AZTEC HUMAN SACRIFICE: CROSS-CULTURAL ASSESSMENTS OF THE ECOLOGICAL HYPOTHESIS[1]

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Ecological, religious, and social predictors of institutionalized human sacrifice are assessed through cross-cultural analysis. While human sacrifice has no significant correlations with measures of agricultural potential, protein, total food, food storage adequacy, and famine risk, there are significant positive correlations with population density, population pressure, and war for land and resources. Population pressure and war for land and resources have independently significant correlations with human sacrifice, and together account for 38 per cent of its variance (multiple $R = .62$, $p < .006$). A measure of low hierarchical focus of religion provides significant additional explanation of variance (multiple $R = .72$, $R^2 = .51$, $p < .000$), suggesting human sacrifice may play a role in ideological integration. (Sacrifice, cannibalism, religion, ethnology, ecology)

Concern with the explanation of human sacrifice and cannibalism gained heightened interest with Harner's (1977a, 1977b) publications on Aztec human sacrifice and cannibalism. Harner suggests their causes were related to protein scarcity as a consequence of high population pressure in a distinctive ecological situation. Ortiz de Montellano (1978, 1990) rejects Harner's arguments based on Aztec dietary information. Price (1978), Hassig (1990), and Isaac (1983) suggest that human sacrifice was an epiphenomenon reflecting geopolitical dynamics, political and military instabilities, demographic conditions, and economic production and distribution networks. But these rejections of the ecological hypothesis do not convincingly support the alternatives proposed as the causes of human sacrifice and institutionalized cannibalism. Although some reports of cannibalism are doubtful (e.g., see Arens 1979), evidence for both human sacrifice and cannibalism is well documented in ethnographic, historical, bioarchaeological, and clinical literature[2] (c.f. Turner and Turner 1995). Cannibalism in some nonhuman primate groups (Goodall 1977) suggests that it may play a role in ecological and social adaptations.

This article reports cross-cultural analyses on previously published data sets of the Standard Cross-Cultural Sample (SCCS) (Murdock and White 1969) to assess the role of ecological factors, religious conditions, and social complexity variables in predicting human sacrifice. The focus is on legitimate human sacrifice carried out by religious leaders as normative social activities. The wide range of measures examined include: social complexity variables; agricultural potential, meat protein, domestic animals, and total foods; food storage adequacy; threat of famine; population pressure; and environmental circumscription (assessed through warfare for land and resources). The relationship of religious and social complexity conditions to human sacrifice are assessed to illustrate the relevance of other social factors to the incidence of human sacrifice, and to suggest directions for further investigations.

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THE ECOLOGICAL HYPOTHESIS

Harner (1977a, 1977b) rejects anthropological theories that reflect Aztec explanations for human sacrifice; i.e., that sacrifice was required by their religion and gods. Based on studies of population pressure, Harner (1970) suggests that the unparalleled scope of Aztec human sacrifice and cannibalism resulted from demographic-ecological factors which created protein shortages and population pressure: unfavorable agricultural conditions, seasonal crop failures, the lack of domesticated herbivores, the depletion of wild game in the region, food scarcity, famine, and environmental circumscription caused by limitations on the expansion of agriculture. The fertile central valley of Mexico is surrounded by poor farming land, creating an environmental circumscription precluding agricultural expansion. While corn and beans provide complementary vegetable proteins, their lack of necessary fatty acids and the seasonal scarcity of these foods made these sources insufficient. This leads Harner to hypothesize that cannibalism provided a significant source of protein. The Aztecs did not ordinarily eat people from their own polity, but practiced warfare, called "flowery wars," as rituals to obtain sacrificial victims. The conquered territories nearby were a convenient source of victims. Although the consumption of human flesh was reserved for the elite, the class system allowed for upward mobility of great warriors, so wars to obtain victims for sacrifice were supported by a hungry population which desired both prestige and protein in the form of human flesh. Great warriors could also receive the right to consume human flesh, which was shared with lineage members.

