Archaeology and Ethnoarchaeology of Mobility

Edited by Frédéric Sellet, Russell Greaves, and Pei-Lin Yu
In regional culture histories, the transition from large, broad-based projectile points to smaller, lightweight forms is often cited as a shift in the launching method from spearthrower (or atlatl) to bow and arrow (cf. Aikens and Higuchi 1982: 109; Cabrera Valdez 1984: 279; Grayson 1994: 250). Much research on the projectile transition has focused on intrinsic attributes of points in order to separate them into discrete types (Bettinger and Eerkens 1999: 231; Beck 1998: 21). In addition to formal variation in stone points, the reduction method may differ. Analysis of one sample from northeastern North America showed that dart points are typically reduced from cores and arrow points from flakes (Nassaney and Pyle 1999: 251–252).

Projectile point types are often used as chronological markers or “guide fossils” (Huckell 1996: 326), although variation in form may also result from mechanically conditioned behaviors, such as breakage, repair, and resharpening (Huckell 1996: 327). In a global survey, Pierre Cattelain (1997: 232) found that projectile point form alone is not correlated with hafting contexts or means of launching. Charlotte Beck’s (1998) analysis of examples from Gatecliff Shelter indicates that neck width is acted upon by selective forces and is useful in distinguishing darts from arrow points. Statistical tests for many archaeological sequences show that small, lightweight points replace or augment large, heavy, broad-based points (Short 1997).

The projectile transition occurred at different times, and at different rates, throughout the world. The transition to bow and arrow never occurred in Australia. Atlatls and bows and arrows were used in tandem in the recent past in the Arctic, the North American Southeast, and parts of Mesoamerica. Recent efforts to explain the variation in scope and timing of the projectile transition have focused on distinguishing between in situ development and diffusion, especially in North America (cf. Bettinger and Eerkens 1999; Nassaney and Pyle 1999), then proceeding to test models for different modes of transmission. Rob-
Pei-Lin Yt. L. Bettinger and Jelmer Eerkens (1999: 240) explicitly define the projectile transition as a cultural evolutionary stage indicative of a culture's versatility and innovativeness.

Technology, however, unlike cultural markers such as style, articulates closely with adaptive strategies of resource use and mobility and therefore is expected to co-vary with selective forces (Beck 1998: 23; Knecht 1997: 2). If selective forces are less intense in a given case, technological behaviors may be adopted and incorporated as part of the preexisting system. In this case the material record would show the new and old technologies coexisting, at least for a time. More intense selective forces and in situ development of a new technology may lead to total replacement of the old system and corresponding replacement in the archaeological record.

This chapter builds on the substantial body of work on projectile point classification and development of regional chronologies by exploring the larger adaptive context of the projectile transition. In order to do this, it is necessary to compare archaeological sequences that share similar projectile transitions but are geographically distinct. Defining and explaining changes in a varied set of adaptive contexts should shed new light on the significance of the projectile point transition for the larger issue of cultural evolution.

Areas of Study

The archaeological records of northeast Asia, southern Europe, and the North American Great Basin all indicate that large projectile points were either replaced by or augmented by smaller, lightweight points.

The decrease in sites containing only large points is a defining characteristic of the projectile transition, regardless of time or place (Figure 9.1).

The following cultural sequences were selected because they include well-dated projectile point transition sites or levels within multicomponent sites: (1) Late Paleolithic/Initial Jomon periods of central Japan and Hokkaido; (2) Late Solutrean/Early Magdalenian periods of Cantabrian Spain; and (3) Late Archaic/Early Prehistoric periods of the North American Great Basin. Table 9.1 shows the sites discussed in this chapter.

Establishing Archaeological Relationships

Basic information on lithic tool types and counts, faunal species present, and methods of excavation is routinely recorded in study area archaeological site reports. These data are useful in determining the nature of the tool kit, the animals targeted, and the depositional context of artifacts. Study area sites or site levels that bracket the projectile transition were selected.

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**Establishing Archaeological Relationships**

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Figure 9.1. Bar graph of pre- and post-transitional projectile points for the study areas.

Lithic tool density (n tools per cubic meter of excavated sediment) in the study areas tends to stay within a range of about 0–100 tools/m³ (Figure 9.2). Post-transition sites show a Y-shaped distribution after ca. 17,000 BP, in which they become densely deposited or continue to be sparsely deposited.

