NEW ZEALAND ARCHAEOLOGICAL ASSOCIATION

ARCHAEOLOGY IN NEW ZEALAND

DETERMINING THE FUNCTION OF THE FLAKE TOOLS OF MOA HUNTERS

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INTRODUCTION

Usewear analysis has been employed in archaeology since Semenov's experiments in the 1960s which involved noting changes which occurred on stone tools after use on various materials (Semenov 1964).

In New Zealand, the application of usewear analysis and experimentation has been limited, with the majority of studies carried out on obsidian (Jones 1972; Morwood 1974; Gillies 1981; Fredericksen 1987). But researchers have shown that usewear is particular to the type of rock being used and the characteristics found in a usewear analysis of one rock type will not necessarily be the same for another (Keeley 1980:5; Tringham et al. 1974:179). As there were many rock types used for the manufacture of flake tools in prehistoric New Zealand, separate usewear studies are required for each type. In the South Island, for example, common rock types used were silcrete, chalcedony, chert and porcellanite. Tools made of these rock types can produce very sharp edges and their usefulness to the moa hunters, especially silcrete and porcellanite, is illustrated by their presence in these sites.

Kooyman (1985) in his PhD thesis "Moa and Moa Hunting: An Archaeological Analysis of Big Game Hunting in New Zealand" undertook usewear analysis of silcrete and porcellanite tools to determine the function and materials worked by moa hunters using tools of these rock types. Though other usewear analysis had been undertaken on silcrete and porcellanite, Kooyman (1985:133) noted that one involved only the applying of characteristics from other studies to the tools (Carty 1981) and the other examined only fourteen experiments with silcrete not being included (Bain 1979).

Kooyman's study was, therefore, the first usewear analysis in New Zealand for silcrete and porcellanite that involved experimenting with manufactured flake tools and comparing the results with tools from archaeological assemblages. Eighty seven porcellanite and twenty silcrete experiments were undertaken. His experiments, however, concentrated on the microchipping and polish that developed on porcellanite and the polish which formed on silcrete. He found that when it came to analyzing microchipping for silcrete "Although microchipping did occur in some of the silcrete experiments, it was rare and seemed essentially random in nature. It also did not occur at all in the experiments on softer materials and hence could not be used to examine the full range of possible worked materials from a site." (Kooyman 1985:135).

From Kooyman's observations, I decided that a usewear analysis study of silcrete flake tools was required to find what various materials produced microchipping seen on silcrete flake tools from moa hunting sites (Schmidt n.d.(a)).

PRELIMINARY EXPERIMENTS

Silcrete is a duricrust which can be described as a "Deposit of the weathering zone especially in subtropical environments, which may ultimately develop into a hardened mass." (Allaby and Allaby 1991:118). Silcrete is one of a number of types of duricrust and is distinguished from the other varieties by its dominant mineral silica (Allaby and Allaby 1991:118). This dominance makes silcrete very hard, having a Mohs hardness of seven (Allaby and Allaby 1991:303), and together with its ease of flaking and ability to produce flakes with glass like edges, it is a very practical rock type for the manufacture of stone tools.

Understanding the characteristics of silcrete as a medium for tool manufacture, involved working a variety of materials using differing forms of flakes and employing different actions when using them. Twenty silcrete flakes were manufactured keeping in mind the kinds of silcrete flake tools seen in moa hunting sites in Otago.

Five flakes were chosen for each action to work meat, bone, softwood and hardwood with each flake being used for fifteen minutes. Table 1 summarises the results of using the twenty flakes on the various materials. The usefulness of the actions for working the materials were described as being good, moderate or poor. The presence of obvious damage accumulation on the edge was describe as being either absent, random (occurring only occasionally on used flakes) or present.

The flake tools were observed as being restricted in their usefulness when it came to performing particular actions on various materials. Cutting and chopping were restricted to the working of meat, with cutting/sawing and high and low angle scraping being useful only for working softwood and hardwood. All actions appeared to perform poorly when attempting to work bone. It was observed that, when attempting to cut or saw bone with silcrete, the tools tended to slide off the bone with the edges of the tools being unable to 'bite' into the bone surface. Scraping of bone also did not appear to be practical other than for possibly cleaning the bone surface of fat.

The only material that produced notable or distinctive damage on the

Table 1. Efficiency of silcrete flakes on materials and the presence of edge damage after use. Good, moderate and poor describe the usefulness of the tool for working the specified material. Absent, random and present describe the occurrence of edge damage on the tools.

Activity	Meat	Bone	Softwood	Hardwood
Cutting	Good/ Absent	Poor/Random	Mod./Random	Mod./Present
Sawing	--	Poor/Random	Mod./Random	Mod./Present
High Angle Scraping	--	Poor/Random	Good/Random	Good/Present
Low Angle Scraping	--	Poor/Random	Good/Random	Good/Present
Chopping	Good/ Absent	Poor/Random	Poor/Random	Poor/Present

flakes was hardwood. It was found that the tough character of silcrete meant that any edge damage that did occur to the flakes and which could be obviously seen, was determined by the type of material being fashioned. This 'observable' damage was seen to occur with hardwood, manuka (*Leptospermum scoparium*), and so this material was chosen for the main experiment.

Three actions were seen as being most useful in the fashioning of hardwood: cutting/sawing, high angle scraping and low angle scraping. The action of chopping would have probably been left to the use of adzes. Cutting/sawing was used to cut grooves and notches in the hardwood as well as sawing off small pieces of wood. High angle scraping was used to shape wood acting similar to a 'plane'. Stripping the bark off hardwood and smoothing the surface of the material after planing was efficient using low angle scraping.

With these actions also came particular shapes of flakes that made the kinetics behind the actions easy and practical. It was found that cutter/sawers were most useful as flat flakes with long cutting edges, whereas high angle scraping was most effective when using thicker flakes. Finally, low angle scraping was most efficient with flat and short flakes.

When experimenting with flake tools, determining how long a tool will be worked with before a usewear analysis is undertaken has often involved either a time period of use (Fredericksen 1987: Table D1(a)) or analysis after 'n' number of strokes (Tringham et al. 1974:184). The preliminary experiments showed that a time period is the most realistic way of determining tool use. This is because a worker of a material does not consider what amount of effective work has been undertaken after a certain number of strokes, but works with the flake until the task is complete or the tool becomes useless. It was found that a great deal of work could be achieved within ten minutes when employing any one of the three actions, this time was therefore used as my constant.