Price (1978) characterizes Harner's hypothesis of cannibalism based on chronic protein shortages as unsubstantiated, insufficiently distinguished from famine and lack of food, and undermined by the fact that human sacrifices were largely consumed by the elite class that already had easy access to other meat. Ortiz de Montellano (1978) presents nutritional resource data and dietary information challenging Harner's hypothesis. By documenting a wide range of meat proteins available, the enormous food tribute they received, the stores of food maintained, and the intensive agricultural techniques employed, he argues for an adequate diet for the Aztec population. Other factors mitigating against the ecological hypothesis include: 1) conquering new lands for agriculture and tribute; 2) the insignificance of the total human protein available from sacrifice; and 3) the preponderance of human sacrifice during the annual periods of food abundance from harvests, rather than during periods of protein scarcity. Ortiz de Montellano suggests that the preponderance of human sacrifice during harvest periods indicated that it was "a gesture of thanks and reciprocity to the gods" (1978:614) rather than filling a need for protein.

RELIGIOUS AND SOCIAL HYPOTHESES

Ortiz de Montellano (1978, 1990) attributes the Aztec practice of human sacrifice to their belief that the gods required it. This cosmological hypothesis is obviously

true but uninformative. Religious justifications for human sacrifice and cannibalism do not alone explain such beliefs and behavior. The individual Aztec warrior's motivation for participation in warfare for sacrificial victims included the social benefits accrued. But such obvious linkages do not inform us of the reasons human sacrifice was adopted as a mechanism for allocating prestige and mobility. The motivations for self-sacrifice were undoubtedly reinforced by religious beliefs that the victims would go to heaven. But why such beliefs would be adopted remains unaddressed. Their beliefs may explain their behavior, but leave unanswered the question of why the beliefs and practices were adopted, and fail to identify the psychosocial functions of human sacrifice.

A dominant perspective in social anthropology, influenced by Emile Durkheim, is that religious beliefs and practices derive from and are reflective of social conditions (Bourguignon 1976; Bourguignon and Evascu 1977; Davis 1971; Swanson 1960; Peregrine 1996; Winkelman 1986, 1990, 1992). If so, the determinants of human sacrifice should be sought in the social conditions which structure religious beliefs. The perspective that determinants of human sacrifice are found in the social conditions which structure religious beliefs is illustrated in assessments of the broader economic networks and political conditions associated with Aztec sacrifice and warfare (Price 1978; Hassig 1990; Isaac 1983). These reject human sacrifice as a motivator for Aztec flowery wars (presumptively for sacrificial victims), and thereby dismiss the importance of human sacrifice within the broader context of state activities, warfare, economic systems, and class stratification.

Price (1978) characterizes cannibalism as a stylistic trait and an epiphenomenon which had little effect on economic intensification, warfare, political expansion, and social stratification. Price suggests that the explanation of Aztec human sacrifice and cannibalism is to be found in economic networks of production and distribution, patterns of state redistribution, political and military instabilities, and pacifications of the nobility. Her model postulates that human sacrifice reinforced existing stratification and political power, but she acknowledges the lack of evidence for such effects in her work. Isaac (1983) hypothesizes that human sacrifice served ideological functions in Aztec society by uniting the class interests of nobles and upwardly aspiring lower-class warriors, but he fails to explain why human sacrifice would be adopted for such integrative purposes.

Hassig (1990) links Aztec human sacrifice to their precarious economic position and consequent social and political adaptation. Their flowery wars are analyzed as a strategy of empire-building which enabled greater expansion by allowing dependent areas to be self-administered yet pay tribute, rather than investing higher political and administrative costs to directly administer the conquered areas. Hassig characterizes the flowery wars as a deliberate strategy to wear down stronger enemies, rather than as an institutionalized procedure for obtaining sacrificial captives. Price (1978) and Isaac (1983) similarly suggest that the flowery wars reflected the shifting balances of power in the geopolitical dynamics of the Aztec Triple Alliance and their inability to conquer the Tlaxcala-Pueblan Valley. Price suggests that the inconclusive nature of

military operations made human sacrifice an ideological mechanism to explain away the failure of military conquest under the guise of ritual pursuits. Moteuczoma's characterization of the wars as rituals for obtaining captives and providing military training for soldiers is seen as a strategic ruse to direct the Spaniards' attention away from Aztec political and military weaknesses (Isaac 1983).

