Complexity among Great Basin Shoshoneans : The World's Least Affluent Hunter-Gatherers?

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This symposium focuses on the general processes by which hunter-gatherers become "affluent". But in order to understand more clearly the factors contributing to what we traditionally consider to be affluence, it is wise to pause and establish a baseline by considering the processes operative among the less affluent hunter-gatherers.
This paper analyzes processes which condition relative simplicity in adaptation and social structure using three case studies selected from Great Basin Shoshonean society. The Shoshoneans have been of interest to anthropology not only because of the readily available and well-documented raw data, but also because of the significance of the Shoshonean case in the development of general cultural ecological and cultural evolutionary thought. Regardless of how cultural evolutionists fabricate their evolutionary sequences, the Shoshoneans almost invariably end up on the bottom rung of the ladder.
This approach is misleading because it obscures the wide range of variability among Great Basin Shoshonean societies. This paper explores the nature of ecological decision making across varied environmental settings, examining how the diverse social forms evolved to cope with these varying settlement and subsistence strategies. [Great Basin Shoshoneans, Foraging-Collecting Strategies, Subsistence-Settlement Patterns, Primitive Social Organization].

The overall objective of this symposium is to evaluate the general processes by which hunter-gatherers become "affluent". But an explanation of how some people struck it rich is incomplete without also considering why so many societies did not do so. The dynamics of hunter-gatherer existence are such that some societies evolve whereas others stabilize. This discussion focuses on three relatively simple hunting-gathering societies, selected because of their low population densities and rudimentary sociocultural systems. The objective is to examine the underlying factors which both foster and hinder sociocultural development. In other words, it seems wise to analyze simplicity before trying to cope with complexity.

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Special attention will be paid to the relationship between population size and the degree of societal complexity, a topic of long-standing interest to social scientists. Writing nearly a century ago, the sociologist Herbert Spencer [1897: 449–450] observed that "as population augments, divisions and subdivisions [of society] become more numerous and more decided." Decades later, Raoul Naroll [1956] proposed an *index of social development* in an attempt to clarify and quantify this relationship. Naroll's pioneering study successfully demonstrated a strong correlation between population, as measured by the size of the largest community, and various indicators of societal complexity, including the number of craft specialists, nature of organizational ramification, and the degree of urbanization. Although Naroll's preliminary index has been refined subsequently, absolute population size seems to remain as the best single indicator of sociopolitical complexity (see TATJE and NAROLL [1970] for a comprehensive review of such measures); but of course correlation is not causality, and this relationship could well be due to yet a third highly correlated variable (see SCHALK, this volume).

Carneiro has followed a related mode of research by applying scale analysis to the study of cultural complexity and evolution [CARNEIRO 1962; CARNEIRO and TOBIAS 1963]. Scale analysis initially indicated a clear-cut relationship between population size and societal complexity, and follow-up study attempted to quantify this relationship [CARNEIRO 1967]. A sample of 46 single-community societies was ranked according to their population size and societal complexity. Specifically, societies were rated according to the presence/absence of 205 "organizational" traits, namely those involving the cooperative activity of two or more people. This list included criteria such as the presence of craft specialization, corvée labor, social segmentation, and state treasury, for example.

The results demonstrate an extremely close and decided relationship between the size of the population and the degree of organizational complexity (Fig. 1). This mathematical relationship is roughly described by the equation

$$N=\sqrt{P}$$

where N is the number of organizational traits and P is the population size.

In simple terms, this equation suggests that the number of organizational traits in a single-community society should be approximately equal to the square root of its population [CARNEIRO 1967: 238]. Although this equation depends in part on the nature and number of traits selected, the form of the relationship seems to be relatively constant.

How does one account for this relationship in human terms? Clearly the more individuals in a society, the more coordination will be required to keep them operating as effective members of the social group. It is also clear that population size alone cannot account for complexity, because other factors, such as the structure of subsistence and economy, are obviously involved (see SCHALK, this volume). Moreover, societies almost always have another option, namely to split into smaller groups rather than to increase in absolute size.

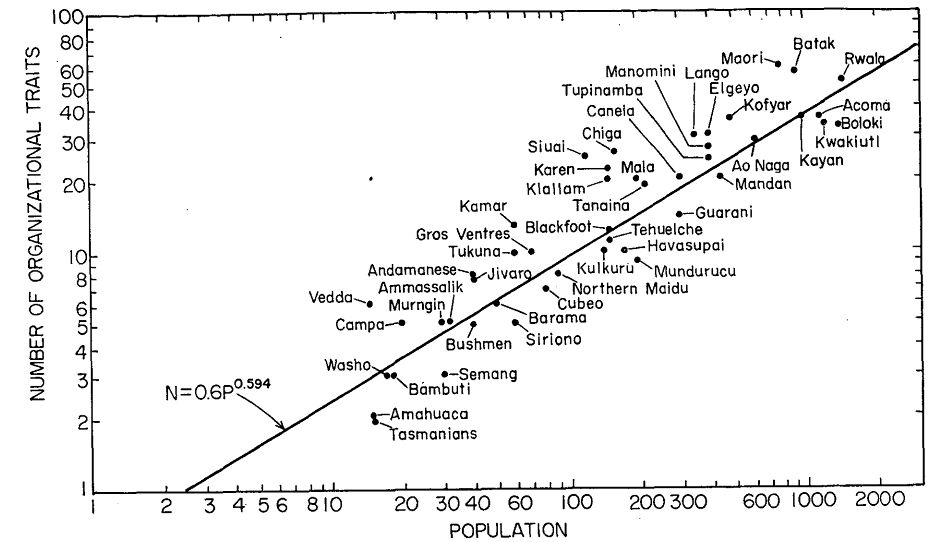

Fig. 1. Relationship of organizational traits to population size, plotted for 46 single-community societies [after CARNEIRO 1967: figure 1].

Given these qualifications, Carneiro's equation tells us that *if* a society does increase significantly in size and *if* it remains unified and integrated, *then* it must systematically elaborate its organization.

Carneiro's study encompasses groups from throughout the world and those ranging in complexity from the simple egalitarian Amahuaca and Tasmanians to the more complex Kwakiutl and Acoma Puebloans. I attempt to examine this relationship here, but will restrict the scope to the simple end of the spectrum; Schalk (this volume) examines some of the more complex cases. To minimize the number of variables, I have chosen three simple societies as case studies; these three groups share a basic culture and operate at a similar level of techno-ecological complexity.

Can we detect a systematic relationship between population size and organizational complexity among very simple societies? If so, what are the processes and decision-making strategies which condition the evolution of key societal institutions among low density hunter-gatherers?

THE GREAT BASIN SHOSHONEANS

This discussion focuses on three Great Basin Shohonean societies. Aside from my own interest in these data, there are other compelling reasons why Shoshonean society is relevant to the analysis of sociocultural complexity. For years, the watchword for the Shoshonean adaptation has been *primitive*. Although more primitive technologies are known, and people can indeed survive in harsher environments, no mode of social and political organization is more primitive than that of the Shoshoneans. This paper considers a spectrum of adaptations within the Great Basin; the continuum itself comprises the crude end of the hunter-gatherer spectrum in general.

Cultural evolutionists frequently use the Shoshonean case to fill the bottommost rung on the evolutionary ladder. In Cohen's "taxonomy of cultural adaptations", the Basin Shoshonean are taken as the most primitive of all foragers because "they rely primarily on muscular energy for their exploitative activities...essentially, they merely stoop to pick up what is available and can do nothing to replenish the stock or find dietary substitution" [COHEN 1968: 48–49]. Similarly, in their recent evolutionary classification of subsistence systems, Lomax and Arensberg [1977] classify the Great Basin Shoshoneans, "those frequently famine-ridden nomads," as the most primitive of all New World societies. And no general discussion of hunter-gatherer technology seems complete without at least cursory consideration of the Great Basin Shoshonean case (see for instance SERVICE [1966]; LEE and DEVORE [1968]; DAMAS [1969]; SAHLINS [1972: 236–266]).

Prehistorians have also found the Basin Shoshoneans to be a useful analogy. MacNeish [1964, 1972: 497] and Flannery [1966: 802] employed the Shoshonean case to reconstruct early hunting behavior and social organization in the prehistoric Tehuacan Valley, Mexico. Similarly, Flannery and Marcus [1976: 207] used the Shoshonean model to posit the evolution of public architecture in Mesoamerica. Wilmsen [1970: 82] suggested that the generalized Shoshonean case is, in part, analogous to band organization of North American Paleo-Indian hunters, and Jennings [1957: 8] referred to Basin Shoshonean ethnography as a "vivid contemporary description of the [prehistoric] Desert culture lifeway."

Why, one might ask, is the Shoshonean case so popular among archaeologists and ethnologists? The answer probably lies in what Steward [1955: 102] called the "quantitative simplicity" of Basin Shoshonean existence. The Shoshoneans are generally characterized by a long list of *absences*: the absence of sharp dialectical, cultural and political boundaries, the absence of well-defined groups larger than the simple village, the absence of men's institutions, the absence of age grades and women's societies, and the absence of recreational activities and warfare. This traditional view of Shoshonean society suggests that they lacked any significant sociocultural grouping above the level of the simple family cluster, which according to Steward, "was the inevitable response to areas of meager resources, low population density and an annual cycle of nomadism" [1970: 115].

There has thus been an overall tendency within ecological and evolutionary anthropology to use the Great Basin Shoshoneans as representatives of simple hunter-gatherer societies in general, as somehow "typical" of a worldwide monolithic cultural substratum. This image of the Shoshoneans is misleading because it avoids consideration of the internal variability that exists within their society. It is this ecological and sociopolitical diversity which forms the topic of this paper.

Our data on Shoshonean ethnography are relatively rich. The Great Basin was one of the last areas in North America to be influenced by white culture. European exploration of North America began nearly 500 years ago and the subsequent centuries of sea-going and overland expeditions slowly revealed the physical and cultural characteristics of the continent, from Atlantic to Pacific. By 1750, only one major region still remained unknown to the white man, namely the Great Basin [CLINE 1963]. A massive area of internal drainage, the Great Basin encompasses approximately 540,000 km^2 and measures almost 1,500 by 1,000 km at its widest parts (Fig. 2). Exploration of this vast area was sporadic and early settlement was slow in developing. As late as 1859, Captain James Simpson still encountered Shoshoneans who had never before seen a white face [SIMPSON 1876].