Many usewear analysis studies employ microscopic analysis of the experimental flakes. These range from the use of a 10x hand lens (Moss 1983), to the use of the Scanning Electron Microscope (Hay 1977; Mansur-Franchomme 1983). Due to the crystalline matrix of silcrete and the tough nature of the rock, I found that the analysis of the flakes using the eye and a 10x hand lens under a laboratory lamp against a dark background, was most appropriate. Using a microscope even as low as 40x and using differing light intensities, made analysis difficult because of the reflective nature of the rock. The descriptive technique involved describing the damage before and after experimentation so that obvious changes in the appearance of the edge could be determined when comparing the pre and post experimental data. The edge damage descriptions considered 5 aspects, with the aspect of staining also being recorded:

1) Damage percentage - indicates what amount of the working edge is damaged. A newly manufactured silcrete flake will have an unmodified and fresh appearance with only a small number of chips being observed along the length of the working edge. An unused flake will have, therefore, a low damage percent. A high damage percent reflects an increase in edge damage along the working edge of a flake due to use. Damage percent, then, can be seen as a change from an unmodified flake edge with a known number of chips before use, to a modified edge with an increase in the number of chips after use.

2) Chip Number - this refers to the number of chips that are present on a working edge. All chips encountered on this edge using a 10x hand lens are recorded.

3) Character - character can be described as smooth, undulating or jagged (Fig. 1). This description looks at the morphology along the working edge of the flake. Smooth: describes the edges of flakes that have little damage over their whole length, their edge, therefore, looking smooth when observed. Undulating: describes flakes that have sustained noticeable damage along their whole length. The flake edge therefore appears to undulate up and down and this may be seen as being low, medium or high in appearance. Jagged: describes flakes where the whole edge is extremely damaged with the edge appearing very sharp due to extreme peaks and dips along its length.

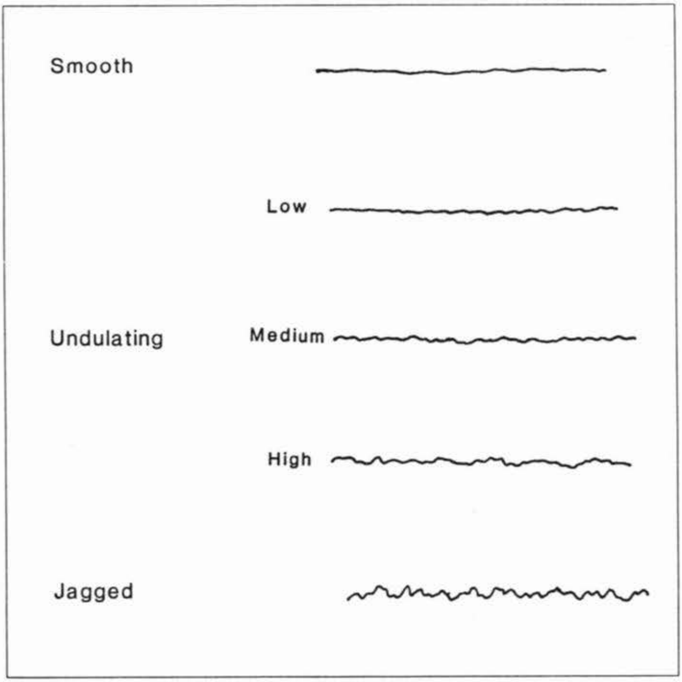


Figure 1. An illustration of the different characters of silcrete flake edges. Changes can be observed before and after the use of a flake on hardwood.

4) Chip Size - describes the actual size of the chips on the working edge overall. A flake can have a working edge where the chips are mostly small (0 to 0.5 mm in width), medium (0.5 to 1mm in width), or large (greater than 1mm in width). With Character describing the vertical aspect of damage, Chip Size describes the horizontal aspect.

5) Damage Side - the face of the flake where most damage has occurred. Chips and their associated scars may occur either predominantly on the Dorsal (D) or Ventral (V) side of the flake. The dorsal side is most often the face of the flake directed away from the material, with the ventral side being the face of the flake directed towards the worked material. With the flattest side directed towards the materials surface, controlling the movement of the flake is easiest. Damage may also occur relatively evenly on either flake surface, Both (B) is used to describe this occurrence.

6) Staining - It was observed during the preliminary experiments that a stain formed on the edges and faces of the flake tools while working manuka.

Usewear studies have considered polish or residues on archaeological samples to help determine material worked using the flake tools (Vaughan 1985; Mansur-Frachomme 1983; Loy 1983). I decided, therefore, to note the presence and position of staining that occurred on the flake tools as this may possibly survive in an archaeological site as a polish or residue. The side of the flake where staining mainly occurs is described as either Dorsal (D), Ventral (V) or Both (B).

As will be explained later, consistency in the analytical technique was maintained using before and after photography of flake edges.

MAIN EXPERIMENT

The experiment had 3 Objectives:
1) To observe the edge damage which occurs on silcrete flake tools after use on hardwood.

2) To note what edge damage occurs for various types of actions used on hardwood.

3) To determine whether edge damage, tool morphology and edge angle of flake tools are related in determining the function of a flake tool. This objective will consider the most useful tool form for undertaking a task and relate this to edge damage to show what material would have been most likely to have been worked using that particular flake.

METHODOLOGY

1) Flakes were manufactured from a core of silcrete by percussion. No flakes were retouched.

2) The flakes were bagged immediately after manufacture to avoid damage occurring during transport and handling.

3) From the manufactured flakes, sixty were chosen for experimentation, using criteria noted during the preliminary experiments, providing twenty for each action.

4) The flakes were then numbered from 1 to 20 for each action, and lettered: 'A' denoting Cutter/Sawers (1A-20A); 'B', High Angle Scrapers (1B-20B); 'C', Low Angle Scrapers (1C-20C). Length, Width and Thickness of the flakes were then recorded, as well as the Edge Angles which were measured using a goniometer.

5) The flakes were then analysed and described under lamplight against a dark backdrop for damage percent, number of chips and character of edge.

6) Ten flakes from each action were then chosen randomly for close up photography of their edges. This was done so as to provide consistency in the flake descriptions before and after use.

7) The flakes were then used to work manuka for ten minutes each according to their particular actions. Total working time for the sixty flakes was six hours. Notes were made during the working of the hardwood relating to the usefulness of each action and of each flake. After each flake had been used it was immediately placed back in its bag.

8) After use, each flake was cleaned using a soft brush. Flakes that had been photographed were then re-photographed.

9) The flakes were then described again using the same technique as in step 5, with the additional descriptions of chip size, damage side and staining side being undertaken.