While there are many economic, social, and political explanations for Aztec human sacrifice, no convincing evidence is offered as to why they should have had a role in these processes. Why should these social conditions lead to human sacrifice? The flowery wars did serve as a population-control mechanism—reducing population pressures in the Valley of Mexico by culling young males through military fatalities (Price 1978)—and undoubtedly relieved pressure on the land tenure system. But why use human sacrifice as a justification and mechanism?

If population or other ecological, economic, class, or political factors are to be demonstrated as causes of religious practices (e.g., human sacrifice), they should be shown to have systematic relations in a cross-cultural sample. Arguments about systemic causes of human sacrifice and cannibalism based on case materials are unconvincing on methodological grounds. The failure to establish relationships of human sacrifice with specific ecological or social variables leaves explanation of the behavior open to characterization as social pathology. But if human sacrifice is to be explained as an ecological, economic, social, or political phenomenon, it must be demonstrated through systematic cross-cultural analysis.

METHODS

This study used a subsample[3] (Winkelman 1986, 1990, 1992; Winkelman and White 1987) from the Standard Cross-Cultural Sample (SCCS) (Murdock and White 1969) and its data sets for a systematic cross-cultural assessment of ecological and social predictors of human sacrifice. The subsample included societies of the major regions of the world and covered a time span from 1750 B.C. to the present century. Assessments of human sacrifice were derived from a study which utilized formal analysis of coded variables based on descriptive data derived from ethnographies (see Winkelman 1992; Winkelman and White 1987 for methodology). Culturally recognized magico-religious practitioner statuses had been previously assessed on social, political, religious, medical, cosmological, and ritual characteristics, including forms of sacrifice. The present study compiled data from the individual magico-religious practitioner statuses to determine the societal incidence of human sacrifice.

Human Sacrifice Variable

The present research assesses ritual human sacrifice rather than sacrificial cannibalism. As there are different forms of human sacrifice (e.g., social control vs. social pathology) (Turner and Turner 1995), the present study distinguishes legitimate human sacrifice (a form of normative behavior, involving propitiation) from

malevolent human sacrifice (immoral practices attributed to sorcerers and witches). These malevolent beliefs (e.g., consuming body parts, or the soul or spirit of the victim) apparently reflect attributions rather than actual behavior and are not the concern of this study. Legitimate human sacrifice is typically associated with magico-religious practitioners called priests. Priests are elite sociopolitical functionaries who also have central roles in communal religious activities associated with propitiation and calendrical agricultural rituals.

Seven societies of the sample had human sacrifice (Ovimbundu, Ibo, Kafa, Roman, Marquesans, Atayal, and Aztec). The Romans were the only case in which the practices of human sacrifice were not carried out by priests. In Rome, human sacrifice was carried out by a practitioner called by terms translated as witch, sorcerer, and necromancer. In formal cross-cultural analysis, this practitioner was classified as a shaman/healer, not a witch/sorcerer (Winkelman 1986, 1992). This practitioner's use of human sacrifice involved efforts to contact and influence the spirit world, making it a form of propitiation. Analyses dropping Romans from the sample produced slightly weaker correlations, suggesting its appropriate inclusion here.

Ecological and Social Variables

The ecological hypothesis of human sacrifice, which postulates humans to be a food resource utilized under adverse conditions, requires assessing the factors affecting food availability (agricultural potential, rainfall, natural disasters, risks of famine, adequacy of storage, trade networks for food, etc.). These ecological predictors were derived from previously published SCCS data sets on agriculture suitability (land slope, suitability of soil, climate, and annual rainfall) (Pryor 1986); subsistence economy and supportive practices (including intercommunity trade as a food source, food preservation and storage, food surpluses, and subsistence variables on contributions of agriculture, hunting, fishing, gathering, and domestic animals to the food supply) (Murdock and Morrow 1970); political organization (Tuden and Marshall 1972); political participation and peace, including decision-making processes and political fission (Ember, Russett, and Ember 1993); measures of war for land and resources and unpredictable resource problems, including threat of famine, weather or pest disasters, and chronic resource problems (Ember and Ember 1992); cultural complexity (Murdock and Provost 1973); settlement patterns and community organization (Murdock and Wilson 1972); and religious variables (Whyte 1978; Murdock 1967; Winkelman and White 1987; Winkelman 1992).