Detailed information on sediment accumulation was not available for all sites, but light lithic tool deposition is apparently an important characteristic of

Table 9.1. Projectile Point Transition Sites in the Analysis

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pre-transition sites in all regions, regardless of age. The consistency of lithic tool density in pre-transition sites is remarkable, with a mean of 27.1 tools/m³. Post-transition sites show a bimodal pattern of light and heavy deposition, with heavy values averaging 425.18 tools/m³. Post-transition sites also exhibit regional clustering, with densest lithics in the Spanish Magdalenian cave sites, intermediate values in Japanese sites, and lowest values in the Great Basin.

Lithic tool density may reflect the frequency or intensity of occupations or site formation processes such as differential sediment accumulation. Hunter-gatherer landscape use is responsive to the timing and location of resources (Binford 1983). If lithic tool density reflects human behavior rather than site formation processes, it is expected that tool density will correlate with archaeological traces of subsistence.

In all three study areas the presence or absence of animal species is the most commonly reported class of subsistence data. Lithic tool density shows a Y-shaped distribution when plotted against the proportion of large to all terrestrial mammal species (Figure 9.3). When the total assemblage of terrestrial mammal species is composed of about 38% large animals, the Spanish cave sites of Ekain, El Juyo, and El Rascaño exhibit a sudden increase in lithics density. Japanese Paleolithic sites are not represented due to poor bone preservation of volcanic soils. Great Basin sites show the lowest values for both lithic tool density and presence of large mammal species.
Figure 9.3. Transition by lithic tool density and large mammal species frequency.

In study sample sites the relationship between lithic tool class density and the frequency of large mammal species demonstrates that varying tool densities reflect real differences in site use rather than site formation processes. If this is true, then pre-transition sites in all three study areas share low tool densities and therefore low discard rates despite variation in chronology, environment, and subsistence. Post-transition sites show a Y-shaped distribution in which Spanish cave sites diverge toward a new pattern of high tool-discard rates. This pattern suggests more frequent or longer occupations. Great Basin sites consistently show low tool-discard rates and low representation of large game and Japanese sites are intermediate.

Assemblage richness, or the number of tool classes, is divided by the number of tools to provide a measure for lithic tool class diversity. In pre-transition sites lithic tool diversity stays within a range of 0.01 to 0.03 regardless of geographic area or chronology (Figure 9.4), with one exception: the pre-transition level of Cowboy Cave in Utah. This site contained very low numbers of tools but a moderate number of tool classes, which increased the value of the ratio between the two. Post-transition sites show a bimodal pattern in tool diversity as with tool density, in which diversity either rises quickly or stabilizes at the low, pre-transition range.

In sum, pre-transition sites or site levels show surprisingly consistent sparse lithic tool density and low tool class diversity. Post-transition sites show a lithic tool density threshold at a ratio of 0.38 large mammals and at site dates of ca.
17,000 BP. Two trajectories are visible, one showing a drastic increase in density and the other maintaining stable pre-transition levels. Post-transition site tool class diversity shows a similar pattern.

The study sample indicates that archaeological correlates of the pre-transition stage are consistent across a broad range of chronologies and environments. Low tool discard rates and low tool class diversity are important defining characteristics of pre-transition behavior that suggest short-term or infrequent use of sites and a conservative tool kit.

In contrast, post-transition sites show significant divergence between "old-fashioned" low values for artifact discard and tool class diversity and new, very high values. The high values may indicate long-term or more frequent site use and a more diverse tool kit.

**Using Projectile Weaponry**

These archaeological patterns suggest significant changes in site use and technological strategies during the projectile transition. Projectile points may be used for many different purposes, but design constraints are generally imposed by their function as hunting tools (Greaves 1997: 313). Therefore, ethnographic information on hunting practices is a useful framework for understanding changes in site use and technology.
Many authors work from the assumption that large lanceolate and small triangular points respectively represent two specific hunting tools, the atlatl and the bow and arrow (Grayson 1994: 253; Straus 1983: 90; Sugihara 1973 inAi­kens and Higuchi 1982: 71). The best available comparative information on these two forms of launching comes from experimental studies of projectile ballistics and from ethnographic hunting accounts.

Experimental Data: Range, Accuracy, and Momentum

Experiments in projectile technology highlight the contrasting abilities of atlatls and bows and arrows. Cattelain (1997: 218) summarizes several experiments in central and northern Australia to arrive at a potential throwing distance for spearthrowers of up to 180 m. Australian hunters’ preferred throwing distances with a spearthrower, however, are between 10 and 20 m (summarized in Cundy 1989: 17).