The combination of extremely simple cultural adaptation and very late white contact has made the Great Basin peoples an important anthropological example; subsequently a rich succession of explorers and anthropologists have traveled to the Great Basin to study the simple, egalitarian Shoshoneans. Many of the early Great Basin explorers, such as Escalante, Lewis and Clark, the mountain men, John C. Frémont, and Capt. Simpson, have left valuable ethnographic data in their memoirs and government reports. But the first major ethnographic account was produced by the famed Colorado River explorer, John Wesley Powell, who led ethnographic and linguistic expeditions throughout much of the Great Basin between 1867 and 1881 [see FOWLER and FOWLER 1971]. By the early twentieth century, Great Basin ethnography was on a firm professional level [see BAUMHOFF 1958]: A. L. Kroeber worked along the western margin of the Great Basin, concentrating on the Mojave Indians; Robert Lowie first studied the Northern Shoshone in 1906 and later conducted fieldwork among the Northern and Southern Paiute, Ute and Wind River Shoshone; Edward Sapir conducted linguistic research among the Ute and Southern Paiute in 1910; and somewhat later, Isabel Kelly, Omer Stewart, and Willard Z. Park worked with various Northern Paiute groups.

Julian Steward, however, is responsible for collecting the most extensive Great Basin ethnographic data. Between 1927 and 1936 Steward worked with several the Great Basin groups, and he subsequently produced a profusion of shorter papers, plus three major monographs [STEWARD 1933, 1938 and 1941]. As Baumhoff [1958: 4] has aptly noted, "Steward's work alone would have been sufficient to change the Great Basin from an ethnographic no-man's land into one of the better known areas of the world."

This paper considers three of the Great Basin Shoshonean groups among which Steward personally conducted fieldwork: the Kawich Mountain Shoshone, the Reese River Shoshone and the Owens Valley Paiute (Fig. 2). Both the Kawich Mountain and the Reese River groups are Western Shoshone and closely related culturally to the Northern Paiute. All groups belong to the Numic branch of the Uto-Aztecan language family; members of each group would have had little difficulty conversing with one another [STEWARD 1938: 5].

These three societies were selected to represent a range of environmental and cultural variability among the Great Basin Shoshoneans.[1] The Kawich Mountain Shoshone were an extremely simple, impoverished group. By contrast the Owens

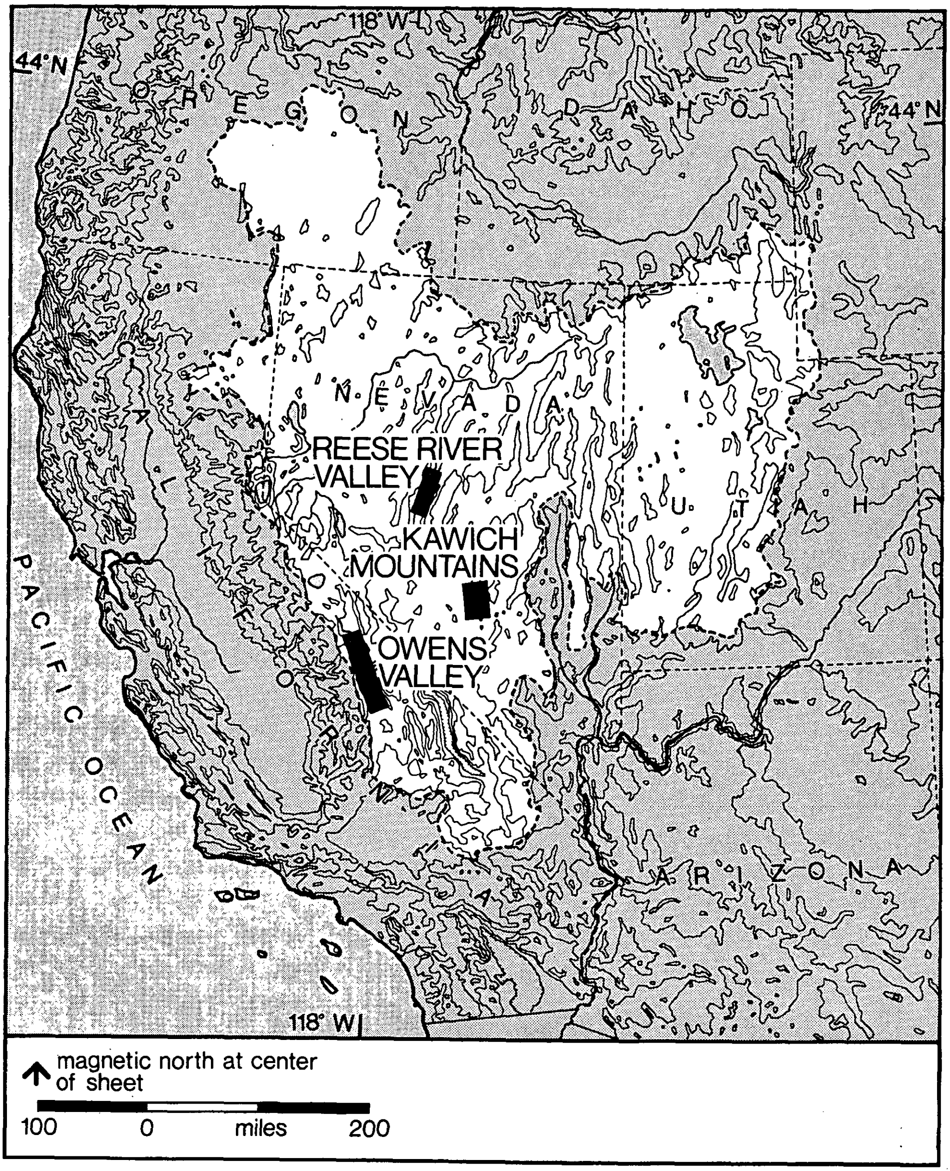

Fig. 2. The location of three Great Basin Shoshonean societies discussed here. Highlighted area is the hydrographic Great Basin.

Valley Paiute were, by Great Basin standards, relatively complex (if not exactly affluent). The Reese River Shoshone fell somewhere in between. Although these groups form a continuum, the Great Basin Shoshoneans still remain, as a whole, one of the most primitive groups of people known to ethnography. This simplicity accounts, no doubt, for their importance to contemporary anthropological theory. As Murphy

[1970: 154] put it, "an anthropologist could no more overlook the brute problem of survival in the aboriginal Great Basin than could the Shoshone themselves."

THE KAWICH MOUNTAIN SHOSHONE

The Kawich Mountains are located approximately 80 km east of Tonopah, Nevada, and the range approaches an elevation of 2900 m above sea level (Fig. 3). Much of the bedrock in this area is volcanic, supporting a piñon-juniper woodland at elevations between 2000 and 2500 m. The valley floor in this area has an average elevation of 1700 m and is dominated by characteristic shadscale vegetation.

During the ethnographic period, the Kawich Mountain Shoshone maintained a population density of only about one person per 40–60 km^2 [STEWARD 1938: 49], an extremely low figure, even by sparse Great Basin standards.

Perennial streams are virtually absent in the Kawich area, and residential base camps were generally established near springs; the local Shoshone occasionally camped higher in the mountains, where snow could be used for water [STEWARD 1938: 111].

Piñon nuts were the major winter staple, and were available for harvest only briefly each fall, even in years of ample yield. A local "piñon chief" directed each family where to gather when the resource was scarce but families were free to collect piñon nuts wherever they pleased during bumper years. In the not uncommon event of local piñon crop failure families travelled 40 to 48 km north into the Monitor Range, some even journeying to the Silver Peak Mountains, over 120 km away. But regardless where the family located suitable piñon, the settlement pattern

1) I must caution here that these three societies should not literally be taken as "typical" or "representative" of Great Basin Shoshonean adaptations in general. In fact, a fairly serious distortion exists in traditional and even contemporary Great Basin ethnography. Elsewhere [THOMAS 1979b] I have discussed the "Bias in the Basin" at some length. The problem is that Julian Steward's fieldwork in the 1930's has generally been taken as pan-Basin. It is not. Steward worked almost exclusively with the Western Shoshone and the Owens Valley Paiute. Other ethnographers, most notably Willard Z. Park and Omer Stewart, conducted the primary ethnographic investigations among the lacustrine adapted Northern Paiute, especially those at Pyramid Lake and Walker River. For a variety of reasons, Steward's Western Shoshone and Owens Valley research has received the brunt of attention from ethnographers, cultural evolutionists and especially cultural ecologists, to the virtual exclusion of other Basin Shoshoneans. It is also possible to detect a progressive oversimplification in Steward's own discussion of Great Basin sociocultural organization [see THOMAS 1979b]. Too often, Steward's later publications [esp. 1955] have been taken as "typical" of Steward's fieldwork, and Steward's fieldwork has been taken as "typical" of Great Basin culture in general. Neither view is correct, and marked distortion exists in many treatments of Great Basin Shoshonean culture, especially by overlooking the apparently more complex lacustrine groups. This caution should be kept in mind; the *specifics* presented here are in no way "typical" of Great Basin Shoshoneans, although the *processes* discussed here do indeed apply to all.

