JOURNAL OF
Pacific
Archaeology

– ARTICLE –

Microwear analysis on *Pinctada margaritifera* tattooing combs from Central East Polynesia

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Abstract

Pearl shell tattooing combs form a small corpus in the material culture in Central East Polynesia, providing evidence for traditional methods of tattooing and body modification, and represent a significant form of cultural practice in ancient island communities. Three combs were analysed with microwear analysis, shedding light on manufacturing techniques and use, with an additional four combs analysed macroscopically. This is the first microwear study on pearl shell artefacts in the Pacific, and the results contribute to the wider corpus on microwear traces on pearl shell artefacts and tattooing implements, shedding new light on their chaîne opératoire.

***Keywords*:** Microwear analysis; tattooing combs; pearl shell; Central East Polynesia

To cite this article:
McGloin, J., Conte, E., and Molle, G. 2026. Microwear analysis on *Pinctada margaritifera* tattooing combs from Central East Polynesia. Journal of Pacific Archaeology, 16(1): Article 8:1-21. DOI: 10.70460/jpa.v16i1.410

Submitted: 10/05/2026, Accepted 30/09/2026, First online 05/11/2026

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The Journal of Pacific Archaeology is a peer-reviewed open access journal published by the New Zealand Archaeological Association

1. Introduction

This article presents the results and interpretation of the first microwear study conducted on archaeological pearl shell tattooing implements from Central East Polynesia (CEP) and the first conducted on pearl shell objects from the Pacific. In Oceania, and Polynesia in particular, tattooing is a significant practice, with social, cultural, and ritual links (Allen 2005; Ottino-Garanger and Ottino-Garanger 1998). In CEP, tattooing was prohibited with the conversion to western religions (Roth 1905), resulting in a loss of traditional knowledge and methods of tattooing. In Polynesia, archaeological tattooing combs are made of bone or in rare cases mother-of pearl (*Pinctada margaritifera* var. cumingii), with pearl shell combs dating to the 13th-14th century in CEP (Molle and Conte 2013).

As such, this study seeks to investigate the object biographies of pearl shell tattooing combs using microwear analysis. To achieve this, the article first considers if microwear analysis is achievable on archaeological pearl shells or if post-depositional surface modification (PDSM) is an inhibiting factor for analysis on this material in this region. Second, we examine what microwear analysis can tell us about the use-wear and chaîne opératoire of these combs. Our analyses allow us to suggest tools and techniques used in manufacturing these objects, provide insight into their production sequence, and that all combs examined indicate evidence of use.

2. Tattoos and tattooing implements in the Pacific

2.1. Tattooing

Tattoos can represent symbols of rank and status within a community but can also be a living identity that changes and grows with new tattoos representing significant life events. In the Sāmoan islands traditional implements and methods still used nowadays have been well documented, such as the context for tattooing related to the rites of passage (Galliot 2019; Hiroa 1930; Mallon and Galliot 2018). Similarly, there is a socio-religious dimension of manufacturing the tattooing implements and creating the tattoos. This highlights the high skill level of the master tattooist, *Tuhuna patu tiki* (in Marquesan) or *tahu'a tātau* (in Tahitian), within a community (Ottino-Garanger and Ottino-Garanger 1998, 52).

The symbols and motifs tattooed were also carefully designed, symbolising access to a social status or group, spiritual significance, or links to magic. Traditional knowledge in the Marquesas Islands was recorded by Willowdean C. Handy (1923) and notes on how patterns adapted to the aging of the body were recorded by German ethnographer and physician Karl von den Steinen in the late 19th C. (1925). Their corpus today form the foundation of the tattooing revival in the Fenua 'enata (Marquesas Islands) (Huukena 2011). Today, tattooing remains an integral part of Pacific culture and identity (Ambrose 2012). In French Polynesia, it is an important figure in the cultural revival that began in the early 1980s and has been widely adopted far beyond Polynesian communities.

2.2. Tattooing methods and materials

There are four main traditional techniques of tattooing: hand poking, incision, hand tapping, and subdermal tattooing (Deter-Wolf et al. 2022). In the Pacific, two methods have been described as the primary methods of tattooing from ethnographic and historical records: 1) Incision has been documented primarily in Melanesia – creating an incision in the skin then rubbing pigments into the wound, or rubbing pigments onto the skin and then cutting; 2) hand tapping has been documented in Micronesia, Melanesia and Polynesia, particularly in CEP – piercing the skin, with the pigment either coating the implement or rubbed onto the skin before piercing (Kononenko 2012; Torrence et al. 2017, 2).

Many records reference the widespread presence of tattoos in CEP (Handy 1923; Ottino-Garanger and Ottino-Garanger 1998; von den Steinen 1925), but very few historical accounts describe the process of tattooing or their significance, and none mention the manufacturing of tattooing implements.

In Tahiti, Cook (1768, 177–78) describes the use of thin and flat bone or turtle shell tattooing combs fastened onto a handle, with the combs dipped into a lampblack liquid made from the smoke of an oily nut. This pigment is believed to be made from candlenut, the fruit of *Aleurites moluccana* (Ellis 1853), and is the principal source of most black pigments in Polynesia. The cupule stones close to or integrated to the *paepae* (stone pavement or platform) were also part of the process to produce the soot for preparing and containing the ink (Ottino-Garanger and Ottino-Garanger 1998, 56–57). Both Porter (1815, 124) and Banks (1769, 294) recount that the comb is pierced into the skin with quick taps with a piece of wood as a hammer. Tattooing experts were in charge of manufacturing and maintaining their tools and they likely held several at a time, including combs of various widths and adapted to the production of specific motifs. For transporting and storing these implements, bamboo containers have been described for the Marquesas (Ottino-Garanger and Ottino-Garanger 1998; Molle 2011), and examples of archaeological ink containers are held by the Te Fare Iamanaha - Musée de Tahiti et des Iles (the museum). Tattooing is achieved by penetrating 1-2mm into the dermis layer of the skin, where the ink permanently remains.

2.3. Pearl shell combs

The lack of evidence for the later use of pearl shell combs and the small corpus found to date indicates a limited period of use, with Ottino-Garanger and Ottino-Garanger (1998, 53) suggesting pearl shell was abandoned around the 15th century in favour of other materials such as bone and tortoiseshell in the Marquesas. Whilst Robitaille's (2007) exhaustive review and classification of Perpendicularly Hafted Tattooing Instruments (PHTIs) particularly focusses on bone tools, it allows a better understanding of where pearl shell tattooing combs fit as one-piece matrix combs within a wider Oceanic tattooing corpus. These combs were hafted onto a wooden stick at an angle with a rope made of natural fibre and were then hit into the skin with a mallet or *tā*.