Potential bow and arrow throwing distance is about 100 m using traditional bows, but preferred throwing distances with bow and arrow are summarized by Cattelain (1997: 227) at about 9–25 m, beyond which accuracy is compromised. Subtracting the actual from the potential throwing distance provides an estimate of the force differential between these weapons: the spearthrower potential minus actual distance is ca. 160 m; for bow and arrow the difference is ca. 75 m or less. Therefore, holding range and projectile weight constant, the spearthrower delivers over twice as much force upon impact, presuming equal weights for projectiles.

This estimate can be refined by looking at the simple momentum of different projectiles. Deceleration due to drag has been shown to be inversely proportional to the projectile’s mass (Cundy 1989: 34), so that high velocity increases the kinetic energy of a projectile but also increases drag by an equivalent amount. Momentum from heavy mass overcomes the drag factor; therefore heavier projectiles will penetrate farther than lighter ones when all other factors are held constant (Cundy 1989: 34; Dietrich 1996: 41).

Academics and modern bowhunters agree that mass is crucial to the constraints and opportunities of different projectiles. Although light weight and higher velocity produce a flatter trajectory and better accuracy at long range, greater mass delivers the greatest penetration and the best wounding potential (Dietrich 1996: 54). Launching velocity of ancient projectile points cannot be known for certain, but point weights can be compared to approximate mass.

Great Basin dart shaft dimensions are known from archaeological specimens at Lake Winnemucca, Humboldt and Lovelock Caves, and Leonard Rockshelter (Spencer 1974: 41). An experimental untipped atlatl dart mainshaft based on those measurements had a length of 57.5 cm and weight of 67.5 gm (Spencer
No foreshaft was manufactured. The mean weight of Elko points from Danger Cave and Hogup Shelter (Aikens 1970: 46–47) is 4.4 gm. The total estimated weight of a Great Basin dart-mainshaft assembly is therefore around 72 gm:

Darts from Cattelain’s ethnographic sample (1997: 229) fall into two size classes; between 30 and 63 cm in length and 55–200 gm in weight for Arctic examples and between 190 and 460 cm in length and 250–600 gm in weight for Australian examples. Arrows are divided similarly: in open temperate or forested tropical areas they are 43–110 cm long and weigh 15–40 gm. Arrows used in open tropical (usually savanna) areas are 110–210 cm long and weigh 35–88 gm (Cattelain 1997: 229).

Among smaller projectiles, arrows are 0.55 the weight of atlatl darts; among larger projectiles, arrows are 0.15 the weight of atlatl darts. The average of these values is a 0.35 ratio for arrow to atlatl dart weights. The relationship between the masses of the two projectiles can be approximated by the relationship between their weights. Given that momentum = mass × velocity, the momentum of darts is from two to seven times greater than arrows, with an average of about 3.5 times greater, if velocity is held constant.

This ratio clearly affects the size of intended prey. An atlatl dart delivers a more forceful blow and penetrates deeper. The point must be correspondingly robust to withstand high impact. Large animals have thicker hides, more meat mass, and denser bones, all of which may deflect or break the point. In order to maximize lethal effect, it is important to decrease the drag of the projectile head once it has struck so that it penetrates deeper (Cundy 1989: 34). Two characteristics can do this: a very sharp cutting edge and a broad head that accommodates the shaft as it follows (Cundy 1989: 34).

Little energy is needed once the skin is penetrated, however, and large animals can be killed effectively by small arrows (Cundy 1989: 36; Knight 1975: 253 in Cundy 1989). If atlatls and arrows are equally lethal, why did some hunters retain atlatls long after bows and arrows came into use?

**Ethnographic Data: Contexts of Use**

Ethnographic studies show that the spearthrower is used almost exclusively in open environments (Cattelain 1997: 219). At the time of European exploration, atlatls were commonly used in only two regions of the world: desert Australia and the Arctic (Cattelain 1997: 215). Atlatls are shock weapons (Churchill 1993: 18; Hutchings 1998: 13) that rapidly debilitate prey and reduce the need for tracking. Australian hunters have completely impaled large game such as kangaroos with atlatl spears (Tindale 1925). Large arrows in open tropical settings work the same way. The Pumé of Venezuela use long arrows whose weight adds
shock to impact, and length inhibits movement after the animal is hit. This is particularly important in prey of high escape risk, such as arboreal, flying, or swimming animals (Oswalt 1976: 81). For example, coastal Eskimo hunters use the bow and arrow for terrestrial game and the atlatl for marine mammals and aquatic birds (Cattelain 1997: 215).