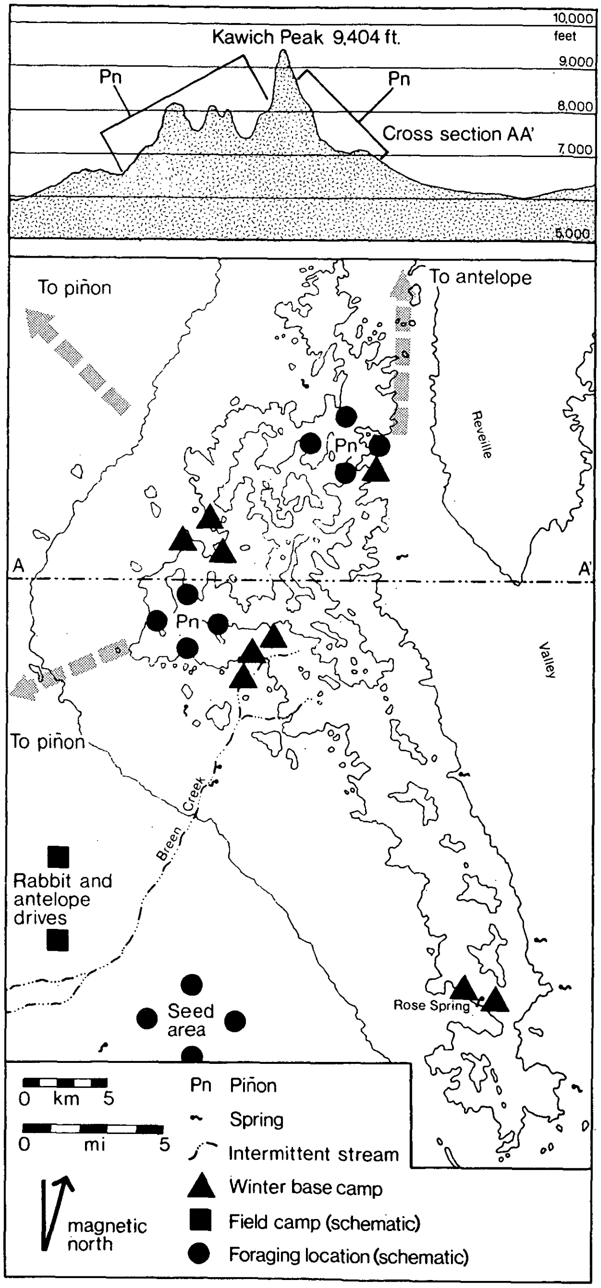

Fig. 3. Settlement pattern of the Kawich Mountain Shoshone [after STEWARD 1938: figure 8]. (Note: 10,000',=3,050 m; 9,000'=2,745 m; 8,000'=2,440 m; 7,000'=2,135 m; 5,000'=1,525 m.)

remained virtually identical: a residential base camp was established in the piñon-juniper woodland, and task-groups daily exploited piñon collecting locations throughout the piñon forest. In areas of exceptional yields, caches were established in the woodland, and subsequently visited during the winter and spring.

Shortly after the fall piñon harvest, the Kawich Mountain Shoshone commonly established short-term field camps to conduct communal rabbit drives and festivals (*fandangos*); these field camps were inhabited for only a week or so, seldom longer. The Shoshone families then returned to their winter residential base camps.

The spring was difficult in this area, requiring a dispersal into short-term base camps near the available springs, whenever bunch grass, *Mentzelia*, and other grass seeds could be gathered. Task groups probably also foraged from these base camps, the women establishing different gathering locations almost daily. The men probably traveled out in small groups, employing an encounter strategy to hunt isolated deer and bighorn sheep [Binford 1978].

Under the guidance of a shaman, communal antelope hunts were sometimes attempted in the spring [Steward 1938: 112]. In such cases, locations (or even field camps) were established along the valley floor, to the west of the Kawich Range.

Social organization of the Kawich Mountain Shoshone was rudimentary. Individual families were almost entirely independent throughout the year, and Steward suggests that had they cooperated more regularly in communal hunts and *fandangos*, these scattered families could have formed an effective band. But the vicissitudes of the seasonal round often forced families to join with their neighbors to the north and south, thereby precluding more long-term social relations. Leadership was exerted only in times of relative stress, and *ad hoc* leaders were responsible for coordinating the communal rabbit and antelope drives.

In sum, the *Kawich Mountain pattern* consisted of individual families who foraged throughout a central area, generally independent of other family units. Whenever the families did cluster, "a kind of village chief" directed socioeconomic functions such as *fandangos*, piñon nut trips, and possibly rabbit drives [Steward 1938: 113]; these aggregations became more common during post-contact times. The seasonal round was consequently quite variable, often taking them up to 125 km away from winter base camps in lean years.

THE REESE RIVER VALLEY SHOSHONE

The Western Shoshone living in the Reese River Valley exploited a relatively more stable and generally more resource-redundant environment than did most of their neighbors in surrounding valleys (Fig. 4). The Reese River Valley had sufficient water to support several perennial streams, and the population density was among the highest in the ethnographic Great Basin. Although historic estimates vary, the best figure for aboriginal population density is probably about one person per $10 km^2$ [Steward 1938: 4, 101].

The aboriginal central Great Basin area was apparently divided into large districts

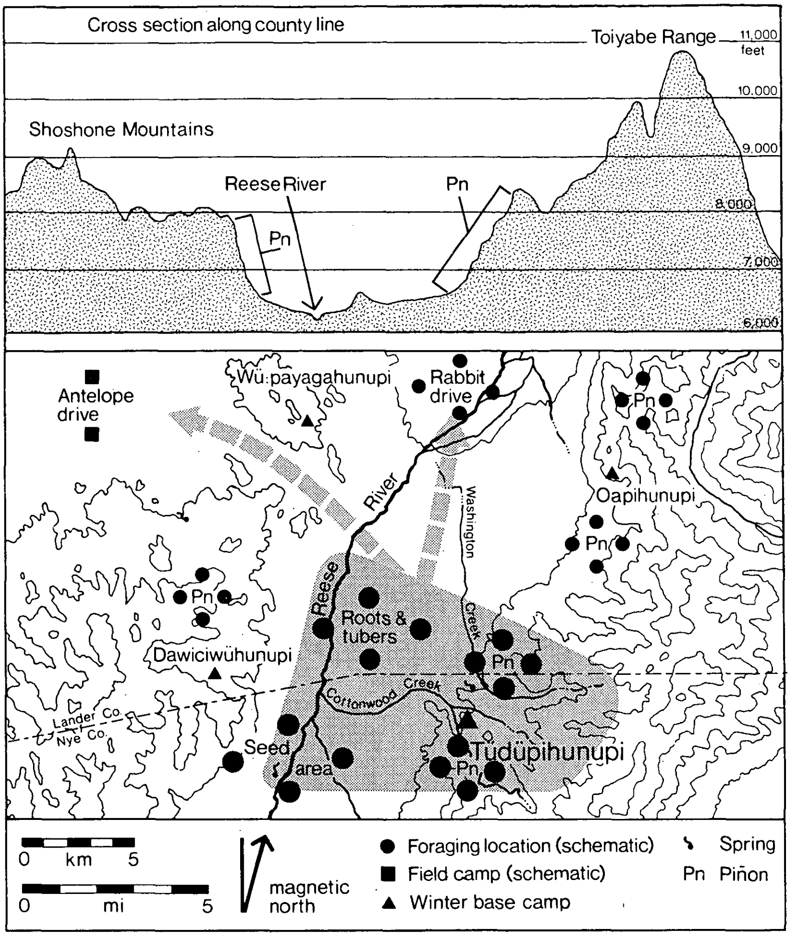

Fig. 4. Settlement pattern of the upper Reese River Valley Shoshone [after STEWARD 1938: figure 8]. Shading denotes the approximate home range of the Tüdüpihunupi winter base camp group. (Note: 11,000′=3,355 m; 10,000′=3,050 m; 9,000′=2,745 m; 8,000′=2,440 m; 7,000,=2,135 m; 6,000′=1,830 m.)

including Ione, Reese River and Smith Creek. Each district was distinct, but not entirely independent; a single chief, *Tutuwa*, extended his influence over several central Basin districts during post-contact times, but this was probably uncharacteristic of prehistoric times.

The ethnographic seasonal round in the Reese River Valley is well-documented by Steward [1938: 100–109], and archaeological investigations suggest significant prehistoric continuities for perhaps the past 6000 or 7000 years [THOMAS 1973, 1974, 1979a]. The primary residential areas occurred along the lower margin of the piñon-juniper woodland, particularly on the west-facing slopes which receive more precipitation (owing to a localized rainshadow effect). Winter residential base camps (what Steward called "winter villages") were established in traditional spots, which were generally named and "owned" by a local family group. Figure 4 reconstructs the seasonal round ethnographically associated with one such winter residential base camp, Tüdüpihunupi, located near the confluence of the San Juan and Cottonwood creeks. Although Steward called these sites "villages", the actual designation seemed to apply more to a generalized location rather than a fixed locus of residence. The families actually lived in somewhat scattered residential areas throughout the hilly piñon-juniper woodland; the "village name" included several more-or-less contiguous ridge-top settlements. Because of the annual redundancy in local yield, these families were "tethered" to the named areas, and groups commonly over-wintered year after year in the same residential base camp.

These winter base camps were well-situated for a variety of resources in addition to piñon, and collecting localities were established nearby for roots, seeds, berries and so forth. Additionally, the valley floor resources were available within a 6–8 km trek from the winter base camp.

Considerable archaeological research has been conducted in the area depicted in Figure 4; a number of archaeological scatters were located and mapped, and their distribution corresponds precisely with those described by Steward for winter piñon base camps [WILLIAMS, THOMAS and BETTINGER 1973; THOMAS and BETTINGER 1976]. Unfortunately it is impossible to pinpoint a specific village such as Tüdüpihunupi, since the name actually refers to a complex of ridge-tops, all of which contain archaeological debris. Because these sites exist only as surface manifestations, it is also difficult to reconstruct exactly what activities occurred at each site, but it is safe to say that the piñon residential camp, was a far-reaching pattern for at least six millennia, and probably longer, at least in the Reese River Valley.

Few long trips were necessary for families living in these base camps. People moved generally only in the event of local piñon crop failure; in that case, they attempted to establish a similar winter base camp in some neighboring range, wherever the local piñon yield was sufficient to fill caches for winter subsistence. Temporary field camps were also established in order to conduct communal drives of antelope and rabbits, and to hold *fandangos*. These task-specific journeys rarely exceeded 60 to 80 km.

Summer was a time of dispersal to the valley floor, somewhere not far from the Reese River. The summer dispersal pattern mingled families of the various winter villages. Other than the fish available in the Reese River itself, the resource patches were scattered over the flats in more-or-less uniform fashion, in marked contrast to the well-defined clumps of winter resources. As a result, the summer residential camps were moved frequently, in order to relocate camp nearer to the seed collecting locations. There was relatively little resource redundancy, and the summer camps were typically short-lived, expedient affairs.

It must be emphasized that in many years, the winter caches of piñon nuts permitted families to remain in their winter base camps throughout the spring and even into the summer months. If the next year provided an ample local piñon harvest, the occupants of such villages could even be termed "sedentary", if only on a temporary basis. In such cases, locations and temporary field camps were established to harvest lowland resources, which were then transported for storage and eventual consumption to the foothill base camp.