The creation of pearl shell artefacts is believed to share common manufacturing stages and technical actions, with combs requiring a series of complex actions. As such, it has been hypothesised that pearl shell fishhooks and tattooing combs were produced using similar technical actions, and therefore likely to exhibit similar manufacturing traces (Molle and Conte 2013). The main features of these tattooing combs include: the proximal part that determines how the comb was fastened to

the stick, which can have straight edges or contain a central notch and wings; the mesial part, containing the flat central face of the comb; and the distal part, containing the grooved teeth (Figure 1). Based on this, Molle and Conte (2013) proposed the following chaîne opératoire for pearl shell-tattooing combs: shaping the plate through grooving or percussion, including making the central notch or wings; using a moistened coral to abrade the faces; using a very fine and pointed tool, such as rat or fish teeth, to groove the teeth of the comb; attaching the comb to a handle; and polishing the comb and re-sharpening the points with use. They also hypothesised three methods of fastening the comb to the stick: direct fixing to the top of the stick through a perforation in the comb; fixing the comb in a notch; or fixing to the top of the stick.

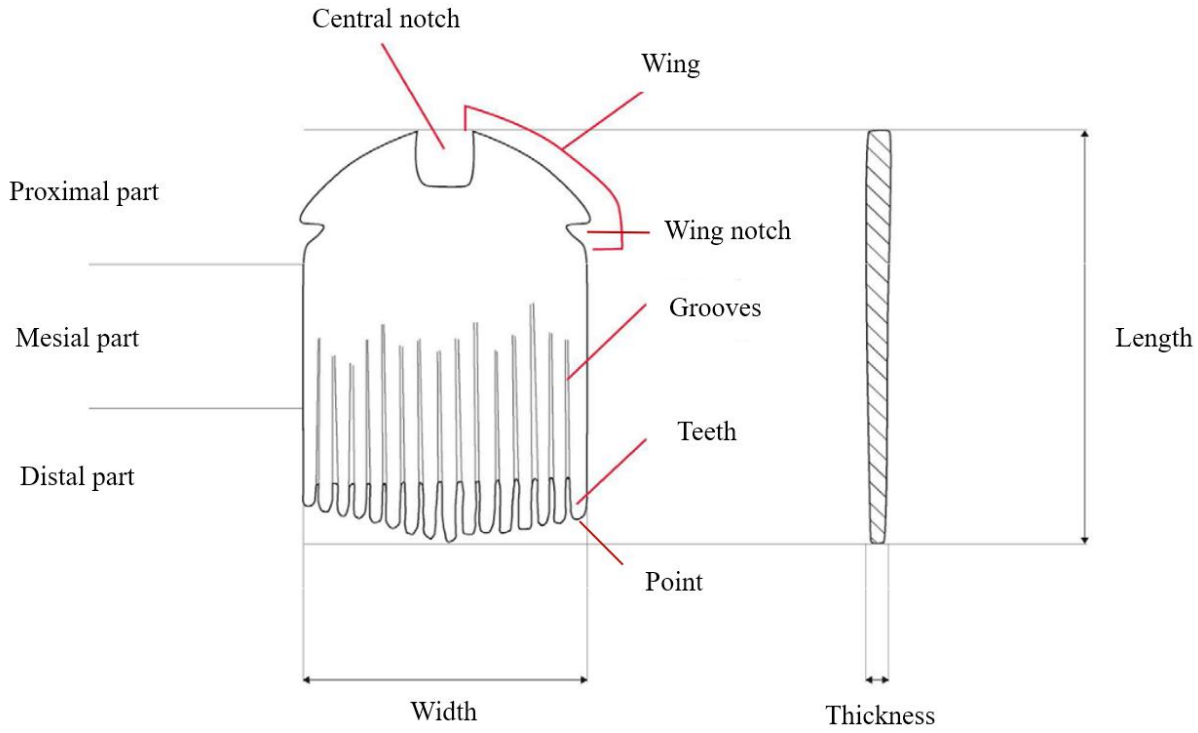


Figure 1: Diagram of a tattooing comb updated from Molle and Conte (2013, Figure 1), translated from French.

2.4. Microwear analysis

Increasing interest in the archaeology of tattooing has expanded into microwear and experimental studies of tattooing in different geographic and cultural contexts. Experimental and use-wear analysis tattooing studies have included tests of: deer and turkey metatarsal awls, catfish dorsal spine, alligator gar teeth, bobcat claw, sharpened river can, honey locust spine, Osage orange thorn, small plant thorn, and lithic flakes or points for Native American tattooing practices (Deter-Wolf and Peres 2013); bone, antler, stone and copper needles (Arcos 2016); deer bone tools on pig and human skin (Deter-Wolf and Clark 2017); bone needles similar to those found in North America (Gates St-Pierre 2018); turkey bone tools from a Native American site in central Tennessee (Deter-Wolf et al. 2021); animal bone, obsidian, copper, boar tusk, and a modern steel needle for traditional tattooing techniques on human skin (Deter-Wolf et al. 2022).

Within the Pacific, studies have focused on the use-wear and residue analysis of obsidian tattooing tools from experiments and artefacts found at Lapita sites in Melanesia (Kononenko 2012; Kononenko et al. 2016; Torrence et al. 2017) and one study examined bone tattooing combs from Tonga (Clark and Langley 2019). No microwear studies have yet been conducted on CEP tattooing implements or on pearl shell combs. Additionally, we are not aware of any published research that has conducted microwear analysis on archaeological pearl shell items from CEP.

3. Materials and Methods

All tattooing combs were photographed, weighed, and measured (Nikon camera using NIKKOR Z MC 105mm f/2.8 VR S macro lens, Medid MD/2019 digital caliper, Kern EMB 100-3 weighing scale, Table 1). These artefacts were not cleaned due to their fragility and to not remove any potential residues.

Table 1: Measurements of the archaeological tattooing combs held at the CIRAP.

Item number	Length (mm)	Width (mm)	Thickness (mm)	Weight (g)	Hafting Type	Notes
E9[D4] #58	16.37	15.84	1.28	0.364	Notch & Wing system	Broken at the points
E8[D4] #26	35.79	17.47	2.09	2.09	Unknown	Largest and intact comb in the CIRAP collection
E7[D4] #34	17.57	21.12	2.03	0.828	Unknown	Broken, with only the points remaining

3.1. Archaeological tattooing combs

There are only 18 known pearl shell tattooing combs dispersed across CEP and recovered from pre-European archaeological contexts (Figure 2, Table S1). Of this small corpus, only three combs held at the Centre International de Recherche Archéologique en Polynésie (CIRAP) at the Université de la Polynésie Française (UPF) were accessible for analysis under the stereomicroscope. Due to museum restrictions, a further four were macroscopically examined whilst on display at the museum. Using the microwear results of the three combs and experimental traces on pearl shell (McGloin et al. 2026) it is possible to infer manufacturing techniques through the macroscopic examination of the museum combs. The combs held by the museum have accession numbers of D2020.1.2, 2132, 2133, 6042. The tattooing combs held at CIRAP were assigned the following item numbers at excavation: E9[d.4] #58, F7 [d.4] #34, and E8[d.4] #26, referred to as combs 58, 34 and 26 in this paper (Figure 3). These combs were found in excavation square units E9, F7 and E8, layer d.4. Post-excavation analysis corresponds layer d.4 to level G in the second phase of the site's cultural sequence dated around CE 1250-1350, which contains the deepest stone pavement discovered in the 2009 excavations (Conte and Molle 2014; Molle 2011).