RESULTS

Data were analyzed with SYSTAT (1992), utilizing the Tables, Correlation, and Multiple Regression programs. Measures of cultural complexity (Murdock and Provost 1973) were used to identify general societal conditions associated with human

sacrifice. These societies are characterized by a variety of social conditions and are typically at the mid-range of levels of cultural complexity. None of the original cultural complexity measures[4] (five-point ordinal scales) is significantly correlated with human sacrifice; the measures do not linearly distinguish societies with human sacrifice from those without. All seven cases of human sacrifice are found in societies with a high reliance upon agriculture and with sedentary and relatively permanent and fixed residence patterns. All of the societies in the sample with human sacrifice relied upon domesticated animals (bovines or smaller domesticated animals) for food sources, but they were not pastoral societies and did not heavily use milk products. Six of the cases were at the highest levels of population density.

Agricultural Potential

Societies with human sacrifice have a major reliance upon agriculture and in all but one agriculture contributed more than any other food source. Gathering contributed less than 10 per cent of the food supply in all cases except one, but all relied upon hunting and gathering to some extent. More than half of the cases had good or better land slope, and all had fair to good land; five of seven cases were rated as having excellent climate, and all had high levels of average rainfall (600 mm, most over 1,000 mm). Neither Pryor's (1986) agricultural potential measures, nor recodes focused on poor climate, land, or agricultural potential, nor summary measures of agricultural suitability had significant correlations with human sacrifice (Table 1). All of the societies with human sacrifice, however, had low or fair agriculture potential (as opposed to good or excellent), and all were in the mid-range of measures of agricultural potential.

Table 1: Correlation of Agricultural Suitability with Human Sacrifice

Independent Variables	Spearman's rho =	p < (one-tailed)
Land Slope	-.09	ns
Suitability of Soil	.11	ns
Climate and Rainfall	.13	ns
Total Suitability	.04	ns
Lowest Suitability	-.07	ns

Food Supply and Famine Threat

Measures of the availability of a range of food supplies and resources (Murdock and Morrow 1970; Ember and Ember 1992) were not significantly correlated with human sacrifice (Table 2). All of the societies with human sacrifice had means of food storage, but five of the seven experienced seasonal or annual variation in the food supply. Three of the seven imported food through intercommunity trade, but four had inadequate food supplies to last through difficult times. The majority of

Table 2: Correlation of Famine and Food Supply Variables with Human Sacrifice

Independent Variables	Spearman's rho=	p< (one-tailed)
Hunting and Fishing	-.22	ns
Domestic Animal Food	.07	ns
Food Surplus via Storage	.03	ns
Storage Adequacy	.00	ns
Season/Annual Variation	.10	ns
Famine Threat	-.02	ns
Weather Threat	-.25	ns
Chronic Resource Problems	-.15	ns
Computed Variables:		
Summary Food Threat	-.18	ns
Risk of Famine (Composite Measure)	-.26	ns
Total Meat Protein	.06	ns
Total Food	-.07	ns
Food Problems	-.10	ns

societies with human sacrifice had low threats of famine, food problems due to weather or pests, or chronic resource problems (one exception on each variable), with only one case of high risk of famine (Aztec). The food shortage data (Ember and Ember 1992) has limited usefulness because of numerous cases of missing data or unreliable codings for the societies with human sacrifice. Over half of all the ratings for these societies were unknown or lacked sufficient rater reliability to report. Given the uncertainty about food reliability indicated by the missing data, this information was used as a part of an index on food uncertainty. Cases with missing data were placed on a scale (Summary Food Threat) between no/low resource problems and moderate resource problems. Human sacrifice had no significant relationship to this recode nor to a composite food resource scale based on the sum of the recodes of resource variables (Table 2). A similar scale was computed on famine risk, utilizing Murdock and Morrow's (1970) variables for food supply and storage adequacy in combination with the Embers' variables. This composite measure of famine risk was nonsignificantly associated with human sacrifice (Spearman's rho=-.26), but in the opposite direction predicted by the ecological hypothesis.