Most of this reconstruction is based on ethnographic evidence, but nearly a decade of archaeological investigation in this and nearby areas has disclosed a major settlement pattern component which apparently went unrecognized ethnographically. Very high altitude hunting sites have recently been located and mapped in the Toiyabe, Toquima and Monitor ranges (Fig. 4); these sites generally contain rock walls and blinds, and clearly are designed to facilitate an intercept strategy of hunting deer and bighorn, and even smaller game (such as sage grouse). These ambush areas contain the expected complement of site furniture and discard debris, but it is clear that at least two of these sites had been used as field camps for the operation of the hunting features; the age of these sites ranges from about 3000 B.C. to A.D. 1. There is even one site, located in the Toquima Range, which appears to be a true residential base camp, probably occupied by entire family units. This site is located at about 3,500 m, an elevation which certainly argues for summer usage; the large number of grinding stones found in association suggests, moreover, that some local (as yet unknown) seed crop was used to supplement the animal resources. These interesting sites are currently under investigation, and such preliminary observation must, of course, be sustained by more detailed excavation and analysis.

It would seem that the pattern of summer dispersal in the Reese River area was concentrated on the lowland valley resources (as indicated on Fig. 4), but this pattern may also have been supplemented at times by major residential moves to very high altitudes, established in known areas of animal migration, near perennial springs. Although the presence of such distinctive high altitude sites was not anticipated by the ethnographic accounts, the sites still mesh into the overall Reese River-type settlement system.

One notable practice of the Reese River Shoshone (and probably characteristic of many central Great Basin peoples) was the deliberate burning of brush in the upland basins behind the winter residential bases; *Mentzelia* and *Chenopodium* were then sown into these cleared areas, for harvesting during the summer. This practice is clearly aboriginal, but apparently was of only minor importance in the overall subsistence system. This strategy created artificially clumped resource patches, deliberately situated near the most common residential base.

Both these artificially sown seed areas and the nearby piñon groves were locally owned and protected against trespass. Ownership was apparently ascribed to the local base camp, whether or not the residents of that camp were related. Such territorial ownership is unusual among the Western Shoshone groups, and probably reflects the high degree of annual redundancy in the overall settlement pattern. That is, the Reese River Valley settlement pattern seemed to be sufficiently predictable so that nearly all of the essential foods were available within a short radius of the residential winter base camp. According to Steward, habitual use eventually led to outright ownership.

The pattern of habitual cooperation also extended beyond the members of a winter base camp during the major fall festivals, often called *fandangos*. At least during ethnographic times, the *fandango* was held in a central location, creating a temporary residential camp which was much larger than any individual winter camp, but lasting for only a week or so. The historic *fandangos* drew from large areas, but the prehistoric versions were probably more local in nature. In addition to the obvious social and ritual aspects, *fandangos* probably functioned to disperse critical ecological information, perhaps even serving as a device to assist in the overall regulation of regional population density [THOMAS 1972, 1979a: 123–126]. In this sense, the temporary *fandango* camp could also be considered to be a station, in the sense of Binford [1980: 10], a place where subsistence strategies were planned but not necessarily executed.

Regional cooperation was also manifest at large spring and summer gatherings, centering on the Round Dance, but these were apparently less important and certainly less frequent than the annual fall *fandango*. The Reese River Shoshone also showed a considerable degree of nucleation and inter-regional cooperation during post-contact times.

The people of the Reese River also practiced a custom which Steward termed *pseudo cross-cousin marriage* [1938: 108, 245]. True cross-cousin marriage was prohibited at Reese River, but marriage with the MoBr or FaSi stepchild was permitted, and in fact encouraged. The "pseudo cross-cousin" is, of course, not a blood relative, but was apparently so considered. Steward suggested that preferred pseudo cross-cousin marriage resulted from the frequent separation and remarriage of couples [1938: 245]. Marriages were generally arranged by the man's parents and brideprice was apparently customary. Postmarital residence, although temporarily matrilocal, reverted to patrilocal after a short term of bride service.

In sum, the ethnographic *Reese River pattern* occurred in a relatively well-watered region, where the seasonal round included only one or two major areas of residence—the winter base camp and the summer dispersal areas—supplemented by a number of task-specific locations and temporary field camps. Most of the foraging occurred within about 8 km of the traditional winter base camp, although families would occasionally travel up to 80 km to participate in communal hunts or to attend a *fandango*. Large upland tracts were artificially managed in order to create localized patches of summer-ripening seeds. Both the piñon and seed tracts were owned by local villages, and were defended against trespassers.

THE OWENS VALLEY PAIUTE

The Owens Valley is a long, narrow, block-faulted trough in the eastern portion of central California. The valley itself is over 160 km in length, and averages about 16 km in width. The margins are defined by the towering Sierra Nevada Mountains to the west and the stark Inyo-White Range to the east; both ranges exceed 4,270 m in elevation (Fig. 5). Direct precipitation in Owens Valley is sparse and most of the

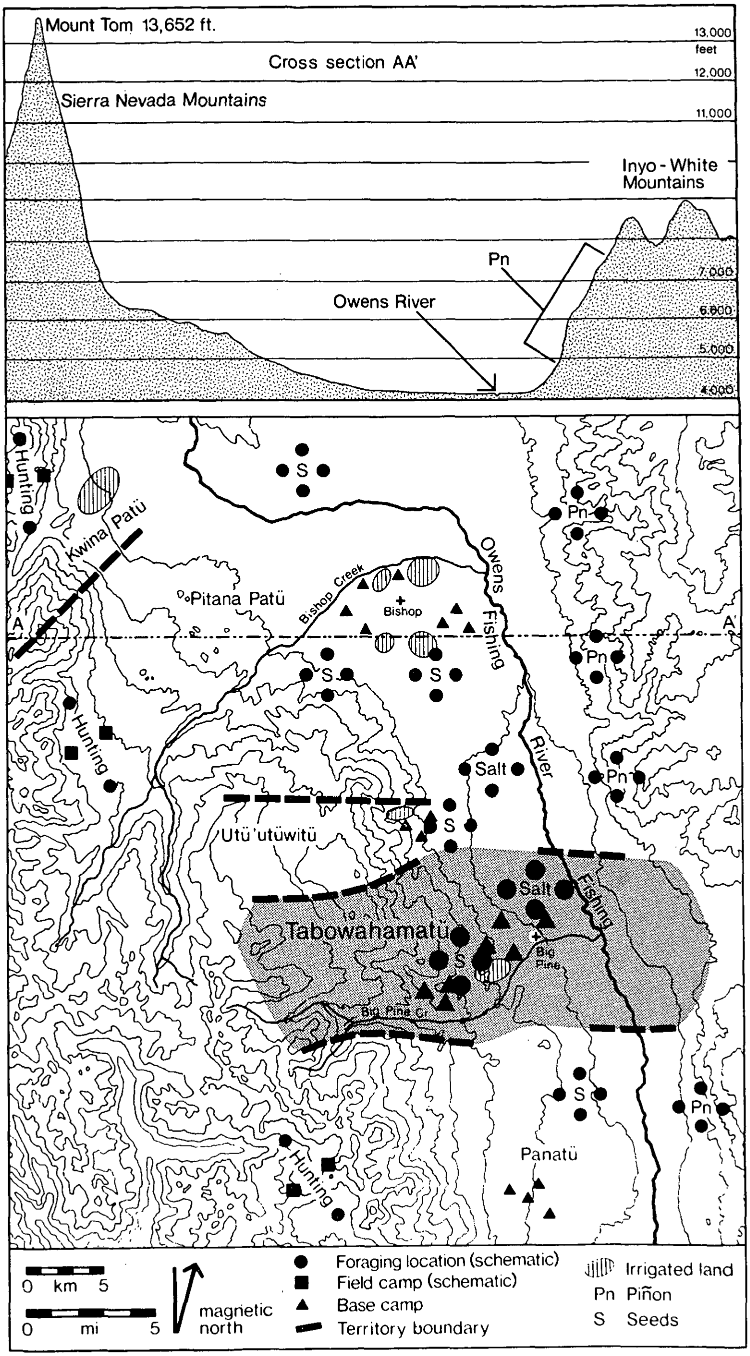

Fig. 5. Settlement pattern of the Owens Valley Paiute [after STEWARD 1933: map 2]. The territory of the Tabowahamatü district is shaded. (Note: 13,000′ =3,965m; 12,000′=3,660m; 11,000′=3,355m; 7,000′=2,135m; 6,000′= 1,830m; 5,000′=1,525m; 4,000′=1,220m.)

available water originates as either rain or snow from Sierran storms. This produces an unusual amount of runoff on the western slope of the valley, which in turn creates numerous perennial streams flowing from the Sierra into the Owens Valley proper. These streams often seep into swamps and ultimately drain into the Owens River.

The vegetation pattern thus produced creates an extremely asymmetrical set of resource patches for the aboriginal collector: the well-watered Sierra to the west, the arid piñon-covered slopes to the east, separated by the sometimes marshy Owens Valley lowlands. The aboriginal population density of Owens Valley is estimated at one person per 5.4 km^2 [STEWARD 1938: 48], a denser population than at Reese River (or about anywhere else in the Great Basin).

The environment also supported a subsistence and settlement pattern significantly different from those discussed above (Fig. 5). At least thirty relatively permanent residential base camps ("valley villages") occurred within ethnographic Owens Valley and extensive archaeological research has established the antiquity of the villages and also the pattern [BETTINGER 1977, 1978]. The base camps are typically located on the western side of the valley, near one of the perennial streams flowing from the Sierra; sites were commonly located from 3 to 6 km away from the valley floor. The people of each village, or cluster of villages, comprised a true land-owning band. Because of the varied, yet closely packed environmental zones, the Owens Valley Paiute villages were relatively close to all of their major resource patches; in the terminology of Binford [1980: 15], *spatial incongruity* ceased to be much of a problem for the Owens Valley Paiute, since, in effect, they were able to move resources to consumers with a minimum number of residential shifts. Game was relatively abundant in the high mountains, and hunting locations were rarely more than a day or two from the village. Similarly, the seed collecting locations in the foothills were relatively close-by, as were the additional seed areas, roots, fish, antelope and rabbits of the Valley floor. In each case task-specific locations could be exploited in the dense resource patches; sometimes it was necessary to establish a temporary field camp for a short time, but generally the task-groups could return to the residential base on the same day.