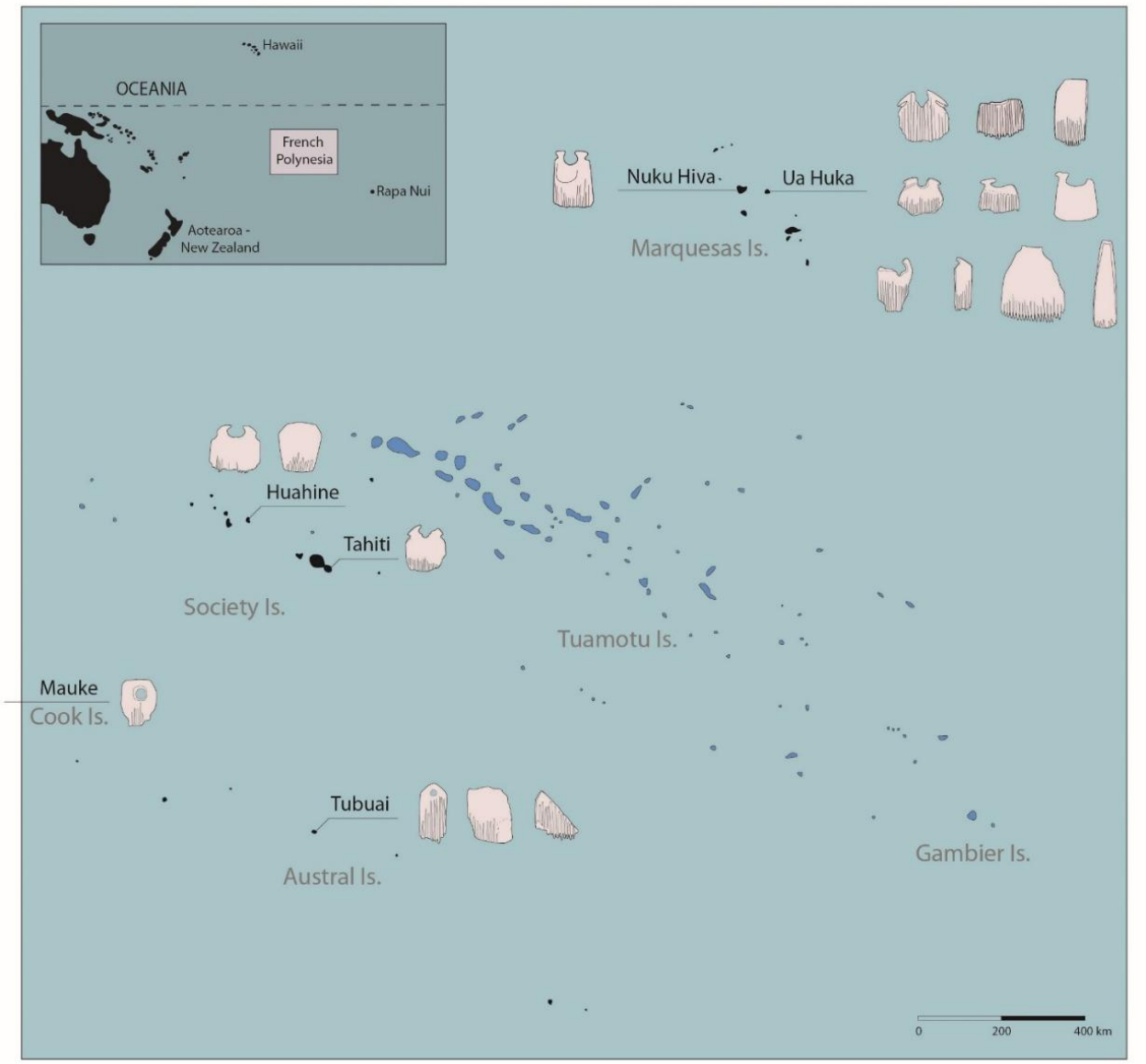


Figure 2: Map of Central East Polynesia showing the location of the pearl shell tattooing combs across archipelagos (Drawings G. Molle, not to scale).