In contrast, bows are used in every environment and exhibit great variation in form and mechanics. Small arrows work as delivery devices for small, sharp points and are often armed with lethal substances in the case of large prey (for example, by desert hunters of South Africa) or arboreal prey (as in the case of the South American tropics). Bows and arrows offer a flexibility of use contexts that cannot be matched by the atlatl. Atlatl spears are bulkier than arrows: 1.3 to 3 times longer and 2 to 5 times heavier. Norman B. Tindale (1925: 98) noted that Australian hunters prefer bamboo for spear shafts if available, in order to increase the number of missiles that they can carry. A hunter can carry fewer spears than arrows, all other things being equal. In addition, the spearthrower itself is bulkier, and often heavier, than a typical bow (Cattelain 1997: 217).

Hunters who use atlatls or long arrows must carry their projectiles by hand, which limits the number that can be carried on trips to four to seven (Bartram 1997: 335; Greaves, personal communication, 1999). Up to twenty arrows might be carried in a quiver, however (Hitchcock and Bleed 1997: 348). More projectiles allow for more shots per trip and longer search times. Search time duration is directly related to potential encounters with resources on hunting trips (Greaves 1997: 310). Also, less time is lost in resharpening or other repair, which may not be necessary if enough arrows are carried.

Modern bowhunting and archaeological experiments indicate that smaller projectiles are flatter in trajectory and more accurate on target (Cattelain 1997: 230; Churchill 1993: 18; Dietrich 1996: 54). Thus bows and arrows, while still lethal for larger game, allow for smaller target sizes if the range is held constant (Churchill 1993: 20).

Finally, the atlatl requires space for the throw and preferably space in front to step forward. Although Eskimo atlatls are small and may be launched from a seated position in a kayak (Nelson 1899: 151-152), the normal position among Australian hunters stalking terrestrial game is standing and walking (Cattelain 1997: 219). The bow and arrow are held close to the body and may be launched when standing still or seated, requiring less space (Figure 9.5).

Hunters attempting to narrow the distance between themselves and prey have two options: concealment and disguise (Dietrich 1996: 160). Disguise involves carrying extra gear, but concealment requires only the presence of minimal obstacles in the prey's line of sight. In a comparison between large and small bows and arrows, Lawrence E. Bartram (1997: 340) found that large arrows hamper
the hunter's ability to stalk by crawling or shoot while hidden in vegetative cover. Small bows and arrows permit the hunter to fire on prey while in heavy vegetative cover or to crawl closer if cover is sparse.

To summarize, ethnographic accounts show that adads immobilize prey upon impact and thus reduce the risk of escape. This is particularly important with large, fast animals or animals that can escape into environments beyond the hunter's reach, such as air and water. At some point, these benefits became outweighed by the arrow's light weight, flatter trajectory, and versatility in launching. Smaller missiles such as bow and arrows offer the hunter longer search times and more shots per trip. Smaller prey can be targeted successfully, and stalking is possible in dense or ground-level cover. The hunter might spend less time in repair or maintenance when equipped with many projectiles.

Extended trip times, higher number of shots, shrinking prey size, and exploitation of previously unused habitats suggest the hunter's need to maximize the number of successful shots per trip. This in turn indicates widening diet breadth and the need to decrease pursuit time averaged across a growing number of prey classes (Churchill 1993: 21). Pre-transition sites and post-transition sites that stay at pre-transition values are characterized by selective use of the landscape and less need to hunt in heavily vegetated areas. For example, Great Basin hunters may not have needed to shoot while standing in dense vegetation but found the bow and arrow useful for targeting the small game characteristic of the desert.

**Climatic Conditioners of the Transition**

The transition to bow and arrow occurred at different times and at different rates in the three study areas, but both Japanese and Spanish transitions predate the Great Basin. Why? Use contexts of the bow and arrow suggest that the answer lies in the hunter's choice to include heavily vegetated terrain in the normal subsistence round. An early projectile transition predicates a high percentage of heavily forested habitat in the general environment.
Temperature and Growing Seasons

As mentioned above, small projectile points appear early in Cantabrian Spain and Japan (ca. 15,000–14,000 BP and ca. 14,000–12,000 BP, respectively). The transition is distinct and is used in both regions as a chronological marker. In the Great Basin the transition took place from ca. 5000 to 1700 BP and was so gradual that the dates are still subject to debate.