Summary Food Ecology Measures

The measures reported above were reduced in categories, weighted, and summed into three major scales assessing food resources: total meat protein (contributions of hunting, fishing, domestic animals, large herbivores); total food (meat protein plus food import, total agricultural potential, and food storage adequacy); and food problems (threat of famine, weather, resource problems, famine risk, poor land, poor

climate, and poor agriculture potential). None of these summary scales had a significant correlation with human sacrifice, thus providing little evidence in favor of the ecological hypothesis. The nonsignificant negative correlations with weather threat, resource problems, and risk of famine suggest the opposite relationship between food supply and human sacrifice of that predicted by the ecological hypothesis.

Population Density and Population Pressure

Murdock and Provost (1973) provide a measure of population density ranked at five levels, from less than one person per square mile (psm) through 100 psm. The societies with human sacrifice all have higher levels of population density, with all but one society with human sacrifice at 26+ psm. There was a significant Pearson correlation of $r = .40$ ($p < .01$) with a binary recode (population $</=$ vs. >26 psm). Population pressure measures were derived by dividing population density by food resource measures and the inverse of famine risk and food problem variables. These assessments emphasize the pressure created by large populations with serious food resource limitations or high famine risks. Human sacrifice was significantly and positively associated with the population pressure measures based upon total food supplies ($r = .49$, $p < .001$), adequacy of food storage ($r = .51$, $p < .001$), and meat protein ($r = .29$, $p < .05$), while the population pressure measures based on a summary of food problems and resources, and famine risk were positively but nonsignificantly correlated with human sacrifice (Table 3).

Table 3: Correlation of Population Pressure with Human Sacrifice

Independent Variables	Pearson's r=	p< (one-tailed)
Population Density Recode	.40	.01
Population Pressure Based on Storage Adequacy	.51	.000
Population Pressure Based on Meat Protein	.29	.05
Population Pressure Based on Total Food	.49	.001
Population Pressure Based on Famine Risk	.20	ns
Population Pressure Based on Food Problems	.22	ns

Environmental Circumscription

One cause of Aztec cannibalism postulated by Harner is environmental circumscription. The lack of availability of good agricultural land in nearby areas further exacerbated food shortages. The measures of Ember and Ember (1992) provide proxy assessments of environmental circumscription in their measures of warfare for the seizure of resources and the use of land obtained in warfare. These original variables were recoded to binary variables reflecting the absence/presence

Table 4: Correlations of Environmental Circumscription with Human Sacrifice

Independent Variables	Spearman's rho=	p< (one-tailed)
Internal War for Land	.44	.007
External War for Land	.20	ns
Overall War for Land	.30	.04
Internal War for Resources	.37	.02
External War for Resources	.17	ns
Overall War for Resources	.30	.05
Overall War for Land and Resources	.35	.02

of such conditions, and the individual summary measures for overall land and resource seizure through war were summed into an overall measure of war for land and resources. The individual summary measures of internal warfare for land and resources, as well as combined measures, were positively and significantly associated with human sacrifice (Table 4). The measure of local political fission was also used as an assessment of (a lack of) environmental circumscription. While there was no significant association with local political fission, six of the seven societies with human sacrifice were without local political fission, consistent with the hypothesis of environmental circumscription. Both population pressure (based on storage adequacy) and the overall measure of war for land and resources have independently significant contributions to the prediction of human sacrifice (population pressure $r=.51$, $p<.001$; overall war for land and resources $r=.35$, $p<.02$; multiple $R=.62$, $p<.006$). But limited explained variance (38 per cent) indicates that other factors are also responsible for human sacrifice.

The hypothesis of general social explanations of human sacrifice is not, however, supported by the present research. Inclusion in the regression equation of ten measures of cultural complexity (Murdock and Provost 1973; see note 4), including variables found predicting magico-religious practices in previous studies (Winkelman 1986, 1992) (fixity of residence, agriculture, political integration, and social stratification), provided no significant increases in explained variance in human sacrifice beyond that accounted for by the ecological variables (population pressure and environmental circumscription). This rejects the notion that human sacrifice is a general adaptation to conditions of increasing societal complexity. But the relatively limited explanation of variance by the ecological measures (38 per cent) indicates that there are still substantial determinants to be identified.

The present study's findings illustrate the relation of sacrifice in general, and human sacrifice in particular, to socioeconomic conditions: the absence of all sacrifice only in hunting and gathering societies; human sacrifice found in complex rather than simple agricultural societies, but not in pastoral societies; and the lack of a linear association of human sacrifice with measures of complexity, with human sacrifice occurring in the mid-range of cultural complexity. Societies with human sacrifice always had priests, but never had shamans (as determined in Winkelman

1986 and 1992). Human sacrifice as a religious activity is related to other religious and social conditions.