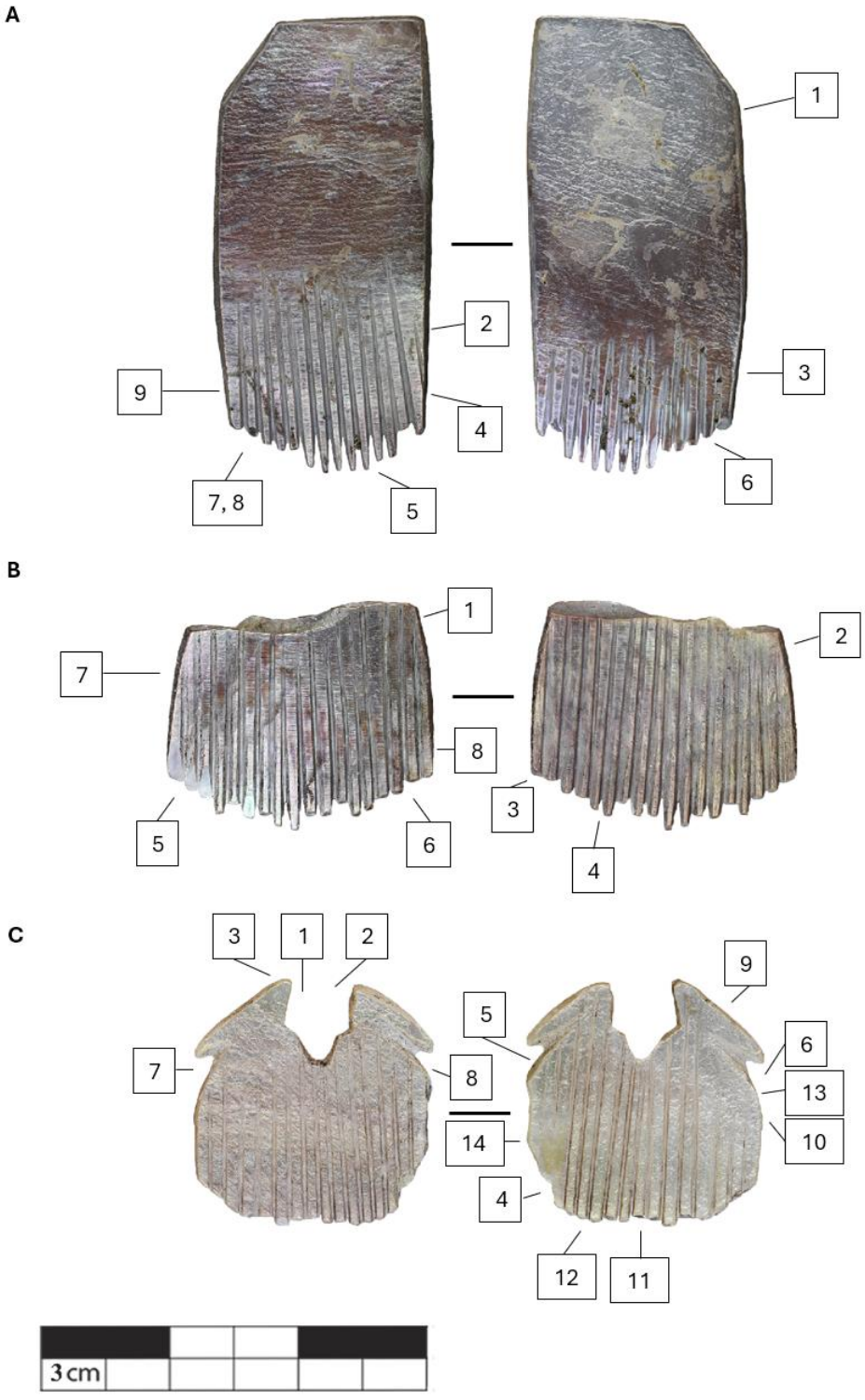


Figure 3: Front and back of the pearl shell tattooing combs A) E8[d.4] #26, B) F7 [d.4] #34, and C) E9[d.4] #58 held at the CIRAP. The numbers around each comb refers to images of microwear traces taken on a stereomicroscope, refer to figures 5-7.

3.1.1. E9[d.4] #58

This object was the only complete and unfragmented comb in the CIRAP collection that contained a notch and wing system used to haft the comb to a stick. Molle and Conte (2013) proposed that the grooves for the teeth were created before the notch and wings and there must have been 17 teeth. The comb contains 15 distal grooves and may have indeed had 17 teeth.

3.1.2. F7 [d.4] #34

Only the mesial and distal parts of this comb remain, including the 17 grooves on each face. This comb would have had 18 teeth, with a maximum of 5 intact points remaining. As the top of the comb is missing, we do not know what the hafting method may have been. Molle and Conte (2013) proposed that filing and polishing the edges of the comb occurred after the grooving of the points.

3.1.3. E8[d.4] #26

Although one of the largest in the assemblage, Molle and Conte (2013) hypothesised that this long rectangular comb was unfinished at the proximal end and proposed it was abandoned during production. This comb would have had 14 teeth, with 7 currently intact, and the comb has 13 grooves on one face and 14 on the other.

3.2. Microwear analysis

Microwear traces on these tattooing combs were compared to the experimental manufacturing traces produced and analysed from McGloin et al.'s experimental study of pearl shell working (2026). This work, the first known study to test the manufacture, use, technical actions and application of various tools and materials in working with pearl shell, builds on ethnographic records of working with pearl shell and provides an initial reference for microwear traces relating to abrading, cutting, sawing, percussion, filing/shaping, drilling, and polish (Figure 4). The three tattooing combs held at the CIRAP were examined for microwear traces using a Leica M80 Stereomicroscope with attached Flexacam (lense achro 1.0x, magnifications 0.75x-6.0x). In this paper, microwear traces encompasses both traces of manufacturing and use, and use-wear specifically refers to traces of use.

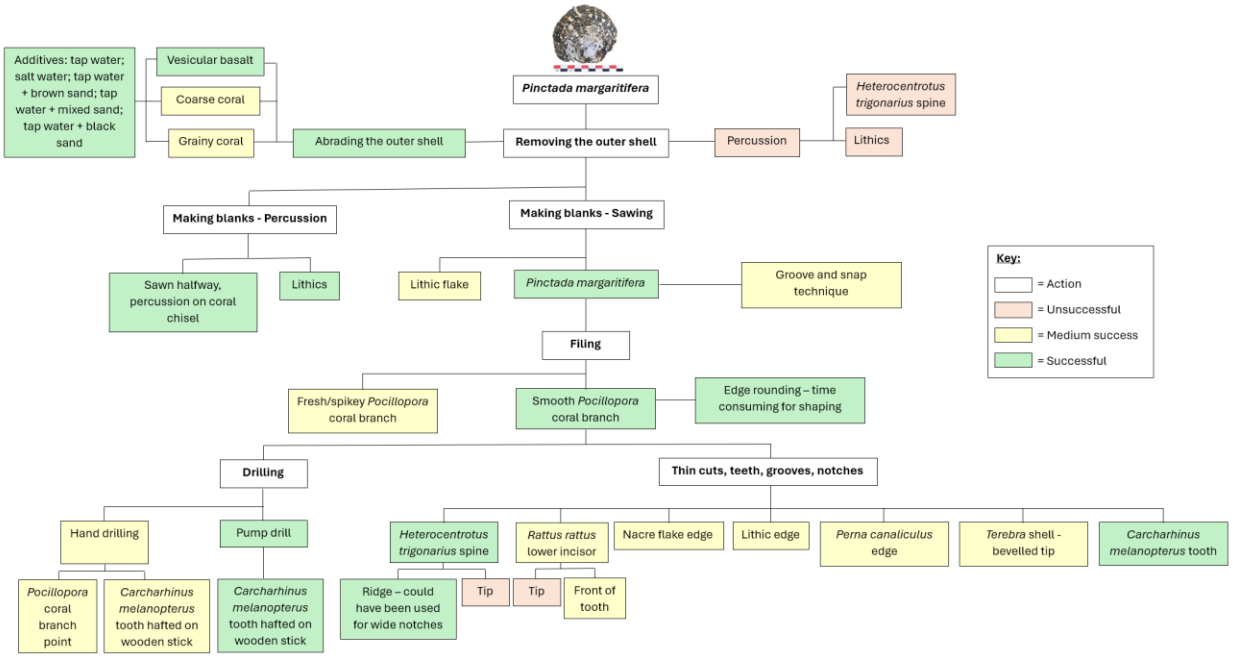


Figure 4: Creating an experimental reference collection (McGloin et al. 2026, Figure 1). CC BY-NC.

4. Results

The following results examine the microwear traces from PDSM, cutting or shaping, abrasion, filing, creating a central notch and wings, the comb teeth, polish, and residue (Figures 5-7).