10) The data from steps 5 and 9 were then compared.

11) The observations noted from the experiment were finally used to deduce the function of silcrete flake tools from an archaeological assemblage.

RESULTS

Table 2 illustrates the change which occurs to a fresh silcrete flake tool after it has been used for various tasks for ten minutes. This change is an important observation as this makes it possible to deduce whether, when found in an archaeological context, a flake has actually been used or not. It can be seen that the mean percentage of damage and the mean number of chips on the working edges increases dramatically overall. The noticeable increase in damage together with the durability of silcrete would mean that any post-depositional damage that may have occurred to flakes in an archaeological assemblage, would probably be negligible and would have little effect on distinguishing between used and unused flakes from an assemblage.

Character of the flakes also changed notably (Table 3). From a total of 14 smooth, 32 undulated and 14 jagged flakes before use, all flakes became undulated, except for one sample which remained smooth. The edge of the flakes became more wave like in appearance as chips were broken off during activity. We could, then, separate out from an archaeological assemblage what flakes have most likely been used to work hardwood.

Table 2. Differences in edge damage before and after working hardwood. (S.D. = Standard Deviation.).

Pre-Use Data

Damage	Cutting/Sawing	High Angle Scr.	Low Angle Scr.
	(Mean/S.D.)	(Mean/S.D.)	(Mean/S.D.)
Mean Damage (percent)	33 $\pm$ 20	33 $\pm$ 19	60 $\pm$ 22
Mean No. Chips	13 $\pm$ 7	11 $\pm$ 5	18 $\pm$ 7
Total N	20	20	20

Post-Use Data

Damage	Cutting/Sawing	High Angle Scr.	Low Angle Scr.
	(Mean/S.D.)	(Mean/S.D.)	(Mean/S.D.)
Mean Damage (percent)	85 $\pm$ 14	81 $\pm$ 16	81 $\pm$ 11
Mean No. Chips	39 $\pm$ 11	36 $\pm$ 11	32 $\pm$ 10
Total N	20	20	20

Table 3. Change in character of working edge before and after working hardwood. (S.D. = Standard Deviation.).

Pre-Use Data

Character	Cutting/Sawing	High Angle Scr.	Low Angle Scr.
Smooth	6	6	2
Und: Low	5	10	4
Med	2	0	6
High	0	4	1
Jagged	7	0	7
Total N	20	20	20

To find what action a silcrete flake had been used for, it was noted during the experiment what particular shapes of flakes were the more useful. From these observations, it was found that those flakes with an edge angle of less than 40 degrees were more useful for cutting/sawing and low angle scraping, and flakes with an edge angle greater than 40 degrees better equipped for high angle scraping. I, therefore, separated from my total assemblage, after pre and post use descriptions had been carried out, those flakes with a 40 degrees or less angle for cutter/sawers and low angle scrapers, and high angle scrapers with an edge angle greater than 40 degrees. On doing this, 10 cutting/sawing, 15 low angle scraping and 13 high angle scraping flakes were isolated.

Table 4. Edge damage of used flakes isolated according to edge angle and most effective morphology for work. (S.D. = Standard Deviation.).

	Cutting/Sawing	**High Angle Scr.**	**Low Angle Scr.**
	(Mean/S.D.)	(Mean/S.D.)	(Mean/S.D.)
Mean Damage percent	90 $\pm$ 5	78 $\pm$ 8	81 $\pm$ 8
Mean No.Chips	43 $\pm$ 10	37 $\pm$ 10	33 $\pm$ 7
Edge Angle	<40	>40	<40
Total N	10	13	15

Table 4 illustrates the mean damage percent and the mean chip number of the isolated post-use flakes. When the most useful flakes for working manuka are isolated from each category, the amount of damage and number of chips that result for each action can be seen to be different. Here the cutter/sawers receive more overall damage on the edge and a greater number of chips. The amount of damage on the edge for the high and low angle scrapers is similar. As the cutter/sawers are more effective with an edge angle of less than 40 degrees, damage appears to increase with this effectiveness (compare Table 2 and 4). This is due to a smaller angle extending up from the end of the tool allowing cuts to be made deeper in the wood. As the tool cuts deeper the edge is continually being worked and so more damage results. When the angle is greater than 40 degrees, the tool is restricted to the depth it can cut and cannot be used effectively for this task.

High angle scrapers have a thicker edge and, when scraping, chips do not break off as often as cutter/sawers. The similarity between damage of the low angle scrapers and the high angle scrapers is due to where the force is being