Despite the ecological diversity of Owens Valley, piñon pine still comprised the single major food resource for the ethnographic Owens Valley Paiute, but piñon exploitation was structured rather differently from the cases discussed above. Piñon occurred only in the relatively dry Inyo-White Range, and during good years, temporary residential base camps were established adjacent to the piñon caches, within the piñon-juniper woodland. But in relatively poor piñon years the cached nuts were transported to the base camps on the valley floor. In other words, the locus of winter residence was determined, in large measure, by the transportation costs involved with the piñon crop. If nuts were abundant the high costs of transportation encouraged a residential move into the piñon zone; but when costs of transportation were fairly low the nuts were simply carried to the valley, and the residential locus remained unchanged.

Owens Valley was also distinctive because of the natural abundance of native seed-producing grasses near the valley villages. Here was another relatively dense, patchy resource which occurred near the residential base camp. At least in ethnographic times, an extensive irrigation system operated whereby streams were diverted to intensify seed yield of these native crops [STEWARD 1930: 15, 1933]. Steward himself vacillated as to whether this system was prehistoric, or merely introduced in post-contact times [STEWARD 1955, 1970]. The antiquity of irrigation in Owens Valley still remains open to question, but recent investigators seem to agree with Steward's initial assessment, namely that the Owens Valley Paiute did indeed conduct seed irrigation during prehistoric times [LAWTON *et al.* 1976; BETTINGER 1978]. The implications for this system relative to the concept of "incipient cultivation" are beyond the scope of this paper (see DOWNS [1966]; LAWTON *et al.* [1976: 15] and BETTINGER [1978]). Evolutionary significance aside, the fact is that this rather rich and predictable native resource further enhanced the positioning strategy employed by the Owens Valley Paiute in locating their base camps.

How does one account for the high aboriginal population density and relatively non-mobile settlement pattern of the Owens Valley Paiute, as compared with the rest of the Great Basin? Steward attributed the density to the "unusually fertile environment" of Owens Valley, particularly the "extreme geographic diversity" [1938: 233, 236]. This emphasis on diversity is consistent with the more general position recently expressed by Binford [1980: 14], that "mobility among hunter-gatherers is responsive to conditions other than gross patterns of 'food abundance'." The most critical resources in Owens Valley were accessible from a single, well-positioned residential base camp; spatial incongruity was minimized. That is, the heavy precipitation in the Sierra provided an unusually heavy flow of unearned runoff water into an otherwise arid Owens Valley. This water occurred as a series of linear sources flowing into the valley at more-or-less regular intervals, in contrast to the stark, piñon-covered Inyo-White Range to the east. The overall result—Steward's [1938: 50] "extraordinarily rich environment"—provided nearly all essential resources within 30 km of the permanent base camp. The combination of relatively predictable, abundant, patchy yet closely-set resources permitted the Paiute of this area to stick very close to their residential villages.

This pattern contrasts markedly with most Great Basin groups who, as we have seen, often undertook round trips of up to 250 km in order to exploit key resources. Many Western Shoshone task groups were absent from their residential bases for days (sometimes even weeks) on end. As a result the Owens Valley villages were considerably more stable, with relatively constant band groupings cooperating extensively in communal hunts and irrigation projects [STEWARD 1938: 234].

Each band in Owens Valley owned a distinct territory, the boundaries of which were generally defined by the streams flowing from the Sierra. Band members conducted their own communal drives for antelope, deer and rabbits, and held their own *fandangos* and mourning ceremonies. They owned seed areas, piñon territories, and irrigated plots of land; each band had a chief and constructed its own community sweat house (this differs from common Great Basin practices, as for example among the Western Shoshone, for whom the sweat house was an individual or family effort; the typical Western Shoshone settlement pattern was "too unsettled and their villages usually too small to make it profitable to construct a large [sweat] house" [STEWARD 1938: 238]).

The resulting *Owens Valley pattern* consisted of a relatively permanent association of family units, many of which may not have been related. This band maintained headquarters in established residential base camps, which provided a stable locus from which to hunt and forage within the band's territory. Leadership was apparently inherited within the band, and a number of integrative mechanisms were common, such as the sweat house, the group name, and territorial ownership.

UNDERLYING SUBSISTENCE STRATEGIES

Binford [1980] has recently published an extremely stimulating paper discussing the nature of hunter-gatherer subsistence and settlement strategies. His interpretation is directly relevant to the case studies considered in this paper.

Binford has defined five site types in common use by hunter-gatherers: *residential base camps, locations, field camps, caches and stations.* Although these distinctions will often be difficult to establish archaeologically, they provide a relatively consistent terminology for describing and comparing ethnographic cases, and Binford's terminology was used in the above section to describe the three Shoshonean cases.

Binford then makes a key distinction between *foragers* and *collectors.* Foragers practice a basic "mapping on" strategy, in which residential moves are scheduled to correspond with availability of major plant and animal resources; foragers generally require only two kinds of sites (base camps and foraging locations). Collectors, on the other hand, follow what Binford calls a "logistical" strategy, making much more extensive use of storage facilities, in an attempt to minimize group movement. In addition to generating base camps and location sites, collectors also characteristically employ the additional site types.

When attempting to explain the factors conditioning the relative roles of "mapping on" as opposed to "logistical" strategies, Binford suggested that the length of the growing season may be a key determinant, pointing out some major global correlations between the use of storage facilities, degree of logistic movement and seasonal variability in temperature.

This is a most useful approach to employ when studying variability in hunter-gatherer adaptations, both in space and through time. But we should point out that one need not resort to a global scale to observe the forager-collector continuum. The Kawich Mountain Shoshone are almost classic foragers in Binford's sense, employing frequent residential moves to solve problems of spatial incongruity within their immediate environment; Kawich Mountain Shoshone clearly follow a "mapping on" strategy, and their site types are indeed limited almost exclusively to residential base camps and foraging locations.

The Owens Valley Paiute occupy the other end of the foraging-collecting continuum, employing a highly logistic strategy to exploit their relative environment. Every effort is made to minimize movement of people (i.e., minimize residential mobility) by bringing resources to the consumers. This relatively more "sedentary" lifeway creates, however, severe demands to insure that task groups are sufficiently organized so that goods flow smoothly and regularly from the collecting locations to the village base camps. The organizational structure of Owens Valley Paiute society reflects this additional logistic burden.

Binford [1980: 19] has emphasized that logistical and residential variability are not to be viewed as opposing principles "*but as organizational alternatives which may be employed in varying mixes in different settings.*" This is precisely what happened with the Reese River Shoshone, who employed a decided mixture of foraging and collecting strategies. In winter, the people of Reese River were organized in a highly logistical fashion, establishing a strategically located residential base camp, relying on task-groups for transporting resources to consumers; the winter pattern at Reese River minimized residential mobility. But the summer dispersal pattern followed a basic "mapping on" strategy by increasing residential mobility. There are qualitative differences between site types produced during summer and winter activities in many years. But on the other hand, in high-bulk piñon years, the pattern became almost exclusively logistical, to the point of approaching temporary sedentism (which is not without its hazards, as discussed by Cohen in this volume).

These examples are not presented to refute Binford's general propositions regarding worldwide hunter-gatherer patterns, but rather to amplify his suggestions. Although it is true that foraging-collecting strategies are correlated with seasonal temperature variability and the length of the growing season on a global scale, it is also true that there is tremendous variability in strategic decision-making within a rather small geographical area, given sufficient microenvironmental diversity. The Great Basin is an excellent case in point. The Kawich Mountain Shoshone were foragers; the Owens Valley Paiute were collectors; the Reese River Shoshone were both, and *all of this strategic variability occurred at one point in time, within a radius of less than 150 km.* These three case studies provide a valuable contrast set in which to examine the microprocesses of hunter-gatherer variability. "Culture" in this case is a constant.

DETERMINANTS OF SETTLEMENT PATTERNS

The specifics of the three case studies now before us, we can return to the questions posed at the beginning of the paper: What is the relationship between population size and organization complexity, and what accounts for the social and ecological diversity evident within the Great Basin?

The key lies, as we will see, in the nuances of settlement strategy and microenvironmental structure. The remainder of this paper focuses directly on how specific Great Basin resources served to condition the nature of human settlements and, in turn, how the demographic patterns conditioned sociopolitical organization.

As a final note, we will consider briefly how the processes of cultural evolution seem to operate as microevolution within simple societies such as these.

How Water Structures Human Settlements

From superficial inspection, one might mistakenly think that water is always the key limiting factor in desert environments. Lee [1972] has observed that the seasonal round of the !Kung of Botswana was heavily influenced by the changing conditions at known waterholes. Similarly, Birdsell [1953] found a strikingly close correlation between aboriginal population densities and rates of precipitation in Australia. The availability of surface water, in both cases, seemed to be the major factor in determining the human settlement pattern.

The situation is less obvious in the Great Basin. Water, like the other resources to be considered here, must be viewed in terms of both absolute abundance and also overall structure within the habitat. The general relationship between precipitation and population density is not particularly strong within the Great Basin as a whole (Fig. 6). The correlation coefficient ($r = +0.34$) is not significantly different from zero.

Water exerts an obvious limiting effect in certain Great Basin habitats; for example, the sparse population in the Kawich Mountain area may be due in large measure to aridity. Not only is surface water at a premium, but the flora and fauna exist at relatively low levels of productivity, limiting the human potential still further.

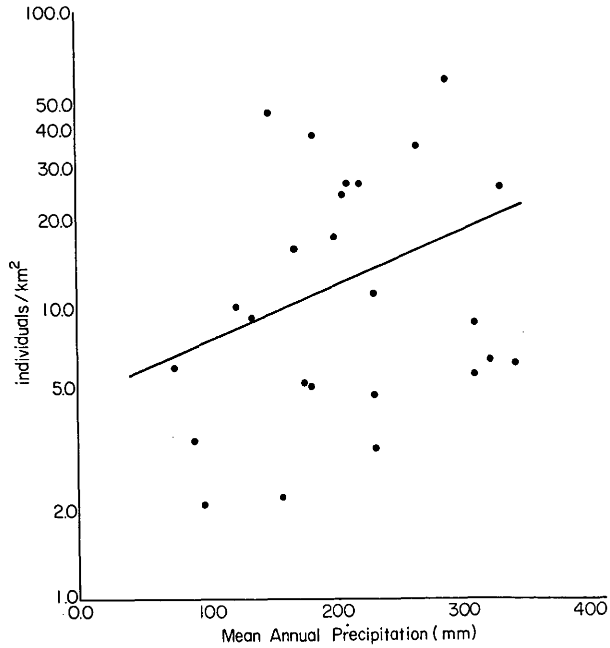

Fig. 6. Relationship of population density to precipitation for 25 Great Basin societies [after THOMAS 1972: figure 1].