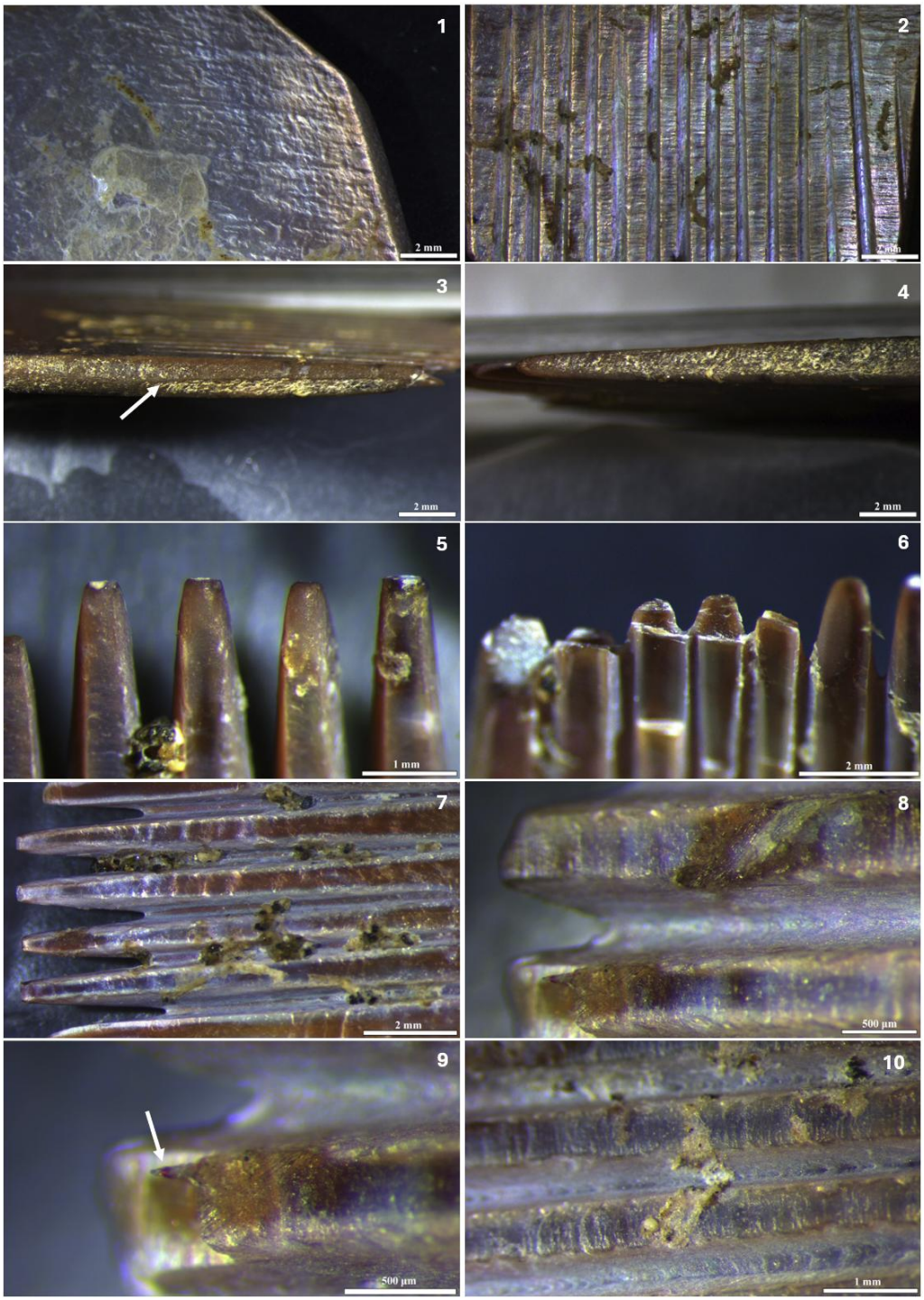


Figure 5: Microwear traces on Comb 26. 1 & 2) directional striations on the faces of the comb with edge rounding and polish at the edges (0.75x magnification); 3) possible trace of the shell being grooved and snapped to shape the comb; 3 & 4) directional striations from filing the edges with pitting on the surface (0.75x magnification); 5 & 6) edge rounding, polish and fresher breakage patterns at the comb tips (5 – 0.25x magnification, 6 – 1.6x magnification); 7) grooves between the teeth and large grains of sand on the surface (1.25x magnification); 8-10) thick, greasy residue with a smeared texture and a bright red residue indicated with an arrow is seen on the edge of the broken tip on image 8, black pigment residue is also seen in the grooves in image 9 (8 – 4.0x magnification, 9 – 6.0x magnification, 10 – 2.5x magnification).