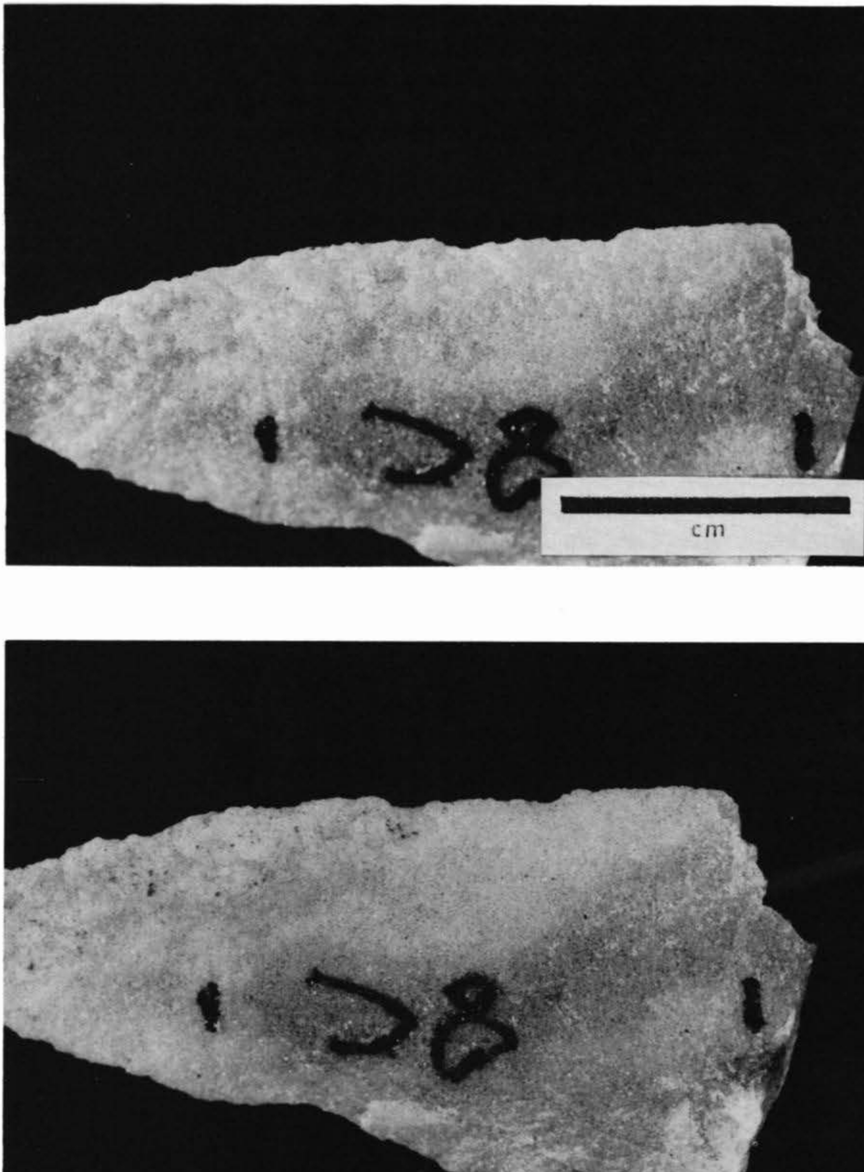
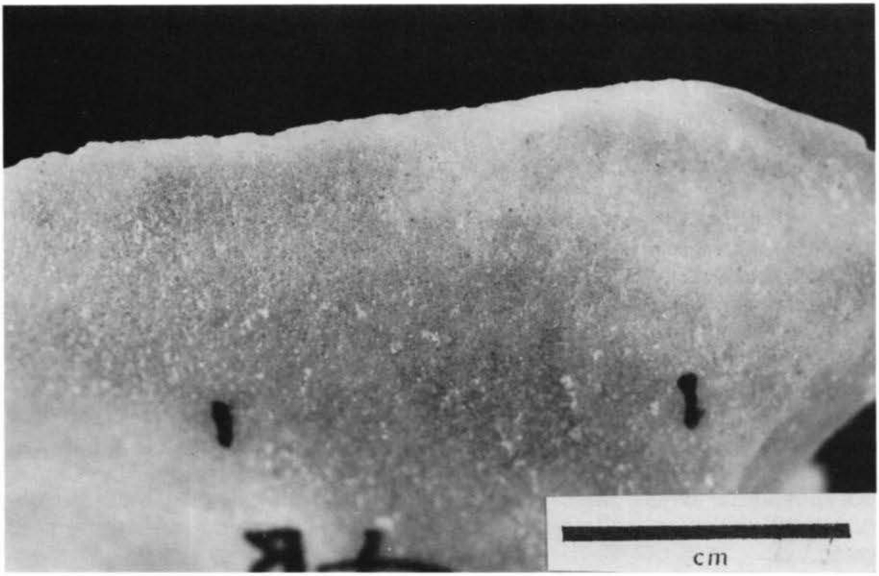


Plate 1. Edge damage sustained on a low angle scraper before (top) and after (bottom) use on hardwood.



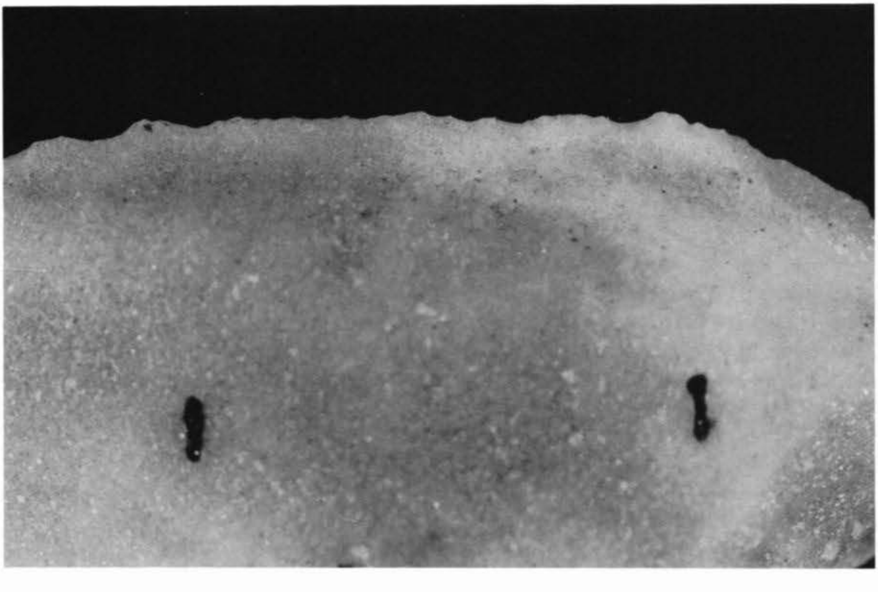


Plate 2. Edge damage sustained on a high angle scraper before (top) and after (bottom) use on hardwood.

exerted during work. Low angle scrapers are thinner but the wood is working against the structure of the silcrete along the edge. High angle scrapers have a thicker edge and this robustness makes up for the wood being forced directly onto the edge face (Fig. 2).

Table 5 illustrates the characteristics of silcrete flake tools that have been used for various actions to work hardwood. Plates 1 to 3 show examples of cutter/sawers, high angle scrapers and low angle scrapers with these characteristics. Looking at the character of the flake tools, the character of the cutting/sawing flakes are mainly high in undulation. The undulation of the high angle scraping flakes are low to medium, and the low angle scraping flakes have low, medium and high being roughly the same. The chip size for cutting/sawing flakes is predominantly large, the high angle scraping flakes have mainly small and medium sized chips. Chips on low angle scrapers are also mainly small or medium. The high undulation and large chips for the cutting/sawing flakes are, again, a result of the rigorous activity employed. It was observed that when cutting/sawing, though the edge does become blunted, it also appears to 'renew' itself. This happens due to the chipping on the edge causing the working edge to remain somewhat serrated for continual cutting and sawing.

High angle scrapers have low to medium undulation and small/medium sized chips due to a higher angle of the working edge. This makes the edge more robust and less prone to damage. Undulation of the edge of the low angle scrapers appears to vary greatly. Occasionally large chips would be removed in the first couple of minutes of using these flakes due to the thinness of the edge, with small chips then forming inside the large chips during the remainder of use. This therefore produced an edge with many small chips, but with a variable undulation from the initial large chips being removed. Tables 4 and 5, then, illustrate that flakes develop damage differently depending on what activity they are used for.