Further assessment of the relationship between human sacrifice and religious beliefs was based on Murdock's (1967) variable on high gods being present and important, and Whyte's (1978) data on the relative status of males and females in religious beliefs. Many of the societies with human sacrifice had religious beliefs characterized by the relative equality of male and female roles, and six of seven had high gods absent or unimportant. The unimportance of high gods in these complex societies with human sacrifice is inconsistent with general findings of high gods associated with social complexity (Swanson 1960; Davis 1971; Peregrine 1996). This suggests that since human sacrifice was associated with societies without hierarchically integrated religious systems, human sacrifice may create religious integration, as suggested by Isaac (1983) and Price (1978). Murdock and Whyte's original variables were recoded into binary variables representing the lack of high gods and the relative equality of male and female religious figures (gods and spirits, mythical founders, and witches). Some of these individual measures were positively and significantly correlated with human sacrifice (Table 5). A summary measure of low religious hierarchy (computed by summation of the binary recodes) had the strongest correlation (Spearman's rho=.49, $p<.001$). Inclusion of this summary religious measure of low religious hierarchy in multiple regression along with the two ecological measures (population pressure and environmental circumscription [overall war for land and resources]) accounted for significant additional variance in human sacrifice (multiple R=.72, $R^2=.51$, F ratio=14.4, 3, 41 df, $p<.000$, 13 per cent increase; 51 per cent total variance explained with inclusion of the religious measure). The low religious hierarchy measure entered the equation before the environmental circumscription measure, suggesting its stronger predictive power.

Table 5: Correlation of Religious Variables with Human Sacrifice

Independent Variables	Spearman's rho=	p< (one-tailed)
High Gods (present vs. unimportant/absent)	.16	ns
Gods and Spirits, Both Male and Female	.42	.004
Mythical Founders, Both Male and Female	.30	.05
Witches, Both Male and Female	.32	.04
Low Religious Cohesion (computed)	.49	.001

AZTEC HUMAN SACRIFICE IN CROSS-CULTURAL PERSPECTIVE

The cross-cultural analyses support the general hypothesis of ecological contributions to the explanation of human sacrifice. Some of the ecological conditions Harner hypothesizes as leading to Aztec cannibalism are correlated with human sacrifice cross-culturally. In contrast to Harner's hypothesis, however, all societies with human sacrifice had domesticated food animals, but the reduction of wild game

is suggested by these agricultural societies with high population density still depending upon hunting and fishing in the overall diet. Measurements of crop failures and famines are not significantly associated with human sacrifice, and the nonsignificant correlations with resource problems and famine risks are the opposite of the ecological prediction. The Aztecs, however, were high on many of these measures.

The significant correlations of human sacrifice with population pressure and environmental circumscription assessments (warfare for land and resources) support the ecological hypothesis. Price's argument that Harner's hypothesis is not sufficiently distinguished from famine or lack of food is addressed in this cross-cultural analysis. The lack of correlation of human sacrifice with famine, resource adequacy, and food threats indicates that the causes of human sacrifice are not a direct function of food availability per se. Societies with human sacrifice appear to have the opposite relationship to food supply, taking steps to assure food adequacy through food storage and importation. The significant prediction of human sacrifice by specific ecological variables clarifies the general ecological conditions Harner hypothesizes as leading to Aztec cannibalism. The ecological effects on human sacrifice are not directly from the availability of resources (food scarcity), but from population pressure. The significantly stronger prediction of human sacrifice by population pressure, rather than population density, indicates that the causes are not the sheer number of people per se, but rather the stressful conditions that density creates under resource scarcity and unreliability.