Local effective precipitation is largely a function of elevation and topography. Within the Great Basin one can expect approximately a 50 mm increase in annual precipitation for every 300 m increase in elevation [THOMAS 1972: figure 2]. Also relevant is the *rainshadow effect* by which significant amounts of moisture are often precipitated by abrupt mountain ranges; the rainshadow effect accounts for the relative abundance of surface water in the Owens Valley. Less than 150 mm of precipitation falls annually at lowland communities such as Bishop, on the floor of Owens Valley, but runoff from the Sierra produces an almost oasis-like situation on parts of the valley floor itself. Runoff from the Toiyabe Mountains creates a similar, yet considerably less striking series of semi-permanent streams in the Reese River Valley.

All resources carry with them limited options for human exploitation (assuming a constant level of technology). We know from the piñon ecotone survey of the Reese River Valley that most piñon villages occurred on relatively flat ground. Although the slope varied from 0 percent to 20 percent, the mean value was 8.4 percent. When plotted graphically, the distribution of percent slope proved to be a perfectly normal distribution [THOMAS and BETTINGER 1976: figure 60].

With these parametric relationships in mind it is possible to construct models for optimal settlement probabilities (i.e., mathematical expressions of structure) for each resource. Consider, for example, the water resources of the Kawich Mountains. Annual rainfall averages less than 250 mm, and water occurs only in springs, not as flowing streams or rivers (Fig. 3). Consequently for the Kawich Mountain Shoshone, water becomes effectively a *point resource* (Fig. 7). Absolute abundance aside, point resources are self-limiting because they can be exploited only in a radial fashion. That is, resources tend to have optimum residential distances associated with them; this distance cannot be so close that game are unable to water, or so far as to raise transportation costs of bringing water back to camp. The resource-to-campsite distances can be expressed in two-dimensional form, often as a normal curve; Thomas and Bettinger [1976] have shown several cases in which this normal curve empirically described archaeological settlement patterns.

For point resources, such as springs, the number of potential settlements is limited because the mean of the infinitely available normal curves forms a doughnut-shaped ring of probability around each spring. In practice, this means that only a few select

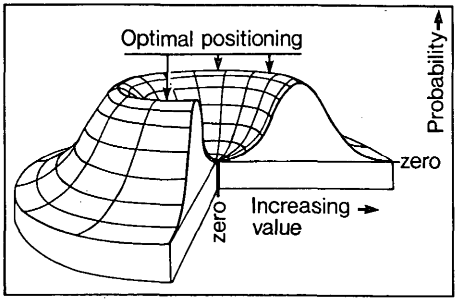

Fig. 7. Hypothetical base camp distributions for exploiting point resources.

localities around each point resource are available for residence. Campsite location, therefore, must be chosen primarily because of water availability, with little latitude left for considering other resource structures.

Water, as a resource, has a higher residential potential in the Reese River and Owens valleys, for two reasons. First is the obvious increased availability of surface water due to the rainshadow effect. But an equally important difference is the structure by which this surface water is available. Both valleys are extremely vertical, with water flowing for the most part in permanent or ephemeral streams. For both Owens and Reese River valleys, water becomes a *linear* resource (see Fig. 8).

Let us consider a mathematical abstraction of this resource. If the stream were a perfectly straight line, then one could live on either side of this line. The distance to this water source is once again conditioned by a number of factors which tend to create an optimal distance for the location of the campsite: not too close, yet not too far. At a spring, this optimal distance forms a ring of potential settlements, arranged radially about a point. But the areas of potential settlement at a stream constitute two parallel bands on either side of the line. In the case of Reese River and Owens valleys, water is a linear resource, and the settlements can be arranged *symmetrically*. The symmetrical, linear resource provides a high degree of latitude in establishing a residential base or field camp. One can move, for instance, up or downstream and still maintain that optimal distance from water. This is an important consideration since *resources other than water* can be taken into account when selecting optimum settlement locations.

To summarize, water was the prime limiting factor for the Kawich Mountain

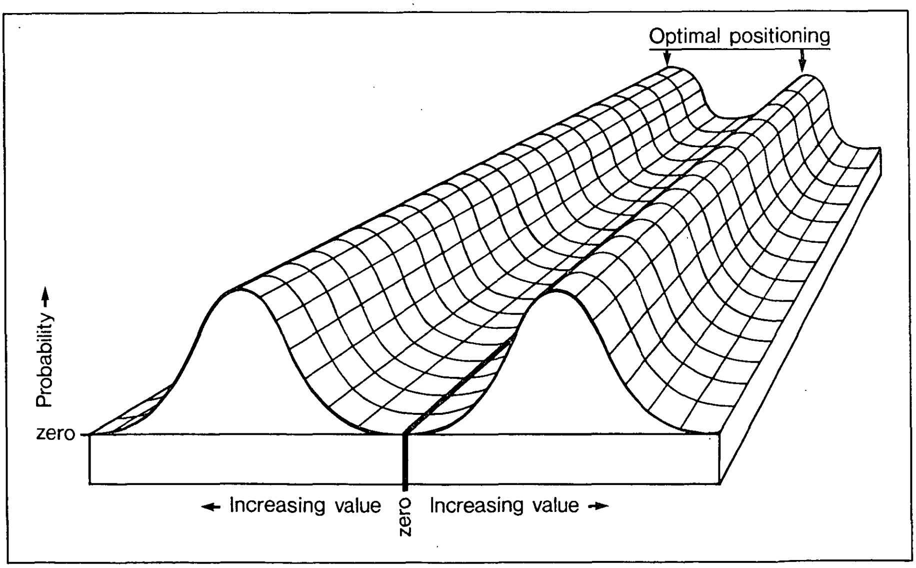

Fig. 8. Hypothetical base camp distributions for exploiting symmetrical, linear resources [after Thomas and Bettinger 1976: figure 65].

Shoshone: not only was the absolute amount of water limited, but the available water was distributed only as a point resource. This combination of circumstances left little latitude for the aboriginal settlement pattern, and similar cases occur throughout the more arid portions of the Great Basin.

By contrast, water was not a directly limiting factor for the Reese River Shoshone or the Owens Valley Paiute. By Great Basin standards, water was relatively abundant, and because water occurred in linear fashion, considerable latitude was available for establishing village locations. In both the Reese River and Owens valleys, resources other than water served to condition the most effective settlement strategy.

How Animals Structure Human Settlements

The abundance and distribution of animals had a rather minor influence on regional settlement patterns in the Great Basin. Some mammals, particularly rodents and cottontail rabbits, and probably also deer and bighorn sheep, were most profitably hunted by individuals employing an encounter strategy [STEWARD 1938: 33–40; HEIZER and BAUMHOFF 1962: 210–218; THOMAS 1969]. Jack rabbits were commonly taken during communal drives; these hunts required the cooperation of several families and could generally be attempted only after an adequate food supply was already at hand. The Kawich Mountain Shoshone, for instance, assembled for communal rabbit drives in November, after the piñon harvest, since this was the only time they had sufficient food to feed such a large group [STEWARD 1938: 112]. Although the picture remains unclear for the Reese River Shoshone, it seems that the regional fall *fandangos* and rabbit drives were also held only after the piñon crop had been successfully harvested [STEWARD 1938: 106].

The situation at Owens Valley was quite different because hunting territories "belonged" to local bands. Large-scale hunts and fishing expeditions on the river involved the cooperation of local band members [STEWARD 1933: 238]. Individuals could hunt anywhere, but communal hunts were conducted only in band-controlled territories.

Animal foods were of secondary importance throughout the Great Basin. Although meat and fish were consumed with relish when available, plants remained the dietary staple. Consequently, the seasonal round was more heavily conditioned by the availability of floral rather than faunal resources. Animals affected the settlement pattern only through the occasional communal hunt. Although such large gatherings doubtless had important sociopolitical ramifications, they were relatively insignificant in terms of the regional settlement pattern.

How Plants Structure Human Settlements

Decisions regarding availability of floral resources dominated the Great Basin aboriginal subsistence strategy and dictated, in large measure, the seasonal movements and aggregations of these populations. As with water, plant availability was manifest in two ways, the absolute abundance and the structure of the resource itself.

Floral structuring provides the very backbone of the settlement systems considered here.

All Kawich Mountain Shoshone encampments were tethered to point water resources. In the winter these families depended on piñon harvests. Since the piñon-juniper woodland was somewhat sparse in the Kawich Mountains (again, due largely to the scarcity of water), families often made fairly long journeys to locate piñon stands suitable to support a winter encampment.

During the spring and summer, the Kawich Mountain Shoshone depended on a number of seed-producing grasses, but potential areas for base camps were again limited by the availability of surface water. It is interesting that although the Cactus Mountains to the west afforded exceptional spring and summer resources, no one wintered there because piñon nuts were absent [STEWARD 1938: 112]. In Binford's terms [1980], the spatial incongruity was too great to overcome in a single subsistence-settlement network.

The world of the Kawich Mountain Shoshone was circumscribed by the need to establish base camps near the few available mountain springs. These springs, as point resources, narrowly limited areas of potential residence. The second major determinant was the availability of adequate piñon harvests; if the local crop was satisfactory, then winter camps could be established near one of the springs in the Kawich Range. Sometimes the piñon crop enabled families to winter near the upper range of the piñon belt where they could use snow as water; for this brief interval, water ceased to be a key limiting factor.

But when the local piñon crop was unsatisfactory, as was often the case, families traveled north or west in search of resources. For a group like the Kawich Mountain Shoshone, access to up-to-date ecological information, particularly the local availability of seed crops, piñon nuts, animal herds and water, was vital to survival. The fall *fandango* and spring Round Dance both functioned as mechanisms for distributing such information [THOMAS 1972, 1979a: 123–126, 275].