The damage side and staining side on the isolated flakes will indicate the location of work on the flake edges (Table 5). All cutting/sawing flakes had damage and staining occurring relatively evenly on both sides of the flake. This is because both sides of the tool are being utilised during activity. There was an additional observation that larger chip scars were more common on the edge creating the edge angle and smaller scars on the flatter side of the flake. Nine out of thirteen of the high angle scrapers had damage mainly on the dorsal side, and nine out of thirteen had staining mainly on the ventral side. All low angle scrapers had damage mainly on the dorsal side and all had staining predominantly on the ventral side.

High angle scrapers have staining mainly on the ventral side where shavings of wood have been lifted off the wood surface. Damage appears on the dorsal side due to the edge being forced backwards causing chips to mainly break off from this face. Occasionally, though, more damage appears on

Table 5. Distinguishing between silcrete blades used for different tasks to work hardwood. (S.D.= Standard Deviation).

	Cutting/Sawing	High Ang.Scr.	Low Ang.Scr.
Character:			
Smooth	0	1	0
Und:Low	1	6	4
Med	3	4	5
High	6	2	6
Total N	10	13	15
Chip Size:			
Small	0	5	6
Med	3	5	8
Large	7	3	1
Total N	10	13	15
Dam. Side:			
Dorsal	0	9	15
Ventral	0	4	0
Both	10	0	0
Total N	10	13	15
Stain Side:			
Dorsal	0	1	0
Ventral	0	10	15
Both	10	2	0
Total N	10	13	15
Morphology (cm):	(Mean/S.D.)	(Mean/S.D)	(Mean/S.D.)
Mean Lgth.	6.2 ± 1.4	4.5 ± 1	3.8 ± 0.7
Mean Wdth.	4.3 ± 0.8	3.2 ± 1	2.5 ± 0.5
Mean Thick	1.6 ± 0.3	1.3 ± 0.4	0.6 ± 0.2
Total N	10	13	15

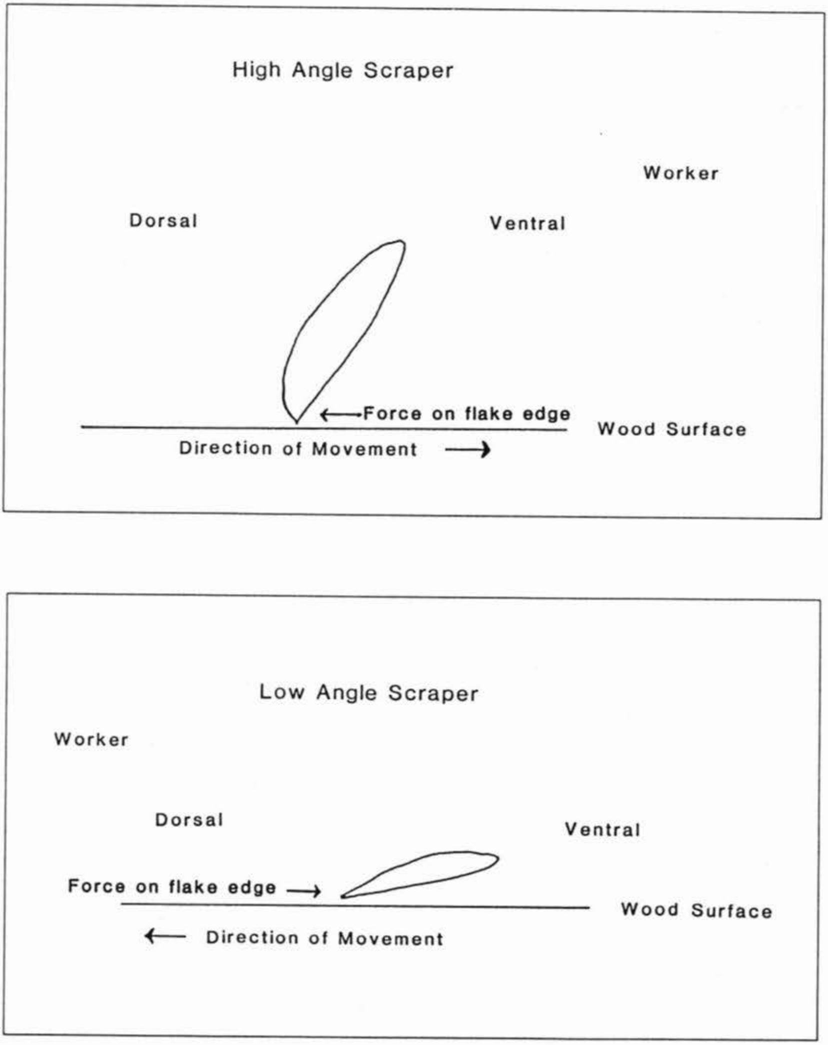


Figure 2. Force exerted on scrapers during the working of hardwood. Note the angle of the flakes when used in relation to the position of the worker. High angle scrapers are pulled towards the worker, whereas the low angle scrapers are pushed.