Effective temperature (ET: average of temperatures taken at the beginning and end of the growing season) in the three study regions has varying effects on the transition (values taken from Binford’s database; also see Binford 2001: 258). The “bow and arrow” line can be traced along effective temperature values, showing the latest transition in the Great Basin at a value of about 13.5°C in the left of the figure (Figure 9.6). Japan’s effective temperatures fall on both sides of the Great Basin, and Spain has the highest effective temperature values on the right of the figure. The bow and arrow line suggests that the transition is delayed at ET values of about 13°C.

Precipitation and Vegetative Cover

Vegetative growth is regulated by the interaction between temperature and rainfall. Figure 9.7 shows how rainfall conditions the net above-ground productivity, or grams of plant material added per m² per year, in each study area (values are from Binford’s database). Overall, higher rainfall results in higher vegetative growth rates. Southern Japan and Spain have higher values, northern Japan is intermediate, and the Great Basin shows very low rainfall and vegetative growth.

Figure 9.6. Transition by effective temperature and ¹⁴C date.
Earliest transitions occur in Spanish and southern Japanese sites, which both are characterized by high annual rainfall, high net above-ground productivity, and high effective temperatures. The Great Basin sites, with lowest annual rainfall, low net above-ground productivity, and moderate effective temperatures, consistently show the latest transition. Northern Japan and Hokkaido, with coldest temperatures in the sample and low to moderate rainfall, are intermediate to Spain and the Great Basin. These results indicate that high aridity and cold temperatures delay the transition but that aridity is a more significant deterrent.

The Great Basin's position along the bow and arrow line strongly indicates a different selective context from Cantabrian Spain and Japan. Recent research indicates that the transition in the Great Basin may have been a historical event of adoption rather than an adaptive process of innovation (Blitz 1988). If this is the case, then selective forces were not intense enough to encourage projectile innovation; high aridity and low plant biomass are associated with low population density and high mobility among hunter-gatherers (Binford 1983). The blurred Great Basin transition across several thousand years and significant geographic variation indicates that the selective forces favoring bow and arrow technology were in play, but at a lower degree of intensity.
Paleoclimatic Triggers

If paleoenvironments affected the chronology of the projectile transition, climatic changes in the study areas may have provided discernible trigger events.

In Japan the projectile point transition occurred at ca. 14,000 BP in the south and moved north over time (Aikens and Higuchi 1982: 87). The terminal glacial climate of the late Paleolithic and early Jomon was several degrees cooler than at present (Pearson 1977: 1239). Pollen records indicate that Hokkaido was open parkland with spruce, beech, and elm and that the main body of Japan was thickly forested with oak, elm, and beech. In the early Holocene these forests began to shift to broadleaf evergreen forests, and climatic warming initiated marine transgression of the Japanese coastline (Pearson 1977: 1240). This transgression probably reached its maximum during the early Jomon, ca. 9000 BP (Pearson 1977: 1240), swamping the coast, moving into topographically varied areas, and offering a greater diversity of coastal swamps, bays, and estuaries than before (Aikens et al. 1986: 16).

The Spanish Solutrean period overlaps with a glacial maximum (ca. 20,000–17,000 BP) and shifts to the Magdalenian period during interstadial warming (Straus 1991: 89). Warming glacial climates in the open coastal plains along the coast of Cantabrian Spain allowed small thickets of trees to develop in wind-sheltered areas (Straus and Clark 1986: 136). Marine transgression had begun by the early Magdalenian, but little coastline was lost (Straus and Clark 1986: 136).

The projectile point transition in the Great Basin occurred much later than in the other two areas, in the late Holocene. During this time the desert underwent cooling temperatures and increasing moisture from an aridity maximum at about 7000–6000 BP. Pollen data indicate that juniper (which follows moisture) became more frequent and that piñon pine moved into the Great Basin from the south (Grayson 1994: 221–222). Overall, cooling temperatures and moisture in the eastern Great Basin caused grass to replace sage and scrub in open areas and allowed the treeline to move down in elevation (Grayson 1994: 221–222).