At Reese River, piñon availability was also a major determinant of the human settlement pattern, but the resource operated somewhat differently than in the Kawich Mountains. Because water was a relatively abundant linear resource in the Reese River Valley, the Shoshone of that area could plan their settlement strategy to include resources other than just water. In addition, the rainshadow effect of the Toiyabe Mountains produced piñon stands as productive as anywhere in the Great Basin. Although piñon nut yield is no more predictable at Reese River than anywhere else [THOMAS 1972: 143–145], the sheer density of the piñon woodland greatly increased the probability of a successful local harvest. In the long run, the Reese River Shoshone were able to remain closer to home more frequently than were groups in less favored areas.

It seems clear that piñon availability was the major determinant of settlement pattern at Reese River. Figure 4 showed how winter residential base camps were usually established along the lower margins of the Toiyabe and Shoshone mountains. Each camp had a distinct name and the nearby piñon tracts and sown seed areas were "owned" by the members of that village. Archaeological investigation in the area has shown that, at least in prehistoric times, the location of each camp was tightly structured according to microtopographic characteristics. Based strictly on such environmental criteria as slope, distance to water, ground cover and elevation, it was possible to predict almost exactly the location of prehistoric piñon camps [WILLIAMS, THOMAS and BETTINGER 1973; THOMAS and BETTINGER 1976].

To minimize transport costs, the Great Basin Shoshoneans attempted to establish their camps directly within the piñon-juniper belt, provided the local yield was satisfactory. Piñon is a bulky resource and individuals harvested 1 to 1.4 kl in a single season [STEWARD 1933: 241], so costs were minimized by camping within the grove itself. But other settlement factors were involved when choosing the residential location, particularly access to manipulated seed areas in the uplands and to the seed and root resources on the valley floor. In addition, winter weather was less severe at the lower elevations. The best overall habitation area was near the lower piñon-juniper margin, preferably near the mouth of a canyon where water was available [STEWARD 1938: 232].

In other words, piñon exploitation at Reese River fostered a series of asymmetrical linear settlements (Fig. 9). The area of potential habitation is a linear band of probability; sites tend to cluster near the lower margins of the piñon ecotone. The pattern is asymetrical because settlements occur only within the piñon-juniper woodland, not on the arid sagebrush flats. This probabilistic model quite accurately describes the distribution of prehistoric piñon villages in the Toiyabe Mountains of the Reese River Valley [THOMAS and BETTINGER 1976].

The major limiting factor in the aboriginal Reese River settlement system was

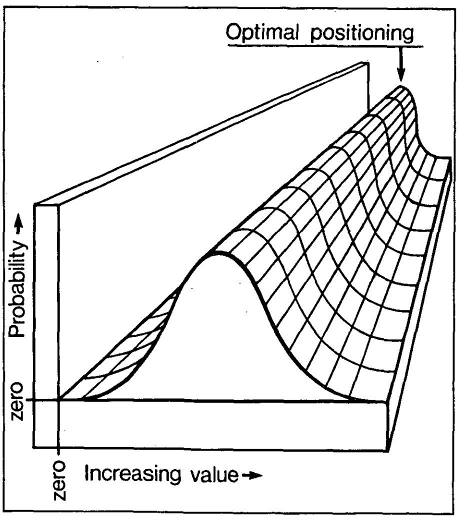

Fig. 9. Hypothetical site distributions for exploiting asymmetrical, linear resources [after THOMAS and BETTINGER 1976: figure 64].

the availability of summer seed crops. Sometimes the local seed crops were sufficient and the family clusters could remain in piñon villages throughout the year. But some years were lean and it was necessary for family clusters to disperse during the summer to exploit seeds on the valley floor, and, to a lesser extent, the roots and berries available in the uplands. But no matter where the vicissitudes of summer might lead them, the Reese River Shoshone would invariably return to their established winter villages (provided the local piñon crop was satisfactory). The pattern of winter agglomeration and summer dispersal seems to be the direct result of a fairly reliable piñon resource and of a sparse and somewhat erratic availability of the summer staples. Piñon functioned in this case as the determinant, whereas summer seed crops imposed the major limiting factor.

Piñon was also the single most important resource for the Owens Valley Paiute [STEWARD 1933: 241], but it structured the Owens Valley settlement pattern rather differently from the Reese River case. Reese River Shoshone families were loosely attached to a piñon village. In a good year they camped at the local village, but when local piñon crops failed they moved elsewhere, as necessary. The piñon base camp of the Reese River Shoshone comprised the dominant face-to-face association.

But the major social aggregation in Owens Valley was not the piñon camp, but rather the "village" or "headquarters", generally located on a permanent stream near the valley floor [STEWARD 1933: 238]. Because water in this case is a linear resource, the Owens Valley Paiute were free to choose village locations relative to resources other than just the availability of water. When piñon ripened in the fall, the village band might pack up and move *as a group* into the uplands. These piñon plots were village-owned and individual families often claimed sub-plots within the band territory [STEWARD 1938: 52]. In very good piñon years, the Owens Valley people wintered together in the piñon groves, living in "mountain houses" near springs or using snow for water [STEWARD 1933: 242]. But if the piñon harvest was only mediocre, then available nuts were gathered and carried back to the permanent valley village [STEWARD 1938: 52].

This is a major adaptive and strategic difference between the Reese River Shoshone and the Owens Valley Paiute. At Reese River, the piñon village provided the major unit for social interaction. At Owens Valley the piñon camp was merely a satellite site, subsidiary to the valley village. The availability of piñon determined the whereabouts of the Reese River family clusters, whereas in Owens Valley, the availability of piñon nuts conditioned only the location of the winter settlement, not its participants. Regardless of where the Owens Valley bands might physically winter, *the same people could be found in permanent face-to-face association.* This relative permanence, what Steward called "habitual cooperation" [1938: 50], is the major sociopolitical factor separating the Owens Valley Paiute from less complex Great Basin Shoshonean societies.

Why could the Owens Valley Paiute establish almost permanent valley villages while other Great Basin groups could not do so? The answer is not simply the availability of piñon, even though piñon nuts were the staple. As an ecological determinant, piñon is secondary in importance to the combined influence of the lesser foodstuffs, particularly the various summer-ripening grasses. It is the combination of these relatively dense, storable resources which made the valley villages the nearly permanent locus of habitation. These villages were strategically situated so that most resources other than piñon nuts were available within a convenient walk from the village (i.e., hunting, digging roots, gathering berries, fishing, and especially seed collecting) [STEWARD 1938: 53]. Productivity in the key seed areas was enhanced by irrigation; these irrigated plots were generally accessible from the valley villages, sites being chosen for convenience of dam and ditch building, soil drainage, and seed yield [STEWARD 1933: 247].

The Owens Valley Paiute may have been unique among Great Basin Shoshoneans because of their ability to store sufficient resources as a hedge against future shortages. Seeds were harvested in the summer and cached; fish were obtained, often communally, and smoked for storage [STEWARD 1933: 251]; roots and greens could often be harvested in sufficient quantities for storage; and acorns were even obtained in trade from the Western Mono, or sometimes gathered directly from zones within the Owens Valley proper [STEWARD 1933: 246].

The implication for settlement patterning is clear. Whereas the Reese River Shoshone relied almost exclusively on the local piñon crop for their winter survival, the Owens Valley Paiute had a surprisingly diversified and logistically organized winter economy, relying on no single resource at any given time. If piñon crops were good the band moved into the mountains; but if they were poor the group remained in the valley villages, dependent on a variety of stored food. The Owens Valley Paiute enjoyed the relative "luxury" of a greater logistical organization compared to most other Great Basin people. The sociocultural correlates of this stability are considered below.

Territoriality

One relevant issue, mentioned only in passing so far, is the matter of human territoriality. Unfortunately, discussion of this interesting topic too often involves simplistic and fruitless appraisals about the so-called innate nature of territoriality among *Homo sapiens*. We will sidestep such facile generalizations and focus instead on the direct relationship between key ecological variables and the relative degree of territoriality among hunter-gatherers.

A *territory* is an area occupied more or less exclusively by an individual or group, and defended either overtly or through advertisement [see DYSON-HUDSON and SMITH 1978: 22–23]. Also relevant is the ecological concept of *economic defendability* [BROWN 1964]; simply stated, territorial behavior is expected whenever the *costs* of exclusive use and defense of an area are outweighed by *benefits* gained from this pattern of resource utilization. Territorial behavior should occur whenever the cost-benefit ratio exceeds one.

Dyson-Hudson and Smith [1978] have related the cost-benefit ratio to the question of human territoriality by using a number of case examples, including the Great

Basin Shoshoneans. My own discussion draws on their ideas, although my emphasis is somewhat different.

Given the previous discussion of settlement pattern limits and determinants, which groups would be expected to exhibit territorial behavior? The concept of economic defendability suggests that human territoriality should arise among those groups dependent on resources which are both *dense* and *predictable*; territoriality should be absent from groups which exploit a sparse and unpredictable resource base [DYSON-HUDSON and SMITH 1978]. Figure 10 shows how this model can be applied to the three Great Basin Shoshonean societies considered here.

As expected, the Kawich people lacked all forms of territoriality (and this is true for most Western Shoshone). Summer resources are sparse and scattered, and it is impossible to tell from one year to the next which area will be suitably productive. This means that Kawich Mountain families often traveled great distances to find food and water. The situation improved only slightly during the winter because the local piñon crops were still scattered and erratic, failing to provide a dependable resource base. The high degree of residential mobility and uncertainty precluded effective ownership of resources; the costs drastically outweighed any potential benefits of territoriality.

In marked contrast is the well-defined band territorial system of the Owens Valley Paiute. Most of the annual resources fell into territories which were owned and controlled by the valley villages. These "districts" were defended against trespassers and were apparently inherited patrilineally in some cases [STEWARD 1938: 52]. The greater predictability and absolute density of the resource base clearly led

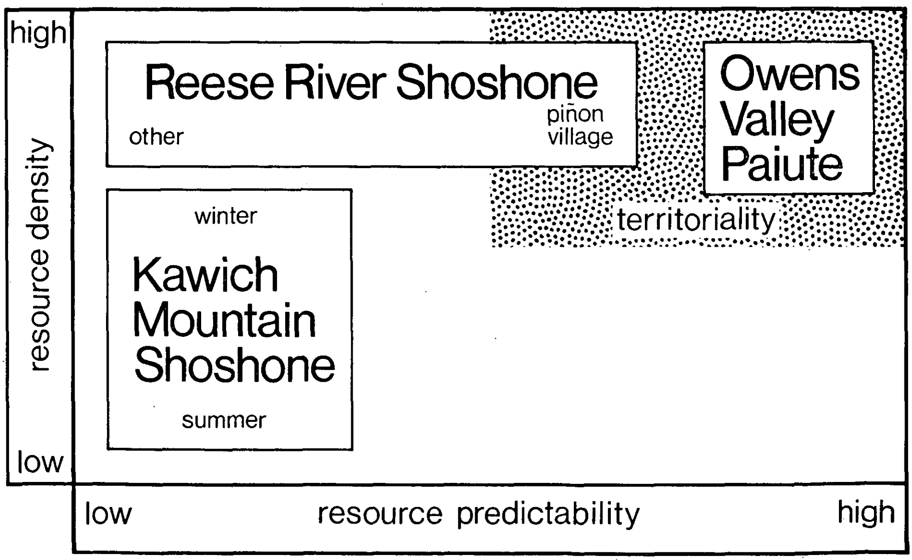

Fig. 10. Relationship of territoriality and resource base for three Great Basin societies.

to this stabilized territorial system, perhaps the most strongly developed in the Great Basin.