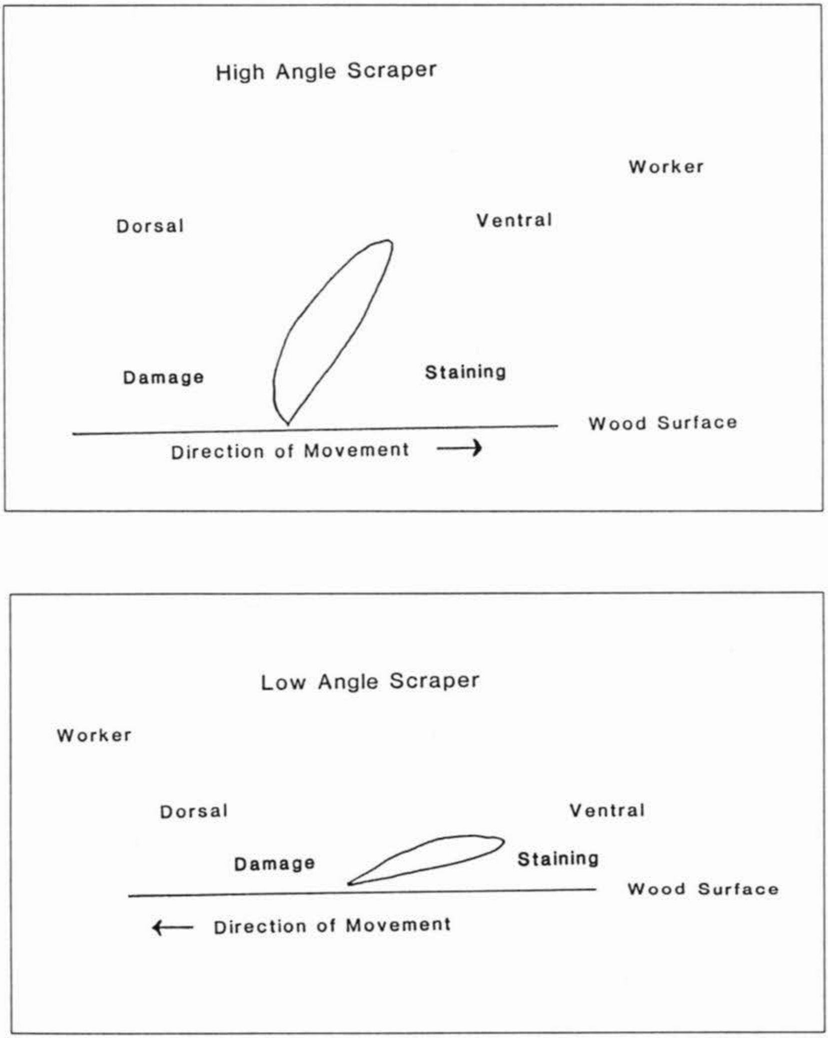


Figure 3. Damage and staining on scrapers. The face of the flake directed away from the hardwood predominantly sustains damage.

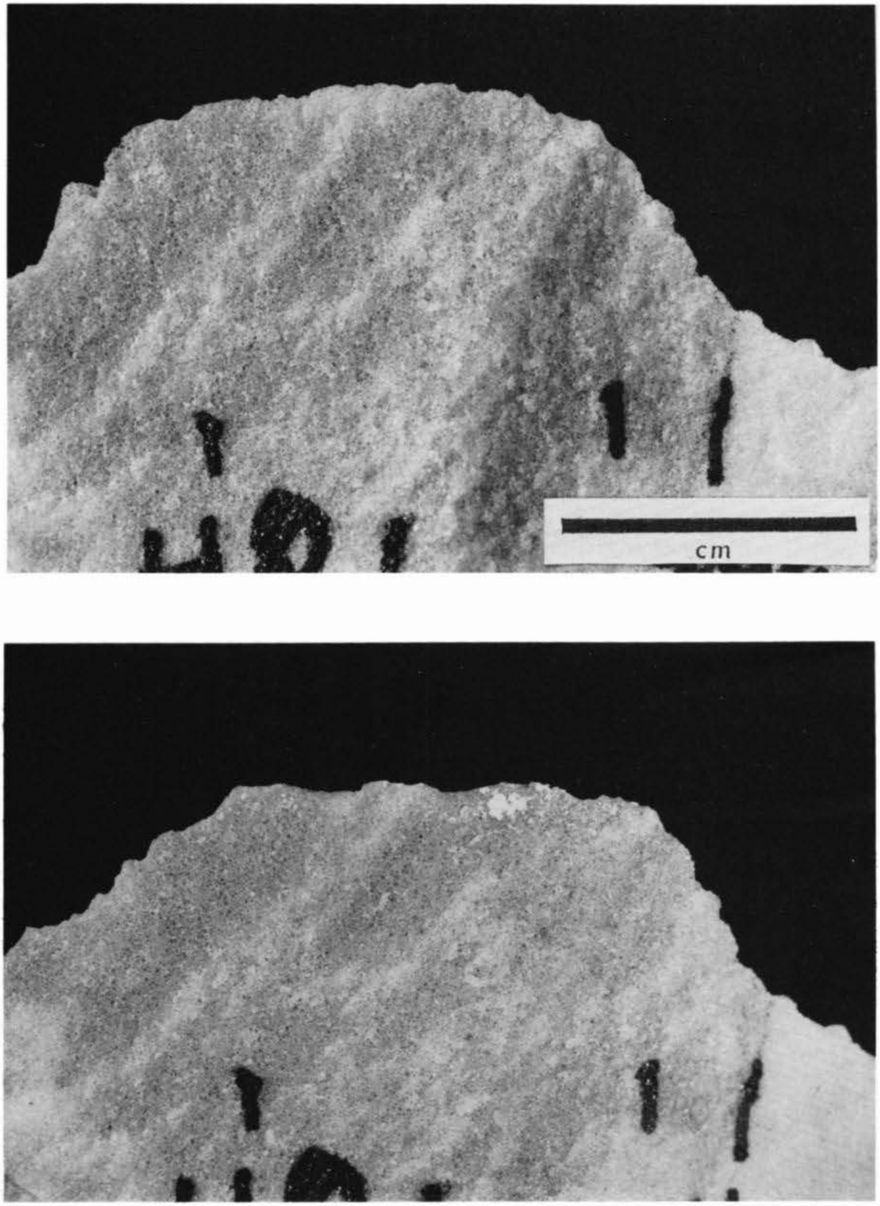


Plate 3. Edge damage sustained on a cutter/sawer after use on hardwood. (Top: before use, Bottom: after use).

the ventral side which gives the working edge the appearance of being rounded. For low angle scrapers, the staining is mainly on the ventral side as this is the face of the flake which is forced into the wood. Damage occurs predominantly on the dorsal side for low angle scrapers. This is because as damage occurs on the ventral side it is 'smoothed' out as the flake is forced against the wood, producing the effect of more damage being sustained on the dorsal side (Fig. 3).

The length, width and thickness of the flake tools play a role in determining the use of a flake tool. These factors would be considered when manufacturing or choosing a flake for a task, possibly along with edge angle. In the experimental flakes, the length of the cutter/sawers were not as great as those found in Otago archaeological sites such as at Shag Mouth where blades would be a desired form for this function. But the experimental flakes still proved to be most effective for this action as shown in Plate 4 where notches and groves were easily cut into manuka after ten minutes using a silcrete flake.

High angle scrapers with a thick edge proved their effectiveness in shaping hardwood. These tools act in a similar way to a spoke shave or plane, rapidly shaving wood to produce a desired shape, the pentagon shape in Plate 5 only taking approximately 30 minutes to form. The thin low angle scrapers stripped bark rapidly and then smoothed knots and lumps from the surface of the wood (Plate 6).