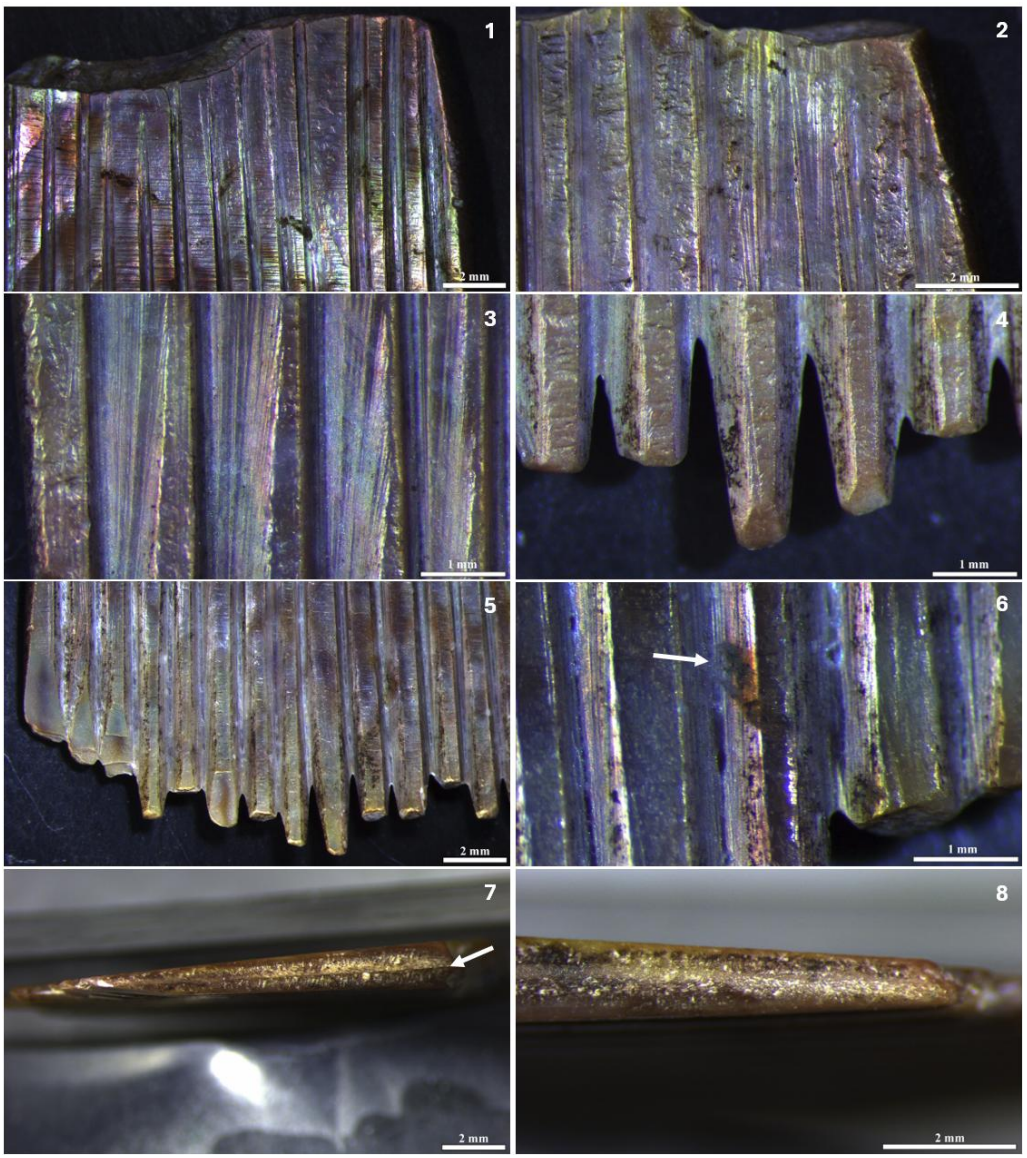


Figure 6: Microwear traces on Comb 34. 1) directional striations on the surface from abrasion (0.75x magnification); 2 & 3) striations from grooving to create the points of the comb (2 – 1.25x magnification, 3 – 2.0x magnification); 4 & 5) the tips of the points showing different levels of edge damage, rounding and polish, and black pigment residue on the surface of the points (4 – 2.0x magnification, 5 – 0.75x magnification); 6) thick, greasy residue with a smeared texture indicated with an arrow and black pigment residue (2.5x magnification); 7 & 8) possible trace of the shell being grooved and snapped to shape the comb and directional striations from filing the edges with pitting on the surface (7 – 0.75x magnification, 8 – 1.6x magnification).

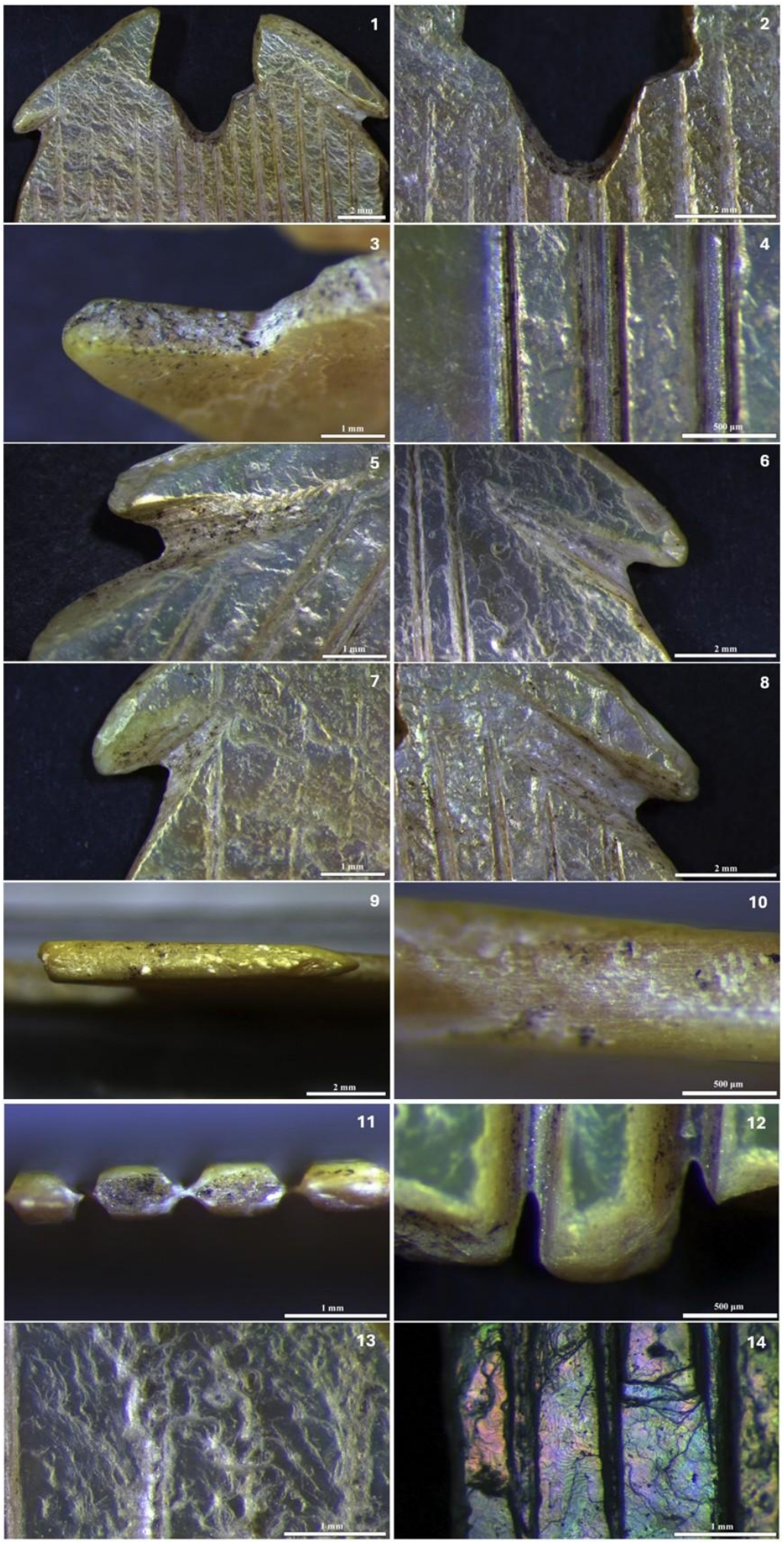


Figure 7: Microwear traces on Comb 58. 1) directional striations on the surface from abrasion (0.75x magnification); 2 & 3) some edge damage at the central notch on the proximal end of the comb from grooving and filing, edge rounding and polish is visible at the edges, and black pigment residue is present (2 – 1.6x magnification, 3 – 2.0x magnification); 4) thin and even striations from grooving to create the points of the comb, with polish visible at the edges of the grooves (6.0x magnification); 5-8) left and right notches to create the 'wings' on the comb with some striations and polish at the edges still visible, and the face of the notch in image 8 appears different to the faces of the other notches (5 & 7 – 2.0x magnification, 6 & 8 – 1.6x magnification); 9 & 10) pitting on the surface of the edges indicates filing occurred with some black pigment present in the pits, directional striations may be the nacreous layers of the shell (9 – 1.25x magnification, 10 – 6.0x magnification); 11 & 12) the tips of the points showing different levels of edge damage, rounding and polish, and black pigment on the surface of the points (11 – 3.2x magnification, 12 – 6.0x magnification); 13 & 14) degradation on the surface of the shell with pitting visible (3.2x magnification).

