected for a treatment like this, I do hope to get more experience learning about shimbari to improve my technique in the future. These were difficult moments. As a conservation student, the last thing I want to occur is for an object to become damaged in my learning process. I learned an important lesson: if a delaminating layer is potentially too stiff to return to its original position, I could have approached stabilization by creating a fill underneath the layer to cushion the layer from impact and decrease the snag risk. I stabilized the components that sustained a crack during treatment, and inpainted cracks to the extent possible.

Treatment Reflections: Fills

During this stage of the treatment, someone asked me "do you like working with bulked B-72?" I thought this was an interesting question. The challenge of making these fills highly reversible made the fill material selection quite clear. Bulked B-72 can do so much, retaining strength and a high degree of reversibility. However, the tactile qualities of the fill weren't intuitive and required some practice to get the hang of. It was easy for the material to become either too sticky, or too full of bulking materials and lack cohesion. The bubbly appearance was quite disconcerting, but as soon as I realized I could easily reduce this appearance with heat and carving tools, I felt more comfortable. It's easy for me to intellectually agree that certain materials are best suited for certain treatments. And, I can have confidence that I can learn new techniques especially with materials I'm very familiar with, such as B-72 in this instance. However, I think it is worthwhile to ask myself: do I *like* working with a particular treatment material? If not, why? Do I simply need more practice or guidance? I think in the beginning of this treatment I didn't *like* the material. Through the course of this treatment, I became much more comfortable with bulked B-72 fills, and hope to have future treatments where I can apply this technique and continue to experiment with bulking agents to achieve varied surfaces, textures, and colors. Now that I've experienced more of the potential of this material, I do actually like working with bulked B-72! For some reason, it feels taboo to be enjoying a particular treatment technique, because I have this silly notion that conservators can be emotionless or hyper-scientific about the process. I don't think this is true or helpful for the field…

Treatment Reflections: Inpainting

The shimbari and fill stage of this treatment took much longer than I anticipated, and I was left with only a week to complete inpainting before the end of the semester. As a full conservator (rather than a student), I am sure I will be faced with deadlines that feel challenging to achieve, if not impossible. This was great practice in maintaining the calm, patience required to do a treatment well while under pressure. There were many moments that I wanted to move on, when I had to tell myself to spend a little bit longer moving the tone a little more yellow, or the shade a little darker. There were also many moments I felt myself wanting to linger in an area and achieve a “more perfect” color or transition, when I had to tell myself that what I had already done was successful at reaching the goals of the treatment. When I felt stuck, I greatly appreciated the insight of my painting conservation classmate, Zoe Avery. She gave me a few tips on how to improve my color matching. Additionally, each time I did inpainting during the day instead of the evening, I was able to complete a section much more quickly. This was actually one of my first treatments that required extensive inpainting, and it was an incredible learning experience. I am grateful for the opportunity to learn new skills while bringing some life and stability back into this magnificent, lively mask.