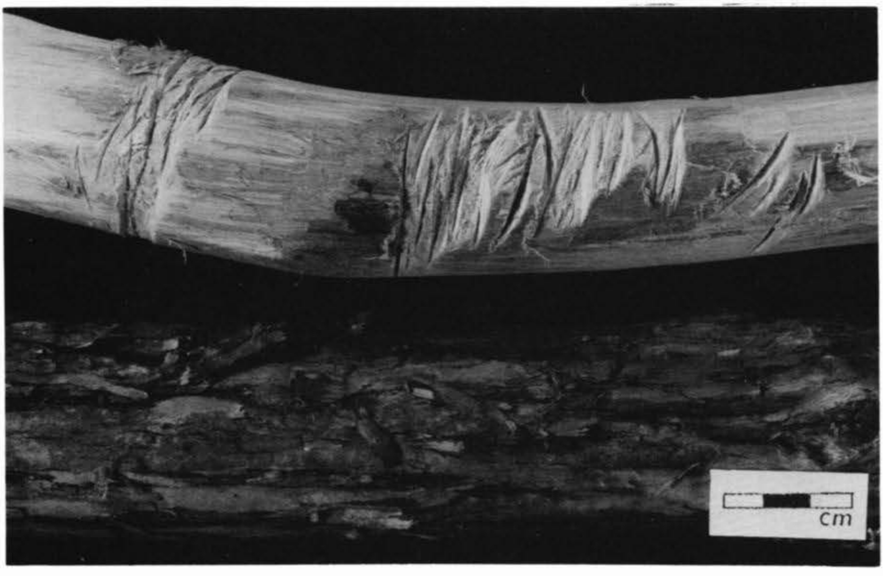


Plate 4. Cut and sawn hardwood.

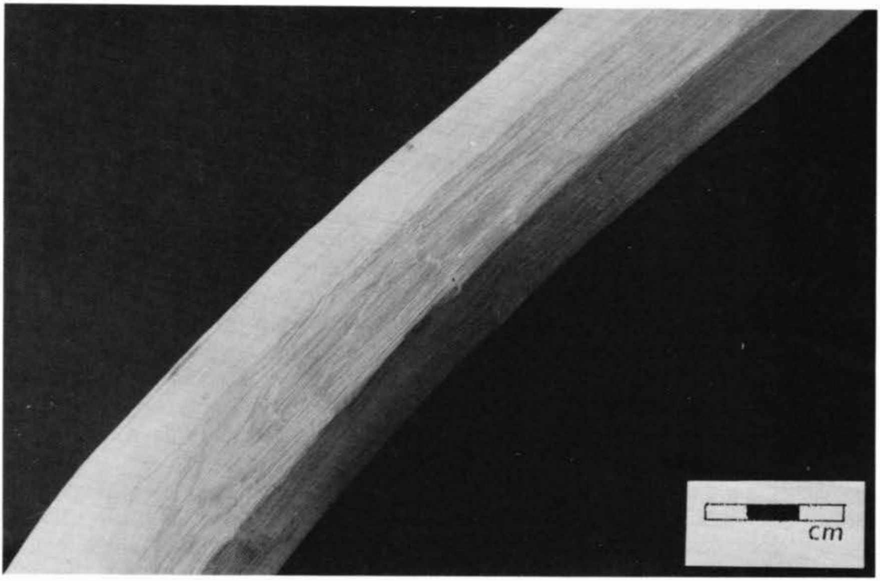


Plate 5. Shaping hardwood using a high angle scraper.

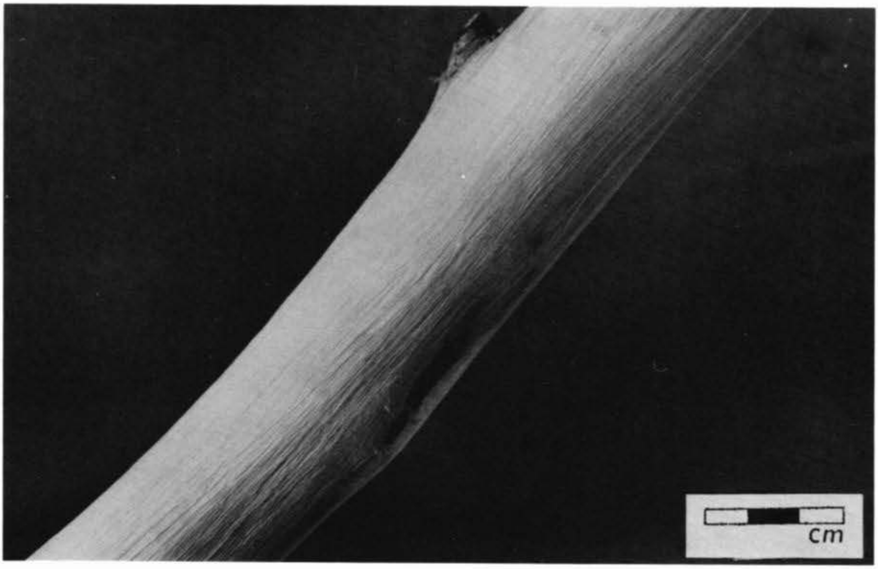


Plate 6. Hardwood that has been stripped of bark and smoothed using a low angle scraper.

COMPARISON WITH AN ARCHAEOLOGICAL ASSEMBLAGE

The results from my experiments on silcrete flake tools were compared with a sample of silcrete flakes from Area 1 of the Pleasant River Mouth Site (J43/1) in East Otago. This was a 5 x 5 m area, excavated in 1991 by the Otago University Anthropology Department annual fieldschool. The excavation uncovered a single occupation layer which included the edge of a midden and an oven. Faunal remains included abundant shellfish, moa and mammal bones along with smaller quantities of fish and birds. Of the artifacts found, there was a piece of a one-piece fish hook and a tab both made from moa bone, and a small nephrite adze of Duff's 1B type (Smith n.d.). Preliminary analysis of the lithic remains by Cutts (n.d.) identified a total of 171 stone tools including 149 flakes, of which 88% were silcrete. More detailed reanalysis (Smith pers.comm.) has modified these figures slightly, but has not altered the predominance of silcrete flakes in the assemblage.

My own analysis was based upon a randomly selected sample of 30 silcrete flakes and blades from this assemblage. I was able to identify 11 tools that I believe had been used to work hardwood. The two examples of blades and both broken blades in the random sample had morphological and edge damage features which I saw as being the result of cutting or sawing hardwood. The working edges of all four samples had an edge angle of less than forty degrees. The width of the complete blades as well as their thin appearance fell within the morphological characteristics for cutter/sawers from my experiments. The length of the blades, however, were greater than my experimental cutter/sawers with one blade being 9.5 centimetres in length and the other being 7.5 centimetres. The broken blades also had thickness and width characteristics similar to the complete blades and would have originally been of a similar length. Both blades and broken blades had over ninety percent of their working edges damaged. All had a high number of chips on their working edges with a mean of 49 chips for the blades and a mean of 25 chips for the blade portions. The size of the chips were predominantly large and the character of their edges were highly undulating. Edge damage for the blades and broken blades occurred relatively evenly on both sides of the tools. It was observed, however, that the chip scars appeared to be smaller in size on the ventral edge of the cutter/sawers, with the ventral face being the flattest surface of the tools.