4.1. Post-Depositional Surface Modification (PDSM)

All combs show some PDSM, such as pitting – a wear trace resulting in small pits on the surface of the object and distinct from existing surface 'micro-depressions' – and swirling patterns on the surface of combs 26 and 58 likely from surface dissolution (Figures 5.1, 7.13 & 7.14). However, some microwear traces remain visible through the surface weathering. On comb 58, long directional lines on the sides are more likely to be a chemical alteration of the nacreous layers of the shell, resulting in some distinction between these layers (Figure 7.10). Some traces from manufacturing and use may have been obscured by degradation, or it may be difficult to distinguish the tools or materials used to create specific traces from a manufacturing stage or action, such as abrasion.

4.2. Cutting/Shaping the preform

On comb 26 and 34 there are possible microwear traces from the groove and snap method to shape the comb, including edge damage, and some sides have two slightly different angles (Figures 5.3 & 6.7). The proximal part diagonal edge on comb 26 also contains some scars, high edge rounding and polish at the edges, indicating this edge may have fractured diagonally during shaping and was then intentionally filed as the comb continued to be worked on.

4.3. Abrasion

Both combs 26 and 34 show similar traces of abrasion on both faces, with long, directional and fine striations (Figures 5.1-2 & 6.1). 26 had a higher level of PDSM pitting and surface dissolution on the proximal parts of the comb compared to the distal parts. One face of 26 and both faces of 34 also have more dense, clear and possibly deeper striations on the distal end, making them more visible and thinning the thickness of the comb points from one face. Whilst comb 58 has clear, long, directional striations on one face, there is greater PDSM on this comb making it difficult to see if these striations are indeed similar to the ones on combs 26 and 34 (Figure 7.1). By comparing these results to McGloin et al.'s (2026) abrasion experiments, the striations show similarities to traces of abrasion with a sand and water slurry compared to abrasion solely with coral or basalt. Whilst thinning of the proximal part appears on all three combs, the greater density of striations on one face over the other suggests that the majority of thinning from abrasion is completed on one face of the comb. The craftsperson may have also utilised the natural gentle curved shape of the pearl shell to craft the teeth towards the thinning distal edge of a shell.

4.4. Filing

All three combs display evidence of filed edges, with visible short and directional striations, some pitting, and edge rounding (Figures 5.3-4, 6.7-8 & 7.9-10). However, comb 58 displays more use-wear rounding and polish on the edges. The pitting on these combs appears similar to microwear traces from experiments of filing pearl shell with a branched *Pocillopora* coral, and is different from pitting by PDSM, which are usually more irregularly shaped.

4.5. Notch and wings

The notch and wing fastening system is only seen on the proximal end of comb 58 (Figure 7.1). Three out of four faces of these wing notches have short, directional and converging striations to form a 'V' shape, with a rounded 'V' to an elongated 'U' shaped edge (Figures 7.5-7). These traces are similar to experimental notches using a *Heterocentrotus trigonarius* spine, which had an elongated 'U' shaped notch with clear directional striations. However, experimenting with these spines has shown that different grooving techniques can produce different traces, highlighting the potential to create a similar trace with a smaller spine or using a spine with a higher spine ridge and changing the angle of grooving on the surface of the shell. Conversely, the fourth wing notch displays a very different shape, with parallel striations forming a wide 'U' shape and a wide rounded 'U' edge (Figure 7.8).

The central notch on this comb appears to have first been cut and then the inner edge filed down, with edge rounding and polish indicating some use (Figures 7.1-3). Filing was done from one face and at a slight angle, with some edge damage. Based on the overlapping of different traces, it is believed the central notch was made after grooving the comb teeth.

4.6. Comb teeth

All combs display very fine, even and deep grooves with 'V' shaped edges between the points (Figures 5.5-7, 6.4-5 & 7.4, 7.11-12). The grooves are also precise with slightly tapered ends on the mesial part. Based on experiments, the traces on the combs were similar to small and thin striations from grooving in a sawing-like motion from the distal edge by a very fine tool. Whilst we infer the teeth may have been created in a similar method, further experimental actions and tools are required to test this. We cannot say if grooving was completed on one face then the other or tooth by tooth, but distal edge grooving creates a notch marker indicating where to groove on the other face. Comb 34 displays less control and skill compared to the other combs, with clear misgrooves on the face of the comb, characterised by the clear overlapping of the grooving striations onto the faces of the comb and is similar to the author's novice experimental grooving of teeth (Figures 6.2-3). For both combs 26 and 34, the complete points display use-wear edge rounding and clear polish. The damaged points have clean breaks and a few show edge rounding, indicating the combs continued to be used before further points broke and it does not appear that they were re-sharpened. All points on comb 58 are broken, with some points showing polish and high edge rounding suggesting the comb continued to be used after they had broken, and other points show fresher breaks. Based on experimental grooving traces on pearl shell, the grooves for the points most closely resemble those made by a shark's tooth, with even, straight striations with clear ends and thin, elongated 'U' shaped edges between the points.

4.7. Residues

All combs have very small and fine black pigments on the surface, which is likely ink residue and differs to the sand grains seen on comb 26 (Figure 5.7). These pigments are present on the distal portion of the combs at the points, noting that comb 34 is missing the proximal end. Conversely, black pigments are found on the edges of the central notch and wings and in the grooves of the teeth on comb 58 (Figures 7.2-12). The presence of pigments on the proximal end may indicate that it settled

under the original ligature. Comb 26 also contains possible dark staining on the proximal end and one spot with an unknown bright red residue (Figure 5.9). Whilst there is no documentation of red pigments being used for tattooing in CEP, a red pigment could have been used for another purpose and transferred to the comb. Alternatively, this residue may be modern from post excavation and residue analysis is required to investigate further. Combs 26 and 34 also contain a thick, greasy residue with a smeared texture, which is believed to be fatty-tissue from skin and blood residue (Figures 5.8-10 & 6.6). Similar residues for charcoal or ink pigments, fatty-tissue, and blood-like residues have been identified on obsidian and bone tattooing implements (Gates St-Pierre 2018; Kononenko 2012; Kononenko et al. 2016; Torrence et al. 2017), but residue studies are required to examine these further.