In all three study areas an environmental rebound from climatic extremes of either Pleistocene cold or mid-Holocene aridity accompanies the projectile point transition. In Japan and Spain, which were more densely vegetated to begin with, the transition occurred earliest. In the desert of the Great Basin post-Pleistocene warming did not constitute a rebound and in fact led to the prolonged drought of the middle Holocene. Only in the late Holocene did the Great Basin return to early Holocene vegetative productivity (Grayson 1994).

Through analysis of the three study areas this chapter has restated relationships that are well known to human ecologists: climate conditions landscape characteristics such as resource distribution, and human hunters adjust their mobility to resource availability in time and space. Technology reflects these adjustments.
Although projectile technology is observed to change at different times and at different rates, these differences may be quantitative rather than qualitative, similar processes playing out in different theaters (cf. Binford 2001: 33).

Another important factor conditions hunter mobility and has the potential to affect the timing of technological shifts: the proximity of other hunters. This brings the analysis full circle. The archaeological values of lithic tool density and assemblage richness, and ethnographically known use contexts of hunting gear, can be linked with environmental characteristics, using human demographics.

INFERRING POPULATION GROWTH AND REORGANIZATION OF HUNTING TERRITORIES

One class of post-transitional sites in the study areas shows evidence of redundant, frequent site use (high lithic tool density tied to discard) and generalized subsistence (high assemblage richness tied to diverse processing needs). The bow and arrow have been demonstrated to suit longer trip times, more shots per trip, and targeting of small prey in previously unfavorable forested terrain. All other things being equal, these adaptations are consistent with decreases in territory for a foraging group (Binford 1983: 211; Kelly 1995: 151).

If hunter-gatherers use mobility as a security option to be abandoned only under duress (Binford 1983: 210), then the factor most likely to decrease residential mobility is the proximity of neighbors. This should also hold true for hunting mobility. Projected hunter-gatherer population densities were derived for the study sites based on ethnographically known hunter-gatherer densities in similar environments (values from Binford 2001). These values show that high population density would have been reached first in Spain, followed by northern Japan, southern Japan, and finally the Great Basin, which patterns well with known dates of the projectile point transition (Figure 9.8).

In arid environments where territories are large and mobility high, packing thresholds are not expected to be reached very quickly. But changing population distributions in highly productive environments may have fueled early projectile transitions. In areas where preferred hunting niches filled and hunting territory overlap increased, hunters could maximize hunting returns in shrinking territories by including more stalking habitats and diverse prey sizes. This favored a lightweight projectile of flexible use context and high accuracy. Features of the landscape, including hunting territories and associated residential sites, began to be used more often or for longer periods. Diversification of tool classes suggests a shift from procurement to processing; various scrapers and awls for hide working constitute most of the assemblage richness in Spain and ground stone and crescent chipped stone forms for vegetable processing in Great Basin. Such
tactical shifts do not necessarily signify an absolute decrease in mobility, but they do reflect strategic adjustments in scope and scheduling as a response to gradual packing of the landscape.

**Changing Modes of Warfare**

Changes in hunting strategies and technology certainly affected the conduct of warfare (Nassaney and Pyle 1999: 258). The results presented in this chapter suggest that arrows allowed the development of ambush or guerrilla tactics. This kind of warfare, which relies on stealth and flexibility, is less formalized and more lethal than melee-style warfare of atlatl users such as those in desert Australia (Gason 1879). Arrows as weapons may also have permitted longer war forays and added the potential to launch more projectiles per foray.

**CONCLUSION**

Changes in tactics or behavior reflect adaptive responses to certain conditions, which the archaeologist may discern through the application of relevant bodies of information to archaeological data. The projectile transition represents a tactical adjustment to changing resource availability; the addition of a new hunting niche. The timing and the rate of this process are predictably associated with
the intensity of selective forces acting upon human populations; factors such as population density, mobility, and resource availability are all conditioned by local environments.

In conclusion, defining the projectile transition (and other changes in type and frequency of materials associated with mobility, technology, and subsistence) in strictly evolutionary terms may not be warranted. Making a strategic adjustment to changing conditions, or choosing not to do so, does not in itself constitute an evolutionary threshold. The true Rubicon, the ability to adopt or develop new strategies of mobility and resource use and to exploit those strategies situationally, was crossed long before the projectile transition took place.

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Shirataki Research Group

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