Two flakes had edge damage which indicated that they had been used for high angle scraping. Though these flakes were not as thick as my experimental examples, both did have similar lengths and widths. Also, their working edges had edge angles of greater than forty degrees. Around eighty percent of their working edges were damaged with both flakes having small sized chips. The number of chips observed on the high angle scrapers were well below those of the cutter/sawers, having a mean of 30 chips, and the undulation of all their edges was low. One of the high angle scrapers had damage predominantly on its dorsal side, with the remaining example having damage mainly on its ventral side giving its working edge the appearance of being rounded.

I could also identify five low angle scraping flakes. These flakes were short, narrow, and thin in appearance, but were slightly larger in length and width than my experimental flakes. The angle of their working edges was less than forty degrees. Their ventral surfaces were flat with damage occurring predominantly on their dorsal edges. Approximately eighty percent of their edges were damaged, with the chips being small for three of the samples and medium in size for the remaining two. The number of chips present were similar for the high angle scrapers with the character of all their edges being medium in undulation.

From my comparison, I found cutter/sawers and low angle scrapers were able to be identified using the characteristics noted from my experiment. High angle scrapers, however, were more difficult to identify.

I also undertook a preliminary identification and analysis of 1885 moa bones from the excavation (Schmidt n.d.(b)). In this sample, a total of 54 cut marks were found, all having only the appearance of nicks and scratches. Due to the fragmented nature of the bone, it appears that the leg bones, which represented the majority of the bone identified, had been smashed rather than cut or sawn. It is quite possible, then, that the damage I identified on the silcrete flake tools from this site, had not been the result of the butchering of moa, but from working hardwood, possibly for the manufacture of wooden items such as spears.

DISCUSSION AND CONCLUSION

From the results of the experiment, silcrete flakes used for working hardwood, and the actions employed with this activity, can be determined through a comparison of the morphology and edge damage of flake tools from a moa hunter site. Table 6 illustrates how cutter/sawers, low angle scrapers and high angle scrapers can be distinguished from each other in an assemblage. Not all of the characteristics noted on Table 6 may appear on the tools, but through a process of elimination and comparison of the flakes, a lithic analyst may gain some idea of what activity was being practised at a moa hunting site. With this in mind, there are a number of reasons of why the damage seen on silcrete flakes from archaeological assemblages are the result of working hardwood.

Silcrete is a tough and durable rock type and because of this, damage which occurs on its edge is the result of rigorous activity on a hard surface. The cutting and chopping of meat will not produce such damage as the tool is working a soft medium. Therefore, there remains two alternatives for the occurrence of damage seen on archaeological samples of silcrete, these are the working of bone and wood. As can be seen from the Pleasant River moa bone sample, only 2.9% of the bone had cut marks and these were only small scrapes and nicks on the bone surfaces. Some care must be taken in interpreting these results as analysis of the complete bone assemblage from Area 1 indicates that the total number of identified specimens for moa bones is 5167, with the minimum number of individuals being 7, and for mammal bones the total number of identified specimens is 351, with the minimum number of individuals being 15 (Smith pers. comm.).

However, the analysed sample represents approximately a third of all moa bone from the site and only if the remaining two thirds of the bone from moa and the bone from mammal have sawing or scraping marks, could it be said that the silcrete tools from the Pleasant River site were used to work bone. Cutts (n.d.:4) indicated that 42.5% of the flake assemblage from this site showed evidence of utilisation. Evidence of utilisation found on the silcrete flakes by Cutts is possibly due to the working of hardwood.

Table 6. Characteristics of silcrete flake tools that have been used to cut/saw and scrape hardwood.

	Cutting/Sawing	**High Angle Scr.**	**Low Angle Scr.**
Flake Appearance in Relation to Length, Width, Thickness.	Flat/Long	Thick/Robust	Thin/Short
Effective Working Edge Length (cm)	>6	<5	<4
Edge Angle (degrees)	<40	>40	<40
Edge Damage (percent)	90	80	80
No. of Chips	High	Medium	Low
Chip Size	Large	Small to Medium	Small to Medium
Undulation	High	Low to Medium	Varies
Damage Side	Both	Dorsal	Dorsal
Staining Side	Both	Ventral	Ventral

Kooyman has noted that, with the processing of the moa carcases, "Butchering was generally seen to involve little bone contact, a point corroborated by the lithic usewear analysis." and that the bone was smashed with blunt objects to remove the marrow (Kooyman 1985:329). Items made from bone, such as fishhooks, would have been made from tabs originating from the smashing of the bones. These tabs would not have been needed to be specifically sawn or cut from the bone using flake tools, the preliminary experiments showing that silcrete was inefficient at cutting and sawing bone.

What does this experiment say about the function of silcrete flake tools at moa hunting sites? From this study the role or function of these tools can be seen as having two purposes for the moa hunters. The first was for the butchering of both moa and mammals. The second function of the tools was for the manufacture of wooden implements, such as spears, used for the hunting of large game. The meat, then, would cause minimal or no damage on the silcrete flakes but the wood working would cause heavy damage on the flake edges. This damage would vary according to what tasks were being undertaken.

Kooyman's usewear analysis considered the microchipping and polish of porcellanite and a polish analysis for silcrete. From his experiments and comparison with archaeological assemblages, he concluded that "The main activity at the sites studied was wood working, with butchering being the next most important task. There was almost no evidence of other tasks based on usewear analysis." (Kooyman 1985:328). Though Kooyman found that "It was not possible to study silcrete effectively using a microchipping analysis because the durability of silcrete resulted in only occasional usewear fracturing occurring." (Kooyman 1985:328), my experiments found that it was because of this durability that characteristic damage only occurred on silcrete flake tools with a particular material, that being hardwood. From my edge damage experiments, woodworking as an activity at a moa hunter site using silcrete flakes would support Kooyman's usewear analysis for porcellanite and silcrete.

This experiment in usewear analysis has provided an insight into the activities of the moa hunters. Further experimentation of this kind, however, is necessary for the full range of activities practised to be found and for us to gain a better understanding of the function of flake tools from these sites.

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