The Reese River Shoshone provide an interesting middle ground for the territorial question. At Reese River, only those resources related directly to the piñon villages were owned, namely the small 40 to 80 ha tracts of piñon trees and the upland sown seed areas. Both locations in the mountains were immediately behind the village sites. These seed areas were defined by well-known landmarks and defended against trespassers, short of outright fighting or killing. Inheritance of the seed areas was probably patrilineal. Steward notes that such ownership was "contrary to Shoshone custom" and suggests that the unusual resource predictability and density were such that habitual use led to ownership [STEWARD 1938: 106].

Note that the nature of territoriality at Reese River is quite different from that at Owens Valley. Not only is the Reese River system more flexible, but it applies only to resources logistically and spatially associated with the village area. In Owens Valley, the local village owned all resources which occurred within their "district", such ownership extending to all hunting, seed collecting, and fishing rights [STEWARD 1933: 305]. At Reese River, there were no strictures regarding valley floor plant resources nor was there any ownership of hunting or fishing territories.

In other words, the Reese River Shoshone extended ownership and territoriality only to those resources sufficiently predictable and dense to warrant habitual use (namely piñon trees and sown seed areas). Had the settlement pattern been more logistical, then territoriality would almost certainly have been extended to other major resources, as in the "district" system of the Owens Valley Paiute. The Reese River case seems intermediate not only in terms of settlement pattern, but also with respect to territoriality.

Territoriality in the Great Basin is thus consistent with what one would expect from the concept of economic defendability [e.g., BROWN and ORIANS 1970]. The general implications of this relationship have been recently reviewed by Dyson-Hudson and Smith, and need not detain us here.

Marriage and Kinship

Steward considered marriage and kinship to be ecologically determined in the Great Basin, the objective being to establish the family as "an economic unit which insured the survival of the individual" [STEWARD 1938: 241]. On-going research by Eggan has reconsidered the issue, and his analysis has "provided some unexpected results" [EGGAN 1978].

Eggan is in the process of reanalyzing the detailed kinship data from 25 valley populations in the Great Basin. By studying the social systems group by group, Eggan hopes to determine the relationship between the social system and the locally exploited microenvironments. Specifically, he finds that marriage practices and kinship groups are critical factors in the overall subsistence strategy of various Shoshonean groups: "it is probable that at the simplest levels of subsistence [in the Great Basin] the kinship systems are sensitive to small variations in the underlying ecology so that a simple basic pattern may not exist over a wide area until the subsistence problems are solved by agriculture or pastoral activities that provide greater certainty" [EGGAN 1978: 21].

In the more extreme Great Basin environments, those areas with low population densities and highly variable settlement patterns, the kinship system functioned primarily to provide a network of relatives. This network was particularly important to pass on information concerning the availability of food, such as the condition of certain patches of grass seeds, areas of fruitful piñon harvest, and so on. The kinship terminology in such cases reflected the attempt to maximize this information network. According to Eggan [1978], the greater the uncertainties of subsistence, the stronger the built-in restrictions on sharing. The seed harvests in these areas were "owned" by the woman who harvested them. She was responsible only for the welfare of her immediate family cluster. In such impoverished areas, brothers and sisters did not have automatic rights to her food supplies. Presumably this was the system operating among the Kawich Mountain Shoshone as well.

The kinship system was rather different in more favored areas, such as the Reese River Valley. True cross-cousin and pseudo cross-cousin marriage was practiced in many such regions. Brother-sister exchange was continued into the next generation, thereby strengthening the bonds within communities while reducing ties with neighboring areas. The kinship system was modified accordingly to differentiate between parallel and cross-cousins. The need for a kinship network to provide information on available food resources in such intermediate areas was relatively less important, according to Eggan [1978]; emphasis shifted toward increasing local integration and band unity.

This tendency was rather strongly developed in the Owens Valley, where kinship shifted even further away from family autonomy and emphasized instead village-level integration. Alliances were intensified between families through infant betrothal, and there were even special kin terms designating relations between prospective parents-in-law. Because the villages were generally comprised of several unrelated families, local exogamy was not necessarily practiced.

Eggan's research, like Steward's, thus emphasizes the adaptive significance of kinship and marriage, but the correlations between specific forms of kinship and microenvironmental variation appear to become more clear-cut.

PROCESSES OF MICROEVOLUTION

We can now return to consider the question raised initially in this paper: How does an increase in population size bring about an increase in societal organization?

Following Carneiro [1967: 242], let us distinguish between growth and evolutionary development: *growth* involves an increase in substance, whereas *development* is an increase in structure. The interplay between the two gives rise to more differentiated forms, and it is this change which constitutes cultural evolution.

How does the interaction between growth and development occur? The two processes are clearly inseparable, since substance can be manifest only through some sort of structure. This growth, while having the external appearance of a size increase, is manifested internally as differentiation, as an increase in the number of units.

But as with the proliferation of cells, growth by simple multiplication of elementary units cannot proceed indefinitely [CARNEIRO 1967: 240]. Beyond a critical point, further growth demands the emergence of new kinds of units, and new forms of relationships between these new units. That is, continued growth ultimately demands development. Translating this into cultural terms, Carneiro [1967: 240–241] suggests that the elaboration of social structure is a systemic response to internal stress caused by the multiplication of social units. As human populations increase, they stretch the capacity of the social system; when this pressure exceeds a critical point, the system responds by giving rise to new practices.

This mechanism of short-term microevolution is clearly one factor operating in the simple Great Basin societies discussed here. Consider the evolution of suprafamilial structures in the Great Basin. Although the Kawich Mountain Shoshone spent most of their time in relatively isolated family clusters, they periodically grouped together for festivals and communal hunts of antelope and rabbits. The fall *fandangos* were held in conjunction with the piñon crops, however they were sporadic, often with families from adjoining valleys participating. After the piñon harvest, families of the Kawich Mountains often tried to join together, generally in November, for a communal rabbit drive. Each morning the rabbit boss would announce plans for the day's hunt and coordinate efforts of all participants. After the gathering, however, his authority evaporated.

Fall festivals and communal rabbit drives were also held in conjunction with the piñon harvest at Reese River, but the pattern was more regularized and more predictable. There were two favored spots for communal gatherings at Reese River (*Wandonawunum*: and *Wiyunutuahunupi*); these were traditional localities known to all. In historic times, the Reese River *fandangos* grew in size and attracted participants from up to 150km away, but this was probably due to acculturation. One man, *Tutuwa*, directed and coordinated the Reese River *fandangos*. Men drove rabbits for five days and everyone participated in the Round and Horn Dances at night. A rabbit boss, *Wandodo'o*, was appointed to direct such functions at Reese River, but villages also commonly conducted local hunts, under village authorities [STEWARD 1938: 105]. Antelope hunts were also held, but they depended on the whereabouts of both antelope herds and the antelope shaman. During historic times, a single antelope shaman, *Wanzigwep tsugu'*, administered for Reese River and the two surrounding valleys.

The pattern was even further stabilized among the logistically organized Owens Valley Paiute. Six-day festivals, involving dances, gambling, and rabbit drives were held for each band after the piñon harvest [STEWARD 1938: 54]. Instead of *ad hoc* officers, leadership in these cases was supplied by the permanent band chief, with invitations sent to neighboring villages. In fact, the various festivals were sometimes scheduled at different times, so that villagers could attend festivals in other areas.

The position of the village chief was critical because his duties included not only the planning and coordinating of communal efforts (such as antelope, rabbit and deer drives), but he was also responsible for overseeing the irrigation of wild seeds, the erection of the sweat house, and for keeping people generally informed about local ripening of piñon crops and scheduling of temporary piñon camps. In some cases the headman approved or directed witch killing [STEWARD 1933: 304–305, 1938: 55].

This foraging-collecting continuum provides clues about the subtle processes of the microevolution of sociopolitical complexity. Among sparsely populated and residentially mobile groups, such as the Kawich Mountain Shoshone, organization above the family level was ephemeral, authority lapsing when the family clusters dispersed. Individual family heads directed their activities during most of the year, relinquishing their authority only during the sporadic communal gatherings. For the Kawich Mountain Shoshone this societal transformation occurred abruptly and dramatically, yet always reversibly.

But as both population and the logistical organization increase, the change is slower, less obvious, and often times irreversible [CARNEIRO 1967: 241]. Communal gatherings at Reese River were sometimes controlled by a single individual who, at least in historic times, assumed control for the entire district. But lesser activities were directed by subordinates, such as the rabbit boss or antelope shaman. In contrast to the Kawich Mountain Shoshone, leadership among the Reese River villages carried over throughout the year, overarching individual *fandangos* and communal hunts. This transformation is a structural response to an increased and more logistically organized population.

The microevolution from ephemeral to relatively permanent leadership is complete among the Owens Valley Paiute. Communal gatherings were merely an extension of annual village activities directed by a chief, who inherited his responsibilities and coordinated all village functions throughout the year. Once again, the added necessity of coordinating and leading increased numbers of people fostered the transformation from part-time, ephemeral, informal leadership to permanent, inherited leadership.

The interplay between growth and development is clearly recognizable. In this case, a quantitative change—increased population size—has led to a qualitative change in political stability. While the two processes are rarely as well differentiated as in this example, it seems clear that the interplay between quantitative and qualitative change is a triggering mechanism which underlies much of what we call cultural evolution.

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