5. Discussion

This research is the first microwear study on pearl shell artefacts in Polynesia and the Pacific, and seeks to address the gap in knowledge about the production of such artefacts. It also demonstrates that microwear analysis is not only achievable but is an invaluable technique that provides critical insight into the manufacture and use of archaeological pearl shell artefacts and traditional tattooing in CEP. The microwear analysis of these combs indicates the high level of skills and knowledge by Polynesian master tattooists to work with pearl shells to create, use and maintain these tools.

All three combs indicate evidence of use, with the comb points on 34 showing less use, and comb 58 displaying high edge rounding and polish at broken comb points, indicating a high use life. The traces suggest that as the points broke, the comb continued to be used, rounding the broken point edges until the comb could no longer be used.

Molle and Conte (2013) hypothesised based on visual analysis that comb 26 was unused and unfinished as the proximal end did not match the hafting methods on the other combs. However, we hypothesise this comb was used due to use-wear traces on the points and the presence of residues, indicating that this comb may have been hafted in a different method or used in a different way to the other combs. This demonstrates microwear's importance in complementing visual analysis to provide further insight into the biographies of archaeological objects.

Based on microwear analysis on comb 58 and the layering of traces, it appears that the teeth, the most delicate part of the comb, were grooved first followed by the notching of the wings. For the chaîne opératoire, this suggests that distal shaping occurred first followed by the proximal end. It is important to note that this does not mean that every winged tattooing comb was completed in this sequence, but indicates that for this comb the craftsperson chose to first create the teeth before making the wings. Whilst this study supports Molle and Conte's (2013) hypothesised chaîne opératoire for pearl shell tattooing combs, our results indicate that rather than the proximal or distal shaping occurring as an interchangeable process at the same stage of manufacturing, distal shaping occurred before proximal shaping for the three combs analysed here. Further analysis of the other combs is required to confirm if the chaîne opératoire is the same or varied across the region.

Three out of four faces of the wings are also very similar, with the fourth face raising questions as to why a different tool or technique was used to groove this face. Clear knowledge of working with pearl shell is evident in these traces, with very straight and even grooves for the teeth, but the wings may indicate the craftsperson was testing new methods to see if they could improve the

manufacturing process or to create a more secure hafting style. The misgrooves on Comb 34 also appear to indicate slightly lower skills in creating fine points than the level of control seen in combs 26 and 58. The breakage of the archaeological comb points raises the question of the durability of this material as breakage during tattooing could compromise the aesthetic of the tattoo. Certainly, durability is one possible explanation for the short period during which Pacific tattooists made use of pearl shell for tattoo combs before shifting to combs made from bone or turtle shell, materials that remained in use for this function over centuries.

The presence of potential ink pigments, blood and fatty tissue residues on the combs under discussion, along with the observed use-wear traces, supports the interpretation that these combs had been used as tattooing implements. The presence of black pigments on the proximal section of comb 58 suggests that this comb or the application of ink may have been handled in a different manner to the other combs. However, a detailed residue study is required to confirm the types of residues found.

5.1. Microscopic data informing macroscopic observations

Using the results of microwear analysis, it is possible to infer manufacturing techniques through the macroscopic examination of the four combs on display at the museum (Figure 8). Combs 2132, 6042 and D2020.1.2 have proximal shaping with a notch and wing system and one comb displays a direct fix method with a perforation on the proximal end. These combs indicate the notches were made through perforation and the wide wing edges were created using a different tool to the wings on comb 58. The grooves for the teeth on the combs with a notch and wings are also shorter than those on comb 58, and the grooves are longer on the direct fix comb than the grooves on combs 26 and 34, highlighting difference in traces made by different craftspeople. All museum combs also show visible pencil lines at the edges, likely from post excavation. Similarly, the results of this study can be used as a reference for general considerations and macroscopic examination of other pearl shell combs and artefacts.

Finally, the description of a tattooing comb by Walter (1998) from Anai'o on Mauke, Cook Islands, is an interesting addition to the known corpus of pearl shell tattooing combs. Geographically, the presence of this comb expands the known region of their use within CEP, underscoring the value of further research into the interactions and exchange of goods and cultural practices between these various archipelagos, including tattooing techniques and traditions.



Figure 8: Pearl shell tattooing combs displayed at the Te Fare Iamanaha - Musée de Tahiti et des Îles. Museum accession numbers D2020.1.2, 2132, 2133, 6042.

6. Conclusion

These results illuminate the manufacturing tools, techniques and use of tattooing combs in the Pacific with all three combs indicating evidence of use, including comb 26 which was previously thought to be unfinished. Further research should focus on expanding understandings of use-wear traces through experimental analysis and use-wear studies on further tattooing implements. This study, while limited by available tattooing combs and preliminary experimental references, provides a critical and novel foundation for examining archaeological objects in CEP, demonstrating the skills of individual Pacific artisans and shared suites of technique and knowledge. Further examination of additional objects for microwear traces will direct new experimental research and, in turn, expand known microwear traces for reference in examination of further objects. This analysis also demonstrates what investigating the traces of manufacture and use can tell us about how past individuals worked, interacted with, and used these objects – highlighting the potential of microwear analysis in examining questions around cultural, social, and ritual dimensions of ancient ways of life in CEP through the practice of tattooing.

Supplementary Materials

The supporting information can be downloaded at https://doi.org/10.70460/jpa.v16i1.410 S1: Information on the 18 known pearl shell tattooing combs from Polynesia. Drawings of each comb are from Molle and Conte (2013, Figures 6-11) and Furey (2017, Figure 11.3) for the comb from Anai'o, not to scale.

Funding

This research is supported by an Australian Government Research Training Program Scholarship. J. McGloin received additional funding support from the University of French Polynesia and CIRAP for her field trip in Tahiti.

Data Availability Statement

The authors confirm that the data supporting the findings of this study are available within the article and its supplementary materials.

Conflicts of Interest

The authors declare no conflicts of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript; or in the decision to publish the results.

Author Contributions

Conceptualization, J.M. and G.M.; methodology, J.M..; formal analysis, J.M.; investigation, J. M.; writing—original draft preparation, J.M.; writing—review and editing, J.M, E.C. and G.M.; supervision, G.M. All authors have read and agreed to the published version of the manuscript.

AI Disclosure Statement

No GenAI was used for any part of this research or manuscript preparation.

Acknowledgements

We thank the Te Fare Iamanaha - Musée de Tahiti et des Iles for providing access to examine the tattooing combs held there. We also thank C. Frieman and S. Samper-Carro for their early reviews and comments on the manuscript.

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