But ecological factors alone are insufficient, as well over half of the variance remains to be explained. In addition to these ecological influences, measures of a lack of religious hierarchy are also significantly associated with the incidence of human sacrifice. Religious beliefs do reflect societal conditions which apparently have a significant effect in motivating the adoption of human sacrifice. The correlations alone do not reveal the psychosocial functions of the religious activities. They suggest that human sacrifice is a mechanism for achieving a form of religious integration in societies lacking integrative hierarchical systems of belief. The motivations for human sacrifice and for cannibalism are illustrated by the broader psychocultural dynamics of sacrifice with respect to intergroup social relations. The psychosocial effects of cannibalism are suggested by the Aztecs' dynamics of in-group and out-group relationships with respect to consumption for sacrifice—whether one is consumed (victim) or co-consumer. Since the Aztecs did not consume members of their own group, uniting with them in wars for sacrificial victims and cannibalistic practices was a mechanism for establishing in-group membership. The functions of sacrifice in creating an integration of people are illustrated by its serving as a mechanism for permitting class mobility of the warrior and his relatives. This extension of the right to consume human flesh to family members signals a very basic level of social inclusiveness.

These systematic correlations of human sacrifice with ecological and religious conditions illustrate that such practices should be understood in the context of social determinants of behavior, rather than as forms of social pathology and aberrance.

Turner and Turner's (1995) assessment of cannibalism in the American Southwest led them to reject explanations based on social pathology. They (Turner and Turner 1995:13) point instead to "violent social control, possibly initiated by socially pathological individuals." The correlation of human sacrifice with population pressure indicates that population dynamics are important contributory factors to the development of these practices. These social dynamics producing human sacrifice are not, however, a general function of increasing social complexity.

CONCLUSIONS

Harner's original hypothesis of ecological causes of Aztec human sacrifice and cannibalism receives partial but significant support from the present cross-cultural analysis. There are, however, additional determinants of human sacrifice that remain to be identified. The hypotheses of systemic economic, social, and political factors involved in the complex of Aztec warfare, human sacrifice, and cannibalism suggest directions for future work to identify additional factors that predispose societies to human sacrifice. While discussions of Aztec human sacrifice and cannibalism have typically emphasized these as unique features of Aztec society, the cross-cultural analyses presented here suggest that the Aztecs typify patterns of human sacrifice found cross-culturally. But the Aztecs might have been particularly motivated to consume human flesh as a consequence of ecological and population pressures. In comparison to other societies with human sacrifice, the Aztecs were extreme in several measures: the only human sacrifice society in this sample with a high risk of famine; the highest on several measures of population pressure; in the highest category of population density (over 500 persons per square mile); and the highest levels of overall warfare for land and resources. So while Aztec human sacrifice conforms to typical cross-cultural patterns, the magnitude of their sacrifice and cannibalism may reflect their extreme conditions on many ecological variables.

NOTES

1. I thank David Jacobs for his encouragement to pursue this research project. I also thank him and Doug White, Michael Harner, Christy Turner, Carol Ember, and Rob Le Veille for helpful suggestions, and Cindy Winkelman for her assistance with data analysis.

2. Acosta Saignes 1950; Benson and Boone 1984; Bergmann 1992; Boal 1982; Brown 1991; Gohain 1977; Gonzalez Torres 1985; Green 1975; Hamerton-Kelly 1987; Hogg 1966; Hughes 1991; Levenson 1993; Lewis 1986; Loeb 1964; Macoby 1982; Roman Berrelleza and Alberto 1990; Sagan 1974; Sugiyama 1995; Tannahill 1975; Tierney 1989.

3. A 25 per cent stratified random 45-society subsample of the SCCS was used in the present study. Societies in the subsample include: Africa: Nama Hottentot, !Kung Bushmen, Ovimbundu, Ibo; Circum-Mediterranean: Wolof, Fulani, Fur, Kafa, Amhara, Tuareg, Babylonians, Romans, Kurd; Eurasia: Samoyed, Toda, Kazak, Garo, Vietnamese, Semang, Tanala, Japanese, Chukchee; Insular Pacific: Iban, Alor, Kimam, Lesu, Pentecost, Marquesans, Trukese, Atayal; North America: Montagnias, Kaska, Twana, Paiute, Hidatsa, Creek, Zuni, Aztec; South America: Bribri, Callinago, Saramacca, Jivaro, Tupinamba, Cayua, Mapuche. Societies with legitimate human sacrifice are: Ovimbundu, Ibo, Kafa, Roman, Marquesans, Atayal, and Aztec.

4. Variables included are: writing and records, fixity of residence, agriculture, urbanization, technological specialization, land transport, money, population density, political integration, and social stratification.

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